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Vita and publications

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PUBLICATIONS AND PRESENTATIONS

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L.Gagliardi, R.Crescenzi, M.Percoco "Social Capital and Innovation in Italy" in Crescenzi, Percoco (editors) "*Geography, Institutions and Regional Economic Performance*", Springer – Verlag, Berlin and New York, forthcoming

Abstract

The thesis is aimed at the empirical investigation of the role of intangible assets, in particular human and social capital, as relevant determinants of local economic performances. Traditional theories of economic growth, focusing on the role of physical capital as fundamental engine of economic growth, have failed to explain much of the differences in the level of income and development among regions and countries. The direct consequence of this evidence was the increasing effort in identifying alternative mechanisms and determinants. In line with this trend the role of intangible assets as determinants of economic outcomes has recently gained increasing importance in the economic literature. However, the empirical evidence remains limited and controversial. The thesis aims at filling this gap by developing a sound analytical framework and robust empirical strategies for the assessment of the potential economic dividend of soft factors.

The analysis is developed through three independent and original papers grounded into different streams of literature and covering in a consistent manner a variety of contributions: from traditional economic theory on the role of human capital and externalities as main source of endogenous growth (Romer, 1986, Lucas, 1988), to the theory and empirics of social capital (Putnam, 1990, Granovetter, 1973, Keefer and Knack, 1997) and some more recent contributions regarding the role of migration and human capital externalities externalities (Breschi and Lissoni, 2000, Moretti, 2004, Duranton, 2007, Faggian, McCann, 2006, 2009). In each of the three papers the empirical investigation is provided building on different econometric techniques (cross section, first difference, panel data, instrumental variables) coherently with the underlying research questions, theoretical motivations and characteristics of the available data.

The papers provide robust empirical evidences in support of the hypothesis regarding the relevant role of intangible assets as crucial determinant of the economic and innovative performance of local areas. The main findings are consistent over changes in the geographical unit of analysis and methodological settings.

Chapter 1: Introduction

Mainstream economic theories (*Solow, 1956*) focusing on the relevance of tangible assets and based on the mechanical expansion of predetermined variables were traditionally unable to fully explain differences in the economic performance of regions and countries (*Banerjee et al. 2004*). The direct consequence of this evidence was the increasing effort in identifying alternative mechanisms and determinants driving the economic performance of regions and countries. Early contributions focused on the crucial role of human capital (*Romer, 1986, 1990, Lucas, 1988*), interpreted mainly as good education and health. Following empirical works have strongly supported the explanatory power of human capital within the traditional growth regression (*Barro, 1991, Mankiw, Romer, Weil, 1992*). However, as pointed out by Shuller (2000) individuals are not isolated entities and their performance and capacity to generate an economic dividend is strongly affected by the relational and institutional environment in which they are embedded. Such powerful consideration explains why the economic literature started to question about the role of social capital, interpreted as trust, networks and relations (*Putnam, 1003, 2000, Coleman, 1990, Fukuyama, 2000, Bourdieu, 1985*), on the economic performance of regions and countries.

Despite the broad consensus on the relevance of these intangible assets the empirical evidence on the existence of an economic dividend associated to the so called soft factors is still controversial.

The thesis is then aimed to contribute to the wide literature on the role of these intangible assets, in particular human and social capital, providing a robust empirical investigation. The role of human capital is addressed in respect to two different geographical contexts, Italy and UK, while the relevance of social capital is explicitly analysed in the case of Italy, one of the most famous case study within the existent literature on social capital.

The first paper analyses the role of skilled migration as crucial determinant of the innovative performance of local areas in Britain. The paper aims to provide robust evidences on a controversial issue in the economic geography literature: the impact of human capital externalities associated to the migration behaviour of high skilled people. The strength of the paper lies in the adoption of a novel dataset and in the definition of a reliable identification strategy in order to account for the 'endogeneity' of migration flows. The results find consistent support for the positive impact of human capital externalities offering an original contribution on the understanding of the British spatial economy.

The second paper aims to contribute to the broad literature on social capital by focusing on its effects on innovation. The paper investigates the channels through which social capital affects the innovative capabilities of Italian provinces building on a distinctive perspective of analysis. This implies a valuable effort in providing a coherent definition of social capital, concept traditionally characterized by a significant vagueness and measured in various different ways, ranging from trust to political participation, from network relationships to associational activities. Focusing on the network dimension and referring on the weak/ strong ties dichotomy introduced by Granovetter the paper offers an original analysis on the relevance of social capital.

The third paper analyses the long-run impact of initial economic conditions and path dependence referring in particular to the role of human capital and trade policy in the case of Italy. The paper offers an interesting perspective for the analysis of regional disparities in Italy suggesting that the initial gap in terms of human capital availability and the protectionist post unification trade policy - more that initial differences in any other economic preconditions (e.g. productivity) were responsible for the emergence of the traditional north-south dichotomy in Italy. The main thesis pursued in the paper is that both dimensions contributed to prevent the industrialization of Southern regions by increasing the specialization in low knowledge-intensity and low value-added agricultural activities.

Chapter 2: "On the Engine of Innovation: the Role of Skilled migrations and Human Capital Externalities"

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Abstract

What is the effect of an increase in the stock of human capital on the innovative performance of a local economy? This paper tests the hypothesis of a causal link between an increase in the average stock of local human capital, due to skilled migration inflows, and the innovative performance of local areas using British data. The paper examines the role of human capital externalities as crucial determinant of local productivity and innovative performances, suggesting that the geographically bound nature of these valuable knowledge externalities can be challenged by the mobility of skilled individuals. Skilled migrations become a crucial channel of knowledge diffusion broadening the geographical scope of human capital externalities and significantly affecting the likelihood of innovation at the local level.

Keywords: Innovation, Migration, Human Capital Externalities.

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1) Introduction

The role of human capital as crucial determinant of the innovative performance of regions and countries has been deeply analyzed within the economic literature.
Since Lucas (1988), economists have supported the idea that human capital accumulation in specific geographical contexts generates two different effects: an increase in individual productivity and a positive effect on local aggregate productivity. The latter effect represents the so called "human capital externalities" (*Moretti, 2004a*).

These externalities were often considered a fundamental engine of endogenous growth (*Grossman, Helpman, 1991*) due to their capability to foster technological innovation and productivity (Jaffe et al, 1993, Saxenian, 1994). Furthermore, because of their geographical boundness, they were often supposed to be responsible for differences in long run economic performance among geographical areas (Lucas, 1988).
However, despite the theoretical relevance of the issue, the empirical literature on the relevance of human capital externalities is still controversial (*Moretti, 2004a*) and there is even less consensus regarding the mechanism at play (*Duranton, 2007*).

A deeper understanding of the mechanisms behind the geographically localized nature of human capital externalities is then crucial in order to shed some more light on real world's economic dynamics.
The limitation in the geographical ray of action of human capital externalities is generally associated to the distinction between codified and tacit knowledge (*Polanyi, 1978*). Tacit knowledge, often assumed to be the real engine of innovation, is both embodied in people (*Feldman, 2000*) and generally bound within specific epistemic communities (*Steinmueller, 2000*). The coexistence of different sources of tacit, individual embodied, knowledge within the same geographical context increases the likelihood of innovation, multiplying the opportunities of exchange and the probability to exploit the benefits related to valuable re-combinations of such knowledge. This implies that the degree of geographical fixedness of these human capital externalities depends on the extent to which human capital is not mobile in space and interactions among individuals remain geographically localized in specific spatial contexts.

Building on these considerations the aim of this paper is to contribute to the debate on the relevance of human capital externalities focusing in particular on their transmission channels. I suggest that the migration behaviour of high skilled individual is a crucial mechanism of (tacit) knowledge diffusion, contributing to the broadening of the geographical scope of human capital externalities and fostering the innovative performance of local areas. The paper tests this hypothesis looking at the role of skilled migration, affecting the average level of human capital, on the innovative performance of local areas in the case of Great Britain.

The possibility to recover reliable predictions is challenged by several empirical shortfalls. In the first instance the endogeneity regarding changes in aggregate human capital, secondly the definition of the most appropriate geographical scope of the analysis and the difficulties in measuring both innovation performance and migration flows.
I will try to address these issues through a careful definition of the relevant variables, the geographical unit of analysis and the identification strategy.

The main findings of the paper confirm that human capital externalities related to migration of skilled individuals can be considered a significant determinant of the innovative performance of local areas in Britain. However in respect to part of the existing literature (*Marshall, 1890, Gleaser, 1999, Gleaser, Mare', 2001, Moretti, 2004a, 2004b, Ciccone and Peri, 2005, Duranton, 2007*) no evidence of an additional effect of human capital externalities in urban areas has been found. I will suggest that this empirical evidence is explained by the characteristics of the sample and the sectoral composition of British cities.

The remainder of the paper is organized as follows: the next section introduces an overview of the existing literature. In section two I will discuss the issue related to the choice of the geographical unit of analysis while in section three I will provide a detailed description of the identification strategy adopted. Section four describes the data. Section five presents the main results and robustness checks, section six introduces a thematic focus on the urban subsamples and the last section concludes.

2) Knowledge externalities, migration flows and innovative capabilities

Externalities associated to the process of human capital accumulation were traditionally considered crucial factors in determining successful economic outcomes (*Romer, 1986, Lucas, 1988, Grossman, Helpman, 2001*) through their effect on technological and innovative capabilities. Moreover, since Marshall (1890) human capital externalities are also accepted as one of the main reasons to justify the existence of cities.
The main argument supporting this positive effect builds on the idea that an increase in the average local stock of human capital positively affects the local economic performance through two channels: the effect on individual productivity and the effect on aggregate productivity (*Moretti, 2004a*), implying that measures of aggregate human capital should matter in the determination of outcomes over and above individual characteristics (*Duranton, 2007*).

Moretti (2004a) distinguished between two fundamental kinds of human capital externalities: the technological externalities, generating technological increasing returns through the positive effect of human capital on all the other production factors due to the sharing of knowledge and skills among knowledgeable individuals (Lucas, 1988), and the pecuniary externalities generally associated with the marshallian labour market pooling effect (*Marshall, 1980*).

Conceptualizing the existence of such valuable knowledge externalities related to human capital and operating among individuals located in the same geographical context implies valuing more the role of location and geography.
Both kinds of externalities, either those mediated by the labour market and those operating through informal social interactions, tend to be geographically bound because of their embeddedness in local formal and informal institutional and relational contexts. The rationale of this statement is intuitive. As Gleaser et al (1992) pointed out "intellectual breakthroughs must cross hallways and streets more easily than oceans and continent". "Co-presence in the same physical space not only improves the visual contact, but goes beyond it into what can be called emotional closeness" (*Leamer, Storper, 2001*) contributing to create those untraded interdependencies fundamentally affecting the likelihood to

exchange valuable, individual embedded, tacit knowledge (*Storper, 1997*).

The geographically bound nature of such externalities could explain the persistence of economic differentials among different areas increasing the importance of a deeper understanding of the mechanisms behind their localized nature.
Addressing the latter issue implies discovering the key microeconomic linkages to endogenous macroeconomic growth (*Audresch, Feldman, 2004*), allowing for a comprehensive evaluation of the innovation process.

Building on that an increasing attention started to be devoted to disentangle the channels through which knowledge externalities related to human capital operate.
Starting from the evidence of human capital as individually embodied characteristic it was suggested that valuable knowledge tends to be geographically bound to the extent to which highly skilled individuals are not mobile in space. Because of the fact that "knowledge tends to travel along people who master it" (*Breschi and Lissoni, 2001*), the migration behavior of highly skilled individuals could challenge the geographically bound nature of knowledge externalities associated with human capital, contributing to extend their ray of action. Inflows of highly skilled individuals determine an increase in the local stock of valuable human capital positively affecting the likelihood of the emergence of knowledge externalities coming from the re-combination of new and pre-existent local knowledge (*Audresch, Feldman, 2004*).

In the analysis of the effectiveness of skilled migration in generating valuable knowledge externalities, the empirical economic literature adopted different perspectives.
Looking at the typology of externalities some authors focused on those that Moretti (2004a) defined as pecuniary externalities, meaning human capital externalities mediated by labour market. Among the most influential papers Gleaser et al. (1992) showed that in-flows of highly skilled workers, acting as additional sources of localized human capital, become a crucial determinant of higher rates of economic growth. Zucher, Darby and Brewer (1998) emphasized the role of star scientists as engine of innovation. This finding was further confirmed by Zucher, Darby and Armstrong (1998) applying the same hypothesis to the

analysis of the biotechnology sector in California. More recently Faggian and McCann (2006, 2009), looking at the migration behaviour of graduates in Britain, suggested that graduates contribute to determine the knowledge base of the local economy fostering innovative activities and that regional specific learning process in Britain are developed primarily via labour mobility.
Other authors looked at the pure technological externalities coming from social interactions among individuals exchanging knowledge and skills. Breschi et al (2010) suggested that the mobility of inventors is a powerful potential channel of knowledge diffusion, but that knowledge effectively spills when the transfer of knowledgeable individuals generate new social networks in the area of destination.

Some general predictions can be drawn from the existent literature. Externalities related to human capital seems to be a crucial determinant of the economic and innovative performance of local economies. Highly skilled migrants facilitating the transfer of valuable, individually embodied, tacit knowledge are a crucial channel through which these human capital externalities diffuse over space. The geographical relocation of knowledgeable individuals and the localized interactions among them (both market mediated or based on informal social interactions) become fundamental channels of knowledge diffusion determining the geographical scope of the externalities associated to human capital accumulation.

3) Addressing the geographical dimension of knowledge externalities related to skilled migration.

The introduction of the concept of human capital externalities within the economic literature implies abandoning the traditional approach to innovation as an a-spatial process, insensitive to issue like location and geography (*Audresch, Feldman, 2004*).
This evidence further suggested that the existent literature on innovation based on the Knowledge Production Function (KFP) approach (*Griliches, 1979, 1986, Jaffe, 1986*), generally adopted in a firm based perspective and built around the definition of the innovative output as function of predetermined innovative inputs, has to be considered myopic and misleading and that a theoretical approach looking at firms as an enclave, completely unaffected by neighbouring characteristics, is inadequate to analyze real world phenomena.
The attempt to account for these externalities in the innovation process stimulated a relevant theoretical and empirical effort devoted to the redefinition of the Knowledge Production Function approach in a place rather than a firm based perspective (*Audretsch, 2003; Audretsch and Feldman 1996; Crescenzi et al., 2007; Feldman, 1994; Fritsch, 2002; Varga, 1998*) in order to account for the territorial dynamics of innovation.

The change in terms of methodological perspective was a crucial step. However fully accounting for the geographical dimension of knowledge externalities related to human capital is far from being obvious. It is still questionable which is the geographical dimension related to these knowledge flows and how to translate it in geographical units of analysis.
The main aim is to identify geographical units of analysis that can be considered economically meaningful and for which it is possible to recover reliable data. Moreover, focusing on the effect of skilled individuals relocating in specific geographical context on the local innovative capacities, the analysis requires the definition of spatial entities that are likely to rule out any potential bias coming from neighbouring effects associated to commuting patterns.

Many of the existent contributions concentrate specifically on the effect of human capital externalities in cities. The focus on the urban dimension relies on both theoretical and empirical reasons. First, human capital externalities may be at the root of the existence of cities and they are expected to manifest themselves strongly at this level of analysis (*Marshall, 1890*). Second, urban areas, when properly defined, provide economically meaningful units of analysis in respect to arbitrarily defined administrative regions or states (*Duranton, 2007*).

However, this focus on the urban dimension is not always suitable to be applied to every country and it implies giving up any attempt to define a more general picture of the role of human capital externalities.

Some of the most relevant empirical papers on the role of human capital externalities in cities (*Moretti, 2004b, Ciccone and Peri, 2005*) tend to analyse US cities that are in terms of number, size and heterogeneity a fairly relevant sample. Moreover historical and cultural characteristics of the US support the idea of a strong centripetal effect of cities within the economic landscape.
It is questionable if the application of the same approach to any European country could be considered as appropriate as in the case of United States. European countries are much smaller and the number of observations is generally less relevant. Moreover the sample is more likely to be strongly unbalanced with capital cities, such as London in the case of Britain, resulting as outliers in terms of size, sectoral composition, attractiveness and economic performance.
Finally the literature focusing on cities is generally aimed to address the role of human capital externalities on variables that are likely to be locally determined and for which cities result to be an interesting sample such as wages or crime. Focusing on innovation could be more interesting to extend the geographical landscape in order to take into account a greater spectrum of analysis in respect to crucial variables such as, for example, differences in sectoral composition.

Following all these ensigns I suggest that the more suitable geographical unit of analysis in Britain is represented by the Travel to Work Areas (TTWAs) (Figure 1). These functional units are constructed in order to be self containing labour markets[1]. This implies that statistics at TTWAs level are referred to people living and working in each specific area and that any potential increase in the local stock of human capital due to inflows of skilled migrants take into account

[1]At least the 75% of people leaving in the area work in the same geo- unit

individuals that are changing permanently their residence and that are likely to work and live in that TTWA.
This further implies that I will be able to account for both technological externalities, coming from the exchange of skills and knowledge through informal contacts, and pecuniary externality explicitly mediated by the labour market. Moreover the sample of TTWAs contains both urban and non urban areas (Fig.2, Tab.1) implying the possibility to extend the analysis beyond the effect of human capital externalities in cities.

4) Data

The empirical analysis is based on a novel dataset constructed using as main data sources the Community Innovation Survey (CIS) and the Labour Force Survey (LFS).
The Community Innovation Survey (CIS) provides firm level microdata on innovation activities and related investments. It is particularly suitable within the framework of the Knowledge Production Function (KPF) because it allows the recovery of firm level data on the amount of capital and labour devoted to the innovation process. The survey is constructed in order to build a balanced sample among all the sectors of activity reducing the traditional bias of patents data toward some specific high innovative sectors. This implies the possibility of unexpected results in respect to the traditional empirical literature using patents data due to both the fact that the spatial distribution of sectors is not random and that their innovative profile is highly specific.
In order to exploit the longest available time series, avoiding the elimination of too many observations, two waves of CIS have been merged: CIS4[2] and CIS2007[3]. This procedure allows for the creation of a

[2] Based on data for 16445 firm for the time interval 2002-2004
[3] Based on data for 14872 firms for the time interval 2005- 2007

sample of 7072 firms that are present in both datasets[4]. Previous research using CIS data focused on a single wave. The rationale of the choice to consider a merged dataset lies on the possibility to control for time invariant fixed effect that are otherwise likely to affect the robustness of the results.
The obvious drawback of this choice is related to the elimination from the final sample of a large number of observations. However further analysis on the sample of excluded firms confirmed that the selection criterion was not systematically affected by firms or area specific characteristics such as the sector of activity, the size of the firm, the region where the firm is located[5] and its product or services specialisation[6]. This additional test supports the robustness of the sample used for the analysis.
In order to get more detailed info regarding the location of each firm, the final sample of firms coming from the CIS4 – CIS2007 was merged with the BSD2004 database[7]. For each firm present in the former sample it is possible to obtain the 7-digit postcode determining its exact location in space.

The dependent variable, based using CIS microdata, is defined as the share of innovation active firms located in each TTWA. Innovation active firms are those performing not only product and process innovation but any other kind of innovation activities (organizational, marketing, acquisition of new equipment and machinery). This broad measure of innovation is used in order to account for innovation both in manufacturing and services.
CIS data are further used to construct some of the firm based controls exploiting the availability of information regarding the size of the firm, the financial investments in innovation and the internal availability of high qualified personnel.

[4] This implies the elimination of 7800 firms that are present only in the CIS2007 survey and 9373 that are available only for the CIS4 survey. The inclusion of other waves of CIS was avoided because of the limited number of common observations. The choice of considering the same sample of firms over time lies in the possibility to reduce any potential bias coming from changes in firm level characteristics other than size, K and L.

[5] NUTS 1 level

[6] Descriptive statistics about the sample of excluded firms are not reported in the paper but are available on request

[7]Geo- referenced firm- based data with 7 digits postcode

Data regarding location specific characteristics, in particular the skilled structure of the population, comes from the Labour Force Survey (LFS). The LFS is a large dataset containing detailed data on individuals. The main advantage of using this source is the availability of a long time series and the opportunity to exploit the raw microdata constructing the TTWAs level controls that are more suitable for the theoretical interest of the paper.

