HOW DOES TRUST AFFECT ECONOMIC GROWTH THROUGH SPURRING INNOVATION? ANALYSIS OF NUTS REGIONS

By

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Abstract

The various transmission channels between trust and economic growth have been researched extensively in the literature throughout the previous decades, however, innovation as a mediating factor became particularly important following the rise of regions as engines of economic development. After drawing a clear difference between the effects of trust and of other factors of social capital, this thesis examines the relation of trust, innovation and economic growth on a sample of 95 NUTS regions for 2000-2007 by employing 2SLS and 3SLS methodology. It finds neither a direct effect of trust on economic growth, nor an indirect effect through patent applications, however trust proves to be a strong determinant of innovation across the specifications. An increase in trust corresponding to a difference between Castilla la Mancha (Spain) and Thuringen (Germany) is associated with a 120% increase in patent applications. As an original contribution to the literature, it tests whether business, government and higher-education R&D investments are more productive in high-trust regions but finds no significant effect.

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1. Introduction

The role of trust in the society and economy dates back at least to Putnam (1993) but already Aristotle emphasized how mutual reliance among people can strengthen groups' position and foster their prosperity through helping them in every transaction, in every interaction with others, in almost every walk of life. Its influence on economy should be obvious, yet the newest studies ascribe more importance to it than we had thought and not necessarily in a straightforward way. Many qualitative and quantitative papers did an outstanding job in revealing the connection between trust and economic development. As more and more information and reliable data became available regarding trust in countries, this work has been getting even easier – which also attracted some criticism. Nowadays, measuring trust in general and toward domestic and international institutions is an indispensable part of surveys such as the European Social Survey and the World Value Survey that are widely used in several studies. Although it is tempting to accept them as a good source of measurement for trust, we have reasons to be cautious while analysing fact-based economic data with questionnaires' results.

This scepticism – or rather carefulness – roots in two factors. First, we cannot ignore that the exciting and undoubtedly important topic of *social capital*, a concept fundamentally associated with trust, inherently involves a level of immeasurability and more and more disagreements regarding its nature. Second, every social and economic analysis should establish a firm mechanism between cause and causality. It is not whether social capital affects or not our everyday life and our economic performance, it is *how* it affects and whether we can measure it according to our common social and economic standards. We need to assess those channels that we believe can translate improved social capital and increased trust in the society into economic benefits. The exact definition of the mechanisms is important since it can reveal endogeneities between trust and such other factors that can further economic development as

well. This question also implies that during every kind of analysis that uses social capital measures we need to be conservative regarding our results and findings.

Although already mentioned by Putnam (1993), innovation as a potential transmission channel has started to get into the focus of empirical studies about trust and economic growth only recently. This lately arrived inquiry on the part of economists can be explained with two factors: innovation became truly a buzzword only in the past decades and its measurability is at least as problematic as of trust. Nevertheless, its intermediary connection between people's confidence in each other and the performance of the economy they live in has been established qualitatively. Innovation became a main engine behind economies' success as it can yield new comparative and *collaborative* advantages for companies amid globalisation by capitalising on the ever-growing scientific knowledge generated in universities, research centres and R&D departments.

Following the footsteps of Florida (2002), the relation of trust and innovation became exceptionally interesting in the context of regional economic development. Regions and cities are increasingly seen as the drivers of growth: the new wave of close collaborations between multinational companies, local SMEs, research institutions and universities creates spatial externalities and spillover effects that exert their influence only at the given territory. With the emergence of various forms of local economic cooperation structures, innovation clusters and region-oriented funding schemes, different devices for fostering local innovation appeared that connect innovation activity with economic performance on a regionally differing way. The success of these initiatives depends not only on the persistence of such local partnerships and on the involvement and dedication of local governments, but also on the historic, institutional and social environment in regions. These factors are mostly predetermined, and thus policy makers and other economic agents should align their expectations to them.

In this thesis, I aim to investigate the connection between trust, innovation and economic performance between 2000 and 2007 by employing regression models. Specifically, using a sample of NUTS regions in Europe, I seek to find answers for the following four questions:

1) How does trust affect economic growth?
2) How does trust affect innovation?
3) Is there a difference in the sectoral R&D expenditures' productivity between low and high trust regions?
4) Does trust affect economic growth through spurring innovation?

The contribution of my thesis to the existing literature is three-fold. First, this study aims to fill in the space created by a shift in the 2000s in the focus of analyses regarding trust's effects on the economy toward for example productivity. Second, although using instrumental variables and 2SLS method is widespread, the examination of the transmission channels so far has largely lacked 3SLS methodology which allows to account for endogeneity between channels and economic growth. Third, according to my best knowledge this is the first study which analyses trust's capability to enhance the productivity of R&D expenditures with respect to innovation by employing interactions terms.

My thesis builds the following way. First, I discuss how trust participates in our life and where it originates from. Afterwards, in *Chapter 3* I present the connection of trust and economic growth discussing in details the potential transmission mechanisms. *Chapter 4* explains the relation of trust and innovation and also relates it to the context of social capital. *Chapter 5* puts together the three factors and explains what role trust and innovation play in regional economic development. Then I move on by explaining the data source and the methodology followed by the presentation of the results. Section seven concludes.

2. The importance of trust

In the context of social sciences, trust is considered the element of social capital – a concept that incorporates an alternative for human and physical capital. The notion of social capital can be traced back to four main establishers of its theory. Besides Loury (1977), who coined the term, Coleman, Putnam and Bourdieu cemented three, somewhat different approaches to the idea. While Coleman defined social capital as "*authority relations, relation of trust and consensual allocation of rights which establish norms*" (1990, p. 300), Putnam phrased it as "*features of social organization, such as trust, norms, and networks that can improve the efficiency of society by facilitating coordinated actions*" (1993, p. 167). Bourdieu focused much more on the interconnectedness aspect, stating that social capital "*is the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance and recognition* " (1986, p. 251). The broader phenomenon of social capital thus incorporates such elements besides trust that are as well serve as a glue for the society and communities and help them in smoothing out everyday interactions by establishing common basics. Although the literature commonly refers to social capital in general, for the sake of this study, it is reasonable to narrow down the focus only to trust due to the reasons I will describe in *Chapter 4*.

By the most popular interpretation associated with Coleman (1990), trust is placing resources at the disposal of others with no legal securement but an expectation that the act will be returned. We can categorize trust according to several considerations. Distinction between two types of trust with respect to its object is made by Uslaner (2000): *strategic trust* refers to the confidence we put in people we know, while *moralistic trust* is trust in people we don't know and are likely different from us. This latter is the one which provide the foundation of a civil society, and can create a more or less same moral community with same moral beliefs. With the words of

Fukuyama, "*trust arises when a community shares a set of moral values in such a way as to create regular expectations of regular and honest behaviour*" (1995, 153). This implies a collective learning process that is quite similar to that of democracy, tolerance and openness. Uslaner (2000) also differentiate between *generalized trust* and *particularized trust*. These indicate the relation of individual towards other people, according to that most people can be trusted *generally* or that we can put our faith only in our own *particular* kind. The difference was presented in a more expressive way by the study of Banfield (1958) covering the relationships in a Southern Italian village where people were in strong connection through their families but were absolutely missing links beyond kinship networks.

2.1. Trust and its impact

Trust is associated with several micro and macro level benefits which are well-collected by Knack (2001). Most importantly, increased trust between people decreases transaction costs. Agreements, commerce and all kind of interactions that involve some level of uncertainty are also accompanied by a proportional level[1] of transaction cost. People strive to insure themselves against their partner's supposed attempt to exploit the situation somehow. These precautionary moves usually demand costs that otherwise would not emerge, decreasing the willing to move into agreements at all. Trust helps solving the prisoner's dilemma and principle-agent puzzles (Knack, 2001): when higher returns are associated with desertion, the individual will not participate in production of new wealth (*making*) but in predation of existing wealth (*taking*) by diverting it from others. The resolution of this puzzle is up to the social and institutional surroundings in which it is set, that is, to the social norms and expectations within society. A more straightforward advantage of trust is that it allows people to spend less on protecting

[1] I use proportional referring to the belief that the more uncertain the situation is the higher the effort parties are willing to put into making it more comfortable.

themselves from theft or expropriation which lets them allocate these resources to other, productive activities (Knack and Keefer, 1997).

Another interesting association with trust is the general cultural attitude in the people: higher trust was already connected to a sense of open-mindedness as early as Fukuyama (1995). Capitalizing on this argument, Uslaner (2002) presented a discussion about how trusting individuals are more tolerant particularly of different cultures and lifestyles and also in general. The argument that diversity and its acceptance provide a good basis for creative environment and the flourishing of high tech industry was popularized maybe most widely by Florida (2002) and Florida and Gates (2001).[2]

The examples prove Fukuyama (1999) and his concept about *radius of trust*, implying that in order to draw firm conclusions about trust's effect we need to specify carefully the observed population and the type and level where the observed trust has the effect. Indeed, in the analysis of trust's effect on entrepreneurship, Kwon and Arenius (2010) highlights that although literature, focusing on trust and its impact on economic interactions, frequently uses *generalized* and *particularised trust* interchangeably – since both are effective in reducing transaction costs –, the latter might help drawing micro-level conclusion, while the former is more suitable for depicting macro-level implications. As they argue, generalised trust has two important features that favours national-level analysis: first, it facilitates free flow of information between separate groups (resembling the openness and tolerance argument from earlier), and second, it reduces inter-group conflicts and assists cooperation instead. As Brehm and Rahn articulated it, "*generalized trust allows people to move out of familiar relationships in which trust is based on knowledge accumulated from long experience with particular people*" (1997, p. 1008). In

[2] Though a slightly different aspect of social capital but an interesting concept, that also orderliness, the norms of being a good citizen, is found to be contradictory to creativity and thinking differently (Kaasa, 2009; Dakhli and de Clercq, 2004).

contrast, high particularised trust might prevent positive intra-group spillovers or might directly has negative consequences[3]: in the view of Olson (1982), strong group preferences may build the well-being of that group and its members at the expense of other groups. History abounds in such examples represented by for example the totalitarian systems.

2.2. What leads to trust or distrust?

Literature proves to have a wide variety of explanations of trust[4] although almost all the studies are keen in quickly laying down the limitation that nor a single variable, neither a group of them can be exhaustive in terms of giving complete explanation for the variance of it. Since the resolution of trust's roots require a deeper level of insight into past events and social institutions, research should be conducted carefully: as Durlauf (2002) emphasizes, endogeneity must be accounted for with even more caution during social and economic inquires. Another important factor we need to weigh in while lamenting over this issue is that any alleged determinant of trust needs to either be time-invariant or involve some persistence over time (Bjornskov, 2006). The reason for this condition is that trust is generally perceived stable over time. Consequently the elements influencing trust should be more or less stable as well otherwise causality would be definitively harmed.

The factors associated with the emergence of trust across the literature can be divided into at least five broader groups: social distance, religious composition, communist heritage, demographic features and other historical characteristics.

The principle assumption behind theories involving **social distance** is that any types of sizeable difference in the society (ethnical, social or economic) hampers the cohesion within it leading to lower trust among citizens. On the one hand, involved parties can come to agreement in

[3] Nevertheless, even distrust can be rational behaviour. For a discussion, see Hardin (1998).
[4] Bjornskov (2006) provides a great overview of the possible determinants of trust while conducting an econometric analysis as well.

debates, policy questions and other interactions much harder, while on the other hand, social distance leads to the lack of mechanisms constraining opportunistic behaviour caused by lower trust which increases the chance of cartel agreements and intense lobbying to emerge (Zak & Knack, 2001). Previously a large share of the studies ended with the robust result that income inequality impedes trust across countries (e.g. Zak and Knack, 2001, Knack and Zak, 2002; Uslaner, 2002), while a few others connect ethnic diversity to lower trust (e.g. Ziller, 2015) or to limited economic growth with trust as an intermediary (e.g. Knack and Keefer, 1997).

Religious composition of societies is another widely supposed factor in the explanation of trust. The connections established by both theory and evidence disperse across many religions: La Porta et al (1997), Bjornskov (2006) and Zak and Knack (2001) find that so-called hierarchical religions (Catholicism and Islam) are associated with lower trust that can be traced back to Putnam's (1993) notion about them creating *vertical* bonds of obligation in society that eventually increases *horizontal* distance between people. On the other hand, Uslaner (2002) and Glaeser et al. (2000) found evidence for Protestantism's trust enforcing influence on individual level which brings to mind rather the idea of Max Weber (1992 [1930]) about the trust-generating aspect of more individualised responsibility in protestant religions.[5]

A major determinant of trust in several economies is the **socialist past**[6] that had a huge impact on every aspect of social capital resulting, not surprisingly, a salient distrust in the society already in communist era. The reasons why trust must been eroded during socialism are obvious, but Paldam and Svendsen (2001) highlight in their 'dictatorship theory' the oppressive behaviour of communist leadership that steered people toward not trusting in anyone beyond their family. With the change of regime a change in trust and other social values would be

[5] A criticism is presented by Ekelund et al. (2002) according to whom the underlying pattern behind Protestantism's role in trust might actually be reversed but in the extremely long run: existing high social mobility made reformation more successful while standing against the aspirations of the Catholic church.

[6] Although my sample of NUTS 2 regions does not include post-socialist countries due to data limitations, this heritage is nevertheless a crucial predictor of the level of trust in societies; thus an overview cannot neglect it.

expected, however, it did not happen. Győrffy (2009) listed four major reasons of continuous distrust for the cases of Hungary and Slovakia which can be generalised to some extent for almost every transition countries: the material losses of the economy, the feeling of injustice among people following the obscure privatisation process, the unrealistic expectations set by people against transition and the failures of the new system that fuelled anxiety. This heritage from the previous system was important because a fair legal system might provide protection for society during such shocks as economic transition, while here the already weak rule of law failed to do this which deteriorated trust further (Bjornskov, 2012).

A few study in the literature claims an association between various **demographic variables** and trust: using different measures, samples and levels of observation, both Putnam (2000), Alesina and la Ferrara (2000), Glaeser et al (2000) and Berggren and Jordahl (2006) confirms a cohort effect meaning that younger people are generally less trusting than older ones. An additional notion is the size of the population as a determinant through either small networks being ideal for the evolution of trust (e.g. Zelmer, 2003) or supposed lower ethnical and cultural diversity in smaller countries (Bjornskov, 2006). Although some lament over the influence of political ideology (partially inspired by e.g. Hirschmann, 1982), the exact expected effects are confusing here: left-wing ideology can be associated with both larger solidarity or with its polarization effect by highlighting inequality. Overall, in the detailed analysis of Bjornskov (2006) none of the upper factors seem to be significant determinant of generalized trust, which indicates that maybe these are not robust determinants of trust and they have effect on it only among specific circumstances.

Finally, the literature provide numerous other explanations that have become extremely popular in quantitative studies as well. Tabellini (2008) argues – relying on Kashima and Kashima's (1998) concept, for example, that languages that forbid dropping personal pronoun are usually associated with more trustful people. This 'pronoun-drop' characteristic coined by Chomsky

(1981) indicates less respect toward the individual and her rights reflecting mistrust as well. Many economists and social scientists observed that constitutional monarchies are associated with higher level of trust: we can remember the Nordic countries as examples, or Jordan that seems to be more trusting than its much richer neighbour, Israel. Bjornskov (2006), in addition to presenting statistical evidence for confirming the theory, lists two major reasons potentially lying behind this phenomenon. Royal or imperial families serve for the country a uniting symbol besides ensuring a political and social stability and providing a common conscience as a role model. Another reasoning is that being a monarchy itself shows a long-term trust that enable political peacefulness which is backed by the example of the Northern countries. Another favoured variable includes some form of measurement for the severity of the winters (Guiso et al, 2008; Bjornskov and Méon, 2015) which concept goes back as far as Aristotle and Hipocrates. This idea involves the realization that survival in the tough winters at North depended to a much more extent on the individual's propensity to rely on others' help and support compared to the warmer Southern and Mediterranean area. Durante (2010) explains it slightly differently by putting the emphasis on climate variability between 1500 and 1750 which made harvests unpredictable and cooperation and collective management necessary. Consequently, a pressure evolved on northern people to extend their trust-radius on unfamiliar people as a dominant evolutionary strategy[7].

[7] For deeper analysis of this relations, see Kong (2013) and Durante (2011) who found significant support for these determinants of trust.

3. Trust and economic growth

This chapter summarizes how trust can impact the economic performance of a country, focusing chiefly on the specific transmission channels. This overview of the various mechanisms is needed in order to establish a reliable theory for this study, particularly since the emphasis of this thesis falls on a channel that has not been researched so extensively in an empirical way during the previous decades compared to the other channels. Moreover, due to the motivation to unfold how particularly trust imposes its effects on innovation, this relation, nevertheless belonging to the transmission channels, will be unfolded in the next chapter. Before turning to the transmission channels themselves, however, I present first the general idea of how the notion of trust influencing economic growth emerged and became widely accepted.

