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How do social capital and government support affect innovation and growth? Evidence from the EU regional support programmes*

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Abstract

This research investigates the role of social capital and government intervention in explaining the differences of innovation output and economic growth for regions of the European Union from 1990-2002. Using several measures of social capital and innovation, and the European Union's Objective 1, 2 and 5b figures for EU regional support, the estimates suggest that EU funding is not significantly contributing to economic outcomes, while social capital is. Investigation of a possible complementary relationship between social capital and government support reveals that regions with higher levels of social capital are more likely to effectively gain from EU regional support programmes. This result implies that aside from the benefits associated with the direct effect of social capital on economic outcomes, social capital appears to be a critical prerequisite for the effective implementation of government programmes. From a policy perspective, it appears to be important to stimulate education to foster human capital formation. When combined, human capital and social capital are likely to yield stronger effects for effective policies which increase economic outcomes.

JEL classification: O1; O3; O52; Z13
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1. Introduction

Do social capital and government support programmes, such as the European Union's Objective 1, 2 and 5b regional support programmes, have a positive impact on regional economic outcomes? The empirical results presented in this study suggest that European Union (EU) funding does not provide a significant contribution to the welfare of EU regions unless it is integrated with social capital. Why is this? Our research indicates that there is a positive interrelationship between levels of education, measures of social capital, and effectiveness of government support programmes. As such, for any given level of economic development, regions with on average higher levels of education and greater social capital are more likely to be characterised by stronger networks where communication, bonds, norms and values, and ultimately production, are more effectively integrated and conducted. This improved structure facilitates a simpler and more effective implementation of policy which fosters economic development and boosts innovation.

More specifically, our estimates and measures suggest that several forms of social capital contribute positively to economic growth and innovation. Our results indicate that EU funding has no direct effect on economic outcomes, further supporting previous studies which emphasized the failure of EU funding to foster development in relatively backward regions. The main contribution of the empirical analysis is that a complementary relationship between government spending and social capital exists and as such contributes to economic development. Estimates suggest that the interaction between social capital and EU funding contributes positively and significantly to economic growth and innovation, which in turn implies that given a current level of development, regions with relatively higher levels of social capital benefit more from EU support programmes. One major problem that comes to the surface when studying the causal link between economic outcome and social capital is related to the difficulties experienced when trying to infer causation from correlations in the data. For example, a correlation between social capital and funding might arise if the funding promoted social capital, if groups with more social capital were able to attract more funding, or if an outside factor influenced both funding and social capital. An instrumental variable approach was used to estimate the causal effects of social capital on both economic growth and innovation, the results of which support strong and robust estimates.

From a theoretical point of view, the results described in this chapter support the concept that institutions are important for both growth and innovation and that this remains true when explaining differentials between relatively homogeneous regions of the EU-12 countries. While these regions

appear to have the same institutional rules and laws and as such, would be expected to perform similarly *ceteris paribus*, the research indicates that informal institutions such as trust are able to make institutions work more effectively in some regions than others. For example, social capital is able to reduce information frictions in investment decisions, which makes the financing of risky projects more transparent. Italy is a case in point, where differences associated with the social structure vary from one region to another and as such, perform very differently in terms of economic growth and innovation.

Our estimates are interesting when referring to policy analysis. The correlation between social capital and education suggest that increasing investments in human capital not only exerts a direct impact on economic growth and innovation inputs, but also an indirect effect which increases levels of trust within societies. It is also important to note that EU programmes have been highly criticised for their inability to boost economic growth in relatively backward regions. These estimates suggest that the programmes administered as such are indeed not causal to economic growth, but when integrated with social capital and education, act as a highly effective means to boost performance. A strategy for future funding of relatively backward EU regions might be one that integrates education into the funding programme to increase program effectiveness. Finally, it was noted that innovation output is higher in regions where more social capital exists. In these cases, EU funding helps stimulate innovative activities when combined with social capital and education. There appear to be two ways in which innovation can be established: one way is to increase the level of education, which is likely to yield multiple effects on economic outcomes; the other way is to design and establish economic institutions with sound reputations to stimulate innovation. For example, provision for venture capital, tax credits for innovation and other benefit types for investors who work in relatively uncertain projects, might be promoted and protected by formal institutions. The advantages associated with these types of institutions are manifold stimulating education, innovation, the creation of social capital, and ultimately stimulating economic performance and prosperity.

The following provides a basic outline of the chapter. In Section 2 the theoretical background of the study is presented along with a discussion on the previous studies of social capital and economic development that were focused on EU funding programme effectiveness. In Section 3 several data sets are applied and discussed. Insight into the most salient details is provided by using a number of descriptive statistics. Section 4 presents and discusses the main findings associated with the estimation of several models. Finally, in Section 5, policy implications associated with the estimates are discussed. In addition, Italy is used as a case study to illustrate the way in which social

capital, education, and government support, develop and act as a reinforcing mechanism that increases economic development and innovation.

2. The role of social capital in implementing policies

2.1 Theoretical background

Two important conditions must exist for social capital to influence economic outcomes: the first condition states that the decentralised equilibrium is not first best, and the second condition states that only a number of cases exist where social capital is able to achieve better outcomes. The first condition implies that a role exists for government institutions to establish property rights, courts and law, and to promote altruistic behaviour, stronger social bonds, and trust so that opportunism is reduced and market transparency is increased. The second condition indicates that social capital is not a term or concept that can be used to explain all of the differences experienced between economic performances of different groups.[1] In this paper, social capital is defined and analysed at the regional level with an understanding that it originates at an individual level due to the different forms of social interaction between people.

The role of social capital to implement government policy can be both positive and negative. Social capital is positively correlated with levels of education (e.g., Goldin and Katz, 1999) as it supports access to publicly provided education and to credit for the poor. This positive correlation is important because higher levels of education generally induce denser networks where social capital forms. In this situation, social capital generates positive externalities which are in turn generated by social interactions. These externalities increase knowledge associated with the behaviour of people, which in turn reduces the potential for opportunistic behaviour to take hold. In addition, and most importantly, these externalities are able to withstand the free-rider problem that occurs when information is limited resulting in coordination problems and failures. The free-rider problem can be reduced by providing public goods and other government initiatives that foster development and reduce friction; by creating banking and insurance institutions; and by creating mechanisms to penalize disobedient "group members". In general, regions with on average higher levels of education do better in terms of economic performance and as such receive less government support. This is certainly true in the case of EU structural funds. That said, it is important to note that given a

[1] Durlauf and Fafchamps (2004) review the literature and argue that social capital may help to resolve coordination problems, alter individual incentives or it may affect the technology of social interactions between economic agents.

certain level of development, regions with higher levels of social capital are more likely to effectively implement support programmes because they are able to internalise the externalities generated by social interactions and networks. This implies that a positive correlation between the average level of education, the measure of social capital, and the government support programme will exist, which is the predicted outcome of the empirical analysis. This analysis also predicts that regions with higher levels of education will be more likely to devote resources to innovative activities. So, the determinants of innovation are likely to be positively correlated to the interaction between social capital, education, and government support.

