

How Economic Crisis is Affecting Firms? Building Resilience Capacity Through Innovation

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Abstract

More than ever firms will be required to develop strategies for coping with future shocks and stresses to our economic and social infrastructures. They will need to build the so called resilience capacity, which is an umbrella term for the planning and design strategies that help firms to develop the necessary capacity to meet challenges. The present paper, based on an assessment of works that explore recent European reports on innovation performance, discusses some underlying effects of the economic crisis. This discussion reveals the main differentiating impacts of a major downturn on innovation behavior. Some of the conclusions acknowledge that firms will have to find new ways to reduce their risk-averse dependency and become more flexible.

To become more resilient, firms will need to adopt planning and design strategies that allow them to develop the capacities to better respond and adapt to the emerging economic and social stresses. Developing these capacities will involve firms in a complex web of planning and development decisions that, in combination, must be designed to transform our current economic systems into much more flexible and dynamic ones. Small and medium enterprises are more exposed to high competitive pressures. Thus, they have to search for new business opportunities. The choice of sectors and the design of public procurement policies can provide new opportunities and it is very likely that those that manage to capture them will be the winners.

With the polarization of innovation and knowledge creation across Europe, a few countries are responsible for the bulk of innovation and knowledge production. The technology gap provides a fundamental potentiality for lagging behind countries to catch-up. However, there is a general fragility as major effects of the crisis have shown. Therefore, a more articulated policy needs to be put in practice as suggested and more attention should be given to investment in knowledge diffusion and absorption depending on the specific national context. The fact that some structural characteristics of the national innovation system explain persistency of innovation in response to major exogenous shocks sheds some light on the behavior of firms during crisis. This represents a step forward in terms of understanding the mechanisms underlying the relationship between macro and micro-determinants of innovation.

Keywords: resilience, economic crisis, innovation performance, innovation systems, SMEs

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1. Introduction

Most managers and academics agree that innovation leads to higher performance. But, how can companies manage innovation in order to become more resilient? Resilience is both an important applicable and concept for companies in turbulent times. The concept is what researchers now refer to the capacity to endure stress and bounce back. It is an umbrella term for the planning and design strategies needed to help firms develop the necessary capacity to meet challenges. Over the coming years, the need to build capacity for resilience will require firms to develop strategies for coping with future shocks and stresses to our economic and social infrastructure systems. This paper compares the results from several reports on the impact of the economic crisis on innovation, like the Innobarometer survey and the annual report on European small and medium-sized enterprises. This discussion captures differentiating impacts of the world crisis on innovation behavior. Some of the conclusions acknowledge that firms will have to find new ways to reduce their risk-averse dependency and become more flexible. Dynamic design strategies, based on clear guidelines for information systems design fitted to an organizational design flexible to infrastructural shocks, will play an important role in facilitating the development of a greater capacity for future resilience.

In social systems, resilience is the added capacity of humans being able to anticipate and plan for the future. But resilience is conferred, in both human and ecological systems, by their capacity for adaptation to the external stresses and shocks. These aspects of resilience can help us in shaping the development of principles for more resilient firms. To become more resilient, firms will need to adopt planning and design strategies that allow them to develop the capacities to better respond and adapt to the emerging economic and social stresses. Developing these capacities will involve firms in a complex web of planning and development decisions that, in combination, must be designed to transform our current economic systems into much more flexible and dynamic ones. Planning and design professions will be more challenged to find new paradigms, new tools/technologies and new business models in order to plan and implement future resilient organizational structures.

Besides the correlation between insufficient financial resources and stagnation at an increasing number of firms, this problem is also connected with convenient technology solutions and lack of related skills and knowledge (Antlová, 2010). Therefore the companies try to develop their applications in-house, sometimes not in a sophisticated form. In companies where the potential of new technologies is incorporated in the long term business strategy, and where the relationship with costumers is developed, there is more sustainable successful growth (Fernandes, 2010). Therefore it is important to improve the technology competencies of management and employees.

The development of knowledge networks in organizations is one concrete solution. A knowledge network involves a set of people, resources and relations assembled in order to capture, transfer and create knowledge with the purpose of creating value. For example, there are some firms with their own wiki-type knowledge

database of operating practices shared by employees whose contributions are then monitored using balanced scorecard method (Kaplan & Norton, 2004). This tool provides managers with comprehensive frameworks that translate a company's vision or strategy into a set of performance measures. These measures can be used to help align individual, organizational and cross-departmental initiatives to achieve common goals. This tool should be used as a communication, informing and also learning system. Previously, it was used the enterprise architecture approach for integrating and crossing these issues for aligning proposes. But now, this approach has lost flexibility and real-time dynamism due to a standardization trend in its application. More dynamic approaches or models are required using wikis, balanced scorecard, action matrixes, etc.

The above-mentioned cases have included in their corporate strategy's requirements the consistent use of their employees' knowledge and experience. On the basis of this common attitude to management, the presence of corporate knowledge management strategies as significant factors of the organization's growth should be surveyed and incentivized. In today business environment, not only organizational, but also individual knowledge can make difference in gaining competitive advantage. It is crucial to align business strategy with knowledge management, especially through knowledge sharing and creation. Also the most effective technology tools should be integrated to support business and knowledge processes and help to create an appropriate sharing environment. Small and medium enterprises are more exposed to high competitive pressures. Thus, they have to search for new business opportunities and this effort has to be significantly supported by information system tools sharing.

