Labour market institutions, skills, and the resilience of innovation during the financial crisis in Europe

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Abstract

This paper compares investments in innovation from the early days of the financial crisis up to mid 2009 using a survey covering more than 5,000 firms across twenty one European countries. Our interest is in how differences in labour market institutions and human capital affect a firm's innovation investment during the recent financial crisis. We find that investment in innovation in Europe during the onset of the financial crisis in 2008-9, was strongest in countries which have *both* high earnings replacement rates and high participation in vocational education and training; countries with just one were more likely to see reduced innovation, while we find no effect - either positive or negative - from employment protection.

Key words: *varieties of capitalism; labour market institutions; skills; innovation investment; financial crisis; comparative studies.*

1. Introduction

This paper concerns innovation, labor market institutions and skills during the recent financial crisis. We compare the persistence of firm-level investments in innovation in twenty one European countries from the two years immediately prior to the financial crisis, through the six months ending in April 2009. Our interest is in how differences in labour market institutions and in the provision of human capital affect a firm's innovation investment during a severe financial crisis-cum-recession.

We might, broadly, expect investment in innovation to decline in such a setting, due both to diminished financial resources and to increased uncertainty. For instance, R&D expenditure has demonstrated to move with the business cycle in OECD economies (OECD, 2009; WIPO, 2010). On the other hand, the disruptive effects of crisis may bring opportunities, or simply a perceived imperative to adapt in order to survive. Innovative activities are characterized by *resilience* to a considerable extent, as they are strongly path-dependent and cumulative in nature (Dosi, 1982; Nelson and Winter, 1982; Patel and Pavitt, 1997). Innovation has demonstrated to be quite persistent not only during less turbulent times (Cefis and Orsenigo, 2001; Gerosky *et al.*, 1997), but even during severe recessions (Filippetti and Archibugi, 2011; Gerosky and Walters, 1995). Deep and long recessions are often characterized by major shifts in technological paradigm, deep technical discontinuities and industry change (Antonelli, 2002; Dosi, 1982; Perez, 2010); Field (2003) finds that the period 1929-1941 was, in the case of the United States, "the most technologically progressive decade of the century."

There is good reason to believe that maintaining innovation during a recession is a desirable characteristic for an economic system. A wealth of research has shown that innovation is the key engine of long-term sustainable growth in advanced countries (for a review see Fagerberg *et al.*, 2010). Moreover, continuity of innovation during a crisis does seem to matter: a recent study from the OECD singles out the cases of the counter-cyclical policies carried out during recent periods of recession in Finland and Korea; it concludes that policies aimed at supporting business and public R&D (the latter was *increased* during the recession by these Governments), as well as policies directed at stimulating job opportunities for skilled labour, were very important in putting these economies on a stronger and more knowledge-intensive growth path (OECD, 2009). Maintaining innovation during hard times may also be important because competencies, skills and knowledge are cumulative, and embedded in organizations' routines, firms' capabilities, and workers' skills (Dosi *et al.*, 2002; Nelson and Winter, 2002; Teece and Pisano, 1994). Thus continuity is key to keep up with changes in technological opportunities, especially in such as fast-changing environment like major recessions.

Scholars of innovation have come to view the innovative active of firms as something shaped, in both its level and character, by national institutions. Following Freeman (1987), this perspective comes under the rubric of "National Systems of Innovation" – see Lundvall (1992), and Nelson (1993). In this vein, Coriat and Dosi (2000) discuss the "institutional embeddedness dimensions of economic change", while Coriat and Weinstein (2002) have put forward a framework to investigate the roles of organizations and institutions in the development of innovation (see also Nelson, 2001; Nelson and Nelson, 2002).

When it deals with the labour input and skill, the innovation literature has tended to focus on advanced science and engineering workers. The potential role in innovation of a much broader section of the workforce, however, has long been understood by students of comparative industrial relations (Best, 1990; Dore, 1973; Lazonick, 1990; Piore and Sabel, 1984; Ramirez *et al.*, 2007) These perspectives inform the past decade's work on national business systems, or varieties of capitalism, which explains national comparative advantage in particular products, process, or industries, as the product of particular differences in labour- and capital market institutions (Hall and Soskice, 2001; Hanckè, 2009). Of particular interest to us here is the relationship, outlined by (Estevez-Abe et al., 2001), between investment in industry or firm specific skills through vocational education and training (VET), and the level and type of 'social protection' in the labor market; what they show is that participation in VET is very low in countries which have neither a strong safety net for the unemployed ("unemployment protection") nor strong job security provisions ("employment protection"). The low-VET countries are the Liberal Market Economies (LMEs), which happen to be the English-speaking industrial countries. Among those rich industrial countries which do have high levels of VET, Estevez-Abe et al identify four clusters of interest: one which we can call the 'flexi-curity' countries, best exemplified by Denmark, with high unemployment protection and low (as non-LMEs go) employment protection; a second in which social protection is provided primarily through security of employment, with very weak unemployment protection (Italy, Japan); a third in which both employment and unemployment protection are very high (e.g., Germany); and a fourth with moderate (for non-LMEs) levels of both (e.g., France).

The policy import of these categories is considerable. The institutions of the liberal market economies are those of the labour market flexibility that plays a central role in neo-liberal economic thinking, and in the policy prescriptions of various international organizations (to take just one recent example, as part of their response to the crisis the IMF and the OECD have prevailed on Spain to reduce statutory employment protection, with the aim of boosting job creation; (see Rodrik, 2010 for a critique of this policy). The prime source of 'inflexibility', in this line of thinking, is employment security, although unemployment security has at times been a target; skill formation is generally understood as being provided by public investment in general purpose, or transferable, skills, and private investment in more specific skills, but in this view is not related to institutions of employment- or unemployment security. Flexi-curity is, among other things, a policy line which engages with the neo-liberal critique while at the same time defending the merits of the social market, and accounting for the risky acquisition of specific skills. While the claims made for flexi-curity have been met with skepticism by some (e.g. Becker, 2005; Schwartz, 2001) (see also the discussion in Giugni, 2009; Gold, 2009), it has become an important element in European policy (Council of Europe, 2005; Crouch, 2010; Kok, 2003; Wilthagen and Tros, 2004).