The famous work of Fukuyama (1995) states that general trust is a form of social capital that leads to a higher economic success in the modern world. Arrow went as far as claiming that "*virtually every commercial transactions has within itself an element of trust (…) much of the economic backwardness can be explained by the lack of mutual confidence"* (1972, p. 357). One of the first substantial empirical research in this field was of Putnam (1993) who compared the economic and governmental performance in the high-trust Northern and the rather chaotic and disorganized Southern Italy. Although this seminal study concentrated especially to the governmental-institutional mechanisms, the channels through which trust's impact takes place are under debate. In the Tanzanian rural environment, for instance, higher associational membership[8] is found to be in connection with higher income (Narayan & Pritchett, 1999). Greif showed that the development of self-enforcing agreements and contract-enforcement institutions – both requiring a trusting atmosphere – fostered the evolution of lasting reputation

[8] Narayan and Pritchett defined social capital as the quantity and quality of local associational life; membership is the participation in such social life.

required for economic vitality (Greif, 2005), and that such formal and informal institutions were essential in the expansion of long distance trade (Greif, 1989).

A quantitative analysis by Knack and Keefer (1997) on 29 countries based on a question of the World Values Survey about respondents' opinion whether "*Most people can be trusted"* was probably the pioneer in establishing firm, empirics-based relationship between widespread assessment of trust in countries and economic growth. In order to underpin the survey data, they used the famous behavioural experiment of *Reader's Digest*[9]. In this experiment wallets with money, address and phone number in them were "lost" in European countries and U.S. cities. The returned wallets' ratio were found to be in high correlation with the main trust-regarded question of the World Values Survey. According to Knack and Keefer, this indicated that survey-based measures for trust did not contain severe noise. Trust's effect was found to be significant and large: a 10 percentage point increase in trust was associated with a 0.8 percentage point increase in growth which association was even larger for poorer countries. However, they also concluded that by including average years of education, social capital loses its significance, thus, human capital accumulation has a dramatic effect. They also left the question of reversed causality open, that is, whether higher income leads to optimism and thereby to trust. In another seminal work, Zak and Knack (2001) built a DSGE model with homogeneous agents transacting with each other and facing moral hazard in a set social, economic and institutional environment. They managed to support the work of their model with data. Their findings are close to that of Knack and Keefer (1997): a 15 percentage point increase in trust is related to a 1 percentage point rise in growth. Moreover, they emphasized that the beneficial effects of trust is mostly translated to better economic performance by higher investment rates.

[9] See The Economist, June 22, 1996.

A firm, established criticism regarding these two seminal works' robustness and reliability were presented by Beugelsdijk, de Groot and van Schaik (2004). They showed that while the results of Zak and Knack (2001) are robust in terms of effect and are especially so in terms of significance, the extension of Knack and Kneefer's (1997) model highly affects its robustness. They found that these changes rather depend on the size and width of sample than on the control variables because the salient differences came up after the inclusion of low-trust countries that are frequently also the less developed countries.[10]

The expansion of available data and of the economists interested in the topic generated thus a ground for more established investigations in the field with the aim of drawing more robust conclusions, while simultaneously allowing researchers to find new correlations with trust as well. A main debate is, for instance, whether trust imposes its effect only on factor accumulation or on productivity as well. Besides the already mentioned works of Knack and Keefer (1997) and Zak and Knack (2001), also Dearmon and Grier (2011) proved that both human and physical capital factor accumulation is indeed spurred by trust. However, the earlier detailed transaction cost-lowering aspect of trust would suggest that it increases productivity as well through enabling people to behave more efficiently – a point made by Arrow (1972), Putnam (1993) or Fukuyama (1995) as well. Attempts to find reliable evidence for the role of trust in productivity have been made several times (e.g. Knack and Kneefer, 1997; Bjornskov, 2012), since, following Solow (1957), TFP is considered a main driver of economic performance on the long run both in the growth accounting (e.g. Klenow and Rodriguez-Clare, 1997; or recently Gómez-Sancho et al., 2013) and in the development accounting literature (e.g. Hall and Jones,

[10] Berggren, Elinder and Jordahl (2008) lament over and serve counter-evidence for the association between trust and growth on the medium-run, although, surprisingly, they think that the relation between them is still more robust than the widely-accepted relation between education and growth.

1999; Caselli, 2005).[11] Bjornskov and Méon (2015) conduct a research on 67 countries for the early 2000s and find that trust indeed affects robustly both TFP level and growth, accounting respectively for long-run economic performance and transitory dynamics[12]. On the other hand, among others, Helliwell (1996) found a significant and negative connection between trust and the productivity growth among his observed OECD countries.

Besides the effect of trust on capital accumulation and productivity, another major disagreement – or rather, a questioning of the original work of Fukuyama (1995) or Putnam (2005) – is whether trust impacts economic performance directly by lowering transaction costs or, alternatively, through *transmission channels* that in fact transform the social, collective and individual benefits of higher trust into various advantages on various fields across the economy. The existence of transmission mechanisms were theoretically argued and empirically endorsed by most key authors in the field like Knack and Keefer (1997) or Bjornskov (2009). The next section provides an overview of how different mechanisms translates trust into improved economic performance.

3.1. Transmission channels of trust

Although the statement that higher trust in the society leads to higher economic growth seems to be plausible for non-professionals as well, the reason behind this is not so evident immediately. The lower transaction costs, mentioned by Arrow (1972), Putnam (1993) or Fukuyama (1995) give a reasonable but not at all exhaustive answer for this question. Besides the fact that it is not always transaction cost that plays the main role, even when it does so the specific mechanism through which trust contributes to the different production factors provide

[11] TFP is important also because it incorporates to an extent the effects of innovation as well: higher productivity is commonly associated with the usage of more advanced technologies – Knack and Keefer (1997) referred to factor productivity as a proxy for innovation.

[12] They also establish that this effect goes through institutional quality, and more specifically, on the economic-judicial institutions – I will discuss this in details later.

us with a deeper understanding about the significance of trust in society as a cohesive power. We will see that trust instead of exerting its effect directly sometimes rather enables economic agents to approach optimal behaviour leading to more efficient decisions on a different market.

We can differentiate between five main transmission channels: education and human capital, institutions, market integration and openness, investments and innovation.[13] Some argue that the channels of human capital and institutions are in fact exhaustive in terms of the mechanisms between trust and economic growth: Bjornskov and Méon (2013) finds no significant effect of trust on economic performance once these two transmission channels are controlled for, supporting the same argument of Bjornskov (2012). There is, in fact, a debate even about which of these two channels is the real key for economic growth. While the "*institutional view*" (North, 1990; Acemoglu et al., 2001; Rodrik et al., 2004 or Boulila et al., 2008) endorses the role of institutions as the main mediators, the "*education view"* (Barro and Lee, 1994, 2013; Mankiw et al., 1992; Bjornskov and Méon, 2013) promotes the notion of education being the chief link between trust and growth. Moreover, Glaeser et al. (2004) argues that underdeveloped countries first invest into policies favouring human capital accumulation, which in turn feeds into better institutions, and eventually their composite effect realises on enlarged economic growth ("*development view*"). Nevertheless, the literature is still divided in the question.

In the following sections I provide a more detailed overview of the transmission channels and their possible criticism. Innovation as a mediating link between trust and growth was endorsed quite early but came to provide a subject for empirical analysis only recently. Since, first, this present thesis focuses mainly on innovation as a chain between trust and growth, and second,

[13] The literature provide a few more possible chains to link the two concept, although they are not so widely promoted as those detailed further. On the example of Finland, Kallio et al. (2010) argues that higher trust is associated with higher absorptive capacity that feeds into innovativeness and growth. The beneficial effect of increased trust on macroeconomic stability is implied in the work of Sangnier (2013). These alternative explanations can usually be assigned to one of the main transmission channels discussed more widely in the literature.

the discussion of this relation poses some contextual conflicts within the topic of social capital, the trust-innovation link is elaborated in a wider context in *Chapter 4*.

3.2. Education and human capital

The relation between higher trust in the society and better educational performance – let it be enrolment into secondary school (e.g. Bjornskov, 2012), share of students in tertiary education among all students (e.g. Akcomak and ter Weel, 2009) or share of population over 25 with tertiary education (e.g. Peiró-Palomino, 2016) – is widely backed, while it is associated at least with two different types of mechanisms, explained by the supply and the demand-side theory.

According to the supply side theory, trust has a benevolent effect on schooling because in high-trust societies, students gain easier access to human capital, which helps them to have a more productive job later (Bjornskov (2012). The supply side theory assumes moreover that participants in the education system – both students and teachers – endowed with a higher level of trust provide a better basis for more advanced educational outcomes, as a means, for example, of lower drop-out rates among pupils (Coleman, 1988). This association was implied also by Papagapitos and Riley (2009) for secondary education enrolment and by Putnam (1993) and La Porta et al. (1997) for the quality of the education.

Within the framework of demand-side mechanism demand can be understood from both the students' and the prospective employers' point of view, reflecting a deeper contribution of trust. We can assume that in more trusting countries people expect higher returns on education since it is associated with higher importance during job search compared to low-trust countries where family ties and friendships play along (as explained in the famous work of Putnam, 1993). To put it another way, living in a more trusting society exercises pressure on the people to go to education since they will find a job by exploiting their networks with much lower chance (Knack and Keefer, 1997). An alternative theory proposed for instance by Galor and Zeira

(1993) and Guiso et al. (2004) is that higher trust also allows for less credit constraints in the society that enables people to finance their education more easily, which statement has been supported by empirical evidence as well (for example, by Buchel and Duncan, 1998). Finally, Bjornskov (2009) argues, while interpreting his findings in support of this argument that demand-side mechanism works also from employers toward higher education graduates. This reasoning is particularly true in more modern societies as it relates the more complex tasks during work to higher monitoring costs from the employer. In case the of a trustworthy employee who is also skilful and well-educated for that given job, costs associated with the assurance of high-quality work performance are much lower, leaving space for the firm to instead concentrate resources to the widening of the labour force. Moreover, trustworthy employees are usually more cooperative as well since trusting environment nurtures the potential in the workers leading to higher productivity through increased information sharing and collaboration[14]. As part of the semi-endogenous growth model, this conclusion results in higher innovation and technology intensity and in turn in higher growth. This concept is enforced also by the findings of Dearmon and Grier (2009) relating trust not only to the higher accumulation of human capital, but also to increased TFP growth. It is important to notice, thus, that this theory is the truer, the more innovative the economy is.

Reverse causality in the case of trust and education can pose a problem on the analysis of their connection (Knack and Keefer, 1997; Glaeser et al, 2000; Knack and Zak, 2002): indeed, maybe more educated people have experienced the benefits of cooperation much more, while they also experienced the underlying trust needed for the diffusion of knowledge in any sciences. As Algan and Cahuc (2013) notes, however, among developed countries trust scores differ a lot despite the much lower variation in average schooling. Therefore, Algun, Cahuc and Shleifer

[14] This connection, too, is examined extensively: for instance, on the example of the Japanese garment industry between 1968 and 2005, Yamamura (2009) strengthen the effect of trust on human capital.

(2013) provide an alternative explanation backed by evidence that although education can indeed directly affect trust level, this relation varies between schools and even within schools and depends mainly on the teaching method. They associate higher generated trust with the so called 'horizontal teaching methods', group works and increased student-student interactions, as opposed to 'vertical teaching methods' incorporating mainly activity between the teacher and the students.

3.3. Institutions

Besides education, the other transmission channel between trust and economic growth promoted widely is the legal, bureaucratic and informal institutions in the society. This theory was outlined rather early but earned larger popularity following the work of North (1990), while being cemented further by the milestone work of Acemoglu et al (2001).

Literature discusses three possible ways institutions can be affected by social capital and trust. First, we can establish a connection from a supply-side perspective: in a country where the trust is higher among people, it is likely that politicians and bureaucrats will be more trustworthy as well and thus less prone to exploiting their position for the purpose of individual benefits (Knack and Keefer, 1997; Knack, 2002). Moreover, these trustworthy officials will also be able to cooperate within the borders of public entities yielding more efficient governance – importantly, it also covers the increased chances for settlements and compromises between the various players of public sphere. Boix and Posner (1998), aside elaborating the previous notion, add that trust helps resolve the principle-agent problem, which is a fundamental characteristics of the relationship between government and public entities.

Second, greater trust appears not only on the level of officials, but also on the level of electorates in the form of demand-side enforcement of high-quality institutions. The level of people's trust is linked to their interest and participation in politics and public discussions, therefore,

borrowing Boix and Posner's words, trust gives rise to more "*sophisticated consumers of politics*" (1998, p. 690). These sophisticated consumers are more willing to supervise the behaviour of public officials and they also have higher expectations regarding the performance of public institutions, putting thus a larger pressure on the government. More trusting people are more willing to participate in public decision-making even at its highest form as suggested by the findings of La Porta et al. (1997) regarding the positive correlations between trust and voter turnout. According to Putnam's (1993) reasoning, voters' more careful supervision is the underlying explanation for the higher-quality public services in more trusting regions of Italy. Finally, a composite effect of the supply and demand side mechanisms is that in more trusting societies politicians will be less able and/or less willing to participate in corruption (Uslaner, 2002; Putnam (2001).

Third, with more trust in the society, the reforms of institutions can be performed more fluently that are particularly essential in polarized societies or those that experience some form of crisis (Boix and Posner, 1998, Knack, 2002). Social trust in these cases can enable public entities and officials to reach consensus more easily, while also providing the necessary public support for the needed restructurings. The key element here is that – as in the case of any structural change or (radical) innovation[15] – the results of the applied modifications will exert their effect only in the future and so trust smooths out possible frictions regarding the transition.

We can collect these institutional explanations into two groups according to the type of the mechanism: *political institutions* and *economic-judicial institutions*. The distinction is crucial since with the evolution of research regarding the transmission channels, more and more studies showed that trust's effect runs through predominantly the latter while the former is less important in this context (e.g. Bjornskov, 2010 or Bjornskov and Méon, 2015). Earlier, the

[15] In this sense, public innovation resembles to business innovations since they both entail considerable uncertainty regarding the outcome of the changes.

trust-literature was eager in emphasizing the role of election of governments and direct democracy. These dominantly democracy-related mechanisms, referred to as *political institutions*, were mostly promoted by Putnam (1993), La Porta et al. (1997) and Uslaner (1999). In contrast, recent developments in the field endorse other structures: trust can affect economic performance through stronger rule of law (Knack and Keefer, 1997; Bjornskov, 2012), lower corruption (Uslaner, 2002; Putnam, 2001), and improved work of public entities (Bjornskov, 2010). These institutions, concerning the protection of private property rights and the delivery of higher quality public services, are usually called as *economic-judicial institutions*. One of the most frequently cited discoveries in this question is that of Méon and Weill (2005): when analysing the World Bank's indicators for the six dimensions of governance, 'voice and accountability' is the least correlated with aggregate efficiency. Also, Bjonskov and Méon (2015) finds that the most important transmission mechanism between trust and TFP is precisely those institutions that protect private property rights.[16]

3.4. Market integration and openness

Under market integration we can understand both the integration into a country's economic activity and the integration of the whole economy into the international trade. Trust increases the participation in the formal economy (Tu and Bulte, 2010) and in the international economy (Guiso et al., 2009; Shu et al., 2015), and the size of foreign direct investment (Guiso et al., 2009) as well, each of them in turn producing larger incomes.

[16] Trust's effect on private property rights is of particular importance in the light of the highly influential impact investigations about property rights' role in growth had on later economic thinking. Dating back to the work of North and Thomas (1973), the "De Soto hypothesis" (De Soto, 1989, 2000) originates economic growth from the security of property rights. Belonging to this group, secure ownership of resources, intellectual property rights and independent legal systems prevent people from rent-seeking and motivates them to turn resources into more efficient and productive activities. Besides, De Soto also puts property rights as an inevitable necessity for having collaterals for credit that can generate capital, that is, factor accumulation. The literature provides empirical evidence for this over the work of both De Soto (1989, 2000), Powell (2002) and the panel analysis of Lewer and Saenz (2005).

There is, however, a division among economists regarding the exact effect of trust on shadow economy and each approach seems equally plausible. As Perry et al. (2007) and De Soto (1989) claim, social capital decreases the transaction costs of agreements and economic exchanges, sometimes giving place to the complete abandonment of formal contracts. Besides, an exit to the informal sector is usually necessary for agents due to the illegal nature of the business they conduct, which means that they cannot expect legal enforcement upon disagreements. Therefore the importance of trust is increased for businesses in the shadow economy. The negative correlation between trust and market integration (or the positive between trust and shadow economy) indicates this causality both ways. However, higher trust is also related to reduced tax evasion (Wintrobe, 2001), which in turn decreases the size of shadow economy (Torgler and Schneider, 2007). Recent developments in the literature seemingly advocate the positive connection theory: for instance, D'Hernoncourt and Méon (2012) give evidence that shadow economy decreases in trust with a causality running from the latter towards the former.

3.5. Investments and financial development

The relevant literature frequently argues the role of trust in the encouragement of investments (Knack and Keefer, 1997; Zak and Knck, 2001) particularly through decreased transaction costs. This association seems rather obvious: higher general trust in the society allows us to believe in other people's goodwill and capability to use invested money in a productive and efficient way. Trust also helps resolve the issue of incomplete contracts, that is, that written agreements cannot cover all possible options, outcomes and risks: higher trustworthiness both directly and indirectly decreases the (transaction) costs of investment through enabling agents to write shorter contracts leaving more flexibility (La Porta et al. 1997). It also allows firms to finance projects that might be a bit riskier or might achieve returns only in the long run. Furthermore, Kwon and Arenius (2010) approaches the role of general (and particular) trust in

the economy from an entrepreneurial perspective, and by endorsing Granovetter's (1973) weak-tie theory they find that the probability of investing in a stranger's business compared to a family member's business was higher in countries with stronger generalized trust scores, which is consistent with Fukuyama (1995).