This paper is organized as follows. In the next section we put forward the theoretical background of the subject. In section III we present some data sources for comparison and discussion on innovation and crisis resilience across Europe. In section IV we explore aspects of convergence in Europe and the challenge of creating a resilient system of innovation. Then, section V concludes the paper with some final considerations.

2. Resilience: a balance between efficiency and renewal

Analysis shows that in the 1980s, companies were primarily interested in furthering innovation through specializing in fields of expertise. In the 1990s the emphasis shifted toward sharing knowledge across these fields of expertise and facilitating communication and internal knowledge transfer (through company intranets and global best-practice teams). Today, companies go beyond conventional knowledge, searching for new knowledge and new insights. The important thing is the company's ability to minimize the damage, recover fast and quickly get back in the game with new strategies, business models and products. These are resilient companies, seeking new knowledge both within and outside their organizations and working hard to increase entrepreneurial behaviors.

Lengnick-Hall and Beck (2005) differentiate three requisites of resilience:

- 'cognitive resilience' when the company has a deep understanding of what is happening around it, not only noticing how things change but making sense of those changes (it helps if workers have a strong sense of the core identity and values of the organization so they know how to behave in times of change or crisis);
- 'behavioral resilience' when the company reacts to the unexpected opening communication channels, creating interpersonal ties and seeking multiple sources of information when uncertainty increases; and

- ‘contextual resilience’ when the company depends on internal social connections, interpersonal networks, which help companies rapidly cope with and respond to changes.

The question is: what prevails, crisis or resilience? The world is becoming turbulent faster than organizations are becoming resilient: the evidence is all around us as companies are failing more frequently and innovating less quickly. Even successful companies are finding more difficult to deliver consistently superior returns. Most companies have been working in retrenchment mode, resizing their cost bases to accommodate an unprecedented competitive pressure. Focus is reinforced every day through many ways: training programs, benchmarking and measurement systems. But are these ways reinforcing strategic variety, wide-scale experimentation and quick resource redeployment? And how have these been instantiated in employee training, management processes and performance metrics? (Hamel & Valikangas, 2003). Resilience will only become an autonomic process when companies dedicate as much energy to laying the groundwork for continuous renewal as they have to building the foundations for operational efficiency.

There are several ways of conceptualizing and adapting the basic idea of resilience to business: some strategies have focused on corporate attributes, while others have focused on issues such as risk awareness, risk protection and the reduction of vulnerabilities. In strategic management resilience has been defined as a process capability companies need, to reinvent themselves and overcome barriers to develop multiple sources of competitive advantage (Reinmoeller and Baardwijk, 2005). According to these authors and their research, most resilient companies are those that continually orchestrate a dynamic balance of four main innovation strategies: knowledge management, exploration, cooperation and entrepreneurship. In short, resilience means taking multiple paths to innovation. But an issue to consider here is related with the reasons why strategies decay. There are four main situations:

- strategies get *replicated* and then lose their distinctiveness to produce above-average returns;
- they also get *supplanted* by better strategies;
- they can get *exhausted* as markets become saturated or customers get bored; or
- they get *eviscerated* as the case of the internet which has dramatically accelerated the migration of power from producers to consumers.

An accurate appraisal of strategy decay is a powerful way to know whether renewal is proceeding fast enough to fully offset the declining economic effectiveness of today’s strategies. Any company that make awareness from its environment, generate strategic options and realign its resources faster than its rivals will have a competitive advantage. This is the essence of resilience, thus variety matters for resilience. If the range of strategic alternatives a company is exploring is significantly narrower than the breadth of change in the environment, its business will be vulnerable to turbulence. And if a company systematically favors existing programs over new initiatives and experimentation, it will soon find itself overinvesting in declining strategies and outdated programs.

DeAngelis (2010) acknowledges, from his work and research on studies in open innovation, that most business leaders are aware that new ideas are found everywhere and are increasingly receptive to the concept of actively looking outside of their organizations for them. This process has been variously referred to as open innovation (or outsourced innovation). As budgets tighten, businesses are outsourcing research and development and the creation of new products as a way to slash costs, speed development time and tap

into top talent outside the company. Open innovation is about bridging internal and external resources and executing on the innovation opportunities that arise from this combination. But while some executives are open to change, most seem to prefer to keep things just as they are. The winners will be the companies and executives that are best at handling this (DeAngelis, 2010). Beyond the benefit of ensuring that companies remain focused on the marketplace, working with external partners means that executives become familiar with other ways of doing things. Open innovation also allows corporate leaders to evaluate their practices in light of other real-world examples. As open innovation becomes more prevalent, the functional, divisional or matrix organizational structures we know today will change. What will replace them is unclear, but new systems will be a clear side effect of these types of initiatives.

