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Firm-level productivity growth returns of social capital: Evidence from Western Europe*

by

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Abstract: We analyse the firm-level labour productivity growth returns of social capital — defined as a synthetic measure of 'generalised trust', 'active participation', and 'social norms'— using a large sample of manufacturing firms in France, Germany, Italy, Portugal, and Spain. We find that firms' labour productivity growth is higher in areas with a better social capital endowment. The positive returns of social capital are, nevertheless, unevenly distributed across firms, with smaller, less productive, less capital-endowed, and low-tech firms benefitting the most from operating in strong social capital ecosystems.

Keywords: Firm labour productivity growth; Social capital; Manufacturing industry; Western Europe.

JEL Codes: C36; D24; R10; Z13.

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1. INTRODUCTION

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The economic effects of social capital have attracted considerable attention since, at least, the seminal works by Putnam (1993) and Knack and Keefer (1997). Building on Banfield's (1958), Coleman's (1988) and Gambetta's (1988) early contributions, Putnam (1993, p. 167) defines social capital as "those features of social organizations, such as trust, norms and networks that can improve the efficiency of society by facilitating coordinated actions." According to this definition, social capital emerges as a multifaced and complex concept capturing a community-specific set of productive intangible assets that make the bulk of a society's informal institutional framework (Durlauf & Fafchamps, 2005; Storper, 1995). As such, social capital impacts on the quantity and quality of social and economic interactions (Andini & Andini, 2019), influencing overall economic performance by reducing transaction costs and facilitating interactions, information flows, and coordination (Forte et al., 2015).

Despite the diversity in the definitions of social capital and in its operationalisation —from individual variables (Forte et al., 2015) to synthetic indices (Akçomak & ter Weel, 2012)—, empirical research generally supports the idea that differences in social capital help explain territorial variations in entrepreneurship, innovation, trade, productivity, and economic growth, both among countries (Algan & Cahuc, 2010; Bjørnskov & Méon, 2015; Guiso et al., 2006, 2009; Knack & Keefer, 1997) and regions within and across countries (Akçomak & ter Weel, 2009; Andini & Andini, 2019; Beugelsdijk & van Schaik, 2005; Forte et al., 2015; Muringani et al., 2021; Peiró-Palomino, 2016, 2019; Percoco, 2012; Tabellini, 2010).

However, the way social capital influences economic performance at the aggregate (country, regional, or urban) level depends on how it affects the behaviour and performance of individual economic actors (de Blasio & Nuzzo, 2010; Guiso et al., 2004). It is thus crucial to understand the micro-level relationship between social capital and economic performance, especially through the lens of the firm. Aggregate economic performance depends on the performance of individual firms, with each firm interacting heterogeneously —both through its workers and as an organisational structure as a whole— with other actors (mainly other firms, banks, public authorities) located within

the same socio-economic ecosystem.

The firm-level literature, despite its scarcity, emphasises how social capital is related to a firm's organisational structure, innovativeness, and output. However, many of the existing studies present limitations that curb the potential for generalisation of their findings. Most works adopt a single-country perspective (Bürker & Minerva, 2014; Bürker et al., 2013; Cooke et al., 2005; Cooke, 2007; Sabatini, 2008; Wang & Steiner, 2020). Di Guilmi et al. (2008) and Bloom et al. (2012) are the exceptions, as they examine cross-country differences in social capital at the national level. Other works focus, rather than on the territory-specific endowment of social capital, on how the entrepreneur's or managers' personal ties and embeddedness in social networks affect firm performance (Kemeny et al., 2016). Finally, most of the abovementioned contributions lack a causal interpretation of the relationship between social capital and firm performance. Bloom et al. (2012), Bürker et al. (2013), and Bürker and Minerva (2014) are exceptions to this rule.

Hence, considerable gaps remain in our knowledge as to how and to which extent social capital plays a role —if at all— in firm-level performance. Are firms located in areas with weaker social capital disadvantaged in terms of their capacity to increase their productivity and to progress? Are certain types of firms, such as the most vulnerable in terms of age, size, technological component, and access to capital, rendered even more vulnerable in the absence of a strong local social capital? These are questions that have considerable policy relevance but that, to date, remain mostly unanswered. Our intention is to fill these gaps in the literature by analysing the causal effects of social capital on firm-level economic performance from a cross-country perspective, under the hypothesis of firm heterogeneity. Specifically, we provide novel evidence on how social capital at the regional level —captured by a synthetic measure encompassing Putnam's (1993) three dimensions of trust, networking, and social norms— shapes manufacturing firms' labour productivity growth over the period 2010-2017 in five Western European countries: France, Germany, Italy, Portugal, and Spain. We explicitly account for firm-level differences in structural conditions, including productive efficiency, physical capital endowment, size, age, and technological level. In doing this, we go

beyond previous firm-level analyses considering local differences in social capital within a single country, as well as region-level studies, as we investigate the micro-level processes driving aggregate regional economic performance. We also complement cross-country firm-level studies by lowering the geographical scale at which social capital emerges. We posit that informal institutions are locally-embedded and, therefore, highly heterogeneous not only across countries, but also within them (Putnam, 1993; Rodríguez-Pose, 2013).[1]

We assess the productivity growth returns of local social capital by exploiting cross-regional heterogeneity in terms of precipitation variability between 1500 and 1750, which is used as a proxy for economic risk. The rationale for this choice is that a high weather risk in a period where individuals' subsistence was based on agricultural production may have favoured the early emergence of shared norms and altruistic/cooperative behaviours to cope with weather-related economic risks (Buggle & Durante, 2021). We find a general positive effect of social capital on labour productivity growth, but also that growth returns of social capital are unevenly distributed across firms of different types.

Our analysis is also relevant for policy, as improvements in social capital are increasingly seen by supra-national institutions, such as the World Bank, the Organisation for Economic Co-operation and Development (OECD), and the European Union (EU), as a means for promoting economic development and growth (Malecki, 2012; Muringani et al., 2021). This is particularly relevant in the European context, where nation-states are characterised by strong economic and political integration, while remaining highly internally heterogeneous in terms of economic potential and development.

The remainder of the paper is structured as follows. The second Section briefly discusses the mechanisms underlying the relationship between social capital and firm performance. The third

[1] Our analysis differs significantly from previous studies reporting a causal effect of social capital on firm-level behaviour and performance. We assess whether and to what extent a region's social capital explains labour productivity growth differentials at firm level. To do that, we explicitly evaluate the type of firm that benefits the most from being located in a 'good' informal institutional environment. Other scholarly contributions focus on different aspects. Bloom et al. (2012), for example, study the effects of social capital on the size, internal organisation, and re-allocation decision of firms across countries; Bürker et al. (2013) analyse the extent to which social capital in Italy influences productivity differentials related to foreign ownership; and Bürker and Minerva (2014) estimate the effects of social capital on the size distribution of plants in Italy. In this respect, we complement existing empirical analyses by providing novel evidence on the productivity growth effects of social capital.

Section presents the data, the empirical model, and the econometric strategy. This is followed by a presentation and discussion of the empirical results. The final Section concludes and draws some policy implications.

2. THEORETICAL FRAMEWORK

Economic research has identified several mechanisms through which a strong social capital in a community can spur economic dynamism, in general, and firm-level performance, in particular. This multiplicity of mechanisms rests on the complexity of the definition of the concept of social capital.

Following Putnam (1993), the endowment of social capital in a society is shaped by at least three interrelated and mutually reinforcing dimensions. The first dimension is generalised trust, i.e., the trust that individuals have in the other members of a collective. This translates into the expectation that the behaviour of others will be fair, predictably honest, and reliable (Fukuyama, 1995; Gambetta, 1988). The second dimension is networking. It captures social connections and interactions among individuals (within and across organisations) and their attitude towards associationism and collective behaviour (Putnam, 1993). The third dimension is the sharing of social norms, i.e., the collective adoption of the system of socially accepted, unwritten rules and codes of conduct defining 'good citizenship' and attitude towards the public interest (Coleman, 1990; Knack & Keefer, 1997). Generalised trust is a prerequisite for social interactions (Putnam, 1993), but, at the same time, strong ties reinforce trust among individuals and society (Beugelsdijk & van Schaik, 2005). In a trusting environment, characterised by high-density social networks, individuals are more inclined to respect community-specific social norms due to both "[i]nternal (e.g., guilt) and external (e.g., shame and ostracism) sanctions" (Knack & Keefer, 1997, p. 1254). As long as norms and behavioural codes are largely shared and observed, individuals will trust others more and increase social interactions (Beugelsdijk & van Schaik, 2005).

Theory suggests that the combination of these three dimensions conforms the bulk of the informal institutional settings in a society. They contribute to define and shape the socio-economic

and business environments where individuals and organisations operate (Durlauf & Fafchamps, 2005; Rodríguez-Pose, 2013; Storper, 1995).

But how can social capital shape the economic performance of a firm? The main idea is that generalised trust and repeated interactions trigger greater economic activity and better performance by reducing transactions costs and increasing transparency and reciprocity among economic actors (Fukuyama, 1995; Putnam, 1993). In trusting environments, where people follow shared norms, individuals are more prone to adopt cooperative behaviours, and less reluctant to diffuse information and knowledge, both within and across firms (Granovetter, 2005; Kaasa, 2009). This favours the cross-fertilisation of ideas across economic and social agents leading to more (radical) innovations and technological progress (Akçomak & ter Weel, 2009; Peiró-Palomino, 2019). The result is higher firm-level productivity and growth (Di Guilmi et al., 2008; Sabatini, 2008).

Moreover, trustworthiness and shared values reduce free-riding and opportunistic behaviours, lowering monitoring costs (Guiso et al., 2011; Knack & Keefer, 1997; Tabellini, 2010). This translates into less effort for entrepreneurs and managers in controlling working tasks within the firm. Hence, more time and resources can be devoted to high-value and productivity-enhancing activities (Bjørnskov & Méon, 2015; Kaasa, 2016). Social capital also facilitates task delegation, which promotes an optimal division of labour within the firm and, consequently, increases organisational efficiency (Bloom et al., 2012; Cingano & Pinotti, 2016), as well as cooperation among employees, leading to collective problem solving (Peiró-Palomino, 2016), higher productivity among workers sharing the firm's goals (Sabatini, 2008), and information and knowledge exchange fostering innovation (Di Guilmi et al., 2008; Kemeny et al., 2016). Less monitoring costs and greater reciprocity derived from repeated inter-firm interactions also reduce the costs of negotiating complex transactions, contract enforcement, and surveillance of third parties, such as suppliers (Beugelsdijk & van Schaik, 2005; Fukuyama, 1995; Knack & Keefer, 1997). The outcome is a maximisation of the gains from transactions and trade, with positive effects on efficiency and productivity growth (Tabellini, 2010).

Social capital also helps solving agency problems of asymmetric information and moral hazard (Bloom et al., 2012; Bürker et al., 2013; Forte et al., 2015), with positive effects on both firm-bank and inter-firm trade credit relationships (Cruz-García & Peiró-Palomino, 2019; Guiso et al., 2004; Knack & Keefer, 1997). Trust, reputation, and embeddedness in local networks facilitate banks' access to soft information on firms, leading to reduced uncertainty and, consequently, lower credit denial rates. Inter-firm transactions based on trust and reciprocity may also translate into financial relationships through trade credit, based on better contracts or delayed payments (Dei Ottati, 1994). Trade credit represents a key alternative source of financing for firms to alleviate problems of limited resources and credit rationing. It increases productivity by promoting investment in physical capital and technology (Rodríguez-Pose et al., 2021).

Finally, social capital favours long-term investment choices. This practice leads to capital accumulation and advanced technology adoption that spur efficiency and productivity growth (Forte et al., 2015). Investors are more likely to venture into potentially risky projects in the presence of trust-based ties (Knack & Keefer, 1997), with entrepreneurs benefitting from easier access to the tangible and intangible assets needed for firm performance (Nahapiet & Ghoshal, 1998).

Overall, we expect that a strong social capital —through its components of trust, networking, and shared norms— will improve firms' performance and deliver greater growth. This can be achieved by creating a favourable socio-economic and business environment, where reduced transaction costs, non-selfish and non-opportunistic behaviours, shared values, and interaction and cooperation among workers, entrepreneurs, and firms promote the availability and accumulation of productivity-enhancing factors: from information and knowledge flows spurring technological diffusion and innovation (Akçomak & ter Weel, 2009), physical capital investments (Knack & Keefer, 1997), or human capital (Bjørnskov & Méon, 2015), to financial resources through both formal and informal credit markets (Guiso et al., 2004; Knack & Keefer, 1997) and trade and

production linkages (Guiso et al., 2009).[2]

However, although social capital represents a key ingredient explaining productivity at firms level and cross-firm productivity differentials (Di Guilmi et al., 2008), it may be the case that not all firms benefit in the same way from the local endowment of social capital. As shown by Ganau and Rodríguez-Pose (2019), heterogeneous firms may interact differently with, and gain unevenly from, their local environment: larger firms, firms already endowed with a high stock of internal resources (physical and human capital), and firms close to the efficiency frontier may have less need for leveraging resources through social capital to grow.

Drawing on the abovementioned theoretical arguments, we explore explicitly whether and to which extent local differences in social capital endowment contribute to explain productivity growth differentials across heterogeneous firms. In doing so, we add new knowledge on the economic returns of social capital by adopting a cross-country and territorial perspective under the hypothesis of firm heterogeneity, thus contributing to understand the micro-level relationship between social capital and economic performance.