These considerations are particularly relevant for the analysis. The paper focuses on the human capital externalities related to the migration flows of high skilled individuals. Data regarding migration and skills characteristics are often difficult to recover and the LFS allows focusing on a specific segment of the population. However it must be highlighted that the LFS is characterized by small within year sample sizes that are likely to generate more pronounced measurement errors (*Dustmann et al, 2003*) in particular when information is aggregated at a very detailed geographical unit of analysis such as TTWAs. This shortfall is likely to affect the precision of the estimates resulting in a higher level of standard errors[8].

The alternative source would have been characterized by Census data. They provide very accurate information on immigrants at a variety of spatial levels, but the frequency of data collection is low.

Examining the pros and cons of both data sources, I considered the LFS to be more coherent with the aims of the paper.

The LFS data is available at the Local Authorities (LA) level. The data have been re-aggregated at TTWA level using a postcode based weighting scheme[9].

The final TTWA based database includes 225 observations[10] for two periods[11] coming from:

- CIS data aggregated at TTWA level;
- LFS data aggregated at TTWA level averaged for the two periods taken into account.

[8] Note that measurement errors due to sampling imprecisions are supposed to be 0 in average. This implies that they are conceptually different from systematic measurement errors coming from misreporting, poor data definition etc.

[9] Additional information are available on request

[10] Some TTWAs are missing because of unavailability of data or changes in the administrative boundaries (and subsequent un-matching postcodes) during the time period took into account.

[11] 2002-2004 and 2005-2007

All the regressors are constructed taking the difference between the two time intervals. Table 2 reports the list of variables coming from the CIS data while Table 3 reports the list of variables coming from the LFS.

5) Identification strategy

The main aim of this paper is to analyse the role of skilled migration on the innovative performance of British local areas assuming that the mobility of skilled individuals can be considered a crucial channel of knowledge diffusion, contributing to the extension of the geographical scope of human capital externalities.
The definition of the most suitable estimation procedure has to take into account the methodological indications coming from both the literature on innovation and that on migration.

The mainstream approach in the literature on innovation builds on the Knowledge Production Function (KPF) approach originally defined in a firm based perspective (*Griliches, 1979, 1986, Jaffe, 1986*) and subsequently adapted to take into account the spatial dimension of innovation (*Audretsch, 2003; Audretsch and Feldman 1996; Crescenzi et al., 2007; Feldman, 1994; Fritsch, 2002; Varga, 1998*).

Regarding the literature on migration the dominant methodology refers to the work of Borjas (1999) as the "spatial correlation" approach. The main idea is that the effect of migration on a certain dependent variable (generally identified with labour market outcomes such as wages or unemployment) can be identified from the spatial correlation between migrants' inflows and changes in the outcome variables within each geographical unit of analysis. As anticipated in the US context such spatial units are generally identified with standard metropolitan statistical areas. In the case of Britain Travel to Work Areas (TTWAs) have been identified as the most suitable geographical unit of analysis.

Building on both strands of literature the estimation procedure adopted is constructed around a place based Knowledge Production Function (KPF) defined at TTWAs level inserting the local variation in the skilled population (used as proxy for migration) as crucial regressor in line the conclusions arising from the traditional "spatial correlation" approach (*Borjas, 1999*). This implies that the traditional KPF, based on the assumption of the innovation outcome as determined by the amount of internal inputs devoted to the process, can be considered the baseline model that will be further extended to account for additional external inputs.

The main challenge in performing this kind of estimation strategy is related to the endogeneity of the regressor of interest. Immigrant inflows and innovative performances may be correlated because of common fixed influences. This implies that the immigrant population may be concentrated in certain areas as a consequence of historic settlement patterns, leading to a positive or negative correlation between skilled migration and innovative performance even in absence of a genuine causality.

Moreover the estimation is potentially affected by a reverse causality bias. It was argued that skilled migration inflows can be considered a fundamental determinant of innovation acting as channels of knowledge transfer and reducing the geographically localized nature of human capital externalities. The empirical proof of the correlation is however controversial. It is in fact reasonable to assume both that migration of highly skilled individuals stimulates further innovation augmenting and enriching the local stock of human capital and that the knowledge capabilities of a region, clearly shown by the local innovative performance, can affect the migration behaviour of skilled individuals (*Faggian, McCann, 2006*). Highly innovative TTWAs could be generally able to attract more skilled migrants because the return of their higher education is greater in areas where this stock of human capital is more intensively exploited. This is likely to generate an upward bias in the estimates because any depressing impact of immigration on innovation (such as for example a displacement effect on skilled natives) could be masked by the fact that inflows of skilled migrants occur in areas where this potential negative effect if offset by positive economic shocks (*Dustmann et al, 2003*).

The statistical solution to the endogeneity problem lies in the possibility of eliminating the area fixed effect and to control for the

reverse causality. The former issue is addressed by estimating the relationship using differences, which implies relating the changes in immigrant concentration between two points in time to changes in the innovative performance of the areas of destination.
The latter shortfall is controlled for adopting an instrumental variable approach (2SLS) which implies finding other measured variables that are likely to be correlated with inflows, but not otherwise associated with the dependent variable through unobserved local characteristics.
Combining the estimation in differences and the instrumental variables approach it is possible to recover robust and reliable estimates as long as the chosen instrumental variable is appropriate.

The estimation will then be performed using Ordinary Least Squares (OLS) in Differences[12] (see Dustmann et al., 2003) and the estimated equation will takes the following form:

$$\begin{aligned} D(Inn^{c}_{t-(t-1)}) = \beta_0 + \beta_1 D(K^{c}_{t-(t-1)}) + \beta_2 D(L^{c}_{t-(t-1)}) + \\ + \beta_3 D(highskills_{t-(t-1)}) + \beta D(X_{t-(t-1)}) + D(\varepsilon_{t-(t-1)}) \end{aligned} \quad (1)$$

Where:

- $D(Inn^{c}_{t-(t-1)})$ is the variation between period t and period t-1 in the share of innovation active firms in TTWA c;
- $D(K^{c}_{t-(t-1)})$ is the variation between period t and period t-1 in the share of firms in TTWA c investing financial resources in innovation enhancing activities;
- $D(L^{c}_{t-(t-1)})$ is the variation between period t and period t-1 in the average ratio of skilled/unskilled employees within firms located in TTWA c;
- $D(highskills^{c}_{t-(t-1)})$, the regressor of interest used as proxy for migration, is the variation (in mean) [13] between period t and period t-1 in the share of skilled population in TTWA c;

[12] Each variable is inserted in terms of variation between two time intervals corresponding to the waves of the CIS: 2002-2004 and 2005-2007.
[13] All the variables constructed using LFS data are averaged within the two time intervals (2002-2004 and 2005-2007) in order to merge them with data coming from the CIS.

- $D(X^{c}_{t-(t-1)})$ is the average variation (in mean) between period t and period t-1 in other TTWA relevant controls;
- $D(\varepsilon^{c}_{t-(t-1)})$ is the difference in the error term between the two periods allowing to eliminate unobserved time invariant fixed effects.

Regarding the instrumental variable strategy to control for the potential bias due to reverse causality a number of different instruments were traditionally adopted in the literature. Time lag is the simplest approach (*Dustmann et al, 2005*). Accessibility measures were often used building on the idea that immigrants tend to cluster close to main access points (*Ottaviano and Peri, 2006*). Both approaches are hardly adoptable in this case. Lagged values are likely to be weakly correlated with actual changes in the high skilled population because during the period taken into account Britain has experienced a relevant shock due to the A8 accession in 2004 (*Dustmann et al, 2010*). From the other side accessibility measures such as ports (*Ottaviano and Peri, 2006*) or land borders (*Bellini et al, 2008*), traditionally adopted in the case of US, are probably less consistent with the geography of Britain. Moreover they strongly rely on the assumption that immigrants tend to remain clustered in the neighboring areas of the main access points, but this expectation is likely to be less pertinent in the case of high skilled migrants.

My methodological choice was therefore oriented to adopt a shift share instrumental variable approach as that popularised by Card (2005, 2007). The main intuition behind this strategy is that the initial share of immigrants is a relevant predictor of subsequent inflows because migrants tend to be attracted by pre-existing communities.
I calculated the share of population in each TTWA by country of birth in 2001 using this initial share to attribute to each group the growth rate in the skilled population of that group within the whole of Britain between 2002 and 2007.
To construct the specific instrument I built on Ottaviano and Peri (2006). Let $(CoB^{c}_{i})_{2001}$ denote the share of population born in country *i*, living in TTWA c in 2001 defined as base year, then $(CoB_{i})_{2001}$ is the share of population born in country *i* among all the British resident at

time *t*. Assume that $(g_i)_{2007-2002}$ is the British national growth rate of high skilled population for each country of birth *i* between 2002 and 2007.

The predicted population per country of birth *i*, in each TTWA c at time t will be:

$$(CoB_i^c) = (CoB_i^c)_{2001}[1 + (g_i)_{2007-2002}] \qquad (2)$$

6) Results and Robustness Checks

Results on the full sample of TTWAs are reported in Table 4. The number of observations drops to 213 because there are 10 TTWA for which the dependent variable is not available, one for which the measure of internal labour force is missing and another one for which both variables[14] are not recoverable.

Column 1 report the standard KFP structure interpreted as baseline model where the innovation output is related to internal inputs, capital and labour, controlling for the size of the firms. Results show that the role of financial investments in innovation activities is largely preponderant.

Column 2 adds the fundamental regressor of interest, namely the variation in the share of high skilled individuals in respect to the total resident population in each TTWA.

At this stage I do not find evidence of a positive effect of the variation in the skilled population on the innovative performance of local areas.

The results still confirm the relevance of financial investments and a relative positive correlation between the local propensity to innovate and the proportion of small and medium enterprises in each TTWA. Despite being generally at odds with the empirical literature on

[14] Due to that the following TTWAs are eliminated from the sample: Badenoch, Barrow in Furness, Dolgellan & Barmouth, Dornoch & lairg, Eilan Siar, Frasembourgh, Pwllheli, Shetland Islands, Stranraer, Thurso and Ullapool & Gairloch. They are all remote rural areas and their elimination is not likely to bias the sample.

innovation using patents data as dependent variable and suggesting a positive correlation between size and firms innovative capabilities, the latter result correlates with the main features of the sample characterized by an higher proportion of small and medium enterprises.
Column 3, 4, 5 control for additional time variant TTWA characteristics including in the regression respectively the variation in population density in each TTWA (Col.4), the variation in the proportion of young population and in the share of employment in manufacturing (Col.5) and the variation in the level of long term unemployment (Col.6). Once these further controls (none of them statistically significant) are included, the regressor of interest, the variation in the share of skilled population, becomes significant at 10% level and its significance level remains stable in all the specifications.
This preliminary evidence suggests that there is a positive effect associated with the variation in the share of skilled individuals, but this effect is likely to be mediated by other TTWA peculiarities.

As commented before the estimation provided using Ordinary Least Squares (OLS) in differences are able to control for a potential bias due to unobserved time invariant fixed effect, but do not allow to take into account the potential endogeneity coming from the reverse causality between the variation in the share of skilled population and the innovative performance of local areas.
In order to rule out this additional source of biasedness an Instrumental Variables approach (2SLS) is adopted.
The variation in the share of skilled migrants is instrumented by the shift-share instrument constructed using LFS data on country of birth (CoB). Results are reported in column 6. The regressor associated to the variation in the proportion of highly skilled individuals remains significant at 10% level supporting my research hypothesis. Moreover the magnitude of the coefficient is fairly relevant suggesting that one point increment in the share of highly skilled population generates a three points increment in the share of local innovative firms. The standard errors, as expected, are slightly higher then before confirming that the precision of the estimates is affected by the drawbacks related to the LFS data. The estimates further confirm the relevance of capital investments and the positive role of small and medium businesses, while, in respect to the standard OLS estimation, I find a significant positive effect aligned with the average proportion of highly skilled

employees working in the firms located in each TTWA (internal labour force)[15].

As suggested before the estimation provided using the combination of OLS in differences and Instrumental Variable approach is able to recover robust predictions as long as the instrumental variable strategy can be considered appropriate. Some robustness checks on the reliability of the Instrumental Variable approach adopted are performed in order to confirm the consistency of the estimates.
As initial standard test I report the first stage of the IV regression (Tab.5). A good instrument is expected to be significantly correlated with the instrumented regressor. Results reported in Tab 5 confirm the reliability of the instrument that appears to be significantly correlated with the regressor of interest. However the econometric literature on the dangers related to weak instruments (*Staiger and Stock, 1997, Stock and Yogo, 2005*) suggest that a good first stage could be not enough to support the robustness of the instrument. To rule out the risk of a weak instrument bias I refer to both the rule of thumb proposed by Staiger and Stock (1997) and the Stock and Yogo (2005) thresholds values. As reported in table 6 the F stat of the first stage is well above the value of 10 and it passes the Stock and Yogo test at 15% maximal IV size.

In second instance it is worth testing if the statistical significance of the regressor of interest is dependent (as suggested by the OLS estimates) on the inclusion of additional controls at TTWA level. In order to ensure that the positive effect associated with skilled migrants is robust and that it is not systematically affected by area characteristics, the IV estimation has been replicated progressively eliminating all the additional TTWA controls. Results reported in table 7 confirm that the positive significant effect of high skilled immigrants is unaffected by the specification of the model given that both the magnitude and the statistical significance level associated with the regressor of interest is unchanging.
Finally to provide further evidence on the appropriateness of the instrument adopted, a standard OLS regression using the instrument

[15] It is worth noting that despite the same significance level the magnitude of the coefficient differs significantly between the internal skilled labour force (employees in each firm) and the proportion of external skilled population in each TTWAs. This evidence has to be interpreted in the light of the sample composition composed mainly by SME that are more likely to refer to external sources of knowledge rather than to internal structures.

(CoB) as the dependent variable and including all the observed TTWA characteristics as regressors has been run. The results shown in table 8 confirm that the instrument is not correlated with any other variable used as control in the main specification. This evidence strongly confirms that my instrumental variable is isolating exactly the effect that I'm interested in, namely the role of high skilled migration on the innovative performance of British TTWAs.

Robust evidences in support of the fact that the instrumental variable approach adopted is not suffering from weak instrument bias and it is not dependent on the specification of the model has been provided by the empirical investigation. However it is still possible that the instrument is correlated with other variables not inserted in the regression, but potentially affecting the interpretation of the estimates.

In particular there is a fairly relevant literature accounting for the counter effect of native outflows correlated to an increase in immigrants in a given area. Such effect, often identified as "displacement", is a strongly debated issue in the existing literature, but there is still no consensus on its magnitude (*Borjas, 1994, Card, 2005, 2007*). Dustmann et al. (2008) suggested that this displacement effect is relatively small in Britain in respect to the US due to the lower level of internal migration. Moreover it is reasonable to assume that this effect, generally analysed in respect to the lower skilled segment of the population and justified by the increasing in labour market competition due to the higher number of individuals in the lower tiers of the skills distribution, is likely to be less relevant for highly skilled individuals for whom competition in the labour market is more related to specific skills.

Despite this theoretical reasoning, in order to rule out any doubt on the fact that the instrument if somehow correlated with such native outflows generating difficulties in the interpretation of the estimates, I regress the instrument itself on the variation in the British population in each TTWA. As shown in table 9, controlling for other TTWA characteristics, the relation is insignificant.

Finally, to ensure that the instrument is isolating exactly the variation within the segment of the highly skilled migrants and that it is not correlated with inflows of low skilled individuals the instrument has been regressed on the variation in the share of the lower skilled population. The results reported in table 10 confirm that even in this case the relation is insignificant.

I can strongly support the assertion that the estimation procedure adopted to recover the causal effect of skilled migrants on the innovative performance of local areas in Britain is able to provide robust and reliable estimates. The estimation using OLS in differences allows for the elimination a potential bias due to unobserved TTWA fixed effect while the Instrumental Variables approach rules out the risk of endogeneity bias due to reverse causality. The instruments passed a number of robustness checks, further confirming the consistency of the results.

7) Innovative Performance, Skilled Migration and Human Capital Externalities in British Cities

In compliance with the existing literature on the role of human capital externalities it is worth testing for the presence of an additional effect associated with the urban dimension. Since Marshall (1890) human capital externalities were traditionally supposed to have a greater influence in cities. However, as already explained, due to the characteristics of the data used in the analysis and the peculiarity of the British economy, the veracity of this supposition remains unsure.

The main aim of this section is to provide a deeper understanding of the dynamics behind the effect and significance of human capital externalities in urban areas. The number of urban TTWAs in the sample is too small to provide consistent estimates on the restricted sample. In order to recover the effect of the urban dimension an alternative strategy has been adopted.

In particular, instead of restricting the sample to the urban TTWAs, I constructed a new independent variable that is methodologically equal to the previous one[16], but is restricted to those firms operating in sectors that are more likely to be concentrated in urban areas.

[16] Number of the innovation active firms over the total number of firms in each TTWA

This indirect measure allows for the preservation of the same number of observations and it is also able to provide some suggestive indications regarding the innovative dynamic of British urban areas.
The choice of the sectors is crucial. The selection criterion adopted in this case took into account several considerations. Since the paper is based on survey data, in order to have a sufficient number of observations in each sector, I am compelled to consider a broader sectoral classification corresponding to the sic frame categories reported by the CIS microdata. Fourteen sectors[17] split between manufacturing and services have been identified and for each of them it was possible to calculate the share of firms localized in urban TTWAs. Urban sectors were identified as those having an above average[18] percentage of businesses commonly located in urban areas.
To further check the robustness of the selection criterion London has been excluded from the sample in order to control for the peculiar characteristics of the capital city. This implies the elimination of approximately 10% of the total number of businesses within the CIS sample. The sectoral composition of urban areas remains generally unchanged[19].
As expected the sectoral composition of British cities tends to be skewed toward services that appear to be strongly concentrated in cities (Tab. 11).

The econometric analysis is provided using the new dependent variable focusing on urban sectors. Results reported in table 12 show

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[17] Mining and Quarrying, Manufacturing of food, clothing and wood, Manufacturing of fuels, chemical and plastic, Manufacturing of electrical and optical, Manufacturing of transport equipments, other Manufacturing, Electricity, gas and water supply, Constructions, Wholesale Trade, Retail Trade, Hotels and Restaurants, Transport and Storage, Financial Intermediation and Real Estate

[18] This criterion implies the selection of those sectors with more of 64% of the total number of firms localized in urban TTWAs. The selected sectors are manufacturing of fuels, chemical and plastic, Manufacturing of electrical and optical, Construction, Wholesale Trade, Hotels and Restaurants, Transport and Storage Financial Intermediation and Real Estate. These sectors represents about the 80% of the total number of firms localized in urban areas.

[19] Manufacturing in Transport equipment is added to the sample of sectors showing a higher attitude to be localized in urban areas. In reality raw data show that this is just due to a statistical effect. The threshold level to assign a sector to urban areas (calculated the average share number of firms located in urban areas) is lower than before. This implies that the elimination of London from the sample is affecting the degree of concentration of certain sectors in urban areas rather than the sectoral composition.

that the effect of the variation in the share of highly skilled individuals is positive but not statistically significant either in the OLS specification or after controlling for the endogeneity due to reverse causality through IV[20]. This result is robust to changes in the sample composition[21]. The significance levels of the other variables, in particular the financial investments in innovation, remains consistent with the results obtained from the full sample.

The absence of an "urban effect" within the sample deserves some additional considerations. LFS data generally suggests that urban areas experienced a higher positive variation in the highly skilled population in respect to non urban areas. It remains to question what breaks the correlation between such skilled inflows and the innovative performance in the case of British cities.
The reason lies with both the characteristics of the data used and the sectoral composition of British cities.

As a preliminary consideration it is worth underlining that CIS data tends to reproduce a balanced sample in terms of sectoral composition and to focus on small and medium businesses[22]. This means that the paper is focusing on a typology of innovation that is extremely different from the one analysed using patents data as dependent variables. This clarification helps to justify why some of the results are fairly unusual in respect to the standard innovation empirical literature.