3. Some light from main European reports

This analysis is based on the data provided by two reports from the European Commission: the *Innobarometer 2009* and the *European Innovation Scoreboard 2008* (European Commission, 2009a; European Commission, 2009b). The first is a survey conducted in April 2009, in the 27 EU Member States. A statistically significant sample of 5,238 enterprises across Europe was considered according to three main criteria: country, company size (20-49, 50-249, +250 employees) and sector. The *European Innovation Scoreboard* (EIS) is a report of the European Commission (carried out by the MERIT since 2001). The EIS aims at measuring and comparing the innovation performance at country level using a synthetic composite indicator. The current EIS composite indicator (*InnoStruct*) is based on 29 indicators addressing several dimensions of a country system of innovation: human resources, finance and support, firm investments, linkages and entrepreneurship, throughputs, innovators, economic effects (European Commission, 2009a).

Regarding the *Innobarometer* survey, the analysis is based on the following three questions of the survey:

Question 1: ‘*Compared to 2006, has the amount spent by your firm on all innovation activities in 2008 increased, decreased, or stayed approximately the same (adjust for inflation)?*’

Question 2: ‘*In the last six months has your company taken one of the following actions [increased, decreased or maintained the innovation spending] as a direct result of the economic downturn?*’

Question 3: ‘*Compared to 2008, do you expect your company to increase, decrease or maintain the total amount of its innovation expenditures in 2009?*’

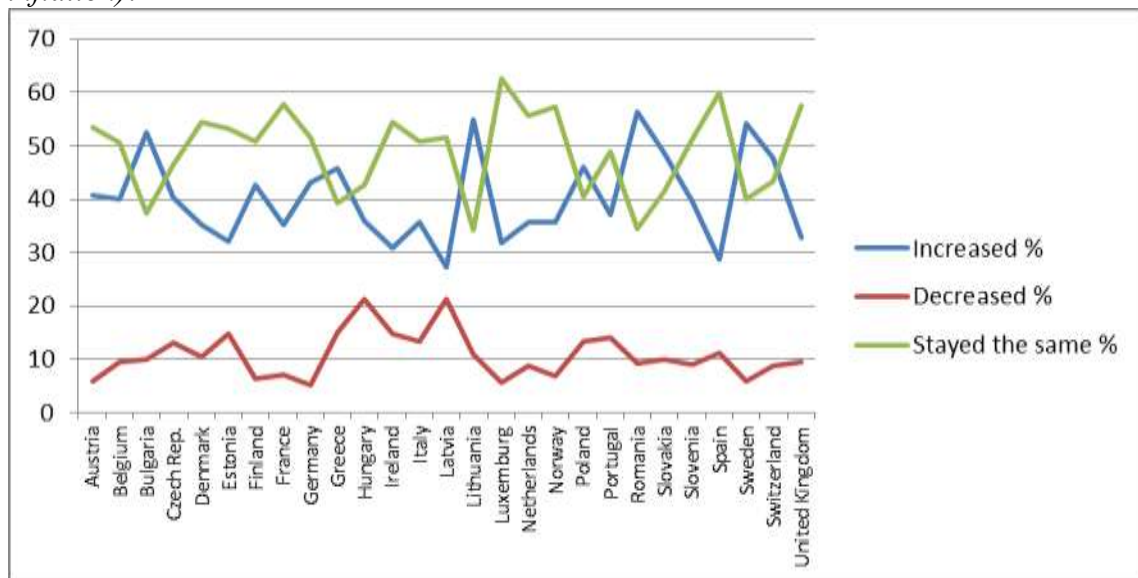
The first question serves to investigate the medium-term steady-state trend of the European firms’ innovation spending before the crisis. The second question sheds some light on the direct effects of the current economic downturn on the firms’ innovation investments. Finally, the third question captures the expectation of firms on innovation investment.

In the second half of 2008, the financial crisis and “collapse” of the financial system took place. It is followed by an economic slow-down or even recession in some

Member States. In studies on access to finance for SMEs, the impact of economic and credit cycles on the supply of SMEs finance are considered. It is generally agreed that economic cycles can have a significant impact on bank lending to SMEs. The severeness of the current financial crisis and consequently the economic slow-down/recession has an adverse effect on SMEs' access to bank financing. SMEs are particularly vulnerable to the credit crunch due to their heavy dependence on bank credit and limited recourse to financial markets (European Commission, 2008).

The following graphics illustrate the firms' investment in innovation concerning the previous three research questions:

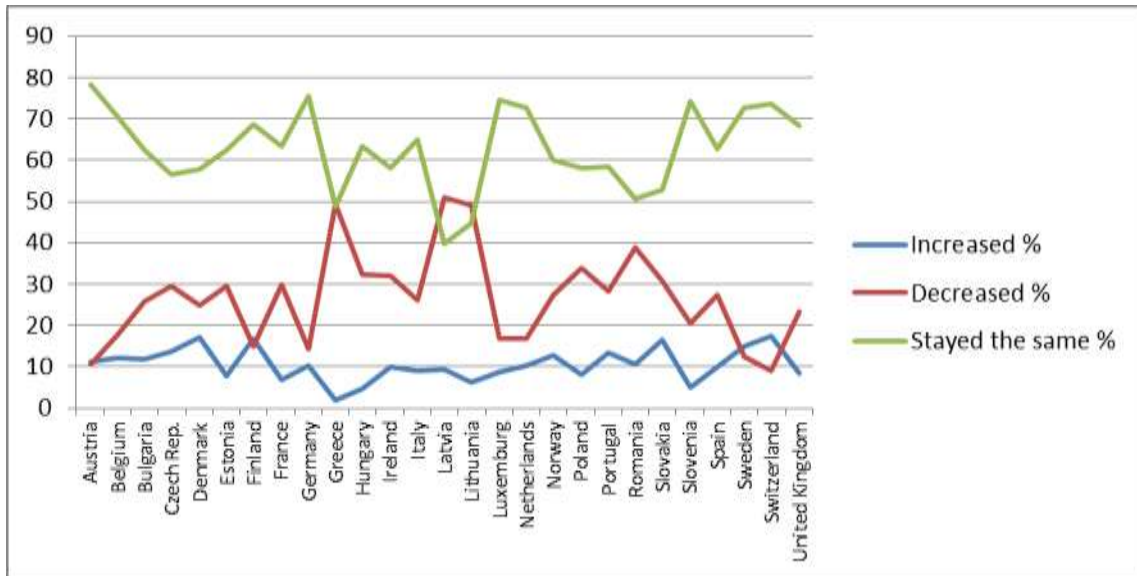
Question 1. 'Compared to 2006, has the amount spent by your firm on all innovation activities in 2008 increased, decreased, or stayed approximately the same (adjust for inflation)?'



Source: re-scaled results by Archibugi and Filippetti (2011) on Innobarometer 2009 (European Commission, 2009)

The first graphic shows that, before the major economic downturn, countries generally maintained or increased their investments in innovation. The cases of higher increase were mostly in new member States (the catching-up countries from Central and Eastern Europe). Countries like Sweden, Austria, Germany, Finland also increased, but in less percentage.

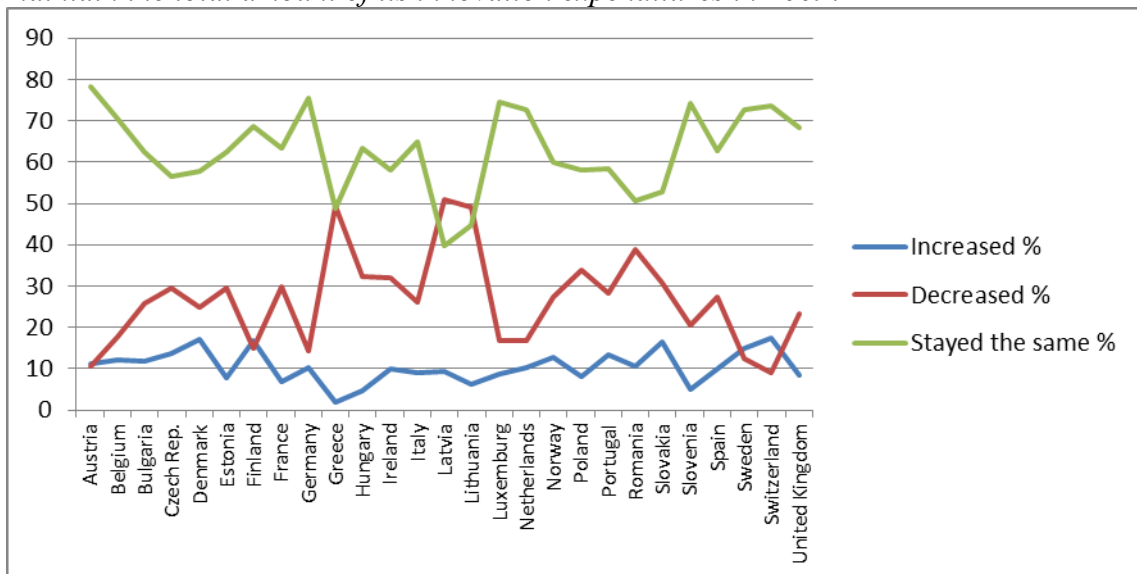
Question 2. In the last six months has your company taken one of the following actions [increased, decreased or maintained the innovation spending] as a direct result of the economic downturn?'



Source: re-scaled results by Archibugi and Filippetti (2011) on Innobarometer 2009 (European Commission, 2009)

The second graphic shows that the economic crisis dramatically affected the previous pattern, getting the maintenance decision the highest percentages (especially in Sweden, Switzerland, Austria, Germany, Finland). The increases are much lower and the decreases are generally situated between 20% and 40% (so the increased% line is now below the decreased% line). The major decreases happened in those catching-up countries making them loose their previous advance.

Question 3. 'Compared to 2008, do you expect your company to increase, decrease or maintain the total amount of its innovation expenditures in 2009?'



Source: re-scaled results by Archibugi and Filippetti (2011) on Innobarometer 2009 (European Commission, 2009)

The third graphic, concerning the future firms' expectations to invest in innovative activities, shows the same behavior from the previous graphic, with a tending up of the decreased% line decision.