Research also indicates that social capital has the potential to worsen economic outcomes if policy interventions undermine social capital instead of change incentive structures (e.g., Tirole, 1996). This is further exemplified in cases where external organizations, such as the Italian Mafia, become sources of civil social capital. In these cases, competition within and between groups destroys other forms of social capital, primarily due to the violence used to maintain the (information) monopoly (e.g., Gambetta, 1996). The presence of kin groups might also be detrimental to economic outcomes. Traditionally these groups have been a valuable resource for enforcing bonds but in modern market economies these "dynasties" may be considered an economic threat as they might foster corruption (Collier and Garg, 1999). In most European regions these forms of detrimental social capital will not occur at a large enough scale and as such, are unlikely to influence the implementation and effectiveness of EU programmes. Reference to the Italian case is discussed in more detail in Section 5.2.

2.2 Previous empirical research on social capital and economic outcomes

Coleman (1990) and Putnam (1993) initiated empirical research on social capital. Coleman presented the basic theory of how social capital and social interactions influence behaviour.[2] Putnam presented an analysis which emphasized the importance of noting the differences in social capital when explaining the differences of economic outcomes between the northern and southern regions of Italy. One of the first and most influential empirical studies in this area was conducted by Knack and Keefer (1997). Knack and Keefer estimated how the contribution of measures of social capital explained the difference of economic performance between countries. The estimates derived for 29 countries suggest there is a positive relationship between different measures of social capital, levels

[2] Becker and Murphy (2000), Grootaert and van Bastelaer (2002) and Durlauf and Fafchamps (2004) provide overview studies of both the theoretical and empirical work in this area.

of education, and economic performance. They find that more trusting societies not only have a stronger incentive to innovate and accumulate physical capital, but also experience higher returns to human capital investments.[3]

Others have applied this study to European economies including Guiso et al. (2004), Tabellini (2005), Moesen et al. (2000), Beugelsdijk and van Schaik (2005a,b), and Akçomak and ter Weel (2006). Guiso et al. (2004) use data associated with blood donations and participation in local elections to measure social capital and demonstrate that a positive correlation between these measures and the financial development of a large number of Italian municipalities exists. Tabellini (2005) examines the effects culture and institutions have on economic development in EU regions. He finds that culture, defined as norms and values created in the past, has a strong impact on current institutions and on the current economic performance of EU regions. The next three papers investigate the extent to which differences in social capital contribute to differences in regional economic growth within regions of the EU. They find that regions with higher levels of "trust" positively correlate to the level of economic growth for the period 1960-2000. Akçomak and ter Weel (2006) stress the importance of studying social capital to better understand and explain differences in innovation and regional development. A recent study by Fritsch (2004) adds the importance of cooperation in R&D processes to make the uncertain process of pursuing innovation activities more transparent to investors and capital providers.

Bilbao-Osorio and Rodriquez-Pose (2004) take a more traditional approach to their study and analyse whether those policies that are designed with intent to foster R&D are paying off. Results from their analysis did not support a strong correlation between innovation performance and economic growth. In addition to these findings, Gambardella et al. (2002) observed that patents, employment density, and openness affected labour productivity in European regions. That said, it should be understood that these studies did not take into account socio-economic variation in terms of social capital, which affects capacity to perform R&D. Verspagen (1999) and Rodriguez-Pose (1999) investigate the degree to which regional clubs exist and cultivate innovation. Both authors find that clubs perform better overall, and that there are economic spillovers to less advanced regions. While clubs and social networks share many similarities, they differ in that networks form spontaneously as free associations of economic agents, whereas clubs are organised and have a

[3] Beugelsdijk et al. (2004) address the robustness of the results of Knack and Keefer (1997) and Zak and Knack (2001) and present some alternative explanations. Generally, the Zak and Knack's estimates survive the robustness analysis, but Knack and Keefer's estimates are only limitedly robust.

relatively defined membership structure. That said, clubs have the advantage of making group decisions, a possibility social networks of agents do not have.

2.3 EU regional support programmes

In 1962, the European Agricultural Guidance and Guarantee Fund (EAGGF) was created to promote the development of agricultural and rural structures. In 1975, the European Regional Development Fund (ERDF) was established to help alleviate regional disparities in the EU member states. In 1986, the European Social Fund (ESF) was developed to improve training, education, and employment. Finally, in 1994, the Financial Instrument for Fisheries Guidance (FIFG) was set up to generate productivity and employment growth in the fisheries industry. These four funds, are generally referred to as the "Structural Funds", and are the funds of interest for this paper.[4] It is important to note that the main objective of an EU support programme is to act to decrease regional disparities in terms of economic cohesion and development.

The effectiveness of EU policy to foster economic development has been addressed in a number of different studies resulting in evidence that is generally mixed. Cappelen et al. (2003) present estimates which suggest that regional support has had a positive impact on economic growth in the 1990s. Estimates for periods before 1990 appear to be less conclusive. Differing effects of regional policy on economic outcomes over a period of time are often attributed to the major reform of 1988 which was amplified during the enlargement of the EU by three relatively poor countries (i.e., Spain, Portugal and Greece).[5] The objective of the reform was to make the funds more effective in reducing income inequalities between regions and, as such, more financial resources were made available to do so. Beugelsdijk and Eijffinger (2005) present estimates of the effect structural funds had on regional economic performance for the period 1995-2001 and find that poorer countries have caught up with richer countries. These results contrast Boldrin and Canova's (2001) estimates which provide the basis for their argument that structural funds serve re-distributional purposes and as such have little relationship to fostering economic growth. These differences in interpretation are most likely related to the splitting of data sets into different regions, and the shortage of information for a

[4] Other EU funds are the Cohesion Fund created in the aftermath of the Maastricht Treaty in 1993 and the European Investment Fund (established in 1994). The aim of the Cohesion Fund is help relatively poor countries to preserve fiscal targets. The European Investment Fund aims at the long run financing of projects to the development of small and medium-sized firms.

[5] See e.g., Begg and Mayes (1993) for a detailed discussion of the reform and Begg (1997) for a discussion of the policy perspective of the structural funds after 1999. Nahuis and de Mooij (2001) argue that there is a new case for reform after the recent EU enlargement with former Communist Eastern European countries.

number of countries (e.g., Boldrin and Canova, 2001, pp. 241-42). In addition, Rodriguez-Pose and Fratesi (2004) found that the effects of structural funds on economic growth are positive but temporary, and they observed that investments in education and human capital appear to be the only factors that have lasting effects in terms of regional convergence. They conclude from their panel estimates that the focus on agriculture seems to be ineffective.

These studies have not linked the effectiveness of EU structural funds on economic development where differences in regional levels of social capital exist. The role of social capital is critical when considering effectiveness of policy implementation because regions with higher levels of trust in government programmes are more receptive to implementation of new policy. Cappelen et al. (2003) is the only paper to note that a relationship between accompanying factors, such as a receptive environment, is likely to exist and impact the effectiveness of regional policies. However, they remain silent about what exactly these factors are. The remainder of this study emphasises the importance of social capital when explaining the effectiveness of regional policy to foster innovation and economic growth.