Europe has maintained a wide variety of different labour market, education and training institutions despite the integration of its markets (Hanckè *et al.*, 2007; Holm *et al.*, 2010); (Manca *et al.*, 2010) find "*substantial heterogeneity* across EU Member States in terms of how close they are to fulfil flexicurity 'requirements'. Geographical clusters […] such as Nordic, Continental, Anglo-Saxon, Mediterranean and New Member States are to some extent confirmed" (p. 61). Europe has also maintained (Lorenz and Lundvall, 2006), and even increased (Archibugi and Coco, 2005) its heterogeneity in terms of innovation performance and technological development. Differences of innovation and technological capabilities make an important contribution to differences in growth rates (Castellacci, 2008; Fagerberg, 1994) and are thus a factor in the convergence – or lack of it – between European economies (Kutan and Yigit, 2007; Tumpel-Gugerell and Mooslechner, 2003)

Our interest here is in whether labour market institutions and human capital provision map into differences in firm-level innovation investment during a particular difficult period. Controlling for firm-level characteristics (including prior investment in innovation) and country-level changes in aggregate demand, we seek to identify country-specific effects on business investment in innovation during the crisis. We then analyze the relationship between the country specific effects and a small number of institutional characteristics: a synthetic index of employment security; enrolment in vocational education and training (VET) programmes; and the short-term income replacement rate for unemployment benefits (our measure of unemployment security).

In the empirical analysis we employ data at the micro (firm) and macro (country) level. For the former, we use the last *Innobarometer Survey* carried out from the European Commission (European Commission, 2009). This survey is covered more than 5,000 firms across Europe. For the country level analysis, our data are from the OECD, Eurostat and the World Bank's World Development Indicators.

Overall, we find that investment in innovation in Europe during the onset of the financial crisis was strongest in countries with high earnings replacement rates coupled with high participation in vocational education and training. We find no relationship between innovation and employment protection.

The paper is organized as follows. The next Section outlines the theoretical background of the analysis. Section three presents the data. Section four analyses the current institutional setting across European countries. Section five presents and discusses the empirical results, while Section six concludes.

2. How might labour market institutions affect firms' innovation decisions during a financial crisis?

Employment- and unemployment protection may have direct effects on firms' innovation decisions. The skills of the workforce may also affect these decisions; the stock of skills is in turn affected by the employment- and unemployment protection provisions previously in place, and in important respects the system of skill provision and the systems of employment- and unemployment protection may be mutually determined. At the risk of simplifying this web of causation, let

us trace a few ways in which these labour market institutions may affect the innovation choices of firms during a financial crisis.
In liberal economic doctrine, employment protection is almost certain to retard innovation by discouraging re-allocation of labour and / or by removing incentives for innovative effort. Yet it is plausible that employment protection can encourage innovation, if the reduced threat of job loss encourages employees' cooperation in productivity improvement, or if the lock-in motivates employers to innovate in order to find productive uses for otherwise surplus labour. (Levinthal and March, 1981; Nohria and Gulati, 1996) have argued that a certain amount of organizational slack – that is, human resources and organizational capabilities in excess of operating requirements - is necessary if firms are to innovate. Employment security is broadly associated with slack, and is certain to produce slack in a downturn. During a crisis, the effects (positive or negative) of employment protection should be especially strong: sharp changes in demand will require greater reallocation of labour and availability of labour in excess; the reduced financial capabilities of firms tighten constraints on their ability to re-allocate labour internally, but financial market conditions (elevated liquidity preference of private investors; curtailed bank lending) also constrain the ability of the labour market to re-allocate labour between firms; the elevated threat of job loss may increase effort or, if job loss appears imminent, may shift workers attention elsewhere.

Many of the possible effects of employment protection do not – for better or worse – hold for unemployment protection, as the latter does not lock firms into employment relationships. It does, however, lower the worker's cost of job loss and might for this reason reduce incentives for work effort generally; it could inhibit innovation through that channel or, on the contrary, encourage it by reducing employee resistance to productivity-enhancing innovation.

A more highly skilled workforce should be better able to contribute to innovation, thereby increasing the return on investment in innovation by employers. The path of causation between skills and security probably runs two-ways: security (whether of employment or of unemployment) encourages investment in specific skills; at the same time, employers face higher turnover costs for employees with specific skills - and especially specific skills related to a firm's innovative activities – creating a lock-in that affords those employees some measure of job security.

The first of these paths is proposed by Estevez-Abe et al (2001). Both employment- and unemployment-protection reduce the risk to individual workers inherent in investing time or money in acquiring skills which are specific to a firm, industry, occupation, or technology. Vocational education and training (VET) is, they assume, disproportionately about the provision of such specific skills; countries with low levels of *both* employment- and unemployment protection are also those with very low levels of participation in VET. However, while both employment- and unemployment protection seem efficacious in encouraging VET participation, the way in which VET is provided differs considerably (Crouch *et al.*, 1999), and we should not take for granted that the different VET systems would necessarily provide skills which feed through to innovation in the same way. In countries with high strong employment security and weak unemployment security (e.g., Italy and Japan in the Estevez Abe sample) VET provision tends either to occur within large firms, or to be sponsored by local associations of smaller ones: in either case, responsibility for VET provision falls on employers. In countries where unemployment security is strong and employment security is relatively weak (e.g., Denmark, the Netherlands), public bodies take the lead in VET provision; this is, of course, the 'flexicurity' package. The countries with 'dual' apprenticeship systems (Germany, Austria, Belgium) are, not surprisingly, ones in which both employment- and unemployment security are strong.

