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Skills, social insurance, and changes in innovation investment after the onset of the financial crisis in Europe

by

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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 continuity of 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 job security.

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

JEL codes: J24, J65, O31, O57, P52.

1. Introduction

Two persistent questions in the comparative study of capitalism are what role skilled labour plays in national systems of innovation, and how different forms of social insurance contribute to the development of skill.

Skilled labour plays a role in innovation by contributing to a firm's ability to adopt new technologies, to make incremental process improvements, and to operate production systems which are flexible in the sense of being able to both vary and to make incremental improvements to the product. Developing the skills which contribute to innovation may require risky investments by the employer, the worker, or both. Investment in a skill is risky for the employer if the worker might move to another job where the skills are useful; it is risky for the worker if the market for the skill is thin or volatile – conditions which will attach not only to skills which are specific to a firm, but also to skills which may be vulnerable to a sudden loss of market due, say, to technological obsolescence or off-shoring. Skills with this sort of vulnerability are often specific to a particular industry or technology, and as shorthand from this point on we will simply call them 'specific skills'.

Either job security (JS) or unemployment insurance (UI), together with some provision for re-training, can provide insurance to offset the risk associated with specific skills (Estevez-Abe, Iversen, and Soskice 2001, [EIS]). A long tradition in comparative research shows how JS, together with restrictions on worker mobility, have contributed to skill development and innovation in both Japanese (e.g. Dore 1973; Aoki 1988) and German (e.g. Sorge and Streeck 1988) firms. In recent years, more interest has been addressed to the contribution of the UI mechanism to skills

and innovation, often as part of a package labelled 'flexicurity' (e.g. Lorenz 2011). (Flexicurity takes different forms in different times and places, and the use of the term itself is perhaps too flexible in policy documents (Viebrock and Clasen 2009); we mean something like the Danish mix of weak JS, strong short term UI, and retraining which can be provided independent of employment, through a strong vocational education and training (VET) system.)

Innovation systems, like labour markets, can be understood as being shaped by national institutions (Lundvall 1992; Nelson 1993). Hall and Soskice (2001) maintained that innovation in liberal market economies (LMEs) tends to be more radical while that in coordinated market economies (CMEs) is more typically incremental. All of the cases just mentioned – high JS Germany and Japan, flexicurity Denmark – would be classified, in the terms of Hall and Soskice, as CMEs. Though the empirical basis for this radical/incremental sorting of national innovation systems has been questioned (Akkermans, Castaldi, and Los 2009), it remains worthwhile to ask how national differences in the composition of skills affects innovation.

The contribution of VET to skill formation, and through skill to innovation, is not always clear. VET has often been found to be ineffective at delivering useful skills (World Bank 1991); critics cite the separation between VET providers and employers (see the discussion in Crouch, Finegold, and Sako 1999) as weakening both the ability and the incentive to provide up-to-date skills under conditions of rapid technological change. In addition to the substantive shortcomings this may reflect, it presents a problem for comparative research: unobserved heterogeneity

in the quality of VET may mean that some VET systems produce skills which are valuable for innovation, while others do not – a difference which will not be evident in, say, the national VET participation rates published by the World Bank.

The mechanism described by EIS can provide a way around the problem of unobserved heterogeneity in VET quality: if the skills required for innovation include specific skills, and if VET outcomes depend on the motivations of the students (workers), then the ability of VET to deliver the skills required for innovation will depend on social insurance (either JS or UI). By the same token, although social insurance may be necessary for the widespread investment in specific skills, it will not on its own be sufficient – institutions which provide VET will also be required.

In this paper we address these questions in the context of Europe in the early months of the financial crisis (late 2008 and early 2009). In the empirical analysis we employ data at the micro (firm) and macro (country) level. For the former, we use the *Innobarometer Survey 2009* carried out from the 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. We ask how national mixes of UI, VET, and JS affect decisions by firms to sustain, increase, or reduce investments in innovation after the onset of the crisis. Controlling for a number of firm-specific characteristics, including pre-crisis changes in innovation investment by the same firms, and for country-level changes in GDP, we get country-level indicators of innovation

investment during the crisis. We then compare these with relative national levels of UI, VET and JS.