3. Data description and strategy

3.1 Data and descriptive statistics

Regional and national data sets were available for the following twelve EU countries: Belgium, Denmark, Germany, Greece, Spain, France, Ireland, Italy, Luxembourg, the Netherlands, Portugal and the UK. (Note: Austria, Finland and Sweden were not taken into account due to insufficient data.) The EU is divided into 83 regions based on the nomenclature of territorial units for statistics (NUTS). Regional divisions for each country were defined by NUTS1 for Belgium, Denmark, France, Germany, Luxembourg, The Netherlands, and the UK, and by NUTS2 for Spain, Italy and Portugal. Ireland and Greece lacked sufficient regional information of structural funds for regional assessment and were measured at the national level.

3.1.1 Social capital

Measures of social capital are not derived without controversy. The fundamental premise behind the value-added contributions of social capital is that it provides a forum where traditional resources (e.g., physical capital, human capital) can integrate with other resources (e.g., social networks, trust, norms and values) to produce better outcomes for individuals (e.g., Coleman, 1988). Indeed, from the economist's point of view, the beneficial impacts arise only in cases where social

capital affects expectations.[6] With this in mind, the following two indicators are used: *(i)* generalised trust (*TRUST*) and *(ii)* an index of social capital (*SC*). The data used to construct the measures of social capital are taken from the European Social Surveys (ESS): a database designed to measure change and persistence of people's social and demographic characteristics, attitudes, and values. The number of observations listed for each region in the ESS varies and is not always representative for the size and demographic structure of the region; therefore weights are applied to reduce the possibility of over sampling.

Most studies that focus on the impacts of social capital on economic outcomes use generalised trust to measure the degree of opportunistic behaviour (Knack and Keefer, 1997; Zak and Knack, 2001). Knack and Keefer (1997, p.1258) argue that trust "reflects the percentage of people in a society who expect that most others will act cooperatively in prisoner's dilemma context". Similarly, *TRUST* is constructed as the answer to the following questionnaire statement: "Most people can be trusted or you can't be too careful". The response category has 11 levels ranging from (0) "you can't be too careful" to (10) "most people can be trusted". The mean (standard deviation) of this variable for the EU-12 countries as a whole, equals 4.945 (2.395), n=25,268.

The second indicator is an index of social capital that reflects different dimensions of social structure such as trust, solidarity, and organisational membership. There are two main reasons for constructing such an index. First, many indicators of social capital are highly correlated with each other, so analysing the effects of different dimensions at the same time (by placing more than two of the indicators in the same regression, for instance) generally does not produce sensible results because of collinearity problems. Second, these variables are not only hypothesised to have individual impact on economic outcomes but may also reinforce each other. Five indicators have been integrated into one measure so that the several possible dimensions of social capital can be captured. The subsequent social capital index (*SC*) is the average of the re-scaled values of the five indicators, specifically: $SC_j = \sum_{j=1}^{m} \frac{X_{ij} - \min(X_{ij})}{\max(X_{ij}) - \min(X_{ij})}$, where X_{ij} is the value of indicator i for region j and m is the number of indicators. The mean (standard deviation) of this social capital

[6] Granovetter (1985), for example, puts stress on the networks of (social) relations in establishing expectations and in generating trust so to create and enforce norms. In a similar vein, Durlauf and Fafchamps (2004) argue that social capital generates positive externalities, which are achieved through shared values, norms and trust that affect expectations and behaviour. Dasgupta (2003) discusses the importance of this latter argument in greater detail.

indicator equals 0.53 (0.10) for the whole sample. The correlation coefficient between *TRUST* and *SC* is 0.81 (n=83).

Table 1 provides information and descriptive statistics concerning different social capital indicators. The first row depicts the mean, standard deviation, minimum, and maximum value of *TRUST*. Of particular interest is the relatively large dispersion in generalised trust between the EU-12 regions, with Spain having the lowest level (i.e., 1.66) and Denmark having the highest (i.e., 7.05). The next row depicts the social capital index which includes the following five indicators: *TRUST*, *PPLHLP*, *PPLFAIR*, *IMPVO* and *VOLUN*. These indicators incorporate the many aspects of social capital referred to in the literature. *PPLHLP* is an indicator which measures the extent to which people are helpful or altruistic vs. unhelpful or egoistic. *PPLFAIR* measures a similar aspect with a slightly different focus on people being fair. This latter variable is on average higher, which could imply that on average people care relatively more for their own well-being and do not take advantage of others to a similar extent. Finally, *IMPVO* and *VOLUN* measure the attitude toward voluntary organisations and participation in voluntary organisations. Coupled with *TRUST,* these indicators are aggregated into the variable *SC*, which is applied to the empirical analysis as a measure of social capital.

3.1.2 Structural funds

EU structural funds are designed to target six objectives, four of which have a clear regional focus.[7] The regional objectives are: economic adaptation of less developed regions (Objective 1); economic recovery of regions affected by the industrial crisis (Objective 2); speeding up adjustment of agricultural structures (Objective 5); and regions corresponding to or belonging to regions at NUTS2 level with a population density of eight inhabitants per squared kilometre or less (Objective 6). Objectives 1, 2 and 5b are taken into account when conducting the empirical analysis. Objective 6 is left out because its coverage is limited to regions in the northern parts of Finland and Sweden where funding is less than 1 percent of the total money available making empirical analysis for all of the EU regions impossible. Objective 5a is also left out because it covers common agricultural policies which are not aimed specifically at the regional level. Objective 5b remains, as it is aimed specifically at rural and agricultural regions where low levels of socio-economic development, high shares of agricultural employment, and relatively low population density and/or a depopulation

[7] The other two objectives involve reducing long-term unemployment (funding covers about 10 percent of the total available money) and facilitating the adaptation of workers to industrial changes and to changes in production systems and technologies (about 2 percent of total funding).

trends exist. As of March 1999 over 85 percent of the overall budget is available for Objectives 1, 2 and 5b.[8]

Regional information is available for the period 1994-1999. The indicator used for the empirical analysis is the summation of structural funds for Objectives 1, 2 and 5b divided by regional GDP. Table 2 outlines a number of descriptive statistics for each of the EU-12 countries. The numbers reveal a variety of interesting trends regarding EU funds. EU structural funds as a percentage of GDP are increasing for all countries with the exception of Ireland and Luxembourg, reaching a level of 3 percent of GDP in Portugal. In Greece and Portugal EU funds appear to be complemented by both private and public spending. This spending is defined as matching funds, which are a prerequisite for obtaining EU funding. In Greece especially, private funding increased almost fivefold over the 1990s. This tendency in Greece can also be seen for the other EU-12 countries in terms of private expenditures. The share of EU funds is highly variable across the countries, with Spain, Portugal, and Greece, consuming more than half of the total structural funds, mainly in the form of Objective 1 support. A more detailed analysis (not presented here) shows that there are significant differences between regions even within countries with relatively poor regions receiving a lot of Objective 1 support. For example in Germany, Baden-Wurttemberg received very little support (0.005 percent of GDP) when compared to Macklenburg-Worpemmern (1.3 percent of GDP). The level of EU funds is as high as 6 percent of GDP in the case of the Açores in Portugal.

