Is the Crisis Striking Innovation?
Evidence from Europe

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Abstract

This article explores the impact of the current economic downturn on investment in innovation. First, what is the impact of the recession on firms' innovation activities? And second, what will be the outcomes on the innovation capabilities across the European countries? Using structural data from the European Innovation Scoreboard and results from the Innobarometer Survey, we show that the recession is having a huge impact on innovation investments across European countries. We also point out that the effects of the economic downturn are not the same across Europe, and that this depends on specific features of the national innovation structure and national policies. Some policy considerations are finally discussed.

1. Introduction

Strangely enough, the economists of innovation are not participating the debate about the causes and impact of the ongoing global crisis. This is probably due to a general belief that innovation has less to do with economic crisis. However, since Schumpeter we know that innovation does play a crucial role in the dynamic of the business cycles (Schumpeter, 1934). The aim of this article is to explore the impact of the current global turmoil of investment in innovation.

In particular, by investigating the firms' investments in innovative activities, we address the following two key questions. First, *what is the impact of the recession on firms' innovation investments*? And second, *what will be the outcomes on the innovation capabilities across the European countries*? From a theoretical perspective, the first question is about exploring whether innovation responds to the business cycle. This debate started with the studies on business cycles summarized by Schumpeter (1939), which had a passionate revival during and after the recession of the 1970s. From one side there were those who claimed that radical innovations are more likely to be carried out during the crises (Mensch, 1979). While on the other side, there were those who answered back that what matters for the economy is mostly the diffusion of innovations, which takes place during the growing phases of the business cycles (Freeman, Clark et al., 1982) (for an overview on the debate see Van Duijn, 1983; Freeman, 1984; Tylecote, 1992; Perez, 2002). In turn, the second question calls for an analysis on the structural effects that the recession is having on the national systems of innovation which can undermine and/or transform the innovation potential of the countries.

The innovation behaviour of firms is crucial to understand how countries will come out of this crisis. In our analysis, we observe that the recession is having a huge negative impact on firms' innovation behaviour with respect to the last three years across all European countries. However, we find that the effects of the economic downturn are not equal across Europe. In particular, the countries which are better reacting to the economic downturn are those characterized by:

i. a strong national innovation system with high public and business R&D expenditures;
ii. high-skilled human resource and extended involvement in life-long learning programmes;
iii. larger shares of employees in the knowledge-intensive sector.

We observe that those countries among the European Union's New Member States which were narrowing their technological gap are now the more struck by the recession.

Two different sources of data are used for the analysis. First, the *European Innovation Scoreboard 2008* (Merit, 2009) which aims at comparing the innovative performance of the European countries through a composite indicator. Second, the *Innobarometer 2009,* a fresh survey carried out in April 2009 which addresses, among other issues, the effects of the economic downturn on innovation spending across the European firms.

The paper is organised as follows. In the next section we present the data sources and the methodology. In section three the impact of the recession on firms' innovation investments is explored. Section four investigates the main relationship between the effects of the current economic downturn and the strength of the national innovation systems. In section five we attempt to find out on the main determinants of the national innovation systems which have played the major role in making countries better equipped to face the recession. Finally, section six summarizes the main findings and discusses the policy implications.

2. **Data and methodology**

The analysis is grounded on two Reports from the European Commission, the *Innobarometer 2009* and the *European Innovation Scoreboard 2008* (European Commission, 2009; Merit, 2009). The first is a survey which has been conducted during April 2009 in the 27 Member States of the EU, Norway and Switzerland, and it is now at its eight wave. The *Innobarometer* placed the focus on innovation spending at firm-level, including the effects of the economic downturn. Overall, 5,238 enterprises across Europe were interviewed according to three main criteria: country, company size (20-49, 50-249, 250+ employees) and activity sector. Both the *Innobarometer 2009* and the *European Innovation Scoreboard 2008* include the same countries and they are thereby suitable for a comparative cross-country analysis.

As regards the *Innobarometer*, our analysis is based on the following two questions of the survey made on April 2009: (see table A1 and A2 in the Appendix):

1. Question no. 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)?"*.

2. Question no. 2 *"In the last six months has your company taken one of the following actions* [increased, decreased or maintain the innovation spending] *as a direct result of the economic downturn?"*

The first question regards the three years period 2006-2008, and the answers refer to the medium-term steady-state trend of the European firms' innovation spending before the crisis. In turn, the second question aims at capturing the direct effects of the current economic downturn on the firms' innovation investments. Unfortunately, these data do not specify neither which kind of innovative investments firms are referring to, nor the relative amount. Innovation expenditures can have a quite different impact on the economic system depending on the typology and size, on the industry as well as on the firm's size. Consequently, our analysis has to be interpreted from a behavioural perspective in terms of the reaction of the firms to the recession relative to their investments in innovation activities taken as a whole.

Similarly to the Innobarometer, the *European Innovation Scoreboard* (EIS) is a Report managed by the European Commission – Directorate General Enterprises and Industry - carried out by the MERIT since 2001.[1] The EIS aims at measuring and comparing the innovation performance at country level using a synthetic composite indicator. For our analysis we will use the current EIS composite indicator (Merit, 2009), which is based on twenty-nine indicators addressing several dimension of a country' system of innovation (see table A4 in the appendix for the detailed list of the indicators). In this paper we will refer to the EIS composite indicator as *InnoStruct* to emphasize the fact that is a measure addressing a structural dimension of innovation, in opposition to the *Innobarometer* which instead focuses on the medium and short-term innovation investments. The *InnoStruct*, like many other composite indicators of innovation and technological capabilities, has demonstrated to be a quite stable measure over time (for a review, see Archibugi, Denni et al., 2009). Accordingly, in this paper we take the *InnoStruct* as a mea sure of the strength of each national system of innovation (Lundvall, Johnson et al., 2002). The *InnoStruct* is a composite indicator normalised between 0 and 1 (see Merit, 2009 for methodological details).

Concerning the *Innobarometer*, we derived our own three indicators.

1. The first, the *Innovation Investments Indicator* relative to the period 2006-2008 *($InnoInv_{06\text{-}08}$),* is based on the balance between the percentage of firms increasing and decreasing their innovation expenditures over the period 2006-2008 (see table A1 in the Appendix). In this way, the

[1] Both the Innobarometer and EIS reports can be find on the web site: http://www.proinno-europe.eu/index.cfm?fuseaction=page.display&topicID=51&parentID=48

InnoInv$_{06\text{-}08}$ represents an indicator of medium-term innovation performance relative to the period 2006-2008 in terms of firms' innovation investments.

2. Similarly, we built the *Innovation Investments Indicator* relative to 2009 *(InnoInv*$_{09}$*)* which is instead based on the *Innobarometer* question relative to the direct impact of the economic downturn on firms' innovation spending in 2009 (see table A1 in the appendix). The *InnoInv*$_{09}$ is thereby a short-term indicator reflecting the firms' innovation performance *in response* to the current recession.
3. Finally, the *Innovation Turbulence Index (InnoTurbo)* is a measure of the turbulence of the countries business environment, as measured by the sum of firms increasing and decreasing their innovation investments relative to the period 2006-2008 (see table A12 in the appendix).