The sectoral composition of British urban areas plays an important role in explaining the lack of empirical support to the existence of valuable knowledge externalities in cities. I suggest that, more than particular local characteristics reducing the effectiveness of human capital externalities associated with skilled migration, the absence of the "urban effect" is due to the systematic lower innovative propensity of sectors traditionally concentrated in urban areas.

[20] This result is confirmed by the basic test based on the inclusion of the urban dummy within the main regression

[21] Columns 1 and 2 report results for the full sample of TTWA, columns 3 and 4 eliminate London from the sample. Fist stage estimates are reported only for the specification without London (Tab. 13 and 14) because for the one on the full sample it is equivalent to the results reported in table 5 and 6.

[22] About 79% of the total number of firms is defined as sme

The sectoral composition of British cities tends to be strongly skewed toward services specialisation: within the total sample of firms coming from the CIS[23] about 66% of the sectors that are more likely to concentrate in urban areas (the so called urban sectors) are classified as services (Tab.15).
Despite the broad measure of innovation, constructed in order to take into account forms of innovation activities other than process and product innovation, services are systematically less innovative than manufacturing sectors (Tab.16). Looking in depth at the innovative performance of urban areas the sectors showing a higher concentration in cities (accounting for about the 79% of the total number of firms in urban TTWAs) are steadily characterised, on average, by a lower innovative performance (Tab. 17). This result is much clearer disentangling the percentage of innovative firms by sic frame. As showed in Table 18 the sectors with the highest innovative performance among those that are more likely to be concentrated in cities are Manufacturing in fuels, chemical and plastic and Manufacturing in electrical and optical that account for just about the 18% of the total number of firms located in urban areas.

These descriptive statistics reinforce the reasoning behind the insignificant effect of skilled migration in urban areas in respect to the effect found looking at the total sample of British TTWAs. Furthermore it is important to emphasise that the classification of urban TTWAs is likely to be restrictive in respect to two main considerations. Firstly, looking in particular at the existent literature on the effect of human capital externalities in cities Metropolitan Areas, usually used to account for the role of human capital externalities in US cities, are generally larger than British TTWAs. It is possible that the lack of evidence in the British sample is partially due to the smaller size of the geographical unit; TTWAs may be unable to account for the broad concept of metropolitan areas, underestimating the potential effect of these externalities. Secondly, and relating to the previous consideration, it is likely that those sectors showing a better innovative performance (for a large part manufacturing) are concentrated in the surrounding areas of urban centres rather than within the cities.

[23] 7072 for two years

8) Conclusions

Human externalities, as source of endogenous growth, have gained popularity in the last few decades (*Lucas, 1988, Grossman and Helpman, 2001*). Within the literature on innovation they were supposed to be able to foster innovation and productivity (*Jaffe et al, 1993, Saxenian, 1994*). Despite this powerful theoretical background, the empirical literature is still controversial (*Moretti, 2004a*) and there is still no consensus regarding the mechanisms at play behind the effect of human capital externalities on the economic and innovative outcomes (*Duranton, 2007*).

Understanding these mechanisms is key to providing a deeper knowledge of the micro-foundation of macroeconomic growth (*Audretsch and Feldman, 2004*). The lack of clear evidences is partially due to the endogenous characteristics of such externalities that, "by their very nature, leave no obvious paper trail by which they can be tracked or measured" (*Duranton, 2007*) as well as to the existence of serious challenges in addressing an unbiased estimate of their effect.

This paper is aimed at contributing to the debate on the role of human capital suggesting that the transfer of knowledge associated with the mobility of highly skilled individuals can be considered a crucial mechanism underlying their positive effect on the innovative performance of local areas. I found that human capital externalities coming from the migration behaviour of skilled individuals are a significant determinant of innovation in British local areas. The estimation procedure addresses the main shortfalls potentially biasing the result: the correlation between migration and area fixed characteristics and the reverse causality between migration and innovation. The instrumental variable approach adopted to address causality proved to be robust to model specification and other robustness checks.

However, due to the particular characteristics of the sample of analysis, I do not find evidence in support for the existence of an additional effect of human capital externalities in cities.
This empirical evidence is explained by several considerations.
In the first instance, using CIS data, I'm implicitly accounting for a typology of innovation behaviour that differs from to the one

addressed in the literature on innovation using patents data. My sample is mainly characterized by small and medium businesses, not necessarily concentrated in high innovative sectors with a relevant percentage of firms operating in manufacturing.
Second and correlated to the previous consideration, the lack of effect in urban areas can be explained by the sectoral characteristics of British cities, clearly skewed toward services sectors systematically characterized by a lower innovative performance.
Third, it is possible that the dimension of my geographical unit contributes to the underestimation of the role of these externalities. I have argued that, in particular in respect to the traditional literature on human capital externalities using Metropolitan areas as main unit of analysis, British TTWAs are potentially unable to fully account for the dimension of the metropolitan areas. This shortfall is expected to be exacerbated by particular characteristics of the CIS data, where innovation tends to be concentrated in manufacturing sectors that are more likely to be localized in the extreme periphery of core urban centres.

The paper offers some reliable statistical evidences in support for the role of human capital externalities, coming from skilled migration, on the innovative performance of local areas. Despite that, in concordance with the existing literature, it is still hard to provide definitive conclusions regarding the size of these externalities. This is partly due to the shortfalls related to the common measures of immigration that are affected by different measurement problems. Regarding the LFS, that in the case of Britain is still the most suitable data source especially to address the role of migration by different skills segments, sampling imprecision due to small sample size may be an issue. In spite of being zero on average and conceptually different from measurement errors due to misreporting and poor data definition (*Dustmann et al, 2003*), this characteristic of the data is likely to generate a certain degree of attenuation bias leading to the estimation of a smaller effect in respect to its real magnitude. This implies that, despite being strongly reliable, the results, confirming the effect of human capital externalities coming from local inflows of skilled individuals, are likely to partially under-represent the magnitude of the real effect.
More research is needed on the topic in order to overcome the empirical challenges related to the estimation and to solve the drawbacks concerning data issues. The precision of the estimates and

the provision of clearer results regarding the magnitude of the effect are likely to improve alongside the quality of data.

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Tables and Figures

Figure 1: British Travel to Work Areas (TTWAs)

Figure 2: Urban Travel to Work Areas (TTWAs)

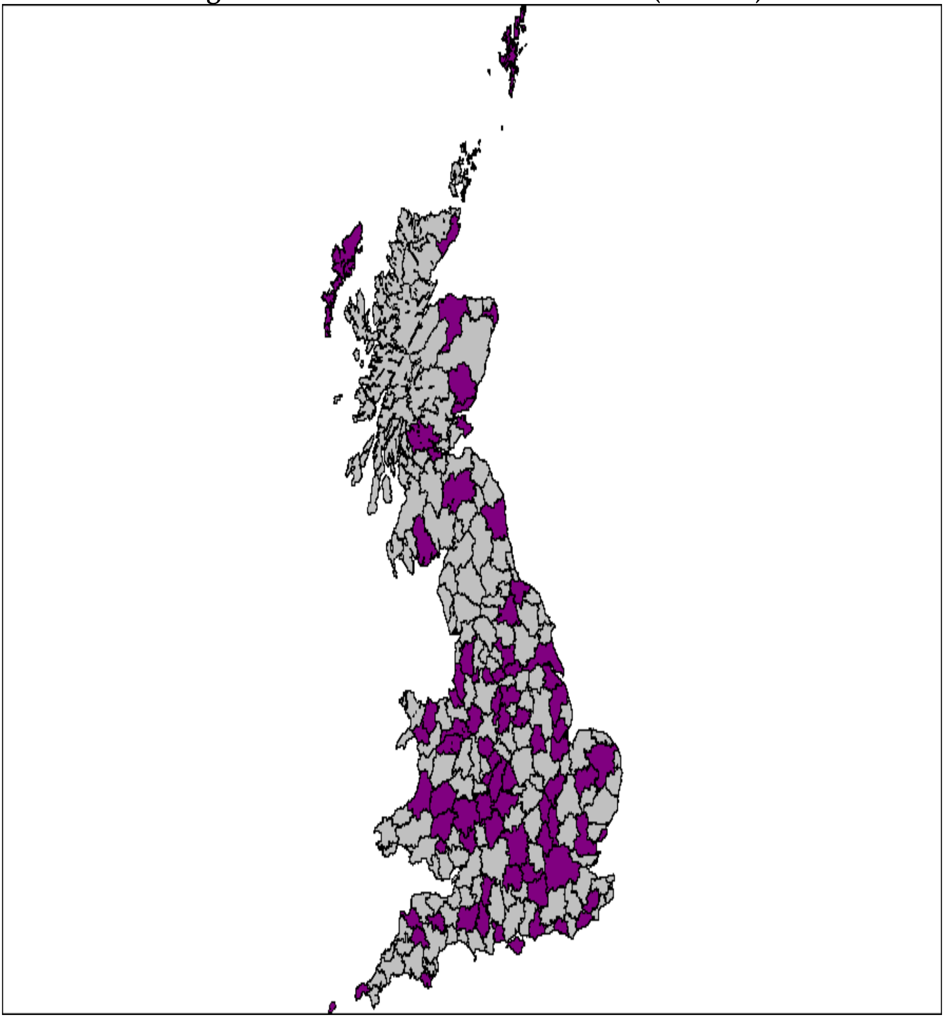

Table 1: Urban/ Non Urban Travel to Work Areas (TTWAs)

Type	N	Freq.	Cumulative
Urban	79	35.11	35.11
Non Urban Welsh	22	9.78	44.89
Non Urban Northern Scotland	24	10.67	55.56
Non Urban Southern Scotland	10	4.44	60.00
Non Urban Northern England	20	8.89	68.89
Non Urban Southern-West England	29	12.89	81.78
Non Urban Rest of England	41	18.22	100.00
Total	225	100.00	

Source: ONS/ CIS

Table 2: CIS Variables

Variable	Description
DInn	Variation in the share of innovation active firms (process or product innovation and other innovation activities[24])
DInn_urban	Variation in the share of innovation active firms operating in urban sectors[25]
Dcap	Variation in the share of firms investing in innovation related activities[26]
Dlabour	Variation in the average percentage of graduate employees within the firms
Dsme	Variation in the share of small and medium enterprises

Note: All the variations are calculated as variation between the two periods corresponding to the CIS waves (2002-2004 and 2005-2007)
All variables are calculated at TTWA level

Table 3: LFS Variables

Variable	Description
Dhiskills	Variation in the share of high skilled individuals (degree or equivalent)
Dpop_dens	Variation in the population/surface ratio
Dyoung_24	Variation in the share of individuals with less than 24 year old
Dmf	Variation in the share of employment in manufacturing
Dltu_share	Variation in the share of long term unemployment
Dlow_skills	Variation in the share of low skilled individuals (no qualification)
Dbrit_hs	Variation in the share of high skilled British population

Note: All the variations are calculated as variation in mean between the two periods corresponding to the CIS waves (2002-2004 and 2005-2007)
All variables are calculated at TTWA level

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[24] Other innovation activities account for organizational innovation, marketing innovation, acquisition of new equipments or machineries

[25] Mining and Quarrying, Manufacturing of food, clothing and wood, Manufacturing of fuels, chemical and plastic, Manufacturing of electrical and optical, Manufacturing of transport equipments, other Manufacturing, Electricity, gas and water supply, Constructions, Wholesale Trade, Retail Trade, Hotels and Restaurants, Transport and Storage, Financial Intermediation and Real Estate

[26] Intramural, extramural equipment, external knowledge, training, design, marketing

Table 4: Estimation Results (1)

	(1)	(2)	(3)	(4)	(5)	(6)
Dep.Var.: DInn	**OLS**	**OLS**	**OLS**	**OLS**	**OLS**	**2SLS**
Dcap	0.858***	0.858***	0.857***	0.858***	0.859***	0.856***
	(0.0499)	(0.0488)	(0.0492)	(0.0488)	(0.0467)	(0.0440)
Dlabour	0.0008	0.0017	0.0018	0.0019	0.0019	0.0049*
	(0.0013)	(0.0015)	(0.0016)	(0.0018)	(0.0017)	(0.0028)
Dsme	0.171	0.179*	0.183*	0.193*	0.193*	0.213**
	(0.108)	(0.106)	(0.104)	(0.0992)	(0.101)	(0.0983)
Dhiskills		0.734	0.779*	0.752*	0.747*	3.304*
		(0.456)	(0.470)	(0.449)	(0.448)	(1.895)
Dpop_density			0.0005	0.0006	0.0006	0.0011
			(0.0004)	(0.0004)	(0.0004)	(0.001)
Dyoung_24				-0.152	-0.147	0.0661
				(0.223)	(0.226)	(0.257)
Dmf				0.0680	0.0652	0.103
				(0.0921)	(0.0905)	(0.0966)
Dltu_share					0.0117	0.0062
					(0.0415)	(0.0414)
Constant	0.0047	-0.0016	-0.0039	-0.0043	-0.0046	-0.0260
	(0.0058)	(0.0054)	(0.0061)	(0.0070)	(0.0066)	(0.0180)
Observations	213	213	213	213	213	213
R-squared	0.887	0.888	0.888	0.889	0.889	0.871

Source: ONS/ CIS-LFS

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 5: First Stage Results (1)

	First Stage
Dep.Var.: Dhiskills	
Dcap	0.0008
	(0.003)
Dlabour	-0.0008**
	(0.0003)
Dsme	-0.0069
	(0.010)
Dpop_density	-0.0002
	(0.0001)
Dyoung_24	-0.0872**
	(0.0393)
Dmf	-0.0175
	(0.0141)
Dltu_share	0.0035
	(0.005)
CoB	0.0271***
	(0.008)
Constant	-0.018**
	(0.008)
Observations	213
R-squared	0.115

Notes: Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: First Stage Statistics (1)

Variable	**Partial Rsq**	**F(1,204)**	**P-value**
Dhiskills	0.0659	11.08	0.000

Table 7: Robustness Check (1)

	(1)	(2)	(3)	(4)	(5)
Dep.Var.: DInn	**2SLS**	**2SLS**	**2SLS**	**2SLS**	**2SLS**
Dhiskills	3.304*	3.279*	3.346*	3.357*	3.508*
	(1.895)	(1.908)	(1.903)	(1.918)	(2.048)
Dcap	0.856***	0.855***	0.857***	0.857***	0.860***
	(0.0440)	(0.0459)	(0.0457)	(0.0458)	(0.0455)
Dlabour	0.0049*	0.0049*	0.0048*	0.0048*	0.0051*
	(0.0028)	(0.0028)	(0.0028)	(0.0029)	(0.0028)
Dsme	0.213**	0.213**	0.212**	0.215**	0.210**
	(0.0983)	(0.0974)	(0.0982)	(0.0974)	(0.100)
Dpop_density	0.0011	0.0010	0.0010	0.0010	
	(0.0008)	(0.0007)	(0.0007)	(0.0007)	
Dyoung_24	0.0661	0.0608	0.0491		
	(0.257)	(0.255)	(0.254)		
Dmf	0.103	0.104			
	(0.0966)	(0.0978)			
Dltu_share	0.0062				
	(0.0414)				
Constant	-0.0260	-0.0256	-0.0275	-0.0280	-0.0254
	(0.0180)	(0.0187)	(0.0186)	(0.0192)	(0.0183)
Observations	213	213	213	213	213
R-squared	0.871	0.872	0.870	0.870	0.866

Source: ONS/ CIS-LFS

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 8: Robustness Check (2)

	(1)
Dep.Var.: CoB	**OLS**
Dpop_dens	0.0009
	(0.0007)
Dyoung_24	0.1530
	(0.3961)
Dmf	0.0684
	(0.1810)
Dltu_share	-0.0391
	(0.0267)
Constant	0.9797***
	(0.0103)
Observations	213
R-squared	0.011

Notes: Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9: Robustness Check (3)

	(1)
Dep.Var.: CoB	**OLS**
Dbrit_hs	-1.8665
	(1.2889)
Constant	.9541***
	(.0124)
TTWA Controls[27]	YES
Observations	213
R-squared	0.094

Notes: Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 10: Robustness Check (4)

	(1)
Dep.Var.: CoB	**OLS**
Dlow_skills	-.1652
	(.1457)
Constant	.9760
	(.0067)
Observations	213
R-squared	0.004

Notes: Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

[27] Variables inserted in the main specification of the model as TTWAs controls

Table 11: Urban Areas sectoral composition by sic frame

SIC FRAME	% of firms in Urban TTWAs (full sample)	% of firms in Urban TTWAs (excluding London)
Mining and quarrying	46.9	41.4
Mfr of food, clothing, wood	61.6	59.3
Mfr of fuels, chemicals, plastic	67.1	65.7
Mfr of electrical and optical e	70.8	68.4
Mfr of transport equipments	62.0	62.0
Mfr not elsewhere classified	59.8	59.2
Electricity, gas & water supply	47.2	36.7
Construction	65.7	62.2
Wholesale trade (incl. cars & bikes)	67.1	63.7
Retail trade (excl cars & bikes)	60.5	57.1
Hotels & restaurants	63.8	58.0
Transport, storage	71.0	67.4
Financial intermediation	80.7	72.4
Real estate, renting & business	73.9	69.3

Source: ONS/ CIS

Notes: CIS microdata are treated as confidential. Raw data on the number of firms are not reported to avoid disclosure

Table 12: Estimation Results (2)

	Full Sample		Excluding London	
	(1)	(2)	(3)	(4)
Dep.Var: Inn_urban	**OLS**	**2SLS**	**OLS**	**2SLS**
Dcap	0.661***	0.661***	0.661***	0.661***
	(0.0547)	(0.0538)	(0.0547)	(0.0538)
Dlabour	0.0184	0.0184	0.0184	0.0185
	(0.0224)	(0.0229)	(0.0224)	(0.0229)
Dsme	0.0002	0.0002	-0.0001	0.000200
	(0.191)	(0.186)	(0.191)	(0.186)
Dhiskills	0.584	0.585	0.604	0.632
	(0.863)	(2.709)	(0.867)	(2.741)
Dpop_density	-0.0025	-0.0025	-0.0025	-0.0025
	(0.0023)	(0.0022)	(0.0023)	(0.00220)
Dyoung_24	1.350	1.350	1.353	1.355
	(1.064)	(1.130)	(1.064)	(1.132)
Dmf	0.238	0.238	0.239	0.239
	(0.185)	(0.179)	(0.185)	(0.179)
Dltu_share	0.0418	0.0418	0.0420	0.0420
	(0.0729)	(0.0711)	(0.0729)	(0.0711)
Constant	0.0123	0.0123	0.0123	0.0121
	(0.0169)	(0.0260)	(0.0169)	(0.0261)
Observations	213	213	212	212
R-squared	0.567	0.567	0.567	0.567

Source: ONS/ CIS-LFS

Notes: Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 13: First Stage Results (2)

	First Stage (excluding London)
Dep.Var.: Dhiskills	
Dcap	0.0008
	(0.0034)
Dlabour	-0.0008**
	(0.0003)
Dsme	-0.0068
	(0.0104)
Dpop_density	-0.0002
	(0.0001)
Dyoung_24	-0.0876**
	(0.0393)
Dmf	-0.0176
	(0.0141)
Dltu_share	0.0034
	(0.0051)
CoB	0.0268***
	(0.0078)
Constant	-0.0179**
	(0.0076)
Observations	212
R-squared	0.114

Notes: Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 14: First Stage Statistics (2)

Variable	Partial Rsq	F(1,204)	P-value
Excluding London			
Dhiskills	0.0647	11.63	0.000

Table 15: Sectoral composition of Urban Areas

	% of firms in manufacturing	% of firms in services
Urban Sectors	33.12	66.88
Non Urban Sectors	67.29	32.71

Source: ONS/ CIS

Table 16: Innovation active firms in Britain by broad sector

	% of Innovation Active firms in British TTWAs
Manufacturing	75.22
Services	64.05

Source: ONS/ CIS

Table 17: Innovation active firms in Urban Areas

	% of Innovation Active Firms in Urban TTWAs
Urban Sectors	68.10
Non Urban Sectors	74.08

Source: ONS/ CIS

Table 18: Innovation active firms in Urban Areas by sic frame

	% of innovative firms in Urban TTWAs	Contribution of each sector to total number of firms in urban TTWA	Cum.
URBAN SECTORS			
Mfr of fuels, chemicals, plastic	77.0	0.13	0.13
Mfr of electrical and optical	84.8	0.05	0.18
Construction	59.6	0.07	0.25
Wholesale trade	66.1	0.10	0.35
Hotels & restaurants	52.2	0.25	0.40
Transport, storage	64.6	0.09	0.49
Financial intermediation	72.6	0.05	0.54
Real estate, renting & business	68.0	0.25	0.79
NON URBAN SECTORS			
Mining and quarrying	70.0	0.00	0.79
Mfr of food, clothing, wood	76.2	0.10	0.89
Mfr of transport equipments	79.8	0.02	0.91
Mfr not elsewhere classified	81.6	0.02	0.93
Electricity, gas & water supply	82.4	0.00	0.93
Retail trade	54.6	0.07	1.00

Source: ONS/ CIS

Notes: CIS microdata are treated as confidential. The raw number of firms per sector is not reported to avoid disclosure.