3.1. Which factors weight most?

After describing graphically the results from the Innobarometer 2009 survey, a question arises: which were the most resilient companies? The same survey concluded that more resilient firms facing the crisis are particularly:

- the more innovative, where products and services account for a larger share of sales, and where R&D is part of their innovation activities;
- with broader innovation strategies, such as open innovation and user innovation;
- serving or operating in local markets than in international markets;
- that have public support;
- that have been experiencing lower rates of improvement in their innovation performance (differently from the catching up countries).

Thus, resilience can lead to less convergence between countries in innovation performance. Considering this aspect, the 2008 EU innovation scoreboard showed a clear convergence, but in the 2009 EU scoreboard this process is less clear. However, it is early to capture the full impacts of the crisis.

Considering the third aspect of operating in local markets, this may reflect a redirection of firms' activities to their home markets, and points to the need to reopen export markets for innovations as part of the economic recovery. Kitching et al. (2009) discuss other roles for firms and public policy to counter the negative effects of current crisis:

- governments could promote examples of firms that have grown fast in previous economic downturns and could build case studies of their successful strategies and their way of resisting, in order to discern the environment in which people will be more confident about innovation;
- policies and strategies should aim at furthering new business models and new networks of private firms and public research organizations;
- pay more attention to new firms initiatives, helping firm creation by facilitating local networks in which small and new firms have better access to investors, technology and information;
- redefine sectors and cross-sector initiatives, through cross-specialism linkages and dialogues, as many policies are still rooted in traditionally defined sectors. Propping up "outmoded" business models or sectors is not appropriate governmental support in recessions;
- foster creative talent and areas of technological strength. Policies focusing on current social stresses – climate change, transformation of regions and ageing population – could encourage new innovative business opportunities.

Surprisingly, size does not appear to be a relevant factor in resilience facing crisis. Most new firms in EU are micro firms, employing less than 4 people. It is the individual entrepreneur who starts his own business, alone or with a few employees. Thus, SMEs play an exclusive role in the net growth of the enterprise population. They are often

established by young people with new ideas and keen to introduce innovations. The continuous renewal of the enterprise population by SMEs has conditions to stimulate the competitive position of the EU economy. The most wanted business starters are in the service sector: research and development; computer and related activities; and real estate activities. And the subsectors that have the highest contribution to employment growth are also in the service sector: real estate activities; financial mediation; construction; hotels and restaurants.

The adversity can turn into advantage for others: high unemployment can lead to more start-ups as people discover opportunities to start a business, either as employee or as young starter. Also enterprise death creates opportunities to latent entrepreneurs for start-up. There are fast growing enterprises which are more innovative than the average enterprise. Besides creating more employment, they create additional growth of production in other enterprises through outsourcing relations. But quite some very small enterprises do not want to grow, because the individual owner fears to become a manager instead of being an entrepreneur. Most fast growing enterprises are found in the non-financial business activities, having experienced over 60% employment growth in 3 years. The value added from this non-financial business economy was 58% in 2007, and higher in small-scaled sectors like hotels/restaurants, real estate, renting, and business activities.

Filippetti and Archibugi (2011) compare EU member states regarding the crisis and resilience of their SMEs through innovation. They investigate that the structural characteristics of National Innovation Systems (NIS), along with demand, play an important role in explaining persistency in the innovation behavior during a major recession. Literature confirms that countries exhibit systematic differences in terms of economic performance due to the role of country-specific characteristics in the innovation behavior of firms, especially in cases of adverse events. These differences depend on different technological and innovation capabilities on the one side, and development of institutions on the other side. Thus, innovation and technology policies are an effective tool for fostering innovation performance of countries. Edquist and Lundvall (1993), in their theory of NIS, go beyond Nelson's conceptualization on recognizing that the ability of countries to foster innovation depends upon social capabilities besides science and technology. So the NIS includes the institutions and economic structure affecting the rate and direction of technological change in the society.

At the core of the latter definition of NIS resides the microeconomic theory of innovation derived from the Neo-Schumpeterian literature, the assumptions of bounded rationality of agents, the role of tacit knowledge and of institutions on economic activities. The main message of the NIS is the systemic nature of innovation activity. Firms carry out innovation through extensive interactions with several agents outside their boundaries such as research centers, universities, users and suppliers. Crucially, this activity occurs within a specific institutional context. The most important NIS characteristics are the stock of knowledge, human resources, credit system and industrial specialization, which are referred as NIS structure by Filippetti and Archibugi (2011).

3.2. How relevant is the NIS structure?

Back to the analysis grounded on both reports from the EC, Filippetti and Archibugi (2011) crossed the respective indicators, *InnoStruct* (EIS composite indicator addressing structure of country system of innovation) and *InnoInv* (Innobarometer indicator addressing country innovation performance) for the 2006-2008 period and then for the

year 2009 (addressing the previous three research questions). The juxtaposition of the two resulting graphics gave origin to the following integrative map:

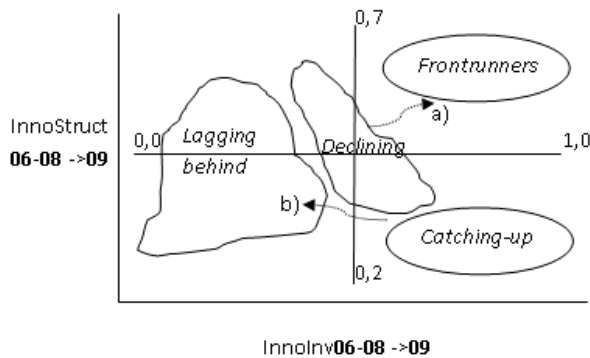


Figure 1 - Innovation performance (*InnoInv*) and national innovation system strength (*InnoStruct*).

