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Review paper

INNOVATION ACTIVITIES IN THE PERIOD OF CRISIS*

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Abstract. *The outbreak of the global economic crisis has caused significant changes in the functioning of modern economies. The effects of the crisis are reflected in production decline, bankruptcy of major financial intermediaries and a sharp drop of turnover in financial markets. The accompanying manifestations of these events are reflected in the sharp fall of aggregate demand, the firms' profit decline and chronic lack of financial funds. In these circumstances, the economic category most affected by the crisis is innovation. However, even in a time of crisis there are firms whose innovation activity has not reduced, while the main drivers of innovation are changing. The paper suggests that the recession may not necessarily cause a drop in the investment activities of the firms, and particularly emphasizes the role of the national innovation infrastructure in encouraging innovation in the crisis period. Social networks as social structures that promote cooperation between firms contribute to the intensification of innovation processes that take place as process embedded in a given social, institutional and cultural environment*

Key Words: *economic crisis, innovations, national innovation system, social networks.*

1. INTRODUCTION

While the initial reactions of contemporary economies to the outbreak of the economic crisis implied implementing emergency measures with the aim of stabilization, avoiding economic collapse and initiating rapid recovery, such measures were not sufficient to secure sustainable growth and economic development. In times of crisis, it is necessary to ensure that the crisis does not threaten the drivers of the long-term growth. Otherwise, the most that could be expected is a temporary recovery, while macroeconomic and structural

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conditions, which led to the crisis, would remain unchanged. The basis of these long-term measures are the activities of fostering innovation and entrepreneurship, investing in research and development, investing in the infrastructure for the creation and exchange of knowledge and encouraging human capital accumulation.

However, one of the most obvious effects of the crisis is the reduction of investments in innovations, given that investment in research and development, patents and trademarks follow the size of gross domestic product and are significantly reduced in periods of economic slowdown. Because of the negative impact of the crisis on the domestic product of developed economies, on the functioning of financial institutions as the most important intermediaries in investment activities, as well as on the public finances as a key support to innovation systems, the economic crisis has left devastating effects on innovative activities. In the period of crisis, cash inflows from regular business activities are reduced and external funding sources are less available, considering all the more cautious and conservative behavior of banks and investors. Investments are directed to short-term, low risk and modest budget innovations, while the long-term and high-risk projects are being suspended. This causes the firms to fire highly educated researchers, while innovating firms are facing serious financial problems. The economic crisis has a devastating effect on the creation of new, innovative firms due to the lack of financial funds.

However, the economic crisis also offers the possibility of *"creative destruction"*, economic restructuring and the launch of a new wave of innovations and entrepreneurship, creating the basis for strengthening the long-term potentials of the economy. Innovations are certainly a key factor of the recovery process and returning to the path of long-term development. Although the financing of innovations is the key problem during the crisis, the factors that influence the size and success of innovation projects are not only of financial character. Social factors, primarily in terms of network ties between innovators and other economic actors, are important determinants of innovative activities, particularly in the field of high technologies and industries where the main resource is knowledge. Along with the changes in the theory of innovations, social factors were given increasing importance to today's understanding of innovations as socially and institutionally embedded processes.

2. THE IMPACT OF WORLD ECONOMIC CRISIS ON INNOVATIONS

The effects of the global economic crisis, which are primarily reflected in a sharp decline of production, reduced intensity of trade and a significant increase in unemployment, are also present in the sector of innovations, research and development. The recovery of national economies is further challenged by increasing public debts of certain countries and a possible debt crisis, as well as fiscal consolidation requirements. Three fundamental aspects of the crisis that are relevant for innovation activities are: (OECD, 2012, p.24):

- *Declining demand for products and services.* The economic crisis has caused a rise in unemployment and the decline in household incomes, which resulted in a sharp drop in demand and growing uncertainty about future trends of aggregate demand. Innovating firms were faced with large revenue shortfalls and problems of financing innovation. The crisis has reduced demand for expensive and innovative products, which is why

innovator firms were forced to divert to the innovation of products that reduce costs and prices. In the increasingly competitive environment, in order to maintain the level of income, firms are motivated to compete for market share by innovations. However, uncertainty about future demand affects the firms to refrain from producing new products and services.