Chapter 3: "The Bright Side of Social Capital: how Bridging makes Italian Provinces more Innovative"

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Abstract

Social capital as determinant of economic outcomes gained increasing relevance in the past decades. In spite of that the existent empirical predictions are still controversial. The paper tests the hypothesis associated to the existence of an economic dividend of social capital providing a novel perspective of analysis. With respect to the mainstream literature the paper discusses the role of social capital looking at innovation rather than growth. This provides the rationale for a more specific focus on its network dimension and for the identification of the channels through which social capital plays its role in affecting the economic prospects of Italian provinces. Building on the bridging/ bonding dichotomy and on the relevance of the weak ties hypothesis popularized by the work of Granovetter, the paper suggests that the positive role of social capital on innovation is crucially mediated by the typology and intensity of the localized network relationships.

Keywords: Innovation, Social Capital, Bridging, Bonding.

1) Introduction

Mainstream economic theories, focusing on the quantitative expansion of predetermined variables, failed to explain much of the stylized evidence related to the persistence of economic differentials among countries and regions stimulating a wider agreement regarding the role of "soft" factors as a complementary and fundamental ingredient for growth and development (*Banerjee et al, 2004*). Economists have then started to refer to social capital in order to explain and analyse a wide range of phenomena: from growth (*Knack and Keefer, 1997*) to political participation (*Di Pasquale and Glaeser, 1999*), development trap (*Woolcock, 1998*), institutional performance (*La Porta et al, 1997*) or the spread of secondary education (*Goldin and Katz, 2001*).

However, the analysis of the link between social capital and the generation of innovation – in its turn a crucially important driver of economic growth – has remained relatively unexplored by 'mainstream' economics literature. Economists of innovation and economic geographers have recently tried to fill this gap in the understanding of the impact of social capital on economic performance opening the way to new insights into the mechanics of social capital in the economy (*Cohen and Field, 2000; Hauser, et al. 2007; Kallio et al., 2010; Laursen and Masciarelli, 2007; Patton and Kenney, 2003; Sabatini, 2009; Tura and Harmakorpi 2005*).

In particular this strand of literature has contributed to a better conceptualisation of 'social capital' shedding light on its 'multidimensionality' and suggesting that different dimensions may impact upon the economy in very different ways. It is the intensity and typology of network relations among innovative actors that matters for innovation. The characteristics of such networks qualify the way in which valuable knowledge is exchanged and re-combined linking together individuals, groups, geographical areas (*Audretsch and Feldman, 2004*), stimulating the relational proximity and preventing stagnation and lock in (*Boschma, 2005*). In this context the traditional debate regarding the optimal level of social capital seems to be less pertinent: the effectiveness of social capital doesn't lies in the quantity of relationship within the network but in their intensity and the extension of their "radius of trust" (*Fukuyama, 1995*). The wider is the radius of trust connected to the network relationship among knowledgeable individuals the greater is the likelihood of exchanging complementary knowledge. This, in turn, implies that in an innovation enhancing perspective the potential negative role of social capital is mainly related to the existence of closed network based on exchanges of redundant knowledge.

Interestingly enough, after a long period of study in which social capital was assumed to have a positive impact on development, a recent strand of economic literature has recognized the distinctive relevance and dangers of strong and weak ties (*Guiso et al.,2010*). The distinction between bonding and bridging social capital is then crucial for our purpose since the diffusion of knowledge as a prerequisite of innovation, is faster in the case of open societies, hence with a large stock of bridging social capital.

In light of its potential to contribute to a deeper understanding of the impact of social capital on the regional economy and provide a better guidance for policy-making, this paper aims to contribute to this strand of literature in an innovative fashion. While the large majority of the existing analyses on the impact of social capital on regional innovation have been based on qualitative methods, this paper adopts a quantitative approach. In addition our analysis will substantially develop upon the only existing quantitative study on this topic (*Hauser et al., 2007*) by focusing on a much more detailed spatial scale and explicitly addressing the endogeneity issue through a robust identification strategy based on an instrumental variable approach.

Our empirical analysis looks at Italian provinces, one of the most intensively studied case studies in the literature on social capital (*Guiso et al, 2004; Ichino and Maggi, 2000; Putnam, 1993*) but – to the best of our knowledge – largely unexplored in terms of the link between social capital and innovation. Recent studies are largely qualitative (*Ramella and Trigilia, 2009*). There are few recent papers applying a quantitative methodology to the analysis of the link between social capital and innovation in Italy. Some of them (*Cainelli et al., 2005*) looks at peculiar geographic areas such as the industrial districts. Others (*Arrighetti and Lasagni, 2010; Laursen and Masciarelli, 2007*) adopt a firm based perspective in order to address the role of social and institutional factors on the probability of firms to innovate and their willingness to invest financial resources in innovation related activities. Despite the valuable effort in providing quantitative evidences on the issue, the existing literature adopts a broad perspective, focusing on all the dimensions traditionally referable to the wide notion of social capital (associational activities, political participation, institutional thickness and trust), and it is only partially addressing the serious shortfalls related to the endogeneity of social capital. Building on these considerations this paper is then aimed to shed more light on the causal mechanisms driving the effect of social capital on the economic performance of the Italian provinces and its conditioning factors. In doing that, and in line with the conclusion reached by Hauser et al (2007), we substantially specify our definition of social capital, focusing on its network dimension, and we carefully define our identification strategy.

In particular, we measure social capital by means of several variables: blood donations, voluntary associations, weekly lunch with relatives and the number of young adults living with their parents. Then, through a principal component analysis, we aggregated those variables and constructed two distinctive measures for bonding and bridging social capital respectively. We relate those measures to innovation activity in Italian provinces and present results of OLS and IV estimates which confirm our prior that bridging social capital is positively correlated with innovation, whereas bonding social capital is either not significant or negatively correlated with innovation. This result suggests that social capital is a fundamental driver of innovation if and only if it operates as a channel for the exchange of non redundant and complementary knowledge.

The paper is organized as follows: we first provide and overview of the economic literature on the role of social capital, highlighting the peculiar meaning of the term in respect to innovation. In section 3 we focus on the methodological issues providing a description of the estimation strategy and the data. section 4 presents some descriptive statistics and the main results discussing the economic implications of our findings. Finally some conclusions are drawn underlining the fundamental role of social capital as a determinant of local innovation performance.

2) How social capital shapes local innovative performances

The aim of this section is to look at the vast literature on the economic impact of social capital in order to develop a suitable 'working definition' and an appropriate conceptual framework for its analysis in relation to the process of innovation.

A fundamental vagueness is still characterizing the definition of social capital (*Guiso e al, 2010*). Coleman (1988) argued that it coincides with the social structure of a society facilitating the actions on individuals. Putnam (1993) identified social capital in terms of trust based relations and groups. Fukuyama (1995) suggested that social capital has to be intended in terms of trust, civicness and network relations. None of the above definitions allowed either to identify a comprehensive measure of social capital or to rule out the traditional debate on the "dark side" of social capital overcoming the "empasse" regarding its optimal size in a growth enhancing perspective. From the methodological perspective, several difficulties exist in operationalizing the concept. As Solow (1999) emphasized in his critique to Fukuyama (1995), if social capital is much more than a fuzzy concept it has to be somehow measurable. However we are still far from dealing with a universal measure of social capital. Different aspects of social capital were alternatively emphasized and different measures were proposed: from civic cooperation to collective action, from trust to political participation, groups and networking. The analysis of the link between social capital and innovation calls for both a rigorous definition of the term, because the channels through which social capital may potentially affect innovation are explicitly qualified by the existent literature on innovation and economic geography, and for a more robust identification of the measurement issues.

The qualification of social capital in respect to innovation builds on the so called "relational turn" of economic geography (*Boggs and Rantisi, 2003*) and the tendency to start questioning the undersocialized nature of the past approach to innovation systematically neglecting the social dimension of the innovation processes. This drawback is clearly evident looking at the traditional mainstream economic theory on innovation based on the firm based knowledge production function approach (*Griliches, 1979*) used in an a-spatial and atomistic perspective.

The rediscovering of the concept of social capital as a fundamental determinant of innovation followed the theoretical contributions of Granovetter (1985) and Coleman (1988). Innovation started to be progressively considered as a social process embedded in the local social environment and systematically affected by the strength and the intensity of social ties.

The emphasis on the social dimension of innovation led to the definition of innovation prone regions (*Rodriguez Pose, 1999*), innovative milieux (*Breschi and Lissoni, 2001; Camagni, 1995*), learning regions (*Florida, 1995; Morgan, 2007*), regional systems of innovation (*Cooke et al, 1997*). In all of those cases the focus is on the network dimension, supposed to be able to foster innovative capabilities facilitating the diffusion of valuable and non redundant knowledge and preventing stagnation and look in (*Boschma, 2005*).

According to the aforementioned literature, the link between social capital and innovation lies exactly in the concepts of networking and embeddedness (*Granovetter, 1985*). Relational networks linking together individuals, groups, firms, industries with different knowledge bases are a critical precondition for knowledge creation and transfer. In this context innovation is emerging from a cumulative process embedded in the social context and systematically affected by processes of interactive learning stimulating the exchange and re- combination of knowledge (*Asheim, 1999; Lundvall, 1992*).

Social capital is then a crucial factor for community development since it stimulates inter-personal interactions and the circulation of valuable knowledge (*Tura, Harmaakorpi, 2005*). If we accept this simple statement, then social capital can be thought to be an input into an ideal knowledge production function.

However, the idea of "relations as central units of analysis" (*Boggs and Rantisi, 2003*) is still questionable. Significant criticisms are associated to the existence of robust empirical evidences in support to this preponderant role of relations and untraded interdependence

(*Markusen, 1999, Overman, 2004*). This shortfall becomes even more relevant looking at the mechanisms driving this potential effect. Capello and Faggian (2005) emphasized the role of relational capital as crucial ingredient in the creation and diffusion of innovation looking at knowledge spillovers as crucial transmission channels to account for the effect of networking and social relations on innovative performances. Kallio et al. (2008) suggested that the link between the social dimension and the emergence of an innovative outcome lies in the local absorptive capacity enabling the diffusion of knowledge within the regional system of innovation. Other authors argued that social capital has only a second order effect and that it is mediated by the increasing return of the investments in human (*Bourdieu, 1986, Gradstein and Justman, 2000, Dakhli and De Clercq, 2004*) or physical capital (*Becker and Diez, 2004, Fritsch and Franke, 2004, Cainelli, Mancinelli, Mazzanti, 2005*). The thesis pursued in this paper is that the rationale of the effect of social capital on innovation should be addressed looking at the innovative potential of network exchanges (*Hauser et al., 2007*) and that the characteristics of this network dimension clarify the mechanism behind the effect of social capital on innovation.

The typology and the intensity of such networks qualify the effectiveness of social capital as a determinant of novel innovative outcomes. They provide the rationale for both the theoretical reasoning behind the link between social capital and innovation and the methodological debate on how to operationalize the concept. However, referring simply to the relevance of the network dimension as channel through which valuable information are exchanged and recombined is not enough. As Florida (2002) pointed out places with strong social capital are often the areas with the worst innovative performance. In this context social capital, based on strong relations between individuals, becomes the reason behind the closure of the network and the insulation from outside information and challenges.

This critic refers to the often cited detrimental effect of social capital (*Akerlof, 1976; Olson, 1982*) and to the debate regarding the optimal level of social capital. The relevance of such reasoning substantially lies in the idea that social capital is directly proportional to the intensity and the tightness of the relations between individuals.

However, this approach to social capital might be misleading for the analysis of innovation. Differences in the types of social networks rather than in the intensity of the relations within the network are responsible for the potential heterogeneous relation between social capital and innovation (*Hauser et al, 2007*).

The so called "weak ties hypothesis" proposed by Granovetter (1973) is crucial in this context. The strength of social ties characterizes the closeness and interaction frequency of the relationship between two parties (*Granovetter, 1973*) considered as carrier of tacit knowledge.

Relationship between people can be characterized by frequent contacts and deep emotional involvement or sporadic interactions with low emotional commitment. The former category is generally identified as strong ties, such as relationships with family or close friends, while the latter is associated with the definition of weak ties linking individuals characterized by loose acquaintances. Following Granovetter's arguments weak ties are assumed to be sources of novel information and responsible for the diffusion of ideas (*Granovetter, 1982; Rogers, 1995*), while with strong ties the risk of exchanging redundant knowledge is much higher simply because they connect the knowledge seeker with people that are more likely to trafficking with information that the knowledge seeker already knows (*Levin and Cross, 2004*).

In other words weak ties are fundamental in spreading information because they operate as bridge between otherwise disconnected social groups (*Ruef, 2002*). Weak ties serve as a bridging mechanism between communities within the same society, while strong ties function as a bonding device within homogeneous groups potentially hampering the degree of sociability outside the closed social circle (*Beugelsdijk and Smulders, 2003*). Bonding social capital (*Rodriguez-Pose and Storper, 2006; Storper, 2005*) is likely to affect negatively innovation because it may work in favour of small groups lobbying for preferential policies and protection of the status quo hampering risky, innovative activities (*Dakhli and De Clercq, 2004; Knack and Keefer, 1997; Portes and Landolt, 1996*). Conversely, bridging social capital, by lowering transaction costs, may contribute to the building of an environment congenial for innovation investment, which is a high risky activity, hence a potential beneficiary of ties based on trust and cooperation.

This implies that the ‘dark side of social capital’ lies in the typology of the ties and in the radius of trust of the network rather then in the intensity of the relationships among knowledgeable individuals: we need to look for the ‘right’ typology, rather than for the optimal ‘quantity’ of social capital if we are to enhance local innovative performance,

In this paper we focus on the relevance of social capital for the production of innovation in Italian provinces. The case of Italy is of potential interest because of both the considerable spatial variation in development and cultural traits and the availability of a large body of specific literature.

Putnam (1993) has in fact proposed the hypothesis that one of the main reasons for the persisting differences in development between North and South of Italy is due to the quality of institutions and social capital which in turn are the outcomes of historical accidents, i.e. areas in which independent city-states (the so-called Repubbliche Comunali) were more diffused are also the areas in which the level of trust and government effectiveness are higher. Recently, Guiso et al. (2008), Percoco (2010a; 2010b) have provided empirical support to this idea, although their main focus was on the explanation of income and productivity levels.

In a similar context, Guiso et al. (2004) found a positive association between industrial development and social capital. Similarly, de Blasio and Nuzzo (2010), on using microdata from the Survey of Household Income and Wealth conducted by the Bank of Italy, report that social capital increases the probability of being an entrepreneur.

Arrighetti and Lasagni (2010) analyse the effect of social conditions on the propensity to innovate of Italian firms and suggest that innovative firms tends to cluster in those provinces characterized by higher level of “positive social capital”, interpreted as civicness and high social interactions, and lower level of “negative social capital” , generally associated with opportunistic behaviours due to the coexistence of groups lobbying for specific interests. On the same line of argument, but focusing on specific case studies as the Emilia Romagna industrial districts, Cainelli et al.(2005) argue that the extensive horizontal relationships among local economic actors generate positive network externalities favouring the exchange of valuable knowledge and fostering the innovative performance of local firms.

3) Model of empirical investigation

Our empirical analysis is based on the Knowledge Production Function (KPF), formalised by Griliches (1979, 1986) and Jaffe (1986). However, rather than working in a firm based perspective using firms as unit of observation, we adopt a place based perspective and adopt Italian provinces (NUTS3 level) as our units of observation. This specification, building on previous research in the field (*Audretsch, 2003; Audretsch and Feldman 1996; Crescenzi et al., 2007; Feldman, 1994; Fritsch, 2002; OOhuallachain, Leslie, 2007, Ponds et al, 2010; Varga, 1998, Moreno et al, 2005*) is particularly coherent with the main purpose of our analysis in that it allows to focus upon the territorial dynamics of innovation introducing social capital as a determinant of regional innovative performance, hence by focusing on the relevance of "soft factors".
The modified Knowledge Production Function takes the following form:

$$\begin{aligned} Patents\_growth_{iT-t} &= \beta_0 + \beta_1 patent_{i,t-T} + \beta_2 soccap_{i,t-T} + \\ &+ \beta_3 grad_{i,t-T} + \beta_4 privrd_{i,t-T} + \beta_5 X_{i,t-T} + \delta_i + \varepsilon_i \end{aligned} \quad (1)$$

Where $Patents\_growth_{i,T-t} = \frac{1}{T}\ln(\frac{Patents_{i,t}}{Patents_{i,t-T}})$ is the logarithmic transformation of the ratio of patent applications in region *i* at the two extremes of the period of analysis (t-T,t). Among the independent variables $soccap_{i,t-T}$ is our variable of interest and represents the measure(s) of social capital in each province *i* at time (t-T); $patents_{i,t-T}$ is the log of the level of patent applications per million inhabitants at the beginning of the period of analysis (t-T); $privrd_{i,t-T}$ is private expenditure in R&D as percentage of regional GDP at (t-T); $grad_{i,t-T}$ is the number of graduates in respect to regional population at time (t-T); $X_{i,t-T}$ is the matrix of additional controls (i.e. regional sectoral composition, population density and female unemployment) at (t-T); Finally, δ_i represents macro-regional dummies for southern, central and northern Italy and ε_i is the error term. A brief description of the main variables is reported in Table 1.

Regional Innovative Performance - Patents data coming from OECD are used as a proxy for innovation. We construct our measures of innovation using the log transformation of the growth rate of patents in the time interval 2001-2007. Patent statistics can be considered a good measure of innovative output providing comparable information on inventors across a broad range of technological sectors. The main limitation of this measure is the intrinsic degree of novelty of patented products and processes: the different propensity to patent of different sectors and the non patentability of many inventions (*Crescenzi et al., 2007*). In fact, differences in the number of patents among provinces may be an indicator of differences in production specialization of provinces. If sectors differ structurally in terms of propensity to innovate or to patent, then those differences will reflect into differentials in terms of number of patents (or their growth). To overcome this limitation, in our empirical approach, we will control for the sector structure of the economy. Note that the definition of our main dependent variable in terms of growth rate represents the attempt to provide, despite the limitations coming from the availability of the cross sectional data, evidences regarding the dynamic effect of social capital on innovation (*Crescenzi et al, 2007*) accounting for the effect of initial social condition on the innovative performance of Italian provinces in the following year. This approach builds on the idea that the potential economic return of social capital could have a long lasting effect and that to fully account for this effect a wider temporal interval is needed.

Initial patent intensity - The initial patent intensity in each province is used as a proxy of the existing technological capabilities and the distance from the technological frontier. It also controls for differences in the patenting propensity often related to pre-existent differences in sector specialization.

Social Capital - Building on our conceptual framework we look at social capital emphasizing the component related to the networking activity, but trying to distinguish such networks in respect to their effect on the circulation of information. As previously mentioned this implies a crucial distinction between networks based on weak ties, or bridging social capital, and networks based on strong ties, or bonding social capital.

We use data on family characteristics as a proxy for bonding social capital based on strong ties (*Ruef, 2002; Beugelsdijk and Smulders 2003; Levin and Cross, 2004*) and data on voluntary associations as a proxy for bridging social capital based on weak ties operating as forms of horizontal relations fostering networks of civic engagement (*Beugelsdijk and Schaik, 2004, Arrighetti and Lasagni, 2010*). To define the strength of family ties we used two indicators regarding the number of families having lunch at least once per week with relatives and close friends (per 100 households) and the number of young adult individuals living with parents (per 100 young adults).