Similarly to the *InnoStruct* of the EIS, all these three indicators are normalized ranging between 0 and 1.

3. The impact of the global turmoil across the European firms

In this section we explore the direct effects of the global economic turmoil on the investments in innovation across the European firms. This implies addressing to question: *is innovation a cyclical phenomenon*? Our data do not allow to provide a comprehensive analysis since they reflect the firms' behaviour in one point time only, but at least they allow us to test if innovation investments are affected by a shock such as the 2008 financial crisis.

In Fig. 1 we plot the average firms' answers relative to the question no. 1 of the *Innobarometer* – *"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)?"* – and question no. 2 - *"In the last six months has your company taken one of the following actions* [increased, decreased or maintain the innovation spending] *as a direct result of the economic downturn?"*. The responses clearly show that the economic downturn is having a profound impact on the firms' innovation behaviour across Europe. The percentage of firms increasing their innovation expenditures drops dramatically as a direct effect of the crisis, from 40.2% to 10.6%. In turn, the percentage of firms decreasing their innovation spending surges from 10.8% up to 26.7%. There is also a high number of firms which are expected to maintain their innovation spending at the same level, which has increased to more than 60% from about 50%.

[Figure 1 here]

The huge impact of the economic downturn on firms' innovation spending is also more evident by looking at the data at the country level, reported in the Figure 2. Here we plot the difference between the percentage of firms increasing and decreasing their innovation spending relative to both the periods 2006-2008 and 2009. The differences between the results relative to the two periods are striking. If we look along the x-axis, reflecting the innovation expenditures over the 2006-2008, all the countries show a positive balance, that is the percentage of firms increasing their innovation spending is higher then firms decreasing them for *all* the considered countries. But if we turn to the y-axis, we see that only *four* countries are resisting above the dot line, which corresponds to a balance equal to zero in 2009. As a direct effect of the economic downturn, only Switzerland, Sweden, Austria and Finland the percentage of firms declaring to increase their innovation spending is higher than the percentage of firms declaring to disinvest. On the contrary, countries like Lithuania, Romania, Poland and Greece show a performance better then the average and in line with the best countries over the period 2006-08, while they remarkably drop in 2009.

[Figure 2 here]

Across all the other countries, the percentage of firms disinvesting in innovation is higher than that increasing their innovation expenditures. As a whole, the average balance across Europe passed from a 29.4% relative to 2006-2008 period to a -16% as a direct effect of the economic downturn in 2009.

4. Firms' innovation investments and National Systems of Innovation

In this section we first explore the relationships between the medium-term innovation performance and the national system of innovation strength, and then we investigate the different effects of the recession across the European countries.

4.1. *The dynamic of the firms' innovation investments over the period 2006-2008*

Fig. 3 shows the results of the $InnoInv_{06\text{-}08}$ calculated relative to the question no.1 of the *Innobarometer*, i.e. the changes compared to the situation three years ago. The countries which increased their investments on innovation more than the average include many EU New Member

States such as Romania, Lithuania, Bulgaria, Slovakia, Poland and Slovenia, together with the best performer innovators such as Sweden, Switzerland, Germany and Finland. To have increased the innovative efforts we find together some catching up countries and the traditional innovation champions. Along the political and economic process of convergence undertaken by these countries, most of them have been also catching-up in terms of firms' innovation spending with respect to the other Member States (for an assessment on the EU enlargement policies see Von Tunzelmann, 2004).

[Figure 3 here]

4.2. The turbulence of the creative destruction process within the countries

The $InnoInv_{06\text{-}08}$ does not, by construction, take into account the extent of the internal dynamism within the countries. Two countries with very different percentages of firms increasing and decreasing their innovation spending can have in fact the same $InnoInv_{06\text{-}08}$ figure, given the fact that this is based on the percentage difference. In order to give account of the extent of the dynamic occurring within the countries we developed the "*Innovation Turbulence Index" (InnoTurbo),* as already illustrated in section two. In Fig. 4 we plot both the $InnoInv_{06\text{-}08}$ performance and *InnoTurbo* performance relative to the three years period 2006-2008. First, the correlation rate between the *InnoTurbo* and the $InnoInv_{06\text{-}08}$ is equal to 0.57. Second, the New Member States which were showing a good performance in terms of $InnoInv_{06\text{-}08}$ are in the upper-right quadrant, together with Sweden and Switzerland. Other large economies which are performing well in terms of $InnoInv_{06\text{-}08}$, namely Germany, Finland and Austria, show instead a degree of internal turbulence below the average. The only country showing at same time a high degree of internal turbulence and a low innovation performance is Hungary, a country profoundly affected by the financial crisis. We can conclude that, in general, a higher *turbulence* of the innovation system is associated with a good medium-term performance of firms' innovation spending.

[Figure 4 here]

4.3. The raise of the new bourgeois

In this section we explore the main relationship between the innovation behaviour of the European firms over the last three years and the national systems of innovation strength. In Fig. 5 we plot on the x-axis the $InnoInv_{06\text{-}08}$ performance, while on the y-axis we report an index of structural innovative capacity such as the *InnoStruct* (see section two). In this way we define the following four quadrants and relative groups of countries:

1. The *Parvenu*: although they 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 several New Member States;
2. The *Aristocracy*: this group consists of those countries which show both a structural consolidated leadership of their innovation performance, and at the same time they are keeping on increasing their investments in innovation;
3. The *Declining Nobility*: these countries which, although have a strong national innovation system, have been relatively less increasing their innovation expenditures over the 2006-2008 period;
4. Finally, the *Third State*: is that group of countries characterized both 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.

[Figure 5 here]

As explained by the Neo-Schumpeterian literature, catching-up processes do not occur automatically in response of a mere existence of technology gaps (Fagerberg, 1994). From Fig. 5 we observe that the process of alignment undertaken by the ex-socialist block, represented by the New Member Countries, resulted in a positive trend relative to innovation investments for several of these. Most of these countries are included among the *Parvenu* group, except for Estonia, Latvia and Hungary. Second, the brilliant performance of the *Aristocracy* does not seem to be a hereditary privilege but rather it is the result of systematic efforts which allow their economies to keep on learning along cumulative patterns. While the innovative systems strength is inherently a structural feature, at the end of the day it is the result of years of investments. Finally, the *Third State* group includes those countries which are likely to wide their innovation delay with respect to their direct competitors and the innovation leaders as well.

To sum up, we do not observe a clear relationship between a structural measure of innovation, such as the strength of the innovation systems, and a medium-term measure of firms' innovation relative to the period 2006-2008. This is also confirmed by the low correlation rate between the *InnoStruct* and the $InnoInv_{06\text{-}08}$ which is equal to 0.14. We will see in the following how the economic turmoil is having different effects on the identified four groups of countries.