Employer's choices about investment in skills also differ among these institutional configurations. In particular, the lock-in of employment protection may motivate firms to select more skilled workers when hiring, and also to seek ways to protect the firm's investment in skills; with respect to the latter, the various forms of inter-firm cooperation, from industry participation in public apprenticeship programmes to anti-poaching conventions, are well documented.

It is important to distinguish here between general skills and more specific ones. Specificity may be with respect to an industry, an occupation, a firm, or a technology. The general problem is that specific skills are risky investments for individuals. Skills which are purely firm-specific can be paid for by employers, but such skills are rare – as evidenced by the fact that the most extensive firm-based training systems seem to require collective action between firms, either to punish poaching (as in Japan), or to share costs (as in Germany) (Culpepper, 2001).

3. Data sources

3.1 Firm-level data: the Innobarometer Survey

Our firm level data is from the *Innobarometer Survey 2009,* designed and collected by the European Commission (2009) in each of the 27 EU Member states, plus Norway and Switzerland,[1] 200 enterprises from most manufacturing and private service industries[2] with 20 or more employees were sampled. 5,238 telephone interviews were completed between the 1st and 9th of April 2009. The sample is a random sample, stratified by country, enterprise size (5 size bands) and industry (2-digit). A detailed description of the survey, sampling and data collection method can be found in European Commission (2009).

Innobarometer has been conducted on an annual basis since 2001. Each year the survey highlights a different issue/theme, which is reflected in additional questionnaire items. The focus of the 2009 survey was innovation related expenditures, and the effects of the economic downturn on such expenditures.

The firms surveyed were asked a series of questions about changes in different aspects of investment in innovation over the period 2006-2008. As explained, the definition of innovation investment is quite broad. The questions addressed research and development (distinguishing between that performed in-house, and that acquired outside); acquisition of know-how; acquisition of machinery; design; collaboration with customers, with suppliers, with other companies in the same field, and with universities and research centres; innovation in marketing, and in organization; patents and design registration; knowledge management practices; open innovation practices; and whether innovation was driven by cost reduction, technological opportunities, or market opportunities. Following these came two summary questions. The first was:

Q3*: "Compared to 2006, has the total amount spent on innovation in 2008, increased, decreased, or stayed the same?"*

Immediately following this, respondents were asked:

Q4: "*In the last six months has your company taken one of the following actions: increased total innovation expenditures, decreased […] or maintained […]?*"

Although “innovation investment” is not a category that many people would have clearly in mind most of the time, and is one of which we might ordinarily expect people to have widely varying interpretations, the fact that these questions come immediately after a series of more specific questions about the company’s innovation activities gives us some confidence that respondents in would have had a reasonable common understanding of the term.

The definition of innovation implicit in this series of questions is in line with the definition adopted in the Community Innovation Surveys and similar surveys elsewhere in the world. A peculiar characteristic of the design of the Innobarometer is the use of an “open approach” in terms of definition, in opposition for example to the CIS, where very detailed instructions are attached to explain the terminology at great length. While there are obvious drawbacks to using a set of subjective self-assessments to measure innovation activity, this approach has the considerable advantage of getting a broad measure of innovation: certain aspects of innovation activity, such as formal R&D and patent applications, can be more precisely and objectively measured, but they capture a narrow and unrepresentative slice of overall innovation activity, and are heavily concentrated in a few industries and in larger firms, mostly in the manufacturing sector. With respect to the question addressed in this paper, R&D/patent measures alone are problematic because firms typically commit to such projects for extended periods, and the response over six months is likely to be slight. In contrast, items such as training or design budgets, or new equipment purchases, can be – and often are – cut quickly. Moreover, the broader measure of innovation encompasses activities to which employees at all levels contribute, and are therefore more pertinent to our study.

*************Table 1 about here********************

10% of firms said they had increased overall investment in the six months following the onset of the financial crisis, while 24% said they had reduced it and 66% reported no change.

The survey also collected data on changes in the firm’s turnover from 2006-8, number of employees and industry classification, among others (see Appendix Table 1). In our analysis, we use binary variables for decreased turnover (turn_fall) and firms with more than 250 domestic employees (LARGE). Pair-wise correlations of firm-level variables are reported in Table 2.

*************Table 2 about here************************

To get a rough picture of how these results differ by country, we treat the responses as scales running from -1 (decreased spending) to 1 (increased), take the mean by country, and plot them (Figure 1). Overall, the positive correlation arising between the innovation investment variables over the two periods the chart suggests the presence of resilience in innovation investment at the firm level, as found by (Filippetti and Archibugi, 2011; Gerosky and Walters, 1995).

****************Figure 1 about here*******************

3.2 Country level variables

At the country level, we have variables dealing with macroeconomic aggregates, labour market institutions and skills, and higher education. For the first, we use the percentage change in GDP from the first quarter of 2007 to the first quarter of 2008, and similarly for 2008 to 2009. Our labour market institution and skills variables are (i) the short-term earnings replacement rate as defined by the OECD as "net income replacement rates for unemployment benefits (percentage of earnings)" in the first year after job loss; (ii) the OECD Employment Protection Index, a measure of the procedures and costs involved in dismissing individuals or groups of workers and the procedures involved in hiring workers on fixed-term or temporary work agency contracts (see www.oecd.org/employment/protection, for details); and (iii) vocational and education training defined by the World Bank World Development Indicator as "Technical/vocational enrolment in ISCED 3 as percentage of total enrolment in ISCED 3". The third group of variables addressing higher education includes science and engineering doctorates per population (Eurostat), science and engineering degrees per population (Eurostat), and the share of labor force with tertiary education (World Bank – World Development Indicators).