Our results are consistent with the complementarity of UI and VET: the countries that sustain innovation well are never weak in both, while almost all of those whose firms do not sustain innovation during the crisis are weak in *either* UI or VET (or, in the case of the UK, both). This is consistent with EIS, and with the flexicurity model. However, while in EIS JS and UI have similar effects, and in the flexicurity model strong JS is viewed as a problem, we find no relationship, positive or negative, between JS and sustained innovation – JS, in this case, is simply irrelevant.

The paper is organized as follows. The Section 2 reviews briefly the theory and previous findings on the relationship JS, UI, skill formation, innovation, and financial crisis. Section 3 presents the data. Section 4 presents the empirical model and results. Section 5 concludes.

2. Social protection, investment in specific skills, innovation, and response to crisis

We are interested in VET as a source of skills which are industry- or technology specific. These need to be distinguished from firm-specific skills and general skills, the categories employed in basic human capital theory. That theory predicts that employers will pay for firm-specific skills and workers for the general ones. We can define general skills in either of two ways: a negative definition is simply that the skill is not firm-specific; a positive one is that the skill is broadly transferable, useful in numerous industries and occupations. The negative definition is far broader – it

includes more skills – not only broadly transferable skills, but also skills which are useful only within a particular industry (those associated with underground mining or clothes manufacturing, for instance) or in the use of a particular technology (for instance, linotype operation, or the ability to customize Linux-based networks and applications). From an employer's standpoint, these industry- or technology-specific skills are fully transferable, and the employer will not pay for training unless employee mobility is restricted (through contract or through employer collusion), or there is some assurance that other employers will do comparable training. From the worker's standpoint, however, investment in such narrow skills can entail a considerable risk. As discussed above, this problem can be remedied through some form of social insurance: if somebody (typically either an employer or the state) can and does make a credible promise of either continued employment or income replacement, together with retraining, in the event the skill loses value, then workers will be willing to spend their time acquiring industry- or technology-specific skills even if the markets for these skills are very thin or uncertain.

In the absence of credible insurance, skills which are specific will command a risk premium, at best (at worst, faced by uncertainty and limited borrowing capacity, workers will simply opt for skills which are truly transferable, or for which demand appears likely to be stable: sales, teaching, accounting, law...), and employers will favour production systems and products which depend less on specific skills. The bias against specificity in the absence of adequate insurance can be seen as analogous to Williamson's (1985) analysis of the way incomplete contracts produce a bias in favour of general purpose, as opposed to transaction specific, assets.

EIS observe that, among rich industrial countries, those with relatively high levels of either JP or UI (or both) have, on average, much higher rates or participation in VET than countries with low levels of both JP and UI; the countries with low levels of both forms of protection are the English-speaking countries, which are also what Hall and Soskice (2001) classify as LMEs. EIS use this observation to support the argument that income and training insurance – whether offered by the state through a combination of strong UI and VET, or the employer as a response to strong JP – encourage investment in specific skills.

The package of policies and institutions known as 'flexicurity' is can be understood as one part of the territory that EIS associate with high VET. Flexicurity includes high UI, retraining for the unemployed (i.e., off-the-job VET available at any stage of a worker's career), but relatively *low* JS (Kok 2003; Wilthagen and Tros 2004; Council of Europe 2005; Crouch 2010). (The Commission of the European Communities (2007) specifies 'moderate' JS in its definition of flexicurity, but their starting point is the perceived problem of high JS.) Here, the relationship between UI and the willingness to invest in skills is consistent with the EIS analysis, although in most accounts of flexicurity the emphasis on specificity is missing; JS, on the other hand, is regarded as hindering the efficient allocation of labour, raising unemployment, fostering labour market dualism, and inhibiting productivity growth. Flexicurity is, roughly speaking, descriptive of the Nordic, Dutch, and Swiss economies; the German-style systems (including also Austria and Belgium), historically high in both UI and JS, can be seen as moving toward flexicurity as they have reduced JS over the past two decades.