4.4. The revenge of the Nobility: the heterogeneous effects of the global crisis across the European countries

How are individual national innovation systems connected to the firms' innovative investment decisions? In Fig. 6, similarly to Fig. 5, we plot on the y-axis the *InnoStruct* performance, while on the x-axis we report the $InnoInv_{09}$ indicator. In this way, we are able to explore the effects of the downturn on the groups of countries. First, with respect to Fig. 5, most of the countries belonging to the *Parvenu* disappear from the lower-right quadrant, namely Romania, Lithuania and Poland, while Bulgaria and Slovakia moved closer to the y-axis. Second, if we look at the upper-right quadrant, a different picture emerges as well. The five countries included in the *Aristocracy*, namely Sweden, Switzerland, Germany, Finland and Austria are all still there, but together with several other countries joining this quadrant. Overall, in Fig. 6 a deeper relationship between the national innovation system strength and the firms' short-term innovation performance emerges with respect to the Fig. 5. The correlation rate is in fact equal to almost 0.73 compared with 0.14 of the previous case. However, it is worth reminding that with respect to the three years period 2006-2008, in all the countries firms significantly disinvest as a result of the economic downturn as we have explained in the previous section. That is, only in the four countries at the right of the dot line in the Fig. 6 the percentage of firms declaring to increase their innovation investments overcomes those reducing them.

[Figure 6 here]

Finally, in Figure 7 we illustrate the direct impact of the economic downturn with a simple indicator. The figures are calculated as follows: [(% of firms increasing – % of firms decreasing innovation investments relative to 2006-2008) – (% of firms increasing – % of firms decreasing innovation investments relative to 2009)]. It is quite significant that in the first six positions the

countries experiencing the stronger negative impact of the economic downturn all belong to the *Parvenu* group, together with Sweden. Among the relatively less affected by the recession we find advanced and dynamic economies such as Finland, Netherlands, Denmark and Switzerland.

[Figure 7 here]

To recap, in this section we find that the impact of the current economic downturn has not the same magnitude across the considered countries. On the contrary, the most struck have been those New Member States which were catching up over the years 2006-2008. Additionally, considering the effects of the economic downturn on the firms' innovation behaviour, we also observe that countries endowed with a stronger national innovation systems are also those less affected, in relative terms, by the recession. This clearly emerges in opposition to the 2006-2008 situation in which we did not observe a significant relationship between medium-term innovation performance and the strength of the national systems of innovation.

5. Winners and losers: the determinants of the different reaction of the countries

We have showed that, although the economic downturn is having a big impact across the European firms, this does not affect all the countries to the same extent. Why are some countries resisting better then other to the recession? In table 1 we show the correlation rates between the $InnoInv_{09}$ scores and each of the twenty-nine variables included in the *InnoStruct* composite indicator grouped for the innovative dimensions (see table A3 in the appendix for the complete description of the *InnoStruct* variables). In the following we comment the most interesting results emerging along the dimensions of the *InnoStruct* indicator.

Human Resources: the most relevant discriminating factor seems to be the doctorate graduates and the participation in life-long learning programmes. This suggests that across European economies the competition level has shifted upwards at post-graduate level. Additionally, the fast moving environment in which firms work today seems to require a continuous (re-)training of the labour force, as reflected by the high figure of the life-long training involvement.

Finance and Support: the high figure relative to the public R&D expenditure emphasizes the crucial role played by investments infrastructures in science and technology in supporting the innovation activities of the business sector.

Firm Investments: the relevance of the R&D expenses also emerges from the high figure of Business R&D (0.80) included in this dimension. While non-structural innovation investments might be easily displaced by firms, it comprehensively becomes more difficult to dispose of long-term projects and of formalised labs.

Linkages & Entrepreneurship: the importance of the linkages within the economic system is confirmed by the high figure (0.73) of public-private co-publication.

Throughputs: the high rate of patents highlights the fact that they still play a major role.

Economic effects: finally, the last relevant figure regards the considerable importance of the share of employment in knowledge-intensive services.

[Table 1 here]

All in all, this evidence suggest three main messages.

1. First, concerning human resources, the competition among the advanced economies on the one hand is shifting upwards at post-graduate level, while on the other hand current fast changing environment requires investments in life-long training programmes.
2. Second, the other relevant correlation rates suggest that the strength of public dimension of the national system of innovation as a whole considerably matters to keep firms willing to invest in knowledge also in bad times. The importance of public R&D, business R&D, public-private collaboration and investments in the ICT infrastructures, if taken as a whole, stress the strategic role played by comprehensive innovation and technological policies.
3. Third, while the correlation rates for technology-based manufacturing and export are positive, the higher figure is the one relative to the *knowledge-intensive services*. This suggests an important consideration regarding the industrial structure. The countries which are performing (relatively) better in the current economic downturn are characterized by a strong R&D base, both public and private, and an industrial specialization in knowledge-intensive services. These countries are inclined to keep in their countries only the R&D and design-based processes of their manufacturing industry, and moving qualified labour forced in the knowledge-intensive service sector.

6. Discussion

6.1. The big impact of the current recession on business innovation

The first fundamental finding of this paper is that we can no longer have doubt that the current economic downturn is bearing substantial consequences on Europe. In section three we show the impact of the recession in terms of a substantial drop of firms' increasing their investments in innovation activities (cf. Fig. 1). Fig. 2 shows that with respect to the 2006-2008 period, in which in every country the balance between the firms increasing and decreasing their innovation spending is positive, in 2009 only four out of twenty-seven countries across Europe show a positive balance. In short, in most of the considered countries the percentage of firms disinvesting innovation activities is higher than those increasing them, as a direct result of the economic downturn. We are aware that our data do not say anything about the quality and quantity of these investments, but still this evidence reflects a huge impact of the downturn on firms' behaviour. There is no proof that depression is increasing innovative investments, as suggested by Mensch (1979).

However, in section four we also find that the negative effects have not the same magnitude across all the European countries. On the contrary, we show that the most negatively affected by the downturn are precisely those EU New Member States which have been catching-up over the period 2006-2008, namely Romania, Lithuania, Poland, Slovakia and Bulgaria (cf. Fig. 5 and Fig. 6). One of the main cause can be the capital escape which has been remarkable over the last months in these countries, leading to a scarcity of capital and the worsening of the credit conditions. We know since the contribution of Schumpeter that the banking system plays a crucial role regarding innovation thanks to its attitude of financing the innovations put forward by emerging entrepreneurs (Schumpeter, 1934; Santarelli, 1995; O'Sullivan, 2004). Whatever the cause, the impact of the current downturn is deeper on the innovation performance and capabilities of those New Member States which were catching-up benefiting by their inclusion within the European Union.