Strong family ties are assumed to imply geographical proximity of adult children: young adults tend to stay longer with parents and the relationships within the family are particularly strong and based on repeated interactions. Family members tend to gravitate around the main core creating a system of nested families and a larger family size (*Alesina and Giuliano, 2010*).

At this point, it should be mentioned that the characteristics of the family are at the heart of the hypothesis on the importance of social capital in Italian development since the very seminal work by Banfield (1958) who advanced the idea that low propensity to cooperate is generally associated to, among other things, the strength of family ties. In particular, Banfield (1958) argued that underdevelopment is a result of a low propensity to cooperate which, in turn, produces high transaction costs. This development trap is the outcome of strong family ties (the so-called "amoral familism"), high uncertainty and a highly unequal distribution of income and wealth. So far, we do not have conclusive empirical evidence supporting Banfield's hypothesis, however, some pieces of evidence seem to confirm at least partially this theory. Alesina and Giuliano (2010), in fact, find that strong family ties are associated to low levels of generalized trust. Similarly, Giavazzi et al. (2010) relate family types to female labor market participation rate in European regions, whereas Duranton et al. (2009) relate past family structures to a number of contemporary outcomes.

Bridging social capital based on weak ties is instead measured using two of the traditional indicators adopted in the economic literature as proxies for social capital. Blood donations and participation in voluntary associations are assumed to be proxies for the participation of individual in activities with positive social externalities and as an indicator for altruism (*Cartocci, 2007*).

The number of families having lunch at least once per week with relatives[28] and the number of young adults living with parents[29] are used to define a composite indicator of bonding social capital while the blood donations and voluntarism concur to define the composite indicator for bridging social capital. We further defined a comprehensive measure of social capital encompassing both the bonding and bridging dimension that is used in the first stage of the analysis in order to detect the overall effect of social capital on innovation before going into details.

Our measure of social capital is constructed using the principal components analysis over the four variables previously identified (table 2, Column 1). We then disentangled the bonding and bridging components defining a specific composite indicator for each dimension (table 2, columns 2 and 3).

We further constructed a spatial lag of our composite measure of social capital in order to control for potential spillovers effect. All the spatially lagged variables are constructed based on a standard queen contiguity spatial weighting matrix.

Innovation inputs- Private R&D in respect to GDP and number of graduates over the total population is used as proxies for capital and labour. Due to data availability our R&D measure is available only at regional level (NUTS 2) while the number of graduates is defined for each province.

Controls - Our specification of the knowledge production function further encompasses controls for population density at province level,

[28] Per 100 households

[29] Per 100 young adults

labour market characteristics in terms of female unemployment rate, and sector structure approximated by the Herfindhal Index.
The Herfindhal Index is defined using data on employment for three sectors: agriculture, industry and services and is interpreted as a measure of specialization.
We further add some controls to take into account the spatial correlation. In particular we defined the spatial lag of population density as a measure of accessibility. Macroregional dummies are inserted to control for time invariant characteristics and other sources of spatial correlation.

Let us now discuss our identification strategy. The identification of the link between innovation and social capital is challenged by several potential shortfalls and flaws casting doubts about its inference. In particular, the main problems that we face in our estimation procedure are related to the potential endogeneity of social capital due to both reverse causality and omitted variable bias.
Our hypothesis is that social capital can be treated as a determinant of innovation because the emergence of a network between knowledgeable individuals stimulates the circulation and diffusion of knowledge favouring the valuable re-combination of information. We also propose the hypothesis that the effect of social capital on innovation depends on the extension of the radius of trust of such networks and that weak ties, bridging members of different epistemological communities, are more efficient than strong ties within the same group as a stimulus for the emergence of an innovative outcome.
Although reasonable, this argument could be only a part of the story. It is in fact realistic to assume that the causal mechanism between innovation and social capital could instead be reverse. This implies that places with higher innovative outcomes may be able to generate, through higher economic incentives to create valuable networks, a virtuous cycle based on cooperation and trust stimulating higher sense of civicness and sense of community.
It is further reasonable to assume that the endogeneity of social capital is related to the classic omitted variable bias, namely the fact that our measure of social capital is potentially correlated with some local characteristics that we are not controlling for. This is particularly realistic looking at the emergence of neighbouring effects and spatial correlation. The omitted variable bias may depends on both local

characteristics and neighbouring peculiarities affecting the local outcome.
We try to control for spatial correlation adding the spatial lag of social capital and inserting macro-regional dummies in the regressions. Furthermore we deal with the issue regarding the endogeneity of social capital adopting an instrumental variable approach (2SLS). In particular we instrument the level of bonding social capital in each province using the number of non profit organizations in 1901 and the level of bridging social capital using the average political participation in referenda[30] . both instruments are calculated using regional data due to the lack of historical provincial data on social capital and related proxies.

The rationale for using those instruments can be found into the path dependence characterizing the stock of social capital. In fact, Putnam (1993) hypothesized that the current stock of social capital in Italian regions was influenced by past (unobserved) quantity of trust and past (observed) institutional quality. Along this line, Tabellini (2010) has proposed an analysis of the link between trust and development, where the former was instrumented with historical variables. Our two instruments, the number of not-for-profit organizations in the past and voter turnout in selected referenda, are both meant to proxy past social capital stock. In particular, we think that our first instrument is negatively correlated with bridging social capital as according to Banfield's hypothesis of a negative correlation between family ties and cooperative behaviour (in this case approximated by the number of not for profit organizations). The political participation to referenda is assumed to be positively correlated to bridging social capital because it can be considered a proxy of civic participation and civic engagement.

[30] The measure is constructed as the average political participation in the following referenda: 1946 (Monarchy vs Republic), 1974 (divorce), 1978 and 1981 (abortion), 1985 ("scala mobile") and 1987 (nuclear power). The average measure is used in order to limit the potential bias coming from peculiar ideological positions in different regions in respect to particular questions.

4) Empirical results

A preliminary evidence on the potential link between the innovative performance of Italian provinces and the characteristics of the local social environment can be analyzed by looking at the descriptive statistics and the correlation between the relevant variables. Data reported in table 3 show that there is a substantial congruence between the local innovative outcome and the bridging component of social capital as well as a systematic negative association between innovation and bonding social capital. This descriptive evidence seems to support the main hypothesis of our analysis: social capital has a beneficial effect on the innovative performance of local areas when it is based on the existence of weak ties between otherwise disconnected communities. Complementary a strong predominance of bonding social capital is associated to lower innovative performances. The two sided effect of social capital on innovation is further confirmed by the correlation matrix reported in Table 4.

The well known north-south dichotomy in Italy could be effectively applied to the characteristics of the social environment. Figures 1 and 2 show the distribution of bridging and bonding social capital in Italian provinces. Bridging social capital seems to be systematically higher in northern Italy and part of the central regions while southern provinces are characterized by a strong predominance of bonding social capital. In concordance with the descriptive statistics reported in tables 3 and 4 the geographical distribution of innovation (Figure 3) seems to be impressively similar to the distribution of bridging social capital further confirming the crucial role of weak ties as complementary preconditions for innovation.

The existence of a systematic correlation between bridging social capital and innovative performance of Italian provinces could be interpreted as a sound and suggestive evidence in support of our theoretical hypothesis. The inference regarding a potential causal link between the two dimensions deserves, however, a deeper and more complex econometric analysis.

Table 5 reports the estimation results for the place based Knowledge Production Function. In the basic version we just control for capital and labour and the initial level of patenting in each region (Tab.5, Col.1). the initial number of patents per million of inhabitants is statistically significant at 1% level and negatively associated to our dependent variable. The sign of the coefficient can be justified through a

convergence trend in patenting due to either the crisis on traditionally successful innovative areas (such as the industrial districts) or the emergence of new successful players.
Our measure for capital is highly significant and positively associated to innovation while at this stage there is surprisingly no evidence of a human capital effect.
We then add some controls for population density, the labour market characteristics, the sector structure and the spatial lag of population density, used as proxy for accessibility (table 5, column 2). Neither the level of female unemployment, used as proxy for the efficiency of the local labour market, nor the Herfindhal index, inserted as an indicator for sector specialization, are statistically significant while population density seems to be positively associated to innovation with a significance level of 5%. On the contrary the spatial lag of population density shows a significant negative effect at 10% level.
In column 3 we control for our measure of social capital which is highly significant at 1% level and positively correlated to innovation in each province. This evidence suggests that provinces characterized by significant level of cooperation and associational activities are more prone to innovation. In the model estimates reported in column 4 we have inserted the spatial lag of social capital in order to control for potential neighbouring effects. The regressor is not statistically significant, however its inclusion among the controls significantly affects the statistical significance suggesting a certain evidence of spatial correlation. To further control for neighbouring effects and spatial correlation we further control for macro-regional dummies[31]. The measure of social capital remains positively associated to innovation with a significance level of 5%.
In line with our theoretical statements and in order to distinguish the two fundamental components of social capital, namely the bonding social capital based on strong ties, and the bridging social capital, based on weak ties, we split our comprehensive measure of social capital in

[31] Moran's I over the residual is calculated in order to test for the existence of spatial correlation. Controlling for the spatial lag of population density and social capital and adding macroregional dummies the coefficient of the Moran I decrease, from 0.25 to 0.085, and becomes statistically insignificant. The p-value further confirms the rejection of the null of spatial correlation in the residuals. We provided the spatial correlation test on the residuals to confirm the "goodness" of our model. However in line with Gibbons and Overman (2010) we argue that spatial econometric techniques should be manly aimed to the description of the data and that they are "pointless" in respect to the central issues of identification and causality.

two separate regressors (table 5, column 5). The bridging component is still statistically significant at 1% level and positively associated to innovation while the bonding social capital seems to be not significant and negatively associated to the innovative performance of provinces. This evidence suggests that the positive and significant effect of social capital on innovation pass through the mechanism of weak ties rather than the importance of strong ties. This finding is perfectly in accord with our theoretical reasoning: weak ties allow to access non redundant information favouring the transfer and re-combination of valuable knowledge.
The main concern remains related to the reliability of our results. The estimates are likely to be biased due to the endogeneity of social capital. In order to control for a potential bias we adopt an instrumental variable approach. First stage regressions (table 6) confirm the validity of our instrumental strategy. Both instruments are highly correlated with the instrumented variables showing the expected sign and confirming the economic reasoning behind their adoption.
Despite of that the econometric literature on instrument validity suggests that it is possible to incur in the problem of weak instruments even when the first stage regression seems to be unproblematic (*Greiger and Stock, 1997; Stock and Yogo, 2005*). In order to rule out the risk of weak instrument we refer to both the rule of thumb applied by Greiger and Stock (1997) and to the Stock and Yogo (2005) threshold values. The F statistics in the first stage is strongly above the critical value and close to the value of 10 respectively for the bridging and bonding instruments and it is generally above the threshold values reported by Stock and Yogo (2005)[32] (Tables 7).

Our instrumental variables strategy can be considered highly robust and definitely not affected by a potential weak instruments bias. Results in Table 5 strongly support the existence of a crucial link between bridging social capital based on weak ties and innovation (statistically significant at 1% level), while our measure of bonding social capital becomes statistically significant (5%) and it remains negatively associated to innovation.
To prove the robustness of our statistical findings we provide some robustness checks. Table 8 reports similar estimates of the main model,

[32] The f statistics is above all the Stock and Yogo (2003) thresholds values in respect to the instrument for bridging social capital, and strictly above three over four threshold values (15% critical value) for the instrument for bonding social capital.

but proposing a different version of the knowledge production function. Our dependent variable is now the level of patents in a specific year rather then the growth rate of patents. The rationale of this choice lies in our interest in providing evidences regarding the dynamic effect of social capital on innovation. In respect to the mail specification, where we use the growth rate of patents as dependent variable controlling for the initial patents intensity in each province, this additional specification is aimed at support our results analysing the dynamic effect of social capital on innovation in an alternative way. We relate our measure of social capital to the innovative performance of Italian provinces in the following years to test if we can effectively assume the existence of a path dependent effect associated to the social dimension. Columns 1, 2 and 3 report the estimation using respectively the number of patents per million of inhabitants in 2002, 2005 and 2007 as dependent variable[33]. Columns 4, 5 and 6 provide the same estimates but controlling for the potential endogeneity bias of social capital through instrumental variables approach. The relation between bridging social capital and innovation is broadly confirmed and it becomes stronger over time suggesting that the rationale of our hypothesis related to a path dependent effect of the social dimension is generally supported and that social capital is a fundamental pre-conditions for a successful innovation activity.
Finally table 9 re-run the instrumental variable regression progressively eliminating all the controls. The statistical evidence provided shows that the effect of bridging and bonding social capital remain consistent in all the specification of the model independently on the inclusion of additional regressors. These results further suggest that social capital has an independent effect on innovation beyond its potential second order effect on physical and human capital.

[33] Note that the number of observations is changing before for 2001 and 2002 the dependent variable can be recovered only for 97 provinces over 103

6) Conclusions

Soft factors such as social capital have gained progressive importance within the economic literature. This paper, by focusing on the link between innovation and social capital, interprets social capital as networking and associational activity so as to become a fundamental determinant of innovation acting as a mechanism for the diffusion and the circulation of valuable knowledge.
The effect of social capital on innovation is then shaped by the degree to which it acts as a facilitator of complementary knowledge transfer between individuals. This further implies that networks and ties bridging individuals coming from different epistemic communities, rather than homogeneous groups, are much more valuable because they allow to access non redundant information.
Our results suggest that social capital based on weak ties is a fundamental determinant of innovation and that the so called dark side of social capital refers to the type and the radius of trust of network relations rather then to their number. This implies that is the type of social capital and not its magnitude that affects the sign of the correlation between social capital and innovation.
These findings are generally in concordance with the recent quantitative empirical literature on the link between social capital and innovation in Italy. However, in respect to the existent contributes, we substantially aimed at disentangling the dimensions of social capital that matters more for innovation, trying to bypass the traditional vagueness of the concept, as well as at defining an identification strategy specifically constructed in order to account for the endogeneity of the social dimension.
Further research is needed to deepen the understanding of the mechanisms driving the correlation between local social characteristics and innovative performances.

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Figures and tables

Figure 1: Innovation in Italy

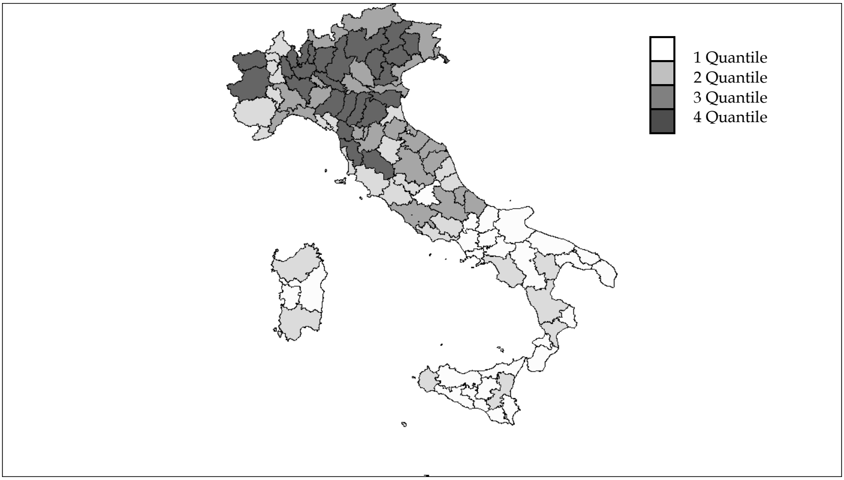

Fig.2: Bonding Social Capital

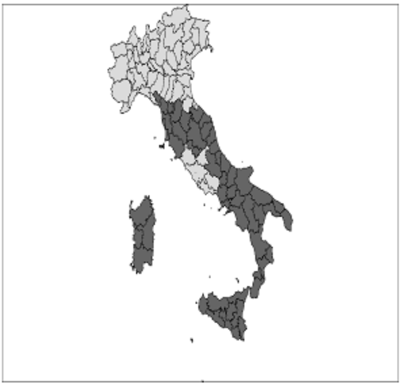

Fig.3: Bridging Social Capital

Table 1: Variables List (1)

VARIABLES	DESCRIPTION	SOURCE	YEAR
Patents_growth	Logarithm transformation of the ratio of patent applications per million of inhabitants in region *i* at the two extremes of the period of analysis (t-T,t)	OECD RegPat database	2001-2007
Patents01	Logarithm of the level of patent applications per million of inhabitants at the beginning of the period of analysis (t-T)	OECD RegPat database	2001
Priv_R&D	Logarithm of private expenditure in R&D as percentage of regional GDP at (t-T)	ISTAT Indicatori Ricerca e Innovazione	2001
Graduates	Logarithm of the number of graduates in respect to regional population at time (t-T)	ISTAT Database Politiche di Sviluppo – Indicatori Asse III – Risorse Umane	2001
Female_unempl	Logarithm of the number of unemployed women in respect to the female labour force	OECD Regional Database - Regional Labour Market TL3 database	2001
Herfindal	Sum of the square of the ratio sector employment/total employment defined for agriculture, industry and services	OECD – Regional Database - Regional Labour Market TL3 dataset	2001
Pop_density	Logarithm of the population in respect to local surface	OECD Regional Database - Demographic Statistics TL3 dataset	2001

Table 1: Variables List (2)

VARIABLES	DESCRIPTION	SOURCE	YEAR
Social_capital	Blood donations	Cartocci (2007)	2001
	Voluntary Association	Cartocci (2007)	2001
	Weekly Lunch	ISTAT Rilevazione "Parentela e Reti di solidarietà"	2001
	Adult Children	ISTAT Rilevazione "Parentela e Reti di solidarietà"	2001
Non_profit_01	Number of non profit organizations per 100 inhabitants	Nuzzo (2006)	1901
Referendum	Logarithm of the average political participation to the following referenda: 1946 (Monarchy vs Republic), 1974 (divorce), 1978 and 1981 (abortion), 1985 ("scala mobile") and 1987 (nuclear power)	Nuzzo (2006)	1946-1974-1978-1981-1985-1987 (Mean value)

Table 2: Principal Components Analysis (PCA)

	PCA: Social Capital (1)	PCA: Bonding (2)	PCA: Bridging (3)
	PC1	**PC1**	**PC1**
Eigenvalues	2.33353	1.078	1.52095
% of explained variance	0.5834	0.5390	0.7605
Variables			
Blood donations	0.5429		0.7071
Voluntary Associations	0.5688		0.7071
Weekly lunch	-0.0663	0.7071	
Adult children	-0.6143	0.7071	

Note: Only principal components with eigenvalues>1 are retained

Table 3: Descriptive Statistics

Macroregion	Variable	Obs	Mean	Std. Dev.	Min	Max
NORTH	**Patents Growth**	45	0.060	0.063	-0.114	0.238
	Bonding	45	-0.937	0.572	-2.838	-0.293
	Bridging	45	0.994	0.575	-0.651	2.054
CENTRE	**Patents Growth**	24	0.058	0.068	-0.072	0.200
	Bonding	24	0.363	0.682	-0.748	1.063
	Bridging	24	-0.077	0.858	-1.478	1.318
SOUTH	**Patents Growth**	28	0.039	0.141	-0.207	0.339
	Bonding	28	1.029	0.486	0.154	1.549
	Bridging	28	-1.492	0.616	-2.668	-0.236

Table 4: Correlation Matrix

	Patents_growth	Bonding	Bridging
Patents_growth	1.0000		
Bonding	0.0079	1.0000	
Bridging	0.2079	-0.5990	1.0000