3. EMPIRICAL FRAMEWORK

3.1. The dataset

We use two main data sources to analyse the firm-level labour productivity growth returns of regional

[2] On top of the 'more traditional' definition of social capital *à la* Putnam (1993), based on trust, networking, and social norms, the literature has proposed alternative conceptualisations of social capital. Some of these distinguish between bonding and bridging social capital (Patulny, 2009; Putnam, 2000): bonding social capital refers to closed networks linking homogenous groups, and, thus, captures the within-group dimension of social capital. Bridging social capital refers to open networks linking heterogeneous groups, encompassing the inter-group dimension of social capital. Our choice of following Putnam's (1993) definition —without distinguishing between bonding and bridging social capital— is based on two factors. First, Putnam's original definition captures a relatively broader spectrum of social capital-related mechanisms that explain the reasons why firms located in high-social capital regions can perform better than their counterparts in low-social capital regions. Second, data availability constraints prevent us from disentangling empirically the bonding (i.e., internal to the firm) and bridging (i.e., external to the firm, but internal to the region) dimensions of social capital. We lack information to quantify the social capital of individual firms. Our measure of social capital relies on the *European Values Study* (EVS). This source provides information on the general population, and not on firms. Accordingly, we can only proxy for a region's social capital endowment. However, our goal is not to compare a firm's social capital endowment (i.e., the bonding dimension) with that external to the firm but internal to its region of location (i.e., the bridging dimension). Rather, we analyse whether social capital —as the informal institution characterising the socio-economic environment where a firm operates— drives labour productivity growth.

social capital. The *Amadeus* database (Bureau van Dijk) contains information and balance sheet figures for European firms. The *European Values Study* (EVS) provides regional data on different dimensions of social capital.

First, we cleaned the *Amadeus* database to only include active manufacturing firms reporting unconsolidated balance sheet data. Second, we excluded firms with missing information for year of incorporation and location at the regional level —defined according to the EU *Nomenclature des Unités Territoriales Statistiques* (NUTS). Third, we excluded firms incorporated after the reference year (2010), as well as firms with missing or unreliable figures for value added, employment, and tangible fixed assets.

The cleaning procedure left us with a final sample of 27,299 manufacturing firms observed in the year 2010, 17,396 of which were still observed in 2017. This means that 63.72% of firms in the sample survived during the entire period of analysis. The final sample covers firms in five EU countries: France, Germany, Italy, Portugal, and Spain.[3] We focus the empirical analysis on these five countries for two main reasons. First, the cleaning procedure performed on the *Amadeus* database left us with usable information on representative samples of firms only in the abovementioned countries. Cleaning the database left only a few dozen firms in many of the excluded countries, taking also into account available local data on social capital and other socio-economic dimensions. Hence, representative sub-samples of firms with respect to the true population of manufacturing firms (according to official figures) can only be constructed for the selected five countries. The country-level representativeness of the sample is good, as only sample firms in France and Italy appear to be slightly under-represented and over-represented, respectively (Online Appendix Table A1). The sample covers the 91.57% of the geography of the countries analysed (Online Appendix Table A2), as well as all two-digit NACE Rev. 2 manufacturing sectors, except for sectors "12—Tobacco products" and "19—Coke and refined petroleum products", for which no firms remained after the

[3] We identified the location of firms using the regional aggregation level available in the 2008 wave of the EVS: this corresponds to NUTS-1 (*Länder*) for Germany, and NUTS-2 for France (*Régions*), Italy (*Regioni*), Portugal (*Grupos de Entidades Intermunicipais* and *Regiões Autónomas*), and Spain (*Comunidades Autónomas*).

cleaning procedure (Online Appendix Table A3).[4] Second, the five countries in the sample are all developed Western EU nation-states characterised by a sufficiently high degree of similarity in terms of their more recent historical, political, and institutional paths. These similarities facilitate isolating regional variations in social capital and estimating its causal effect on firm-level labour productivity growth (Ganau & Rodríguez-Pose, 2019).

We then enriched the firm-level dataset by adding regional data on social capital drawn from the 2008 wave of the EVS and regional data for 2010 on Gross Domestic Product (GDP), population, surface, and human capital provided by Eurostat (*Regio* database). In addition, we included regional 2010 data on government quality drawn from the *European Quality of Government Index* dataset, compiled by the Quality of Government Institute at the University of Gothenburg, and historical regional data for 1900 on GDP and population, drawn from Rosés and Wolf (2019).

3.2. Empirical model and variables

Let's consider a representative firm i, which operates in industry s in region r in country c. We assume that this firm is characterised by a standard Cobb-Douglas production function. We also assume that, at time t, it produces a certain output level (Y_{isrct}), using the existing stock of physical capital (K_{isrct}) and the available labour force (L_{isrct}), according to a Hicks-neutral technology parameter (A_{isrct}). We can express the production function in units of labour as follows:

$$y_{isrct} = A_{isrct} k_{isrct}^{\alpha} \quad (1)$$

where y_{isrct} denotes labour productivity, and k_{isrct} denotes the capital-to-labour ratio.

Having observed its current labour productivity level (y_{isrct}), the firm sets the target of reaching a certain variation in labour productivity between periods t and T ($\dot{y}_{isrct}$), with $T > t$. Inspired by

[4] The sample includes firms operating in both low- and high-technology manufacturing sectors (Online Appendix Table A4).

Romer (1990), we express the variation in labour productivity as follows:

$$\dot{y}_{isrct} = y_{isrct}^{\beta}(a_k k_{isrct})^{\gamma}\Phi_{isrct} \quad (2)$$

such that $\dot{y}_{isrct}$ is defined as a function of the current labour productivity level y_{isrct}^{β}, capturing a firm's accumulated production capacity; the fraction of the capital-to-labour ratio still available from the realisation of y_{isrct}, and needed to increase labour productivity between t and T ($a_k k_{isrct}$); and the technology parameter Φ_{isrct} influencing the overall labour productivity dynamics.

We define Φ_{isrct} as a function of firm-specific capabilities (F_{isrct}) —e.g., new managerial competences—, industry-specific technology (I_{st}), the region-specific socio-economic and institutional environment (R_{rct}), and country-specific macroeconomic and institutional conditions (C_{ct}). We further express the regional dimension in two main categories for social capital and structural conditions, respectively, such that $R_{rct} = Z_{rct}^{\mu} Z_{rct}^{\nu}$. First, the social capital dimension (Z_{rct}^{μ}) captures the informal institutional setting where firms operate. This setting, as discussed earlier, can influence a firm's labour productivity dynamics by reducing transaction costs, stoking interactions among workers and firms leading to information flows (e.g., knowledge exchange for innovation), facilitating access to credit via formal markets and trade credit (e.g., allowing a firm to invest in new technologies or enlarge the business), and reducing coordination problems and free-riding. Specifically, we model $Z_{rct}^{\mu} = e^{\lambda Social\ Capital_{rct}}$, where λ denotes the relative position of a region in the cross-regional distribution of social capital. This means that location in a region characterised by a relatively stronger social capital will result in a higher variation in a firm's labour productivity. Second, the structural conditions of a region (Z_{rct}^{ν}) captures the economic and formal institutional ecosystem influencing the production process through, for example, labour market specificities, agglomeration forces, and government efficiency.

By dividing both sides of Equation (2) by y_{isrct}, and taking logarithms, we obtain the following expression for firm-level labour productivity growth:

$$\Delta y_{isrct} = \omega \log(y_{isrct}) + \gamma \log(a_k k_{isrct}) + \log(F_{isrct}) + \log(I_{st}) + \log(C_{ct}) + \\ + \nu \log(Z_{rct}) + \lambda Social\ Capital_{rct} \quad (3)$$

where $\Delta y_{isrct} = [\log(y_{iscrT}) - \log(y_{isrct})]$ denotes labour productivity growth between periods t and T, and all the terms on the right-hand side of Equation (3) are defined at period t. We set $\omega = -(1-\beta)$, where $\beta \in [0, 1)$ captures the effects of a firm's existing production capacity on labour productivity growth. A higher β indicates a higher growth potential in a firm. Simultaneously, and in line with the standard macroeconomic convergence model *à la* Solow (1956), more productive firms are also expected to grow less than firms far away from the labour productivity frontier.

We further restrict the term for firm-specific capabilities as a linear combination of a constant term (τ_0), firm fixed effects (η_i), time fixed effects (θ_t), and an error component (ε_{isrct}) —such that $\log(F_{isrct}) = \tau_0 + \eta_i + \theta_t + \varepsilon_{isrct}$. We model the industry- and country-level terms as industry (ϑ_s) and country (ξ_c) fixed effects, respectively. This allows to rewrite Equation (3) as the following empirical firm-level labour productivity growth equation:

$$\Delta y_{isrct} = \tau_0 + \omega \log(y_{isrct}) + \gamma \log(a_k k_{isrct}) + \eta_i + \theta_t + \vartheta_s + \xi_c + \nu \log(Z_{rct}) + \\ + \lambda Social\ Capital_{rct} + \varepsilon_{isrct} \quad (4)$$

Given the cross-sectional nature of our analysis and considering data availability restrictions, we derive the following equation that we use to estimate the firm-level labour productivity growth returns of regional social capital over the period 2010-2017:

$$\Delta Productivity_{isrc} = \alpha_0 + \alpha_1 Social\ Capital_{rc}^{2008} + \alpha_2 \log(Productivity_{isrc}^{2010}) + \\ + \alpha_3 \log(Capital\ Endowment_{isrc}^{2010}) + \alpha_4 \log(Age_{isrc}^{2010}) + \\ + \alpha_5 Size\ Class_{isrc}^{2010} + \alpha_6 \log(GDP\ Per\ Capita_{rc}^{2010}) +$$

$$+\alpha_7 \log(Population\ Density_{rc}^{2010}) + \alpha_8 \log(Human\ Capital_{rc}^{2010}) +$$

$$+\alpha_9 Institutional\ Quality_{rc}^{2010} + \alpha_{10} \log(GDP\ Per\ Capita_{rc}^{1900}) +$$

$$+\boldsymbol{\vartheta}_s + \boldsymbol{\xi}_c + \varepsilon_{isrc} \quad (5)$$

where the dependent variable captures labour productivity growth defined as the log-difference in labour productivity between the years 2010 and 2017, with labour productivity defined as deflated value added over employment.[5]

The key explanatory variable represents regional social capital, defined using information drawn from the 2008 wave of the EVS. The proxy measure for social capital is calculated using the principal component of three key dimensions usually employed to measure social capital (Akçomak & ter Weel, 2009; Forte et al., 2015; Tabellini, 2010), namely 'generalised trust', 'active participation', and 'social norms'.

The first dimension of social capital is 'generalised trust'. It is defined as the percentage of individuals who replied "most people can be trusted" to the survey question "Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?" (Tabellini, 2010).

The second dimension of social capital is 'active participation', measured by voluntary unpaid work. It is used as a proxy for the network component of social capital (Forte et al., 2015; Peiró-Palomino, 2019). Specifically, the EVS asks interviewed individuals not only whether they are members of a voluntary organisation, but also whether they do unpaid work for it. Therefore, the second dimension of social capital is defined as the percentage of individuals who 'mentioned' that they do voluntary unpaid work, and proxies for association life.

The third dimension is 'social norms'. We define it, following Forte et al. (2015), considering responses about the extent to which a variety of actions is viewed as justifiable. Specifically, the EVS asks "Which of the following behaviours you think can always be justified, never be justified, or

[5] The deflator for value added is defined at the sector-country level. Data are drawn from Eurostat.

something in between". The selected actions are: (i) claiming state benefits which you are not entitled to; (ii) cheating on tax if you have the chance; (iii) someone accepting a bribe in the course of their duties; (iv) paying cash for services to avoid taxes; (v) avoiding a fare on public transport. Those interviewed are asked to reply in the range from 1 ("never justified") to 10 ("always justified"). Answers to the five questions were averaged to construct the indicator for 'social norms' in the interval $[1, 10]$. A linear transformation is then applied for ease of interpretation, such that the higher the value of the indicator, the better the score in terms of 'social norms'.[6]

The three dimensions of social capital have been standardised with zero mean and unitary standard deviation to construct a synthetic index through a principal component analysis (Akçomak & ter Weel, 2012).[7] Finally, the resulting score has been normalised in the interval $[0, 1]$ to obtain the variable for social capital ($Social\ Capital_{rc}^{2008}$) used in the empirical analysis. A higher value of the index represents a higher regional endowment of social capital.[8]

The right-hand side of Equation (5) includes also the initial, log-transformed firm-level variables for labour productivity. Labour productivity is defined as the deflated value added over employment ($Productivity_{isrc}^{2010}$); capital endowment, defined as tangible fixed assets over employment ($Capital\ Endowment_{isrc}^{2010}$); age, or the difference between 2010 and the year of a firm's incorporation (Age_{isrc}^{2010}). It also includes a four-level categorical variable capturing the size

[6] The answers to the survey questions used to construct the three dimensions of social capital have been weighted using the EVS original weights to avoid biases due to the oversampling of certain categories of individuals interviewed (Di Guilmi et al., 2008).

[7] The choice of capturing social capital through a synthetic index relies on the fact that "[s]ocial capital is different from other forms of capital in the sense that it is not directly observable ... is hard to measure and should best be treated as a latent construct" (Akçomak & ter Weel, 2012, p. 328). Survey data —such as the EVS data used in this paper— may only provide a poor proxy for such a complex and multifaced phenomenon. In particular, social capital emerges as a combination of different factors —in Putnam's (1993) words, as a combination of trust, networking, and social norms— that, as previously discussed, are highly interrelated and mutually reinforce one another. Therefore, we expect that the mechanisms and channels through which social capital stimulates economic performance result from the combined —rather than the isolated— effect of the different dimensions defining the concept of social capital. We also test the three dimensions of social capital separately.

[8] Online Appendix B reports details on the survey questions considered to construct the synthetic measure of social capital. It also discusses the geographical dimension of social capital. We also test our operationalisation choice of social capital by considering two alternatives. The first alternative variable simply avoids any further normalisation in the interval $[0, 1]$ of the principal component. The second alternative variable, instead, defines social capital as the logarithm of the arithmetic average value of the three dimensions for 'generalised trust', 'active participation', and 'social norms'.

class of a firm ($Size\ Class_{isrc}^{2010}$), with firms classified into micro (1 to 9 employees), small (10 to 49), medium (50 to 249), and large (250 and more).[9]

Equation (5) also includes a series of region-level controls. These are (i) GDP per capita in 2010, defined as GDP over population, representing a region's development level ($GDP\ Per\ Capita_{rc}^{2010}$); (ii) population density in 2010, measured as population over surface, to proxy for agglomeration-related forces ($Population\ Density_{rc}^{2010}$); (iii) human capital endowment in 2010, calculated as the percentage of the population aged 15-64 years with tertiary education, as a measure of the availability of educated labour force in a region ($Human\ Capital_{rc}^{2010}$); (iv) government quality in 2010 ($Institutional\ Quality_{rc}^{2010}$), to account for any potential confounding effects related to a region's formal institutional framework (Bjørnskov & Méon, 2015; Cruz-García & Peiró-Palomino, 2019);[10] and (v) GDP per capita in 1900, to control for historical differentials in economic development across regions, which may have affected subsequent development, urbanisation, and education levels ($GDP\ Per\ Capita_{rc}^{1900}$).