These results are subject to a limitation. Our data cannot tell us if among these bad figures about the impact of the recession there are also the Bill Gates or Steve Jobs of the future. Both Gates and Jobs founded *Microsoft* and *Apple* respectively in the second half of the 1970s, when everyone was playing the *"The Dying Swan"* of the international economy. The thesis that radical innovations emerge particularly during the negative phases of the business cycle is not a new one. It was put

forward by Mensch (1979) and hardly criticized by Freeman among others (Freeman, Clark et al., 1982) as already mentioned in the introduction. In short, these data cannot tell us how much *creative* is the *destruction* process which emerges from our analysis.

6.2. *Firms' innovation performance and National Innovation Systems*

Innovation is a phenomenon characterized by a long-term and structural nature, whose evolution is intertwined to the structural changes of the industrial structure, as well as the social and cultural factors (Freeman and Soete, 1997; Breschi, Malerba et al., 2000; Antonelli, 2003; Fagerberg and Srholec, 2008; Von Tunzelmann, Malerba et al., 2008). Our analysis shows that during the 2006-2008 period the relationship between the innovation national system strength and the medium-term innovation performance of the firms was not significant. In fact, both the *Aristocracy* and the *Parvenu* show a good performance in terms of innovation investments although having very different levels of structural innovation capabilities (cf. Fig. 5). This indicates the existence of a large group of countries within the New Member States which have started building innovation competences and technological capabilities along their process of convergence with the European Union.

While during the expansion period 2006-2008 firms innovation behaviour and national innovation system strength are not closely related, this is no longer true in the current economic downturn situation. In this case, countries having a stronger innovation structure are also those whose firms' innovation investments are, in relative terms, less affected by the negative business cycle. In a nutshell, when the hard times have come, *structure matters*. Countries which have not reached a high level of structural innovation capabilities are those whose firms are showing a stronger cyclical behaviour.

6.3. The effect of the economic downturn: the winner and losers in the innovation race

The second question we put forward in the introduction was: *what will be the outcomes on the innovation capabilities across the European countries*? Two answers are possible. First, after the crisis the *Parvenu* will recover the strong impulse and keep on narrowing their innovation gap with respect to the *Declining Nobility* and the *Aristocracy*. Second, the effects of the downturn will turn out to be structural, and as a result of the crisis the New Member States, or some of them, will be no longer able to undertake that catching-up process which characterized their economies before

the recession. Answering to this question is made even more complicated by the fact that many other interrelated elements play a role, such as the duration of the crisis, the capital flows, the credit market and the currency market among the others. However, competences, skills and knowledge are not an ephemeral phenomena, although immaterial in nature. The Neo-Schumpeterian stream of literature has demonstrated that they are indeed embedded in organizations' routine, firms' capabilities, workers' skills and capital goods (Lall, 1992; Evangelista, 1999; Massini, Lewin et al., 2002). Additionally, it is not guaranteed that after the turmoil the *loci* of the competitive advantage will remain the same. New sectors can emerge as a result of the large public policies which the States are putting forward as a deficit spending strategy to hamper the effects of the crisis. A case in point is the renewable energy industry, which is likely to represent a fundamental source of innovation and profits for the coming future.

We argue that while the winners are easier to identify, this is not the case for the possible losers. The former are in fact more likely to be those countries which are both equipped with a strong innovation structure base and are keep on increasing their expenditures on innovative activities. On the other side, the capacity of the *Parvenu* to recover their previous catching-up patterns cannot be taken for guarantee. This will crucially depend on their capacity to maintain their acquired knowledge, skills, competences and human resources in their business sector and within their borders. This will require offsetting negative reactions such as the emigration of skilled workers, budget cuts of R&D public spending and educational system, and the weakening of their credit system. Such kinds of responses would have substantial negative effects on the national systems of innovation and undermine their growth potential for the coming years. In section five we showed that comprehensive policies ranging from public R&D, to life-long learning and ICT infrastructures play a key complementary role to sustain innovation investments in the business sector. Finally, the large public expenditures programmes put forward by most of the States in response to the crisis also represent a crucial mean concerning innovation capabilities in so far as they are linked to industrial policies. To this regard, the choice of the sectors and the structure of the public procurement policies are also going to deeply contribute to determine the winner and losers of the current global turmoil.

To conclude, our findings clearly show the big impact of the on-going recession on the European business environment in terms of innovation investments. This is likely to bear profound consequences in the coming future. Unfortunately, we do not have data regarding non-EU countries such as the United States, Japan, China and India among the others. But a key question is: what if

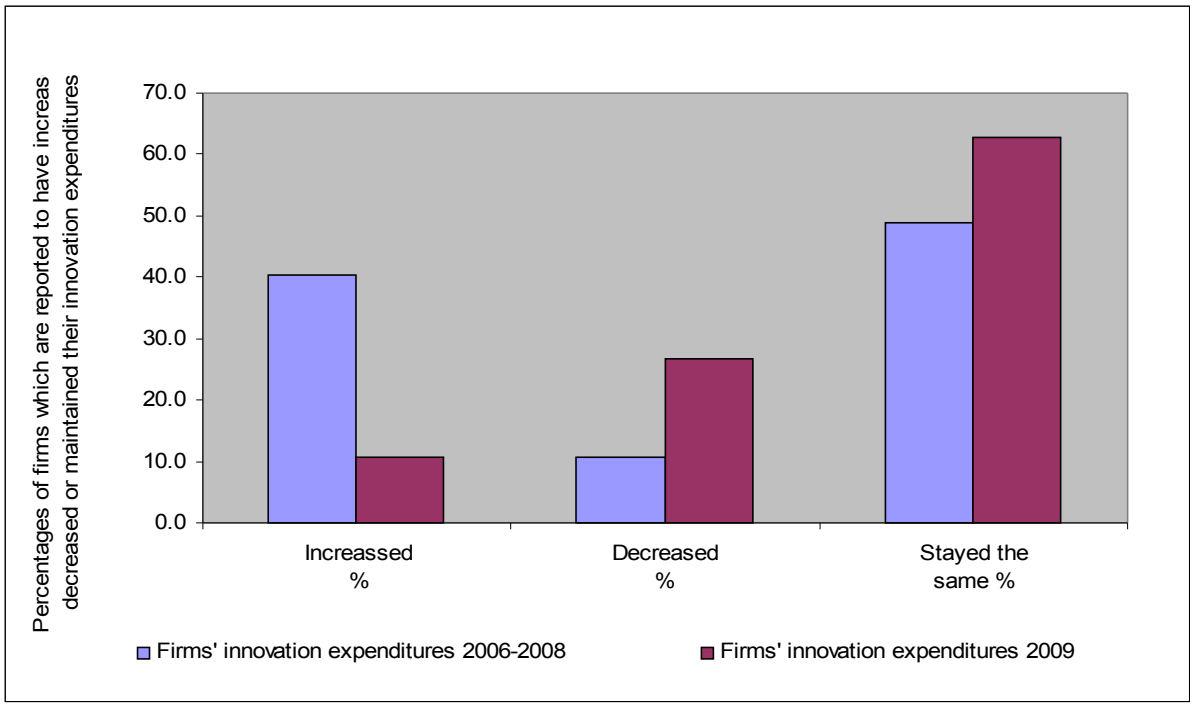
these countries are not reacting like the European countries vis-à-vis the current recession? That is, what if their firms are not decreasing their innovation investments – or are decreasing them to a considerable lesser extent? The way firms and countries are reacting to the global turmoil is likely to profoundly affect technological leadership in the global arena in the coming future. At such, our results show that public policies are key to face this recession and thus the strategy appears clear, but who will be able to sustain these kinds of policies usually characterized by a low short-term "political return"? Finally, we show that this crisis is heavily striking particularly the New Member States undermining their growth potential. Is that good news for the European Western economies and the European Union as a whole? The need for a stronger and cooperative innovation policy at European level is a pressing need for the entire European Union, not only in good times but especially in bad times.