Table 5: Estimation Results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dep Var: Patents growth	**OLS**	**OLS**	**OLS**	**OLS**	**OLS**	**OLS**	**2SLS**
Patents01	-0.0407*** (0.0104)	-0.0396*** (0.0107)	-0.0824*** (0.00924)	-0.0830*** (0.00977)	-0.0872*** (0.00970)	-0.0828*** (0.0102)	-0.0879*** (0.0101)
Priv R&D	0.0373*** (0.00992)	0.0376*** (0.0104)	0.0215** (0.00959)	0.0210** (0.00879)	0.0179 (0.0119)	0.00991 (0.0108)	0.0216* (0.0124)
Graduates	0.0766 (0.0488)	0.107* (0.0528)	0.0396 (0.0530)	0.0406 (0.0542)	0.0257 (0.0564)	0.0199 (0.0561)	0.00356 (0.0510)
Female unempl.		0.0140 (0.0137)	0.00649 (0.0115)	0.00682 (0.0110)	0.00912 (0.0108)	0.00734 (0.0114)	0.00524 (0.0114)
Herfindal Index		-0.00216 (0.00209)	-0.00139 (0.00202)	-0.00128 (0.00187)	-0.000655 (0.00196)	-0.000553 (0.00202)	-0.000460 (0.00188)
Pop density		0.0311** (0.0146)	0.0324*** (0.0102)	0.0329*** (0.0108)	0.0326*** (0.0110)	0.0303*** (0.0104)	0.0290*** (0.00904)
Spatial lag Pop density		-0.0385* (0.0212)	-0.0383** (0.0147)	-0.0396** (0.0157)	-0.0299** (0.0135)	-0.0231 (0.0155)	-0.0154 (0.0124)
Social Capital			0.0472*** (0.00520)	0.0413* (0.0211)	0.0467** (0.0221)		
Spatial lag Social Capital				0.00720 (0.0231)	0.00321 (0.0249)		
Nord					0.00612 (0.0394)	0.0407 (0.0784)	-0.0836 (0.0719)
Centro					0.0352 (0.0289)	0.0612 (0.0424)	0.00321 (0.0402)
Bonding						-0.00582 (0.0148)	-0.0300** (0.0142)
Bridging						0.0477*** (0.0119)	0.0742*** (0.0152)
Constant	0.428** (0.165)	0.599** (0.229)	0.491** (0.192)	0.499** (0.200)	0.406* (0.228)	0.319 (0.214)	0.334 (0.204)
Obs.	97	97	97	97	97	97	97
R-squared	0.181	0.253	0.456	0.457	0.474	0.461	0.434

Clustered robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 6: First stage regressions

	(1)	(2)
Dep.Var:	**Bonding**	**Bridging**
Patents01	-0.0876 (0.0785)	0.0349 (0.0877)
Private R&D	0.255 (0.148)	-0.246*** (0.0825)
Graduates	0.0684 (0.204)	0.473 (0.292)
Female unempl.	-0.0108 (0.0488)	0.0729 (0.0663)
Herfindal Index	-0.00538 (0.0119)	-0.00257 (0.0102)
Pop density	0.0613 (0.0605)	0.126* (0.0716)
Spatial lag Pop density	0.168 (0.146)	0.00841 (0.115)
Nord	-2.820*** (0.605)	0.853** (0.385)
Centro	-1.351** (0.555)	-0.0344 (0.322)
Referendum	2.960 (1.972)	9.107*** (1.389)
Nonprof01	-0.000630*** (0.000188)	6.81e-05 (0.000101)
Constant	-12.37 (9.397)	-41.89*** (6.337)
Observations **R-squared**	97 0.810	97 0.855

*** p<0.01, ** p<0.05, * p<0.1
Clustered robust standard errors in parentheses

Table 7: First stage statistics

Variable	**Shea Partial R2**	**Partial R2**	**F(2, 19)**	**P-value**
Bonding	0.1471	0.1920	7.24	0.0046
Bridging	0.3199	0.4175	21.50	0.0000

Table 8: Robustness Check (1)

	(1)	(2)	(3)	(4)	(5)	(6)
Dep.Var. Patents growth	**Patents02**	**Patents05**	**Patents07**	**Patents02**	**Patents05**	**Patents07**
	OLS	**OLS**	**OLS**	**2SLS**	**2SLS**	**2SLS**
Private R&D	-0.157 (0.127)	-0.0162 (0.108)	0.00324 (0.0867)	-0.163 (0.105)	-0.0775 (0.115)	0.0425 (0.0826)
Graduates	0.514 (0.435)	-0.410 (0.306)	-0.0720 (0.443)	0.460 (0.417)	-0.457 (0.315)	-0.125 (0.423)
Female unempl.	0.113 (0.0722)	-0.0427 (0.0837)	-0.0223 (0.0911)	0.107 (0.0738)	-0.0493 (0.0795)	-0.0318 (0.0878)
Herfindal Index	0.00620 (0.0260)	-0.00685 (0.0165)	0.00570 (0.0191)	0.00563 (0.0242)	-0.00759 (0.0171)	0.00282 (0.0177)
Pop density	0.198** (0.0901)	0.205** (0.0911)	0.312*** (0.0703)	0.178* (0.0956)	0.178* (0.0943)	0.294*** (0.0667)
Spatial lag Pop density	0.0939 (0.236)	-0.136 (0.161)	-0.106 (0.128)	0.0540 (0.208)	-0.200 (0.155)	-0.0982 (0.103)
Nord	1.390 (1.145)	0.870 (0.782)	1.006 (0.619)	1.392 (0.911)	1.272 (0.809)	0.486 (0.640)
Centro	1.230** (0.534)	0.863** (0.400)	1.057*** (0.308)	1.165** (0.486)	0.964** (0.403)	0.760** (0.324)
Bonding	-0.0985 (0.220)	-0.163 (0.145)	-0.108 (0.138)	0.0257 (0.130)	0.0996 (0.144)	-0.116 (0.137)
Bridging	0.326 (0.189)	0.368*** (0.128)	0.370*** (0.0905)	0.441** (0.225)	0.471*** (0.154)	0.555*** (0.138)
Constant	1.947 (1.697)	1.187 (1.443)	1.267 (1.592)	2.105 (1.591)	1.240 (1.316)	1.533 (1.443)
Obs. **R-squared**	97 0.724	103 0.726	103 0.764	97 0.714	103 0.701	103 0.753

*** p<0.01, ** p<0.05, * p<0.1
Clustered robust standard errors in parentheses

Table 9: Robustness Check (2)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dep.Var: Patents growth	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Patents01	-0.0879*** (0.0101)	-0.0843*** (0.0101)	-0.0848*** (0.0110)	-0.0856*** (0.0106)	-0.0855*** (0.0112)	-0.0872*** (0.0115)	
Private R&D	0.0216* (0.0124)	0.0225 (0.0150)	0.0224 (0.0150)	0.0221 (0.0148)	0.0222 (0.0145)		
Graduates	0.00356 (0.0510)	0.00605 (0.0545)	0.00133 (0.0503)	-0.00350 (0.0465)			
Female unempl	0.00524 (0.0114)	0.00559 (0.0119)	0.00594 (0.0118)				
Herfindal Index	-0.000460 (0.00188)	-0.000608 (0.00197)					
Pop density	0.0290*** (0.00904)						
Spatial lag Pop density	-0.0154 (0.0124)						
Nord	-0.0836 (0.0719)	-0.0586 (0.0791)	-0.0592 (0.0791)	-0.0563 (0.0782)	-0.0564 (0.0782)	0.0122 (0.0500)	-0.175** (0.0825)
Centro	0.00321 (0.0402)	0.0110 (0.0467)	0.0117 (0.0473)	0.0120 (0.0473)	0.0117 (0.0469)	0.0497 (0.0346)	-0.0761 (0.0558)
Bonding	-0.0300** (0.0142)	-0.0192* (0.0115)	-0.0196* (0.0113)	-0.0194* (0.0115)	-0.0192* (0.0111)	-0.00769 (0.00710)	-0.0364*** (0.00602)
Bridging	0.0742*** (0.0152)	0.0708*** (0.0159)	0.0711*** (0.0158)	0.0709*** (0.0161)	0.0708*** (0.0165)	0.0695*** (0.0165)	0.0503** (0.0250)
Constant	0.334 (0.204)	0.392** (0.199)	0.374** (0.180)	0.349** (0.159)	0.359*** (0.0627)	0.299*** (0.0406)	0.151*** (0.0560)
Obs.	97	97	97	97	97	97	97
R-squared	0.433	0.400	0.399	0.397	0.397	0.386	-0.012

*** p<0.01, ** p<0.05, * p<0.1
Clustered robust standard errors in parentheses

Chapter 4: "Regional Disparities in Italy over the long run: the Role of Human Capital and Trade Policy"

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Abstract

The well known Italian dualism in terms of development disparities between the North and the South has been one of the most debated issues in economics over the last few decades. In the aftermath of the Unification of Italy, the gap between North and South in terms of human capital stock was more relevant than the dualism in terms of GDP per capita. In 1871 the percentage of population able to read and write was 57.7% in the North-West and only 15.9% in the South, while there is no evidence of income disparities. Interestingly, in 1951 income per capita in Southern regions was only about 50% of that of the North. Bearing this evidence in mind, and using a novel panel dataset, we investigate the pattern of regional development focusing on the role of initial human capital conditions as a major driver of growth over the period 1891–1951. We provide further empirical evidence on the impact of protectionist trade policies in the late 19th century on long run development. We find that a numerically large human capital stock in the North provided fertile soil for early industrialization, while the protection of agriculture resulted in an incentive for the South to specialize further in the primary sector, which turned out to be harmful in the long run.

Keywords: Regional Disparities, Human Capital, Trade Policy.

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1) Instructions

The economic and financial crisis of 2009 has focused the attention of economists on the analysis of long run growth potential. At the local level, some regions are suffering more than others because of their economic structure, and most policy interventions are actually aimed at providing temporary relief, with no particular reference to the fundamental structures of regional economies. In terms of regional disparities, the lack of a long run perspective could prove to be particularly harmful, resulting in myopic and often ineffective policies.

A large body of literature has, in fact, tackled the issue of finding the driving forces of regional growth and the ensuing pattern of convergence/divergence (*Abreu et al., 2005*). This literature has provided sound evidence on the determinants of regional growth over a relatively short time period, but it has often neglected the questions of *why* and *when* regional disparities emerged and *how* they evolved in the long run, albeit with a few notable exceptions. Acemoglu and Dell (2009) have proposed theoretical arguments in favour of a negative relationship between the quality of institutions and regional disparities. Tabellini (2009), building on Putnam's (1993) hypothesis, has provided evidence of the influence of past institutions on current economic development in European regions. Combes et al. (2008) analyze spatial inequalities in France, finding strong support for the economic geographic view, according to which the decrease in transport costs first tends to increase regional disparities, then subsequently reduces them. Esposto (1997) and Fenoaltea (2003) studied Italian regions over the period 1891–1931, establishing that the dramatic increase in regional disparities started in the early 20th century and coincided with the country's industrialisation.

Building on this literature, our aim is to disentangle the origins of regional disparities in Italy in the aftermath of Unification, which took place in 1861. In particular, we set out to highlight two specific aspects of regional disparities in Italy. Firstly, that the Northern population was more educated on the eve of the industrialisation wave, and therefore constituted a more productive factor than did the Southern labour force. This implies that the initial human capital gap may have an important factor in determining the subsequent diverging pattern of development. Secondly, in the crucial years of industrialisation (1891–1911), high trade duties were imposed on agricultural goods and the products of some fledgling industries considered to be strategic (e.g., chemicals, iron, steel, textiles), mostly located in the North. Such protectionism preserved high profits in the primary sector and did not promote structural change in the South. In sum, protectionist trade policies were beneficial in the short run but, by blocking structural change, had negative effects in the long run.

In 1871 the percentage of Italian population able to read and write was 57.7% in the North-West and only 15.9% in the South. Over time this initial gap was partially bridged; by 1951 literacy rates were around 75% in the South and more than 90% in the rest of the country, although the convergence rate in human capital stock was probably too low to promote convergence in development.
The model we have in mind is similar to the one proposed by Ngai (2004), where different timings of the transition from a Malthusian to a Solow economy was a consequence of barriers (economic, technological, social, political, etc.), which increased the opportunity cost of the switch. In our paper we investigate the hypothesis that a low initial level of human capital stock and protectionist trade policy were barriers to the industrial transition of Southern regions.

The remainder of the paper is organized as follows. In the section below we review the conditions of regional economies in Italy in the aftermath of Unification, while in section 3 we consider econometric evidence on the long run impact of initial human capital conditions. In section 4 we provide evidence on the growth impact of trade policy, as well as its joint impact of initial human capital disparities on structural change. Section 5 contains our conclusions.

2) Italy in the aftermath of unification

Prior to the Unification of 1861 Italy was comprised of two main states: the Kingdom of Sardinia, in the North and in most of the central part of the country, and the Kingdom of the Two Sicilies, in the South[34]. In the aftermath of Unification, disparities between the two parts of the country in terms of GDP per capita were not significant, as reported in Figure 1. Interestingly, the gap between North and South started to be relevant in conjunction with the early stages of industrialisation. Figure 2 documents the contraction of industrialisation indexes occurring in

[34] Rome and the Church State were annexed in 1870.

the South during the period 1891–1911, and their increase in the North. Questions as to why this happened are crucial.

Several theories have been proposed to explain the divide. The "geography view", reviewed in Fenoaltea (2006), highlights the importance of natural resources, easily available in the North (Rapp, 1975; Fenoaltea, 1999), as well as the North's geographical proximity to the European core (*Malanima, 2002*). The "institutions view" strongly emphasises the role of social capital (notably higher in the North) and past *de jure* institutions in lowering transaction costs, thus boosting private investment and entrepreneurship (*Putnam, 1993; Percoco, 2009*).

Here, we further advance the hypothesis that a low level of initial human capital stock and protectionist trade policies for agriculture in the 19th-20th centuries enveloped the South in a low industrialisation equilibrium, which negatively affected the level of development in the long run.

Considering data for 1891 in terms of index number (per worker value added in comparison to average national per worker value added), substantial uniformity may be noted in the level of productivity among regions. The comparison among all Italian regions (Figure 3a) shows the absence of a clear North-South dualism in terms of productivity: Lazio was the most productive region, while the regions of Puglia, Sicily and Sardinia were characterized by higher productivity levels than those of Lombardy and Piedmont.

The scenario is, however, completely different when considering regional data on literacy rates (Figure 3b). The comparison in this case already shows a significant disparity among regions. In particular: (1) the spatial distribution of the gap shows the existence of two different clusters: Northern regions plus Tuscany and Lazio characterized by a high level of education, and Southern regions plus Marches and Umbria with a literacy rate clearly lower than the average; and (2) the magnitude of the gap underlines that in 1891 the literacy rate in the Northern regions was almost twice that in the South of Italy.

Differences in terms of the spatial distribution of the two indicators are clearly identified when the cartographic representation is taken into account.

The number of classes in the clustering process is defined by Sturges' formula (*Sturges, 1926*):

$$n°classes = 1 + \left[\left(10/3\right) * \log\left(n°observations\right)\right]$$

This formula allows us to define the optimal number of classes with respect to the number of observations, which, in our case, coincides with the number of Italian regions. Employing the above formula five different clusters are identified. They show the spatial distribution of the indicators, considering potential agglomeration phenomena in terms of per worker value added (Figure 4a), literacy rate (Figure 4b) and agricultural specialization (Figure 4c).

Such an assumption does not propose that human capital was the only determinant of divergence in regional economic trends. On the contrary, the rise of regional inequality in Italy is due to a complex system of factors. In particular, on the eve of Italian Unification the country had a relatively small degree of protectionism, with an average trade tariff of 7% (*Federico and O'Rourke, 2000*). Starting, however, with the signing of a new treaty with France in 1877, and the consequent increase in tariffs in 1878, free trade was replaced by increasingly protective policies. In a certain sense Italy anticipated protectionist policies implemented by other countries in the 1890s (*Blattman et al., 2002*). In 1887, landowners sitting in parliament succeeded in gaining approval for an increase in wheat duties, along with high duties on textiles, iron and steel, a tariff structure that was to remain in force up to World War I[35].

The effect of trade policy in the late 19th century has been the subject of a number of studies. Recently, O'Rourke (2000) found a positive effect of trade tariffs on growth in the last part of the century[36]. As for Italy, Pescosolido (1998), Sapelli (1991) and Zamagni (1993) point out the positive role of protectionism in stimulating strategic industries, such as the iron and steel industries. Gerschenrkon (1962) argues that Italy could have benefited from protectionism of highly skilled intensive sectors, such as engineering and chemicals. Similar arguments are also at the heart of Fenoaltea's (1973) analysis. In assessing the effect of trade policy in a static computable general equilibrium model, Federico and O'Rourke (2000) find little evidence in support of the hypothesis that protectionism blocked structural change[37].

[35] Interestingly, the involvement of land elites in the process of tariff setting is worthy of further investigation with regard to the political economy of tariffs in Italy (Nunn and Trefler, 2007).

[36] For additional reviews, see also Tena (2006; 2007).

[37] For a different application of a general equilibrium model in the case of the American autarky experience in 1807–1809, see Irwin (2005).

Previous literature has, in fact, neglected the use of panel models because of the lack of historical data at the regional level. However, recent findings in economic history allow us to conduct econometric analysis to disentangle the effect of trade policy and initial human capital stock on the development process of Italian regions. Our argumentation strategy consists in, firstly, assessing separately the role of initial human capital stock and trade policy. To this end, we make use of two datasets which allow us to exploit all the available information. The first—with a higher number of variables—consists of an unequally spaced panel spanning the period 1891–1951 and reporting information only for the census years. The second—with a lower number of variables—consists of regional yearly time series over the period 1891–2004.

As a second step in our argumentation, we consider jointly initial human capital stock and trade policy as determinants of structural change in a unified framework.

In the section below, we start using the first dataset to corroborate our hypothesis on the relevance of initial conditions in human capital stock.

3) Human capital and regional productivity gaps

3.1. Data

New growth theory and, in particular, endogenous growth models emphasize human capital as a key factor for stimulating growth (*Lucas, 1988; Romer, 1986 and 1990*). We intend to contribute to this literature by highlighting the long run impact of human capital in Italian regions. The analysis is based on data from several studies in the economic history field that analyze long run trends in terms of regional economic, demographic and social conditions. Regional value added data and sectoral shares are from Felice (2005a). Sectoral shares are defined as the ratio between sector value added and total value added in the region. Value added in manufacturing and services are from Felice (2005b), while agricultural value added is from Federico (2000).

All indicators are defined in per capita terms based on the level of annual population for a time interval starting from 1891 to 1951; they are defined at the end of each period and at 2008 prices. Due to incomplete data the analysis is performed over an unequally spaced panel that considers for the available number of regions (*Piedmont, Lombardy, Veneto, Liguria, Emilia Romagna, Tuscany, Umbria, Marches, Abruzzo, Molise, Campania, Puglia, Calabria, Sicily and Sardinia, except for Valle d'Aosta, Trentino Alto Adige and Friuli Venezia Giulia*) the following years: 1891, 1911, 1938 and 1951.

To test the impact of education on regional development in terms of path dependence, we consider the literacy rate in 1871 as the number of individuals over six years in age who were able to read and write (*Felice, 2005b*). This methodological choice reflects the aim of the analysis. This paper strives to test whether the pre-conditions of regional development in terms of education affected the divergent long run development trends between the North and South of Italy. This hypothesis is supported by the evidence discussed in section 2 regarding the initial characteristics of the Italian regions. The main idea is that whereas just after Unification the gap between northern and southern regions in per worker value added was negligible, there was already a huge difference in terms of human capital. Based on this historical evidence we infer that the differences in human capital were at the root of the subsequent North-South dualism. In order to test this hypothesis we use the level of education in 1871 as a proxy for these preconditions, and we analyse its effect on the level of regional value added in the following period. This approach allows us to test for the persistence in the effect of education on regional development.

In order to isolate the effect of human capital, we will control variability among sectors in terms of different degrees of specialization by introducing a vector, $spec_{rst}$, that measures shares of value added related to region *r,* sector *s* at time *t* as a regressor.

3.2. Human capital and the productivity growth rate

We attempt to assess the effect of education on productivity, highlighting sectoral specialization. The path-dependence perspective implies that the analysis focuses on the effect of education in terms of initial conditions (i.e., education in 1871) on subsequent regional development. To this end, the time invariant level of education will be multiplied by temporal dummy variables. The interaction terms allow us to estimate the effect of education in 1871 on productivity levels during subsequent periods by inserting the time invariant level of education in 1871 as an explanatory variable of the fixed effect regression.