Besides investments, the literature serves a few evidence also for general financial development mediating trust's effect toward higher economic growth. Following their inquiry on Italian regions throughout the 1980s and 1990s, Guiso et al. (2004) conclude that in the more trusting northern regions households a) use cheques more frequently, b) keep a larger proportion of their money in banks and in the stock market and c) are more prone to apply for credits. This third factor is backed also by Cole et al. (2013) on the example of rural Indian regions. The complexity of financial markets, showing analogy to the complexity of tasks in companies in case of human capital channel, provides another field where trust can exert its beneficial influence by enabling investors to outsource more decisions to intermediaries, which consequently can yield a better-diversified portfolio (Guiso and Jappelli, 2005).

The underlying problem with investment as a transmission channel is that the literature indicates large endogeneities with other possible channels: investment might operate as a linkage between trust and human capital (Dearmon and Grier, 2009). Bjornskov (2012) connects trust to increased investment through improved governance (better legal circumstances) and higher schooling measures. As a further drawback of drawing connection between trust and investment, Algan and Cahuc (2013) make the point that trust may in fact correlate with other factors such as optimism or risk aversion that raise the propensity to turn to financial products

The previous sections presented an overview of human capital, institutions, market integration and investment as transmission channels between trust and economic growth. The literature is

very diverse: most of the explanations seem plausible and likely none of them can provide a exclusive way of how higher trust is transformed into better economic performance. The concern in the literature regarding reverse causality is noteworthy: almost all channels are alleged to be responsible for an at least long-term increase in the level of trust in a country. This is an important idea for everyone who aims to analyse this topic empirically.

The following chapter discusses the transmission channels which is of my particular interest in this thesis, innovation. This part is presented separately due to this highlighted focus and to the wider context in which I analyse trust, innovation and growth.

4. Trust and innovation

In this section, I introduce the notion of innovation by first elaborating on how it has evolved to eventually integrate social capital as a core element of the innovative activity, then I argue that, in contrast to the majority of the literature, it is more appropriate to explicitly distinguish between the effects of social capital in general and the effects of trust particularly. In a vein to explain it, I also touch upon the impact of social networks on innovation before elaborating in details how trust expedite innovation.

The general concept that innovation partakes in the trust-and-growth process is not new at all and in elements appeared already at Knack and Keefer (1997). Why innovation is an intriguing aspect of the topic is, first, because to some extent it incorporates all the previously mentioned transmission mechanisms and, second, because innovation's nature has changed in the past several decades. While earlier it was only one element of the business conduct, and apparently, an element quite distinct and isolated, done in labs, by today it has definitely become not only fully integrated but also a main keyword for companies. Nowadays innovation is rather perceived to happen as a result of a process involving many actors' interaction and a very intense knowledge sharing. Landry, Amara and Lamari (2002) provide us with a great summary of how and why innovation transformed in the recent ages. They describe innovation as a problem-solving process occurring chiefly within the companies, involving formal and informal relationships between the different actors. In the knowledge-society, innovation is observed to happen partially in the form of learning-by-using, learning-by-doing or learning-by-sharing where the new knowledge can originate both from within and outside the organization and be both tacit and codified. Finally, innovation increasingly appears also physically within the framework of an integrated system (innovation clusters).

Landry, Amara and Lamari (2002) identifies five theories applied for describing the process of social capital becoming a key ingredient of innovation activity. The first is the *engineering theory of innovation*, where innovation is a direct result of basic and industrial R&D conducted in labs. Here the final production is a solution to an engineering problem and the transformation process of the invention into product definition and technology application is linear. The source of innovation is solely traced back to tangible capitals, such as physical, technological, financial and human capital. An alternative to this theory emerged in the '60s in the form of *market pull theories*. The two new key ingredients are the appearance of market needs as a source of innovative ideas and the lift of organizational feasibility among the circle of necessary factors for innovation. The original tangible capitals are complemented with data about markets in the explanation of innovation. Realising that connection between R&D activity and market needs is not as straightforward, experts turned their attention in the 1980s toward explaining this connection more thoroughly in the framework of *chain-link theories of innovation*. While some (e.g Mowery and Rosenberg, 1978) emphasized the role of marketing, sales, technological development and production as mediation channels, others (e.g. Von Hippel, 1988) stressed the importance of existing information between the companies and its customers and suppliers. In the explanation of innovation, the role of data about markets were changed to data about suppliers and customers while still holding the necessity of traditional tangible capitals. It was the 1990s that brought the advent of social capital-related theories: the *technological network theories of innovation* claimed that by forming "systems of innovation" (among many others e.g. Edquist, 1997), innovation is a result of intense interactions between actors arranged into networks. The collaboration of diverse agents such as the government, universities, research laboratories and firms produce information exchange and knowledge spillover into the firm principally from outside the firm. Beyond the already indispensable technological feasibility and market feasibility, now firms also need network feasibility to benefit from collaboratively

and collectively generated information. In the explanation of innovation, traditional tangible capitals are thus complemented with technological networks yielding data absorption. Finally, *social network theories of innovation* got into the focus of experts. The arrival of a new concept was inevitable as the already existing notion about the relevance of research network interaction between actors was accompanied by the increasing gravity of knowledge in the procedure. The two chief novelty compared to technological network theories is the shift from technological networks to knowledge networks and from technical tools to relational tools (Lengrand and Chatrie, 1999). *Technological networks* and *technical tools* are associated with the acquisition of new information through communication technologies that are more and more widely available to anyone. However, the *knowledge networks* and *relational tools* are associated rather with the ways of conducting business and sustaining cooperation. Since technical tools are available to anyone, the competitive advantage in this framework hinges upon the firm's capability to transform information to knowledge by putting it into context and linking to other developments, abilities and forms of knowledge. Since in these theories the success of innovation pertains to how the firm capitalizes on its networking and community embeddedness, the impact of social capital becomes essential. On this level, the explanation of innovation involves, beside the classical tangible capitals, also the social capital element which puts the analysis of the subject into a historical, social, institutional and relational context.

The summary of Landry, Amara and Lamari's (2002) description about the main steps of the process of social capital becoming a quintessential element for the creation of innovation can give us a new insight, implying that the connection between trust and innovation actually may not be stable over time. As the different theories pictured, the role of personal connections and information networks and consequently the importance of mutual trust for the sharing of knowledge and for benefitting from spillover effects have boomed recently. Whereas some parts of this trust-innovation relation was certainly necessary already in the age of engineering

theories of innovation, we might have a sense that it was less of a main driver of innovation than it is today.

Although many articles lump trust in with social capital (for the theoretical discussion, partly e.g. Akcomak and Müller-Zick, 2015), actually the impacts of extended social networks, trust and civic norms (helpfulness, fairness or honesty) on economic mechanisms are not the same. The network aspect of social capital can induce innovation three ways: a) it can create new channels of information exchange, where b) collecting quality information is less costly, and c) reputation became more important with the lower distance between economic agents. Maskell claimed that "*firms in communities with large stock of social capital will (...) always have a competitive advantage to the extent that social capital help reduce malfeasance, induce reliable information (...), cause agreements to be honoured, enable employees to share tacit information and place negotiators on the same wave-length*" (2001, p. 7). Moreover, the emergence of social networks is important also for the creation of both strong and weak ties: the general advantages of having the latter is well-known since the seminal work of Granovetter (1973), but Rost (2011) applied it also to technological knowledge production in a regional framework. She argues that weak ties between actors in business and research are important for both reducing the transaction costs, lowering the risk of moral hazard, encouraging information exchange and steering people towards better individual behaviour. Capitalizing on this theory, she also finds evidence for the implication of the previous concept that social capital and inventive activity stand in an inverted U-shaped relationship. It suggests that a 'middle way' is better than extensively much social capital which can deteriorate the beneficial leveraging influence of weak ties among actors and might create "lock-in" effect.

Nevertheless, all these channels and mechanisms differ from the one between trust and innovation – an observation endorsed also by Kaasa (2009). For instance, using Rost's (2011) theory, Akcomak and Müller-Zick (2015), while testing various trust-related measures

econometrically, finds no significance for the squared terms of trust variable – failing to strengthen the argument of Rost (2011)[17]. Although the authors explicitly and deliberately use trust interchangeably with social capital, this result still reflects that it is social networks and not trust that may be able to build strong and weak ties beneficial for innovativeness. Moreover, they also distinguish the different policy conclusions accordingly whether social capital was represented by associational activity and networks or by trust. In another example, in order to measure the impact of various social capital factors on a) the likelihood of innovation and b) the radicalness of innovation, Landry, Amara and Lamari (2002) used a survey of 2300 firms in Québec. Significant effect on both a) and b) is found for the participation in business meetings, associations and networks (*participation assets*) and for the involvedness with the local economic actors like universities, municipalities, etc. (*relational assets*), however, no reliable connection can be established between innovation and trust. The authors themselves claim that instead of their question in the survey focusing on the importance of reciprocal trust for the respondent's business in case of clients, suppliers and government agencies, other measure should be applied for the measurement of cognitive form of social capital.[18] Although the field still provides further proof for the valid connection between structural social capital – social networks or civic norms – and innovation activity (e.g Crescenzi et al, 2013; Leyden and Link, 2015), these connections entail other characteristics, implying other consequences and might exhibit other trends compared to those of cognitive social capital. The extensive, 'uncoordinated' usage of the concept of social capital was criticized by Adam (2011) particularly for the case of researching innovation activity. Therefore, a more firm

[17] It has to be noted that Echebarria and Barrutia (2013) and Cuevas-Rodríguez et al. (2014) found significant effect of the squared terms.

[18] One might remember the argument I earlier referred to from Kwan and Arenius (2010) that instead of particularized trust – and in line with it, of reciprocal trust used also by Landry, Amara and Lamari (2002) – general trust is a more appropriate measure to be used for the analysis of macro-level relationships.

differentiation between these factors and their impacts should be advocated also among empirical studies. In the followings, therefore I carry on with focusing only on the trust aspect.

Innovation indeed received increasingly more attention even in the popular information channels and public discussions in the recent decades. As it was already mentioned, to a degree innovation incorporates all the previous transmission channels in the mediation process towards growth. The precise mechanisms thus are fuzzy even in the literature – it might be the reason why economists used to focus for a long time rather on the classical popular theories of institutions and human capital. Arguments regarding how trust aids innovative activity can be grouped around four main notions: firm organization, project financing, opportunistic behaviour and monitoring costs. The common, very basic starting element appearing in all of these is the considerable and elevated risk associated with almost any type of inventive activity that appear in varying forms across the upper four subjects.

First, trust can assist in the development of the firm organization by allowing higher decentralization. As Aghion and Tirole (1997) explains, facing with a problem when firm leaders have to choose between delegation or direct problem solving, they are more likely to opt for the former one when general trust is higher and employee is expected to act in accordance with the CEO's preferences. Otherwise, the risk here is that the employee will mishandle the task and potentially act opportunistically. This decentralization effect implies two potential spillover effects on the economy (Algan and Cahuc, 2013): first, it results in more efficient decision making and so higher productivity and second, low-trust economies might steer toward industries with less importance of individual decision making. Its consequence on the IT and high-tech sector is salient and in fact Bloom, Sadun and Van Reenen (2012) find evidence on the 4000-firms US, Europe and Asian-wide sample that firms in trusting regions are more likely to decentralize (sustaining the direction of causality) and that such decentralized firms are more productive and prone to focus on innovation and IT. These results are confirmed

through the study of Cingano and Pinotti (2012) by the analysis of companies across Italian regions who find that an increase in trust significantly raise the value added in delegation-intensive industries compared to less delegation-intensive industries.

A second way trust improves innovation is through the easier financing of risky projects. Mutual confidence in each other makes matching of projects and financial resources easier (Akcomak and ter Weel, 2009). On the one hand, if investors find either the given firm or the researcher trustworthy, they will devote their funding to the given project with a higher probability. The researcher (or the firm) needs to build a reputation in this regard, since their partners would like to alleviate risks as much as they can by selecting the most reliable people and plans.[19] Trustworthiness is important the other way around as well, since researchers want to be sure both that funding will not disappear during the project and that the partner will not break the rules regarding either autonomy, patent rights, etc. Moreover, trust in the institutions[20] and in the legal system is important, too, since conditional on the existence of a reliable environment, motivation for innovation and for investing in innovation is higher. Both the researchers and the investors can be confident that R&D expenditures and the results of the activity are protected through stable legal institutions, e.g. patent rights (Tabellini, 2006).

Third, under the existence of higher trust, enforcement of informal norms is easier, generating a shift from opportunistic behaviour towards cooperative behaviour (Akcomak and ter Weel, 2009). There are evidence-based arguments that trust directly decreases the risk of failure in R&D since it facilitates the belief that the collaboration with the other parties instead of opportunism is more beneficial on both community and individual level (Fitjar and Rodriguez-Pose, 2014; Cantner et al., 2011).

[19] In this sense, the social network aspect of social capital contributes here by enhancing small-world norms and thereby the role of reputation (Akcomak and Müler-Zick, 2015).

[20] As Kaasa (2009) notions, the institutional trust of a firm is based on the institutional trust of the individuals in the firm.

Finally, as a fourth reason, under higher trust between actors, monitoring costs are lower. It would both turn the innovative project in itself into more efficient and, maybe, profitable, and, as a form of lower search costs, can help investors to discover and to collect information on the companies and initiatives (Akcomak and ter Weel, 2009). This argument resembles the one from the human capital section, and for instance Bjornskov (2009) indeed explicitly connected the theory of lower monitoring costs of employees in the company not only to complex tasks but specifically to those that are associated with technological progress. An indirect advantageous consequence of lower monitoring costs is noted by Knack and Keefer (1997): due to the decreased alternative costs of monitoring, companies can devote more time to invent new products and services.

In this chapter, I showed that innovation came a long way until social capital became a crucial element in its success. Nowadays, social networks, norms and trust all are considered factors that facilitate innovative, inventive and knowledge-producing activity. However, I also argued that a large share of the literature is mistaken in identifying trust as a measure of social capital. Trust, social networks and norms, in fact, have different consequences on innovation, so in my analysis I focus specifically on trust. I highlighted that there are four ways higher general trust can spur innovation: by allowing higher firm decentralization, by easier financing, by eliminating opportunistic behaviour and by decreasing monitoring costs. All these mechanisms are extended and complemented by the beneficial effects of wider social networks. In the following chapter, I present how regional development raised to the focus of economists and why innovation and trust is important in its analysis.

5. Putting everything together: innovation as a source of regional development in the context of trust

This chapter shortly summarises why the analysis of innovation is feasible on the regional level, and how regional development came to feature innovation as a main catalyst and social capital as a necessity for it. One of the first papers connecting innovation to regional growth in the context of local factors was that of Rodriguez-Pose (1999): he differentiated between "innovation prone" and "innovation averse" regions depending on how education, institutions or physical and social capital formed the societies' openness to new ideas. As he formulated, while obviously impacting each other, both R&D investment and economic activity meet a social filter of which the weakness or strength determines how integrated innovative activity will become in the given region's society.

The usage of regions instead of countries as units of observation stands with a long history due to several causes. For a somewhat obvious methodological reason, it is advantageous because we can extend the size of the analysed sample substantially. In order to establish reliable assumptions of causality, one needs to have a large enough variation among the observations either horizontally, by widening the sample, or by extending it in time to a panel. Although not the same solution, most articles solve this problem by selecting dependent variables that cover long enough time to vary substantially across the units. Moreover, the availability of reliable data likely correlates with the countries' economic development. In order to establish robust and firm connection, we need to have as many observations as we can collect, and bringing down the analysis to the level of regions is an evident solution. As Akcomak and ter Weel (2009) notes, most country-level research in the field of trust inevitably include several developing countries where the connection between social capital, education, institutions, economic growth and other factors might differ from that of developed countries. The regional overview – particularly in case of Europe – provides the possibility of a widened sample that

allegedly is more homogeneous compared to a country-level sample. Analysing regions, thus, supposedly improves the robustness of the results for developed countries, however, also restricts the explanation to them which needs to be kept in our mind throughout the analysis.

However, the reason why many articles observe innovation regionally and not on the country level, is in fact because substantial difference was found in terms of both inventive activity, social capital and trust within countries, too (e.g Dakhli and de Clercq, 2004). On the first hand, the roots of current cultural and social attitudes are in the 16^{th}-17^{th} centuries when not countries but rather smaller regions exhibited similar culture. On the other hand, the regional diversification of innovative activity rests largely upon the easier collaboration in a smaller geographical scale and, recently, upon the regional focus of European Union subsidies.

Meanwhile, with the emergence of various forms of local economic cooperation structures, innovation clusters and region-oriented funding schemes, different devices for fostering local innovation and economy appeared. The new wave of strengthening collaboration between multinational companies, local SMEs, research institutions and universities create spillover that exert their effect only at the given territory. This phenomenon clearly connects innovation activity with economic performance on a regionally differing way depending on the existence and success of such local partnerships and on the involvement and dedication of local governments to these collaborations.