***************Table 3 about here*********************

4. Analysis

Our strategy for analyzing the data is to estimate an ordered logit model on the firm-level data and macro-economic variables, with country-level random effects. We then rank the country-level effects and compare them in tables with the tertile ranks of the country level variables. In principle, the random effects estimated in the first stage could be modelled as functions of the country-level variables – that is, an alternate strategy would have been to estimate a two-level model. We do not do this because, with only twenty-one countries, the statistical properties of the second stage estimates are not good. Moreover, there are plausible and important hypotheses which could only be tested using both levels and *interactions* of country-level variables (the efficacy of flexicurity, for instance): we can get nice looking results with three country-level institutional variables (notably, with employment protection, the replacement rate, and VET enrolment), but when we add further variables or, in particular, interactions, the results become unstable – unsurprisingly, given the paucity of independent observations. This difficulty is commonly encountered in doing statistical analysis of comparative international data, and in presents a choice between making heroic statistical assumptions (including the omission of variables of interest), and resorting to a low-tech tabular or visual presentation (Bowers and Drake, 2005; Kedar and Shively, 2005). We opt for the latter.

Our regression model is:

$$\text{Innovation2009}_{i,k} =$$

$$\text{b1*Innovation2008}_{i,k} + \text{b2*Large}_{i,k} + \text{b3*turn\_fall}_{i,k} + \text{b4*INMKT}_{i,k} + \text{b5*GDP0801}_k + \text{b6*GDP0901}_k + \text{industry controls} + e_k + u_{i,k}$$

where e_k is the country random effect. This is estimated in Stata using the GLLAMM package (Rabe-Hesketh and Skrondal, 2004).

Results of this estimation are reported in Table 4. The innovation trajectory in 2006-2008 is a strong predictor of the innovation trajectory in the six months prior to the survey. Reduced turnover during 2006-8 dampens innovation investment in 2009; GDP growth in both 2007-8 and 2008-9 is, to our surprise, negatively associated with the change in innovation investment during the crisis, but the effect is not statistically significant; similarly, the circumstances to operate in international markets (INMKT) and firm size (LARGE) show little effect.

******************Table 4 about here*******************

The country effects from this regression, with their standard errors, are shown in Figure 2. The countries in which firms showed the strongest innovation performance during the crisis are all in north-western continental Europe, and are among what Hall and Soskice (2001) would classify as 'coordinated market economies': Switzerland tops the ranking, followed by Austria, Finland, Denmark, Germany, Belgium and the Netherlands. There are, of course, significant differences among these countries' economic institutions, but those seem small compared with the differences among the countries in the lower tail: starting at the bottom, we have Greece, Hungary, Ireland, Czech, the UK, Italy, and Slovakia. One might think that that what the countries performing worst have in common is a particularly bad experience with the financial crisis, but we have controlled for change in GDP.

****************Figure 2 about here*******************

Table 5 shows the country effects alongside each country's ranking for unemployment replacement (REPLACE), VET enrolment (VET), and employment protection (EMPLOY). We have grouped these variables, so that that 1/3 of the countries with the lowest rankings for, e.g., REPLACE get a 1 in that column, those in the middle 1/3 get a 2, and those in the top 1/3 get a 3.

***************Table 5 about here***********************

Two things are striking about this table. One is that all of the countries in the top 1/3 of the table – that is, those with relatively persistent firm-level innovation during the financial crisis - are in the top 2/3 in terms of *both* the earnings replacement rate *and* VET enrolment. In the bottom half of the table, many countries rank highly in *either* earnings replacement or VET enrolment, but only one (Czech) is strong in both of them; all other countries in the bottom half of the table are in the bottom 1/3 of *either* earnings replacement or VET – or in a few cases, both. A good earnings replacement safety net together with a strong system of VET are, of course, key elements of "flexicurity".

The second striking thing about the table, however, is that while it shows clearly that the unemployment security and training elements of flexicurity are, in combination, associated with greater resilience of investment in innovation by firms, it is not clear at all about labour market flexibility. The 'flexi' end of flexicurity is, of course, limited employment security. But what we see in Table 5 is an extremely weak association between employment security and the persistence of investment in innovation: the countries with the strongest employment security are grouped together in the middle of the pack, while countries at the top and bottom are both decidedly mixed in their levels of employment security. For the present question, at least, the level of employment security (or its inverse, numerical flexibility for employers) does not appear to be very important.

These impressions are reinforced by Appendix figures 1A-3A, which plot the Country Effect against the replacement rate, VET enrolment and employment protection variables. Note, in particular, the absence of a relationship between the country effect and employment protection in 3A.

In Table 6, we present a similar breakdown for the three higher education variables. These are of interest both as additional measures of skill in a country's workforce, and as indicators of the country's science base. These are also, of course, the sort of education variables more commonly associated with innovation in the academic literature on the subject. The patterns here are not so clear cut. Science and engineering degrees (the middle column) bear no apparent relation to the country effect, but most of the countries which rank high in the persistence of innovation also rank high in science and engineering *doctorates,* and in tertiary education generally.

************Table 6 about here***********************

The percentiles of our institutional variables, used in Figures 5 and 6, mechanically assign one third of the countries in each level on the basis of *ranking*, otherwise ignoring the distribution of these variables. However, the distribution of the labour market variables (those in Figure 5) tends to be quite uneven. To check the robustness of our results, we create a similar three-level classification in which each variable's *range* is divided into thirds, and countries are assigned to groups based on which third of the range they fall into. This produces uneven numbers in the groups, since (for instance) most countries in the sample have earnings replacement rates which are greater than .67 (i.e., more than 67% of that in the country in the sample with the highest replacement rate) on our 0-1 scaling. We should note that in the case of employment protection, these "levels" are somewhat arbitrary, since this variable is an index, not a primary measure. The other two variables present no problems in this regard.