3.1.3 Economic performance

Economic performance is measured using several indicators. All indicator data was sourced from the Eurostat REGIO database.[9] GDP per capita dispersion from 1990 to 2002 is calculated based on Cappelen et al. (2003).[10] In addition, information about Gross Value Added (GVA) is used.[11] The resulting computations display a moderate form of catching-up especially after 1995 (e.g., the dispersion of GDP per capita drops from 0.160 in 1995 to 0.138 in 2002). This tendency towards convergence decreases when Greece, Spain, and Portugal are excluded from the sample. The GVA figures for the three main sectors in the economy depict a different picture. They indicate an increased level of divergence in the agricultural sector accompanied by relatively strong convergence in the industrial sector. On the other hand, the service sector displays the strongest level of

[8] Authors' own calculation from the available structural funds data at the country level.
[9] In addition, information available at http://europa.eu.int/comm/eurostat has been used as well.
[10] The per capita GDP dispersion figures are calculated by first computing the logs of regional GDP relative to EU averages for each year. The standard deviation of these numbers is used as a measure of dispersion.
[11] GVA is the net result of output valued at basic prices, minus intermediate consumption valued at purchasers' prices, of a resident producer unit in a region. More information is available from the Eurostat webpage.

convergence compared to the other two sectors over the same period. The main indicator for empirical analysis is the growth of per capita GDP between 1990 and 2002.

3.1.4 Innovation

The innovation data was sourced from the Eurostat REGIO database and the Eurostat database located on the Eurostat web pages. Expenditures for business R&D and government R&D are used as primary innovation indicators from the input side. R&D activity is measured by using the data on R&D expenditures as a percentage of GDP for government and business sectors in 1995. Both *R&D BUS* and *R&D GOV* have a minimum value of 0 and a maximum of 3.13 (East England) and 1.05 (Berlin), respectively. The mean (standard deviation) for *R&D BUS* is 0.67 (0.66) and 0.20 (0.20) for *R&D GOV* with n=83.

A composite innovation index, constructed by taking both the input and output side indicators into account, was added to the study. The innovation index (*INNOV*) is a version of the regional summary innovation index with different variables.[12] The values for each indicator are re-scaled, summed, and then divided by the number of indicators as explained above for the social capital index. *INNOV* consists of an index of ten variables:[13] *(i)* R&D personnel relative to the active population (i.e., education, government, and business sectors were applied separately as unique indicators); *(ii)* R&D expenditure as a percentage of GDP (i.e., education, government, and business sectors were applied separately as unique indicators); *(iii)* human resources in science and technology (i.e., total, per population); *(iv)* EPO patent applications relative to the region's labour force; *(v)* employment in high-technology manufacturing (i.e., as a percentage of total employment); and *(vi)* employment in high-technology knowledge intensive services (i.e., as a percentage of total employment). *INNOV* has a mean (standard deviation) of 0.258 (0.130). The minimum value of *INNOV* is 0.046 (Valle d'Aosta, Italy) and the maximum is 0.647 (Baden Wurttemberg, Germany). Several indices using different variables were constructed to check the robustness of the innovation indicator. The correlation between them ranges from 0.94 to 0.99, adding confidence to the validity of the innovation measure.[14]

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[12] For details see European Innovation Scoreboard 2003-Indicators methodological report, available at *http://trendchart.cordis.lu/scoreboards/scoreboard2003/scoreboard_papers.cfm*.

[13] The innovation data are for 1995 except for the patent data. The selection of 1995 is due to data availability. Patent data are the average of 1990, 1991 and 1992 number of patent applications.

[14] Composite indices with different indicators may render different results; therefore we constructed several innovation indices by omitting and including different indicators. As mentioned above the correlations between the indices are high. Moreover, all of the indices behave similarly in the regression analysis (i.e., all the indices produce significant coefficients, at least at the 10% significance level, when included in the regression).

Patent data is used to proxy innovation output so that the determinants of innovative output can be assessed. More specifically, patent applications to the European Patent Office (EPO) by year of filing per inhabitant (or per labour force) are used in the regression analysis below. Patent data contained in the Eurostat database refers only to patent applications made to the EPO and does not include data associated with patent applications made to the National Patent Offices in Europe. Therefore, the figures associated with this data may not reflect the true regional potential for innovation. Following Furman et al. (2002), this measure nevertheless reflects "commercially significant innovations at the world's technological frontier". Keeping in mind that patent data may not be a perfect indicator for the innovative performance of a region (e.g., Pavitt, 1982, 1988), it remains to be the only well-established source of data that reflects inventive activity (Trajtenberg, 1990). Patent applications display a trend of catching up revealed by a correlation coefficient of -0.54 between the growth of patents in the 1991-2000 period and the initial level of patent applications. A second innovation index, only including the innovation input indicators, has been computed as well. *INNOV_input* is based on four indicators; *(i)* R&D personnel relative to the active population (total); *(ii)* business R&D expenditure as a percentage of GDP; *(iii)* employment in high-technology manufacturing (i.e., as a percentage of total employment); *(iv)* employment in high-technology knowledge intensive services (i.e., as a percentage of total employment).

3.2 Empirical implementation

Two sets of equations were estimated to show that indicators of social capital are causal to economic outcomes. One equation was used to determine the effect social capital has on economic growth for the period 1990-2002 and the other was used to determine the effect social capital has on patent growth for the period 1991- 2000. The difficulty associated with reverse causation is that there remains an inherent fundamental problem when estimating these relationships, primarily due to the fact that current levels of social capital are likely to be influenced by past and current economic conditions. Simple OLS estimates depicting the relationship between social capital and economic outcomes might be biased; therefore they cannot be interpreted as a causal effect of social capital on economic growth and innovation. Problems associated with this bias were solved by using a 2SLS strategy where indicators of past political institutions between the 17th and 19th centuries were used as instruments for social capital. These instruments are similar to those used by Tabellini (2005) in his study on the causal effect of culture on income.

Tabellini (2005) argues that it is highly probable that the formal institutions that belong to a region's historical past shape its current cultural state. This becomes even more apparent when one considers that there were EU regions located within the same country that were governed by different political institutions and powers, especially before the 19th century. His estimates show that political liberalism has a positive impact as it shapes "good" cultural character, whereas past rigid autocratic political power may have had a negative impact resulting in "bad" cultural character. In order to capture the impacts associated with past political institutions, we refer to Acemoglu et al. (2005) and to a greater degree, Tabellini (2005), by using 'constraints on the executive' as a proxy to historical political institutions as defined in the POLITY IV project.[15] This variable is meant to capture "institutionalised constraints on the decision making powers of chief executives". It is coded on a scale from 1 to 7, where 1 represents "unlimited authority" and 7 represents "accountable executive constrained by checks and balances". Information is available for the following five dates: 1600, 1700, 1750, 1800, and 1850. The main data source for this variable is Tabellini (2005). In cases where data was missing, observations for some of the regions and countries were sourced from the POLITY IV data set located on the POLITY IV project webpage. The appendix in Akçomak and ter Weel (2006) shows in detail how these variables are constructed.