Although these upper mentioned reasons provide a mostly satisfactory methodological and contemporarily actual justification for the regional aspects, the topic of regional economic development has concerned economists in the recent decades for a global perspective as well. Regions in the context of economic performance has been becoming increasingly important hand in hand with globalisation – and hand in hand with the emergence of innovation as an imperative factor in business, entrepreneurship and economic development.

Stimson et al. proposed that regional economic development is "*the application of economic processes and resources available to a region that result in the sustainable development of, and desired economic outcomes for a region and that meet the values and expectations of businesses, of residents and of visitors*" (2006, p. 6). This description is expressive for the argument of Blakely (1994) regarding the two-fold nature of regional economic development. According to him, it should be seen as both a *product* and a *process*: on the one hand, those who live, work or invest in a region are mostly concerned with the opportunities the region promises for them, let it be jobs, quality of life or conditions of work environment. This holds a product view where the economic development of the region in itself is the outcome. Alternatively, we can focus on the process aspect by emphasizing the creation of infrastructure, labor force preparation, human capital and market development. Both of these views can be associated with qualitative and quantitative measures as well (Stough et al., 2011) whereas besides the relevance of income level, financial security or employment also the creation of sustainable development, the variety of employment opportunities and the generation of creative capital is catching up recently. The advantage of Stimsons' definition is that it successfully incorporates all these factors at least to some extent.

Reflecting in the local communities' and stakeholders' changing vision and approach to the development of their region in the context of increasing globalisation, Stimson et al. (2006) list several levels on the ladder of theories about regional economic development. *Neo-classical economic growth theory* aimed to foster our understanding of traditional factors of production function. However, it implied a convergence on the long run between regions and served with no explanation for the role of technology and productivity. Contrarily to this, *polarization theory* assumed non-homogenous production factors, imperfect markets and externalities, which, together with cultural, social and institutional factors, in turn explained why some regions are lagging and some are leading. This theory, under the umbrella of agglomeration

economies, also induced the notion that there are spatial spillovers and inferences between the regions. After the second World War both a shift from the Keynesian to the *monetarist approach* and a move from comparative to *competitive advantage* (Porter, 1985) and eventually to *collaborative advantage* (Huxham, 1996) was taking place. Finally, as a consequence of free movement of capital factors during globalization, cities and mega-city regions emerged as centres of creativity and entrepreneurship and accordingly the drivers of growth (Knight and Gappert, 1989; Florida, 2002). Amid the tough competition regions more and more was forced to turn to self-help. The latest changes in the conceptualization of regional development evolved into the rise of a "*new growth theory*" of which the key elements is summarized by Stough et al. (2011). Within this emerging concept the weight of technical progress was increasingly underlined by several economists, frequently presenting it as a main engine behind regional growth and competitiveness. Besides, it was assumed (Norton and Rees, 1979) that regions enter to and profit from the three stages of product cycle, the innovation, the growth and the standardization stage, differently: while some are seen as innovator regions, others earn only from the production of the new invention. The formers were generally associated with an "*innovation milieu*" (Aydalot, 1986) meant to explain the circumstances of the highly inventive regions. Following especially the work of Krugman (e.g. 1991), a key part of this milieu was the knowledge generated mostly locally. Complementing these aspects, finally, also the intangible factors were highlighted in the discussion of regional development. Social capital, trust and institutions were articulated as catalytic if not indispensable ingredient in a region's economic development for the dissemination of knowledge and information. To sum up, the new growth theory not only accounted for but also explained the importance of market imperfections and externalities in the regional dynamics, while drawing a link between intangible assets such as knowledge or social capital and the economic performance of a region.

In the process of generating new ideas and knowledge, cities clearly stepped to the leading position as hubs for education, entrepreneurship and innovation. Although a number of theories were provided by the literature to understand the chief drivers of cities' leading position[21] (ecological socio-cultural view, clustering and industrial networks view, political-economic power view, etc.), Nijkamp (2008) proposed a more integrated framework called "systems economics". The properties of this approach makes it capable to analyse urban context of growth, since cities are characterised by (Stough et al., 2011)

- density and proximity externalities,
- dependence on their resource base (physical and cultural),
- learning and creativity (as factor of institutions, culture and the mobility of capital, knowledge and human capital).

This third feature prompted economists and policy makers, but particularly Florida (1995) and Morgan (1997) to coin the term "*learning regions*" that reflects "*locations with a strong social and institutional endowment that exhibit continuous creation and diffusion of new knowledge and high rates of innovation*" (Hauser et al., 2007). Although a somewhat fuzzy concept, it is strongly encouraged also by the OECD to implement regionally policies that enable such learning process. Many emphasized that cities have an outstanding role within the learning region concept and that a *sustainable innovative development* is needed for ever-growing cities to boost regional development. Nijkamp et al. (1994) proposed five factors that are critical for this: productive capital (labour and capital), human capital (education), social capital (networks, interactions, trust, etc.), creative capital (new ways of thinking, artistic expressions, innovative foresight, etc.) and ecological capital (attractive living environment, green space and water, quality of life). These elements can be considered as parts of the urban production function.

[21] For a summary, see Nijkamp (2008).

The relevance of regional development and of the driving factors behind it culminates in the notion of local knowledge generating mechanisms being the vehicle behind pursuing economic growth. The "triple helix" concept, coined by Etzkowitz and Leydesdorff (1997), implies that capitalizing on local sources, investment in R&D and innovation can produce higher quality outputs and can lead to economic development, and that this can be achieved by the synergic collaboration of universities, industries and government. The idea of learning regions, thus, is encouraged by many actors in order to enable lagging regions to catch up. In this effort, not only the cooperation within regions, but also the interactions between them are crucial as well.

In all these interactions, platforms and dimensions that are involved in the analysis of regional development and innovation's contribution to it, there is always an aspect of social capital and cultural determinants mentioned. Researchers, eager to explain what the differences between leading and lagging regions boil down to, almost never miss to mention the role of economic actors' attitude and of how they approach to each other. In a vein to unfold these relations, the enquiry connecting social capital and economic growth also extended to the lower levels of regions, realising their two-fold importance in this topic: first, regional characteristics' share in the success or failure of not only regions but also countries, and second, the sometimes large regional differences in historical determinants and current policies.

I presented in this chapter that in the light of globalisation and following the influential work of economists such as Florida, regional economic development transformed into a main source of economic growth. In this process, the increased competition between regions and the human, physical and social capital comprising it, pushed innovation into the frontline of regional focus. The new structure of inventive and innovative activities necessitates trust (and the other elements of social capital as well) as a foundation for successful local knowledge generation. In the following chapters, I present an analysis of how trust affects regional growth through spurring innovation.

6. Analysis

While for decades economists were mostly interested in unfolding the relation between trust and economic growth on the country-level, this inquiry has extended in the recent decade to regions. Both for economists and policy experts, the relevance of disparities across regions' predetermined and policy-relevant characteristics is evident as regional development is increasingly seen as a vehicle of whole countries' growth. The division between leading and lagging regions is enlarged also by the tendencies in industries' attempt to gain competitive (or now, *collaborative*) advantage: the formulation of geographical areas with high knowledge-generating capacity by the concentration of innovative companies, research institutions and universities attracts many firms to start their business or build their new plants at such innovative regions. The emergence of such "innovation clusters" or "innovation districts" is yet to be clearly explained – nevertheless, as we could see in *Chapter 4* (Landry, Amara and Lamari, 2002) from the evolution of theories accounting for the dynamics of innovation, a changing impact of social context can be assumed. Through the increasing interconnectedness of the process of innovation, particularly in a geographically and physically close setting, the influence and importance of trust increases. This chapter aims to investigate this hitherto somewhat neglected but now crucial mechanism by using sophisticated regression methods.

The contribution of my work is three-fold: first, analysis of trust's effects shifted after the 1990s' focus on growth to TFP and other measures. Therefore, deeper investigation of the connection for the 2000s on regional level is largely missing which space this study intends to fill. Second, only very few studies (Bjornskov, 2006 and Akcomak and ter Weel, 2009) so far have employed 3SLS methodology during the examination of this relation therefor its applications potentially increases the robustness of the results. Third, although Dominicis et al (2013) included in their model sectoral R&D expenditures as inputs of innovation but

previously no one has connected the productivity of these investments directly to trust level. This thesis is thus pioneer in introducing interaction terms between trust and sectoral expenditures in order to test whether R&D moneys are more productive in high-trust regions.

6.1. *Data*

The present inquiry will use a sample of NUTS [22] regions in Europe which builds on the instrumental variables of Akcomak and ter Weel (2009). Although they aim was a NUTS 2 based dataset, due to limited availability of historical data, the dataset does not contain all the currently existing 276 NUTS 2 regions and for some countries it considers the NUTS 1 level. After the limitations I faced during data collection, the final database thus consists of 95 regions ranging across 12 EU countries counting with NUTS 1 regions in Austria, Belgium, Denmark, Germany, Greece, France, the Netherlands and the UK, and with NUTS 2 in Ireland, Italy, Spain and Sweden (*Appendix 1*). Akcomak and ter Weel (2009) note that the higher the decomposition, the more reliable the results are due to significant data differences even between regions belonging to the same higher-level statistical unit. They also add, however, referring to Akcomak and ter Weel (2008) that the NUTS 1 / NUTS 2 disintegration of the data does not alter the results significantly.

The focus of this study falls on the effects running through the 2000s. There are several reasons behind this decision. It seems that after the considerable contribution to the trust-growth question using data from before 2000, the focus of empirical analysis regarding trust's economic impact shifted to more specific areas such as total factor productivity (Bjornskov and Méon, 2015), patents (Crescenzi et al, 2013) or entrepreneurship (Kim and Kang, 2014) – as

[22] The Nomenclature of Territorial Units for Statistics is an EU elaborated system for dividing member countries into smaller statistical parts, measuring them on three level: NUTS 1 according to major socio-economic regions, NUTS 2 according to basic regions for regional policies and NUTS 3 according to smaller regions for specific diagnoses. Subdivisions are not necessarily in line with the countries' administrative divisions. As of the current NUTS 2013 classification valid from the beginning of 2015, there are 98 NUTS 1, 276 NUTS 2 and 1342 NUTS 3 regions in the European Union (Eurostat website, NUTS Overview).

also the precise collection of Akcomak and Müller-Zick (2015) indicates. On the other hand, data availability for several variables is quite restricted before 2000, and in some cases problematic even at the beginning of the decade which will force me to use several multi-year averages. Finally, until the 2007-2008 world crisis, the 2000s saw a rather prosperous period of the world economy when several new dynamics appeared – as also detailed previously. During the selection of the time of observations it was assumed that effects from trust and innovation inputs to innovation outputs, and from innovation outputs to economic growth need time to take place, which is mirrored also by the wide usage of time lags in the literature during the analysis of the question: Dakhli and de Clercq (2004) allow a 3-year time lag between innovation and its factors, Kaasa (2009) uses a 1-year time lag, however, e.g. Landry, Amara and Lamari (2002) use no time lags et all, while Akcomak and ter Weel (2005) employ innovation data from earlier than its factors. The implicit assumption behind these latter applications is that most of these measures are stable over time, which is partially true, however, it is still feasible to leave a gap between the different effects. Nevertheless, fulfilling these requirements is fundamentally limited by the unavailability of data for many variables. Therefore, inputs are measured around 2000, innovation around 2003 while economic growth throughout 2000-2007. The selection might be a source of wrong results, although different specifications did not show substantially different results. In what follows, I present the variables of which a descriptive summary can be found in *Table 1* and the country-level averages in *Table 2*.

6.1.1. Economic performance

The main assumption is that trust encourages economic growth in our regional sample also – or primarily – through innovation. For the dependent variable economic growth is measured as the increase in (euro) per capita GDP between 2000 and 2007 (applied also by e.g. Akcomak and ter Weel, 2009). The per capita variation of regional GDP level allows to implicitly control

for the differences in size of regions.[23]. This yields an economic growth variable with a mean value of 31% and a 13.4% standard deviation. The slowest growth in the period was experienced in Berlin (DE3) where GDP per capita from 2000 to 2007 increased by 11%, while on the other end of the scale, per capita income in Attiki (GR3) region of Greece grew by 68.3% in the upper period.

Assuming a convergence trend and controlling for varying economic development stages, also the GDP per capita in euro in 2000 was added to every models. The initial GDP per capita values range from €10,100 in Extramadura (ES43) to €50,000 in Bruxelles (BE1), showing an average of €23,063 and a standard deviation of €7,793. Indeed, as *Graph 1* shows, regions with lower initial per capita GDP saw a larger rise in their economic performance implying a convergence trend among the observed regions.

6.1.2. Trust

In the previous chapters substantial theoretical reasoning was provided for the assumption that social capital, and particularly trust influences economic growth in several ways. I also argued that although trust is frequently used as a substitutive measure for social capital, this simplification seems to be a misidentification of these phenomena's impact on social and economic dynamics. Although Akcomak and ter Weel (2009) sees trust as an indicator of social capital, this thesis uses this variable exclusively as a measure of trust.

In the literature, the most widely applied tools for estimating trust are the databases of European Social Survey (ESS), European Value Survey (EVS) and World Value Survey (WVS). These programmes are intended to investigate the countries' various social and demographic

[23]Source is Eurostat. Values for the three Belgian regions for 2000-2002 were missing and thus substituted with ESA95-calculated data in place of the generally used ESA2010 data. For the rest of the observed period, correlation in case of these three regions between ESA95 and ESA2010 values are over 99%, meaning that the substitution should not cause any measurement error.

characteristics, attitudes and values. For this study, information is gathered from the first wave of the ESS conducted in 2002, where trust is measured by the answers given to the statement "*Most people can be trusted or you can't be too careful*" ranging from 0 – "*You can't be too careful*" to 10 – "*Most people can be trusted*". As shown by many papers (e.g. Akcomak and ter Weel, 2009) the figures of EVS and ESS highly correlates in terms of trust.

Due to nearly equal sampling despite the varying populations in the countries, data is adjusted by population weights to prevent over-sampling. Individual scores are then aggregated to regional level. The values range from 1.67 (Cantabria, ES13) to 7.05 (Denmark, DK0) with a mean of 4.88 and standard deviation of 0.77. As it can be seen in *Table 3*, aggregating data further to country level results in a high within-country variation in trust values which is in line with the general findings of the literature (on the example of European regions in Beugelsdijk and van Schaik, 2005, and on the example of US states in Iyer et al. (2005). The largest variation is presented by Italy (std=0.89) and Spain (std=0.72) while the lowest by Ireland (std=0.03) and the Netherlands (std=0.09). The most trusting country seems to be Denmark and Sweden, that is, the Northern European countries, while Greece and France, and in general the Southern countries, have the lowest trust values.

6.1.3. Education, human capital

Measurement of human capital shows substantial variance across the literature, though all of them builds on education inputs/outputs. In this research maybe the most widely used variable is employed, the share of tertiary level students in all students according to ISCED 1997 levels (source: Eurostat). The usage of this variable (following e.g. Akcomak and ter Weel, 2009) as opposed to enrolment in secondary education (Bjornskov, 2012) or percentage of population aged 25-64 with some form of secondary education (E.g. Bjornskov and Méon, 2013 following Barro and Lee, 2013) is that by the 2000s with high likeliness secondary education became mandatory in almost all the countries showing thus no significant variation at regional level

either. Moreover, for the purpose of innovation, people educated at the tertiary level of education is a more important input. The dataset shows a large variation here as well: its average value is 14.8% with a standard deviation of 5.1% values ranging from 0.9% in Valle d'Aosta (ITC2) to 25.9% in Attiki (GR3).

6.1.4. Innovation and R&D

Measuring innovation has been a concern for experts for a while, and there is a tendency of using patent applications for it (e.g. Akcom and ter Weel, 2009; Echebarria and Barrutia, 2013; Crescenzi et al, 2013; Kaasa, 2009). Patent applications are intended to approximate the output of innovative activity, however, there are several issues with it both as a measurement for innovation and in the context of enabling trust to impose its (supposedly) beneficial effects on innovation. First, the most widely mentioned difficulty with patent applications is that it reflects ideas that carry some type of "*novelty, originality and potential use*" (Bottazzi and Peri, 2003). Thus, patent applications rather approximate the inventive activity instead of innovation, that is, commercialized inventions. Innovation can be of either product or process kind, meaning, they do not necessarily lead to a submitting a new patent, nevertheless having a big impact on the firm's productivity, cost structure, profitability or on consumers' satisfaction. Vica versa, neither patented ideas always lead to eventually applied techniques. As Jensen et al. (2007) notes, this variable also leave aside the increasingly important learning-by-doing, learning-by-using and learning-by-interacting aspect of innovation.

This also introduces us the second major problem with patents that are less discussed in the literature and which relates directly to our context of trust. Trust is meant to lower the transaction costs in interactions between economic agents. Any form of innovation involves a high degree of risk, as discussed earlier, where this transaction cost-lowering impact is crucial. Although it appears also during the patenting of ideas, other types of innovations sometimes rely to an even higher extent on the individual relationships' nature, whereas for a manager to

allow his or her employees to innovate arbitrarily within their work field or try new methods needs to trust in them. These smaller innovations might not be reflected in the patent applications, only for instance in productivity enhancement. Although sometimes TFP level and growth is used in the literature as a mean of measurement of innovation, the nature of innovation has become more sensitive to the nuances of how it happens through the interaction of knowledge-generating factors, yielding a more complex effect.