In the last part of the analysis the time invariant level of education of 1871 is introduced through an interaction term with sector specializations. In this framework the interaction term captures the joint effect of education and specialization, while the coefficients related to specialization could be interpreted as the effect of sector specialization when the level of education is equal to zero.

The analysis is based on a balanced sample that provides observations for all Italian regions and at four points in times: 1891, 1911, 1938 and 1951. Table 1 reports summary statistics.

Note that Table 1 emphasizes the relevance of a fixed effect estimation due to the predominance of the within variability in the sample for the two fundamental dependent variables.

Our analysis builds on the classical production function framework with the aim to analyse the persistence of initial human capital stock We begin by estimating the impact of initial conditions in terms of human capital on long run growth. The aim is to evaluate the effect of the preconditions, in terms of human capital, on the variation of regional productivity over time after controlling for the structure of the economy. In particular, we estimate an equation in the form:

$$growth_{r,t} = \alpha + \beta_1 va_{rt-1} + \sum_{t=1891}^{1951} \beta_{2t} educ_{r71} \cdot d_t + \\ + \sum_{s=1}^{3} \beta_{3s} spec_{rst-1} + \gamma_t + \gamma_r + \varepsilon_{st} \quad (1)$$

where *growth* is the log of the average annual growth rate of region *r*, va_{rt-1} is the log of value added, $educ_t$ is the log of the level of education in 1871 or 1891, d_t is a vector of time dummy variables, γ_t and γ_r are year and region fixed effects, and ε_{st} is a well behaved error term that captures potential shocks in productivity. Variables $spec_{rst-1}$ are the log of sectoral shares (with *s*= agriculture, manufacturing, service). Note that this specification contains both region- and year-specific fixed effects so as to minimize the problem of omitted variable bias.

Table 2, columns 1 and 2, reports the estimation results of equation (1). The magnitude of coefficients is not easily definable given the high standard errors, but it is possible to infer the sign and the statistical significance of the relations. Coefficients of specialization are statistically significant for all sectors, meaning that a general increase in the level of sector specialization positively affected productivity. Considering the coefficients for education in 1871, it is clear that the effect on productivity level just after World War I is negligible, while the effect on productivity level after World War II becomes relevant and statistically significant. This evidence can be interpreted as a result of the progressive increase in labour market skills requirements.

After World War II, Italy embarked upon the well known "economic boom", characterized by a speeding up of industrialization and a progressive rise in the economic significance of the tertiary sector. The new economic conjuncture reasonably provoked an increase in the average labour skills requirements and a higher relevance, in terms of labour market participation, of higher educated workers.

Regions traditionally characterized by a higher level of education faced a comparative advantage in terms of quality of human capital, and they were reasonably able to benefit from the opportunities of the "new economy", both in terms of capacity of innovation in traditional sectors and the possibility to rely on a wider range of new activities.

Column 2 of Table 2 reports the same type of regression using the regional level of education in 1891, about 20 years later. These additional estimates can be considered as robustness checks, given the reasonable persistence in the level of education; the sign and the statistical significance of all coefficients remain unchanged.

3.3. Human capital and the productivity level
In the previous specification we analysed the effect of education in 1871 on growth rate then on the variation of value added over time. The analysis of the effect of human capital on productivity is further investigated taking as a dependent variable the level of value added in each year, rather than its variation over time. This analysis is designed to isolate the effect of human capital on annual productivity.

The second estimated equation is:

$$va_{rt} = \alpha + \sum_{t=1891}^{1951} \beta_{1t} educ_{r71} \cdot d_t + \\ + \sum_{s=1}^{3} \beta_{2s} spec_{rst} + \gamma_t + \gamma_r + \varepsilon_{rt} \tag{2}$$

where the dependent variable is the log of value added per capita of region r at time t., $educ_t$ is the log of the level of education in 1871 or 1891, d_t is a vector of time dummy variables, γ_t and γ_r are year and region fixed effects, and ε_{st} is a well behaved error term that captures potential shocks in productivity. Variables $spec_{rst-1}$ are logarithms of sectoral shares (with s= agriculture, manufacturing, service). It should be noted also that equation (2) has region- and year-specific dummy variables in order to minimize the omitted variable bias.

Columns 3 and 4 in Table 2 report estimates for this specification. The quality of the estimates is generally improved as revealed by the magnitude of the standard errors.

Column 3 reports estimates related to the effect of education in 1871 on productivity level. The effect of specialization in agriculture is negligible, while the effect of an increase in industrial specialization remains positive and statistically significant. The data refer to approximately a half century, from 1891 to 1951, a period characterized by a progressive industrialization process. The different capacity of each region to cope efficiently with this economic change will be one of the most relevant stimuli to productivity growth.

An interesting result is related to the effect of specialization in services: The high coefficient is statistically significant but shows a negative sign. Interpreting this estimate could be controversial. The main point is that in the time period under consideration the tertiary sector was not highly productive, consisting mainly of personal service activities. The increase in the share of the service sector as ancillary to industrial development has been a feature of the decades starting from the 1960s, years that lie outside our sample.

The level of education in 1871 is still not significant for productivity in 1911, although it is positive and highly statistically significant after the World War II, when the increase in labour market complexity required more highly skilled workers. Even in this case the fourth column of Table 2 reporting estimates of the education level in 1891 could be interpreted as a robustness check for the analysis of the effect of human capital quality levels on productivity and confirms the results reported in the third column.

3.4. Human capital, productivity level and sectoral structure

The regression in question emphasizes the positive effect of industrial specialization on value added, suggesting a relevant impact of the manufacturing sector on total regional productivity. This conclusion is reasonable for the time period under scrutiny, which is characterized by low value added in agriculture. Further analysis suggests possible correlations between sector specialization and education level. This specification allows us to investigate another channel through which education affects value added, i.e., by stimulating specialization in more productive sectors.

Table 3 shows the level of correlation between the education level in 1871 and specialization for each sector. The education level is closely correlated with industrial specialization, while the correlation is negligible for services and negative for agriculture.

To test the effect of initial education on productivity we will provide a further specification of the model to allow for an interaction term between education level in 1871 and sector specialization. The main aim of this new specification is still to analyze whether the level of value added is affected by education in 1871, but in this case the focus is on the channel through which such an effect appears. As emphasised by the coefficients shown in Table 3 the correlation between sector specialization and education in 1871 is an important dimension, and it could be an important source of variability in the regional economic performance. We will try then to account for the simultaneous effect of specialization and education in 1871 through an interaction term.

The estimated equation takes the form:

$$va_{rt} = \alpha + \sum_{t=1891}^{1951} \beta_{2t} educ_{r71} \cdot spec_{rst} + \sum_{s=1}^{3} \beta_{3s} spec_{rst} + \gamma_t + \gamma_r + \varepsilon_{st} \quad (3)$$

where the dependent variable is the log of value added per capita of region r at time t., $educ_t$ is the log of the level of education in 1871 or 1891, $spec_{rst}$ is the variable related to sector specialization, γ_t and γ_r are year and region fixed effects, and ε_{st} is a well behaved error term that captures potential shocks in productivity.

By inserting an interaction term for sector specialization and education in 1871 we are able to account for the time invariant level of education in 1871 in the fixed effect regression. In order to interpret consistently this effect the variable related to sector specialization is also considered in the regression as it is time-variant. Note that the robustness of the estimation requires that both the terms of the interaction term are inserted individually. In our case the time invariant variable related to education in 1871 is already included in the fixed effect then the interaction term is perfectly identified.

The estimates reported in column 5 show that the interaction term capturing the simultaneous effect of education in 1871 and sectoral specialization is negligible for agriculture and services, while it is positive and statistically significant for industry. This result becomes even more important when considering the value of specialization as a baseline for evaluating the value added of education in determining the level of productivity.

The coefficients relating to sector specialization may not appear to be easily interpretable: They are completely different from the one already presented. In order to justify their retention it is necessary to interpret them as a baseline of the interaction term, for in this sense they are able capture the effect of sector specialization when the level of education is equal to zero.

Allowing for this interpretation, the coefficient relating to industrial specialization becomes negative, meaning that industrial specialization has a negative and statistically significant effect in the presence of zero education. Comparing this estimate with the positive sign of the interaction term implies that the possibility to affect productivity through industrial specialization is strictly related to human capital endowments. As expected, human capital plays a less fundamental role in agriculture or services.

This last specification of the model highlights a significant joint relevance of education and industrial specialization. Regions with more educated labour forces tend to specialize in industry, and regions with a large initial stock of human capital obtain benefits from industrial specialization. In both cases it is possible to show a significant interaction between human capital and industrial specialization, positively affecting productivity level.

Important spatial implications are connected to this assumption. Figure 2 shows that in 1871 Northern regions were significantly more educated than Southern ones, and our results suggest a higher correlation between education level and industrial specialization. This is probably because regions with a more qualified human capital were able to switch from an agriculture-based economy to a more productive, industry-based economy. Data actually support this hypothesis, given that more productive Northern regions in 1951 were characterized by a higher level of industrial specialization, while the less productive Southern regions remained devoted to agriculture.

In this section we have provided evidence on the relevance of the 1871 level of human capital stock for subsequent development in Italian regions. In the following section, we will provide evidence on the effect of trade policy on long run development and structural change.

4) Trade policy and regional growth

It is common to think of the positive effects of trade liberalization in terms of economic efficiency and short run growth (*Giavazzi and Tabellini, 2005*). Free trade is generally considered to increase economic performance and social welfare in trading countries, and a large body of literature has focused on the growth and development implications of trade. Little work, however, has been produced on the effect on regional disparities.

In developed countries such as the U.S., the increase in trade openness has resulted in a widening gap between skilled and unskilled workers. Studies have found the increase in income inequality to be as much as 20% (*Feenstra and Hanson, 1999; Borjas et al., 1997; Baldwin and Cain, 2000*).
It has also found, however, that trade does not increase inequality[38] within all countries (*White and Anderson, 2001; Ravallion, 2001; Dollar and Kraay, 2002*), while there is some evidence in the literature an increase in inequality in developing countries (*Calderon and Chong, 2001*). Interestingly, Spilimbergo et al. (1999) and Fischer (2001) find that the effect of openness on inequality increases as human capital endowment increases. While the link between trade and inequality has

[38] As is standard in the literature, in this section we use the term "inequality" to indicate inter-individual income differences, while we use "disparities" to refer to interregional disparities.

attracted the interest of a number of scholars, the impact of trade openness on regional disparities has received comparatively less attention.

Krugman and Elizondo (1996) propose a theoretical framework in which international trade may act as an equilibrating force in regional disparities as long as more supplies are sourced from abroad and more output is sold abroad. Opposing this conclusion, and by considering the sectoral composition of regional economies and trade, Paluzie (2001) found that an increase in manufacturing trade exacerbates regional disparities if workers in agriculture are relatively immobile in relation to manufacturing. Similarly, Rodriguez-Pose and Gill (2006) find that regional disparities are likely to increase as trade in primary sector goods loses importance in the composition of total trade.

Such studies constitute the basis of our further analysis of long run regional disparities in Italy. In particular, Figure 5 depicts the temporal pattern of the protection index (defined by the average duty as a percentage of goods value) and of trade openness (defined as the ratio between the sum of imports and exports and total GDP). Both indicators show the effect of 19th century protectionism in terms of increasing duties or contraction of the share of international trade on GDP. It is interesting to note that, despite the increase in protectionism during the period 1878–1898 (with relatively high tariffs also in the following fifteen years), trade openness slightly increased. This has led Federico and O'Rourke (2000) to question the effectiveness of protectionism in Italy. On this point we assume an agnostic view and choose not pursue the argument. Rather, we introduce both measures in our regression analysis.

Our dependent variable is GDP per capita at 1911 prices over the period 1891–1990 (*Daniele and Malanima, 2007*). The index of protection is from Federico and O'Rourke (2000) and covers the years 1863–1932, while the index of trade openness (defined as the ratio between the sum of total imports and total exports to total GDP) is calculated from data in Rossi et al. (1993) and covers the years 1891–1990. All variables are annual.

The reason why we make use of a different dependent variable is that in assessing separately the role of trade policy we want to exploit all the information available, which, in this case, exists on a yearly base.

Following Acemoglu et al. (2005), we can test the impact of trade policy on regional development by estimating the following regression equation:

$$\ln gdp_{rt} = d_t + \delta_r + \sum_{t=1891}^{1990} \beta_{1t} South \cdot d_t + \beta_2 South \cdot trade_t + \varepsilon_{rt} \qquad (4)$$

where the dependent variable is the logarithm of GDP per capita in region *r* at time *t*, d_t is a vector of time dummies and δ_r a vector of regional fixed effects, *South* is a dummy variable taking the value of 1 for regions in the South and 0 otherwise, and *trade* is either the logarithm of trade openness or of the index of protection.

The results for models 1 and 2 in Table 4 disclose a positive impact of protectionism on GDP per capita in Southern regions. In fact, we found a positive and significant coefficient for the term South*Protectionism, implying that higher tariffs lead to higher GDP in the South. Similarly, the coefficient for South*Openness is negative and significant, implying that lower openness to international market leads to higher GDP in Southern regions. In models 3 and 4, we propose a specification in which trade is interacted with the logarithm of productivity in industry in 1891, instead of *South*. Both estimated coefficients confirm the positive effect or protectionist policy in regions with a high level of productivity in the manufacturing sector in 1891.

Taken together, models 1–4 point out the benefits of trade policy in the South, possibly because of high tariffs for agricultural goods, and in highly productive regions, possibly because of tariffs on chemicals, iron, steel and textiles.

In Table 5 we assess the impact of trade policy on growth in a convergence regression function. In model 1 we found a positive effect of protectionism on regional growth in the South, while the results of model 2 propose a contrasting (negative) effect. The reasons for such opposite results are not clear, however they could be traced in Figure 5, which shows in the years 1891–1901 and 1911–1918 a substantial co-movement of the protection and of the openness indexes, possibly because total imports and exports respond not only to trade policy but also to other socio-economic variables. Models 3 and 4 also present unsatisfactory results in terms of the signs and significance levels of the coefficients.

Taken together, results in Tables 4 and 5 point to a positive effect of protectionism on Southern GDP, although the effect on the short run growth process is unclear or negligible.

Our argument is that initial conditions on human capital stock and protectionist trade policy blocked the industrialization of the South by providing incentives to remain specialized in agriculture through a positive short run effect on GDP. In order to put together the two separate pieces of evidence we estimate the following specification using the dataset described in Section 3:

$$\Delta spec_{r,ind,t} = d_t + \delta_t + \sum_{1911}^{1951} \beta_{1t} educ_{r71} \cdot d_t + \beta_2 educ_{r71} * trade_t + \varepsilon_{rt} \qquad (5)$$

where the dependent variable is percentage change in the manufacturing share. Because of the structure of the dataset, the variable *trade* is averaged over the years. Columns 1 and 2 in Table 6 reports estimates that confirm the hypothesis that high protection generally leads to larger changes in manufacturing shares of Italian regions. In column 3, however, we show the results of a model that can test our hypothesis more explicitly, i.e.:

$$\Delta spec_{r,ind,t} = d_t + \delta_t + \sum_{1911}^{1951} \beta_{1t} educ_{r71} \cdot d_t + \beta_2 educ_{r71} \cdot spec_{r,ind,t-1} + \qquad (6)$$
$$+ \beta_3 South \cdot trade_t + \beta_4 spec_{r,ind,t-1} + \varepsilon_{rt}$$

Here *trade* is the average tariffs on agricultural goods, as in Federico and O'Rourke (2000). Our a priori assumption is that higher protection of agricultural goods leads to lower growth of industry share in the South – a corollary of our hypothesis that trade policy blocked structural change in the South. Interestingly, we find a slight process of structural convergence, as the coefficient associated with $spec_{r,ind,t-1}$ is negative and significant, while the coefficient β_2 is positive and significant, implying a diverging pattern of industrialization imposed by initial disparities in literacy rates. Also to be noted is the coefficient for the variable $South*trade_t$, which is negative and significant at 5%. Results are also confirmed in model 4, where we select the change in agriculture protection instead of its level.

Taken as a whole, these results show that our argument is reasonably corroborated by data, suggesting that initial human capital conditions and protectionist trade policy slowed industrialization and structural change in Southern regions, resulting in an increase of regional disparities in the long run.

5) Concluding Remarks

Estimation results support the positive effect of human capital both on productivity levels and on the growth rate of productivity. The model introduces education level in 1871 and 1891 as a proxy for human capital stock in each region, evaluating how much the traditional education level affected the regional development path. Not inserting a continuous variable for education level reflects limited data availability, as well as a deliberate methodological choice.

Introducing education through an interaction term in a fixed effect framework allows for controlling for both for region and year fixed effect, as well as for evaluating the effect of education in 1871 over the years. The results can be interpreted in terms of a path dependence assessment of the role of regional gaps in human capital level on long run regional development rates.

The methodology is particularly relevant for considering the regional structural gaps analyzed in the first part of the paper. It has been underlined that just after the unification process the main source of heterogeneity among regions was not related to differences in productivity but to those in education level. In addition, the cluster structure of this heterogeneity has been analyzed through a cartographic representation, showing that the well known North-South duality was negligible in terms of productivity performances, but was already in force in terms of human capital differentials.

This empirical evidence in the first part of the analysis suggested a significant correlation between educational gaps and divergent development trends between the northern and southern parts of Italy. The estimates obtained further confirm this evidence of the crucial role of education in influencing the regional development rate.

Deepening the analysis, a higher correlation between education level and industrial specialization has been shown. Such evidence, combined with the stronger effect of industrial specialization on total productivity, leads to the conclusion that sectoral specialization can be considered the main channel through which education affects productivity. The general conclusion is that regions with more educated labour forces can specialize in more productive sectors.

Moreover, it is suggested that the ineffectiveness of industrial policy in the south of Italy over past decades was probably due to the lack of adequate preconditions in terms of human capital. This conclusion constitutes a proof of the crucial effect of education on local development. However, an open question persists: Does education fully explain the heterogeneity in sector specialization among regions?

The answer is clearly negative: Education level is a significant variable, allowing some regions to deal with a structural change in their economies. Other policies, however, naturally played a fundamental role in the definition of national economic equilibria. The above analysis has attempted to assess the effect of intra-national trade as a fundamental determinant of the regional economic structure.

Our findings show that the short term effect of protectionism on GDP is positive and statistically significant, but focusing on its variation over time the impact remained positive only in the South of Italy. Such empirical evidence suggests a positive correlation between the level of GDP and protectionism for both agricultural and industry-based economies, although when we look at the variation in GDP over time it is clear that this effect is no longer relevant for industrial regions,. This system of incentives, together with the lacking human capital, blocked the industrialization process in the South of Italy. The lesser endowments of human capital made coping with structural change difficult, while protectionism encouraged southern regions to specialize in agriculture.

The results of our analyses suggest these dual overall conclusions:

- Human capital was a fundamental determinant in the divergence between North and South of Italy; it prevented southern regions from switching from a low value added agriculture-based economy to a higher value added, industry-based economy

- Protectionism incentivised southern regions to focus on agriculture, with the positive effect of protectionism on the agriculture-based economy (as compared to its negligible effect on the industry-based economy) providing a justification for local governments to block industrial development.

The well known North-South duality depends on regional structural characteristics in terms of human capital differentials, but it was exacerbated by a national trade policy that stimulated the persistence of agricultural specialization in regions where traditional gaps could imply higher opportunity costs in modifying the structure of the economy.