The following equations were estimated for a set of 83 EU regions:

$$GDP_{1990-2002} = C + \alpha_1 GDP_{1990} + \alpha_2 SC + \alpha_3 EUFUND + \alpha_4 X + \alpha_5 EDUC + \alpha_6 INT_1 + \alpha_7 INT_2 + \varepsilon \quad (1)$$

$$PAT_{1990-2002} = C + \beta_1 PAT_{1990} + \beta_2 SC + \beta_3 EUFUND + \beta_4 X + \beta_5 EDUC + \beta_6 INT_1 + \beta_7 INT_2 + \nu \quad (2)$$

where the subscript r for regions has been suppressed for notational convenience, and where ε and ν are error terms with the usual assumptions. $GDP_{1990-2002}$ is the average annual GDP per capita growth in the period 1990-2002 and $PAT_{1991-2000}$ is the average annual change in patent applications per head for the period 1991-2000. GDP_{1990} and PAT_{1991} are included as measures of convergence. SC is either trust or the social capital index as defined above, and $EUFUND$ is the total structural funds as a percentage of GDP. The variables INT_1 and INT_2 denote interaction terms. INT_1 is the

[15] For more information about the variable and the POLITY IV data set see the POLITY IV project webpage http://www.cidcm.umd.edu/inscr/polity/. Tabellini (2005) provides a thorough historical appendix about the political state of EU regions between 17th and 19th centuries.

interaction between education and social capital, which are expected to reinforce one another. INT_2 is the interaction between measures of education, social capital, and EU funding. This interaction term captures complementary relationships that may exist between social capital and EU funding. Depending on the equation estimated, X denotes a vector of other variables. For the per capita GDP growth these are: share of employment in industry and agriculture sectors in 1990; education, as measured by the share of upper secondary students in total students as defined by ISCED97 for 1993; innovation indicators such as R&D expenditure as a percentage of GDP for business and public sectors; and the composite innovation index. The patent growth model does not include employment variables, and the share of students in tertiary education replaces the education variable since it is more plausible to hypothesize higher education as a proxy to represent education in a patent growth regression. *INNOV_input* also substitutes the innovation index.

4. Results

This section discusses the results of estimating equations (1) and (2). Second-stage regression results of the 2SLS estimates are presented (first-stage results are available upon request). As expected, first-stage estimates generally depict a strong and positive relationship between the instruments and the measures of social capital. The first row of each table indicates whether the estimates are OLS or 2SLS. The standard errors reported in all tables of the paper have been adjusted for clustering. In addition, F-tests for the joint significance of the instruments always exceed the critical value of 10, as suggested by Staiger and Stock (1997). This adds confidence to the validity of the instruments by removing problems associated with weak instruments. Finally, the null-hypothesis that the over-identifiying restrictions are valid is never rejected.

4.1 Economic growth

Estimates of equation (1) using different sets of independent variables are presented in Table 3. Average annual regional GDP per capita growth for the period 1990-2002 is explained in column (1) by GDP in 1990, shares of employment, business R&D activities, the region's share of students in upper secondary education, trust, and EU funding. In addition, an interaction term between education and trust is included to show the complementary relationship between the two, as outlined in Section 2. The estimates reveal convergence among the EU-12 regions reflected by a negative effect of initial GDP per capita on economic growth in the subsequent period. Furthermore, a higher share of agricultural employment is likely to result as a detriment to economic growth. The indicators

of innovation, social capital, government support, and education do not appear to have a significant correlation to growth during this period. It is interesting to note that the interaction between education and trust is positive and significant, pointing out the complementarity between the two. The results presented in columns (2) and (3) of Table 3 show the effects that occur when the interaction between structural funds, education, and trust is added. This interaction term always significantly contributes to economic growth and it depicts the independent effect of trust on economic outcomes in the EU regions. Similar results are obtained when the social capital index *SC* replaces *TRUST*. These OLS estimates are reported in column (4).

Since problems associated with reversed causality between measures of social capital and economic growth are serious, a 2SLS strategy where the social capital variables are instrumented by the historical information on institutions is applied to present the same type of analysis. These results are listed in columns (5) to (8) of Table 3. The estimates presented in column (5) and (6) are the 2SLS equivalent of the OLS estimates presented in column (3) and (4) respectively. What is most interesting to observe is that instrumenting social capital increases the coefficients on *TRUST* and *SC* considerably suggesting a strong link from social capital to economic growth. The interaction effects also become more powerful and significant. In addition, the effect that R&D has on economic growth is positive and significant, likely because the 2SLS approach removes measurement error from the social capital variables. The results presented in columns (7) and (8) replace the business R&D variable by an indicator of public R&D (*R&D GOV*). This is done because there might be cases where regions with more social capital not only benefit from policy initiatives that foster development, such as the EU funds, but also benefit from their ability to gain from public spending on innovation. Indeed, the estimates presented in columns (7) and (8) for *TRUST* and *SC* respectively, suggest that government R&D significantly contributes to economic growth. The effects of social capital and EU funding on growth remain similar to the results presented for business R&D investments.

To further investigate the importance of innovation, the variable *INNOV* replaced R&D indicators resulting in the estimates presented in the final four columns of Table 3. The advantage of *INNOV* is that it captures both input and output characteristics of innovation. The results of this exercise suggest that innovation contributes to growth in a significant way and that when combined, social capital and EU funding also contribute positively to development throughout the 1990s.

A sensitivity analysis was carried out to determine the robustness of the estimates. This analysis was designed to examine the responsiveness of *TRUST*.[16] The methodology basically involves assessing the "fragility" of *TRUST* with respect to additional independent variables that have the potential to reflect the cultural characteristics of a region and, as such, explain GDP growth. The first step is to estimate a GDP growth model. This model includes initial GDP, the share of agricultural and industrial employment, the composite innovation index, education, trust, interaction terms, and the set of 12 country dummies. Then we determined the number of switch variables that are not only exogenous to *TRUST*, but also have a low correlation with each other avoiding any problems associated with multicollinearity. Fifteen switch variables were introduced to the base model in groups of one to three variables at a time. This exercise resulted in 575 regression estimations. The results show that the relationship between *TRUST* and per capita GDP growth is robust with respect to inclusion of other relevant variables. *TRUST* has a mean coefficient of 0.027 with a confidence interval of [0.025 to 0.029]. More than 85 percent of the estimated coefficients of *TRUST* are significant at least at the 10 percent level. The only noteworthy effect of switch variables on growth were those related to religion (i.e., belonging to a certain religion).

When combined, these results suggest that EU funding did not have a direct effect on economic performance during the 1990s. This finding corroborates earlier evidence presented by Boldrin and Canova (2001) which suggest that monies already spent do not make a positive contribution to the economic development of relatively backward regions. That said, it is important to note that the main finding of this analysis is that in order for EU policy to be effective, social capital must be present. Given a certain level of economic development, regions with higher levels of social capital benefit more from EU funding than regions with lower levels of social capital.

4.2 Innovation

The estimation results of equation (2) are presented in Table 4. The table shows only the second-stage results of the 2SLS estimations. The dependent variable is defined as the number of patent applications per million inhabitants. Results using the number of patent applications relative to a region's labour force yield similar qualitative results.

[16] The methodology used is carried out using the MetaGrowth computer programme employed in Beugelsdijk et al. (2004) and provided by Henri de Groot. The software is designed specifically to assess the robustness of estimating models of cross-country/region empirical analyses. For details about the programme see Heijungs et al. (2001).