Note: axes cross at average values

Source: Filippetti and Archibugi (2011)

Legend:

- Frontrunners: this group consists of those countries which show both a consolidated structural leadership of their innovation performance and, at the same time, keep increasing their investments in innovation;
- Catching-up: although these countries do not show a high strength of their national innovation system, they have been increasing their investments more than the average relative to the considered period. This group includes five new Member States;
- Declining: countries which, despite having a strong national innovation system, have been relatively increasing their innovation expenditures less over the 2006-2008 period;
- Lagging-behind: group of countries characterized by a low innovation performance at national level and a low performance in firms' innovation spending. Interestingly this group includes both new Member States (such as Hungary and Latvia) as well as large countries (like Italy and Spain).

The previous map illustrates a transition from the previous cross-country situation (2006-2008) to a more adverse situation in 2009. In the period from 2006 to 2008, the countries within the groups or clusters obtained were first behaving as:

- Frontrunners: Sweden; Switzerland; Finland; Germany; Austria
- Catching-up: Romania; Lithuania; Bulgaria; Slovakia; Poland
- Declining: Denmark; UK; Luxemburg; Belgium; France; Netherlands; Slovenia; Czech Rep.; Norway; Greece
- Lagging-behind: Ireland; Estonia; Portugal; Spain; Italy; Hungary; Latvia

In 2009, a considerable change took place – marked in the map as *a)* and *b)*. The countries within the groups or clusters obtained were now behaving as:

- Frontrunners: Sweden; Switzerland; Finland; Germany; Austria; and *a)* Denmark; UK; Luxemburg; Belgium; Netherlands (these came from the previous Declining group)
- Catching-up: Bulgaria; Slovakia (tending to move towards the Lagging behind group)
- Declining: France; Slovenia; Czech Rep.; Norway; Portugal; Spain; Italy

- Lagging-behind: Ireland; Estonia; Hungary; Latvia; and *b) Romania; Lithuania; Poland* (these came from the previous Catching-up group)

As a consequence of the crisis (from 2006-08 to 2009), the distance between the Frontrunners and the other countries has increased. This result is related with three major issues (Filippetti and Archibugi, 2011):

- uneven effects of the crisis: the impact of the global economic downturn on firms' investment in innovation has been of different magnitude across European countries (such as the new Member States which were catching up over the years 2006–08);
- structure of NIS matters: countries endowed with stronger national innovation systems are also those less affected by the recession (this has not happened in the 2006–08 period);
- NIS patterns of countries: the outcomes of historical processes in which the development of organizations/industries interact with national policies and institutional development over time (Fagerberg et al., 2009) also contribute to the strength of the NIS (path dependency and technological accumulation efforts).

Concerning the overall firms' innovative behavior facing crisis in Europe, Filippetti and Archibugi (2011) conclude there are three main different reactions:

- Persistency behavior: over 40% of the firms declared to have kept their innovation investment unchanged in spite of the crisis. This somehow confirms the importance of technological accumulation (such as Frontrunners and those that have joined them);
- Cyclical behavior: almost 50% of the firms revealed a cyclical innovative behavior, mainly in new Member States which have reduced their investment in innovation in times of major crisis. The main reasons for cyclical behavior are related with: drops in their external demand (exports) as their clients are enterprises located in developed countries; drops in their domestic demand; and low strength in their NIS structure namely the credit system. Another reason concerns their qualified human resources which they resist to fire even when facing a drop in their demand;
- Counter-cyclical behavior: only 6% of the firms are counter-cyclical, i.e., invest more in innovation in times of major economic downturns. An analysis on these exceptions should be object of further research, to learn more about the determinants of this behavior.

The study of these three global behaviors (persistency, cyclical and counter-cyclical) was based on a complementary analysis including the demand variables, the NIS variables and the interactions between both through an ordered logit model. A special contribute comes from the interactions' model (between the demand and the NIS variables) which is a multiplicative model, very useful when the relation between inputs and results of applied policies varies with the institutional context. This is known as *context conditionality* and is well captured by this type of models.

For example, Netherlands has “strong local agents and a good coordination of them to get their synergies and this create national research”, said Peter Nijkamp at an international meeting (Nijkamp, 2011). If these principles of connectivity are accomplished, for reinforcing research initiatives for national and international projects, national research will function. According to population evolution (on data from the United Nations), cities will increase and be based in virtual and physical proximities.

Then, European countries have to analyze and plan this very well taking into account their resources and sustainability. These issues are very urgent and require new policies for combining knowledge in terms of its high accessibility and sustainability. For example, how to combine knowledge in tourism area from Portugal, with Spain or others

stronger in the same area, to reinforce its position (quite below EU average scientific production)? In an open cooperative economic environment, without losing competitiveness, the motivation will be higher and also the resulting performance.