- *Fiscal consolidation as a priority.* Due to the growing public debt and bankruptcy risk of some countries, fiscal authorities in developed world economies insist on reducing government expenditure and thus jeopardize the financing of large innovation projects. Economic policy makers have other priorities, so the public support for innovation weakens.
- *Weakening of the world financial system.* A lack of trust in the financial system, negative trends in the financial markets and the instability of the banking system that emerged as a result of the crisis, impede external financing of innovation activities.

The empirical analysis (European Commission 2009a; 2009b) indicate that the economic crisis has left a deep impact on the innovative behavior of firms. A direct effect of the crisis is the percentage of firms that have increased their investments in innovation during the crisis compared to the pre-crisis period. Specifically, during 2008 as much as 38% of the firms increased investment in innovative activities compared to 2006, but after the outbreak of the crisis, that number has dropped to just 9%. Also, only 13% of firms expected that their investments in innovation would increase in the future. On the other hand, observing the firms that have reduced their investments in innovation shows that in 2008 only 9% of the firms reduced their investments in innovation, while in 2009 this percentage increased to 24% and 30% of the surveyed firms planned to reduce investments in innovation in the following period.

The effects of the crisis on innovation have not been equal in different countries, industries or in different types of firms (OECD, 2012, p. 27). Some countries have felt strong negative impact of the crisis on innovation, while the recovery is still slow and uncertain. These are countries with serious structural deficiencies that have become apparent owing to the economic crisis, such as Greece and Spain. Also, the crisis has particularly negatively affected innovation in the automobile industry and other middle technology sectors, financial innovations, the launch of start-up businesses, as well as the profits of small and medium enterprises. The prospect of recovery for these categories directly affected by the consequences of the crisis depends largely on the implementation of structural reforms and financing of research and development. There is a serious threat that the chronic unemployment will jeopardize human capital accumulation necessary for future innovation.

In most countries of the European Union and the United States, the negative effects of the economic crisis on innovation activities were temporary. Undertaking structural reforms, these economies have started recovering, which in the future will depend on the degree of demand recovery, public finance and long-term state of (un)employment.

There are countries and industries that have maintained high level of innovation activities even during the crisis, such as China and emerging Asian economies. High technology sector is one of the sectors that have not experienced a drop in innovation in the crisis period (airline industries, IT, medical equipment manufacturers).

3. ECONOMIC CYCLES AND INNOVATIVE BEHAVIOR

According to Schumpeter's theory of business cycles (Schumpeter, 1939), innovations are the main cause of economic fluctuations. Relationship between innovations and dynamics of economic development has been studied in the voluminous literature on the long-term economic cycles. Unlike Keynes, who regarded investments as a key component of aggregate demand, Schumpeter emphasized the purpose of investing; pointing out that *investment in innovation* is a necessary condition for economic development. Bearing in mind the relationship between innovation and economic cycles, there are two possible conclusions about the impact of the crisis on innovation intensity (Filippetti, Archibugi, 2011). First, because of the cyclical nature of innovation, the firms will reduce the intensity of innovation activities in the crisis phase of the cycle. In terms of economic downturn, all investments are lower because of low profit margins and the general pessimism that prevails in the business environment, while in the periods of economic expansion intensive technological progress is achieved. However, there is on opposite view that innovations should act counter-cyclically and that period of recession is perfect for intensifying innovation.

The cause of such macroeconomic dynamics is to be found in the behavior of individual firms: some will consistently invest in innovation even during the recession, while others will reduce or suspend innovation activities. The behavior of firms during the crisis is affected first by the factors related to their specific characteristics: corporate strategy, management attitude, state of development. Furthermore, the cumulative nature of innovations, technological changes and the state in the field of research and development further determine the destiny of investment activities during the crisis. Certainly, the total amount of profits and cash flows play a major role in innovating. Current state of a particular industry - the level of demand for products, profit opportunities and technological capabilities are also a determinant of the innovation dynamics of firms in times of recession.

Observing the dynamics of innovation activities during the crisis imposes the crucial question - which firms correspond to the economic crisis by increased innovation? There are two possible answers (Archibugi et al. 2010). First, these can be dynamic firms, whose survival depends critically on the improvements of products and services, and which are necessarily obliged to constantly innovate, regardless of the current phase of the economic cycle. In such firms, innovations take place cumulatively, representing normal business routines and are based on long-term learning process. In the latter case, it might be the small firms that are just entering the market, and have not previously dealt with the process of innovation. The crisis is a chance for them to penetrate into the competitive market.