Acknowledgment

We would like to thanks Hugo Hollanders and Keith Sequeira for providing us the data on the European Innovation Scoreboard.

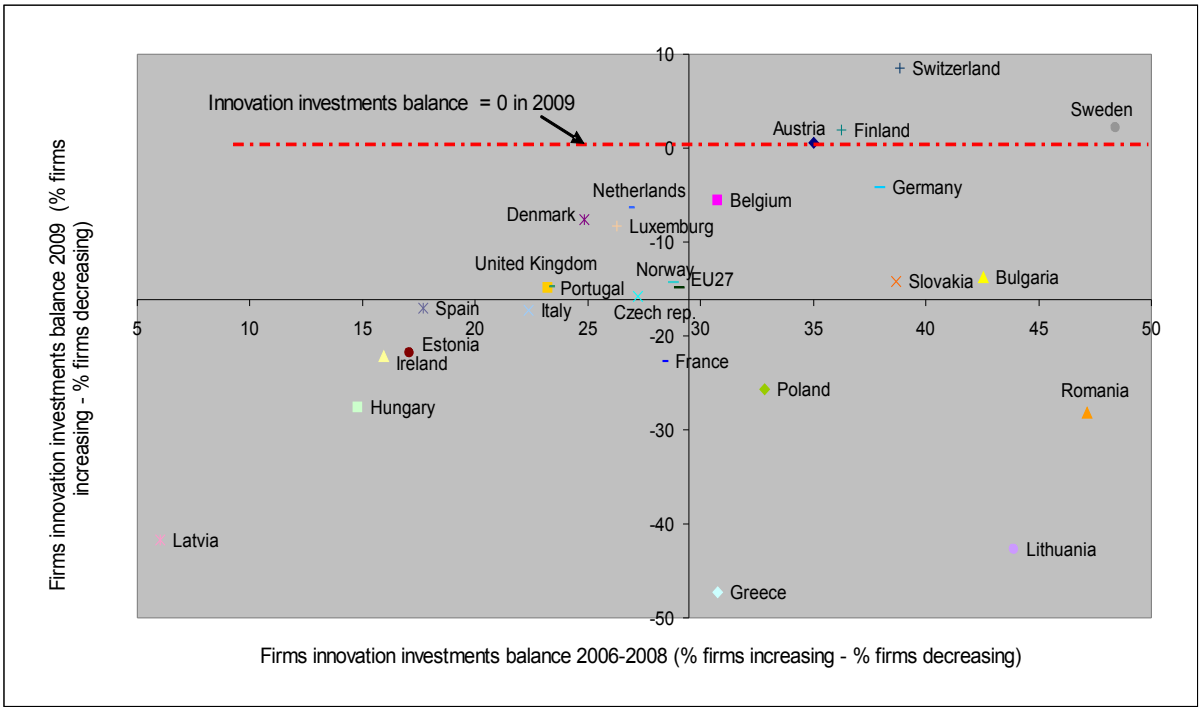
Table and Figures

Fig. 1. Firms' innovation expenditures: comparison between the three years period 2006-2008 and the first six months of 2009



Source: author's elaboration on the two questions of the *Innobarometer* (see tables A1 and A2 in the appendix)

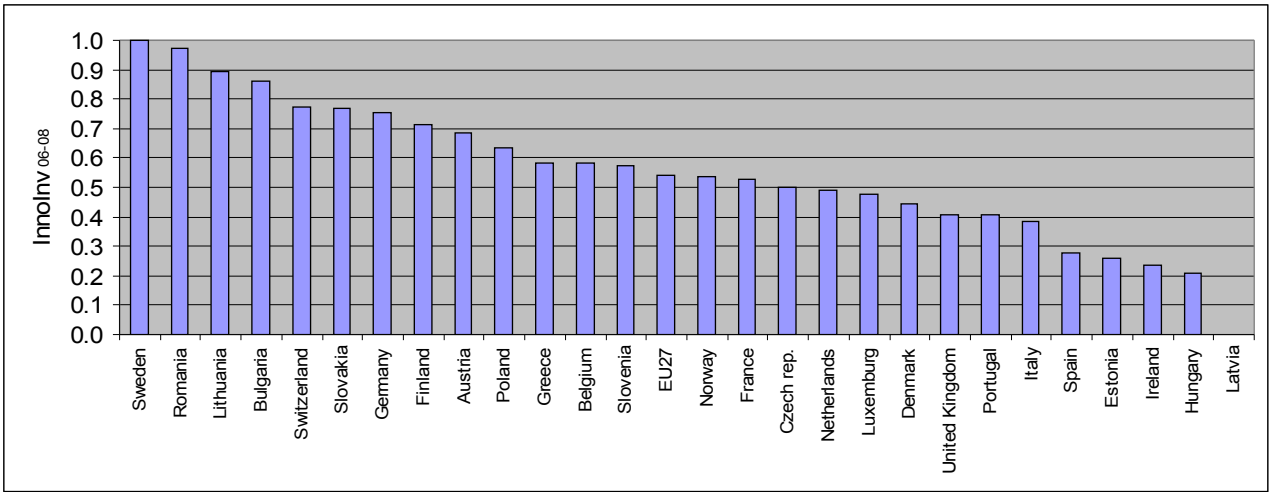
Fig. 2. The balances of firms investing and disinvesting in innovation before and after the crisis