4. A resilient European System of Innovation

The European Union (EU) is grounded on three main goals: cohesion, integration and convergence. What about the effects of the current world crisis on these goals? It will be important for policy advisers to investigate what is the resulting impact (Hodson & Quaglia, 2009). While several studies have addressed the impact of the financial crisis in terms of income, productivity and employment, less attention has been paid to the impact on innovation performance. Convergence in innovation is crucial for a successful European integration since innovation is either a key asset to enhance competitiveness, or a provider of cohesion between social and political spheres (Sharp, 1998). It is why the European Council declared its intention of making the European area the world's most competitive and dynamic knowledge-based economy in the world. However, the process of EU enlargement has turned it more heterogeneous and polarized in terms of innovation performance and knowledge creation (Archibugi and Filippetti, 2011). Several European countries are still lagging behind in knowledge and competence building. In some cases, the gap in innovation performance has become an opportunity for the new Member States to catch-up with the more advanced countries. But the more recent statistics show that the emerging countries became the most vulnerable to external shocks, since they have reduced their innovative investment as a direct consequence of the economic crisis.

As European policy makers put the knowledge economy at the centre of economic policy, they ask new Member States to make a major effort to invest in R&D and other innovation related activities. But the EU countries vary considerably in terms of technological capabilities: while some of them such as Sweden and Finland are world innovation leaders, others are lagging behind such as Portugal. The new member countries are more vulnerable, not only in scientific and technological infrastructure, but also in financial institutions and therefore likely to be hit more severely by adverse effects. The existence of major technological gaps within Europe has been recognized as a constraint to the building of a strong European System of Innovation (Lorenz and Lundvall, 2006). The EU enlargement has led to a more heterogeneous area in terms of innovation and technological development. Then, EU policy makers need to take into account the increasing variety in technological competences, innovation performance and industrial structure. In contrast to the United States or Japan, a proper European System of Innovation is still far from being in place as EU still appears to be an agglomeration of autonomous and diverse national innovation systems (Lorenz & Lundvall, 2006).

What issues EU is lacking for a proper System of Innovation? i) highly consolidated mechanisms of knowledge and technology transfer; ii) sharing the same institutional setting such as the same education system, industrial policies, etc. (Rodriguez-Pose, 1999); and iii) human resources as a fundamental mechanism of knowledge diffusion, especially of tacit knowledge. In these three issues, which the US System of Innovation has, there is a general awareness of the need to coordinate science, technology and innovation policies at the EU level. In figure 2, it is plotted an "ideal" European Innovation System taking into account the EU multilevel - Community and Member States - governance of innovation (Archibugi and Filippetti, 2011). It also shows different components of an ideal European Innovation System:

- the four groups of countries that contribute to the core of innovation activities;
- the production of core innovation and new knowledge;
- the cross-European flows of knowledge, technology and human resources;
- the absorptive capacity, which allows countries to take advantage of technological opportunities from outside national boundaries; and
- the joint large-scale projects in basic research.

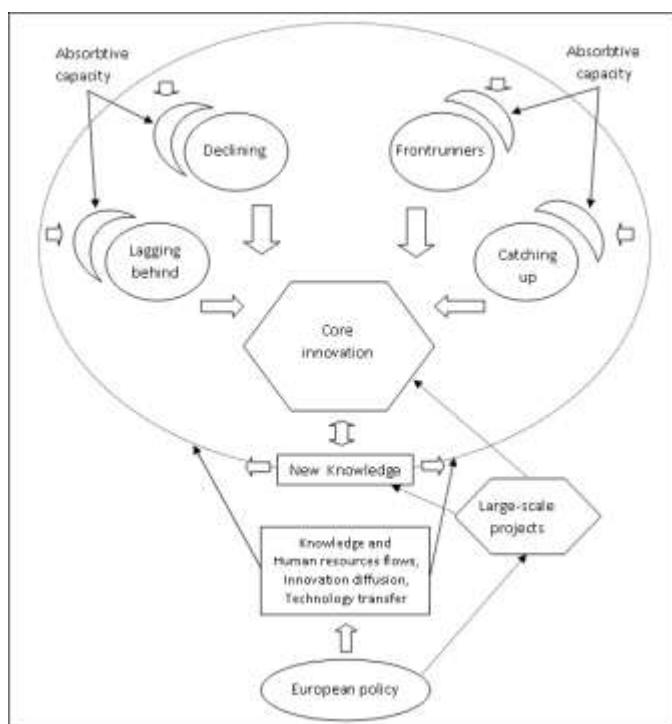


Figure 2: An “ideal” European System of Innovation: the development and diffusion of innovation outcomes across the EU countries

Source: Archibugi and Filippetti (2011)

With the polarization of innovation and knowledge creation across the EU, a few countries are responsible for the bulk of innovation and knowledge production. The technology gap provides a fundamental potentiality for lagging behind countries to catch-up and, in fact, some of them have benefited from this. However, there is a general fragility as major effects of the crisis have shown. Therefore, a more articulated policy needs to be put in practice as suggested by the report of European Commission (2009c).