While flexicurity provides an attractive policy package, both the positive and the negative planks of the flexicurity platform have uncertain empirical support. The overall macroeconomic benefits of flexicurity are contested (see also the discussion in Schwartz 2001; e.g., Becker 2005; Giugni 2009; Gold 2009), as is its functioning in times of crisis (Tangian 2010). And, while JS appears to have an adverse effect on employment levels, the effect is small compared with those caused by variations in monetary policy (Baccaro and Rei 2007); as with minimum wages (DiNardo, Fortin, and Lemieux 1996), the aggregate loss of labour income from downward flexibility may outweigh gains from employment; and incremental reforms (e.g., the reduction of JS for new hires or certain groups of workers) can produce an employment quality outcomes worse than either broad JS or employment at will (Blanchard and Landier 2002). In light of these problems, and in light of the acknowledged role JS has played in the growth of certain national economies in the post-World War II period, the curtailment of JS is not something to be pursued without careful examination.

These functional roles of strong JS can be important even if it is so that flexicurity – the strong UI/high VET package – is a globally superior solution. Manca et al. (2010) find "substantial heterogeneity across EU Member States in terms of how close they are to fulfilling flexicurity 'requirements'." Flexicurity is not simply as a policy package that can be put in place by the passage of legislation: it depends on institutional functions which may not be present in states that are fiscally or administratively weak, or which have political systems that do not support inter-generational bargains. EIS's argument is that greater investment in specific skills occurs when there is a credible promise of both income support and retraining in

the event of job loss at some unknown future point in a young worker's career. In other writings (e.g.Iversen 2005; Cusack, Iversen, and Soskice 2007; Estevez-Abe 2008) the same authors argue that this credibility requires not only institutions which *are* seen to be delivering income support and retraining, but also a 'consensual' constitutional setup that supports inter-generational bargains. Elimination of the laws sustaining strong JS, on the other hand, is a policy choice which in many countries could be effected by a single legislative act. In the absence of institutions which can sustain and credibly promise the strong UI/high VET package, a policy decision in favour of flexicurity could result simply in the elimination of JS, with the promised new form of social insurance and new incentive for specific training both stillborn.[1] Given this difficulty it is worth knowing just how important is this 'flexibility' leg of 'flexicurity'.

We turn now to innovation. In general, we expect investment in innovation to decline during a financial crisis, due both to diminished financial resources and to increased uncertainty: R&D expenditure (one category of investment in innovation) is pro-cyclical in OECD economies (OECD 2009; WIPO 2010). Yet, the disruptive effects of crisis may bring opportunities, or simply a perceived imperative to adapt in order to survive. Deep and long recessions – such as those occasioned by major financial crises - are often accompanied by major shifts in technological paradigm and industry structure (Dosi 1982; Perez 2010); Field (2003) finds that the Great

[1] . The difficultly of delivering an alternative to JS tells us something about why the defence of JS has been so stubborn: why in countries with strong JS and low UI, 'reforms' have protected insiders, not so much curtailing the strength of JS as increasing the proportion of new entrants to the workforce not legally entitled coverage by the JS umbrella, thus institutionalizing labour market dualism. This creates outcomes which – independent of movement on the UI/VET question – may be worse than either univ**e**rsal strong JS or no JS at all (Blanchard and Landier 2002; Bassanini et al. 2009).

Depression in the United States – the period 1929-1941 - was for that country also "the most technologically progressive decade of the [20th] century."

Studies of innovation have often emphasized the frontiers of technological advance and the development new processes and products – not least because data on patent filings and formal R&D expenditures is readily available, while measures of most other innovation activity are not. In recent decades, however, data on the innovative activity of firms, more broadly defined, has been gathered through a number of ongoing surveys. "Innovation" in this context includes the application and adaptation of technologies new to the firm using them, and non-technological forms of innovation, in areas such as marketing, design, organization, business models (OECD 2005). This broad definition of innovation is consistent with the view, long evidenced in comparative studies, that the skills relevant to innovation are not only those of scientists and engineers at the top level, but include what are often classed as "intermediate" skills.