The *Measuring Innovation* report of OECD (2010) attempts to reflect to the approximation problem of innovation, however, neglect the question of social context. New efforts are made, though, for example by NESTA (2016) to measure innovation by big data and social media. They respond to the infeasibility of patents as a proxy by applying big data methods for the videogame and the graphene industry, while in a vain to incorporate social networks they analyse social media connections on Twitter or Facebook during technology or science conferences. Although these tools are rather preliminary and still not capturing the trust aspect, they suggests that in the future more appropriate and sophisticated techniques might appear for measuring innovation.

Nevertheless, for my research the number of patent applications to the EPO (European Patent Office) per million inhabitants centred around 2003 (average of 2002-2004) will be used as an innovation activity proxy (source: Eurostat). The three-year average is used for two reasons: first, to overcome possible fluctuations in the data, and second, because data is missing in a few years for some observations. Data about patent applications indicate extremely large differences across regions: why the number of per million patent applications was only 2.3 in Extramadura (ES43) the same figure amounts to 589.2 in Zuid-Nederland (NL4), representing a 110.5 standard deviation with a mean value of 106.6. The distribution of patent applications demonstrate a large correlation with the GDP per capita of a region (*Graph 3*).

For measuring the input of innovation, intramural R&D expenditures as a percentage of regional GDP are used. I differentiate between four variables according to the sector of expenditure: business, government, higher-education or the three together (I exempt private non-profit sector due to data unavailability, which usually amounts to a very low share of the R&D expenditures anyway). The source of the data is Eurostat. The usage of R&D expenditures for the approximation of intensity is severe in the literature (e.g. Kaasa, 2009; Akcomak and Müller-Zick, 2015; Akcomak and ter Weel, 2008), with total R&D personnel and researchers being an alternative for this. However, for this latter, data unavailability touched upon a sizeable share of our sample. Due to less huge but still significant missing value problem in case of expenditure, values are averaged over the years 1999-2003. Such long averaging is employed also by Akcomak and Müller-Zick (2015) for the same reasons.[24] Values range in case of

- total expenditure from 0.2% in Illes Balears (ES53) to 5.5% in Vastsverige (SE0A) (mean=1.5%, std=1%),
- business expenditure from 0.01% in Nisia (GR4) to 4.8% in Vastsverige (SE0A) (mean=0.9%, std=0.8%),
- government expenditure from 0% in Smlland Med Qarna (SE09) and Mellersta A Norrland (SE07) to 1% in Berlin (DE3) (mean=0.1%, std=0.1%), and
- higher-education expenditure from 0.03% in Valle d Aosta (ITC2) to 1.5% in Ovre Norrland (SE08) (mean=0.4% ,std=0.2%).

6.1.5. Instrumental variables

As touched upon several times in *Chapter 3* endogeneity bias might be a problem during the analysis of trust's effects. In the trust-patent or trust-growth connection not only trust might exert effect on innovation and growth, but vica versa, higher patents or larger economic growth

[24] Minor data imputations needed in the case of R&D expenditures: due to unavailability of information for the upper period, the 1998 value is used for Ostösterreich and Sudösterrech.

can indicate an environment where trust between people emerges and improves much easily. There has been, however, many rejections to this idea: besides many others, Uslaner (2008) claimed that trust is relatively stable over time which notion was supported also by the reasoning of Bjornskov (2007) stating that economies had been growing after World War II while trust had not changed together with it[25]. Analysing second and third generation immigrants in the US, Uslaner (2008) found that they have a very similar trust level compared to those countries from where they grandparents came suggesting the deep roots of trust. Yet, the same author also added that US trust level has not been stable in the recent decades (Uslaner (2002). Besides, there might be a third factor that affects both trust and patent numbers or trust and economic growth resulting in a correlation between the residuals and the predicted values.

Nevertheless, to prevent possible OLS biases, I employ an instrumental variable approach that is the most widely applied method in the analysis of trust and growth. By using appropriate IVs we can ensure that causality indeed runs from trust towards patents and growth. For variables to be used as IVs and prove potential causality, they need to meet three conditions. First, they cannot have direct effect on our final dependent variables, patent numbers and economic growth. Second, they should be predetermined, or, put another way, time-invariant but at least persistent over time. Third, they must provide sufficient identification in the first stage regressions to identify the instrumented variable clearly.

Being aware of these conditions, I use three IVs: historical data on literacy rates, institutions and universities (each borrowed from Akcomak and ter Weel, 2009)[26]. Past literacy rates are used as a proxy, since it is assumed that educational performance centuries ago is a determinant of the current social capital and cultural environment. Literacy rate is defined as percentage of

[25] Bjornskov (2006) also stated however that maybe a very basic level of education and rule of law is needed for trust to evolve or remain stable.

[26] The detailed description of the variables can be found in Akcomak and ter Weel (2009); descriptive statistics in *Table 1* and *Table 2.*

population that is able to read or able to read and write. Literacy rates show an equal variation across regions in richer European countries and unbalances in poor countries.

Next, historical data about universities is used. Based on the beneficial long term effect of education on social capital and culture (an endogeneity problem I also point on in *Chapter 3)*, Akcomak and ter Weel (2009) built a variable on the history of European universities composed of two measures: the foundation date of the first university in the region and the density of universities in a region defined as the number of universities per 100.000 inhabitants around 1850. The IV is constructed then by taking the first principle component of the two variables. They establish that universities were more equally distributed in richer countries like Germany or the UK, were clustered in Southern countries like Greece or Italy, and showed concentration near the sea in Sweden and the Netherlands.

Third, following the argument of Tabellini (2006) and Acemoglu et al. (2005), an IV was created by Akcomak and ter Weel (2009) as a proxy of past institutions which might have nurtured good cultural habits and social environment. They use the "*constraints on the executive*" variable form POLITY IV project where possible values range from 1 – "*unlimited authority*" to 7 – "*accountable executive constrained by checks and balances*" where the larger values mirror a tendency toward democratic institutions and political liberalism. The assumption is that these institutions in the past affected positively the current cultural and social atmosphere. The authors consider this variable in 1600, 1700, 1750, 1800 and 1850, with a 40-year windows. Regional differences in this respect are presumably less influential after the unification processes ending in the second half of the 19th century. The IV is constructed as the first principle component of the variables in the five time periods. The authors found that countries like Denmark, the UK or Belgium tended quickly toward democratic setting after the 1700s, while in Greece, Italy or Austria this shift was much slower. A third set of countries

containing Germany, Greece and Italy showed important territorial heterogeneity throughout the observed period.

The IVs need to meet with three requirements: comply with the exclusion restriction, be predetermined and identify trust clearly. I believe that the employed instruments are mostly in line with these conditions in the context of patents and per capita GDP growth. There is no known way why they should directly affect the number of current patents or GDP growth. Historical variables are clearly predetermined since they were collected from centuries ago. Finally, *Table 4* shows the correlations between the instruments and the trust measure: historical institutions and literacy rate correlate with trust with 37% and 43% (respectively) which associations are significant at 1%. Moreover, the strength of identification in the first stage is evaluated in each cases (described in details at the given specifications), showing that these three IVs identify trust properly.

6.2. Empirical strategy

In this chapter I present the methodology I employ in revealing the connection between trust, innovation and economic growth. The most conventional way of estimating the effects is by using OLS in which the dependent variable is the per capita GDP growth while the right hand side variables contain standard determinants of economic growth. However, past and present economic performance might affect the level of trust in the society which results in reversed causality. Besides, as pointed out several times in *Chapter 3*, the transmission channels between trust and growth can be a source of simultaneity as well. Due to these issues, OLS estimation can be biased and prevent the interpretation of results as causal effects of trust on growth, hence, this topic is widely analysed by using 2SLS-technique.

Since the main aim of this thesis is to show how trust affects particularly innovation, I also introduce a model where I regress the number of patents on the possible inputs of innovation,

R&D investments and human capital and on the trust variable. It is assumed, based on *Chapter 4*, that a more trusting environment nurture new ideas and facilitate the emergence of innovative solutions. *Graph 2* shows that indeed there is a correlation between trust and the number of patent applications. However, it is likely that the creation of an innovation-facilitating environment enables people to have a higher confidence in each other. Moreover, I have shown previously that in the generation of new knowledge human capital is imperative, which in turn correlates with trust. Endogeneity, thus, is a problem here as well, through reversed causality and simultaneity, therefore I will apply also a 2SLS methodology besides the standard OLS estimates. The variables instrumenting trust are the same as in the previously discussed growth-regression. Moreover, building on the mechanisms how trust facilitates innovation, I assume that in more trusting regions R&D investments are used in a more efficient and productive way. In order to check this, I will employ interaction terms between trust and the respective sectoral R&D expenditures. The methodology of overcoming problems in case of interacted endogenous variables is explained in *Appendix 2*.

Finally, my main argument is that innovation is a transmission channel between trust and economic growth. However, literature also implied that causal relations can run through several channels (Kaasa, 2009): from trust to growth, from trust to innovation and from innovation to growth. Additionally, human capital also counts as an important factor in innovative activity, though it impacts economic growth through other channels as well. Finally, it is also possible that trust correlates with a factor that is omitted from the model. The solution to the problem is the implementation of the 3SLS method where trust is regressed on the instrumental variables, patent is regressed on predicted trust and then GDP is regressed on predicted patent and trust values. The IVs for trust are the same as in the previous cases. The proper identification of effects in three-stage-least-squares relies on the well-identification in lower stages.

The following system is then estimated both separately, through 2SLS and through 3SLS:

$$GDP\ growth_j = \beta_0 + \beta_1 initial\ GDP_j + \beta_2 patents_j + \beta_3 trust_j + \beta_4 education_j + \varepsilon_j,$$

$$patents_j = \alpha_0 + \alpha_1 R\&D\ investments_j + \alpha_2 trust_j + \alpha_3 education_j + \nu_j,$$

$$trust_j = \delta_0 + \delta_1 literacy_j + \delta_2 past\ institutions_j + \delta_3 past\ universities_j + \delta_4 X_j + \mu_j,$$

where *j* subscripts the regions, *GDP growth* is the increase in GDP per capita between 2000 and 2007, *initial GDP* is the per capita GDP in 2000, *patents* is the number of total/high-tech/biotech patents per million inhabitants centred around 2003, *trust* is the employed ESS measure, *education* is the share of tertiary students in total students, *R&D investment* is the average of R&D investments in business, government and tertiary education sector and overall across 1998-2003, while *literacy*, *past institutions* and *past universities* are the instrumental variables, and ε, ν and μ are the error terms.

6.3. Results

This chapter summarizes the findings of the models detailed in *Chapter 7*. By employing OLS, 2SLS and 3SLS methods, I seek to find answers for the following set of questions:

1) How does trust affect economic growth?
2) How does trust affect innovation?
3) Is there a difference in the sectoral R&D expenditures' productivity between low and high trust regions?
4) Does trust affect economic growth through spurring innovation?

Throughout the sections, I discuss the robustness of the results, which is rather dubious. Finally, the main limitations of the study and the possible further research directions are elaborated.

6.3.1. How does trust affect economic growth?

Table 5 presents results for the direct relation between trust and economic growth for the 95 regions by calculating

$$GDP\ growth_j = \beta_0 + \beta_1 initial\ GDP_j + \beta_2 trust_j + \beta_3 education_j + \varepsilon_j,$$

using OLS and 2SLS. *Column 1* and *Column 2* differ only in terms of the inclusion of country dummies: we see that trust was a strong determinant of regional GDP per capita growth in the period only until country dummies are not included in the model. This finding is consistent with the conclusion of Algan and Cahuc (2013) who saw a significant effect of trust on regional GDP per capita level only without country fixed effects both in the EU and in the OECD countries. Approximately 30% of the variation in growth is explained solely by the variation across countries (as the inclusion of country dummies show). It suggests that trust-variation might be important rather at the country level, while variation across regions is less conclusive.

Because of the endogeneity of trust, I continue with implementing a 2SLS approach. Here, IVs are the ones detailed in *Chapter 6*, and *Column 3* shows the first-stage regression. Although the individual coefficients are not always significant, the joint F-test (being larger than the commonly hold threshold of 10) shows that they are different from zero and identify trust properly. *Column 4* show the 2SLS estimations that imply the robust significance only of the initial GDP per capita, while trust is not a significant determinant of GDP per capita growth. Moreover, based on the low value of Sargan-test we cannot reject the null hypothesis that the over-identifying restrictions are valid which implies that one of the IVs is actually endogenous with the error term.

The results strangely divert from the findings of Akcomak and ter Weel (2009) whose estimations yielded a robust, positive trust coefficient and rejected over-identification hypothesis. The authors used a similar sample with similar right hand side variables, but for an earlier period which might give a hint about the insignificant effects of *trust* in *Table 5*: although convergence across regions is still robustly confirmed, and the coefficient of the initial GDP per capita is quantitatively similar throughout the models, it is far lower than in the original findings of Akcomak and ter Weel. Education was not found significant in their specifications

either, while the constants in their models are higher. These suggest overall that, first, differences across regions have shrunk from the 1990s (their observed period) to the 2000s and second, that the average speed of economic growth in the regions decreased as well. This is consistent with the notion that less developed economies grow faster, thus after starting to catch up with their developed counterparts the pace of growth slows down.

The missing effect of trust on economic growth can be traced back to four reasons. First, trust might be an important vehicle of growth particularly in underdeveloped regions and countries, giving place instead to other mechanisms and drivers when they reach a threshold of economic development. Other factors aside trust might still affect the earlier considered transmission channels as regions develop: therefore, although trust did not change substantively, growth was fostered by the improvement in the transmission channels. Second, as I suggested in *Chapter 5*, regional development became an important drive of countries' development, possibly transforming the mechanisms behind regional economic performance. Consequently, regions might not needed the beneficial impacts of trust in the 2000s since the emergence of new factors. Third, trust's effect might still exists, although it is so little that after the lowered variance in GDP per capita growth across regions it is harder to show trust's significant effect by econometric models. Finally, the fourth possible explanation is that the models in *Table 5* are badly specified which is possible following the result of the Sargan-test.

Therefore, in order to check the robustness and the possible problems behind the former models, in *Table 6* some alternative specifications are presented. Columns show first-stage regressions and 2SLS estimations with the one-by-one implementation of the three IVs. We see that trust is rather sensitive to the different instruments, which was an issue at the work of Akcomak and ter Weel (2009) as well, although to a lower extent. Interestingly, in various groupings of two or three IVS, the joint F-tests were usually larger than 10.

The overall conclusion is that the causal effect of trust on economic growth in this sample is not backed, although the possible reasons are quite diverse. Indeed, the applied IVs seem less strong compared to the similar usage of Akcomak and ter Weel, and the employed variables show instability. Durlauf (2002) warned about the inability of instruments for trust to be generalised for every circumstances. Although he highlighted the risk of using the same IVs in different cultural, historical and economic settings, the differing strength of the IVs Akcomak and ter Weel (2009) and I used might suggests that IVs should be employed with caution also across various time periods. Therefore, in the upcoming analyses of the next chapters care should be taken regarding the robustness of the results.

6.3.2. How does trust affect innovation?

This section overviews how trust affects innovation for which I use the number of patent applications per million capita as an (imperfect) proxy. Throughout the models, possible inputs of innovation such as human capital or R&D expenditures are controlled for, which yields the following function to be estimated:

$$patents_j = \alpha_0 + \alpha_1 R\&D\ investments_j + \alpha_2 trust_j + \alpha_3 education_j + \nu_j,$$

where also country dummies are included in every regressions.

In *Table 7*, *Column 1* shows the OLS regression which suggests a strong correlation between a region's innovative output and its trust level. Using standardised values allows to directly compare the effects of the explanatory variables which reflects that trust has a higher impact on patents than the relative size of higher education students. The coefficient of trust (0.228) is very close to the calculation (0.292) of Akcomak and ter Weel (2009) in the same setting for patent measures centred around both the year 2000 and 1991.

Column 2 of *Table 7* tests the concept of Rost (2011) about the inverted U-shaped effect of social capital on innovative activity in the context of trust. As I argued in *Chapter 4*, trust is not

a proper measure for social capital since it is only an element of that, having thus different influences. Due to this reason, including a quadratic form of trust into the regression seeks to tests whether specifically trust has an optimal level in terms of patent applications. The figures in *Column 2* seem to reject this idea: neither trust, nor its quadratic form are significant while the two other variables remained exactly the same as in the previous model. This result can be specific to this sample, period or context, but it may also imply that trust indeed has a different impact on innovative activity, and that – opposed to social capital generally – it does not have an optimal value[27]. The theoretical background Rost (2011) provided for her observation actually does not contradict with my conclusion: she referred to Granovetter's (1973) weak-ties hypothesis which is imperative for the network element of the social capital concept but less conclusive for trust.

The 2SLS model (*Column 3)* indicates trust's very high influence on the number of patent applications besides the still significant effect of total R&D investments and a somewhat less significant impact of education. In comparison with the results of Akcomak and ter Weel (2009), both trust and investments seem a bit more important factor in innovation (although using a 95% confidence interval, they statistically do not alter), while education lost from its size and significance as well. The Sargan test now advocates the proper instrumenting in the first stage. According to my estimations, a one-standard deviation increase in trust, corresponding to a difference between Castilla la Mancha (ES42) and Thuringen (DEG) is associated with a 120% increase in patent applications.