Source: as for Fig. 1

Note: axis cross at average values

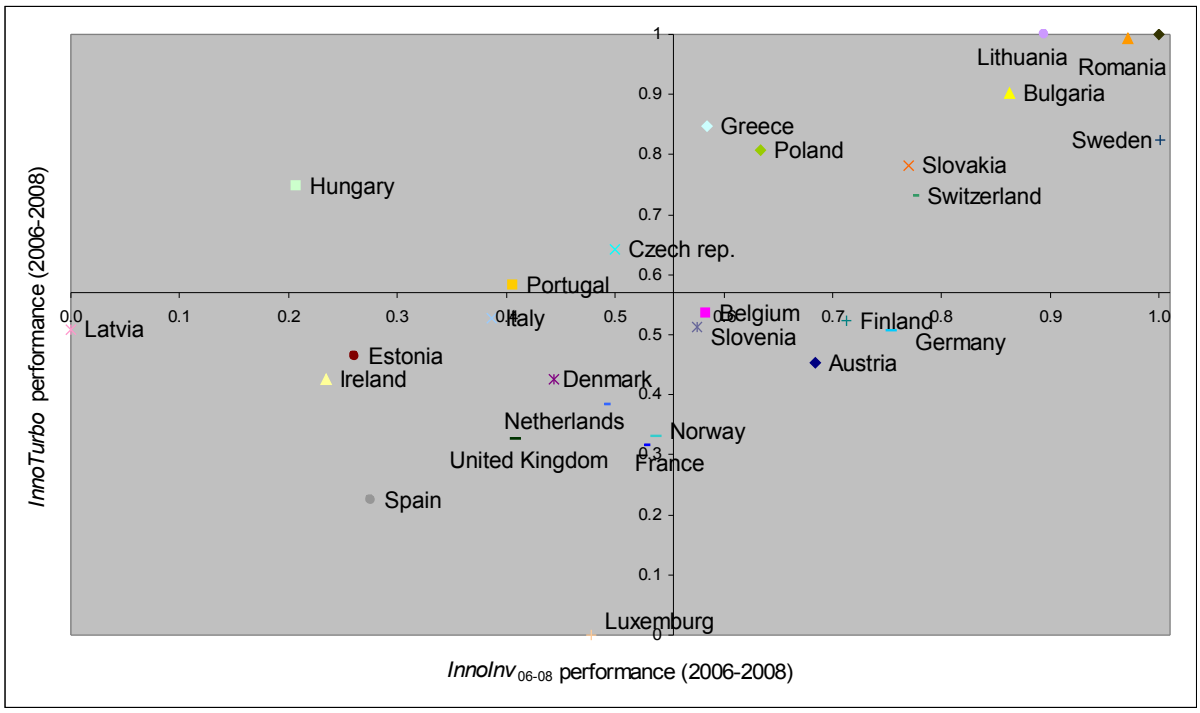
Fig. 3. Medium-term firms' innovation performance over the period 2006-2008 (*InnoInv*$_{06\text{-}08}$)*



Source: author's elaboration on *Innobarometer* data

* Calculated on the question no.1 of the *Innobarometer* :*"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)?"* (see Table A1 in the appendix)

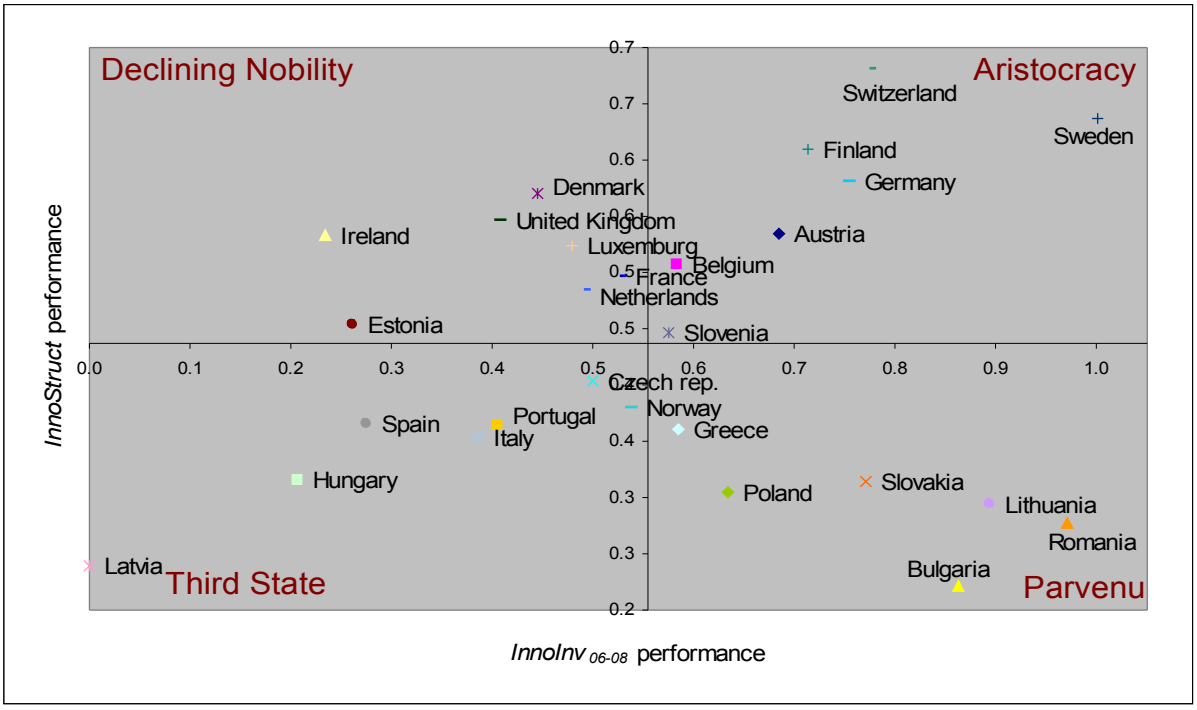
Fig. 4. Medium-term firms' innovation performance (*InnoInv*$_{06\text{-}08}$) and internal turbulence of the economic systems – *InnoTurbo* - over the period 2006-2008