The relationship between innovation, skills, and employment systems can be seen as one of the central ways in which the innovative activity of firms is shaped, in both its level and character, by national institutions (Freeman 1987; Lundvall 1992; Nelson 1993). Within the European union, states have maintained (Lorenz and Lundvall 2006), and even increased (Archibugi and Coco 2005) their heterogeneity in terms of innovation performance and technological development. Differences of innovation and technological capabilities make an important contribution to differences in growth rates (Fagerberg 1994; Castellacci 2008) and

are thus a factor in the convergence – or lack of it – between European economies (Tumpel-Gugerell and Mooslechner 2003; Kutan and Yigit 2007)

JS and UI 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 JS and UI provisions previously in place, and in important respects the system of skill development and the systems of JS and UI 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, JS is almost certain to retard innovation by discouraging in a crisis re-allocation of labour and / or by removing incentives for innovative effort. Yet it is plausible that JS 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), and 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. JS is broadly associated with slack, and is certain to produce slack in a downturn. During a crisis, the effects (positive or negative) of JS 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.

UI could also affect innovation activity during a downturn, though expected the direction of the effect is not clear: by lowering the worker's cost of job loss UI could reduce incentives for work effort (Gintis and Ishikawa 1987), and innovating presumably requires effort; on the other hand, income security should reduce employee resistance to productivity-enhancing innovation.

From the employer's standpoint, a more highly skilled workforce should be a more flexible instrument, enhancing the relative value of innovating during a crisis. Also, if innovation may be undertaken to make use of under-employed workers, then is should be positively associated with hoarding of skilled workers; whether such hoarding is more prevalent when skilled workers make up more of the work force (so that more are worth hoarding) or when they are scarcer, is not clear *a priori.*

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,[2] 200 enterprises from most manufacturing and

[2] 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.

private service industries[3] with 20 or more employees were sampled. 5,238 telephone interviews were completed between the 1st and 9th of April 2009. The sample is random, 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).

The 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:

[3] 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.

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 Q3 and Q4 come immediately after a series of more specific questions about the company's innovation activities gives us some confidence that respondents would have had a 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. 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 expenditures 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 provides data on changes in the firm's turnover from 2006-8, number of employees, proportion of sales exported, 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 changes in innovation investment 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 Geroski and Walters (1995) and by Filippetti and Archibugi (2011).

**********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 measure of UI is the short-term earnings replacement rate (REPLACE), defined by the OECD as "net income replacement rates for unemployment benefits (percentage of earnings)" in the first year after job loss. The short term rate is the one relevant to both the EIS thesis and the flexicurity model, in that it facilitates re-training.

Our measure of JS is the OECD Employment Protection Index (PROTECT). This is 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.

VET in our models is 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".

For comparison, we include a third group of variables addressing higher education – an area of education more usually included in innovation studies than VET is. These include science and engineering doctorates per capita (Eurostat), science and engineering degrees per capita (Eurostat), and the share of labour 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. This is especially so given that there are plausible and important hypotheses which could only be tested using both levels and *interactions* of country-level variables. 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:

$$\text{Innovation2008-9}_{i,k} = \text{b1*Innovation2006-8}_{i,k} + \text{b2*Large\_Firm}_{i,k} + \text{b3*Turnover\_fall}_{i,k} + \text{b4*Export\_Dependence}_{i,k} + \text{b5*GDP0801}_{k} + \text{b6*GDP0901}_{k} + \text{industry controls} + e_k + u_{i,k} \quad (1)$$

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 JS (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. One striking thing 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. 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 UI and training elements of flexicurity are, in combination, associated with a reduced likelihood of cutting expenditures on innovation, there is no clear relationship between JS and changes in innovation investment: the 'flexi' end of flexicurity appears to be irrelevant in this case. We see, in Table 5, the countries with the strongest JS grouped together in the middle of the pack, while countries at both the top and bottom are decidedly mixed in their levels of JS. 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.

