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THE LINK BETWEEN INNOVATION PERFORMANCE and GOVERNANCE

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Abstract

This paper aims to explore in a descriptive way the relationship between country level indicators on governance and innovation. It explores in detail the association between innovation and governance by looking at the relationship between six governance indicators from the World Bank and the innovation performance measures used in European Innovation Scoreboard and the Global Innovation Scoreboard (Hollanders and Arundel, 2006). The basic methodology used in exploring this link is an ordinary least squares (OLS) linear regression model. The analysis has been realized for single countries as well as the EU aggregate average.

1- Introduction - Importance of good governance

Good governance became the buzzword in explaining good economic performance as well as the well being of a society during the last decade (see Berthelier et al., 2003). Research has been usually focused on the role of good governance in promoting different aspects of economic performance; let it be economic growth or productivity. There is however, less work done so far in exploring the link between the innovation performance and good governance. In general, it is agreed that innovation has a direct link to the productivity and studies concentrating on the role of good governance on inducing productivity are so far thought to be serving also for this concern.

However, using productivity as a proxy for innovation is at best an inadequate attempt and at worst a fruitless one. In reality, "innovation performance" covers a broad range of different policy fields including research, industrial regulation, education, employment, taxation, environmental regulation, health standards, quality control, and IPR law (Sloan, B.), which results in interweaving of policy governance with innovation inputs and outputs and rises the curiosity of finding the link between policy governance and innovation performance of a country on the macro level.

The major problem is that such relationships are empirically very difficult to verify and would imply a very time consuming, costly and complex research design. A first step, however, might be to relate the existing innovation performance indicators (or composite indicators) with existing governance indicators. The main aim of this paper is to explore in a descriptive way the relationship between country level indicators on governance and innovation.

2- Definitions, concepts and methodological choice

2.1 Measuring Innovation

In very general terms, innovation is defined as the act of bringing a new product into the market or the alteration of what is there such that it constitutes a novelty. A more complete definition could be found in the Oslo manual (OECD, 2006), which identifies innovation as "a new significant improved product (good or service), or process, a new marketing method, or a new organizational method, business practices, workplace organization or external relations" (OECD, 2006, p. 46). In other words, innovation is part of the process through which technological change affects the productivity and the living standards of different societies (first ENGIME report, 2003).

In line with the aforementioned definitions, economists so far aimed to measure either the rate of technological change or the level and the impact of knowledge spillovers in order to have an indicator of innovation. However this is easier to say than to do. It is very unlikely to come across with an appropriate indicator for innovation and/or technological change in the literature and we only come across proxy measures to grasp the meaning of these concepts. A quite common one, which explains the effort of firms and countries in undertaking innovation, is usually measured through the resources devoted to R&D. However, this provides only one of the various measures those of which would be classified as inputs for innovation. In order to understand how technology changes over time, measures that would fall under the category of outputs of innovation are needed. Economists have repeatedly used patent statistics as a proxy to technological output. However, there are plenty of limitations on this account. Many innovations are never patented, the economic value of the patents varies considerably and moreover, the number of patents depends more on the level of employment at the granting patenting institution than innovative output (Halls et al., 2001 in ENGIME Report 2003).

In addition to these aforementioned indicators to quantify or proxy innovation, there are some recent research attempts aiming to build composite indicators, incorporating different aspects and

dimensions of innovation. In our work, two of such tools are identified and will be used[1]: European Innovation Scoreboard (EIS) and Global Innovation Scoreboard (GIS). EIS provides an annual benchmark of the innovation performance for the 27 EU Member States and Croatia, Turkey, Iceland, Norway, Switzerland, the US and Japan. The overall benchmark is done by comparing rankings of the composite indicator, the Summary Innovation Index (SII). Thus SII will be used to carry on the exploratory analysis. SII is a score constructed with data for 25 indicators divided in five broad innovation areas within and input - output scheme:

A) Input

(1) Innovation drivers (*inidrv*), which measures the structural conditions required for innovation, mainly in terms of educational attainment of the population;
(2) Knowledge creation (*inikc*), which measures aspects of R&D;
(3) Innovation & entrepreneurship (*inientrep*), which measures mainly efforts for innovation at the company level;

B) Output

(4) Applications (*inoapp*), which measures the performance, expressed in terms of labour and business activities, and their value added in innovative sectors; and
(5) Intellectual Property (*inoip*), which measures the achieved results in terms of successful know-how in terms of patents and other innovative outputs, specially referred to high-tech sectors.
An average of the two output indicators (*inoav*) was also calculated in order to see if there is a relationship between innovation output and educational benchmarks.

Global Innovation Scoreboard Indicators (GIS) were created in order to compare the innovation performance of the EU with other non-EU member states (see Hollanders and Arundel, 2006). It has similar areas than the EIS but it is composed of less number of indicators. The indicators are in many cases from other sources, due to the availability of the data, which makes, to some extent, GIS a different measure than EIS. The list of indicators for GIS is presented in table 2. In the present paper only the overall GIS scores will be considered for the relationships.

[1] This part is a summary taken from Villalba, 2007. Villalba mainly bases his work on Sajeva et al. 2006, p. 9.

Table 1: European Innovation Scoreboard (EIS) and sources, 2006

	INPUT – INNOVATION DRIVERS (*inidrv)*	
1.1	S&E graduates per 1000 population aged 20-29	EUROSTAT
1.2	Population with tertiary education per 100 population aged 25-64	EUROSTAT, OECD
1.3	Broadband penetration rate (number of broadband lines per 100 population)	EUROSTAT
1.4	Participation in life-long learning per 100 population aged 25-64	EUROSTAT
1.5	Youth education attainment level (% of population aged 20-24 having completed at least upper secondary education)	EUROSTAT
	INPUT – KNOWLEDGE CREATION (*iniKC*)	
2.1	Public R&D expenditures (% of GDP)	EUROSTAT, OECD
2.2	Business R&D expenditures (% of GDP)	EUROSTAT, OECD
2.3	Share of medium-high-tech and high-tech R&D (% of manufacturing R&D expenditures)	EUROSTAT, OECD
2.4	Share of enterprises receiving public funding for innovation	EUROSTAT (CIS4)
	INPUT – INNOVATION & ENTREPRENEURSHIP (*inientrep*)	
3.1	SMEs innovating in-house (% of all SMEs)	EUROSTAT (CIS3)[2]
3.2	Innovative SMEs co-operating with others (% of all SMEs)	EUROSTAT (CIS4)
3.3	Innovation expenditures (% of total turnover)	EUROSTAT (CIS4)
3.4	Early-stage venture capital (% of GDP)	EUROSTAT
3.5	ICT expenditures (% of GDP)	EUROSTAT
3.6	SMEs using organisational innovation (% of all SMEs)	EUROSTAT (CIS4)
	OUTPUT – APPLICATIONS (*inoapp)*	
4.1	Employment in high-tech services (% of total workforce)	EUROSTAT
4.2	Exports of high technology products as a share of total exports	EUROSTAT
4.3	Sales of new-to-market products (% of total turnover)	EUROSTAT (CIS4)
4.4	Sales of new-to-firm products (% of total turnover)	EUROSTAT (CIS4)
4.5	Employment in medium-high and high-tech manufacturing (% of total workforce)	EUROSTAT
	OUTPUT – INTELLECTUAL PROPERTY (*inoip*)	
5.1	EPO patents per million population	EUROSTAT
5.2	USPTO patents per million population	EUROSTAT, OECD
5.3	Triadic patent families per million population	EUROSTAT, OECD
5.4	New community trademarks per million population	OHIM[3]
5.5	New community designs per million population	OHIM[7]

[2] CIS4 data for the indicator on the share of SMEs innovating in-house were not available.

[3] Office for Harmonization in the Internal Market (Trade Marks and Designs): http://oami.eu.int/

Table 2: Global Innovation Scoreboard indicators (GIS) and sources, 2006

INPUT – INNOVATION DRIVERS		
1.1	New S&T graduates	UNESCO
1.2	Labour force with completed tertiary education	WORLD BANK (WORLD DEVELOPMENT INDICATORS)
1.3	Research per million population	WORLD BANK (WORLD DEVELOPMENT INDICATORS)
INPUT – KNOWLEDGE CREATION		
2.1	Public R&D expenditures (% of GDP)	OECD, WORLD DEVELOPMENT INDICATORS
2.2	Business R&D expenditures (% of GDP)	OECD, WORLD DEVELOPMENT INDICATORS
2.3	Scientific articles per million population	WORLD BANK (WORLD DEVELOPMENT INDICATORS)
INPUT – DIFFUSSION		
3.1	ICT expenditures (% of GDP)	WITSA/IDC (DIGITAL PLANET 2004)
OUTPUT – APPLICATIONS		
4.1	Exports of high technology products as a share of total exports	WORLD BANK (WORLD DEVELOPMENT INDICATORS)
4.2	Share of medium-high/high-tech activities in manufacturing value added	UNIDO (INDUSTRIAL DEVELOPMENY SCOREBOARD)
OUTPUT – INTELLECTUAL PROPERTY		
5.1	EPO patents per million population	OECD
5.2	USPTO patents per million population	OECD
5.3	Triadic patent families per million population	OECD

2.2 Institutions and institutional indicators

A sound definition of the concept "institution" is provided by the Work Bank as "institutions are humanly devised constraints that structure political, economic and social interactions. They consist of both informal constraints and formal rules" (WB,1998).