Source: as for Fig. 3

Note: axis cross at average values

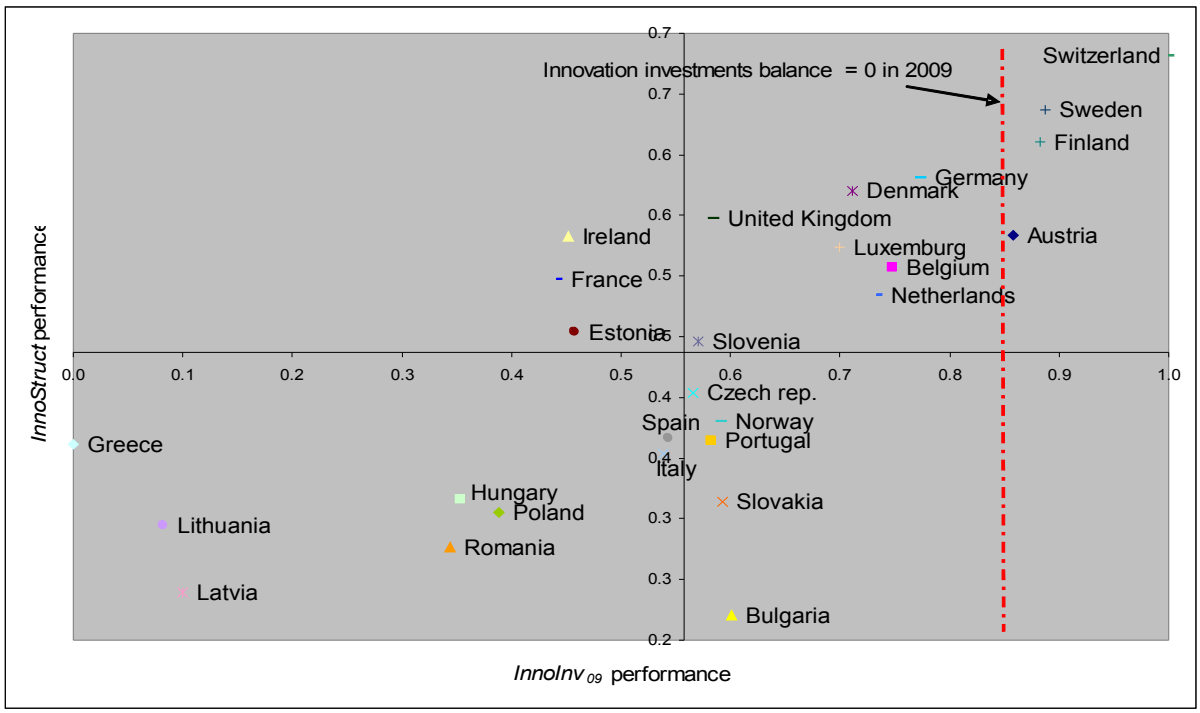
Fig. 5. Medium-term firms' innovation performance (*InnoInv*$_{06\text{-}08}$) and national innovation system strength (*InnoStruct)*



Source: author's elaboration on *Innobarometer* data (as for Fig. 3), and on *EIS* data (see table A4 in the appendix)

Note: axis cross at average values

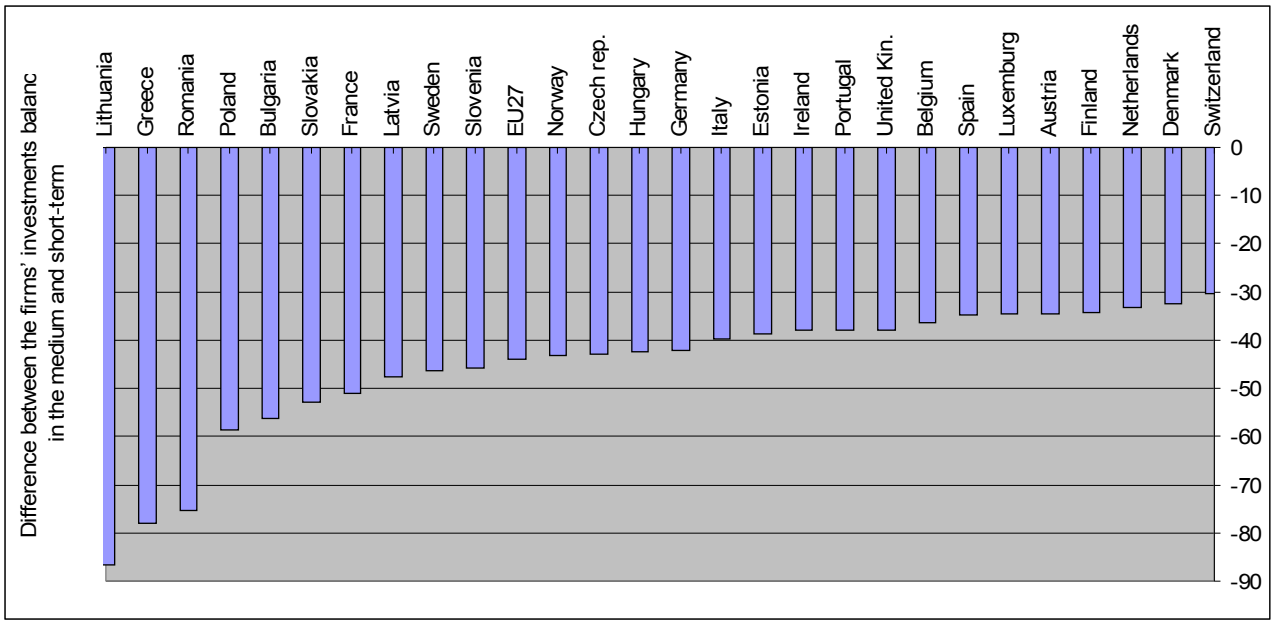
Fig. 6. Short-term firms' innovation performance (*InnoInv*$_{09}$), and national innovation system strength (*InnoStruct)*



Source: author's elaboration on question no. 2 of the *Innobarometer* data (see table A2 in the appendix), and on *EIS* data (see table A4 in the appendix)

Note: axis cross at average values.

Fig. 7. The impact of the current recession on firms' innovation investments*



Source: author's elaboration on *Innobarometer* data (see Tables A1 and A2 in the appendix)

* Calculated as the difference between the firms' investments balance in the medium-term (2006-2008) and short-term (2009)

Table 1. Correlations rates between the $InnoInv_{09}$ and the *InnoStruct* indicators

Dimensions	Indicators	Correlation rates	Dimensions	Indicators	Correlation rates
Human resources	S&E and SSH graduates	-0.31	Throughputs	EPO patents	**0.76*** **
	S&E and SSH doctorate	**0.67*** **		Community trademarks	0.38**
	Population with tertiary education	0.29		Community designs	0.43**
	Participation in life-long learning	**0.61*** **		Technology Balance of Payments flows	0.21
	Youth education attainment	-0.10			
Finance and support	Public R&D expenditures	**0.67*** **	Innovators	SMEs introducing innovations	0.48***
	Venture capital	0.34		SMEs intr. marketing/organisational inn.	0.27
	Private credit*	0.29*		Labour costs innovators	-0.22
	Broadband access by the firms	0.52***		Materials and energy innovators	-0.41
Firm investments	Business R&D	**0.80*** **	Economic effects	Employ. medium&high-tech man.	0.40**
	IT expenditures	0.65***		Employ. knowledge-intensive services	**0.63*** **
	Non-R&D expenditures	-0.06		Medium and high-tech man. Exports	0.43**
Linkages & entrepreneurship	SMEs innovating in-house	0.55***		Knowledge-intensive services exports	0.11
	Innovative SMEs collaborating	0.39**		New-to-market sales	-0.09
	Firm renewal	-0.27		New-to-firm sales	-0.04
	Public-private co-publications	**0.73*** **			

Source: as for Fig. 6

Note: *** significance at the 0.01 level; ** significance at the 0.05 level; * significance at the 0.1 level.