The table is divided into two sets of results. The first four columns list estimates including those related to business R&D, and the second set of columns reports estimates that used *INNOV* input as an indicator for technology related activities.[17] The estimates suggest a positive role for *TRUST* and *SC* in explaining changes in innovation output, which stresses the importance of these variables for carrying out successful research projects. If the level of social capital is high, then there will likely be a decrease in the number of information frictions that occur between the capitalists (i.e., those who finance the innovation project) and the entrepreneurs (i.e., those who implement the project). Higher levels of trust between these parties will work to increase penalties to those who continue to cheat investors, so that any further damage to reputation can be avoided. It is more likely that there will be less cheating and more (venture) capitalist project investment in regions where higher levels of trust and social norms occur.

This exercise also suggests that there is a direct negative effect of EU funding on innovation output. This is partly due to the fact that many of the funded regions are backward and as such, are not doing much in terms of innovation as is reflected in the number of patents. In these cases it appears that an increase in funding does not benefit innovation. This direct estimate supports the doubts many academics and policy makers have had during their pursuit for effective regional policy that fosters development. That said, it appears that a complementary relationship between social capital and policy effectiveness exists due to the strength and significance of the effects associated with the interaction between social capital and EU funding. Interpretation of these results supports the fact that certain levels of trust must be present to carry out innovation. If trust is high, then more funds will be devoted to innovation. As trust increases, problems associated with information decrease and as such, prescribed funding is spent more appropriately. This also holds true for EU funding which is spent more effectively when information problems are reduced, improving the potential for innovation and growth.

Finally, the sensitivity analysis of *TRUST* in the patent growth regression model suggests similar findings to those found in the case of GDP per capita growth. The OLS version of model (6), Table 4, is used as the base model. Twelve switch variables were selected to assess the robustness of the estimates presented in Table 4. A total of 298 regression equations were estimated to determine robustness. Our findings suggest that a robust relationship between *TRUST* and patent growth exists. The analysis produced a mean coefficient of 0.117 ranging from 0.108 to 0.126. Over 80

[17] Estimates for government R&D suggest similar outcomes. These results are available upon request.

percent of the estimated coefficients of *TRUST* are significant at least at the 10 percent level. Two of the twelve switch variables are worth mentioning when explaining patent growth: they include *(i)* indicators measuring different aspects of the importance of obeying laws and *(ii)* regulations. This would appear to make sense, since patent protection and intellectual property rights are known to be important for innovation output growth.

5. Discussion and implications

This section discusses three ways in which the implications associated with the estimation results impact innovation. First, policy implications associated with the results are discussed with a focus on education policy, EU support programme effectiveness, institutional design, and establishment. Second, the case of Italy is presented as an illustration of social capital working within a country to make a difference in its economic outcomes, further stressing the importance to stimulate the creation of social capital. Finally, there is a brief summary of the main findings followed by a discussion of the potential for wider application of the estimates.

5.1 Policy implications for innovation

5.1.1 Education

What does the future hold for education in Europe? The estimates in this chapter have shown the positive effects education has had on economic outcomes. It is important to note that the educational variable was not split up into different educational categories. This was intentional for two reasons: first, data availability limited the number of regions that had sufficient information for each of the specific fields of education; second, from a theoretical and empirical point of view, specific fields of education are not considered critical for the formation of social capital. Recall that the effects of education interact directly with social capital, and that previous work indicated that the level of education is more important than the field. The policy perspective for education is simple: an increase in the levels of education in backward regions will increase norms and values, bonds, and connectivity in the form of networks, which will in turn increase the level of social capital. Policy makers should make this their primary goal given the fact that a relatively large dispersion in educational levels exists.

A second effect associated with an increase in the levels of education is that it serves as input into the process of innovation. Perhaps in this case, a focus on technical ability coupled with an increased inflow into technical studies would help to increase innovation efforts. On the other hand,

past examples of specific labour-market policies which aim to make labour flow towards innovation have not been very effective. This is primarily due to the fact that when labour flows from one sector to another the associated supply and demand must be adjusted to yield different prices. Goolsbee (1998) has shown that an increase in the wages for scientists and engineers in innovative sectors results in a flow of workers towards these sectors and a labour shortage in the sectors where these workers were originally employed. This increases the overall level of wages for these occupations thereby rendering only a price effect. A better approach would be to stimulate education in specific fields of study.

5.1.2 EU programme effectiveness

What does the future hold for programmes in Europe? The debate surrounding EU funding effectivity is complicated because it has been going on for a long period of time and because it is difficult to assess empirically. From an econometric point of view it is difficult to distinguish cause and effect and to address the effectivity of exogenous variation which is required to estimate EU funding contributions to economic development. From a more practical point of view the correlations presented in this research suggest that the EU policies are ineffective in their direct contribution to innovation and development, but effective in combination with social capital. The policy implication of this strong and significant result is that the Objective 1, 2 and 5b EU programmes should come with an appropriate amount of education and dissemination of information in the regions at stake. While a provision of education from specific fields would be advantageous to a region, an increase of the overall level of education within a region would likely provide a better situation having both direct and indirect effects on economic outcomes. Increasing levels of social capital is only possible if problems associated with information are solved. Policies targeted at solving such issues should take into account the length of time it takes to establish trust, and perhaps more importantly, should ensure that the right design of institution is established.

5.1.3 Institutions

What institutions should Europe develop in the future? While social capital is useful when explaining potential economic outcomes, it is difficult to transform social capital into formal institutions. Traditional approaches that were implemented to increase innovation and growth include the establishment of intellectual property rights protection, courts of justice, and law. While there is no question that these institutions help increase the potential for innovation and growth, it remains unclear how they interact with social capital. Generally speaking, these institutions work to

increase the probability that start-up firms will be established and will innovate and produce with great success. However, if a situation occurs where the people of a region have little or no trust in the government, then the institutional framework will be perceived as a detriment to innovation and growth. Currently, Europe has a sound and homogenous institutional framework but a considerable level of heterogeneity in terms of social capital throughout all of its regions. The fight against corruption and opportunism should be realized so that increased levels of social capital coupled with strong institutional frameworks can serve as an engine to growth and innovation.

Provision for venture capital is primarily based on trust between the innovator and the capitalist. The provision of venture capital by the market is more effective if the capitalist is protected from corruption and if incentives are such that the innovator is punished when he defaults. In addition, the expenditure of government monies must be held accountable by providing detailed follow-up reports outlining the results and merits of the expenditure, to promote confidence in the EU governing bodies and effectiveness of their associated policies. This can only be accomplished by supporting a cooperative and transparent exchange of information throughout the entire process. The current growth and extension of the EU into other countries provides an excellent opportunity to improve the exchange of information by revising the monitoring and information system in Brussels. Decentralised funding from investors who are trusted by the public and support for improved access to information at "the construction site", are likely to boost confidence in both the EU and local government authorities.

5.2 Italy

Italy is one of the more prominent examples of a country where society is stratified along the lines of income, development, and crime: the rich and trustworthy north, and the poor and corrupt south. Putnam (1993) based his study of social capital on Italy, and Guiso et al. (2004) based their study on the differences between regional patterns of economic development and social cohesion in Italy, with an emphasis on the split between the northern and southern regions.