These results reinforce those from Table 5. Appendix Table 2 shows the national innovation persistence effects together with the re-scaled labour market variables. The seven countries at the top of the innovation persistence scale are all in the top group for replacement rate, and in the top or middle group for VET. Both countries with the lowest scores for replacement rate and four out of five of the countries with the lowest scores for VET are in the lowest third of the innovation persistence scale. Again, the pattern at the bottom of the scale suggests that a high replacement rate and high VET enrolment are complementary: all counties with low scores or *either* are low on the innovation persistence scale. With this scaling, the middle-of-the pack performance of countries in the top tier of employment protection is even more pronounced, and low- and middle employment protection rankings are split between the top and bottom of the innovation persistence scale.

5. Discussion and conclusion

A centrally debated issue in Europe over the last decade has been that of the labour market reform. This has increased in importance in the light of the recent financial crisis, whose effects have been significantly heterogeneous across EU Member states. This study aimed to contribute to the debate by bringing new insights and fresh evidence, by investigating how different labor market institutions and provisions of skills affected a key activity such as innovation investment of the firms.

We find that firm-level investment in innovation in Europe during the onset of the financial crisis in 2008-9, was strongest in countries with high earnings replacement rates, high participation in vocational education and training, and high numbers of people completing doctoral degrees in science and engineering subjects. We see no relationship, good or bad, with employment protection or with lower-level science and engineering degrees. These results must be treated with caution, both due to the short time frame covered by the data (six months into the crisis), and the small number of independent units for country level data. They are, nonetheless, striking in several respects. One is the clear association between the persistence of innovation and the replacement rate/VET *combination*, in keeping with the flexi-curity model. Another is the apparent *unimportance* of employment security: a great deal of political and academic energy is spent both attacking and defending it, but at least within the very limited scope of the present question the stakes seem small. A third is the apparent diversity of the countries that performed badly: rich liberal market economies (the UK and Ireland), countries emerging from centrally planned economies in central and eastern Europe (all of those in the sample), and the poorer countries of the EU's south (Greece and Portugal). What these countries have in common is that they lack – with the exception of the Czech Republic - the combination of high replacement rates and high VET participation. Finally, while it is not surprising to find - excepting the UK and Ireland – that countries with large numbers of science and engineering doctorates are relatively persistent in innovation, it is more surprising that this relationship is notably stronger than that for overall science and engineering *degrees*, or for tertiary education generally. In one sense this is parallel to the apparent importance of VET, since doctorates like VET tend to be more *specific* than first university degree; in another, taken with the VET, it suggests a synergy between production skills and research.

Tables for the text

TABLE 1

Direction of change in total innovation expenditure

q3. compared to 2006, has the total amount spent on innovation in 2008 …		
increased	1,399	41.40%
decreased	316	9.40%
stayed the same	1,661	49.20%
Total	3,376	100.00%
q4. in the last six months has your company taken one of the following actions?		
increased total amount of innovation expenditures	349	10.30%
decreased total amount of innovation expenditures	805	23.80%
maintained total amount of innovation expenditures at the same level	2,222	65.80%
Total	3,376	100.00%

TABLE 2

Correlation matrix for firm-level variables

	Innovation 2008-9	Innovation 2006-8	LARGE	turn_fall
Innovation 2008-9	1			
Innovation 2006-8	0.245*	1		
LARGE	-0.013	0.077*	1	
turn_fall	-0.123*	-0.215*	-.0787*	1

*: pair-wise correlation significant at .01

TABLE 3

Country-level variables

country	replacement	Employment protection index	VET	S&E doctorate	S&E graduates	Tertiary education	GDP0801	GDP0901
Switzerland (ch)	.97	.16	.77	.82	.66	.78	3	-2.2
Austria (at)	.72	.47	1.00	.56	.00	.18	3.4	-5.2
Finland (fi)	.90	.48	.58	.75	.41	1.00	2.6	-7.5
Denmark (dk)	.99	.30	.56	.22	.62	.82	-.2	-3.4
Germany (de)	.74	.55	.63	.49	.11	.47	2.1	-6.4
Belgium (be)	.74	.57	.60	.22	.28	.81	2.1	-4.1
Netherland (nl)	.97	.48	.82	.19	.36	.75	3.6	-4.5
Luxemburg (lu)	1.00	1.00	.69	.	.	.57	3.4	-6
Norway (no)	.87	.78	.59	.22	.19	.91	.5	1.2
France (fr)	.72	.92	.38	.30	1.00	.58	1.7	-3.3
Spain (es)	.58	.89	.38	.11	.14	.68	1.9	-3.9
Sweden (se)	.82	.45	.67	.79	.20	.78	.9	-6.7
Portugal (pt)	.68	.96	.18	1.00	.22	.00	.9	-4.4
Poland (pl)	.59	.46	.43	.19	.77	.22	6.5	.9
Slovakia (sk)	.45	.28	.90	.20	.07	.04	9.7	-5.7
Italy (it)	.15	.46	.68	.20	.26	.00	.3	-6.4
Un. Kingdom (uk)	.64	.00	.00	.51	.75	.80	2	-4.9
Czeck Rep. (cz)	.75	.48	.94	.19	.10	.00	2.7	-4.4
Ireland (ie)	.84	.14	.17	.30	1.00	.82	-1.4	-9.3
Hungary (hu)	.72	.36	.06	.00	.21	.19	1.9	-6.7
Greece (el)	.00	.79	.16	.07	.09	.37	3.4	.3

Note: except for the GDP variables, these have been standardized with a maximum of one and minimum of zero, representing respectively the highest and lowest levels in the sample.