4.1. Policy issues and future research

More attention should be given to investment in knowledge diffusion and absorption depending on the specific national context. The following policy recommendations are derived from analyzing this aspect within the proposed EU innovation system (Archibugi and Filippetti, 2011):

- innovation policies aimed at enhancing the mechanisms underlying the diffusion of knowledge and the circulation of human resources will facilitate the catching up of more fragile countries and increase the European innovative level;
- a greater harmonization between the labour market and the educational system will be able to increase the absorptive capacity and innovative potential of an increasing number of countries (Filippetti and Guy, 2011). These authors have shown that a

highly qualified labour force reduces the risk of innovation disinvestment in adverse economic conditions;

- joint large-scale projects in basic research would push the EU towards the scientific frontier, making possible to tap future major technological developments. Evidence from the US show that the academic research corporate practitioners mostly use is performed in universities, publicly funded and accessible. This will be a good way to make knowledge available to all European players, especially if the priority is the creation of absorptive capabilities in laggard countries;

- countries need to build their own endogenous capacity to absorb knowledge and technology generated elsewhere, as well as a suitable environment for attracting qualified human resources.

The requirement of these policies involves three main factors of the EU context that should be further analyzed: i) the high polarization in terms of generation of knowledge; ii) the potential offered by a system of public R&D and human resources that has not yet been transformed into a consistent business innovation strategy; iii) the weakness of newcomers in sustaining their innovative projects when there are external shocks such as the current financial crisis.

A future research can also focus on the potential of electronic networks of companies (e-business and other platforms), especially on finding case studies of success, in order to determine which competencies and interactions most contribute to that success (Fernandes and Almeida, 2011). And to a large extent, what factors make e-business a successful inter-organizational activity and mean of knowledge diffusion. The performance and ability of the partners to create value in such networks would therefore depend on relationship competencies. Due to SMEs' limited capital, scarcity of information experts and inexperienced human resources to innovate and improve the information systems, the successful adoption and use of e-business technology is then crucial for the survival of SMEs. This is important because SMEs play an exclusive role in the net growth of the enterprise population and its continuous renewal has conditions to stimulate the competitive position of the EU economy.

5. Conclusion

From the results discussed, it can clearly be concluded that the negative effects of the world economic crisis are remarkable and this is not likely to diminish in the immediate future. As the new Member States are the worst hit by the recession, this is also affecting the process of convergence in innovation performance. This could seriously hinder the reduction of regional disparities which is a key factor for the EU to compete today with US and Japan, and in the very near future with emerging Asian economies such as India and China. Strengthening the innovative potential of laggard countries may become a crucial way to allow the EU to grow and compete in the global economy. Another important issue to address would be the impact of the crisis at country's regional level. Is the crisis exacerbating regional disparities as well? This analysis would shed some light on the presence of a double-level divergence in innovation performance across countries. The availability of data at the regional level describing the impact of the crisis would therefore be useful (European Commission, 2010).

Even discussions of regional development are shifting from a focus on growth and development to the analysis of the relative resilience of regional economies in response to rapid transitions in technologies, markets and exogenous economic shocks.

This emphasis on sustainable regions rather than economic competitiveness extends research on learning regions to a broader conceptualization of embedded institutional adaptive capacities. Empirical evidence increasingly indicates that institutional capacities and firm networks are more critical to the ability of regions to manage transition than those factors measured by innovation metrics alone (Treado & Giarratani, 2008). First, agglomeration economies alone are not sufficient to guarantee the kind of ongoing innovation essential to firm success in a world with short product cycles and heightened global competition. Second, innovation requires a skilled creative regional labor market operating under entrepreneurial conditions (Gertler and Wolfe, 2002). The resilience discussion emerges into this uncertain debate about the role of small firm innovation and entrepreneurship in developing long-run adaptive capacities in regions.

It remains to be seen how the countries will be able to react since competencies, skills and knowledge are not an ephemeral phenomena, but are rather embedded in organizations, routines, firms' capabilities, workers' skills and capital goods. There is another aspect to struggle with: how will the new economic environment be transformed by the crisis? New sectors can emerge as a result of new technological opportunities as well as of substantial public policies that governments are enacting to hamper the effects of the crisis. A case in point is the "green industry" which is believed to represent a fundamental source of innovation and growth for the coming future (OECD, 2009).

Catching-up processes based on the adoption of technology require a reliable base of internal knowledge, human resources and infrastructures. The winners are more likely to be those countries which are equipped with both strong innovative infrastructures and domestic knowledge base. The capacity of the catching-up countries to recover crucially depends on their capacity to maintain their acquired knowledge, skills, competences and human resources in their business sector and within their borders. If these factors are not properly counter-acted by public and business policies, there is the risk that the national system of innovation (NIS) will be substantially weakened and the potential for growth will be undermined.

The choice of sectors/activities and the design of public procurement policies can provide new opportunities and it is very likely that those that manage to capture them will be the winners. The fact that some structural characteristics of the NIS explain persistency of innovation in response to major exogenous shocks is an important finding. It sheds some light on the behavior of firms during crisis and represents a step forward in terms of understanding the mechanisms underlying the relationship between macro and micro-determinants of innovation.

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