The concept is however complex and multi-faceted. Moreover, it can include a broad range of areas like political, legal, market institutions as examples of formal ones and norms and societal constraints as examples of informal ones. The literature provides a good summary of "formal institutions" (Berthelier et al., 2003):

- Political institutions: functioning of political institutions, public rights and liberties;
- Law and order: safety of persons and goods, management of conflicts within society and between the society and the government, external security;
- Public governance: transparency and effectiveness of action taken by the authorities, corruption, independence of government from private actors (collusion, State capture), independence and level of application of justice;
- Markets' operating freedom: share of the private sector in the productive and financial systems, proportion of freely-set prices, degree of flexibility of the labour market;
- Preparation for the future, absorption of technology, aptitude for reform: modalities for the diffusion of technology, strategic view taken by the authotorities, management of the environment;
- Security of transactions and contracts: respect for property rights, contract law, handling of commercial disputes;
- Regulation: competition on the markets for goods and services, on the capital market and on the labour market and arrangements regulating competition; corporate governance, supervision of the financial system, instruments for social dialogue;
- Openness to the outside world: freedom of circulation of goods and services, capital, persons and information;
- Social Cohesion: social and regional balance, equality of treatment (by sex, ethnic group, etc.) in traditions and in the actual operation of formal institutions, social mobility, solidarity (traditional, institutional).

The main idea of this paper is to correlate successively the two composite indicators of innovation presented above with some indicators measuring the institutional setting of a country. As mentioned above, the institutional indicators are too diverse. For the sake of simplicity and limitations related to data, this paper will just use some indicators measuring the institutions of a country within the framework of the first three categories aforementioned, namely political, legal and public governance indicators. This requires restricting the definition of our independent variable as "governance indicators". Governance consists of the traditions and institutions by which authority in a country is exercised. This includes the process by which governments are selected, monitored and replaced; the capacity of the government to effectively formulate and implement sound policies; and the respect of citizens and the state for the institutions that govern economic and social interactions among them (see the World Bank's web-site *governance matters*). A governance approach refers not only to the conventional boundaries between politics, policies and administration, but also how they are interlinked to each other (ENGIME Report, 2001, pp.69).

The indicators measuring one or more aspects of governance of a country are various as well. Some common information sources from which governance indicators can be obtained are listed below (taken from Berthelier et al., 2003):

- Grading by agencies in the political and economic fields (Business Environment Risk Intelligence (BERI), International Consulting Resources Group (ICRG), Control Risks Group (CRG), Direct Rendering Infrastructure (DRI), etc.)
- Publications by foundations defending ideological objectives and realized with the support of universities or newspapers (Fraser Institute, Heritage Foundation etc.)
- Indicators produced by NGOs (Transparency International etc.)
- Publications by research centres (State Capacity Study by Columbia University)
- Publications by private firms (Price Waterhouse Coopers (PWC) etc.)
- International financial institutions (World Bank, International Monetary Fund, European Bank for Reconstruction and Development etc.)

The nature of these indicators is highly diverse. They are based either on the collection of assessments by country experts or on the results of surveys of representative samples. The data are then centrally reprocessed. The geographic fields covered are either the whole world or individual regions.

Among all these indicators, a group deserves to be singled out: the governance indicators of World Bank from all the rest. This is because the authors compiled the indicators on the basis of the aggregation of 6 indicators emancipating from 15 different sources among the indicators listed above (Kaufman et al. 1999). On the assumption that the biases affecting these different indicators are in part independent, the indicators resulting form the aggregation of these elementary indicators must be more robust than the elementary indicators themselves (Berthelier et al., 2003). Moreover, the sample of the World Bank Governance Indicators covers a cross-section of 150 countries including the entire EU Member and Candidate Countries. The six governance aggregate indicators correspond to six basic governance concepts: Voice and Accountability, Political Stability and Absence of Violence, Government Effectiveness, Regulatory Quality, Rule of Law and Control of Corruption. Box 1 provides a brief explanation for each dimension.

Box 1: Dimensions of World Bank Governance Indicators (Kaufman et al., 1999)

Voice and Accountability includes in it a number of indicators measuring various aspects of the political process, civil liberties, political and human rights, measuring the extent to which citizens of a country are able to participate in the selection of governments.
Political Stability and Absence of Violence combines several indicators which measure perceptions of the likelihood that the government in power will be destabilized or overthrown by possibly unconstitutional and/or violent means, including domestic violence or terrorism.
Government Effectiveness combines responses on the quality of public service provision, the quality of the bureaucracy, the competence of civil servants, the independence of the civil service from political pressures, and the credibility of the government's commitment to policies.
Regulatory Quality focuses more on the policies themselves, including measures of the incidence of market unfriendly policies such as price controls or inadequate bank supervision, as well as perceptions of the burdens imposed by excessive regulation in areas such as foreign trade and business development.
Rule of Law includes several indicators which measure the extent to which agents have confidence in and abide by the rules of society. These include perceptions of the incidence of crime, the effectiveness and predictability of the judiciary, and the enforceability of contracts.
Control of corruption is a measure of the extent of corruption, conventionally defined as the exercise of public power for private gain. It is based on scores on variables from polls of experts and surveys.

2.3 Data, Methodology and Limitations

Given the aforementioned reasons about its robustness we have preferred to work with the data taken from the "World Bank Governance Matters" database [4]. The data for the Summary Innovation Index and Global Summary Innovation Index can be accessed via Pro-Inno web-site [5]. It is important to underline here that in this work, limitations in data availability and resolution level allow the use of simple statistical tools and the conclusions that can be drawn from the analyses cannot have the detail that one would expect.

The paper is mainly exploratory and aims to give an idea about the possible statistical association between the institutional settings of a country on the aggregate level and innovation performance of enterprises in that country, which is gathered through aggregated results based on micro surveys. We wish to underline once more the drawbacks of building a statistical link between governance indicators, only available at macro level, and innovation indicators, built on micro data. The paper does not aim to pose the question of whether the governance of an enterprise leads to better (or worse) innovation performance of that enterprise at the micro-level. Instead, we attempt to see if the governance setting of a country on the macro level has any impact on the innovation performance of its enterprises as a whole.

The basic methodology used in exploring this link is an ordinary least squares (OLS) linear regression model. As one-way OLS regression models only give a limited evaluation of the association, fixed and random effects models were also tried to estimate the relationship between governance indicators and SII and between governance indicators and GIS, as widely suggested in the literature for panel data analysis (see Mascherini, 2006 for further discussions). However, sound explanations could not be obtained by any of these models, mainly due to the sparse availability of micro data.

[4] The governance indicators data set has been extracted on 20th of July 2007.

[5] http://www.proinno-europe.eu/doc/EIS2006_final.pdf

It is worthwhile mentioning that, we are also encountered with the usual problem of using composite indicators to explain complex, multi-dimensional phenomena, those of which are, in this particular case, innovation and the dimensions of governance at a country. The indicators used to measure these complex phenomena provide an overall picture, incorporating various dimensions of the concept; however, they are a simplification of the reality[6]. To put it in simpler words, indicators used in this paper to quantify institutions and governance do not cover the whole essence of the concepts, but represent them as approximate as possible within the limits of the data.

As one of our main concerns in this work has been to identify the place of the European Union (EU-27 hereby on) in comparison with the rest of the world on the basis of this possible association, an aggregate value for the EU-27 is needed. SII and GIS composite indicators already provide aggregated values for the EU-25[7] while World Bank governance data do not present aggregated values for country groups. For this reason, a simple weighted average, based on GDP weights[8] has been computed for the EU-27 as a whole.

Finally, it is important to bear in mind that the impacts of good governance on different areas, including innovation, may take some years to be measured. Because of this reason, the results attained based on the association between governance indicators of 1996 (the earliest available) and SII and GIS of 2005 (the most recent available) have been studied. However, only one pair of data is not enough to study whether the impact of governance on innovation has changed within time, and in what way. So, an association between governance indicators of 2005 and innovation performance in the same year is also presented to give an overview of how it might get stronger or weaker with respect to the previous data set.

[6] See for instance http://composite-indicators.jrc.ec.europa.eu/ for a complete assessment of pros and cons of using the composite indicators. Further information is available in Nardo, M., M. Saisana, A. Saltelli, S. Tarantola (JRC) & Hoffman, A. and E. Giovannini (OECD), 2005, *"Handbook On Constructing Composite Indicators: Methodology And User Guide"*

[7] As Bulgaria and Romania became members of the EU starting from 01.01.2007, they were not taken into consideration while computing an aggregate for the EU for SII 2006.

[8] Own calculations done by using GDP at current prices in USD, taken from World Economic Outlook April 2007 database.

3- The importance of good governance for innovation: country level evidence from indicators

3.1 World Bank Governance Indicators and their relationship with the Summary Innovation Index

Governance Indicator#1, Voice and Accountability

Voice and Accountability is a composite indicator measuring various aspects of the political process, civil liberties, political and human rights; by meaning, one does not expect to find a direct link to innovation performance. However, the results presented in table 3 show a moderate to high correlation between the two composites, for the sample of EU Member States and Candidate Countries (y= 0.364x-0.02).