These two possibilities fit into two Schumpeter's models of innovation. The first one is the *model of creative accumulation* (Schumpeter, 1942), which relates to stable conditions, during the phase of economic prosperity, where innovator firms grow into large oligopolistic corporations, with large expenditures on research and development. The issue of innovating for them implies a necessary source of competitive advantage through systematic and gradual improvement and differentiation of products comparing to other oligopolistic firms. Therefore, innovations in these firms are of incremental character, being based on previous innovation activities and are relatively frequent. A key source of innovation is a systematic process of research and learning, which is mainly developed within firms, given their capacity to develop internal functions of innovation.

The model of creative destruction (Schumpeter, 1911) is relevant for the conditions of economic instability where negative shocks could undermine the firms that are large innovators, so that small businesses that are emerging in new sectors become the main drivers of innovation. Innovation activities of these firms are not based on the cumulative process of learning and research, but on the possibility of exploiting new technological opportunities. External shock, such as the economic crisis causes changes in the balance of power between the industries, enabling the emergence of new industries and leading to a decline in profits in large industries. In such circumstances, what happens is that large innovator firms cannot quickly adapt to such changes because of the inertia of their innovation strategies. That is why the major role in the innovation process is overtaken by individual entrepreneurs and innovators. Innovations in this case are based on internal knowledge sources, which are often combined and exchanged within a network of relationships with other firms and research institutions (universities, laboratories, development agencies). Most often, the results of these innovations are radical changes of products or processes, entirely new solutions, based on new knowledge and skills. This is the only way for the firms to survive in the highly competitive and dynamic market, with the ever-changing balance of power between innovators.

Based on the analyzed models the authors (Archibugi et al., 2010) conclude that in periods of normal business dynamics (before the crisis) creative accumulation model prevails, while during the crisis, the behavior of innovators can be described by the model of creative destruction. Before the crisis, the essential drivers of innovation are large firms with advanced research and development functions. During the crisis that role is taken by small innovators, whose innovation activity is based on collaboration with a large number of different actors, linked to each other through a variety of business and innovation networks within which common knowledge bases are developed. The main driver of innovations is the possibility of opening new markets due to the economic crisis. This shows that in times of crisis firm size and level of research sector development is not of crucial importance, as much as flexibility, relations of cooperation and exploring new markets.

3. National Innovation System

The analysis of the possible role of social networks in shaping the dynamics of innovation and creating innovative capacity of economic actors indicates that the processes of innovation, learning and technological development have undoubtedly taken on the character of systemic activities, which involve a number of different actors. Different behaviors and ways of carrying out business activities, but also different results of innovative actors belonging to different countries or regions suggest that the social and institutional context in which the actors perform has a strong impact on their capabilities to acquire, create and apply knowledge necessary for innovation. The concept of social networks, as a social structure that enables but also limits the potential actions and determines the behavior of economic actors, is essential in the detection of modes of interaction between economic actors and their social and institutional environment.

Changes in the way of studying innovation and understanding of this process as a complex, non-linear and primarily social, enabled the analysis of the impact of external economic and non-economic factors on encouraging creative interactions between hetero-

geneous economic actors that foster innovative activities. In fact, many theoretical and empirical studies have identified that the national institutional environment has a strong influence on the behavior of economic agents and performances of the firms (Nelson 2001; North 2005). National institutions and policies (innovation policy, technological development policy) shape innovative behavior of economic actors. The theoretical concept that links economic, institutional and cultural determinants of innovation is *national innovation system* (Edquist 1997, Lundvall 1992). According to this approach, information flows and transfer of technology between individuals, firms and institutions are crucial for innovation processes (Agapitova 2003). Specific factors at the national level, such as the character of scientific and technological institutions, the educational system, the financial system, the structure of the labor market and the specialization of production, determine ways in which economic actors carry out innovative activities and learning processes. According to this concept, innovation is an activity which is systemic in nature and carried out by the firms through extensive interactions with various actors, such as universities, research centers, consumers, suppliers, within the specific (national) institutional context (Filippetti, Archibugi 2011). In this regard, the national innovation system is a contextual framework that allows the analysis of different dimensions of innovative activities. In addition to the analysis of internal innovation process, which is based on learning and takes place in firms that have specific assets and procedures, it is necessary to take into account that each company is an open system that generates various interactions with the environment. Therefore, an innovative firm is regarded as being part of a complex network of firms and other institutions that cooperate and compete with each other, while their interactions lead to initiation, introduction and application of new technologies.