The 'triple helix' concept of Etzkowitz and Leydesdorff (1997), mentioned at the end of *Chapter 5,* implies that regional development can be encouraged throughout the cooperation of business sector, universities and government by capitalizing on local sources. Although R&D

[27] However, Roth (2009) found an inverted U-shaped relation between trust and economic growth with a panel analysis on mixed sample of European and OECD countries.

investment is not a perfect measure for policy activity, in accordance with the 'triple helix' theory across *Columns 4-7* the two-stage-least-squares models' specifications differ regarding the inclusion of business R&D, government R&D and higher education R&D investments. We might expect that individually these factors are either less powerful or does not have effect at all. This theory seems to be confirmed by the results: while the coefficient on business R&D expenditure is high and strongly significant, the effect of government expenditure is not significantly different than zero, and the effect of university research and development spending is negative at 10% level. Finally putting all the sectoral expenditures into the model confirms the significance of business and somewhat strengthen the significance of higher education spending. The first-stage F-tests and the 2SLS Sargan-tests indicate that the models do not suffer from weak instrument problems and the null-hypothesis that the over-identifying restrictions are valid cannot be rejected. My findings are mostly coherent with the results of de Dominicis et al. (2013) who, although on a larger regional sample, found the strong impact of business R&D investments and a significant negative effect of public R&D investments, but an insignificant effect of trust.

Nevertheless the robustness of the results is tested in *Table 8*: the table shows first-stage and 2SLS calculations with only one of the three instruments. Only the principal component of variables about universities' history fails to identify trust properly in the first stage which is also reflected in the insignificance of trust in the second stage. This result, however, is in line with those of Akcomak and ter Weel (2009) who nevertheless accepted the validity of the instruments since their joint F-tests produced similarly sufficient support.

The established connection between trust and innovation seems to be much stronger and robust compared to that of between trust and growth. I did not find support for a supposed optimal level of trust, following Rost (2011), but confirmed that trust is indeed a robust and actually very important determinant of patent applications. The 'triple helix' concept suggests that the

local government, universities and the business sector should cooperate in leveraging local resources and transforming them efficiently into successful innovations and eventually economic growth. Using sectoral R&D expenditures share in regional GDP, I could not strengthen the theory that government and higher-education investments increase patent applications but I found the relative large impact of business expenditures. In the following section, I will elaborate this question in the light of differences in trust levels between regions.

6.3.3. *Is there a difference in the sectoral R&D expenditures' productivity between low and high trust regions?*

I showed in *Chapter 4* that the beneficial effect of trust can take effect through several channels in the stimulation of innovation: the productive and efficient use of higher R&D investments is one of them. Sectoral R&D expenditures are routed towards the innovation output according to the nature of spending: while university R&D is usually considered to be part of *basic research* where the aim is the general improvement of scientific knowledge often driven by curiosity (but can still fuel industrial innovation indirectly), in the case of *applied research* the focus is on the solution of problems, based partly on the exploitation of scientific community's previous findings and partly on research and development. This latter therefore is more related to firms and industries where the usual goal of research activity is to eventually introduce a new product, advance an already existing one or improve some functional process.

R&D spending of different sectors can be assumed to have varying influence on innovation activity according to the trust level of a country. Trust acts as a productivity-enhancing environmental factor between R&D investments and innovation outputs – this is basically the conventional mechanism I detailed in *Chapter 4*. In order to test whether trust indeed augment R&D investments, I added to the patent-regression an interaction term between trust and R&D

expenditure, both for the total investment and also separately for the sectors, that is, the estimates are

$$patents_j = \alpha_0 + \alpha_1 R\&D\ inv_j + \alpha_2 trust_j + \alpha_3 trust_j * R\&D\ inv_j + \alpha_4 education_j + \nu_j,$$

$$patents_j = \alpha_0 + \alpha_1 R\&D\ business\ inv_j + \alpha_2 trust_j + \alpha_3 trust_j * R\&D\ business\ inv_j + \alpha_4 education_j + \nu_j,$$

$$patents_j = \alpha_0 + \alpha_1 R\&D\ government\ inv_j + \alpha_2 trust_j + \alpha_3 trust_j * R\&D\ government\ inv_j + \alpha_4 education_j + \nu_j,$$

$$patents_j = \alpha_0 + \alpha_1 R\&D\ university\ inv_j + \alpha_2 trust_j + \alpha_3 trust_j * R\&D\ university\ inv_j + \alpha_4 education_j + \nu_j.$$

OLS results can be seen in *Table 9*: *Column 1* shows the patent-regression with the interaction term between trust and total R&D expenditure, in *Column 2-4* the distinct sectoral spending and the interaction term are included while in *Column 5* the three sectoral R&D expenditures and their interactions with trust appear. The results vary a lot: in the first model, only the clustered version shows a significant coefficient on the interaction term and it is surprisingly negative. It would mean that in a high-trust region more total R&D spending decreases the number of patents. In the models with the separately included sectoral R&D investments, interactions are never significant, while in the model with all sectoral expenditures and interactions included, both the government and the university trust-R&D interactions are significant at 5%. Although trust remains stable throughout the models, other variables show a very high variability of which the reason can be that here not only trust but also the interactions are endogenous.

Table 10 shows a solution for this where the same models are estimated with 2SLS methodology. In the instrumentation of the interaction variables I followed Murnane and Willett (2006), and accordingly I included in the first-stage regressions the interactions of the original

instruments and the R&D expenditures. [28] The table represents only the 2SLS calculations, in the first-stage join F-tests always exceeded the required threshold of 10 for both trust and the interactions. According to the figures, we cannot confirm that indeed along the change of trust level in a region the productivity of sectoral R&D spending changes as well. None of the interaction terms are significantly different from zero, and only some of the sectoral expenditure variables indicate significance, however these are not stable across clustered and non-clustered versions of the models. Moreover, the variable controlling for human capital does not show stability either, ranging from strong significance in the model with government spending to no significance at all in the model whit business expenditures. Trust, nevertheless, is still strongly significant throughout the specifications, although its size move on a large amplitude. The robust significance of business R&D expenditures remains across the models with moderate variations. This effect throughout various specifications suggests that indeed in the number of patent applications the companies' willingness to invest into R&D matters a lot in contrast to government and higher-education expenditures. Due to the drawn differences in the nature of applied and basic research, however, we cannot conclude though that R&D expenditures in these sectors are unnecessary since they might provide useful ground for further business implications. The missing significance of interactions, besides, draws a picture where lower trust levels do not hamper the effective investment into R&D.

6.3.4. Does trust affect economic growth through spurring innovation?

Innovation is increasingly considered an important field that channels the advantageous effects of trust toward increased economic growth through enabling economic agents to collaborate more effectively, share their ideas and implement new solutions. My final question in this thesis is whether this hypothesis can be confirmed on my sample. Earlier in this chapter I proved that

[28] A more detailed description of how instrumenting interacted variables were done according to Murnane and Willett (2006) can be found in *Appendix 2*.

even after resolving the endogeneity problem, causal effect of trust on economic growth on the analysed European regions were found to be insignificant during the observed period. However, it might be the case that visible impact operates through transmission channels only.

First I, incorporate both trust and the number of patents in the growth regression. *Column 1* in *Table 11* shows that neither trust, nor the number of patents have a significant effect on growth. Moreover, using clustered standard errors leads to the loose of significance in case of human capital and initial GDP per capita. It seems from this specification that neither factor affects economic growth. However, we know that innovation and trust is highly correlated and they might influence each other, which leads to multicollinearity problem in the OLS model. The final elaboration of my modelling is thus the employment of 3SLS strategy. Here trust is instrumented with the usual IVs and then used to make estimation for patent numbers. Finally, these estimated trust and patent numbers are included in the growth regression as explanatory variables. The chain of supposed causality here runs the following way: past political and educational institutions and political environment determines the level of current trust in regions whereas the more advanced the previous factors are, the higher general trust present dwellers of these regions have (*Column 7*). This higher trust in the people allows economic agents to more efficiently capitalise on traditional capital factors such as education and R&D investments. Finally, higher innovation in regions fuels economic growth.

The reduced form can be seen in *Column 2-3*, the first stage in *Column 4*, while the full 3SLS model in *Column 5-7*. The results are consistent with that of the OLS model, none of the variables in question have a significant effect on economic growth. Trust, however, still strongly determines the number of patents, its size is around the same as in the 2SLS-case (*Table 7, Column 4*) and much higher compared to the OLS-estimation (*Table 7, Column 1*). Due to the lack of significant coefficient on innovation in the growth-regression, trust's effect seems not to operate through innovation.

These findings are in contrast with the conclusion of Akcomak and ter Weel (2009) who in fact observed innovation's significant and positive effect on economic growth on the same sample for the period 1990-2002. According to their calculations patent applications could explain cross-region variation in per capita income growth to the extent of 15%. It is worth noting, however, that their estimated effect of trust on innovation in the 3SLS-specification is statistically identical with the implications of *Column 6*. It seems so that the relation between trust and patent applications operates similarly in the two cases and periods, however, mechanisms alter in the connection between innovation and growth.

I provide an extension of the previous 3SLS model in *Table 12* (where first stage trust regressions are not included for notational convenience). In the first model (*Column 1-2*), instead of total R&D expenditure the three sectoral R&D investments are included separately. Trust's effect on patent applications decreases a little but remains strong, whereas business R&D spending has a strong positive effect on innovation which confirms that some beneficial effect of trust indeed takes place through business R&D expenditures. The weak but negative effect of government R&D spending is confusing, and although the coefficient usually appeared to be negative throughout the specifications. The concerned effects in growth-regression are still far from being significant. Compared to the differences purely in total R&D spending, the variation in business, government and university R&D investments across regions seems to explain 13% of the variation in patent applications. Finally, in *Column 3-4* the trust-expenditure interactions employed in the previous section are included, following again the approach of Murnane and Willett (2006). None of the interaction terms is significant, and also the variables indicating R&D expenditures lose their significance. Trust is quantitatively around the same as in the previous model, though somewhat lower compared to the standard 3SLS.

6.3.5. Summary of results, limitations and possible further directions of research

There are three important findings in my analysis. First, trust seems to be a strong determinant of patent applications which is robust to various model specifications – a one standard deviation increase in trust is associated with a 120% increase in patent applications. Second, despite its role in patent applications, I does not find support for trust's productivity-enhancement effect on sectoral R&D investments. Since previously this question has not been studied, this empirical contradiction to the theory is a new finding in the literature. Third, results of the 3SLS models that overcome the endogeneity and multicollinearity problems rejects innovation's mediating effect between trust and economic growth.

As far as comparison allows, my conclusion fits into the mixed results of the literature. For European regions, Akcomak and ter Weel (2008, 2009) found significant causal effects of trust on economic growth in the 1990-2002 period while Tabellini (2010) on the average growth between 1977 and 2001; and de Clercq and Dakhli (2004) confirmed effects on innovation activity. On the other hand, Hauser et al. (2007) or Kaasa (2007) found that other factors of social capital are more important for innovation and Beugelsdijk, de Groot and van Schaik, (2004) reject trust's positive effect on growth. Although Peiró-Palomino (2016) proposes the usage of non-parametric regressions, implying that the problem with the commonly used parametric regression's restricted functional form is that connection between trust, innovation and growth departs from the assumed linearity, many (Beugelsdijk and van Schaik, 2005; Adam, 2011) highlight that the source of high variation across results is not bad model specifications or omitted variables. As the meta-analysis of Westlund and Adam (2010) shows, implications of studies diverge primarily due to the different samples and the lack of common agreement about the concept of social capital and its measures, but also because of the levels of analysis or the deviations across secondary data sources.

The diverse results in the literature imply also the large limitations of my study. First and foremost, the instrumental variables that I borrowed for my research from Akcomak and ter Weel's (2009) restrict largely the sample of observed regions which can bias my results. A frequent criticism is that the robustness of trust greatly depends on the size and width of sample, and particularly on the inclusion of less developed countries (Beugelsdijk, de Groot and van Schaik, 2004). Even if country effects are controlled for, the general underlying mechanisms in the connection between trust and economic performance might involve different factors and vary across time periods. Second, measurement errors might occur, particularly in the case of innovation and trust. I discussed earlier that the number of patent applications as a proxy for innovation output does not reflect fully the results of innovative activities that sometimes relates to cheaper production technologies, optimized supply management or logistics or a new, synthetized application of existing knowledge. A clear direction of current policy initiatives and further academic investigations is the creation and then incorporation of new, more appropriate measures for innovation output. The same can be told about trust as well: Glaeser et al. (2000) show that actually the answers given to the most widely used trust-question (employed in my research, too) did not comply with the acts of respondents in game theory experiments. Bjornskov (2006) highlights that answers given to trust-related questions might reflect cultural-specific attitudes or some transitory phenomena such as scandals in a country or national achievements in sports. Westlund and Adam (2010) propose solutions for improving trust measures' reliability. Finally, the control variables for e.g. human capital or innovation's inputs in studies assessing the relation of trust and growth varies a lot which can be a source of problem, too. In different countries and regions, different factors might contribute to the mechanisms making comparison much harder. Similarly, there are differences whether studies control for other factors such as capital cities, openness or price distortions.

In spite of the limitations and the diverse results in literature, a shift might actually take place in the mechanisms driving local innovation and development systems. Maybe it is increasingly the other factors of social capital, namely networks, norms and civic engagement that can fuel the economic performance of a region, particularly of those where population already have a higher general trust. As Beugelsdijk and van Schaik (2005) noted, trust yields a significant coefficient usually after the inclusion of low trust countries or regions. While this particular characteristics is widely supposed to adjust only over a long period of time, advanced social networks and civic engagement might be generated during a shorter period. The competitive advantage of leader regions therefore can be traced back now to these attributes in which some are well ahead of other regions.

Further research in the question of how trust affects economic growth particularly through innovation can incorporate elements of the above mentioned restrictions. An outstandingly interesting aspect would be the trust-dependent efficiency of regional, national or EU-wide policies in affecting innovation activity. In this thesis, I analyse whether sectoral R&D expenditures differ in their impact on patent applications according to the trust level of the given region. However, this is far from being an exhaustive measure of relevant policies. Easing administrative burdens or access to loans, lowering tax or applying special tax-schemes can all have a positive effect on innovative activity however their relation to trust is ambiguous. The attempt of local and regional governments to create innovation clusters or innovation districts might be, on the other hand, policy actions that either *complement* higher trust levels in regions, or, exactly the opposite way, they can *substitute* missing trust in the local society. Whether innovation policies in contemporary Europe *should* target the complementation or substitution of embedded trust-attitudes (and in a wider context, social capital) is definitely a very interesting question that can have straightforward implications regarding the competitiveness of European regions within Europe and also outside Europe.

7. Conclusion and policy implications

In this thesis I sought to show how trust affects economic growth through encouraging innovation and also implemented an empirical analysis. The exceptional role of social capital, especially of trust, in driving economic development is getting into the focus of economists and other experts of social sciences. Although the benevolent effects of trust is widely accepted, economists debate about the transmission channels that transform these impacts into better economic performance. Besides the two most widely claimed mechanisms, human capital and institutions, other factors are also frequently mentioned – among which innovation is one of the most popular ones recently.

I showed that innovation came a long way until social capital became a crucial element in its success. Nowadays, social networks, norms and trust all are considered to be factors that facilitate innovative, inventive and knowledge-producing activity. However, I also argued that a large share of the literature is mistaken in identifying trust as a measure of social capital since trust, social networks and norms have different consequences on innovation. After clearly differentiating between the role of trust and social capital, I underlined four mechanisms through which higher general trust can spur innovation: higher firm decentralization, easier project financing, less opportunistic behaviour and decreased monitoring costs.

The connection between trust, innovation and economic growth is fully augmented under the new growth theory of regional economic development. Following the influential work of economists such as Florida (2002), who highlighted the novel concept of *learning regions*, regional economic development transformed into a main source of economic growth. In this process, the increased competition between regions and the human, physical and social capital comprising it, pushed innovation into the frontline of regional focus. The new structure of inventive and innovative activities necessitates trust as a foundation for successful local

knowledge generation. To sum up the chain of effects, higher trust in the society allows economic agents to collaborate more effectively particularly on a regional level, which facilitate such spatial externalities and spillover effects that act as competitive advantages for regions.

I intended to contribute to the literature at three points: fill in the gap in the analysis of trust and growth for the 2000s, increase the robustness of results by employing the rarely-used 3SLS methodology, and, finally, introduce interaction terms between trust and sectoral expenditures in order to test whether R&D expenditures are more productive in high-trust regions which is an original addition to the field. I conducted an analysis on 95 European NUTS regions using Akcomak and ter Weel's (2009) instrumental variables and by employing 2SLS and 3SLS methodology. My goal was to find answers for the following four questions:

1) How does trust affect economic growth?
2) How does trust affect innovation?
3) Is there a difference in the sectoral R&D expenditures' productivity between low and high trust regions?
4) Does trust affect economic growth through spurring innovation?