Table 3: SII and Voice and Accountability (2005)

Source	SS	df	MS		Number of obs	29
Model	0.464508047	1	0.464508047		F(1, 27)	42.34
Residual	0.296236774	27	0.010971732		Prob > F	0.0000
Total	0.760744821	28	0.027169458		R-squared	0.6106
					Adj R-squared	0.5962
					Root MSE	0.10475

sii2005	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
voiceandac~2	0.3640365	0.0559482	6.51	0.000	0.2492403	0.4788327
_cons	-0.0200227	0.0632205	-0.32	0.754	-0.1497404	0.1096951

Table 4: SII and Voice and Accountability (1996)

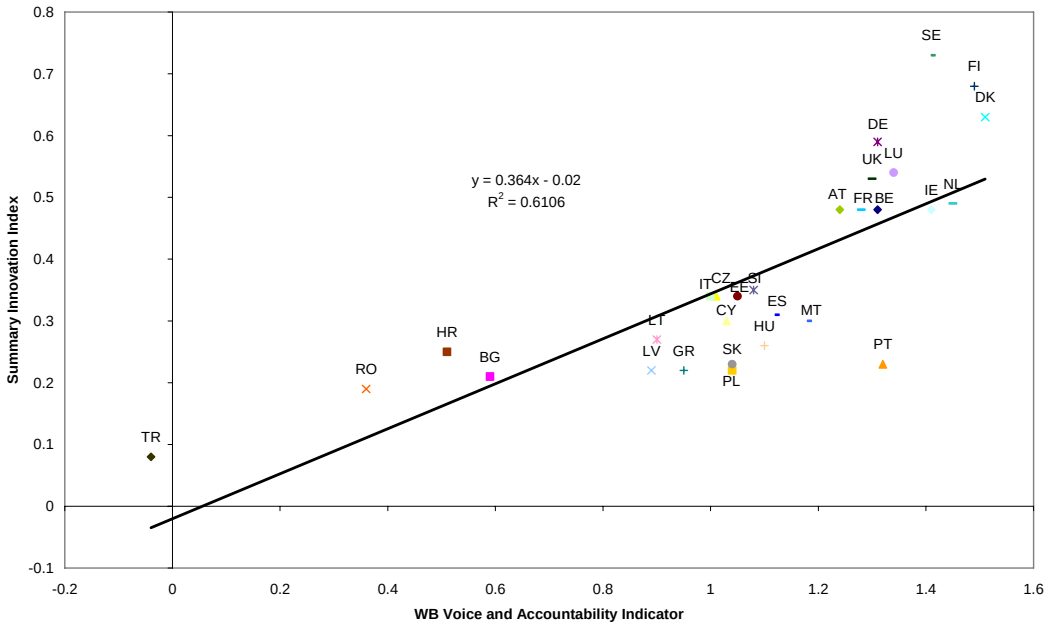
Source	SS	df	MS		Number of obs	29
Model	0.481783077	1	0.481783077		F(1, 27)	46.63
Residual	0.278961745	27	0.010331916		Prob > F	0.0000
Total	0.760744821	28	0.027169458		R-squared	0.6333
					Adj R-squared	0.6197
					Root MSE	0.10165

sii2005	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
voiceandac~1	0.2132125	0.0312232	6.83	0.000	0.1491478	0.2772772
_cons	0.1631663	0.0358605	4.55	0.000	0.0895865	0.2367460

Table 3 provides the results of the OLS regression between the 2005 value of the Voice and Accountability indicator and Summary Innovation Index, 2005. The R^2 value in the table is 0.61, which falls into the category of a moderate to high association with a 0.01 level of significance. If we take a look at the results of the same association (table 4), this time with voice and accountability index at the time 1996, the R^2 value is more or less the same (0.63) with the same level of significance.

More interesting results are observed concerning the behaviour of different countries within our sample. Figure 1 shows the position of the EU member and candidate countries within this association. It is possible to observe in general the "Four European Models", Scandinavians on the top, Continental European at the middle, followed by new Member States and Candidates Countries.

Figure 1: SII and Voice and Accountability (2005)



Governance Indicator#2, Political Stability/No Violence

The political stability/no violence indicator is a composition of several indicators which measure perceptions of the likelihood that the government in power will be destabilized or overthrown by possibly unconstitutional and/or violent means, including domestic violence or terrorism. As our sample is the set of the EU Member States or Candidate Countries, for which the political stability is a prerequisite to become a Member by default by the founding treaties, one would anticipate a possibly strong association between political stability and the innovation performance for the new members of (or the candidates to) the EU who are still in process of adapting but for the EU-15 states that have had the political stability for at least some decades, the same association is expected to be not that strong. The results of the OLS regressions presented in tables 5 and 6 are in line with this assumption. The R^2 value is moderate compared to those of the other indicators that are presented in this section. Still, in table 6, we can see a higher R^2 value for the association of the variables of political stability measured in 1996 and SII of 2005.

Table 5: SII and political stability/no violence(2005)

Source	SS	df	MS		Number of obs	29
Model	0.268473045	1	0.268473045		F(1, 27)	14.73
Residual	0.492271776	27	0.018232288		Prob > F	0.0007
Total	0.760744821	28	0.027169458		R-squared	0.3529
					Adj R-squared	0.3289
					Root MSE	0.13503

sii2005	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
politicals~2	0.2171367	0.0565853	3.84	0.001	0.1010333	0.3332401
_cons	0.228743	0.0448370	5.1	0.000	0.136745	0.3207409

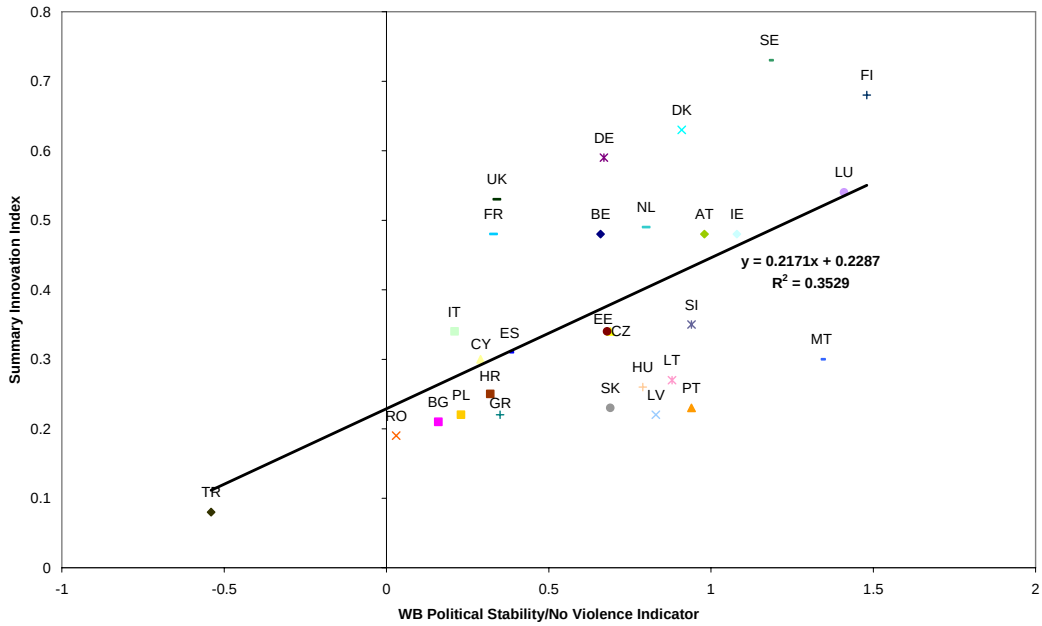
Table 6: SII and political stability/no violence(1996)

Source	SS	df	MS		Number of obs	29
Model	0.40619211	1	0.406192110		F(1, 27)	30.93
Residual	0.354552711	27	0.013131582		Prob > F	0.0000
Total	0.760744821	28	0.027169458		R-squared	0.5339
					Adj R-squared	0.5167
					Root MSE	0.11459

sii2005	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
politicals~1	0.2200699	0.0395688	5.56	0.000	0.1388813	0.3012585
_cons	0.2307622	0.0330462	6.98	0.000	0.1629571	0.2985674

The scatter plot visibly supports our aforementioned assumption. The new member states are closer to the regression line than the old ones. Still, the four European models can be observed.

Figure 2: SII and Political Stability/No Violence (2005)



Governance Indicator#3, Government Effectiveness

The indicator of Government effectiveness is a combination of responses on the quality of public service provision, the quality of the bureaucracy, the competence of civil servants, the independence of the civil service from political pressures, and the credibility of the government's commitment to policies. By definition, the degree of effectiveness of a government is anticipated to

have a close link to the innovation policy performance. The results of our statistical analysis, as demonstrated in table 7 and 8, support this assumption.

Table 7: SII and government effectiveness (2005)

Source	SS	df	MS		Number of obs	29
Model	0.618714037	1	0.618714037		F(1, 27)	117.62
Residual	0.142030785	27	0.005260399		Prob > F	0.0000
Total	0.760744821	28	0.027169458		R-squared	0.8133
					Adj R-squared	0.8064
					Root MSE	0.07253

sii2005	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
government~2	0.2495547	0.0230107	10.85	0.000	0.2023406	0.2967688
_cons	0.0867149	0.0295018	2.94	0.007	0.0261822	0.1472475