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**********

5. Discussion and conclusion

Firm-level investment in innovation in Europe during the onset of the financial crisis in 2008-9, held up best relative to pre-crisis investment in countries with both high UI and high participation in VET; these were also countries in which high numbers of people completed doctoral degrees in science and engineering subjects. We find no relationship, positive or negative, between the resilience of innovation investment and JS, nor with lower-level science and engineering degrees. These results must of course 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 UI/VET *combination*. For reasons discussed above, it is not surprising that firms with skilled workforces would be more likely to maintain innovation during a downturn, than those without skilled workforces. But why should this not show up simply as a relationship between VET and innovation? If VET produces skill then, given a certain level of VET participation, why should UI matter? Similarly, there are plausible reasons why UI might affect innovation during a crisis, but why should this only be the case when VET participation is high?

We believe that an explanation for the VET/UI pairing may lie in variations in what VET means in practice. The VET variable measures the proportion of a relevant age group undertaking vocational education and training at the secondary and post-secondary levels, but of course the content of this education and training can mean different things in different circumstances. As noted above, many critics regard VET as unresponsive to actual labour market needs. The tendency has been to attribute this problem to the difficulty public education systems have keeping up with changing workplace technologies; following EIS's logic, we propose a different understanding of why VET programmes may fail, based on student motivation. Where UI is weak, students will devote their efforts to obtaining transferable skills (or, more cynically, transferable credentials). In EIS's account, this should lead to a low rate of VET participation. Our results suggest a different possibility, which is that while poor social insurance *may* be associated with low VET participation, it

can sometimes instead produce *ineffective* VET. In the absence of adequate insurance students may want broadly transferable skills; they may want skills for relatively safe, stable occupations; they may want a relatively cheap and / or easy course which leads to a credential of some kind; but what they will surely *not* want is to make a substantial investment in specific, risky skills. If VET providers respond to student demand (or if students get out of VET what they are motivated to get), VET outcomes will be qualitatively different in settings with and without strong UI: only the latter will produce a strong supply of skills geared to bear the risk of rapidly changing technologies and markets.

The apparent *unimportance*, in our results, of JS, poses a problem for the EIS analysis, and another much different problem for flexicurity policy. The problem for EIS is that the symmetry, in their story, between UI and JS, is not borne out in this case. The problem for flexicurity policy is that the flexibility element appears, at least in this case, to be irrelevant. As we noted above, the elimination of JS is, institutionally, the simplest element of flexicurity to implement: eliminating JS and failing to secure the other elements of flexicurity may accomplish exactly nothing, while establishing solid UI and VET may make reductions in JS superfluous. In theory, the irrelevance of JS after UI and VET are taken into account should not be surprising. JS should be a problem only when a lack of outside options keeps workers in bad job matches; where outside options are good enough – and the UI/VET combination can have a lot to do with whether they are good enough – the strength of JS becomes largely a question of whether workers or employers bear the costs of separations – that is, a distributional question rather than an allocational one (Fadda 2011). While we cannot come to a strong conclusion in this

respect on the basis of the narrow empirical results reported here, our finding is consistent with the existing literature in the area; further research on this question should be a priority.