TABLE 4

Regression Output

Dependent variable: inno2009	
inno2008	0.768***
	-0.063
LARGE	-0.157
	-0.084
INTMKT	-0.042
	-0.082
gdp0901	-0.027
	-0.029
gdp0801	-0.027
	-0.033
turn_fall	-0.422***
	-0.102
industry dummies	included
_cut11	
Constant	-1.160***
	-0.247
_cut12	
Constant	2.412***
	-0.251
coun1	
Constant	0.285***
	-0.062
R-squared	
N	3237

* p<0.05, ** p<0.01, *** p<0.001

TABLE 5

Country innovation effects and labour market institutions

country	country effect	replacement rate	VET	employment protection
ch	0.385	3	3	1
at	0.297	2	3	2
fi	0.251	3	2	2
dk	0.237	3	2	1
de	0.232	2	2	2
be	0.210	2	2	3
nl	0.191	3	3	2
lu	0.106	3	3	3
no	0.086	3	2	3
fr	0.037	2	1	3
es	0.032	1	1	3
se	0.029	2	2	1
pt	-0.055	1	1	3
pl	-0.088	1	2	2
sk	-0.115	1	3	1
it	-0.177	1	3	2
uk	-0.202	1	1	1
cz	-0.242	2	3	2
ie	-0.302	3	1	1
hu	-0.389	2	1	1
el	-0.523	1	1	3

Note: countries abbreviations as for Table 3

TABLE 6
Country Innovation Effects and Tertiary Education

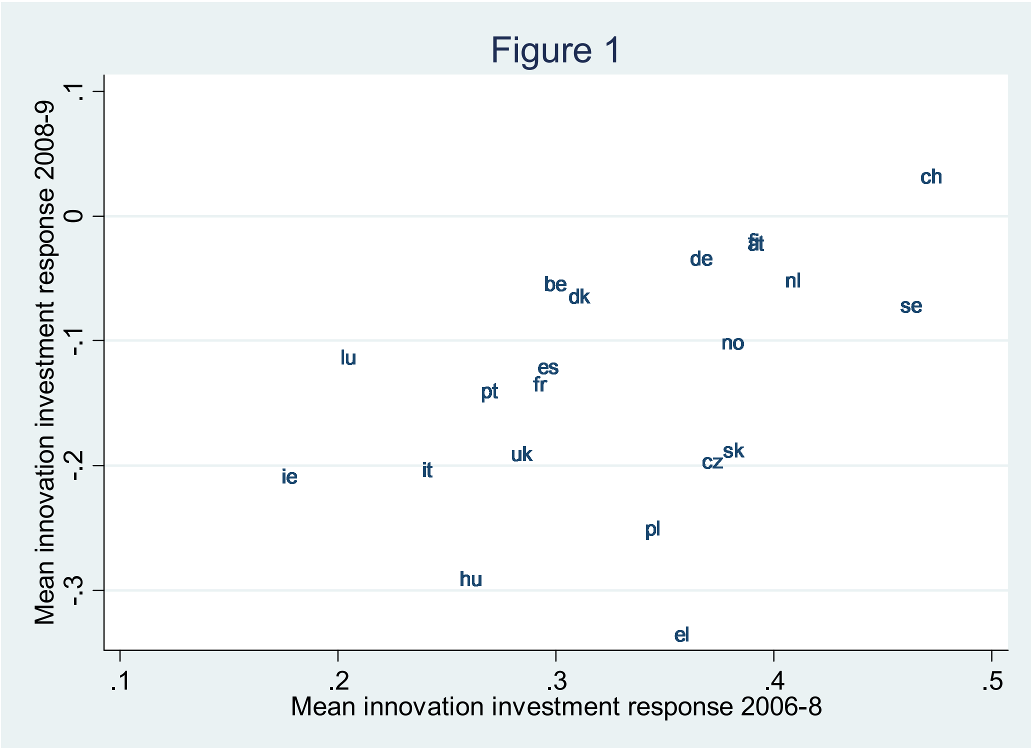
country	country effect	S&E doctorate	S&E graduates	Tertiary education
ch	0.39	3	3	2
at	0.30	3	1	1
fi	0.25	3	2	3
dk	0.24	2	3	3
de	0.23	2	1	2
be	0.21	2	2	3
nl	0.19	1	2	2
lu	0.11	.	.	2
no	0.09	2	1	3
fr	0.04	2	3	2
es	0.03	1	1	2
se	0.03	3	2	2
pt	-0.05	3	2	1
pl	-0.09	1	3	1
sk	-0.11	1	1	1
it	-0.18	1	2	1
uk	-0.2	3	3	3
cz	-0.24	1	1	1
ie	-0.30	2	3	3
hu	-0.39	1	2	1
el	-0.52	1	1	2