Table 5 lists a number of core variables associated with the empirical analysis. Note that all numbers in the table are standardized means, so that the average of the 83 regions' indicators found in the sample is equal to zero. The first two rows depict the discrepancy between the measures of social capital found in the north and south. The next two rows similarly depict a huge difference in the levels of education found in the north and south. Taken together, these four indicators imply

that development in the southern areas of Italy should be far less than the economic development in the northern areas. An examination of the GDP indicators and innovation measures determines that this is certainly the case.

Now, what should Italy's policy look like in the future? First and foremost, policy should focus on increasing levels of education so that an increase in the level of social capital might be realized to increase innovation and output. Note that Italy had the greatest regional difference in levels of education (i.e., between its northern and southern regions) for all EU countries in our data. A secondary effect associated with increasing levels of education is that it provides a means for people to make a living on their own so that they might escape involvement with illegal acts and crime. Final observations indicate that social capital in southern Italy is almost non-existent. This implies that the theoretically detrimental effects of social capital on society should be absent. Social capital and bonds can be high within the gang structure, but levels of trust for society as a whole will be exceptionally low.

5.3 Conclusion

The estimates discussed in this paper suggest that a positive correlation between social capital and government support programmes designed to foster economic development and economic outcomes exists. There appears to be a greater capacity to implement government support programmes in specific regions where higher levels of social capital exist. As such, the region benefits in terms of higher levels of economic growth and increased innovative activity. The empirical analysis indicates that there is an interplay between social capital and government investments in the EU regions. This is an important finding as it suggests that norms and values that have not been institutionalised by property rights or integrated into other legal institutions, play a critical role in the effective implementation of support programmes. As such the EU Objective 1, 2 and 5b programmes for EU regional support do not appear to foster economic development on their own but when combined with higher levels of social capital, they benefit both economic development and innovation.

One of the main advantages of this study is that it has used information from a set of relatively homogeneous countries and/or regions, which decreases the influence of other (unobserved) factors on the estimates. While it would be premature to draw firm conclusions for other countries or regions based on these estimates, it is likely that these estimates suggest that a certain level of social capital is necessary for successful implementation of government support. Indeed, case study

evidence from Kenya suggests that if social capital cannot be created in the short term it can be in the long term by spending monies to foster education so that there is an increase in the levels of trust and participation in groups, which in turn will increase levels of social capital (Gugerty and Kremer, 2002). In addition, fostering investment in human capital appears to be an effective way in which levels of social capital might be increased. Aside from the direct impact of human capital on economic performance and its role as an input into the process of innovation and human capital's indirect approach to the promotion of social cohesion and compliance with norms and values is an effect that should not be overlooked. At this point in time there is a difference between the average levels of education of about 8.2 years between the most advanced regions of the EU (i.e., located mostly in the northern parts of the EU) and the least advanced regions of the EU (i.e., located mostly in the southern areas of the EU). It would appear the EU's capacity to support future development would be improved greatly if this education gap was closed. This of course, would require a commitment to invest in resources to support education. Human capital must be viewed as an investment good that requires effective policy programs to support skills acquisition from an early age onward. Investment in schools and training, coupled with a campaign to promote awareness of the importance of education within the family unit, will foster technological progress and human capital as a whole.

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Table 1
The measurement of social capital

Variable	Description	Mean (st. dev.)	Min	Max
TRUST	Most people can be trusted or you can't be too careful. Coded as 0 to 10 in ESS. Higher number representing higher trust.	4.78 (0.69)	1.66	7.05
SC	Index of social capital constructed by using the five variables below.	0.53 (0.10)	0.13	0.76
PPLHLP	Most of the time people are helpful or mostly looking out for themselves. Coded as 0 to 10 in ESS, 10: most people are helpful.	4.59 (0.74)	1.52	6.14
PPLFAIR	Most people try to take advantage of you, or try to be fair. Coded as 0 to 10 in ESS, 10: most people try to be fair.	5.37 (0.75)	2.20	7.36
IMPVO	Important in life: voluntary organizations Coded as 0 to 10 in ESS. Higher numbers representing higher importance.	5.04 (1.18)	2.91	7.45
VOLUN	Index constructed from ESS measuring the involvement of the respondents in active voluntary work for different organizations.	0.02 (0.01)	0.00	0.06

Note: The number of regions equals 83. Further information is provided in Section 3.1.1.

Table 2
EU support as a percentage of GDP

	1994-1999			1989-1993		
	Total SF	Nat. Exp.	Priv. Exp.	Total SF	Nat. Exp.	Priv. Exp.
Belgium	0.29	0.38	0.25	0.09	0.13	0.06
Denmark	0.09	0.10	0.08	0.08	0.10	0.08
Germany	0.18	0.17	0.35	0.09	0.14	0.12
Greece	2.76	1.25	1.44	2.40	1.35	0.29
Spain	1.37	0.70	0.46	0.67	0.55	0.25
France	0.18	0.24	0.10	0.13	0.20	0.08
Ireland	1.74	0.65	0.61	2.38	1.52	1.48
Italy	0.34	0.30	0.26	0.26	0.26	0.10
Luxembourg	0.09	0.18	0.03	0.12	0.00	0.25
Netherlands	0.11	0.21	0.05	0.06	0.10	0.04
Portugal	3.10	1.22	1.24	2.82	1.62	1.28
UK	0.18	0.17	0.05	0.12	0.15	0.05
EU average.	0.64	0.36	0.47	0.48	0.36	0.28

Note: "Total SF" is the total structural funds as percentage of GDP received by a country. "Nat. Exp." and "Priv. Exp." stand for the national public and private sector expenditures, respectively that matches structural funds.