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

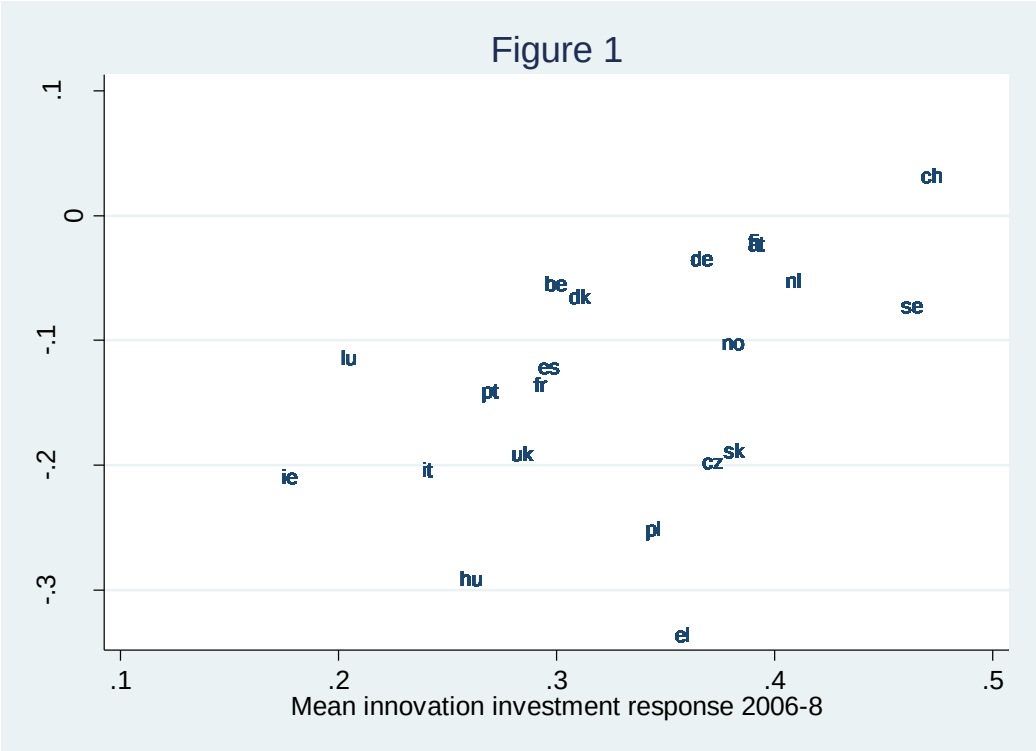
country	country effect	S&E doctorate	S&E graduates	Tertiary education
ch	0.39	3	3	2
at	0.30	3	1	1
fi	0.25	3	2	3
dk	0.24	2	3	3
de	0.23	2	1	2
be	0.21	2	2	3
nl	0.19	1	2	2
lu	0.11	.	.	2
no	0.09	2	1	3
fr	0.04	2	3	2
es	0.03	1	1	2
se	0.03	3	2	2
pt	-0.05	3	2	1
pl	-0.09	1	3	1
sk	-0.11	1	1	1
it	-0.18	1	2	1
uk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

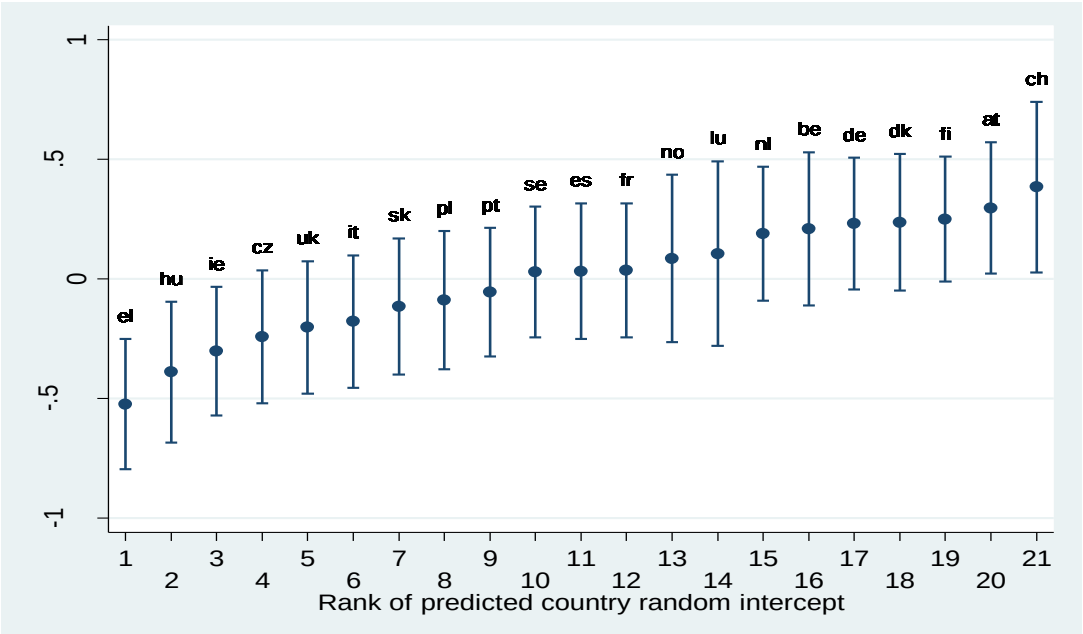
Innovation investment prior the crisis and during the crisis



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%

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