Finally, Equation (5) includes the terms $\boldsymbol{\vartheta}_s$ and $\boldsymbol{\xi}_c$ denoting sets of two-digit industry dummies and country dummies, respectively, and the error term (ε_{isrc}). Online Appendix Tables C1 and C2 report some descriptive statistics of the dependent and explanatory variables, and the correlation matrix of the explanatory variables, respectively.

3.3. Estimation and identification strategy

Equation (5) is estimated via Ordinary Least Squares (OLS). However, two key econometric issues

[9] Size classes are defined according to the European Commission Recommendation 2003/361/EC.

[10] This control variable proxies for the 'quality' rather than the 'quantity' of regional institutions. It captures the capacity of regional governments to provide and administer public services impartially, effectively, and in a non-corrupt manner (Charron et al., 2014; Rodríguez-Pose & Ganau, 2022; Rothstein & Teorell, 2008). The institutional quality variable is constructed using survey information collected in 2010 on a sample of 34,000 citizens. The information refers to individuals' perception and experience with corruption, quality, and impartiality with respect to education, public health care, and law enforcement in their own region —see Charron et al. (2013) and Charron et al. (2014) for details. Following Charron et al. (2014), we have aggregated individual survey questions into four main region-specific institutional pillars capturing the dimensions of rule of law, government effectiveness, voice and accountability, and fight against corruption. The four indices are standardised, with a zero mean and unitary standard deviation. We, subsequently, use principal components to obtain the region-specific synthetic measure for institutional quality. Finally, we normalise the resulting variable in the interval $[0, 1]$.

arise: sample selection and endogeneity of the social capital variable. Sample selection can bias the OLS estimation of Equation (5) because labour productivity growth is observed only for the sub-sample of firms surviving over the growth period 2010-2017 (Cainelli & Ganau, 2019; Ganau & Rodríguez-Pose, 2018). Endogeneity can arise for three main reasons. First, measurement errors, as the social capital variable is only a proxy for what is a multifaceted and complex phenomenon hard to capture through any composite index. Second, spatial sorting, if better-performing firms locate in (or re-locate towards) regions already characterised by a high level of social capital. Third, an omitted variable bias, as there are perhaps unobservable factors and exogenous shocks that influence regional social capital and firm-level labour productivity growth simultaneously.

We deal with sample selection by means of a Heckman (1979)-style estimation approach and by specifying as exclusion restriction for firms' survival a third-order polynomial expansion $\varphi(\cdot)$ in firm age and capital endowment (Ganau & Rodríguez-Pose, 2018; Griffith et al., 2009; Olley & Pakes, 1996).[11]

With regard to the potential endogeneity of regional social capital, we follow the usual approach of relying on historical and geographical instrumental variables (IV) under the rationale that the current stock of social capital of a community is the result of historical events (Akçomak & ter Weel, 2009; Buggle & Durante, 2021; Guiso et al., 2016; Tabellini, 2010).[12] Specifically, we follow Buggle and Durante (2021), who analyse the historical and long-lasting relationship between economic risk and social cooperation and find a positive association between climate variability in historical times and current levels of social trust in European regions.

Drawing on this evidence, we identify current regional social capital by exploiting the cross-regional exogenous variation in precipitation during the growing season in the period between 1500

[11] We also consider an alternative version of the exclusion restriction by replacing capital endowment with total assets.

[12] Examples of historical and geographical IVs used in the literature to identify the causal effect of regional social capital include historical literacy rate (Akçomak & ter Weel, 2009), early establishment or presence of universities (Akçomak & ter Weel, 2009; Peiró-Palomino, 2016), historical institutional regimes (Akçomak & ter Weel, 2009; Bürker et al., 2013; Bürker & Minerva (2014), cultural and religious traits (Akçomak & ter Weel, 2012; Ketterer & Rodríguez-Pose, 2018), linguistic rules such as the pronoun-drop feature of the spoken language (Bjørnskov & Méon, 2015; Peiró-Palomino, 2016, 2019), latitude (Peiró-Palomino, 2016, 2019), and the minimum temperature of the coldest month of the year (Bjørnskov & Méon, 2015; Cruz-García & Peiró-Palomino, 2019).

and 1750, before the industrial revolution took off. The rationale for using this identification strategy relies on the idea that high weather risk —captured by precipitation variability during the growing season in a period where individuals' subsistence was based on agricultural production— may have favoured the emergence of 'good' informal institutions, characterised by shared norms and altruistic/cooperative behaviours to cope with weather-related economic risks. Following North (1990) and Putman (1993), informal institutional settings are featured by strong path dependency: they are the result and keep traces of past local the ecosystems. For this reason, current regional social capital is expected to reflect past regional informal institutional settings. Moreover, we can reasonably consider our identification strategy valid for two reasons: first, climate variability in the period before the Industrial Revolution is a weather phenomenon hardly affected by human activity; second, climate variability in the agriculture-dominated, preindustrial period is an exogenous force with respect to firm-level labour productivity growth in the present, when economic development and growth are driven by technological progress, innovation, and automation, among other factors (Rodríguez-Pose & Ganau, 2022).[13]

The region-specific variable capturing precipitation variability between 1500 and 1750 is defined using reconstructed paleoclimatic data. Paleoclimatic data are drawn from the *European Seasonal Temperature and Precipitation Reconstruction* (ESTPR) database. This dataset provides grid cells of 0.5° width, each containing annual seasonal observations for the period 1500-2000 — see Luterbacher et al. (2004) and Pauling et al. (2006) for details. Formally, let p denote precipitations, let g denote seasons (winter, spring, summer, autumn), f the grid cell, with $f \in r$ and r representing the region, and let t indicate the year, with $t = 1500, \dots, 1750$. First, a season-specific inter-annual standard deviation measure is calculated at the cell level for p_{fgt} over all years t, before averaging the cell-level standard deviation measures over all cells within a region r in order to obtain

[13] We are conscious that exogeneity can be violated if cross-regional differentials in historical weather-related economic risk left long-lasting effects, thus affecting subsequent development paths in economic potential and output. In other words, if early development of social capital as a means to manage environment-related economic risk led to high levels of economic development and industrialisation in the past that, in turn, resulted in variations in economic performance at the firm-level. We, however, partially address this concern by controlling for current (i.e., 2010) levels of GDP per capita, urbanisation, and human capital, and, especially, for historical (i.e., 1900) levels of GDP per capita.

region- and season-specific measures of precipitation variability. Then, the region- and season-specific inter-annual standard deviation measures defined over the period 1500-1750 are averaged with respect to the growing seasons identified with spring and summer for Europe. Therefore, the IV captures the mean variability during the growing season averaged over the years from 1500 to 1750, i.e., from the first available year of information to what can be considered as the starting year for the Industrial Revolution.

We therefore account for endogeneity of regional social capital by relying on a Two-Stage Least Squares (TSLS) approach. We tackle sample selection and endogeneity issues simultaneously through the Maximum Likelihood estimation of a three-equation system for firm-level survival, endogenous regional social capital, and firm-level labour productivity growth.[14]

4. EMPIRICAL RESULTS

4.1. Main results

Table 1 reports the results of the estimation of Equation (5) on the whole sample of firms. It is worth noting, first, that the exclusion restriction of the first-step selection equation is relevant and that the correlation between the error terms of the survival and labour productivity growth equations is statistically significant. This justifies the use of a Heckman (1979)-type selection model —see bottom part of Table 1, Specifications (2) and (4). Second, the first-stage estimated coefficient of the IV capturing precipitation variability in the preindustrial period shows the expected positive sign and is statistically significant, while the associated first-stage F statistic is greater than the conservative cut-off value of 10 —see bottom part of Table 1, Specifications (3) and (4). The first-stage estimates

[14] Some recent contributions have relied on multilevel estimation approaches to analyse the firm- or individual-level effects of region-level phenomena. They account for the hierarchical structure of the data at the expense of a causal interpretation of the results —see, for example, Neira et al. (2018) in the context of regional social capital and individual subjective well-being, Agostino et al. (2020) for regional institutional quality and firm productivity, and Bykova and Coates (2020) for regional economic freedom and firm performance. Although our estimation strategy —based on a combination of Heckman (1979)-style and IV approaches— does not account for the hierarchical structure of the data —i.e., firms 'nested' within regions—, it adequately deals with sample selection and endogeneity issues that existing firm-level studies have highlighted as key for identifying the causal effect of a regional phenomenon on firm-level performance (e.g., Cainelli & Ganau, 2019; Ganau & Rodríguez-Pose, 2018). As we will discuss later in the paper, our main results are robust when relying on a multilevel estimation approach.

suggest that current differences in social capital are historically rooted and geographically bounded (Buggle & Durante, 2021; Guiso et al., 2016).

Table 1: Social capital and firm labour productivity growth.

Dependent Variable	$\Delta\text{Productivity}_{\text{isrc}}$			
Estimation Approach	OLS	Heckman	TSLS	IV-Heckman
	(1)	(2)	(3)	(4)
$\text{Social Capital}_{\text{rc}}^{2008}$	0.198***	0.210***	0.328**	0.353**
	(0.074)	(0.074)	(0.150)	(0.149)
$\log(\text{Productivity}_{\text{isrc}}^{2010})$	-0.487****	-0.482****	-0.489****	-0.486****
	(0.020)	(0.021)	(0.020)	(0.022)
$\log(\text{Capital Endowment}_{\text{isrc}}^{2010})$	0.038****	0.038****	0.039****	0.039****
	(0.005)	(0.005)	(0.006)	(0.006)
$\log(\text{Age}_{\text{isrc}}^{2010})$	-0.006	-0.005	-0.008	-0.006
	(0.005)	(0.005)	(0.005)	(0.005)
$\text{Micro Firm}_{\text{isrc}}^{2010}$ (d)	Ref.	Ref.	Ref.	Ref.
$\text{Small Firm}_{\text{isrc}}^{2010}$ (d)	0.155****	0.163****	0.155****	0.163****
	(0.011)	(0.011)	(0.011)	(0.011)
$\text{Medium Firm}_{\text{isrc}}^{2010}$ (d)	0.206****	0.226****	0.206****	0.225****
	(0.018)	(0.016)	(0.018)	(0.016)
$\text{Large Firm}_{\text{isrc}}^{2010}$ (d)	0.252****	0.272****	0.251****	0.268****
	(0.022)	(0.022)	(0.022)	(0.021)
$\log(\text{GDP Per Capita}_{\text{rc}}^{2010})$	-0.019	-0.020	-0.015	-0.014
	(0.012)	(0.012)	(0.014)	(0.016)
$\log(\text{Population Density}_{\text{rc}}^{2010})$	-0.011	-0.011	-0.011	-0.013
	(0.012)	(0.013)	(0.012)	(0.012)
$\log(\text{Human Capital}_{\text{rc}}^{2010})$	0.053	0.052	0.065	0.064
	(0.044)	(0.046)	(0.043)	(0.043)
$\text{Institutional Quality}_{\text{rc}}^{2010}$	0.158***	0.172***	0.154***	0.164***
	(0.055)	(0.058)	(0.057)	(0.060)
$\log(\text{GDP Per Capita}_{\text{rc}}^{1900})$	0.116****	0.113****	0.107***	0.105***
	(0.032)	(0.034)	(0.039)	(0.040)
Two-Digit Sector Dummies	Yes	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes	Yes
No. Firms	17,396	17,396	17,396	17,396
Model F Statistic [p-value]	149.96 [0.000]	137.27 [0.000]	146.87 [0.000]	122.62 [0.000]
Selection Equation				
No. Firms	…	27,299	…	27,299
H_0: $\varphi(\cdot) = 0$ (χ^2 [p-value])	…	62.34 [0.000]	…	65.42 [0.000]
$\rho(\text{Survival}_{\text{isrc}}, \Delta\text{Productivity}_{\text{isrc}})$	…	0.167***	…	0.162***
		(0.054)		(0.052)
First-Stage Equation (IV)				
$\text{Precipitation Variability}_{\text{rc}}^{1500-1750}$	…	…	0.013****	0.013****
			(0.003)	(0.004)
First-Stage F Statistic on Excluded IV [p-value]	…	…	15.41 [0.000]	12.47 [0.000]

Notes: * p < 0.1; ** p < .05; *** p < 0.01; **** p < 0.001. Standard errors are clustered at the regional level, and are shown in parentheses. All specifications include a constant term. (d) denotes a dummy variable. $\varphi(\cdot)$ denotes the third-order polynomial in age and capital endowment used as exclusion restriction in the selection equation.

The results hint at a positive and statistically significant effect of regional social capital on firms' labour productivity growth. We find that a one percent increase in social capital leads to an increase in firm-level labour productivity growth between 0.19 and 0.35 percentage points, depending

on the estimation approach adopted.

The coefficients of the firm-level control variables go along with expectations. They indicate that firms have experienced convergence in labour productivity, as denoted by the negative coefficient of the labour productivity variable. Moreover, labour productivity growth is positively and statistically significantly connected with a firm's capital endowment. The association with a firm's age is, in contrast, negative but negligible. Larger firms also grow faster than medium- and small-sized ones, relative to micro firms. The results of the region-specific control variables indicate that firms' labour productivity growth is positively associated with high-quality formal institutions and historical economic development. By contrast, the regional controls for current GDP per capita, population density, and human capital show negligible estimated coefficients. Overall, looking at Specification (4), social capital emerges as the most relevant factor explaining firm-level labour productivity growth differentials, taking into account the magnitude of the estimated coefficients.