Note: countries abbreviations as for Table 3

Figures for the text

FIGURE 1

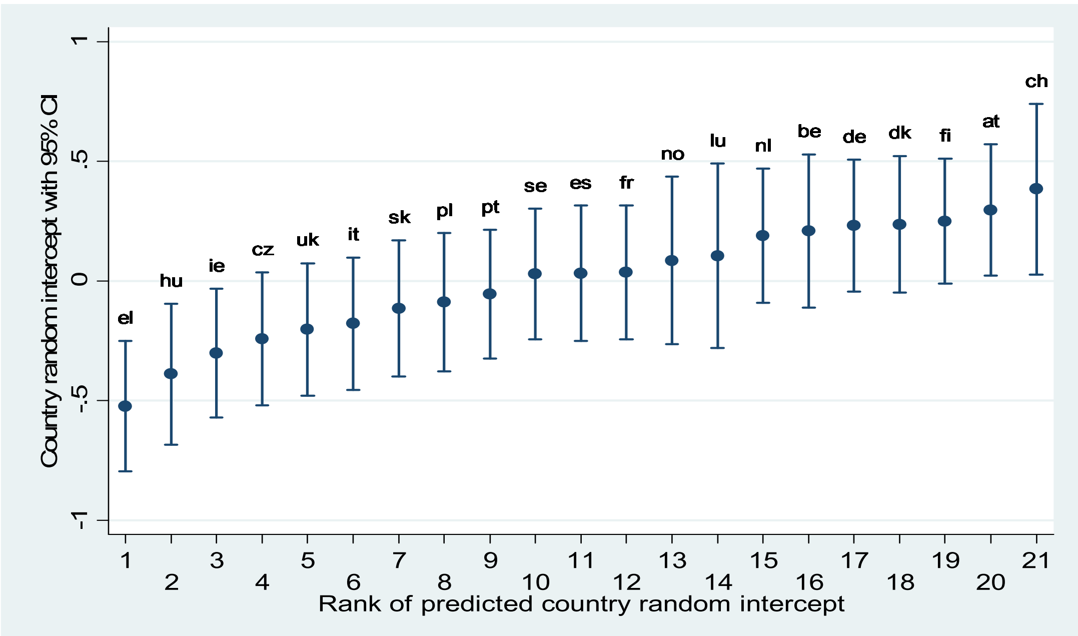
Innovation investment prior the crisis and during the crisis



Note: countries abbreviations as for Table 3

FIGURE 2

Country Effects



Note: countries abbreviations as for Table 3

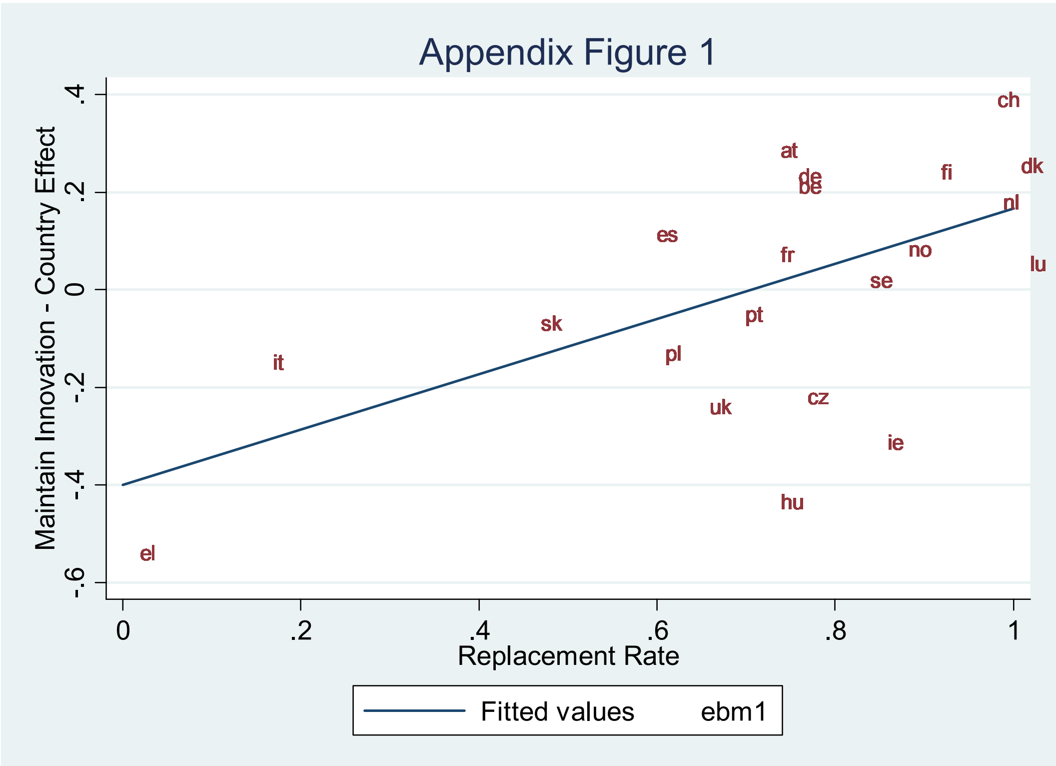
Appendix

TABLE 1A

Domestic employment and turnover trend

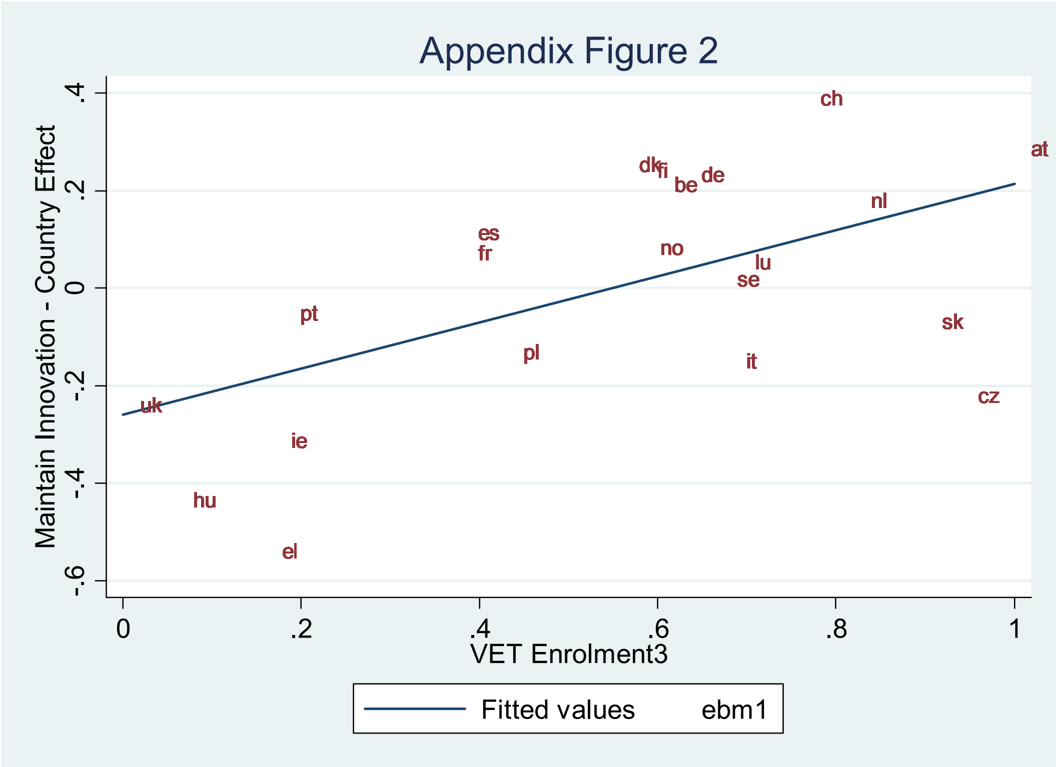
	No.	%
d2. how many employees does your company have [in your country]?		
20-49	1,330	39.40%
50-249	1,075	31.80%
250-499	634	18.80%
500 or more	337	10.00%
Total	3,376	100.00%
d4. comparing your turnover of 2008 to that of 2006, did the annual turnover		
decreased	561	16.60%
increased	2,032	60.20%
approximately the same	692	20.50%
dk/na	91	2.70%
Total	3,376	100.00%