My findings are mixed. First, I did not find a direct effect of trust on economic growth, which can be explained both by potentially weak instruments in the first stage, but, following the claim of Beugelsdijk and van Schaik (2005) and Westlund and Adam (2010), also by the specificity of this particular sample for this particular time period. Second, trust seems to be a strong determinant of patent applications which is robust to various model specifications – a one standard deviation increase in trust is associated with a 120% increase in patent applications. Third, despite its role in patent applications, I does not find support for trust's productivity-enhancement effect on sectoral R&D investments. Since previously this question has not been studied, this empirical contradiction to the theory is a new finding in the literature. Finally,

results of the full-fledged 3SLS models that overcome the endogeneity and multicollinearity problems rejects innovation's mediating effect between trust and economic growth.

The implications of my findings for policy makers are dubious. In the relation of trust and growth, local governments should foster the emergence of such regional collaborations that either increase people's confidence in each other or build on existing ties. Delemarle (2014) show how public policy can supply such *promise-securing* and *judgement-enabling mechanisms* that can help entrepreneurs, industries and institutions to build a more trusting atmosphere. However, considering that general trust is assumed to be rather stable over time, the question is whether particularised trust between interacting economic agents can substitute general trust in a region. If it does so, which is the optimistic scenario, local and regional governments should propose policy actions that build and complement trust. Otherwise, public policy makers should even more tailor-make projects for regions by substituting missing trust.

Even if policy can intervene in the trust-innovation relation, my analysis suggests that among the observed regions higher innovative activity is not associated with higher economic growth. If we assume that trust indeed facilitates the development particularly of very poor regions, then in the European context maybe it is increasingly social networks, norms and civic engagement that can fuel the economic performance of a region. This would definitely be the most optimal scenario for policy makers: the abundance of examples of how to create buzzing local networks provide a good basis for implementing region-specific cooperation schemes. Innovation clusters are the most notable illustrations of such initiatives. Whether they can exploit social networks and possibly trust and eventually further economic growth on the long term, or remain only an exciting space for entrepreneurs, scientists and venture capitalists, will be a question for economists in the upcoming decades.

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Tables

Table 1 – Descriptive statistics of variables by countries

Variable	Mean	Std. Dev.	Min	Max
GDP capita growth 2000-2007	0.31	0.14	0.11	0.68
GDP capita 2000	23063.16	7793.42	10100	50000
Education	0.15	0.05	0.01	0.26
Patent applications centred around 2003	106.56	110.54	2.28	598.24
Total R&D expenditure	0.015	0.010	0.002	0.055
Business R&D expenditure	0.009	0.009	0.0001	0.048
Government R&D expenditure	0.002	0.002	0	0.010
Higher-education R&D expenditure	0.004	0.002	0.0003	0.012
General trust	4.89	0.77	1.66	7.05
IV – literacy	64.64	28.73	14.60	99.00
IV – universities	0.03	0.85	-1.22	2.42
IV – institutions	0.08	2.04	-1.90	4.10

Table 2 – Averages of variables by countries

Country	Growth	GDP capita	Education	Patent	Business R&D	Government R&D	Higher-education R&D	Total R&D	Trust	IV - literacy	IV – universities	IV - institutions
Austria	0.291	25966.670	0.157	167.692	0.015	0.001	0.005	0.021	5.105	91.500	0.272	-1.695
Belgium	0.293	30733.330	0.162	125.517	0.011	0.001	0.004	0.017	4.681	69.000	-0.152	0.558
Denmark	0.285	33300.000	0.151	197.653	0.016	0.002	0.005	0.023	7.053	97.000	0.279	-0.484
France	0.245	23612.500	0.139	118.403	0.011	0.002	0.004	0.018	4.453	75.600	0.720	-0.388
Germany	0.197	25700.000	0.125	202.494	0.013	0.004	0.004	0.021	4.577	94.567	0.082	-1.203
Greece	0.561	13000.000	0.158	6.089	0.001	0.001	0.003	0.005	3.693	20.000	-0.575	-1.695
Ireland	0.587	25500.000	0.144	61.826	0.007	0.001	0.002	0.010	5.474	76.500	-0.656	2.714
Italy	0.259	20768.420	0.160	59.880	0.004	0.001	0.004	0.009	4.570	35.242	0.164	-0.961
The Netherlands	0.336	26225.000	0.132	226.243	0.010	0.002	0.005	0.017	5.691	89.000	0.054	3.596
Spain	0.510	15806.250	0.187	22.617	0.004	0.001	0.003	0.008	4.941	36.013	0.249	-0.868
Sweden	0.223	30162.500	0.138	191.634	0.021	0.001	0.007	0.029	6.064	99.000	-0.696	0.523
UK	0.245	26375.000	0.119	81.297	0.010	0.002	0.004	0.016	5.058	75.975	-0.254	3.981
Overall	0.311	23036.160	0.148	106.559	0.009	0.002	0.004	0.015	4.887	64.635	0.029	0.082

Table 3 – Descriptive statistics of trust according to countries

Country	Mean	Std. dev.	Min	Max
Austria	5.10	0.14	5.00	5.26
Belgium	4.68	0.51	4.12	5.13
Denmark	7.05	.	7.05	7.05
France	4.45	0.24	3.94	4.72
Germany	4.57	0.30	3.88	4.88
Greece	3.69	0.48	3.07	4.22
Ireland	5.47	0.03	5.45	5.49
Italy	4.57	0.89	1.66	6.11
The Netherlands	5.69	0.09	5.60	5.79
Spain	4.94	0.72	3.61	6.40
Sweden	6.06	0.20	5.86	6.43
UK	5.06	0.23	4.66	5.46
Total	4.88	0.78	1.66	7.05

Table 4 – Simple pairwise correlations between IVs and trust

	trust	IV – institutions	IV – universities	IV – literacy
trust	1.0000			
IV – institutions	0.3744*	1.0000		
IV – universities	0.0151	-0.1662	1.0000	
IV – literacy	0.4334*	0.3091	-0.0526	1.0000

*Significant at 1%.

Table 5 – Trust and growth

VARIABLES	(1) OLS growth	(2) OLS growth	(3) OLS trust	(4) 2SLS growth
trust	0.033***	0.001		0.027
	(0.011)	(0.008)		(0.021)
	[0.011]***	[0.005]		[0.017]
log GDP capita 2000	-0.105***	-0.042***	0.280**	-0.054***
	(0.011)	(0.010)	(0.125)	(0.014)
	[0.017]***	[0.018]**	[0.08]***	[0.017]***
education	0.050***	0.021***	-0.189**	0.024***
	(0.010)	(0.007)	(0.084)	(0.007)
	[0.019]**	[0.014]	[0.104]*	[0.016]
IV - universities			0.248***	
			(0.088)	
			[0.073]***	
IV - institutions			0.459**	
			(0.178)	
			[0.197]**	
IV - literacy			0.264	
			(0.235)	
			[0.161]	
Constant	0.320***	0.336***	2.192***	0.279***
	(0.010)	(0.055)	(0.673)	(0.072)
	[0.023]***	[0.033]***	[0.16]***	[0.05]***
F-test			209.32	
			(0.000)	
Sargan-test				5.52
				(0.063)*
Observations	95	95	95	95
R-squared	0.542	0.880	0.686	0.866

Variables are standardised, except growth. Standard errors in parentheses and clustered standard errors in brackets. Clustering is done at the country level. Column 1 does not include country dummies. F-test is the test of joint significance of the instruments. Sargan is a test of over-identification; null hypothesis: over-identifying restrictions are valid.
*** p<0.01, ** p<0.05, * p<0.1

Table 6 – Trust and growth alternative specifications

VARIABLES	(1) OLS trust	(2) 2SLS growth	(3) OLS trust	(4) 2SLS growth	(5) OLS trust	(6) 2SLS growth
IV - universities	0.225**					
	(0.091)					
	[0.072]***					
IV - institutions			0.441**			
			(0.180)			
			[0.268]			
IV - literacy					0.448*	
					(0.243)	
					[0.33]	
trust		-0.009		0.039		0.106
		(0.032)		(0.036)		(0.071)
		[0.034]		[0.043]		[0.116]
log GDP capita 2000	0.461***	-0.038**	0.360***	-0.060***	0.349***	-0.091**
	(0.111)	(0.017)	(0.119)	(0.019)	(0.129)	(0.037)
	[0.155]**	[0.016]**	[0.088]***	[0.03]*	[0.122]**	[0.071]
education	-0.188**	0.019**	-0.140*	0.026***	-0.112	0.035**
	(0.086)	(0.008)	(0.084)	(0.009)	(0.086)	(0.015)
	[0.083]**	[0.012]	[0.088]	[0.02]	[0.119]	[0.037]
Constant	2.155***	0.358***	2.457***	0.253**	1.839**	0.105
	(0.661)	(0.088)	(0.668)	(0.098)	(0.700)	(0.181)
	[0.2]***	[0.093]***	[0.097]***	[0.093]**	[0.325]***	[0.237]
F-test	9.74		2.7		1.84	
	(0.010)***		(0.128)		(0.201)	
Observations	95	95	95	95	95	95
R-squared	0.646	0.878	0.646	0.850	0.635	0.649

Variables are standardised, except growth. Standard errors in parentheses and clustered standard errors in brackets. Clustering is done at the country level. F-test is the test of joint significance of the instruments. All the regressions include country dummies.
*** p<0.01, ** p<0.05, * p<0.1

Table 7 – Trust and innovation

VARIABLES	(1) OLS patents	(2) OLS patents	(3) 2SLS patents	(4) 2SLS patents	(5) 2SLS patents	(6) 2SLS patents	(7) 2SLS patents
trust	0.228***	0.214	0.736***	0.547***	0.929***	0.853***	0.551***
	(0.070)	(0.445)	(0.186)	(0.168)	(0.203)	(0.187)	(0.168)
	[0.043]***	[0.300]	[0.077]***	[0.12]***	[0.126]***	[0.156]***	[0.123]***
trust^2		0.009					
		(0.050)					
		[0.039]					
log total R&D expenditure	0.422***	0.422***	0.292***				
	(0.076)	(0.077)	(0.107)				
	[0.06]***	[0.062]***	[0.097]**				
log business R&D expenditure				0.432***			0.404***
				(0.096)			(0.101)
				[0.166]**			[0.180]**
log government R&D expenditure					-0.149		-0.104
					(0.093)		(0.650)
					[0.088]		[0.064]
log higher-educ. R&D exp.						-0.164*	-0.116
						(0.088)	(0.072)
						[0.09]*	[0.043]**
education	0.110*	0.111*	0.131*	0.096	0.232***	0.285***	0.177**
	(0.056)	(0.056)	(0.072)	(0.059)	(0.082)	(0.085)	(0.069)
	[0.042]**	[0.046]**	[0.068]*	[0.07]	[0.094]**	[0.114]**	[0.098]*
IV - universities							
IV - institutions							
IV - literacy							
Constant	-0.102	-1.438	-1.398*	-0.977	-1.544*	-1.337	-0.815
	(0.489)	(0.963)	(0.753)	(0.632)	(0.885)	(0.835)	(0.622)
	[0.098]	[0.282]***	[0.148]***	[0.208]***	[0.376]***	[0.463]**	[0.264]***
F-test			267.8	67.65	132.48	156.29	41.03
			(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Sargan-test			2.102	0.709	2.481	1.689	0.530
			(0.350)	(0.702)	(0.290)	(0.494)	(0.767)
Observations	95	95	95	95	93	95	95
R-squared	0.798	0.799	0.666	0.780	0.540	0.585	0.797

Variables are standardised, except trust and trust^2 in *Column 2*. Standard errors in parentheses and clustered standard errors in brackets. Clustering is done at the country level. F-test is the test of joint significance of the instruments. F-tests in Column 5-8 refer to the first stage results. Sargan is a test of over-identification; null hypothesis: over-identifying restrictions are valid. All the regressions include country dummies.
*** p<0.01, ** p<0.05, * p<0.1

Table 8 – Trust and innovation alternative specifications

VARIABLES	(1) OLS trust	(2) 2SLS patents	(3) OLS trust	(4) 2SLS patents	(5) OLS trust	(6) 2SLS patents
IV - universities	0.188*					
	(0.103)					
	[0.14]					
IV - institutions			0.611***			
			(0.173)			
			[0.255]**			
IV - literacy					0.685***	
					(0.228)	
					[0.315]*	
trust		0.521		0.673***		1.021***
		(0.385)		(0.234)		(0.355)
		[0.357]		[0.103]***		[0.155]***
log total R&D expenditure	0.196	0.347***	0.222**	0.308***	0.152	0.220
	(0.120)	(0.128)	(0.111)	(0.109)	(0.117)	(0.150)
	[0.16]	[0.146]**	[0.11]*	[0.062]***	[0.058]**	[0.086]**
education	-0.072	0.122*	-0.094	0.128*	-0.044	0.143
	(0.088)	(0.063)	(0.084)	(0.069)	(0.084)	(0.091)
	[0.107]	[0.052]**	[0.07]	[0.066]*	[0.091]	[0.093]
Constant	2.560***	-0.852	2.741***	-1.238	1.860**	-2.125*
	(0.709)	(1.104)	(0.676)	(0.817)	(0.724)	(1.166)
	[0.142]***	[0.861]	[0.087]***	[0.319]***	[0.413]***	[0.5]***
F-test	1.80		5.74		4.75	
	(0.207)		(0.036)**		(0.052)*	
Observations	95	95	95	95	95	95
R-squared	0.584	0.754	0.624	0.697	0.610	0.477

Variables are standardised. Standard errors in parentheses and clustered standard errors in brackets. Clustering is done at the country level. F-test is the test of joint significance of the instruments. All the regressions include country dummies.
*** p<0.01, ** p<0.05, * p<0.1

Table 9 – Productivity of R&D expenditures (OLS)

VARIABLES	(1) OLS patents	(2) OLS patents	(3) OLS patents	(4) OLS patents	(5) OLS patents
trust	0.233***	0.155**	0.333***	0.291***	0.154**
	(0.071)	(0.061)	(0.081)	(0.083)	(0.065)
	[0.034]***	[0.052]**	[0.074]***	[0.038]***	[0.061]**
log total R&D expenditure	0.549***				
	(0.159)				
	[0.069]***				
trust*total R&D expenditure	-2.177				
	(2.379)				
	[0.759]**				
log business R&D expenditure		0.516***			0.406***
		(0.094)			(0.099)
		[0.113]***			[0.166]**
trust*business R&D expenditure		1.154			3.623**
		(1.541)			(1.789)
		[1.652]			[2.302]
log government R&D expenditure			-0.050		0.055
			(0.124)		(0.091)
			[0.112]		[0.081]
trust*government R&D expenditure			-6.774		-17.093*
			(14.263)		(10.227)
			[12.914]		[5.818]**
log higher-education R&D expenditure				-0.242**	-0.206**
				(0.120)	(0.094)
				[0.121]*	[0.065]***
trust*higher-education R&D expenditure				6.266	7.569
				(9.798)	(8.392)
				[3.933]	[2.76]**
education	0.097*	0.079	0.240***	0.311***	0.191***
	(0.058)	(0.049)	(0.063)	(0.067)	(0.058)
	[0.041]**	[0.062]	[0.073]***	[0.108]**	[0.117]
Constant	0.109	-0.083	0.173	0.073	-0.129
	(0.540)	(0.430)	(0.587)	(0.585)	(0.465)
	[0.136]	[0.174]	[0.198]	[0.145]	[0.187]
Observations	95	95	93	95	93
R-squared	0.801	0.857	0.735	0.745	0.879

Variables are standardised, except interactions. Standard errors in parentheses and clustered standard errors in brackets. Clustering is done at the country level. Interactions are between level-level variables. All the regressions include country dummies.
*** p<0.01, ** p<0.05, * p<0.1

Table 10 – Productivity of R&D expenditures (2SLS)

VARIABLES	(1) 2SLS patents	(2) 2SLS patents	(3) 2SLS patents	(4) 2SLS patents	(5) 2SLS patents
trust	0.688***	0.537***	0.821***	0.808***	0.484***
	(0.179)	(0.169)	(0.178)	(0.188)	(0.149)
	[0.096]***	[0.15]***	[0.063]***	[0.132]***	[0.148]***
trust*total R&D expenditure	-1.010				
	(3.333)				
	[4.569]				
log total R&D expenditure	0.364				
	(0.231)				
	[0.361]				
trust*business R&D expenditure		0.954			2.092
		(2.052)			(2.427)
		[3.048]			[3.326]
log business R&D expenditure		0.395***			0.346**
		(0.139)			(0.137)
		[0.293]			[0.312]
trust*government R&D expenditure			8.892		-7.614
			(25.926)		(17.627)
			[23.995]		[8.843]
log government R&D expenditure			-0.204		-0.037
			(0.208)		(0.143)
			[0.207]		[0.102]
trust*higher-education R&D expenditure				4.423	2.641
				(14.472)	(12.610)
				[6.121]	[6.554]
log higher-education R&D expenditure				-0.209	-0.156
				(0.168)	(0.131)
				[0.084]**	[0.067]**
education	0.123*	0.103	0.230***	0.288***	0.199***
	(0.073)	(0.062)	(0.078)	(0.084)	(0.072)
	[0.065]*	[0.079]	[0.084]**	[0.112]**	[0.121]
Constant	-1.173	-1.019	-1.354	-1.333	-0.790
	(0.845)	(0.670)	(0.880)	(0.850)	(0.671)
	[0.6]*	[0.449]**	[0.205]***	[0.314]***	[0.51]
Sargan-test	3.506	1.687	7.140	3.219	4.221
	(0.477)	(0.793)	(0.129)	(0.522)	(0.837)
Observations	95	95	93	95	93
R-squared	0.693	0.785	0.596	0.604	0.826