4.2. Robustness analysis

We present here a series of exercises testing the robustness of the results of Table 1. The outcomes of these exercises are reported in Tables D1 to D10 in Online Appendix D. They fully confirm the main evidence of Table 1.

First, we test the validity of our estimation strategy against correlation bias among regressors by excluding from the empirical model region-level controls only, and both region- and firm-level controls (Table D1).

Second, we test the sensitivity of our analysis against potential biases related to the selection of countries included in the sample, and estimate Equation (5) excluding the countries in the sample one by one (Table D2). We also test for country-specific effects by augmenting Equation (5) with the interaction term between the regional social capital variable and the vector of country dummies (Table D3). The comparison of the estimated marginal effects suggests a cross-country positive effect of social capital on firms' labour productivity growth (Table D4).

Third, we replace the set of firm size dummies with a log-employment variable to check for model specification (Table D5).

Fourth, following some recent contributions analysing the relationship between regional phenomena and firm- (or individual-) level outcomes (Agostino et al., 2020; Bykova & Coates, 2020; Neira et al., 2018), we rely on a multilevel (random slope) estimation approach to account for the hierarchical structure of the data (Table D6).

Fifth, we consider two alternative identification strategies to assess the robustness of our IV estimates (Table D7). We exploit cross-regional historical variations in institutional regimes, and construct an IV capturing whether a region belonged to, or was a tributary territory of, the Carolingian Empire at the time of Charlemagne's death. The logic behind the choice of this alternative instrument is that an early exposure to what could be regarded as a 'modern' system of governance may have influenced positively social capital through civic behaviour, shared norms, and a strength in trust and embeddedness in the local community (Ketterer and Rodríguez-Pose, 2018). Then, following Bjørnskov and Méon (2015) and Cruz-García and Peiró-Palomino (2019), we exploit cross-regional variations in the coldest temperature recorded during the winter season. The rationale of this IV rests on the idea that communities living in cold areas developed a higher sense of trust and deeper cooperation mechanisms to survive harsher winter conditions compared to those living in relatively warmer areas.

Sixth, we consider an alternative exclusion restriction for the first-step selection equation of firms' survival by specifying a third-order polynomial expansion using total assets rather than capital endowment in the year 2010 (Table D8).

Seventh, we examine two alternative operationalisation approaches for defining social capital (Table D9): (i) a variant for social capital, defined by avoiding any further normalisation in the interval $[0, 1]$ of the principal component; (ii) a variable defined as the logarithm of the arithmetic average value of the three dimensions for 'generalised trust', 'active participation', and 'social

norms'.[15]

Finally, we test for the returns of social capital on labour productivity at firm-level (in 2010 and 2017) rather than growth (Table D10).

4.3. Assessing the individual dimensions of social capital

We now disentangle the social capital variable by assessing the productivity growth returns of its individual dimensions of 'generalised trust', 'active participation', and 'social norms'. We estimate Equation (5) via an IV-Heckman approach, and consider the three social capital dimensions —normalised in $[0, 1]$— separately. Two main insights emerge from the results of Table 2.[16] First, firms' labour productivity growth is positively affected by all the three dimensions of social capital. Second, 'active participation' —a proxy for networking— emerges as the most relevant social capital dimension for firms' productivity growth. Its estimated coefficient is 3.03 times larger in magnitude than that of 'social norms', and 3.76 times larger in magnitude than that of 'generalised trust'.

These results reinforce the idea that social capital is a complex construct encompassing a multiplicity of dimensions. Hence, no individual variable can single-handedly capture it. They also indicate that the networking component of social capital plays the greatest role as a transmission channel for firms' productivity growth. It favours interaction and cooperation among workers both within the firm —by improving organisational efficiency (Bloom et al., 2012)— and across organisations. It simultaneously facilitates knowledge and information flows that both spur technological diffusion and innovation (Akçomak & ter Weel, 2009), and enables the acquisition of productivity-enhancing resources through production and credit markets (Guiso et al., 2004, 2009; Knack & Keefer, 1997).

[15] When we consider the principal component of regional social capital without any further normalisation in the interval $[0, 1]$, we estimate that a one unit increase in social capital leads to an increase in firm-level labour productivity growth between 3.4 and 6.1 percent —see Specifications (1) to (4) in Table D9 in Online Appendix D. When we consider regional social capital as the logarithm of the arithmetic mean of the three dimensions of 'generalised trust', 'active participation', and 'social norms', we estimate that a one percent increase in social capital leads to an increase in firm-level labour productivity growth between 0.11 and 0.22 percent —see Specifications (5) and (8) in Table D9 in Online Appendix D.

[16] We report here only the main results on the three dimensions of social capital. Table E1 in Online Appendix E includes the full set of results.

Table 2: Individual components of social capital and firm labour productivity growth.

Dependent Variable	$\Delta\text{Productivity}_{\text{isrc}}$		
Estimation Approach	IV-Heckman		
	(1)	(2)	(3)
$\text{Genralised Trust}_{\text{rc}}^{2008}$	0.128*	…	…
	(0.073)		
$\text{Active Participation}_{\text{rc}}^{2008}$	…	0.481**	…
		(0.229)	
$\text{Social Norms}_{\text{rc}}^{2008}$	…	…	0.159**
			(0.072)
Firm-Level Controls	Yes	Yes	Yes
Region-Level Controls	Yes	Yes	Yes
Two-Digit Sector Dummies	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes
No. Firms	17,396	17,396	17,396
Model F Statistic [p-value]	193.02 [0.000]	259.35 [0.000]	186.08 [0.000]
Selection Equation			
No. Firms	27,299	27,299	27,299
H_0: $\varphi(\cdot) = 0$ (χ^2 [p-value])	61.88 [0.000]	62.90 [0.000]	61.13 [0.000]
$\rho\left[\text{Survival}_{\text{isrc}}, \log\left(\text{Productivity}_{\text{isrc}}^{2017}\right)\right]$	0.160***	0.161***	0.155***
	(0.051)	(0.051)	(0.051)
First-Stage Equation (IV)			
$\text{Precipitation Variability}_{\text{rc}}^{1500-1750}$	0.039****	0.009***	0.027****
	(0.005)	(0.003)	(0.004)
First-Stage F Statistic on Excluded IV [p-value]	67.11 [0.000]	18.95 [0.000]	46.75 [0.000]

Notes: * p < 0.1; ** p < .05; *** p < 0.01; **** p < 0.001. Standard errors are clustered at the regional level, and are shown in parentheses. All specifications include a constant term. $\varphi(\cdot)$ denotes the third-order polynomial in age and capital endowment used as exclusion restriction in the selection equation.

4.4. Accounting for firm-level heterogeneity

In this sub-section we present the estimates obtained by accounting for firm-level heterogeneity considering variations in initial labour productivity, capital endowment, size, age, and technological level. As suggested by Rutten and Gelissen (2010), social capital is heterogeneously distributed across sub-groups within a population of economic agents, replicating what happens with formal institutions (Ganau & Rodríguez-Pose, 2019). More specifically, we report the results of estimating Equation (5) through TSLS, as well as by accounting simultaneously for endogeneity of regional social capital and sample selection bias (IV-Heckman). Overall, the results reveal that the positive returns of social capital on labour productivity growth are unevenly distributed across different types of firms .[17]

When splitting the sample around the mean value of the log-transformed variable for labour productivity in 2010, the results in Table 3 suggest that only low-productivity firms benefit from

[17] We report here only the main results on social capital. Tables E2 to E6 in Online Appendix E include the full set of results concerning the estimates accounting for firm-level heterogeneity.

regional social capital. The comparison between Specifications (2) and (4) shows that the labour productivity growth returns of social capital are about 2.6 times larger for low-productivity than for high-productivity firms. The difference in the estimated coefficients for the two groups of firms is statistically significant (p-value equal to 0.000).[18]

Table 3: Social capital and firm labour productivity growth, accounting for heterogeneity in firm-level labour productivity.

Dependent Variable	$\Delta\text{Productivity}_{\text{isrc}}$			
Growth-Initial Labour Productivity Level	Low (≤ Sample Mean)		High (> Sample Mean)	
Estimation Approach	TSLS	IV-Heckman	TSLS	IV-Heckman
	(1)	(2)	(3)	(4)
$\text{Social Capital}_{\text{rc}}^{2008}$	0.539**	0.538**	0.191	0.211
	(0.243)	(0.239)	(0.170)	(0.175)
Firm-Level Controls	Yes	Yes	Yes	Yes
Region-Level Controls	Yes	Yes	Yes	Yes
Two-Digit Sector Dummies	Yes	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes	Yes
No. Firms	7,949	7,949	9,447	9,447
Model F Statistic [p-value]	191.10 [0.000]	187.73 [0.000]	50.71 [0.000]	54.21 [0.000]
Selection Equation				
No. Firms	…	13,003	…	14,296
H_0: $\varphi(\cdot) = 0$ (χ^2 [p-value])	…	35.87 [0.000]	…	41.67 [0.000]
$\rho(\text{Survival}_{\text{isrc}}, \Delta\text{Productivity}_{\text{isrc}})$	…	0.068*	...	0.139***
		(0.039)		(0.051)
First-Stage Equation (IV)				
$\text{Precipitation Variability}_{\text{rc}}^{1500-1750}$	0.012****	0.013****	0.014****	0.014****
	(0.003)	(0.004)	(0.004)	(0.004)
First-Stage F Statistic on Excluded IV [p-value]	15.85 [0.000]	12.23 [0.000]	14.46 [0.000]	12.31 [0.001]

Notes: * p < 0.1; ** p < .05; *** p < 0.01; **** p < 0.001. Standard errors are clustered at the regional level, and are shown in parentheses. All specifications include a constant term. $\varphi(\cdot)$ denotes the third-order polynomial in age and capital endowment used as exclusion restriction in the selection equation.

When we split the sample around the mean value of the log-transformed variable for capital endowment in 2010 —evaluating firm-level heterogeneity in terms of available tangible resources for the production process—, we find that only low-capital endowed firms increase their productivity as a result of stronger regional social capital (Table 4). Moreover, the difference in labour productivity growth returns of regional social capital is highly statistically significant (p-value equal to 0.000).

[18] Inference on the difference in the estimated coefficient of regional social capital is obtained through permutation (Cleary, 1999). The same statistical level of significance is reached when comparing the estimated regional social capital coefficients in Specifications (1) and (3). See also Table E7 in Online Appendix E, which reports the difference in the estimated coefficient of regional social capital for the five different sub-samples considered in this sub-section.

Table 4: Social capital and firm labour productivity growth, accounting for heterogeneity in firm-level capital endowment.

Dependent Variable	$\Delta\text{Productivity}_{\text{isrc}}$			
Growth-Initial Capital Endowment Level	Low (≤ Sample Mean)		High (> Sample Mean)	
Estimation Approach	TSLS	IV-Heckman	TSLS	IV-Heckman
	(1)	(2)	(3)	(4)
$\text{Social Capital}_{\text{rc}}^{2008}$	0.547**	0.635**	0.206	0.218
	(0.270)	(0.320)	(0.171)	(0.164)
Firm-Level Controls	Yes	Yes	Yes	Yes
Region-Level Controls	Yes	Yes	Yes	Yes
Two-Digit Sector Dummies	Yes	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes	Yes
No. Firms	7,643	7,643	9,753	9,753
Model F Statistic [p-value]	166.44 [0.000]	129.63 [0.000]	104.69 [0.000]	104.50 [0.000]
Selection Equation				
No. Firms	…	13,067	…	14,232
H_0: $\varphi(\cdot) = 0$ (χ^2 [p-value])	…	37.49 [0.000]	…	33.14 [0.000]
$\rho(\text{Survival}_{\text{isrc}}, \Delta\text{Productivity}_{\text{isrc}})$	…	0.486***	…	0.052**
		(0.169)		(0.022)
First-Stage Equation (IV)				
$\text{Precipitation Variability}_{\text{rc}}^{1500-1750}$	0.011****	0.011****	0.015****	0.015****
	(0.003)	(0.003)	(0.004)	(0.004)
First-Stage F Statistic on Excluded IV [p-value]	18.07 [0.000]	13.08 [0.000]	14.49 [0.000]	12.62 [0.000]

Notes: * p < 0.1; ** p < .05; *** p < 0.01; **** p < 0.001. Standard errors are clustered at the regional level, and are shown in parentheses. All specifications include a constant term. $\varphi(\cdot)$ denotes the third-order polynomial in age and capital endowment used as exclusion restriction in the selection equation.

When the sample is split into two size classes: micro and small (up to 49 employees) and medium and large (50 or more employees) firms, we find that smaller firms reap more productivity benefits from regional social capital than larger firms. The benefits of regional social capital are significantly larger for the former than for the latter (Table 5). The comparison between Specifications (2) and (4) highlights how the labour productivity growth returns of regional social capital are 1.9 times larger for micro and small than for medium and large firms. As in the previous cases, the difference in the estimated coefficient of regional social capital is highly statistically significant (p-value equal to 0.000).

Table 5: Social capital and firm labour productivity growth, accounting for heterogeneity in firm-level size.