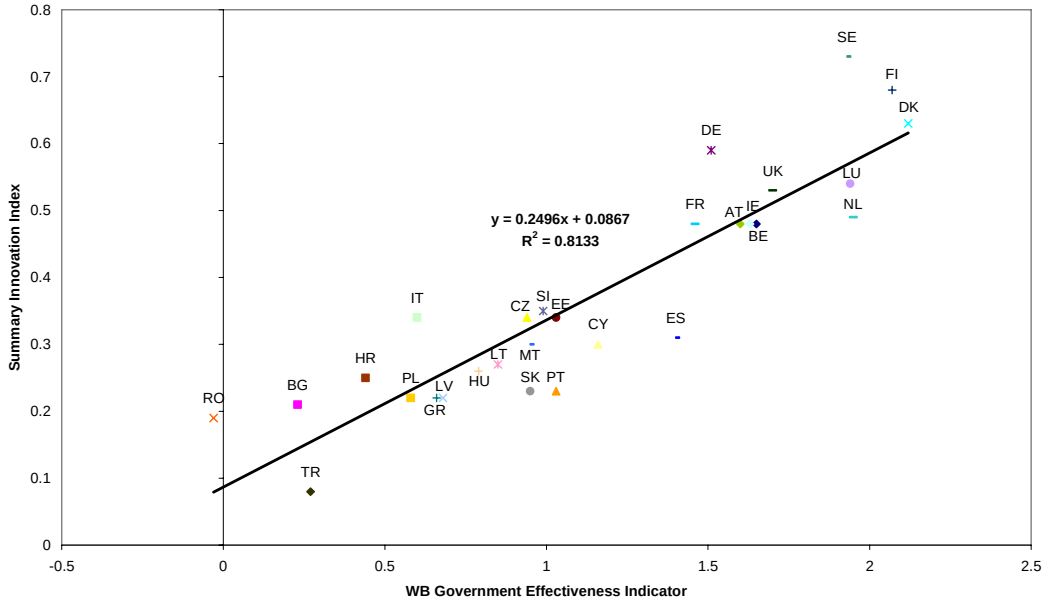
Table 8: SII and government effectiveness (1996)

Source	SS	df	MS		Number of obs	29
Model	0.532114482	1	0.532114482		F(1, 27)	62.84
Residual	0.228630339	27	0.008467790		Prob > F	0.0000
Total	0.760744821	28	0.027169458		R-squared	0.6995
					Adj R-squared	0.6883
					Root MSE	0.09202

sii2005	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
politicals~1	0.1338489	0.0168849	7.93	0.000	0.099204	0.1684938
_cons	0.2401612	0.0237906	10.09	0.000	0.1913469	0.2889756

Accordingly, within 0.01 level of significance, the R^2 value denotes a strong association between governance effectiveness and innovation performance. The same strong association is observed with the index of government effectiveness from 1996, though the R^2 value is somewhat lower. Figure 3 displays the location of the countries in our sample in accordance with the statistical model and sustains the positioning of Social models in Europe.

Figure 3: SII and Government Effectiveness (2005)



Governance Indicator#4, Regulatory Quality

The Regulatory quality indicator focuses more on the policies themselves, including measures of the incidence of market unfriendly policies such as price controls or inadequate bank supervision, as well as perceptions of the burdens imposed by excessive regulation in areas such as foreign trade and business development. In fact, the product and labour market institutions' impact in shaping economic performance and specialization patterns including innovation has attracted quite a lot of attention recently and more elaborate theoretical and empirical studies are available in the literature[9]. In our work, for the sake of consistency, we will analyze the impact of regulatory quality on innovation as in the case of other WB governance indicators. Hence table 9-10 show the results of the OLS regressions between these two indicators. In line with the literature, regulatory quality index both for 2005 and 1996 is positively associated with innovation index. Figure 4 also portraits this association on the country level.

Table 9: SII and regulatory quality (2005)

Source	SS	df	MS		Number of obs	29
Model	0.458489415	1	0.458489415		F(1, 27)	40.96
Residual	0.302255406	27	0.011194645		Prob > F	0.0000
Total	0.760744821	28	0.027169458		R-squared	0.6027
					Adj R-squared	0.5880
					Root MSE	0.1058

sii2005	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
regulatory~2	0.3023779	0.0472488	6.4	0.000	0.2054314	0.3993244
_cons	0.0219764	0.0580244	0.38	0.708	-0.0970798	0.1410326

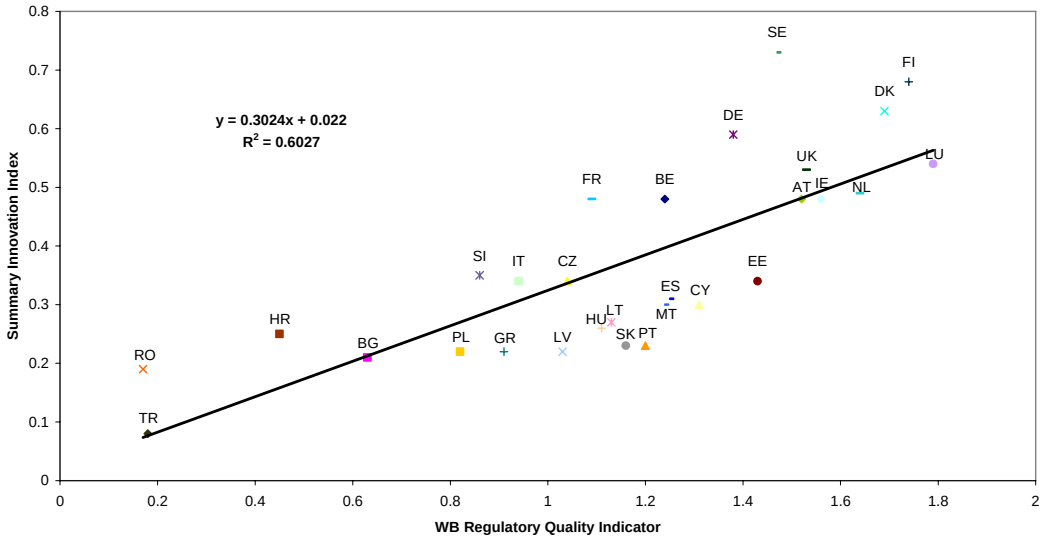
Table 10: SII and regulatory quality (1996)

Source	SS	df	MS		Number of obs	29
Model	0.413427339	1	0.413427339		F(1, 27)	32.14
Residual	0.347317483	27	0.012863610		Prob > F	0.0000
Total	0.760744821	28	0.027169458		R-squared	0.5435
					Adj R-squared	0.5265
					Root MSE	0.11342

sii2005	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
regulatory~1	0.2220126	0.0391615	5.67	0.000	0.1416598	0.3023654
_cons	0.1903242	0.0382562	4.97	0.000	0.1118289	0.2688194

[9] See Basanini, A. and E.Ernst (2002), " Labor Market Institutions, Product Market Regulation, and Innovation: Cross Country Evidence", OECD Economics Department Working Papers, No.316, OECD Publishing for a review of the existing literature on the topic.

Figure 4: SII and Regulatory Quality (2005)



Governance Indicator#5, Rule of Law

Rule of Law index includes several indicators which measure the extent to which agents have confidence in and abide by the rules of society. If we consider that this also includes protection of intellectual property rights by law, it is not a surprise to see high association between rule of law and summary innovation index. It is expected that if the transparency and equal opportunities in granting a patent in a country as well the framework of the innovation policies overall are under the supervision of the legal check, then this will have a positive stimulus on the innovation performance.

Table 11: SII and rule of law (2005)

Source	SS	df	MS		Number of obs	29
Model	0.590993834	1	0.590993834		F(1, 27)	94.00
Residual	0.169750987	27	0.006287074		Prob > F	0.0000
Total	0.760744821	28	0.027169458		R-squared	0.7769
					Adj R-squared	0.7686
					Root MSE	0.07929

sii2005	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ruleoflaw2	0.206454	0.0212939	9.7	0.000	0.1627624	0.2501456
_cons	0.1638574	0.0259794	6.31	0.000	0.1105521	0.2171628

Table 12: SII and rule of law (1996)

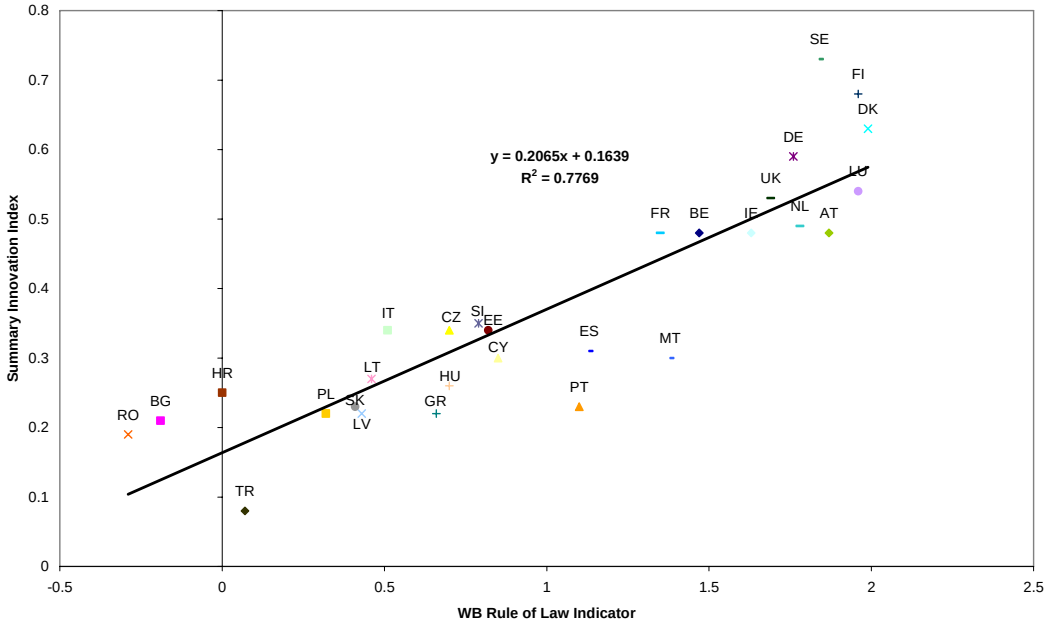
Source	SS	df	MS		Number of obs	29
Model	0.559817381	1	0.559817381		F(1, 27)	75.23
Residual	0.200927441	27	0.007441757		Prob > F	0.0000
Total	0.760744821	28	0.027169458		R-squared	0.7359
					Adj R-squared	0.7261
					Root MSE	0.08627

sii2005	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ruleoflaw1	0.1651984	0.0190467	8.67	0.000	0.1261177	0.2042790
_cons	0.2208779	0.0236159	9.35	0.000	0.172422	0.2693338

According to the results from our regression analysis, indeed the R^2 value for association between summary innovation index and the rule of law indicator at time 1 is 0.73 and that of time 2 is 0.77,

which means a high correlation with 0.01 level of significance. Figure 5 demonstrates the position of countries as to this association, where we can once again observe the four clusters of the social models of the EU.