The concept of national innovation system is based on institutional analysis, given that it emphasizes that the activities of economic actors are contextually dependent and that political and social factors greatly influence their efficiency. Institutional infrastructure, which itself evolves, also shapes the patterns of technological development, regarding innovation as a systemic function of a society. In this context, it is necessary to analyze the national investment system as a whole, taking into account the close relationship of its elements, but it is also necessary to detect the logic underpinning their interdependence and analyze knowledge flows between different actors.

The most widely used approach to the analysis of knowledge flows in an innovation system is the theory of clusters (Porter 1990). According to this theory, firms and supporting institutions are interrelated by informal agreements on cooperation, encouraging the creation and exchange of knowledge owing to trust that governs an innovation environment. Key factors that determine national capacity for innovation are (Porter, Stern 2001):

- *Common innovation structure* (human and financial resources, innovation policy, the level of technological sophistication of the economy)
- *Specific conditions in clusters* (the quality of specialized inputs, demand conditions, interrelated industries, competitiveness)
- *The quality of ties between actors* (formal and informal organizations and networks).

In order to fully understand the process of creation and functioning of innovative networks, it is necessary to analyze the way in which national institutional arrangements shape the process of creating and applying knowledge at the level of individual firms, which factors specifically initiate cooperative arrangements between the firms and how the process of their mutual evolution with the environment is carried out. These questions

can be answered with the help of the concept of social networks, which compared to the standard economic analysis leaves room for subjective (human) factors, insisting on the structure and limitations (Powell, Smith-Doerr 1994). This way, a conceptual framework is created that takes into account the cultural and institutional environment in which innovative activities take place, but also stresses the influence of social relations on innovation and economic development.

The concept of national innovation system stresses that social networks not only explain the logic of political and institutional arrangements between firms and their environment, but are also essential for understanding the development patterns of new productive structures and innovative activities. This way, the introduction of the concept of social networks in the national innovation system enables dynamic analysis of interactions within the system. In the basis of network analysis is the fact that the behavior of individuals cannot be fully understood without relating it to the conduct and activities of other individuals, mutually connected through network ties. There are two simultaneous processes that underlie the dynamic social ties and interactions in the network. The members of the network are connected by different types of ties, and depending on the content they carry and the strength of the ties, two types of ties can be distinguished. The first are sporadic, weak ties, which usually do not develop into long-term relations while on the other hand there are embedded relations arising from a particular social structure that characterizes an organization in which decision-making takes place. Such structures are primarily governed by relations of trust. It is the process of developing such embedded ties, which actually involves the creation and development of the network, along with the process of network fragmentation that makes the dynamics of network relations and interactions. Network fragmentation is the process of relaxation of network ties, through which most of the resource sharing between individual actors takes place.

Embeddedness refers to the system of social control, developing a system of common rules and norms, and even specific language, which strengthens the network and gives its members the ability to respond to changing conditions. Embeddedness involves building relations of trust between members of the network, making it easier to facilitate the transfer of information across the network. Introducing network analysis into the concept of the national innovation system allows studying the ties between actors that determine their choices. In this sense, research of technological development is based on the analysis of the relation between actors and not on the characteristics of the individual members. Thus, embeddedness as a feature of the network can have a multiple effect on the social efficiency. On the one hand, this is a positive impact, through encouraging trust and cooperation; while on the other hand strong ties can affect the network rigidity, inertia, and isolation from the environment.

4. The Role of National Institutional Environment

In addition to above analyzed factors, it must be remembered that national institutional environment significantly affects the behavior of economic actors and their ability to respond to changes in the business environment, which is particularly evident in the period of economic downturn. Namely, as a significant drop in demand is the basic manifestation of the economic crisis, it is expected that firms will greatly reduce the investment activi-

ties. Under these conditions, the characteristics of national innovation policies and institutions play an important role in maintaining the intensity of innovation.