Dependent Variable	$\Delta\text{Productivity}_{\text{isrc}}$			
Growth-Initial Size Class	Micro and Small Firms		Medium and Large Firms	
Estimation Approach	TSLS	IV-Heckman	TSLS	IV-Heckman
	(1)	(2)	(3)	(4)
$\text{Social Capital}_{\text{rc}}^{2008}$	0.430**	0.451**	0.217**	0.243***
	(0.187)	(0.191)	(0.095)	(0.087)
Firm-Level Controls	Yes	Yes	Yes	Yes
Region-Level Controls	Yes	Yes	Yes	Yes
Two-Digit Sector Dummies	Yes	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes	Yes
No. Firms	12,276	12,276	5,120	5,120
Model F Statistic [p-value]	159.89 [0.000]	157.37 [0.000]	74.99 [0.000]	75.01 [0.000]
Selection Equation				
No. Firms	…	19,462	…	7,837
H_0: $\varphi(\cdot) = 0$ (χ^2 [p-value])	…	109.86 [0.000]	…	27.86 [0.001]
$\rho(\text{Survival}_{\text{isrc}}, \Delta\text{Productivity}_{\text{isrc}})$	…	0.100***	…	0.175
		(0.037)		(0.217)
First-Stage Equation (IV)				
$\text{Precipitation Variability}_{\text{rc}}^{1500-1750}$	0.008****	0.008****	0.023****	0.025****
	(0.002)	(0.002)	(0.006)	(0.007)
First-Stage F Statistic on Excluded IV [p-value]	16.38 [0.000]	16.35 [0.000]	13.76 [0.000]	13.43 [0.000]

Notes: * p < 0.1; ** p < .05; *** p < 0.01; **** p < 0.001. Standard errors are clustered at the regional level, and are shown in parentheses. All specifications include a constant term. $\varphi(\cdot)$ denotes the third-order polynomial in age and capital endowment used as exclusion restriction in the selection equation.

We also account for heterogeneity in terms of age by splitting the sample into two groups reflecting a firm's age in the year 2010. The first group, 'young' firms, includes firms in the first five years of their existence. 'Older' firms are those with more than five years of existence. The results obtained by accounting for either social capital endogeneity or both social capital endogeneity and sample selection bias are reported in Table 6. Looking at Specifications (2) and (4), we estimate that the labour productivity growth returns of social capital are about 1.1 times larger for younger than for the established firms, despite the fact that the difference in the estimated social capital coefficient is statistically negligible (p-value equal to 0.295).

Table 6: Social capital and firm labour productivity growth, accounting for heterogeneity in firm-level age.

Dependent Variable	$\Delta\text{Productivity}_{\text{isrc}}$			
Growth-Initial Age Group (in Years)	$1 \leq \text{Age} \leq 5$		$\text{Age} > 6$	
Estimation Approach	TSLS	IV-Heckman	TSLS	IV-Heckman
	(1)	(2)	(3)	(4)
$\text{Social Capital}_{\text{rc}}^{2008}$	0.390*	0.385*	0.318*	0.345*
	(0.207)	(0.205)	(0.176)	(0.181)
Firm-Level Controls	Yes	Yes	Yes	Yes
Region-Level Controls	Yes	Yes	Yes	Yes
Two-Digit Sector Dummies	Yes	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes	Yes
No. Firms	1,978	1,978	15,418	15,418
Model F Statistic [p-value]	146.29 [0.000]	137.96 [0.000]	137.57 [0.000]	101.32 [0.000]
Selection Equation				
No. Firms	…	3,308	…	23,991
H_0: $\varphi(\cdot) = 0$ (χ^2 [p-value])	…	14.96 [0.092]	…	51.13 [0.000]
$\rho(\text{Survival}_{\text{isrc}}, \Delta\text{Productivity}_{\text{isrc}})$	…	0.171*	…	0.160***
		(0.092)		(0.059)
First-Stage Equation (IV)				
$\text{Precipitation Variability}_{\text{rc}}^{1500-1750}$	0.011****	0.012****	0.013****	0.014****
	(0.003)	(0.003)	(0.003)	(0.004)
First-Stage F Statistic on Excluded IV [p-value]	17.73 [0.000]	13.50 [0.000]	15.34 [0.000]	12.58 [0.000]

Notes: * p < 0.1; ** p < .05; *** p < 0.01; **** p < 0.001. Standard errors are clustered at the regional level, and are shown in parentheses. All specifications include a constant term. $\varphi(\cdot)$ denotes the third-order polynomial in age and capital endowment used as exclusion restriction in the selection equation.

Finally, we account for heterogeneity in technological level by comparing low- and mid-low-technology firms versus high- and mid-high-technology firms, with a firm's technological level defied according to Eurostat taxonomy based on the NACE Rev. 2 three-digit level classification of manufacturing sectors. We find that social capital matters for the labour productivity growth of only low-technology firms (Table 7). Looking at Specifications (2) and (4), we estimate that the labour productivity growth returns of social capital are about 2.2 times larger for low- than for high-tech firms, and the difference in the estimated coefficient of regional social capital is highly statistically significant (p-value equal to 0.000).

Table 7: Social capital and firm labour productivity growth, accounting for heterogeneity in firm-level technological level.

Dependent Variable	$\Delta\text{Productivity}_{\text{isrc}}$			
Technological Level	Low- and Mid-Low-Technology		High- and Mid-High-Technology	
Estimation Approach	TSLS	IV-Heckman	TSLS	IV-Heckman
	(1)	(2)	(3)	(4)
$\text{Social Capital}_{\text{rc}}^{2008}$	0.415**	0.443**	0.152	0.203
	(0.203)	(0.211)	(0.228)	(0.219)
Firm-Level Controls	Yes	Yes	Yes	Yes
Region-Level Controls	Yes	Yes	Yes	Yes
Two-Digit Sector Dummies	Yes	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes	Yes
No. Firms	12,509	12,509	4,887	4,887
Model F Statistic [p-value]	92.12 [0.000]	120.45 [0.000]	77.64 [0.000]	85.72 [0.000]
Selection Equation				
No. Firms	…	19,952	…	7,347
H_0: $\varphi(\cdot) = 0$ (χ^2 [p-value])	…	33.19 [0.000]	…	70.26 [0.000]
$\rho(\text{Survival}_{\text{isrc}}, \Delta\text{Productivity}_{\text{isrc}})$	…	0.135***	…	0.355
		(0.042)		(0.259)
First-Stage Equation (IV)				
$\text{Precipitation Variability}_{\text{rc}}^{1500-1750}$	0.012****	0.013****	0.014****	0.015***
	(0.003)	(0.003)	(0.004)	(0.005)
First-Stage F Statistic on Excluded IV [p-value]	16.48 [0.000]	13.64 [0.000]	12.91 [0.001]	10.15 [0.001]

Notes: * p < 0.1; ** p < .05; *** p < 0.01; **** p < 0.001. Standard errors are clustered at the regional level, and are shown in parentheses. All specifications include a constant term. $\varphi(\cdot)$ denotes the third-order polynomial in age and capital endowment used as exclusion restriction in the selection equation.

Overall, our heterogeneity analysis corroborates the previous finding that regional social capital has positive effects on firm-level labour productivity growth, even though its positive returns are unevenly distributed across different types of firms. Indeed, we find that less productive, less capital endowed, smaller, and low-technology firms stand to benefit the most from a high level of regional social capital. By contrast, there is limited evidence of a statistically significant difference of social capital returns on the labour productivity growth of young versus more established firms. In this respect, we complement previous firm-level evidence of a positive but heterogenous role played by formal institutions (Ganau & Rodríguez-Pose, 2019) by highlighting how social capital has different effects on the performance of heterogenous firms. We also complement previous region-level analysis for the EU showing a positive aggregate regional effect of social capital on economic growth (Beugelsdijk & van Schaik, 2005; Forte et al., 2015; Peiró-Palomino, 2016) by identifying at the micro-level those actors who benefit the most from being located in places with a favourable social capital. Overall, our contribution to existing knowledge stresses the micro-level effects of regional

social capital and identifies sources of firm-level heterogeneity for social capital as a driver of productivity growth.[19]

5. CONCLUSIONS

Social capital —as the bulk of the informal institutional setting of a society— has long been regarded as a fundamental factor for economic growth and development. However, despite the growing number of studies analysing this relationship at country and regional level, limited attention has been paid to how a community's social capital endowment affects the performance of local firms. In this paper we have covered this gap in existing knowledge by investigating the firm-level economic effects of social capital. Specifically, we have analysed the extent to which social capital at the regional level across Western EU countries over the period 2010-2017 impinges on labour productivity growth at a firm-level.

Our results, based on sample selection and IV estimation approaches, suggest that social capital —and, especially, its networking dimension— is pivotal for the labour productivity growth of firms. However, we also find that not all firms benefit from a high social capital endowment in the same way. Local social capital is far more beneficial for those firms that lack the conditions to prosper on their own. Firms with size constraints, a reduced availability of internal resources, limited levels of productivity, and operating in low-technology sectors stand to benefit the most from being located in regions with a good endowment of social capital. Why is this the case? A plausible explanation is that social capital contributes to the emergence of a local socio-economic and business ecosystem where interactions across workers, firms, banks, investors, and public authorities are maximised. Relatively 'weak' firms in these dense social capital ecosystems can exploit external resources, compensating for their internal limitations to improve efficiency and, consequently, grow more.

Our analysis corroborates previous studies and adds some important novel insights to existing

[19] We also evaluate the aggregate effect of regional social capital by considering the region-specific average value of firm-level labour productivity growth. Online Appendix F discusses this exercise, and presents OLS and TSLS estimates. The region-level analysis corroborates our micro-level evidence of an aggregate positive effect of social capital on labour productivity growth.

knowledge with relevant policy implications. As the productivity and viability of smaller firms with a lower access to capital is highly dependent on the characteristics of the social capital of the places where they are located, measures aimed at enhancing their productivity should not be just restricted to direct interventions at firm level, but should take into account the conditions of the ecosystem in which these firms operate. Policies targeting productivity should, therefore, consider not just what can be done for the firm itself, but, as importantly, what can be done in order to improve the social capital conditions that often constrain firm-level progress. This does not just apply to the southernmost countries in our sample (Italy, Portugal, and Spain), which have long suffered from a productivity slowdown (Rodríguez-Pose & Ganau, 2022). Rather, policy measures aimed at strengthening the social capital endowment of local communities will also benefit firms in relatively economically and institutionally stronger countries (Germany and France). In other words, improving social capital emerges as a cross-country productivity enhancing strategy. This is particularly important given the increasing attention devoted by supra-national institutions —such as the Social Capital Initiative of the World Bank (1998), or the analyses carried out by the OECD and the EU (OECD, 2001; European Commission, 2005; Stiglitz et al., 2018)— to informal institutions as a means for compensating government inefficiency and 'weak' formal institutions (Malecki, 2012; Muringani et al., 2021; Rodríguez-Pose, 2013). If policies aimed at enhancing productivity and, as a consequence, promoting a more territorially inclusive growth and stimulating convergence are to be successful, more attention towards the social capital in which firms operate may be crucial to guarantee that especially the most vulnerable firms can thrive and lift their competitiveness to a new level. Such a social capital improvement strategy is, of course, not straightforward or easy to implement, as informal institutions are 'remarkably time-invariant' (Cruz-García & Peiró-Palomino, 2019, p. 664).

Our paper, of course, comes with limitations. First, we have focused on a small number of countries all belonging to the 'nucleus' of the EU, and this could cap the generalisation of our results to other parts of the world. It would thus be interesting to extend our analysis to other countries, in

Europe and beyond, and particularly to those that are relatively less developed and structurally different in comparison to Western European ones. Second, our dataset does not allow us to investigate properly the transmission mechanisms of social capital by disentangling the within-firm and the cross-firm dimensions. Indeed, although the focus of the paper has been to assess whether and to which extent regional social capital is a labour productivity growth-enhancing factor, it would be interesting to treat the firm as an organisation in order to evaluate the relative effects of a firm's internal social capital endowment versus its community's social capital endowment. Despite these caveats, our research pushes existing boundaries by bringing to the fore the strong role social capital plays in increasing the productivity of particularly those firms less capable of doing so on their own.

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ONLINE APPENDICES

APPENDIX A – Structure of the sample

Appendix A provides details about the structure and representativeness of the sample. Table A1 displays the country-level representativeness of the sample firms. Table A2 shows the geographical coverage and representativeness. Table A3 reports the sample distribution by manufacturing sector defined at the two-digit level of NACE Rev. 2 classification. Table A4 reports the sample distribution by technological level defined according to the NACE Rev. 2 three-digit level taxonomy adopted by Eurostat.

TABLE A1: Representativeness of the sample

Country	Manufacturing Industry (SBS 2010)		Sample	
	No.	%	No.	%
France	212,190	19.13	4,148	15.19
Germany	209,372	18.87	5,152	18.87
Italy	426,778	38.47	11,558	42.34
Portugal	72,273	6.51	1,780	6.52
Spain	188,740	17.01	4,661	17.07
Total	1,109,353	100.00	27,299	100.00

Notes: SBS stands for Structural Business Statistics. SBS data on the population of manufacturing firms by country in the year 2010 are drawn from Eurostat. Percentage values are defined on column totals.

TABLE A2: Geographical coverage and representativeness

Country	Regions			
	NUTS Level	In the Country	In the Sample	Percentage Covered
France	2	22	20	90.91
Germany	1	16	16	100.00
Italy	2	21	20	95.24
Portugal	2	7	5	71.43
Spain	2	17	15	88.24
Total		83	76	91.57

Notes: The five French *Département d'Outre-Mer*, and the Spanish autonomous cities of Ceuta and Melilla have been excluded from the analysis *à priori*. The French regions of Alsace and Corsica, the Italian region of South Tyrol, the Portuguese autonomous regions of Azores and Madeira, and the Spanish Balearic Islands and Canary Islands are excluded from the analysis due to data availability issues.

TABLE A3: Sample distribution by two-digit manufacturing sector

NACE Rev. 2 - Two-Digit Manufacturing Sectors	Firms	
	No.	%
10 - Food products	2,839	10.40
11 – Beverages	479	1.75
12 - Tobacco products	0	0.00
13 – Textiles	929	3.40
14 - Wearing apparel	796	2.92
15 - Leather and related products	706	2.59
16 - Wood, wood and cork products (except furniture), articles of straw and plaiting materials	964	3.53
17 - Paper and paper products	577	2.11
18 - Printing and reproduction of recorded media	1,105	4.05
19 - Coke and refined petroleum products	0	0.00
20 - Chemicals and chemical products	1,082	3.96
21 - Basic pharmaceutical products and pharmaceutical preparations	218	0.80
22 - Rubber and plastic products	1,576	5.77
23 - Other non-metallic mineral products	1,376	5.04
24 - Basic metals	640	2.34
25 - Fabricated metal products, except machinery and equipment	5,294	19.39
26 - Computer, electronic, and optical products	999	3.66
27 - Electrical equipment	957	3.51
28 - Machinery and equipment N.E.C.	3,037	11.12
29 - Motor vehicles, trailers and semi-trailers	576	2.11
30 - Other transport equipment	230	0.84
31 – Furniture	901	3.30
32 - Other manufacturing	870	3.19
33 - Repair and installation of machinery and equipment	1,148	4.21
Total	27,299	100.00

Notes: Percentage values are defined on the total number of firms.