Figure 5: SII and World Bank Rule of Law Indicator (2005)



Governance Indicator#6, Control of Corruption

In broad terms, political corruption is the misuse by government officials of their governmental powers for illegitimate private gain[10]. The control of corruption index is a set of indicators from polls and surveys that indicates to the level of measures taken against corruption in a country. The role of corruption in undermining economic development by generating considerable distortions and inefficiency has been a principle research focus especially for the last decades[11]. In line with this argument, we also expect to observe a strong association between innovation and control of corruption.

[10] www.wikipedia.org

[11] See for instance Kimberly Ann Elliott, ed, *Corruption and the Global Economy* (1997) or Johann Graf Lambsdorff (2007), The Institutional Economics of Corruption and Reform: Theory, Evidence and Policy Cambridge University Press

Table 13: SII and control of corruption (2005)

Source	SS	df	MS		Number of obs	29
Model	0.631130763	1	0.631130763		F(1, 27)	131.47
Residual	0.129614058	27	0.004800521		Prob > F	0.0000
Total	0.760744821	28	0.027169458		R-squared	0.8296
					Adj R-squared	0.8233
					Root MSE	0.06929

sii2005	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
controlofc~2	0.189243	0.0165046	11.47	0.000	0.1553784	0.2231076
_cons	0.1765895	0.0213105	8.29	0.000	0.1328639	0.2203151

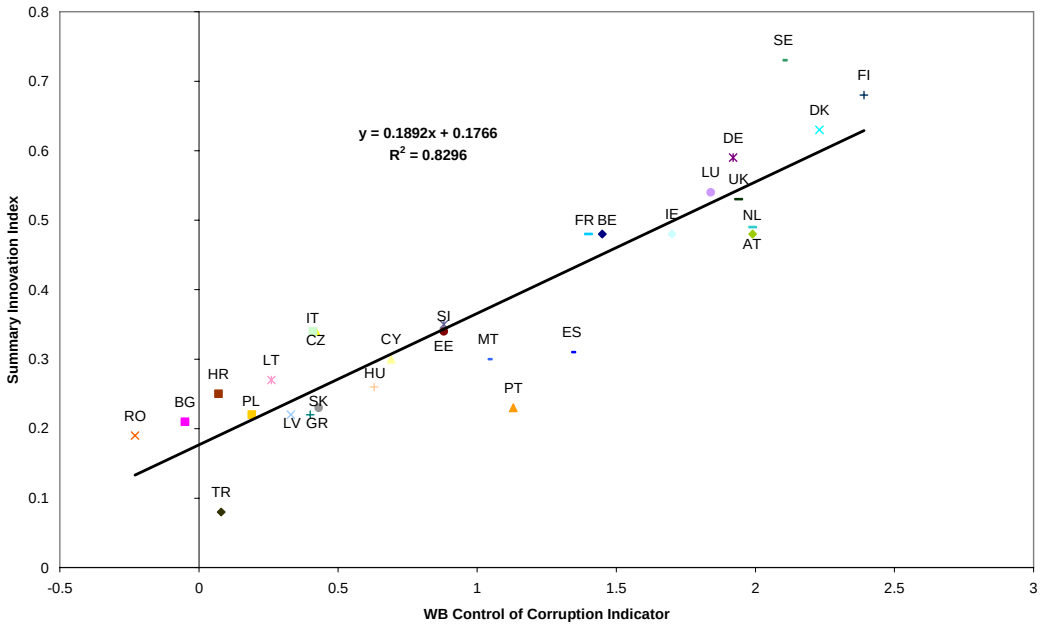
Table 14: SII and control of corruption (1996)

Source	SS	df	MS		Number of obs	29
Model	0.546555231	1	0.546555231		F(1, 27)	68.90
Residual	0.21418959	27	0.007932948		Prob > F	0.0000
Total	0.760744821	28	0.027169458		R-squared	0.7184
					Adj R-squared	0.7080
					Root MSE	0.08907

sii2005	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
controlofc~1	0.141757	0.0170783	8.3	0.000	0.1067152	0.1767987
_cons	0.2302578	0.0237194	9.71	0.000	0.1815896	0.2789260

The results of our OLS regressions between summary innovation index and control of corruption index of 1996 and 2005 are observed in tables above. Indeed control of corruption shows the strongest association with the SII among all the other WB governance indicators. The R^2 value is 0.82 with a significance of 0.01. The positioning of the countries on the scatter plot is along the line of the four clusters we have identified with the other governance indicators as well.

Figure 6: SII and Control of Corruption (2005)



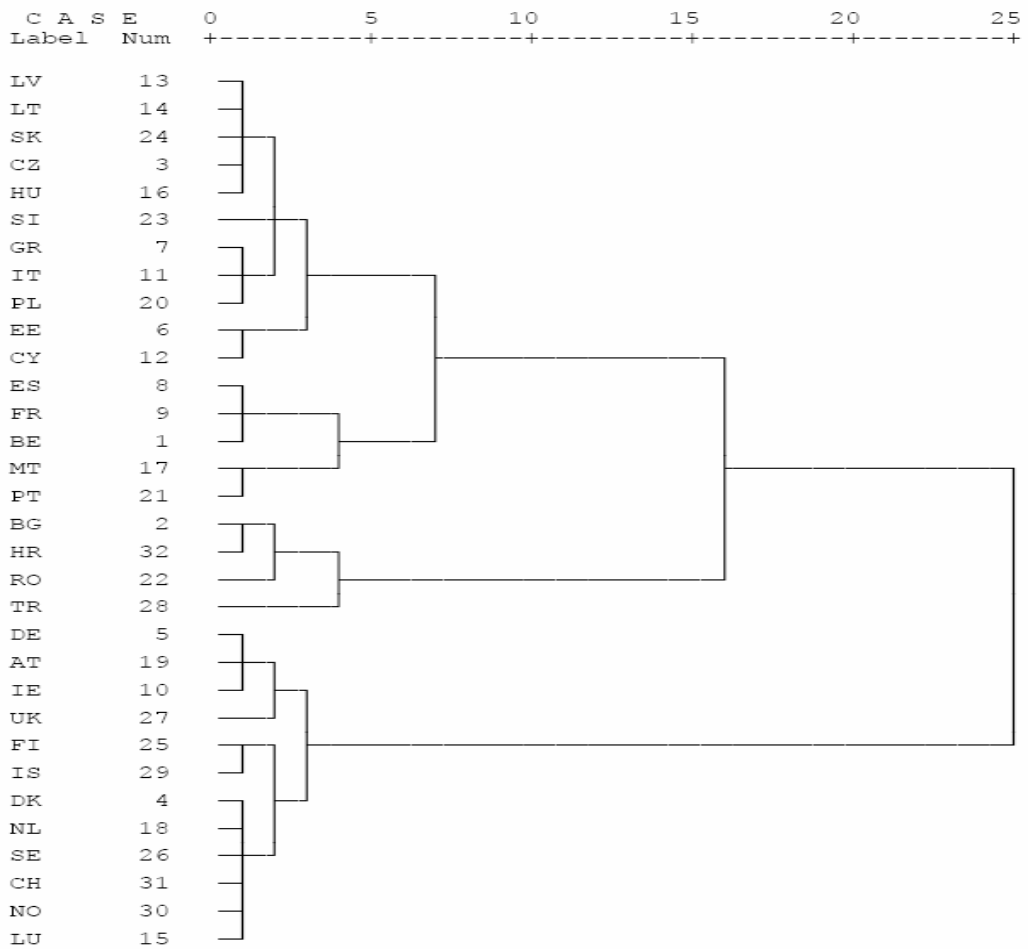
3.2 World Bank Governance Indicators and their relationship with Global Innovation Index (GIS)

To see the place of the EU member states within the world, we use GIS to study the same association. As mentioned before, for the EU-27, we use the aggregate value we have calculated based on GDP weights. As to the limited space, we will not study the results indicator by indicator but just demonstrate them graphically in the appendix part (See tables 15-26 and Figures 7-12 in the appendix). On the global level, the pictures look very noisy but still we can see that the model explains quite a lot of the variance, and the error estimate for EU-27 is smaller than for instance the USA or Japan.

3.3 Results of cluster analysis between SII and World Bank Governance Indicators

As mentioned frequently in the previous section, four clusters of the European Social Models are observed in the scatter plots gathered via the OLS regression analysis between the SII and each of World Bank governance indicators. In all cases, Scandinavian countries are at the top, followed by Continental European countries. Then the Southern member states and new member states follow and finally the candidate countries are placed. There seem to be few exceptions to this classification, like Italy and France performing "worse" than expected while Malta performing "better". To test this assumption statistically, we have run a hierarchical cluster analysis using SII and the 6 World Bank Governance indicators. The result of the analysis is presented in figure 14. Accordingly, Scandinavian and Continental member states with the exception of France and Belgium form a cluster, as well as the candidate countries and the newest members, Bulgaria and Romania. We can also see a grouping among new EU-10 members and Italy.