Referring to the concept of national investment system where innovation activities are considered to be a systemic function which involves a large number of different actors and is influenced by the nature and structure of the national institutions, the ability of the economy to maintain the innovation intensity in the period of crisis will also depend on social factors, and not solely on science and technology. Institutions, broadly defined as the rules of the game are at the same time constraints and a source of opportunities for economic actors, thus determining their behavior, organizational structure and patterns of economic development. The way in which firms realize the processes of innovation and learning is determined by a large number of institutional factors, such as the labor market, patterns of specialization in production, education and the structure of the financial system. In particular, national institutional environment is the result of long-term historical process in which the firm and industry development process took place interactively with macroeconomic policies and institutions, and as such has a significant effect on the intensity of innovation activities of firms during the crisis.

The main components of the institutional infrastructure that can affect the level of innovation in the period of crisis are (Filippetti, Archibugi, 2011):

- *The quality of human resources*, in the sense of education level and participation in the activities of constant learning and training;
- *The stock of accumulated knowledge*, investing in research and development, investing in information technologies;
- *Depth of financial system*, and
- *The level of industrial specialization*, in the sense of relative importance of high technology sectors and service sectors based on knowledge.

According to empirical studies, countries with strong national innovation systems (Switzerland, Sweden, Finland …) have dealt better with the effects of crisis and have maintained the ability to respond adequately to the requirements of doing business in a recession. In these countries, the structural characteristics of the national innovation system had a stronger effect on innovation intensity than the drop in demand that occurred as a result of the crisis. They are expected to recover from the crisis with relatively stronger innovation capacities. In particular, the availability of qualified human resources has proven to be a key factor in preventing a considerable decrease in innovation activities during the crisis.

5. CONCLUSION

Despite the sharp drop in domestic demand and exports due to the economic crisis, the final effect of economic downturn on investment in innovation activities is not necessarily negative. Economic and institutional infrastructure of the country is a factor that determines the directions in which the processes of innovation and learning are developing, which affects the innovative behavior of firms during the recession. Specifically, competence and quality of human capital, specialization in the field of high technologies and a developed credit system represent the structural factors that are able to mitigate the effects of the economic crisis on firms' investments in innovative activities.

A large number of countries have implemented policy measures in order to encourage innovation after the crisis, focusing on innovation infrastructure and providing financial assistance to firms. However, under conditions of increasing budget deficits, fostering innovation by funding from the state budget becomes increasingly difficult. Innovation policy at the present time must be aimed at encouraging long-term positive trends in innovation activities, and eliminating the negative effects of the crisis. Recommended measures include support for research institutions and educational programs that will ensure the continued accumulation of human capital and influence the creation of a skilled labor supply that will be able to carry out innovation activities.

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INOVACIONE AKTIVNOSTI U PERIODU KRIZE

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Izbijanje svetske ekonomske krize izazvalo je značajne promene u funkcionisanju savremenih privreda. Očigledne posledice krize ogledaju se u padu proizvodnje, bankrotstvu velikih finansijskih posrednika i oštrom padu prometa na finansijskim tržištima. Prateće manifestacije ovih događanja ogledaju se u znatnom padu agregatne tražnje, padu profita preduzeća i hroničnom nedostatku finansijskih sredstava. U ovakvim uslovima, ekonomska kategorija koja je najviše pogođena krizom jesu inovacije. Međutim, čak i u kriznom periodu postoje preduzeća čija se inovaciona aktivnost ne smanjuje. Takođe, u periodu krize se menjaju osnovni pokretači inovacija. U radu se ukazuje da u recesiji ne mora neminovno doći do opadanja investicione aktivnosti preduzeća, a posebno se ističe uloga nacionalne inovacione infrastrukture u podsticanju inovacija u kriznom periodu. Društvene mreže kao društvene strukture koje podstiču saradnju između preduzeća doprinose intenziviranju inovacionih procesa koji se odvijaju kao ukorenjeni procesi u datom društvenom, institucionalnom i kulturnom okruženju.

Ključne reči: *ekonomska kriza, inovacije, nacionalni inovacioni sistem, društvene mreže*