TABLE A4: Sample distribution by technological level

Technological Level	Firms	
	No.	%
Low- and Medium-Low-Technology	19,952	73.09
High- and Medium-High-Technology	7,347	26.91
Total	27,299	100.00

Notes: Percentage values are defined on the total number of firms. Taxonomy adopted by Eurostat based on the NACE Rev. 2 three-digit level classification of manufacturing sectors. Low-technology: 10, 11, 12, 13, 14, 15, 16, 17, 18 (excluding 182), 31, and 32 (excluding 325). Medium-low-technology: 182, 19, 22, 23, 24, 25 (excluding 254), 301, and 33. Medium-high-technology: 20, 254, 27, 28, 29, 30 (excluding 301 and 303), and 325. High-technology sectors: 21, 26, and 303.

APPENDIX B – Definition and geographical dimension of regional social capital

Appendix B provides details on the measure for social capital used in the empirical analysis. First, Table B1 details the survey questions considered from the 2008 wave of the *European Values Study* (EVS) to construct the three dimensions of social capital —"active participation," "generalized trust," and "social norms."

Figure B1 maps the spatial distribution of the regional index for social capital defined in percentage terms. Figure B2 plots within-country variations of the regional social capital index. Germany and Italy display not only the highest levels of social capital, but also the highest degree of internal heterogeneity (Figure B2). The top-ten regions by social capital in the sample includes just German and Italian regions. French, Portuguese, and Spanish regions appear at the bottom of the distribution (Table B2) —see also Table B3, that reports the regions with the highest and the lowest level of social capital by country.

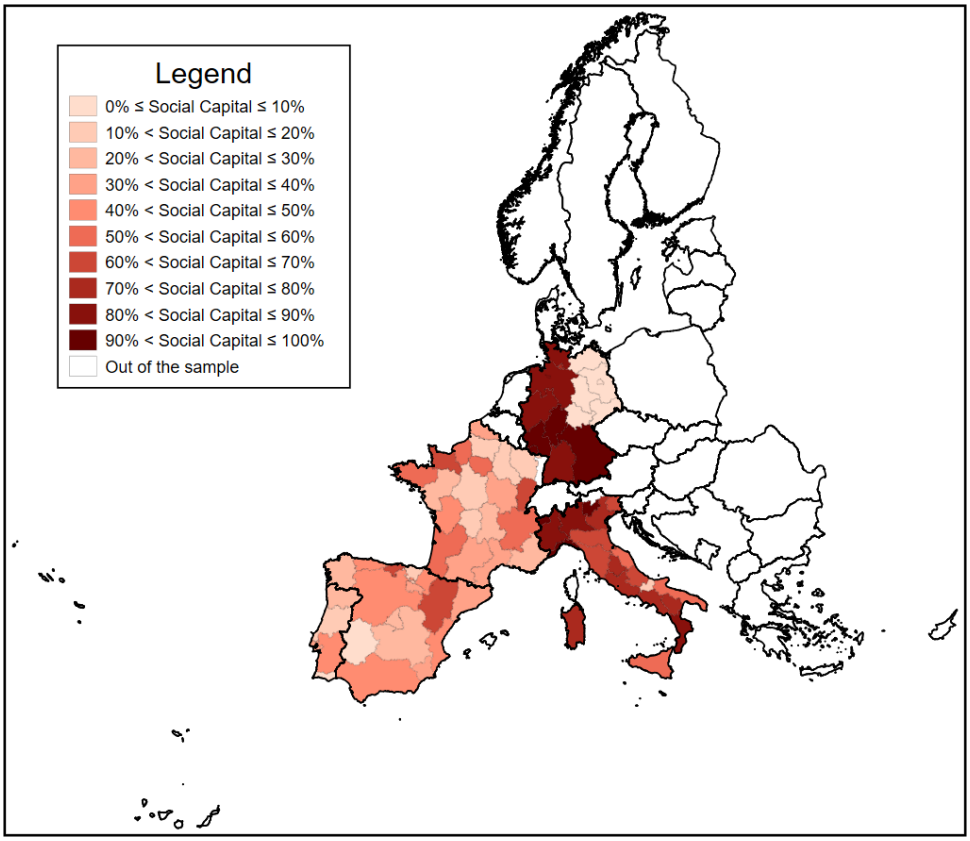
In Germany there is a clear West-East divide. Italy has a more spatially variegated distribution of regions with high and low social capital endowment, eschewing the traditional north-south division of the country in terms of development (Figure B1). In addition, and on average, German and Italian regions lie above the mean value with respect to the five countries covered in the analysis; by contrast, French, Portuguese, and Spanish regions lie, on average, below the mean value of social capital (Figure B2). All Portuguese regions present a level of social capital below the sample average (Figure B2). French, Portuguese, and Spanish regions not only show relatively lower values of social capital than most of German and Italian regions, but also present a spatial distribution where regions with high and low values of social capital coexist without a clear spatial pattern (Figures B1 and B2).

TABLE B1: Social capital dimensions

Dimension	Survey Question
Active Participation	Which, if any, voluntary organisations are you currently doing unpaid voluntary work for?
	Social welfare services for elderly, handicapped or deprived people
	Religious or church organisations
	Education, arts, music or cultural activities
	Trade unions
	Political parties or groups
	Local community action on issues like poverty, employment, housing, racial equality
	Third world development or human rights
	Conservation, the environment, ecology, animal rights
	Professional associations
	Youth work (e.g., scouts, guides, youth clubs etc.)
	Sports or recreation
	Women's groups
	Peace movement
	Voluntary organisations concerned with health
	Other groups
	None (spontaneous)
Generalized Trust	Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?
	Most people can be trusted
	Can't be too careful
Social Norms	Which of the following behaviours you think can always be justified, never be justified, or something in between
	Claiming state benefits which you are not entitled to
	Cheating on tax if you have the chance
	Someone accepting a bribe in the course of their duties
	Paying cash for services to avoid taxes
	Avoiding a fare on public transport

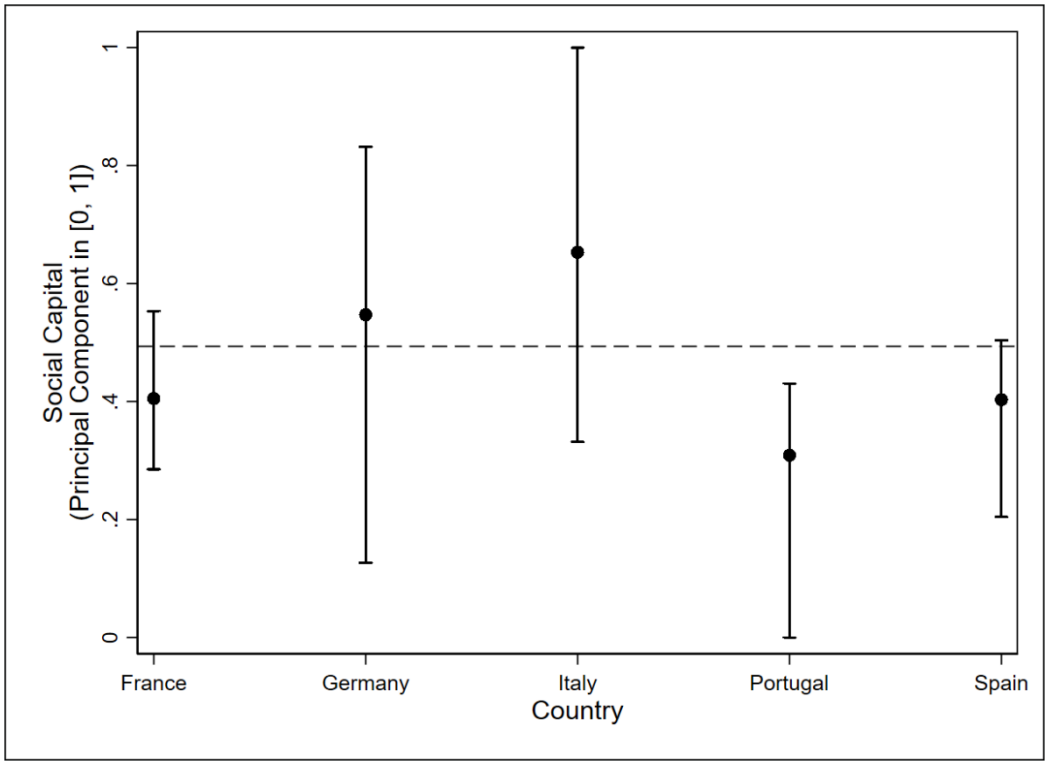
Notes: Authors' elaboration on data from the 2008 wave of the EVS.

FIGURE B1: Spatial distribution of regional social capital



Notes: Social capital index, percentage values. Darker shades correspond to higher levels of social capital.

FIGURE B2: Within-country variability of regional social capital



Notes: Social capital index defined in the interval $[0, 1]$. The dashed line refers to the sample average, while the dots refer to country-level average values.

TABLE B2: Top and bottom 10 regions by social capital

Top 10 Regions			Bottom 10 Regions		
Rank	Region	Country	Rank	Region	Country
1	Aosta Valley	Italy	67	Limousin	France
2	Liguria	Italy	68	Champagne-Ardenne	France
3	Trento Autonomous Province	Italy	69	Sachsen-Anhalt	Germany
4	Rheinland-Pfalz	Germany	70	Türingen	Germany
5	Saarland	Germany	71	Brandenburg	Germany
6	Hessen	Germany	72	Extremadura	Spain
7	Bayern	Germany	73	Berlin	Germany
8	Niedersachsen	Germany	74	Sachsen	Germany
9	Baden-Württemberg	Germany	75	Mecklenburg-Vorpommern	Germany
10	Nordrhein-Westfalen	Germany	76	Algarve	Portugal

Notes: The sample includes 76 regions.

TABLE B3: Regions with the highest and lowest value of social capital by country

Country	Highest Social Capital	Lowest Social Capital
France	Basse-Normandie	Champagne-Ardenne
Germany	Rheinland-Pfalz	Mecklenburg-Vorpommern
Italy	Aosta Valley	Molise
Portugal	Alentejo	Algarve
Spain	Cantabria	Extremadura

Notes: Total number of sample regions by country: 20 in France; 16 in Germany; 20 in Italy; 5 in Portugal; 15 in Spain.

APPENDIX C – Descriptive statistics and correlation matrix

Appendix C reports some descriptive statistics (Table C1) and the correlation matrix (Table C2) of the variables used in the empirical analysis.

TABLE C1: Descriptive statistics of the dependent and explanatory variables

	Mean	Std. Dev.	Min.	Max.
Dependent Variable				
$\Delta\text{Productivity}_{isrc}$	-0.016	0.542	-7.707	4.862
Firm-Level Explanatory Variables				
$\log(\text{Productivity}_{isrc}^{2010})$	10.686	0.649	2.766	15.412
$\log(\text{Capital Endowment}_{isrc}^{2010})$	10.235	1.399	0.169	16.432
$\log(\text{Age}_{isrc}^{2010})$	2.756	0.860	0.000	5.704
$\text{Micro Firm}_{isrc}^{2010}$ (d)	0.336	0.472	0	1
$\text{Small Firm}_{isrc}^{2010}$ (d)	0.377	0.485	0	1
$\text{Medium Firm}_{isrc}^{2010}$ (d)	0.245	0.430	0	1
$\text{Large Firm}_{isrc}^{2010}$ (d)	0.042	0.200	0	1
Region-Level Explanatory Variables				
$\text{Social Capital}_{rc}^{2008}$	0.556	0.169	0	1
$\log(\text{GDP Per Capita}_{rc}^{2010})$	-5.138	0.664	-6.360	-1.298
$\log(\text{Population Density}_{rc}^{2010})$	5.307	0.761	3.183	8.259
$\log(\text{Human Capital}_{rc}^{2010})$	-1.323	0.461	-2.091	-0.253
$\text{Institutional Quality}_{rc}^{2010}$	0.502	0.225	0	1
$\log(\text{GDP Per Capita}_{rc}^{1900})$	-6.131	0.339	-6.949	-5.169

Notes: Statistics on the dependent variable refer to a sample of 17,396 firms, while statistics on the explanatory variables refer to 27,299 firms. (d) denotes a dummy variable.

TABLE C2: Correlation matrix of the explanatory variables

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
$\log(\text{Productivity}_{\text{isrc}}^{2010})$	[1]	1											
$\log(\text{Capital Endowment}_{\text{isrc}}^{2010})$	[2]	0.378	1										
$\log(\text{Age}_{\text{isrc}}^{2010})$	[3]	0.183	0.140	1									
$\text{Small Firm}_{\text{isrc}}^{2010}$ (d)	[4]	-0.033	-0.029	0.058	1								
$\text{Medium Firm}_{\text{isrc}}^{2010}$ (d)	[5]	0.151	0.055	0.206	-0.443	1							
$\text{Large Firm}_{\text{isrc}}^{2010}$ (d)	[6]	0.091	0.066	0.083	-0.163	-0.119	1						
$\text{Social Capital}_{\text{rc}}^{2008}$	[7]	0.240	0.017	0.106	-0.070	0.164	0.074	1					
$\log(\text{GDP Per Capita}_{\text{rc}}^{2010})$	[8]	-0.070	0.026	-0.070	0.086	-0.155	-0.069	-0.317	1				
$\log(\text{Population Density}_{\text{rc}}^{2010})$	[9]	0.164	-0.001	0.067	-0.049	0.110	0.071	0.376	-0.523	1			
$\log(\text{Human Capital}_{\text{rc}}^{2010})$	[10]	0.098	0.022	0.053	-0.104	0.159	0.098	-0.359	0.012	-0.014	1		
$\text{Institutional Quality}_{\text{rc}}^{2010}$	[11]	0.082	0.128	0.044	-0.121	0.183	0.072	0.027	0.112	-0.083	0.546	1	
$\log(\text{GDP Per Capita}_{\text{rc}}^{1900})$	[12]	0.313	-0.022	0.131	-0.105	0.239	0.138	0.056	-0.292	0.471	0.594	0.133	1

Notes: Correlation coefficients refer to 27,299 firms. (d) denotes a dummy variable. The dummy variable for "micro firms" is excluded because is used as the reference category for the set of size dummies in the regression model.