FIGURE 1A



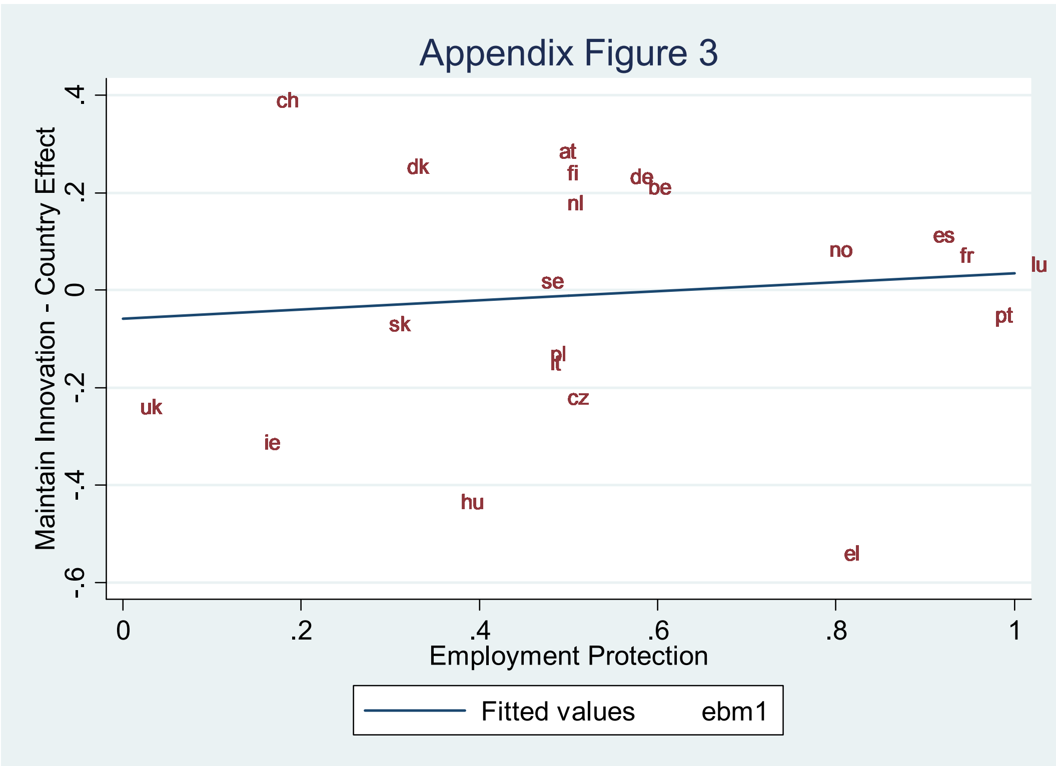
Note: countries abbreviations as for Table 3

FIGURE2A



Note: countries abbreviations as for Table 3

FIGURE 3A



Note: countries abbreviations as for Table 3

TABLE 2A

Country effect and re-scaled labour market variables

country	country effect	replacement rate	VET	employment protection
ch	0.39	3	3	1
at	0.29	3	3	2
dk	0.25	3	2	1
fi	0.24	3	2	2
de	0.23	3	2	2
be	0.21	3	2	2
nl	0.18	3	3	2
es	0.11	2	2	3
no	0.08	3	2	3
fr	0.07	3	2	3
lu	0.05	3	3	3
se	0.02	3	3	2
pt	-0.05	3	1	3
sk	-0.07	2	3	1
pl	-0.13	2	2	2
it	-0.15	1	3	2
cz	-0.22	3	3	2
uk	-0.24	2	1	1
ie	-0.31	3	1	1
hu	-0.43	3	1	2
el	-0.54	1	1	3

Note: countries abbreviations as for Table 3

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Notes

[1] In the smallest EU countries, Cyprus, Malta, and Luxembourg, the sample consisted of 70 enterprises and in non-EU countries, Switzerland and Norway, the sample size was 100.

[2] Aerospace, defence, construction equipment, apparel, automotive, building fixtures, equipment, business services, chemical products, communications equipment, construction materials, distribution services, energy, entertainment, financial services, fishing products, footwear, furniture, heavy construction services, heavy machinery, hospitality and tourism, information technology, jewellery and precious metals, leather products, lighting and electrical equipment, lumber and wood manufacturers, medical devices, metal manufacturing, oil and gas products and services, paper, (bio)pharmaceuticals, plastics, power generation & transmission, processed food, publishing and printing, sport and child goods, textiles, transportation and logistics, utility.