Table 3
Growth in EU Regions: Growth of per capita GDP 1990-2002

GROWTH 1990-2002	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) 2SLS	(6) 2SLS	(7) 2SLS	(8) 2SLS	(9) OLS	(10) OLS	(11) 2SLS	(12) 2SLS
INITIAL GDP	-0.461	-0.445	-0.415	-0.486	-0.471	-0.585	-0.440	-0.563	-0.433	-0.500	-0.494	-0.587
	(0.097)***	(0.095)***	(0.098)***	(0.102)***	(0.077)***	(0.118)***	(0.062)***	(0.112)***	(0.085)***	(0.088)***	(0.067)***	(0.099)***
AGREMP	-0.010	-0.012	-0.012	-0.012	-0.013	-0.013	-0.012	-0.012	-0.010	-0.010	-0.012	-0.012
	(0.003)**	(0.004)**	(0.004)**	(0.004)**	(0.003)***	(0.003)***	(0.003)***	(0.003)***	(0.003)**	(0.003)**	(0.003)***	(0.003)***
INDEMP	-0.001	-0.002	-0.002	-0.001	-0.002	-0.002	0.000	-0.000	-0.001	-0.001	-0.001	-0.001
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
R&D BUS	0.026	0.030	0.029	0.028	0.028	0.027						
	(0.015)	(0.014)*	(0.013)**	(0.013)*	(0.015)*	(0.013)*						
TRUST	0.014	0.037	0.026		0.078		0.078		0.024		0.081	
	(0.015)	(0.012)***	(0.014)*		(0.017)***		(0.011)***		(0.010)**		(0.024)***	
EU FUND	0.015	0.061	0.070	0.027	0.066	0.004	0.066	0.006	0.080	0.039	0.075	0.018
	(0.038)	(0.046)	(0.044)	(0.038)	(0.053)	(0.028)	(0.049)	(0.024)	(0.036)**	(0.031)	(0.051)	(0.019)
EDU_second	0.030	0.049	0.046	0.031	0.060	0.026	0.059	0.027	0.054	0.040	0.069	0.035
	(0.041)	(0.033)	(0.036)	(0.036)	(0.044)	(0.045)	(0.041)	(0.043)	(0.024)**	(0.023)	(0.033)*	(0.032)
SC				0.029		0.103		0.114		0.024		0.092
				(0.011)**		(0.029)***		(0.039)**		(0.009)**		(0.019)***
R&D GOV							0.028	0.025				
							(0.012)**	(0.011)*				
INNOV									0.061	0.061	0.058	0.056
									(0.015)***	(0.013)***	(0.020)**	(0.014)***
EDU*TRUST	0.022		0.020		-0.011		-0.009		0.023		-0.011	
	(0.012)*		(0.010)*		(0.021)		(0.020)		(0.010)**		(0.031)	
EUF*EDU*TRUST		0.064	0.062		0.087		0.081		0.061		0.090	
		(0.030)*	(0.030)*		(0.042)*		(0.037)*		(0.026)**		(0.039)**	
EDU*SC				0.000		-0.037		-0.039		0.007		-0.027
				(0.007)		(0.023)		(0.020)*		(0.010)		(0.021)
EUF*EDU*SC				0.025		0.049		0.052		0.025		0.046
				(0.010)**		(0.013)***		(0.016)**		(0.007)***		(0.012)***
CONSTANT	5.052	4.887	4.559	5.362	4.954	6.419	4.601	6.164	4.671	5.434	5.089	6.086
	(0.883)***	(0.878)***	(0.919)***	(1.023)***	(0.861)***	(1.160)***	(0.662)***	(1.108)***	(0.790)***	(0.857)***	(0.706)***	(0.958)***
N	83	83	83	83	83	83	83	83	83	83	83	83
ADJ R^2	0.86	0.87	0.87	0.86	0.85	0.82	0.85	0.80	0.90	0.88	0.87	0.85
OVERID					4.26(0.37)	4.39(0.36)	5.03(0.28)	3.89(0.42)			3.58(0.47)	4.90(0.30)

Note: Standard errors in parentheses are robust in the sense that we allow arbitrary correlations within countries. To assess whether instruments are jointly significant in the first stage we performed F-tests. The F-tests are significant for all the models at the 1 % level and the values range from 21.57 to 61.77. OVERID stands for Sargan over identification test. The numbers in parentheses are the p-values [$\chi^2(4)$] associated with each model. *** is significant at the 1% level, ** is significant at the 5% level, and * is significant at the 10% level.

Table 4
Growth of patent applications 1991-2000: Results of 2SLS estimations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
INITIAL PAT.	-0.527	-0.681	-0.536	-0.642	-0.552	-0.727	-0.557	-0.695
	(0.127)***	(0.136)***	(0.123)***	(0.139)***	(0.136)***	(0.129)***	(0.119)***	(0.132)***
EDU_higher	0.105	0.163	0.103	0.124	0.091	0.150	0.090	0.113
	(0.035)**	(0.046)***	(0.029)***	(0.038)***	(0.028)***	(0.035)***	(0.025)***	(0.034)***
EU FUND	-0.333	-0.885	-0.328	-0.653	-0.323	-0.899	-0.321	-0.716
	(0.109)**	(0.197)***	(0.099)***	(0.178)***	(0.113)**	(0.174)***	(0.108)**	(0.195)***
R&D BUS	0.161	0.174	0.141	0.164				
	(0.075)*	(0.075)**	(0.069)*	(0.078)*				
INNOV_input					1.344	1.611	1.147	1.420
					(0.603)*	(0.499)***	(0.497)**	(0.589)**
TRUST	0.114	0.305			0.109	0.308		
	(0.093)	(0.113)**			(0.084)	(0.096)***		
SC			0.228	0.297			0.225	0.314
			(0.134)	(0.134)*			(0.136)	(0.129)**
EDU*TRUST	0.120	0.188			0.111	0.180		
	(0.031)***	(0.020)***			(0.026)***	(0.027)***		
EUF*EDU*TRUST		0.550				0.578		
		(0.119)***				(0.108)***		
EDU*SC			0.122	0.151			0.114	0.149
			(0.012)***	(0.022)***			(0.015)***	(0.028)***
EUF*EDU*SC				0.203				0.247
				(0.078)**				(0.087)**
CONSTANT	2.123	5.130	2.800	2.317	2.235	5.030	1.851	4.357
	(0.243)***	(0.900)***	(0.399)***	(0.325)***	(0.306)***	(0.756)***	(0.189)***	(0.673)***
N	83	83	83	83	83	83	83	83
Adjusted R-sqr	0.52	0.61	0.48	0.45	0.54	0.64	0.49	0.46
OVERID	0.14(0.93)	0.82(0.66)	0.44(0.80)	1.01(0.61)	0.27(0.87)	1.48(0.48)	0.45(0.80)	1.35(0.51)

Note: Standard errors in parentheses are robust in the sense that we allow arbitrary correlations within countries. To assess whether instruments are jointly significant in the first stage we performed F-tests. The F-tests are significant at 1% level for all the models and the values range from 34.41 to 72.95. OVERID stands for Sargan over identification test. The numbers in parentheses are the p-values [$\chi^2(4)$] associated with each model. *** *** is significant at the 1% level, ** is significant at the 5% level, and * is significant at the 10% level.

Table 5
The case of Italy

	North Italy	South Italy	Italy
TRUST	0.321	-1.000	-0.246
Composite social capital index (*SC*)	0.208	-0.947	-0.339
Share of students in upper secondary level, 1993	0.648	0.292	0.488
Share of students in tertiary level, 1993	0.838	-0.125	0.405
Composite innovation index (*INNOV*)	-0.318	-0.591	-0.447
Total R&D as a percentage of GDP 1995	-0.383	-0.585	-0.479
Business R&D as a percentage of GDP 1995	-0.295	-0.725	-0.499
Government R&D as a percentage of GDP 1995	-0.365	-0.037	-0.210
Patent application per population, 1995	0.098	-0.686	-0.274
Gross value added, total, 1995	0.396	-0.746	-0.093
Gross value added, agriculture, 1995	0.063	0.060	0.062
Gross value added, industry, 1995	0.471	-1.011	-0.164
Gross value added, services, 1995	0.328	-0.534	-0.042
Total EU structural fund as a percentage of GDP	-0.503	-0.007	-0.280
Objective 1 EU structural fund as a percentage of GDP	-0.505	0.045	-0.258
Objective 2 EU structural fund as a percentage of GDP	0.174	-0.650	-0.197
Objective 5B EU structural fund as a percentage of GDP	0.146	-0.413	-0.106

Note: All values are standardized meaning that a value of 0 equals the mean of the sample n=83.
North Italy: Piemonte, Valle d'Aosta, Liguria, Lombardia, Trento, Veneto, Friuli-Venezia, Emila-Romagna, Toscana, Umbria, Marche.
South Italy: Lazio, Abruzzo, Molise, Campania, Puglia, Basilicata, Calabria, Sicilia, Sardegna.

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