Figure 14: Cluster Analysis of SII and 6 World Bank Governance Indicators (2005)



3.4 Summary and suggestions for future work

The immediate conclusion from the summary results presented all together in figure 15 would be that there is a moderate to high correlation between governance and innovation performance.

Figure 15: Regression results explaining the link between governance and SII

	Adjusted R^2	Constant		Independent variable		Significance level
		Coefficient	T value	Coefficient	T value	
(INNOVATION) GOVERNANCE						
Voice and accountability '05	0.5962	-0.020023	-0.32	0.3640365	6.51	***
Political stability	0.5167	0.228743	3.84	0.2200699	5.56	***
Government effectiveness	0.8064	0.2307622	2.94	0.2495547	10.85	***
Regulatory quality	0.5880	0.0219764	0.38	0.3023779	6.4	***
Rule of law	0.7686	0.2208779	9.7	0.206454	9.7	***
Control of corruption	0.8233	0.2302578	9.71	0.141757	11.47	***

However, if we consider the positioning of different countries in the scatter plots we have presented before and those in the appendix, we could see that to a great extent these results can be explained by country-specific factors where the GDP can be thought as one of the strongest latent variables. In other words, the correlations might be driven in many ways by the high scores of, for instance, Sweden, Finland, Singapore and the low scores of Romania, Turkey or Latin American countries. Using GDP/capita[12] as a control variable, the good governance might be still observed as a driver of innovation performance but not as important as we found previously, as presented in figure 16 below. While the association is retained in government effectiveness, rule of law and control of corruption; the significance remarkably decreases for the other three governance indicators. This suggests that further studies aiming to identify the reasons behind the variations in innovation performances of countries should focus on a wider perspective of determinants including the socio-economic setting of the sample countries.

[12] GDP/capita (current prices) values are taken from World Economic Outlook September 2007 database.

Figure 16: Regression results explaining the link between governance and SII, controlled for GDP/capita

Control variable: GDP/capita	Adjusted R^2	Constant		Independent variable		Significance level
		Coefficient	T value	Coefficient	T value	
(INNOVATION) GOVERNANCE						
Voice and accountability '05	0.685	-0.845787	-2.95	0.1629816	1.93	*
Political stability	0.6851	-1.0439	-4.57	0.0872194	1.93	*
Government effectiveness	0.8019	-0.096727	-0.33	0.223084	4.61	***
Regulatory quality	0.6889	-0.841702	-3.00	0.1360309	2.02	*
Rule of law	0.7621	-0.028904	-0.08	0.1831109	3.65	***
Control of corruption	0.8193	-0.005797	-0.02	0.1706873	5.08	***

4- Conclusions

Throughout the paper, we have first defined and came up with some indicators that measure innovation and governance. After that, we have tested the association between the summary innovation index and each of the World Bank governance indicators, for the years 2005 and 1996, one by one.

As a first conclusion, the direction of association in each pair of indicators is positive. If we categorize the associations from 0 to .3 (inclusive) as weak, .4 to .6 as medium and 0.7 and 1 as strong; the associations between SII and control of corruption, SII and rule of law and SII and government effectiveness are strong. For the voice and accountability, political stability and regulatory quality indicators the association is moderate. In other words, we can make a hypothesis that the presence of an institutional culture in a country helps the country overall and its enterprises on the micro level to innovate more, although an analysis based on micro data would add much more to this main conclusion.

Secondly, the R^2 values of the association of SII with governance indicators of 2005 or those of 1996 are not dramatically different from each other, but show heterogeneous results for different governance indicators. The magnitude of the relation is always positive, while for some indicators like voice and accountability and political stability the association gets stronger if studied with the value of the governance indicator from 1996 and innovation performance indicator from 2005.For the rest, it either stays the same or gets stronger, once the governance indicator from 2005 is used. A rough explanation for this might be related to the different nature and address of different indicators and their possible effects on innovation policy area. However, with the current data availability, we regret to say that it is not possible to elaborate more on this. Another explanation for heterogeneous results might be that better governance is usually achieved over a long time span and the diffusion of its effects to other policy areas requires even longer time. The existing data on governance indicators do not go beyond the 1996. For this simple reason, we do expect to see more sound results concerning the effects of good governance on different policy areas in the coming decades. Moreover, the quality of an institutional environment is not characterized only by

its relevance at a given moment but also by its capacity to implement reforms. We also need indicators to measure the aptitude of an institutional setting towards reforms, in order to study the association in a more appropriate way (Aghion, 2006).

Another major conclusion is the clustering of the countries in line with the association that we have identified. On the EU level, the emergence of four clusters, Scandinavians on top, followed by simultaneously continental European countries, Mediterranean Ring, New Member States and the Candidate Countries, confirms similar models presented in the literature (see for example Esping-Andersen 1990 and 1996, Ferrera, 1996, 1997 and 1999, Sapir, 2005 etc.) and goes in line with the hypothesis that the more the economy is based on impersonal transactions, the more important the institutional structure becomes for the innovation performance. The new member states and Southern EU member countries are in catching up process and/or are more small, self-contained and rural communities compared to the Nordic and rest of Continental EU member states, where exchanges take place at the personal (non-institutional/informal) level. In such countries, the division of labour and level of innovation is limited to a great extent by the small market size, unlike the rest of the old EU member states, that are large, complex and open and exchanges are carried on a more impersonal basis (which means at a more global level), so factors like policy governance might be expected to have a more direct impact. In other words, in the Nordic and Continental models, the situation gets more efficient if society manages to create well-functioning institutions on each policy account, including innovation (Berthelier et al., 2003). The analysis done at the global level, using the GIS, also presents similar clustering for similar economies (Latin Americans or Asian Tigers) still, to a great extent these results can be explained by country-specific factors where the GDP is one of the strongest latent variables. The correlations are driven in many ways by the high scores of, for instance, Sweden, Finland, Singapore and the low scores of Romania, Turkey or Latin American countries. This not only provides a basis for further studies aiming at identifying underlying reasons behind variations in innovation performance of various countries. It also highlights to policy makers that wish to boost innovation performance in their country that good innovation performance is deemed to be achieved in a more stimulating socio-economic environment.

As a last say, as mentioned previously, to elaborate more on the association of innovation with governance, we need to have micro-data for both sets of indicators. There are attempts to collect micro data for innovation performance however; this can not be applied to the existing macro-level governance indicators. One suggestion might be to incorporate some “governance-related” questions to the forthcoming innovation surveys done at the EU-level, to enable researchers to come up with sound comparable results on the enterprise governance at the micro level and its link to innovation.

APPENDIX

Table 15: GSII and Voice and Accountability (2005)

Source	SS	df	MS		Number of obs	49
Model	0.237258233	1	0.237258233		F(1, 27)	8.25
Residual	1.35190906	47	0.028764022		Prob > F	0.0061
Total	1.58916729	48	0.033107652		R-squared	0.1493
					Adj R-squared	0.1312
					Root MSE	0.1696

gsii2005	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
voiceandac~2	0.1125178	0.0391774	2.87	0.006	0.0337031	0.1913325
_cons	0.3183999	0.0426433	7.47	0.000	0.2326126	0.4041871

Table 16: GSII and Voice and Accountability (1996)

Source	SS	df	MS		Number of obs	49
Model	0.596527234	1	0.596527234		F(1, 27)	28.24
Residual	0.992640056	47	0.021120001		Prob > F	0.0000
Total	1.58916729	48	0.033107652		R-squared	0.3754
					Adj R-squared	0.3621
					Root MSE	0.14533

gsii2005	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
voiceandac~1	0.1568687	0.0295167	5.31	0.000	0.0974887	0.2162487
_cons	0.2795065	0.0334927	8.35	0.000	0.2121279	0.3468851

Table 17: GSII and political stability/no violence(2005)

Source	SS	df	MS		Number of obs	49
Model	0.271902705	1	0.271902705		F(1, 27)	9.70
Residual	1.31726459	47	0.028026906		Prob > F	0.0031
Total	1.58916729	48	0.033107652		R-squared	0.1711
					Adj R-squared	0.1535
					Root MSE	0.16741

gsii2005	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
politicals~2	0.1164817	0.0373971	3.11	0.003	0.0412483	0.1917150
_cons	0.3568779	0.0311789	11.45	0.000	0.294154	0.4196017

Table 18: GSII and political stability/no violence(1996)

Source	SS	df	MS		Number of obs	49
Model	0.456771454	1	0.456771454		F(1, 27)	18.96
Residual	1.13239584	47	0.024093528		Prob > F	0.0001
Total	1.58916729	48	0.033107652		R-squared	0.2874
					Adj R-squared	0.2723
					Root MSE	0.15522

gsii2005	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
politicals~1	0.1365893	0.0313702	4.35	0.000	0.0734806	0.1996981
_cons	0.3532027	0.0268578	13.15	0.000	0.2991718	0.4072335

Table 19: GSII and government effectiveness (2005)

Source	SS	df	MS		Number of obs	49
Model	0.926382368	1	0.926382368		F(1, 27)	65.69
Residual	0.662784922	47	0.014101807		Prob > F	0.0000
Total	1.58916729	48	0.033107652		R-squared	0.5829
					Adj R-squared	0.5741
					Root MSE	0.11875

gsii2005	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
government~2	0.1873061	0.0231097	8.11	0.000	0.1408154	0.2337968
_cons	0.2102418	0.0308602	6.81	0.000	0.148159	0.2723246

Table 20: GSII and government effectiveness (1996)