Variables are standardised, except interactions. Standard errors in parentheses and clustered standard errors in brackets. Clustering is done at the country level. Joint F-test on the first stage always exceeded the required threshold of 10. Sargan is a test of over-identification; null hypothesis: over-identifying restrictions are valid. Interactions are between level-level variables. All the regressions include country dummies.
*** p<0.01, ** p<0.05, * p<0.1

Table 11 – Trust, innovation and economic growth

		Reduced form		First stage	3SLS		
VARIABLES	(1) OLS growth	(2) OLS growth	(3) OLS patents	(4) OLS trust	(5) growth	(6) patents	(7) trust
trust	0.001				-0.003	0.812***	
	(0.009)				(0.031)	(0.165)	
education	0.021***	0.022***	-0.032	-0.202**	0.018**	0.136*	-0.195***
	(0.007)	(0.007)	(0.050)	(0.086)	(0.008)	(0.070)	(0.075)
log GDP capita 2000	-0.041***	-0.056***	0.324***	0.275**	-0.057***		0.336***
	(0.011)	(0.010)	(0.073)	(0.125)	(0.013)		(0.076)
log patents	-0.003				0.033		
	(0.012)				(0.028)		
log total R&D expenditure		0.006	0.325***	0.073		0.266***	0.061
		(0.009)	(0.064)	(0.111)		(0.102)	(0.098)
IV - universities		-0.004	0.121**	0.232**			0.160***
		(0.007)	(0.053)	(0.092)			(0.057)
IV - institutions		0.009	0.178*	0.458**			0.308***
		(0.014)	(0.104)	(0.179)			(0.112)
IV - literacy		0.043**	0.327**	0.229			0.421***
		(0.019)	(0.140)	(0.242)			(0.128)
Constant	0.336***	0.305***	-0.148	2.169***	0.334***	-1.587**	1.863***
	(0.055)	(0.054)	(0.392)	(0.676)	(0.079)	(0.707)	(0.581)
F-test				91.52			
				(0.000)***			
Sargan-test					7.989		
					(0.157)		
Observations	95	95	95	95	95	95	95
R-squared	0.880	0.891	0.877	0.688	0.867	0.624	0.680

Variables are standardised, except growth. Standard errors in parentheses. Clustering is done at the country level. F-test is the test of joint significance of the instruments. Sargan is a test of over-identification; null hypothesis: over-identifying restrictions are valid. All the regressions include country dummies.
*** p<0.01, ** p<0.05, * p<0.1

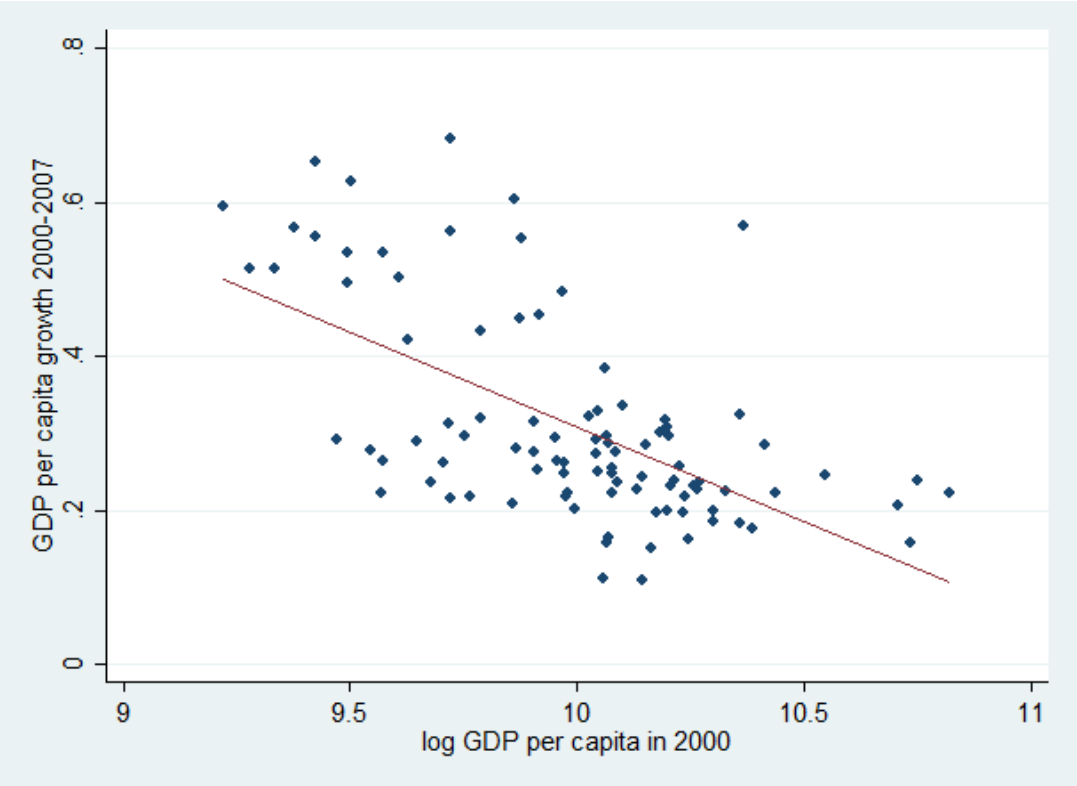
Table 12 – Trust, innovation and economic growth with sectoral R&D and interactions

	3SLS with sectoral R&D		3SLS with interaction	
	(1)	(2)	(3)	(4)
VARIABLES	growth	patents	growth	patents
trust	0.020	0.642***	0.006	0.713***
	(0.023)	(0.144)	(0.019)	(0.112)
education	0.023***	0.183***	0.019***	0.229***
	(0.007)	(0.067)	(0.007)	(0.068)
log GDP capita 2000	-0.053***		-0.042***	
	(0.012)		(0.011)	
log patents	0.003		0.005	
	(0.020)		(0.018)	
log business R&D expenditure		0.373***		0.222*
		(0.095)		(0.122)
log government R&D expenditure		-0.113*		-0.093
		(0.064)		(0.134)
log higher-education R&D expenditure		-0.111		-0.149
		(0.071)		(0.125)
trust*business R&D expenditure				2.975
				(2.280)
trust*government R&D expenditure				-0.820
				(16.529)
trust*higher-education R&D expenditure				0.114
				(11.925)
Constant	0.332***	-0.094	0.320***	-1.410**
	(0.033)	(0.307)	(0.031)	(0.595)
Sargan-test	8.84		43.679	
	(0.264)		(0.016)	
Observations	93	93	93	93
R-squared	0.871	0.759	0.878	0.730

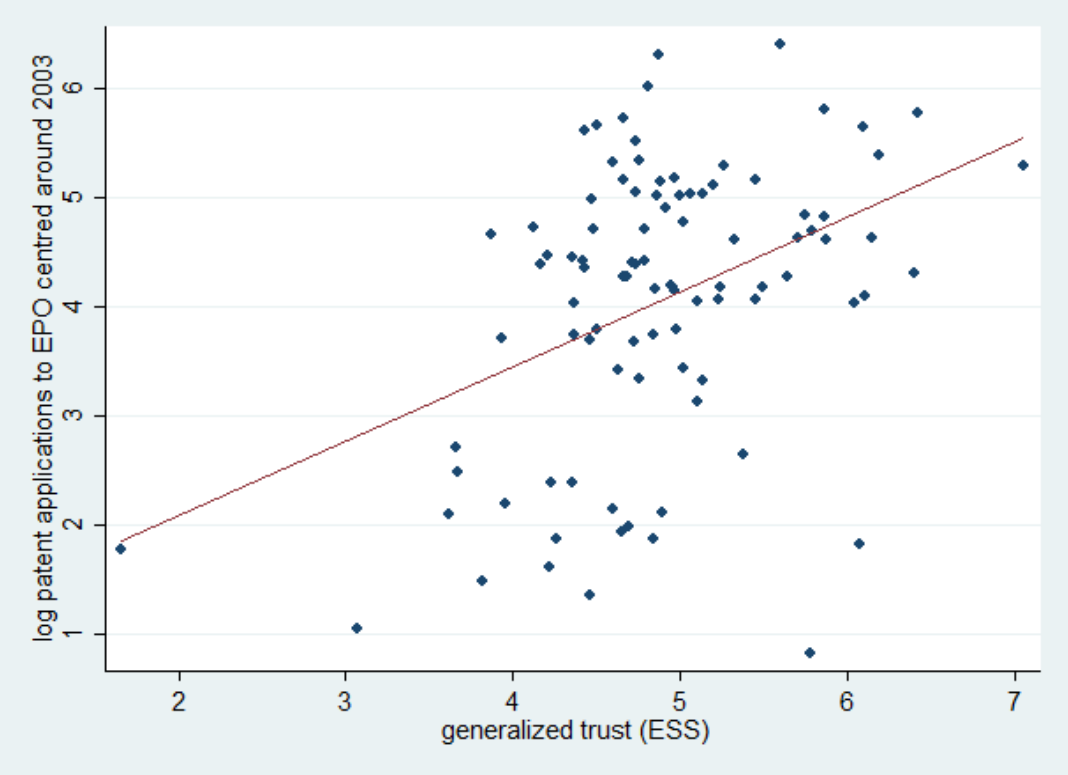
Variables are standardised, except growth and interactions. Standard errors in parentheses. Clustering is done at the country level. Joint F-test on the first stage always exceeded the required threshold of 10. Sargan is a test of over-identification; null hypothesis: over-identifying restrictions are valid. Interactions are between level-level variables. All the regressions include country dummies.
*** p<0.01, ** p<0.05, * p<0.1

Graphs

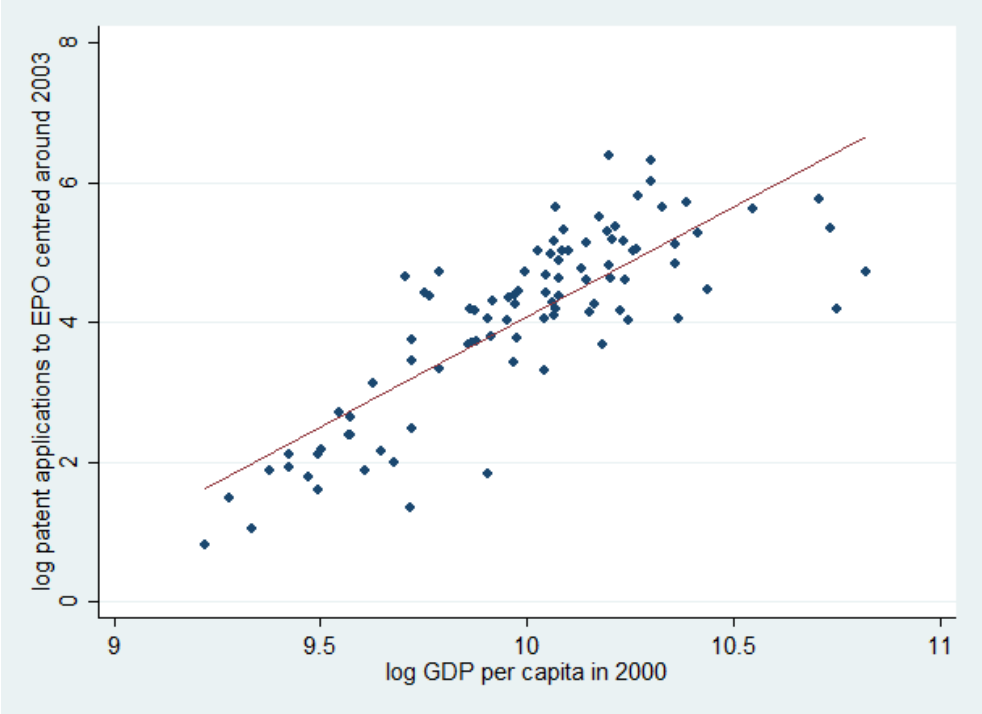
Graph 1 – GDP per capita in 2000 and GDP per capita growth 2000-2007



Graph 2 – Generalized trust and log patent applications to EPO centred around 2003



Graph 3 – Log GDP per capita in 2000 and log patent applications to EPO centred around 2003



Appendix

Appendix 1 – Regions and countries in the sample

Country	Regions	Level
Austria	Ostösterreich [AT1], Südösterreich [AT2], Westösterreich [AT3]	NUTS 1
Belgium	Reg Bruxelles-Cap / Brux HFDST. Gew. [BE1], Vlaams Gewest [BE2], Region Wallone [BE3]	NUTS 1
Germany	Baden Wurttemberg [DE1], Bayern [DE2], Berlin [DE3], Brandenburg [DE4], Bremen [DE5], Hamburg [DE6], Hessen [DE7], Mecklenburg-Worpem [DE8], Niedersachsen [DE9], Nordrhein-Westfalen [DEA], Rheinland-Pfalz [DEB], Saarland [DEC], Sachsen [DED], Schleswig-Holstein [DEF], Thuringen [DEG]	NUTS 1
Denmark	Denmark [DK0]	NUTS 1
Spain	Galicia [ES11], Asturias [ES12], Cantabria [ES13], Pais Vasco [ES21], Navarra [ES22], La Rioja [ES23], Aragon [ES24], Madrid [ES30], Castilla Y Leon [ES41], Castilla La Mancha [ES42], Extramadura [ES43], Cataluna [ES51], Valenciana [ES52], Illes Balears [ES53], Andalucia [ES61], Murcia [ES62]	NUTS 2
France	Île De France [FR1], Bassin Parisien [FR2], Nord-Pas-De-Calais [FR3], Est [FR4], Ouest [FR5], Sud-Ouest [FR6], Centre-Est [FR7], Mediterranee [FR8]	NUTS 1
Greece	Voreia Ellada [GR1], Kentriki Ellada [GR2], Attiki [GR3], Nisia [GR4]	NUTS 1
Ireland	Border, Midland, Western [IE01], Southern And Eastern [IE02],	NUTS 2
Italy	Piemonte [ITC1], Valle D Aosta [ITC2], Liguria [ITC3], Lombardia [ITC4], Veneto [ITD3], Friuli-Venezia-Giulia [ITD4], Emilia Romagna [ITD5], Toscana [ITE1], Umbria [ITE2], Marche [ITE3], Lazio [ITE4], Abruzzo [ITF1], Molise [ITF2], Campania [ITF3], Puglia [ITF4], Basilicata [ITF5], Calabria [ITF6], Sardegna [ITG1], Sicilia [ITG2]	NUTS 2
The Netherlands	Noord-Nederland [NL1], Oost Nederland [NL2], West-Nederland [NL3], Zuid-Nederland [NL4]	NUTS 1
Sweden	Stockholm [SE01], Östra Mellansverige [SE02], Sydsverige [SE04], Norra Mellansverige [SE06], Mellersta A Norrland [SE07], Övre Norrland [SE08], SmĺLand Med Oarna [SE09], VästsverigE [SE0A]	NUTS 2
UK	North East [UKC], North West [UKD], Yorkshire-Humber [UKE], East Midlands [UKF], West Midlands [UKG], East Of England [UKH], Greater London [UKI], South East [UKJ], South West [UKK], Wales [UKL], Scotland [UKM], Northern Ireland [UKN]	NUTS 1

Appendix 2 – Technical details for the instrumentation of interacted variables

For instrumenting the interacted variables I followed Murnane and Willett (2006). This meant that in the first-stage, separately for each models in *Table 10*, multiple regression were run. For example in *Model 1*, estimating the effect of total spending and its interaction with trust on the number of patents, the first-stage consisted of a regression on both trust and trust's interaction with total spending where the right hand side variables were the exogenous variables in *Model 1* and the interactions of the original IVs with the total R&D spending. That is, first stage was estimated following

$$\begin{aligned} trust_j = {} & \delta_0 + \delta_1 literacy_j + \delta_2 past\ institutions_j + \delta_3 past\ universities_j + \delta_4 literacy_j \\ & * total\ R\&D\ expenditure_j + \delta_5 past\ institutions_j * total\ R\&D\ expenditure_j \\ & + \delta_6 past\ universities_j * total\ R\&D\ expenditure_j + \delta_7 total\ R\&D\ expenditure_j \\ & + \delta_8 human\ capital_j + \mu_j, \end{aligned}$$

$$\begin{aligned} trust_j * total\ R\&D\ expenditure_j & \\ = {} & \delta_0 + \delta_1 literacy_j + \delta_2 past\ institutions_j + \delta_3 past\ universities_j \\ & + \delta_4 literacy_j * total\ R\&D\ expenditure_j + \delta_5 past\ institutions_j \\ & * total\ R\&D\ expenditure_j + \delta_6 past\ universities_j * total\ R\&D\ expenditure_j \\ & + \delta_7 total\ R\&D\ expenditure_j + \delta_8 human\ capital_j + \delta_4 X_j + \mu_j, \end{aligned}$$

where country dummies are always included and clustered standard errors are employed.

Similarly, in the case of, for example, *Model 5* where each sectoral expenditures are included, the strength of identification is calculated in the first stage separately for each trust-expenditures interactions on the LHS where the RHS variables always included all the possible IV-expenditure interactions.