Appendix

Table A1. Results from the following question from the *Innobarometer 2009*: "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)?"*

Country	Increased %	Decreased %	Stayed the same %	Total
Austria	40.8	5.8	53.4	100
Belgium	40.1	9.4	50.5	100
Bulgaria	52.6	10.1	37.3	100
Czech rep.	40.3	13.1	46.6	100
Denmark	35.2	10.4	54.4	100
Estonia	32.0	14.9	53.1	100
Finland	42.7	6.4	50.9	100
France	35.3	7.0	57.7	100
Germany	43.2	5.2	51.5	100
Greece	45.8	15.0	39.2	100
Hungary	36.0	21.3	42.7	100
Ireland	30.8	14.9	54.3	100
Italy	35.8	13.4	50.8	100
Latvia	27.3	21.2	51.5	100
Lithuania	54.9	11.0	34.2	100
Luxemburg	31.9	5.6	62.5	100
Netherlands	35.6	8.7	55.7	100
Norway	35.8	6.9	57.3	100
Poland	46.1	13.3	40.6	100
Portugal	37.2	14.0	48.8	100
Romania	56.4	9.2	34.4	100
Slovakia	48.6	9.9	41.5	100
Slovenia	39.5	9.1	51.3	100
Spain	28.8	11.2	60.0	100
Sweden	54.2	5.8	40.0	100
Switzerland	47.8	8.9	43.4	100
United Kingdom	32.9	9.6	57.5	100
EU27	38.7	9.7	51.6	100

Source: author's elaboration on *Innobarometer 2009* (European Commission, 2009)

* With respect to the Innobarometer 2009, the results are been re-scaled to make them comparable across countries

Table A2. Results from the following question from the *Innobarometer 2009*: "In the last six months has your company taken one of the following actions* [increased, decreased or maintain the innovation spending] *as a direct result of the economic downturn?"*

Country	Increased %	Decreased %	Stayed the same %	Total
Austria	11.2	10.7	78.1	100
Belgium	12.0	17.6	70.5	100
Bulgaria	11.9	25.7	62.3	100
Czech rep.	13.8	29.6	56.5	100
Denmark	17.2	24.9	57.9	100
Estonia	7.9	29.6	62.5	100
Finland	16.7	14.8	68.5	100
France	7.0	29.7	63.2	100
Germany	10.3	14.4	75.3	100
Greece	2.0	49.3	48.7	100
Hungary	4.6	32.2	63.2	100
Ireland	9.9	32.1	58.0	100
Italy	8.9	26.1	65.0	100
Latvia	9.2	51.0	39.8	100
Lithuania	6.3	49.1	44.6	100
Luxemburg	8.6	16.9	74.5	100
Netherlands	10.4	16.8	72.8	100
Norway	12.9	27.2	59.8	100
Poland	8.2	33.8	58.0	100
Portugal	13.4	28.2	58.4	100
Romania	10.7	38.8	50.5	100
Slovakia	16.5	30.7	52.7	100
Slovenia	5.1	20.6	74.2	100
Spain	10.1	27.2	62.7	100
Sweden	14.8	12.6	72.6	100
Switzerland	17.5	9.0	73.5	100
United Kingdom	8.5	23.2	68.4	100
EU27	9.8	24.7	65.4	100

Source: author's elaboration on *Innobarometer 2009* (European Commission, 2009)

Note: with respect to the Innobarometer 2009, the results are been re-scaled to make them comparable across countries

* Question made on April 2009

Table A3. Indicators for the *InnoStruct* of the European Innovation Scoreboard 2008

Dimension	Indicators
Human resources	S&E and SSH graduates per 1000 population aged 20-29 (first stage of tertiary education) S&E and SSH doctorate graduates per 1000 population aged 25-34 (second stage of tertiary education) Population with tertiary education per 100 population aged 25-64 Participation in life-long learning per 100 population aged 25-64 Youth education attainment level
Finance and support	Public R&D expenditures (% of GDP) Venture capital (% of GDP) Private credit (relative to GDP) Broadband access by firms (% of firms)
Firm investments	Business R&D expenditures (% of GDP) IT expenditures (% of GDP) Non-R&D innovation expenditures (% of turnover)
Linkages & entrepreneurship	SMEs innovating in-house (% of SMEs) Innovative SMEs collaborating with others (% of SMEs) Firm renewal (SME entries plus exits) (% of SMEs) Public-private co-publications per million population
Throughputs	EPO patents per million population Community trademarks per million population Community designs per million population Technology Balance of Payments flows (% of GDP)
Innovators	SMEs introducing product or process innovations (% of SMEs) SMEs introducing marketing or organisational innovations (% of SMEs) Share of innovators where innovation has signifi cantly reduced labour costs (% of firms) Share of innovators where innovation has signifi cantly reduced the use of materials and energy (% of firms)
Economic effects	Employment in medium-high & high-tech manufacturing (% of workforce) Employment in knowledge-intensive services (% of workforce) Medium and high-tech manufacturing exports (% of total exports) Knowledge-intensive services exports (% of total services exports) New-to-market sales (% of turnover) New-to-firm sales (% of turnover)

Source: European Innovation Scoreboard 2008 (Merit 2009)

Table A4. *InnoStruct* values of the European Innovation Scoreboard 2008

Country	Values
Belgium	0.507
Bulgaria	0.221
Czech rep.	0.404
Denmark	0.57
Germany	0.581
Estonia	0.454
Ireland	0.533
Greece	0.361
Spain	0.366
France	0.497
Italy	0.354
Latvia	0.239
Lithuania	0.294
Luxemburg	0.524
Hungary	0.316
Netherlands	0.484
Austria	0.534
Poland	0.305
Portugal	0.364
Romania	0.277
Slovenia	0.446
Slovakia	0.314
Finland	0.61
Sweden	0.637
United Kingdom	0.547
Norway	0.38
Switzerland	0.681
EU27	*0.475*

Source: European Innovation Scoreboard 2008 (Merit 2009)

Methodology: the three indicators

1. The $InnoInv_{06\text{-}08}$ Indicator: is based on following *Innobarometer 2009* question: *"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)?"*.

$InnoInv_{06\text{-}08\text{country-i}} = (X_{\text{country-i}} - X_{\text{country-min}}) / (X_{\text{country-max}} - X_{\text{country-min}})$

Where $X_{\text{country-i}}$ = (% firms increasing - % firms decreasing) - see Table 2

2. The $InnoInv_{09}$ Indicator is based on following *Innobarometer 2009* question: *"In the last six months has your company taken one of the following actions* [increased, decreased or maintain the innovation spending] *as a direct result of the economic downturn?"*

$InnoInv_{09\text{country-i}} = (X_{\text{country-i}} - X_{\text{country-min}}) / (X_{\text{country-max}} - X_{\text{country-min}})$

Where $X_{\text{country-i}}$ = (% firms increasing - % firms decreasing) - see Table 3

3. The *InnoTurbo* Indicator is based on following *Innobarometer 2009* question: *"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)?"*.

$InnoTurbo_{\text{country-i}} = [(X_{\text{country-i}} - X_{\text{country-min}}) / (X_{\text{country-max}} - X_{\text{country-min}})]^{1/2}$

Where $X_{\text{country-i}}$ = [1 / % firms stayed the same] - see Table 2

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