Source	SS	df	MS		Number of obs	49
Model	0.970546537	1	0.970546537		F(1, 27)	73.74
Residual	0.618620753	47	0.013162144		Prob > F	0.0000
Total	1.58916729	48	0.033107652		R-squared	0.6107
					Adj R-squared	0.6024
					Root MSE	0.11473

gsii2005	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
politicals~1	0.1368797	0.0159402	8.59	0.000	0.1048121	0.1689472
_cons	0.2730297	0.0236285	11.56	0.000	0.2254954	0.3205640

Table 21: GSII and regulatory quality (2005)

Source	SS	df	MS		Number of obs	49
Model	0.624326133	1	0.624326133		F(1, 27)	30.41
Residual	0.964841157	47	0.020528535		Prob > F	0.0000
Total	1.58916729	48	0.033107652		R-squared	0.3929
					Adj R-squared	0.3799
					Root MSE	0.14328

gsii2005	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
regulatory~2	0.1831434	0.0332097	5.51	0.000	0.1163342	0.2499526
_cons	0.2262103	0.0405389	5.58	0.000	0.1446566	0.3077640

Table 22: GSII and regulatory quality (1996)

Source	SS	df	MS		Number of obs	49
Model	0.648353585	1	0.648353585		F(1, 27)	32.39
Residual	0.940813705	47	0.020017313		Prob > F	0.0000
Total	1.58916729	48	0.033107652		R-squared	0.4080
					Adj R-squared	0.3954
					Root MSE	0.14148

gsii2005	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
regulatory~1	0.190539	0.0334796	5.69	0.000	0.1231866	0.2578913
_cons	0.2651582	0.0337782	7.85	0.000	0.1972052	0.3331112

Table 23: GSII and rule of law (2005)

Source	SS	df	MS		Number of obs	49
Model	0.929871799	1	0.929871799		F(1, 27)	66.29
Residual	0.65929549	47	0.014027564		Prob > F	0.0000
Total	1.58916729	48	0.033107652		R-squared	0.5851
					Adj R-squared	0.5763
					Root MSE	0.11844

gsii2005	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ruleoflaw2	0.1640672	0.0201512	8.14	0.000	0.1235282	0.2046063
_cons	0.2603398	0.0258245	10.08	0.000	0.2083876	0.3122920

Table 24: GSII and rule of law (1996)

Source	SS	df	MS		Number of obs	49
Model	1.01538218	1	1.015382180		F(1, 27)	83.17
Residual	0.573785106	47	0.012208194		Prob > F	0.0000
Total	1.58916729	48	0.033107652		R-squared	0.6389
					Adj R-squared	0.6313
					Root MSE	0.11049

gsii2005	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ruleoflaw1	0.1590078	0.0174353	9.12	0.000	0.1239325	0.1940831
_cons	0.2659845	0.0230506	11.54	0.000	0.2196126	0.3123564

Table 25: GSII and control of corruption (2005)

Source	SS	df	MS		Number of obs	49
Model	0.964240934	1	0.964240934		F(1, 27)	72.52
Residual	0.624926356	47	0.013296305		Prob > F	0.0000
Total	1.58916729	48	0.033107652		R-squared	0.6068
					Adj R-squared	0.5984
					Root MSE	0.11531

gsii2005	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
controlofc~2	0.1516755	0.0178110	8.52	0.000	0.1158444	0.1875066
_cons	0.2653723	0.0244455	10.86	0.000	0.2161944	0.3145503

Table 26: GSII and control of corruption (1996)

Source	SS	df	MS		Number of obs	49
Model	0.961899298	1	0.961899298		F(1, 27)	72.07
Residual	0.627267992	47	0.013346127		Prob > F	0.0000
Total	1.58916729	48	0.033107652		R-squared	0.6053
					Adj R-squared	0.5969
					Root MSE	0.11553

gsii2005	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
controlofc~1	0.1385096	0.0163152	8.49	0.000	0.1056876	0.1713316
_cons	0.2718829	0.0239461	11.35	0.000	0.2237095	0.3200564

Figure 7: GSII and Voice and Accountability (2005)

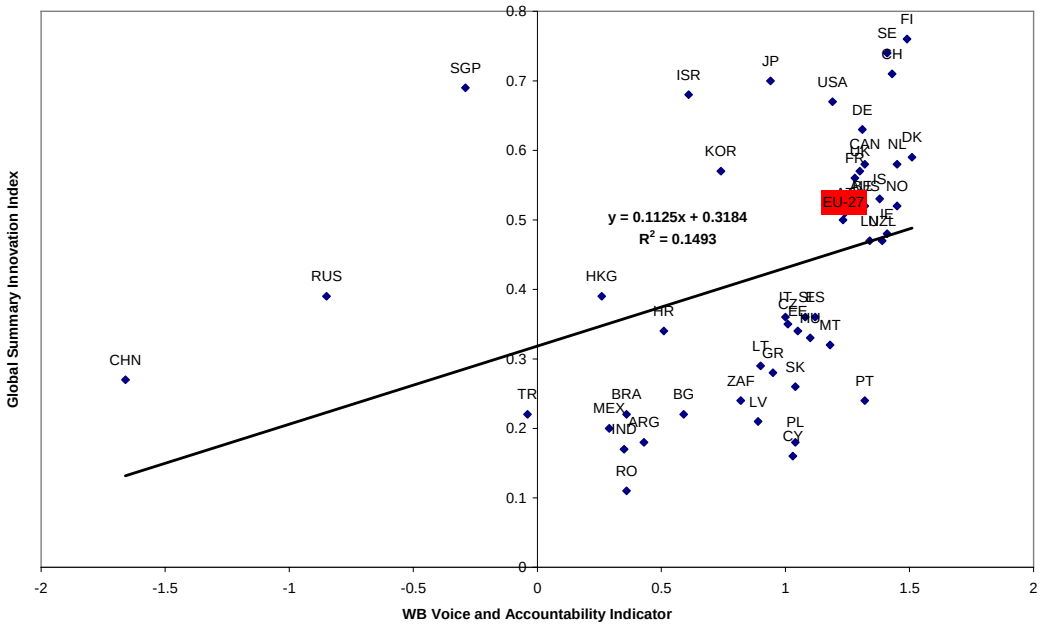


Figure 8: GSII and Political Stability/No Violence (2005)

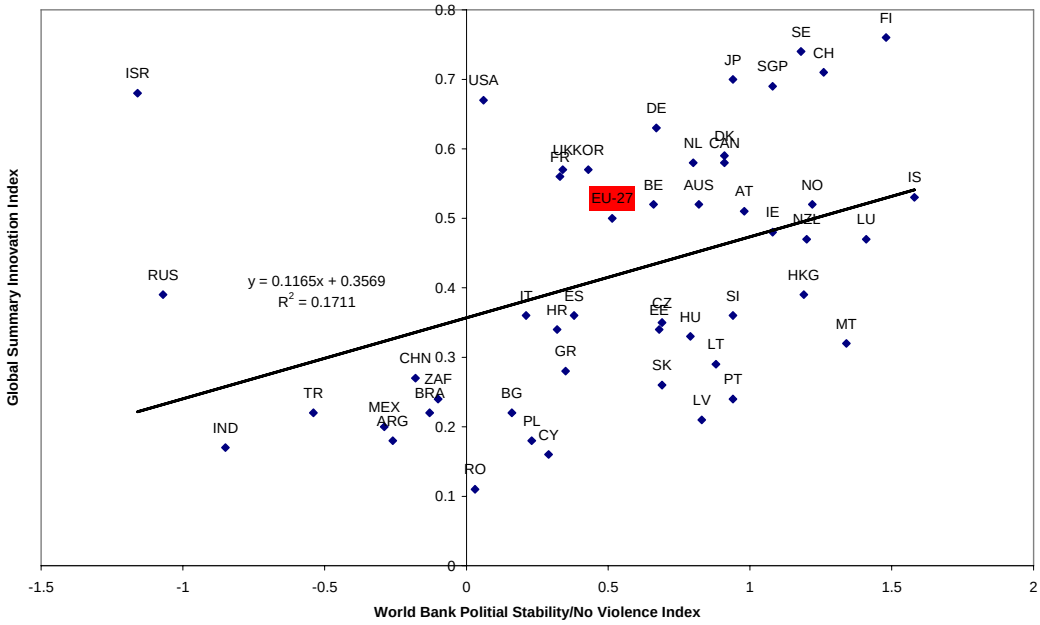


Figure 9: GSII and Governance Effectiveness (2005)

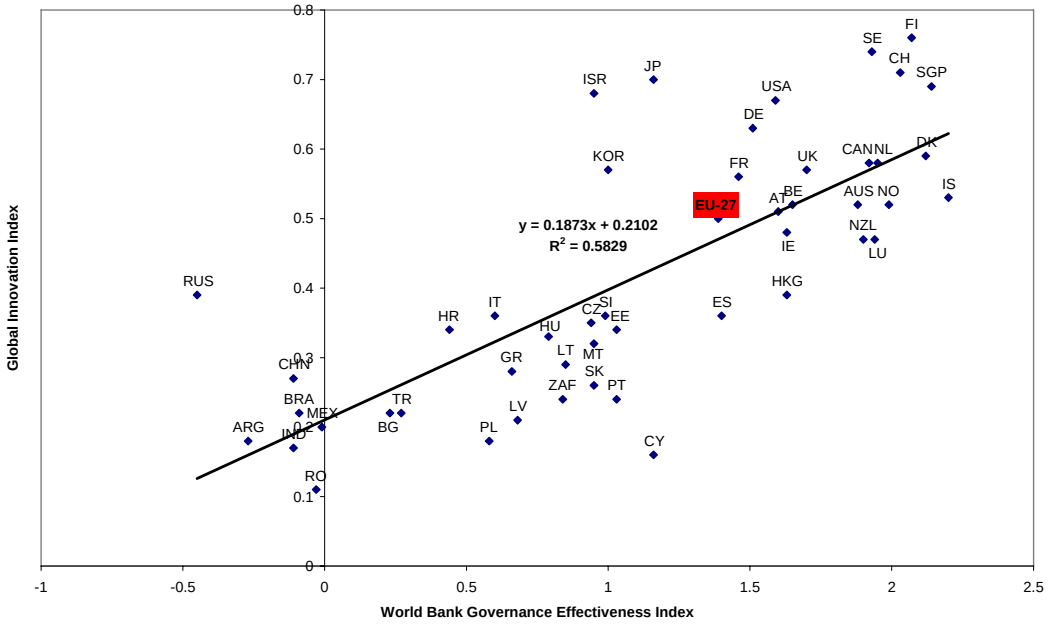


Figure 10: GSII and Regulatory Quality (2005)