APPENDIX D – Robustness tests on the whole sample of firms

Appendix D reports the results of the robustness tests carried out on the whole sample of firms and presented in sub-section "4.2. Robustness analysis" in the manuscript.

Table D9 reports the results obtained by relying on two alternative operationalization approaches for defining social capital. The variable $A\_Social\ Capital_{rc}^{2008}$ is defined by avoiding any further normalization in the interval $[0, 1]$ of the principal component, while the variable $B\_Social\ Capital_{rc}^{2008}$ is defined as the logarithm of the arithmetic average value of the three dimensions for "generalized trust," "active participation," and "social norms."

TABLE D1: Social capital and firm labor productivity growth – Removing control variables

Dependent Variable	$\Delta\text{Productivity}_{isrc}$							
Estimation Approach	OLS	Heckman	TSLS	IV-Heckman	OLS	Heckman	TSLS	IV-Heckman
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\text{Social Capital}_{rc}^{2008}$	0.228****	0.239****	0.640***	0.642***	0.194***	0.142**	0.672***	0.429**
	(0.066)	(0.065)	(0.234)	(0.230)	(0.061)	(0.056)	(0.235)	(0.175)
$\log(\text{Productivity}_{isrc}^{2010})$	-0.478****	-0.473****	-0.486****	-0.483****	-0.430****	-0.457****	-0.437****	-0.462****
	(0.020)	(0.022)	(0.021)	(0.022)	(0.019)	(0.018)	(0.020)	(0.018)
$\log(\text{Capital Endowment}_{isrc}^{2010})$	0.036****	0.037****	0.040****	0.040****	…	…	…	…
	(0.005)	(0.005)	(0.006)	(0.006)				
$\log(\text{Age}_{isrc}^{2010})$	-0.003	-0.001	-0.008	-0.007	…	…	…	…
	(0.005)	(0.005)	(0.006)	(0.006)				
$\text{Micro Firm}_{isrc}^{2010}$ (d)	Ref.	Ref.	Ref.	Ref.	…	…	…	…
$\text{Small Firm}_{isrc}^{2010}$ (d)	0.155****	0.165****	0.157****	0.166****	…	…	…	…
	(0.011)	(0.011)	(0.011)	(0.011)				
$\text{Medium Firm}_{isrc}^{2010}$ (d)	0.207****	0.228****	0.210****	0.227****	…	…	…	…
	(0.018)	(0.016)	(0.018)	(0.016)				
$\text{Large Firm}_{isrc}^{2010}$ (d)	0.256****	0.277****	0.254****	0.268****	…	…	…	…
	(0.022)	(0.022)	(0.021)	(0.021)				
Region-Level Controls	No	No	No	No	No	No	No	No
Two-Digit Sector Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. Firms	17,396	17,396	17,396	17,396	17,396	17,396	17,396	17,396
Model F Statistic [p-value]	131.63 [0.000]	122.88 [0.000]	118.09 [0.000]	106.94 [0.000]	130.11 [0.000]	149.84 [0.000]	100.56 [0.000]	126.37 [0.000]
Selection Equation								
No. Firms	…	27,299	…	27,299	…	27,299	…	27,299
H_0: $\varphi(\cdot) = 0$ (χ^2 [p-value])	…	62.69 [0.000]	…	69.54 [0.000]	…	159.61 [0.000]	…	163.77 [0.000]
$\rho(\text{Survival}_{isrc}, \Delta\text{Productivity}_{isrc})$	…	0.173***	…	0.174***	…	-0.598****	…	-0.578****
		(0.057)		(0.055)		(0.061)		(0.062)
First-Stage Equation (IV)								
$\text{Precipitation Variability}_{rc}^{1500-1750}$	…	…	0.011****	0.012****	…	…	0.012****	0.012****
			(0.003)	(0.003)			(0.003)	(0.003)
First-Stage F Statistic on Excluded IV [p-value]	…	…	18.28 [0.000]	15.83 [0.000]	…	…	18.00 [0.000]	15.44 [0.000]

Notes: * p < 0.1; ** p < .05; *** p < 0.01; **** p < 0.001. Standard errors are clustered at the regional level, and are shown in parentheses. All specifications include a constant term. (d) denotes a dummy variable. $\varphi(\cdot)$ denotes the third-order polynomial in age and capital endowment used as exclusion restriction in the selection equation.

TABLE D2: Social capital and firm labor productivity growth – Excluding countries one by one

Dependent Variable	$\Delta\text{Productivity}_{isrc}$									
Excluded Country	Germany		Spain		France		Italy		Portugal	
Estimation Approach	TSLS	IV-Heckman	TSLS	IV-Heckman	TSLS	IV-Heckman	TSLS	IV-Heckman	TSLS	IV-Heckman
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$\text{Social Capital}_{rc}^{2008}$	0.454**	0.558**	0.198**	0.222**	0.237**	0.120*	0.421***	0.467***	0.326*	0.343*
	(0.218)	(0.263)	(0.098)	(0.107)	(0.110)	(0.071)	(0.129)	(0.154)	(0.185)	(0.182)
$\log(\text{Productivity}_{isrc}^{2010})$	-0.507****	-0.504****	-0.507****	-0.504****	-0.493****	-0.510****	-0.431****	-0.425****	-0.489****	-0.485****
	(0.020)	(0.021)	(0.022)	(0.023)	(0.021)	(0.020)	(0.025)	(0.026)	(0.021)	(0.022)
$\log(\text{Capital Endowment}_{isrc}^{2010})$	0.039****	0.040****	0.037****	0.037****	0.038****	0.036****	0.046****	0.047****	0.037****	0.038****
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)	(0.007)	(0.007)	(0.006)	(0.006)
$\log(\text{Age}_{isrc}^{2010})$	-0.010*	-0.009	-0.003	-0.001	-0.008	-0.014**	-0.006	-0.003	-0.007	-0.005
	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)	(0.008)	(0.009)	(0.005)	(0.005)
$\text{Micro Firm}_{isrc}^{2010}$ (d)	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
$\text{Small Firm}_{isrc}^{2010}$ (d)	0.153****	0.160****	0.170****	0.177****	0.161****	0.132****	0.082****	0.094****	0.157****	0.166****
	(0.011)	(0.010)	(0.011)	(0.012)	(0.011)	(0.014)	(0.014)	(0.018)	(0.011)	(0.011)
$\text{Medium Firm}_{isrc}^{2010}$ (d)	0.222****	0.235****	0.212****	0.230****	0.223****	0.169****	0.091****	0.125***	0.210****	0.228****
	(0.015)	(0.013)	(0.017)	(0.016)	(0.017)	(0.031)	(0.021)	(0.043)	(0.018)	(0.015)
$\text{Large Firm}_{isrc}^{2010}$ (d)	0.261****	0.277****	0.256****	0.274****	0.276****	0.230****	0.135****	0.167****	0.254****	0.271****
	(0.031)	(0.031)	(0.022)	(0.022)	(0.024)	(0.033)	(0.024)	(0.047)	(0.022)	(0.021)
$\log(\text{GDP Per Capita}_{rc}^{2010})$	-0.024	-0.020	-0.047***	-0.049***	-0.022	-0.018	0.016	0.020	-0.015	-0.014
	(0.020)	(0.022)	(0.015)	(0.017)	(0.014)	(0.013)	(0.012)	(0.015)	(0.014)	(0.015)
$\log(\text{Population Density}_{rc}^{2010})$	-0.026	-0.028*	0.015	0.017	-0.006	-0.007	-0.009	-0.011	-0.010	-0.012
	(0.016)	(0.016)	(0.016)	(0.017)	(0.013)	(0.011)	(0.011)	(0.012)	(0.013)	(0.013)
$\log(\text{Human Capital}_{rc}^{2010})$	0.106*	0.088	0.017	0.020	0.081	0.066	0.051	0.052	0.068	0.067
	(0.059)	(0.060)	(0.041)	(0.043)	(0.052)	(0.052)	(0.035)	(0.036)	(0.043)	(0.044)
$\text{Institutional Quality}_{rc}^{2010}$	0.156**	0.152*	0.299****	0.316****	0.182***	0.125***	-0.037	-0.071	0.154***	0.167***
	(0.079)	(0.090)	(0.058)	(0.064)	(0.056)	(0.047)	(0.119)	(0.114)	(0.057)	(0.059)
$\log(\text{GDP Per Capita}_{rc}^{1900})$	0.103**	0.107**	-0.021	-0.031	0.110***	0.134****	0.117***	0.107***	0.107***	0.108***
	(0.049)	(0.047)	(0.053)	(0.054)	(0.042)	(0.033)	(0.037)	(0.039)	(0.039)	(0.038)
Two-Digit Sector Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. Firms	14,615	14,615	14,172	14,172	16,178	16,178	7,605	7,605	17,014	17,014
Model F Statistic [p-value]	293.15 [0.000]	257.79 [0.000]	224.65 [0.000]	211.37 [0.000]	224.46 [0.000]	285.58 [0.000]	188.01 [0.000]	152.92 [0.000]	156.55 [0.000]	134.78 [0.000]
Selection Equation										
No. Firms	…	22,147	…	22,638	…	23,151	…	15,741		25,519
H_0: $\varphi(\cdot) = 0$ (χ^2 [p-value])	…	130.42 [0.000]	…	45.76 [0.000]	…	46.24 [0.000]	…	21.26 [0.001]		81.43 [0.000]
$\rho(\text{Survival}_{isrc}, \Delta\text{Productivity}_{isrc})$	…	0.141***	…	0.148***	…	-0.554****	…	0.184		0.157***
		(0.045)		(0.053)		(0.094)		(0.171)		(0.051)
First-Stage Equation (IV)										
$\text{Precipitation Variability}_{rc}^{1500-1750}$	0.008****	0.007****	0.014****	0.014***	0.015****	0.016****	0.021***	0.020***	0.013****	0.014****
	(0.002)	(0.002)	(0.004)	(0.005)	(0.004)	(0.005)	(0.007)	(0.007)	(0.003)	(0.004)
First-Stage F Statistic on Excluded IV [p-value]	14.00 [0.000]	11.68 [0.001]	11.65 [0.001]	10.18 [0.001]	15.14 [0.000]	12.36 [0.000]	11.04 [0.000]	10.19 [0.001]	15.35 [0.000]	12.43 [0.000]

Notes: * p < 0.1; ** p < .05; *** p < 0.01; **** p < 0.001. Standard errors are clustered at the regional level, and are shown in parentheses. All specifications include a constant term. (d) denotes a dummy variable. $\varphi(\cdot)$ denotes the third-order polynomial in age and capital endowment used as exclusion restriction in the selection equation.

TABLE D3: Social capital and firm labor productivity growth – Country-level heterogeneity

Dependent Variable	$\Delta\text{Productivity}_{\text{isrc}}$	
Estimation Approach	TSLS	IV-Heckman
	(1)	(2)
$\text{Social Capital}_{\text{rc}}^{2008}$	0.042*	0.617**
	(0.023)	(0.287)
$\text{Social Capital}_{\text{rc}}^{2008} \times$ Country		
France	1.205****	1.542****
	(0.150)	(0.258)
Germany	0.296**	0.890***
	(0.141)	(0.288)
Italy	0.545**	1.417***
	(0.247)	(0.438)
Portugal	Ref.	Ref.
Spain	0.707***	1.661**
	(0.222)	(0.744)
$\log(\text{Productivity}_{\text{isrc}}^{2010})$	-0.485****	-0.461****
	(0.021)	(0.025)
$\log(\text{Capital Endowment}_{\text{isrc}}^{2010})$	0.037****	0.039****
	(0.006)	(0.007)
$\log(\text{Age}_{\text{isrc}}^{2010})$	-0.007	-0.002
	(0.006)	(0.006)
$\text{Micro Firm}_{\text{isrc}}^{2010}$ (d)	Ref.	Ref.
$\text{Small Firm}_{\text{isrc}}^{2010}$ (d)	0.156****	0.196****
	(0.011)	(0.033)
$\text{Medium Firm}_{\text{isrc}}^{2010}$ (d)	0.207****	0.298****
	(0.020)	(0.081)
$\text{Large Firm}_{\text{isrc}}^{2010}$ (d)	0.250****	0.342****
	(0.021)	(0.076)
$\log(\text{GDP Per Capita}_{\text{rc}}^{2010})$	0.008	0.011
	(0.027)	(0.033)
$\log(\text{Population Density}_{\text{rc}}^{2010})$	0.004	0.016
	(0.018)	(0.026)
$\log(\text{Human Capital}_{\text{rc}}^{2010})$	-0.048	-0.100
	(0.054)	(0.069)
$\text{Institutional Quality}_{\text{rc}}^{2010}$	0.088	0.122
	(0.076)	(0.089)
$\log(\text{GDP Per Capita}_{\text{rc}}^{1900})$	0.115***	0.090*
	(0.042)	(0.054)
Two-Digit Sector Dummies	Yes	Yes
Country Dummies	Yes	Yes
No. Firms	17,396	17,396
Model F Statistic [p-value]	157.83 [0.000]	172.26 [0.000]
Selection Equation		
No. Firms	…	27,299
H_0: $\varphi(\cdot) = 0$ (χ^2 [p-value])	…	55.10 [0.000]
$\rho(\text{Survival}_{\text{isrc}}, \Delta\text{Productivity}_{\text{isrc}})$	…	0.377**
		(0.164)
First-Stage Equation (IV)		
First-Stage F Statistic on Excluded IV [p-value]		
$\text{Social Capital}_{\text{rc}}^{2008}$	19.52 [0.000]	11.18 [0.000]
$\text{Social Capital}_{\text{rc}}^{2008} \times$ France	38.12 [0.000]	27.99 [0.000]
$\text{Social Capital}_{\text{rc}}^{2008} \times$ Germany	31.51 [0.000]	36.75 [0.000]
$\text{Social Capital}_{\text{rc}}^{2008} \times$ Italy	44.74 [0.000]	39.28 [0.000]
$\text{Social Capital}_{\text{rc}}^{2008} \times$ Portugal	Ref.	Ref.
$\text{Social Capital}_{\text{rc}}^{2008} \times$ Spain	20.07 [0.000]	17.88 [0.000]

Notes: * p < 0.1; ** p < .05; *** p < 0.01; **** p < 0.001. Standard errors are clustered at the regional level, and are shown in parentheses. All specifications include a constant term. $\varphi(\cdot)$ denotes the third-order polynomial in age and capital endowment used as exclusion restriction in the selection equation.