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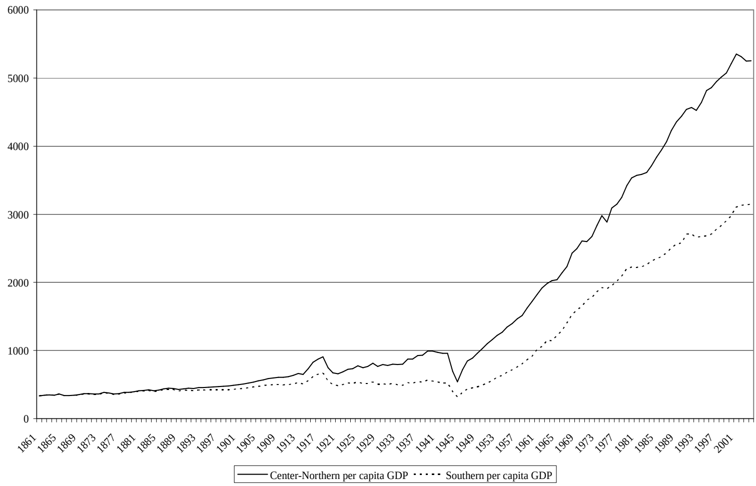
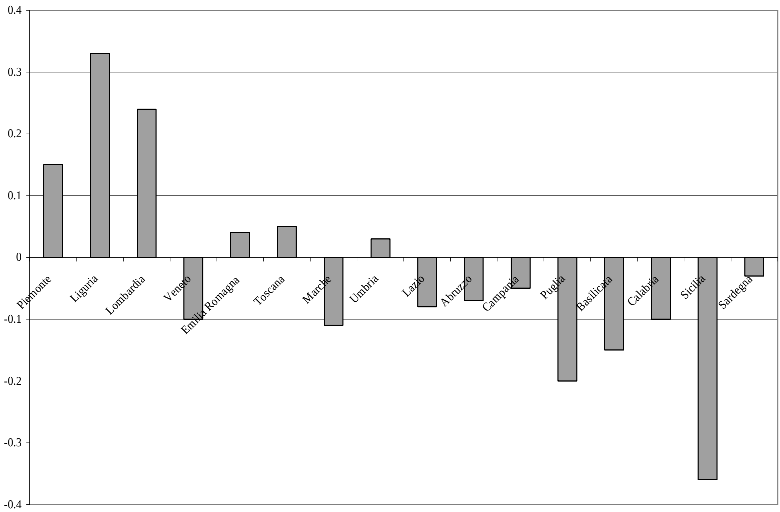
Figures and tables

Figure 1: Per capita GDP in Italian macroareas (at 1911 prices)



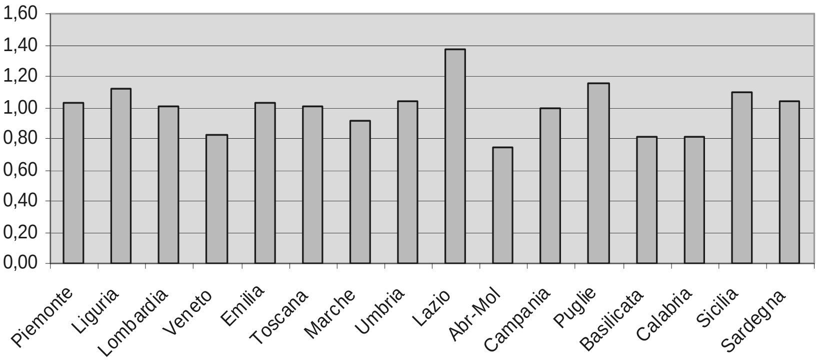
Source: Daniele and Malanima (2007)

Figure 2: Variation of the index of industrialisation, 1891–1911



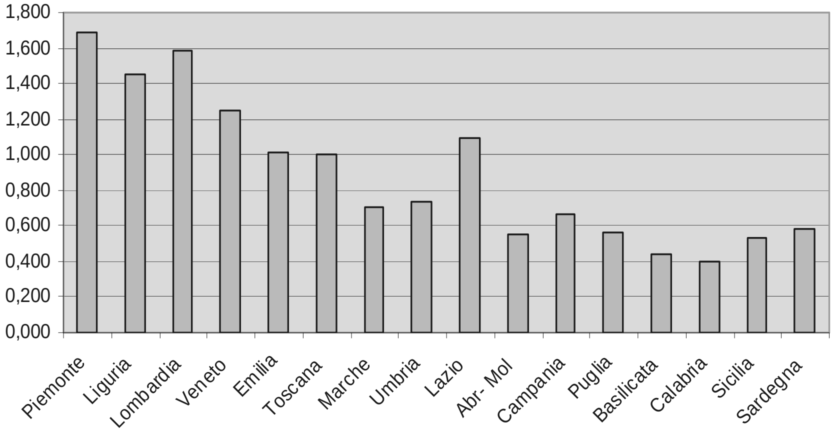
Notes: The index of industrialisation is the ratio between the regional share of industrial value added and the regional share of male population older than 15 years. The graph displays the absolute variation of the index between 1891 and 1911. Source: Fenoaltea (2006).

Figure 3a: Value added in 1891 (Italy=1)



Source: Felice (2007)

Figure 3b: Literacy rate in 1891 (Italy=1)



Source: Felice (2007).

Figure 4a: Per worker value added in 1891 (in Liras)

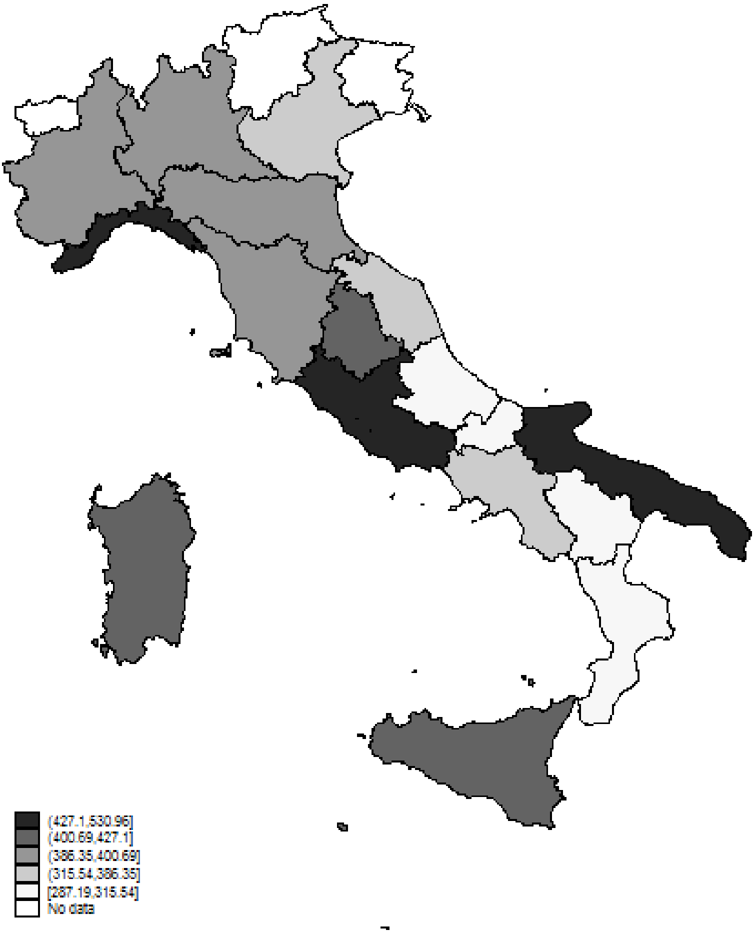


Figure 4b: Literacy rate in 1891 (in percentage)

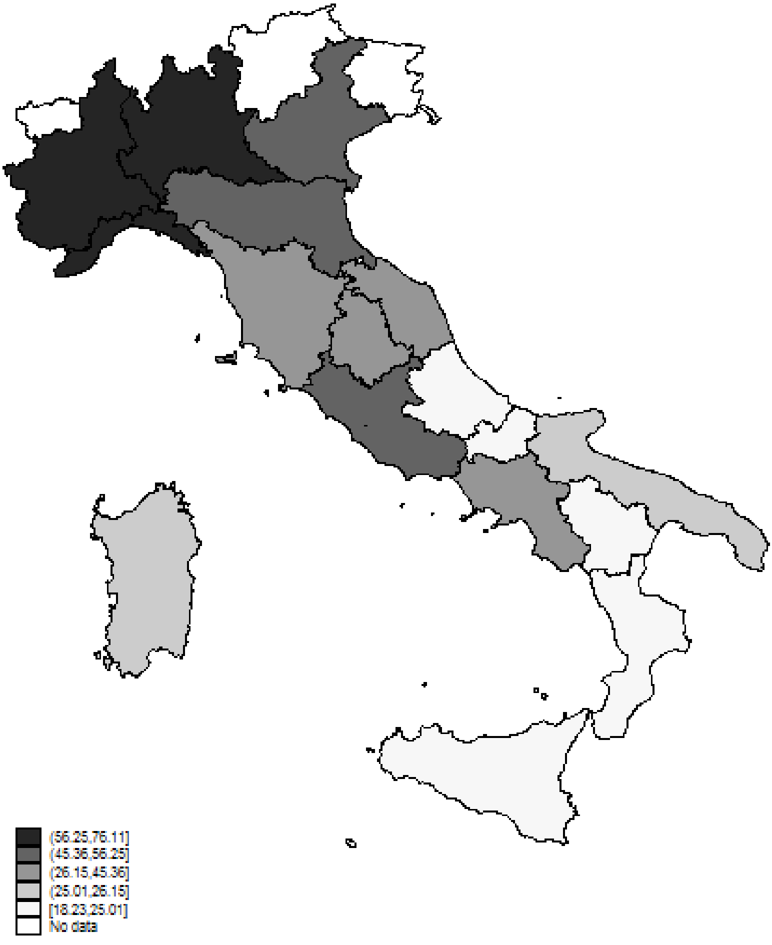


Figure 4c: Specialization in agriculture in 1891

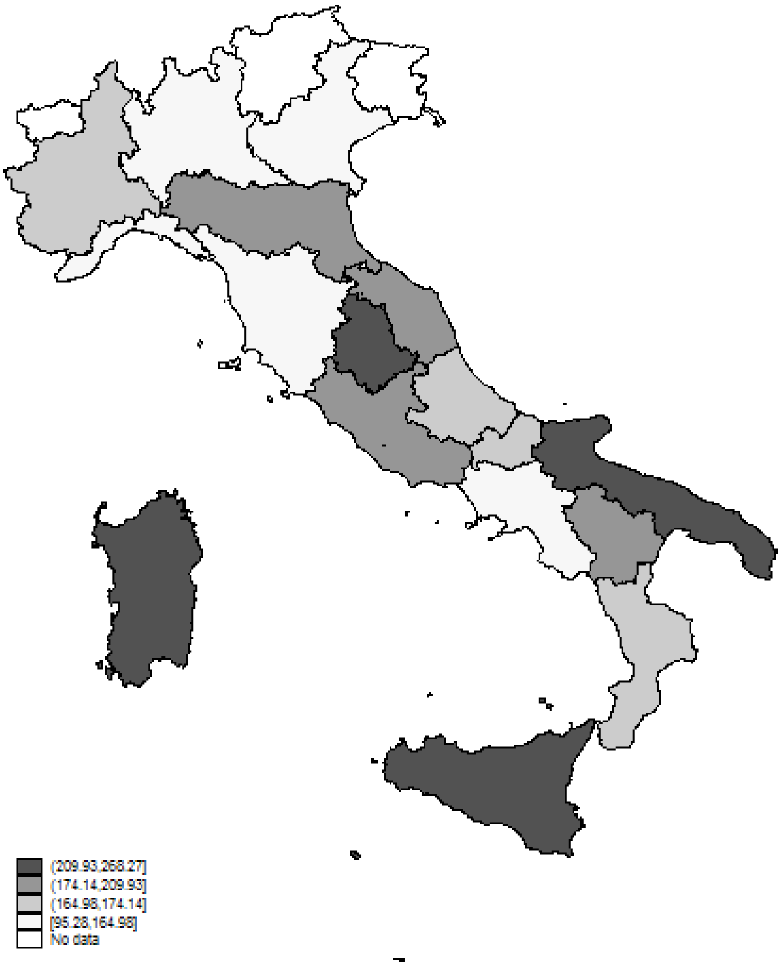
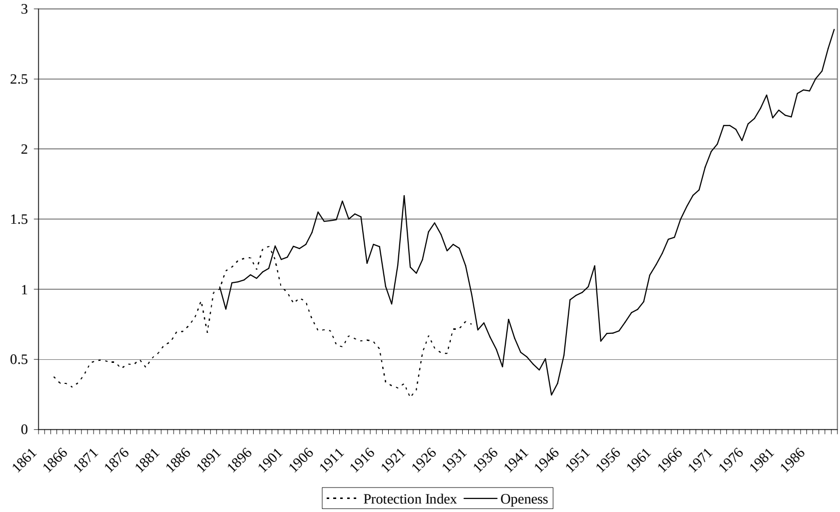


Figure 5: Temporal pattern of the index of protection



Notes: Both indices are normalized at 1891 level.
Sources: Federico and O'Rourke (2000) and Rossi et al. (1993).

Table 1: Dependent variables: overall, between and within variation

		Mean	Std. Dev.	Min	Max	Observations
growth	**Overall**	8.4352	2.9537	4.5119	13.3260	N = 48
	Between		0.3426	7.9795	9.0790	n = 16
	Within		2.9346	4.8691	12.6822	T = 3
$\ln va_{rt}$	**Overall**	8.1579	2.5246	5.6601	13.3339	N = 64
	Between		0.2310	7.7984	8.5767	n = 16
	Within		2.5145	5.5691	12.9151	T = 4

Notes: N stands for the total number of observations, n is the number of regions in the sample and T is the number of temporal observation for each region.

Table 2: Productivity, human capital and sector specialization

	growth		$\ln va_{rt}$		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
$\ln spec_{ragrt-1}$	.53** (.24)	.62* (.33)			
$\ln spec_{rindt-1}$	.50** (.21)	.57** (.22)			
$\ln spec_{rtert-1}$	1.49** (.71)	1.3** (.56)			
$\ln spec_{ragrt}$			-.05 (.15)	-.05 (.16)	.08 (.39)
$\ln spec_{rindt}$			.35** (.14)	.34** (.14)	-.92** (.41)
$\ln spec_{rtert}$			- 1.1*** (.15)	-1.2*** (.20)	-.30 (.51)
$\ln educ_{r71} * d_{11}$	-.04 (.14)		.00 (.04)		
$\ln educ_{r71} * d_{51}$	.50** (.21)		.29*** (.15)		
$\ln educ_{r91} * d_{11}$		.0084 (.1332)		.00 (.04)	
$\ln educ_{r91} * d_{51}$		.42** (.18)		.19** (.08)	
$\ln educ_{r71} * \ln spec_{ragrt}$					-.00 (.22)
$\ln educ_{r71} * \ln spec_{rindt}$					.79*** (.26)
$\ln educ_{r71} * \ln spec_{rtert}$					-.33 (.33)
Obs. **R^2**	48 0.99	48 0.99	48 0.99	48 0.99	64 0.99

Robust standard errors in parentheses.
*** p<0.001, ** p<0.01, * p<0.05.
All regressions include year and region fixed effects. All models have time and region specific fixed effects.

Table 4: Regional development and trade policy

	GDP per capita			
	(1)	**(2)**	**(3)**	**(4)**
South*Protectionism	0.08** (0.03)			
South*Openess		-0.04** (0.02)		
Productivity in industry 1891*Protectionism			0.16** (0.07)	
Productivity in industry 1891*Openess				-0.26** (0.07)
Observations **R-squared**	656 0.90	1600 0.98	656 0.93	1600 0.99

Robust standard errors in parentheses.
*** p<0.001, ** p<0.01, * p<0.05.
All regressions include year and region fixed effects. All continuous variables are in logs. All models have an interaction term between South and a full set of time dummies, although not reported in the table.

Table 5: Regional growth and trade policy

	GDP growth			
	(1)	**(2)**	**(3)**	**(4)**
Log GDP per capita t-1	-0.04** (0.01)	-0.02* (0.01)	-0.03* (0.01)	-0.02* (0.01)
South*Protectionism t-1	0.01** (0.00)			
South*Openess t-1		0.01** (0.00)		
Productivity in industry 1891*Protectionism t-1			-0.01 (0.02)	
Productivity in industry 1891*Openess t-1				-0.00 (0.00)
Observations **R-squared**	656 0.93	1600 0.93	656 0.93	1600 0.93

Notes: All regressions include year and region fixed effects. All continuous variables are in logs. All models have an interaction term between South and a full set of time dummies, although not reported in the table.
Robust standard errors in parentheses.
*** p<0.001, ** p<0.01, * p<0.05.

Table 6: Trade policy and structural change

	Growth of manufacturing share			
	(1)	**(2)**	**(3)**	**(4)**
Education in 1871	[0.16]	[0.19]	[0.11]	[0.18]
Openess*Education in 1871	0.71* (0.32)			
Protection*Education in 1871		0.11** (0.05)		
Share of industry t-1			-0.09*** (0.01)	-0.08*** (0.01)
Share of Industry (t-1)* Education in 1871			0.01*** (0.00)	0.01*** (0.00)
Agriculture protection*South			-0.04** (0.01)	
Change in agriculture protection*South				-0.03** (0.01)
Observations	48	48	48	48
Adj. R-squared	0.42	0.39	0.42	0.40

Robust standard errors in parentheses.

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

All regressions include year and region fixed effects. All continuous variables are in logs. The row for Education in 1871 report the p-values of the test for joint significance of the variable interacted with a full set of time dummies. All models have an interaction term between South and a full set of time dummies, although not reported in the table.

Chapter 5: Conclusions

This thesis is aimed at provided an empirical investigation of the role of intangible assets as crucial determinant of the economic and innovative performance of local areas. The analysis has been developed through three independent papers (Chapter 2, 3 and 4). Two of them addressed the role of human capital respectively in UK and Italy, while the third paper focused on the relevance of social capital in the Italian provinces.

Each paper builds on different relevant strands of literature: from traditional economic theory on the role of human capital and externalities as main source of endogenous growth (*Romer, 1986, Lucas, 1988*), to the theory and empirics of social capital (*Putnam, 1990, Granovetter, 1973, Keefer and Knack, 1997*) and some more recent contributions regarding the role of migration and externalities (*Breschi and Lissoni, 2000, Moretti, 2004, Duranton, 2007, Faggian, McCann, 2006, 2009*). Building on distinctive identification strategies the thesis provides reliable empirical evidences on the role of intangible assets. Each paper contributes to the current debate trying to identify the main gaps within the theory and to shed some more light on the causal mechanisms at play.

The first paper supported the existence of a positive effect associated to human capital externalities on the innovative performance of British local areas further extending the analysis to the identification of the channels through which these externalities may diffuse across space. The paper found significant and robust evidences of the role of skilled migration as crucial transmission mechanism of these valuable externalities, contributing to provide empirical evidences on a strongly debated issue within the economic geography literature.

The second paper contributes to the wide literature on the economic dividend of social capital focusing on the extensively analysed case of Italy. Despite referring to a strongly debated issue, the paper offers an original perspective of analysis focusing the empirical investigation to the effect of social capital on innovation rather than growth. This methodological choice allowed overcoming the traditional vagueness in the definition specifying a distinctive measure of social capital. Focusing on the network dimension of social capital and building on the bridging – bonding dichotomy, the paper showed that the typology and the intensity of localized ties justify the existence of the traditional two sided effect of social capital.

The third paper provides an empirical investigation of the long run determinants of regional disparities in Italy. Offering a novel perspective of analysis, the paper suggests that the well-known north-south dichotomy in Italy could be explained by systematic differences in the initial level of human capital and by the role of the post unification protectionist trade policy. The paper argued that both dimension contributed to prevent the industrialization of southern regions providing incentives to specialize in low knowledge intensive and low value added economic activities.

More research is needed on the role of "soft factors", within this thesis analysed in particular in respect to human and social capital, to provide a deeper understanding of their effect on the economic prospects of local areas. Future extensions of this thesis should be devoted to exploit new methodologies and theoretical approaches in order to overcome the exceptional challenges related to the identification of the causal mechanisms at the root of the existence of persistent economic differentials among regions and countries.