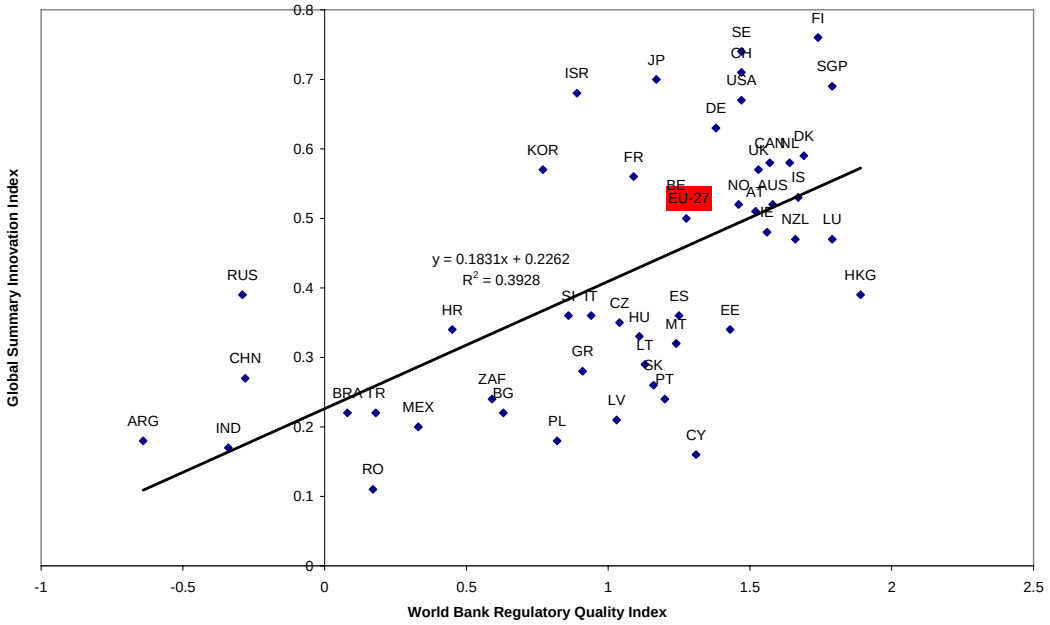


Figure 11: GSII and Rule of Law (2005)

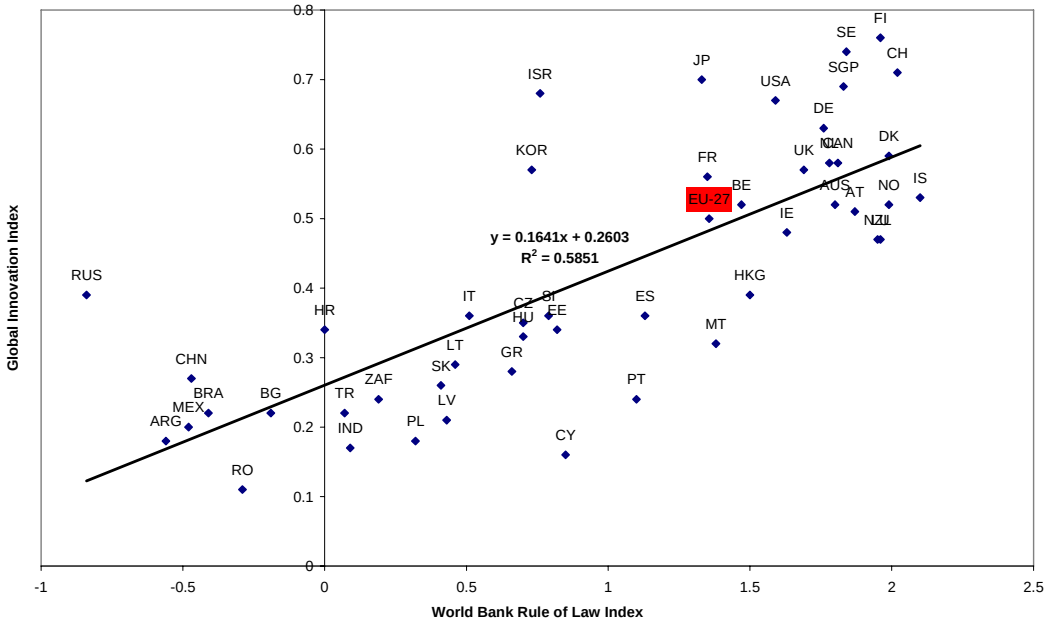


Figure 12: GSII and Control of Corruption (2005)

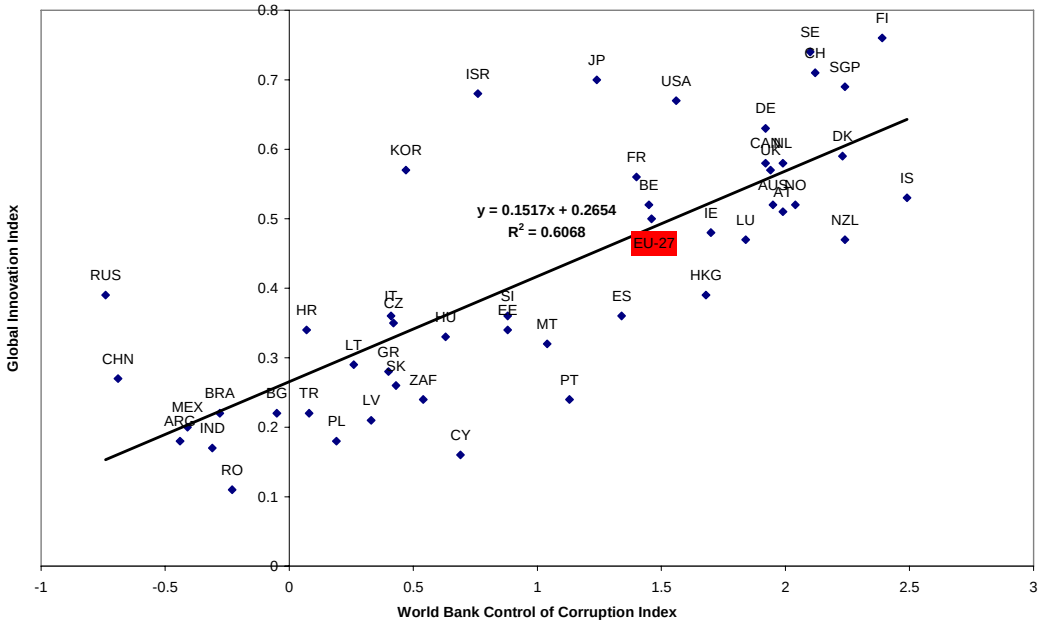


Figure 13: Regression results explaining the link between governance and GSII

	Adjusted R^2	Constant		Independent variable		Significance level
		Coefficient	T value	Coefficient	T value	
(INNOVATION) GOVERNANCE						
Voice and accountability '05	0.1312	0.3183999	7.47	0.1125178	2.87	***
Political stability	0.2723	0.3568779	3.11	0.1365893	4.35	***
Government effectiveness	0.5741	0.3532027	6.81	0.1873061	8.11	***
Regulatory quality	0.3799	0.2262103	5.58	0.1831434	5.51	***
Rule of law	0.5763	0.2659845	8.14	0.1640672	8.14	***
Control of corruption	0.5984	0.2718829	11.35	0.1385096	8.52	***
Control variable: GDP/capita	Adjusted R^2	Constant		Independent variable		Significance level
		Coefficient	T value	Coefficient	T value	
(INNOVATION) GOVERNANCE						
Voice and accountability '05	0.5613	-1.108096	-5.24	-0.698375	0.078	*
Political stability	0.5405	-1.018515	-4.64	-0.0381045	-1.03	
Government effectiveness	0.5882	-0.2709449	-0.93	0.1190126	2.53	**
Regulatory quality	0.5297	-0.8914872	-3.15	-0.0024563	-0.04	
Rule of law	0.5896	-0.2333098	-0.77	0.1051365	0.014	**
Control of corruption	0.6069	-0.1638439	-0.56	0.1058113	2.97	***

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Abstract

This paper aims to explore in a descriptive way the relationship between country level indicators on governance and innovation. It explores in detail the association between innovation and governance by looking at the relationship between six governance indicators from the World Bank and the innovation performance measures used in European Innovation Scoreboard and the Global Innovation Scoreboard (Hollanders and Arundel, 2006). The basic methodology used in exploring this link is an ordinary least squares (OLS) linear regression model. The analysis has been realized for single countries as well as the EU aggregate average.

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