TABLE D4: Social capital and firm labor productivity growth – Country-specific marginal effects

Dependent Variable	$\Delta\text{Productivity}_{isrc}$	
Estimation Approach	TSLS	IV-Heckman
Corresponding Column in Table D3	(1)	(2)
By-Country Marginal Effect of $\text{Social Capital}_{rc}^{2008}$		
France	1.248***	0.925***
	(0.458)	(0.346)
Germany	0.338**	0.273**
	(0.153)	(0.127)
Italy	0.587**	0.799*
	(0.264)	(0.458)
Portugal	0.042*	0.617**
	(0.023)	(0.287)
Spain	0.750**	1.044**
	(0.326)	(0.433)

Notes: * p < 0.1; ** p < .05; *** p < 0.01; **** p < 0.001. Standard errors are clustered at the regional level, and are shown in parentheses. Marginal effects refer to the estimated specifications reported in Table D3 (Online Appendix D).

TABLE D5: Social capital and firm labor productivity growth – Replacing size dummies with 2010 employment level

Dependent Variable	$\Delta\text{Productivity}_{\text{isrc}}$			
Estimation Approach	OLS	Heckman	TSLS	IV-Heckman
	(1)	(2)	(3)	(4)
$\text{Social Capital}_{\text{rc}}^{2008}$	0.196**	0.206***	0.328**	0.350**
	(0.075)	(0.075)	(0.155)	(0.166)
$\log(\text{Productivity}_{\text{isrc}}^{2010})$	-0.482****	-0.478****	-0.484****	-0.481****
	(0.020)	(0.021)	(0.020)	(0.021)
$\log(\text{Capital Endowment}_{\text{isrc}}^{2010})$	0.037****	0.037****	0.038****	0.038****
	(0.005)	(0.005)	(0.006)	(0.006)
$\log(\text{Age}_{\text{isrc}}^{2010})$	-0.011**	-0.010*	-0.013**	-0.012**
	(0.005)	(0.006)	(0.006)	(0.006)
$\log(\text{Employment}_{\text{isrc}}^{2010})$	0.074****	0.079****	0.075****	0.079****
	(0.006)	(0.005)	(0.006)	(0.005)
$\log(\text{GDP Per Capita}_{\text{rc}}^{2010})$	-0.020	-0.021*	-0.016	-0.015
	(0.012)	(0.012)	(0.015)	(0.016)
$\log(\text{Population Density}_{\text{rc}}^{2010})$	-0.012	-0.012	-0.012	-0.014
	(0.013)	(0.013)	(0.013)	(0.013)
$\log(\text{Human Capital}_{\text{rc}}^{2010})$	0.049	0.048	0.061	0.060
	(0.046)	(0.047)	(0.044)	(0.044)
$\text{Institutional Quality}_{\text{rc}}^{2010}$	0.154***	0.166***	0.150***	0.158***
	(0.056)	(0.059)	(0.058)	(0.061)
$\log(\text{GDP Per Capita}_{\text{rc}}^{1900})$	0.117****	0.114****	0.107***	0.107***
	(0.033)	(0.034)	(0.040)	(0.040)
Two-Digit Sector Dummies	Yes	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes	Yes
No. Firms	17,396	17,396	17,396	17,396
Model F Statistic [p-value]	144.96 [0.000]	135.47 [0.000]	142.60 [0.000]	123.31 [0.000]
Selection Equation				
No. Firms	…	27,299	…	27,299
H_0: $\varphi(\cdot) = 0$ (χ^2 [p-value])	…	61.18 [0.000]	…	64.54 [0.000]
$\rho(\text{Survival}_{\text{isrc}}, \Delta\text{Productivity}_{\text{isrc}})$	…	0.146***	…	0.141***
		(0.047)		(0.045)
First-Stage Equation (IV)				
$\text{Precipitation Variability}_{\text{rc}}^{1500-1750}$	…	…	0.013****	0.013****
			(0.003)	(0.004)
First-Stage F Statistic on Excluded IV [p-value]	…	…	15.37 [0.000]	12.41 [0.000]

Notes: * p < 0.1; ** p < .05; *** p < 0.01; **** p < 0.001. Standard errors are clustered at the regional level, and are shown in parentheses. All specifications include a constant term. $\varphi(\cdot)$ denotes the third-order polynomial in age and capital endowment used as exclusion restriction in the selection equation.

TABLE D6: Social capital and firm labor productivity growth – Random slope model

Dependent Variable	$\Delta\text{Productivity}_{\text{isrc}}$
	(1)
$\text{Social Capital}_{\text{rc}}^{2008}$	0.198****
	(0.059)
$\log(\text{Productivity}_{\text{isrc}}^{2010})$	-0.494****
	(0.020)
$\log(\text{Capital Endowment}_{\text{isrc}}^{2010})$	0.039****
	(0.005)
$\log(\text{Age}_{\text{isrc}}^{2010})$	-0.008
	(0.005)
$\text{Micro Firm}_{\text{isrc}}^{2010}$ (d)	Ref.
$\text{Small Firm}_{\text{isrc}}^{2010}$ (d)	0.154****
	(0.011)
$\text{Medium Firm}_{\text{isrc}}^{2010}$ (d)	0.206****
	(0.018)
$\text{Large Firm}_{\text{isrc}}^{2010}$ (d)	0.252****
	(0.022)
$\log(\text{GDP Per Capita}_{\text{rc}}^{2010})$	-0.009
	(0.012)
$\log(\text{Population Density}_{\text{rc}}^{2010})$	-0.004
	(0.010)
$\log(\text{Human Capital}_{\text{rc}}^{2010})$	0.060
	(0.042)
$\text{Institutional Quality}_{\text{rc}}^{2010}$	0.087
	(0.064)
$\log(\text{GDP Per Capita}_{\text{rc}}^{1900})$	0.111***
	(0.040)
Two-Digit Sector Dummies	Yes
Country Dummies	Yes
No. Firms	17,396
Model χ^2 Statistic [p-value]	4,426.15 [0.000]
Variance of Random Effects	
$\text{Social Capital}_{\text{rc}}^{2008}$	0.002
	(0.006)
Constant	0.001
	(0.002)
Residuals	0.221****
	(0.008)

Notes: * p < 0.1; ** p < .05; *** p < 0.01; **** p < 0.001. Standard errors are clustered at the regional level, and are shown in parentheses. All specifications include a constant term. (d) denotes a dummy variable.

TABLE D7: Social capital and firm labor productivity growth – Alternative IVs for social capital

Dependent Variable	$\Delta\text{Productivity}_{isrc}$			
Exclusion Restriction	Carolingian Empire		Minimum Winter Temperature	
Estimation Approach	TSLS	IV-Heckman	TSLS	IV-Heckman
	(1)	(2)	(3)	(4)
$\text{Social Capital}_{rc}^{2008}$	0.465****	0.515****	0.255***	0.267****
	(0.112)	(0.124)	(0.084)	(0.081)
$\log(\text{Productivity}_{isrc}^{2010})$	-0.492****	-0.489****	-0.488****	-0.484****
	(0.020)	(0.021)	(0.020)	(0.021)
$\log(\text{Capital Endowment}_{isrc}^{2010})$	0.040****	0.041****	0.038****	0.039****
	(0.005)	(0.006)	(0.005)	(0.005)
$\log(\text{Age}_{isrc}^{2010})$	-0.009*	-0.008	-0.007	-0.005
	(0.005)	(0.006)	(0.005)	(0.005)
$\text{Micro Firm}_{isrc}^{2010}$ (d)	Ref.	Ref.	Ref.	Ref.
$\text{Small Firm}_{isrc}^{2010}$ (d)	0.155****	0.164****	0.155****	0.164****
	(0.011)	(0.011)	(0.011)	(0.011)
$\text{Medium Firm}_{isrc}^{2010}$ (d)	0.207****	0.225****	0.206****	0.226****
	(0.018)	(0.016)	(0.018)	(0.016)
$\text{Large Firm}_{isrc}^{2010}$ (d)	0.250****	0.266****	0.251****	0.271****
	(0.021)	(0.021)	(0.022)	(0.022)
$\log(\text{GDP Per Capita}_{rc}^{2010})$	-0.011	-0.006	-0.017*	-0.018*
	(0.013)	(0.013)	(0.010)	(0.010)
$\log(\text{Population Density}_{rc}^{2010})$	-0.010	-0.013	-0.011	-0.011
	(0.013)	(0.014)	(0.012)	(0.013)
$\log(\text{Human Capital}_{rc}^{2010})$	0.077	0.069	0.058	0.057
	(0.049)	(0.049)	(0.044)	(0.046)
$\text{Institutional Quality}_{rc}^{2010}$	0.150**	0.149**	0.156***	0.171***
	(0.061)	(0.065)	(0.055)	(0.058)
$\log(\text{GDP Per Capita}_{rc}^{1900})$	0.096**	0.099**	0.112***	0.110***
	(0.041)	(0.041)	(0.036)	(0.036)
Two-Digit Sector Dummies	Yes	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes	Yes
No. Firms	17,396	17,396	17,396	17,396
Model F Statistic [p-value]	128.84 [0.000]	106.89 [0.000]	160.04 [0.000]	129.63 [0.000]
Selection Equation				
No. Firms	…	27,299	…	27,299
H_0: $\varphi(\cdot) = 0$ (χ^2 [p-value])	…	64.11 [0.000]	…	64.44 [0.000]
$\rho(\text{Survival}_{isrc}, \Delta\text{Productivity}_{isrc})$	…	0.167***	…	0.167***
		(0.053)		(0.054)
First-Stage Equation (IV)				
$\text{Part of or Tributary to Carolingian Empire}_{rc}^{814}$	0.203****	0.194****	…	…
	(0.050)	(0.051)		
$\text{Minimum Winter Temperature}_{rc}$	…	…	-0.248****	-0.262****
			(0.033)	(0.035)
First-Stage F Statistic on Excluded IV [p-value]	16.73 [0.000]	14.67 [0.000]	57.09 [0.000]	57.26 [0.000]

Notes: * p < 0.1; ** p < .05; *** p < 0.01; **** p < 0.001. Standard errors are clustered at the regional level, and are shown in parentheses. All specifications include a constant term. (d) denotes a dummy variable. $\varphi(\cdot)$ denotes the third-order polynomial in age and capital endowment used as exclusion restriction in the selection equation.

TABLE D8: Social capital and firm labor productivity growth – Alternative exclusion restriction for selection equation

Dependent Variable	$\Delta\text{Productivity}_{\text{isrc}}$	
Estimation Approach	Heckman	IV-Heckman
	(1)	(2)
$\text{Social Capital}_{\text{rc}}^{2008}$	0.161**	0.218**
	(0.068)	(0.103)
$\log(\text{Productivity}_{\text{isrc}}^{2010})$	-0.504****	-0.505****
	(0.019)	(0.019)
$\log(\text{Capital Endowment}_{\text{isrc}}^{2010})$	0.036****	0.037****
	(0.005)	(0.005)
$\log(\text{Age}_{\text{isrc}}^{2010})$	-0.013**	-0.013***
	(0.005)	(0.005)
$\text{Micro Firm}_{\text{isrc}}^{2010}$ (d)	Ref.	Ref.
$\text{Small Firm}_{\text{isrc}}^{2010}$ (d)	0.122****	0.122****
	(0.014)	(0.014)
$\text{Medium Firm}_{\text{isrc}}^{2010}$ (d)	0.131****	0.131****
	(0.034)	(0.034)
$\text{Large Firm}_{\text{isrc}}^{2010}$ (d)	0.177****	0.176****
	(0.035)	(0.035)
$\log(\text{GDP Per Capita}_{\text{rc}}^{2010})$	-0.014	-0.012
	(0.012)	(0.014)
$\log(\text{Population Density}_{\text{rc}}^{2010})$	-0.011	-0.012
	(0.011)	(0.011)
$\log(\text{Human Capital}_{\text{rc}}^{2010})$	0.057	0.060
	(0.039)	(0.040)
$\text{Institutional Quality}_{\text{rc}}^{2010}$	0.104**	0.101**
	(0.044)	(0.046)
$\log(\text{GDP Per Capita}_{\text{rc}}^{1900})$	0.128****	0.125****
	(0.027)	(0.031)
Two-Digit Sector Dummies	Yes	Yes
Country Dummies	Yes	Yes
No. Firms	17,396	17,396
Model F Statistic [p-value]	174.24 [0.000]	212.97 [0.000]
Selection Equation		
No. Firms	27,299	27,299
H_0: $\varphi^1(\cdot) = 0$ (χ^2 [p-value])	171.17 [0.000]	177.50 [0.000]
$\rho(\text{Survival}_{\text{isrc}}, \Delta\text{Productivity}_{\text{isrc}})$	-0.557****	-0.553****
	(0.070)	(0.070)
First-Stage Equation (IV)		
$\text{Precipitation Variability}_{\text{rc}}^{1500-1750}$	…	0.013****
		(0.004)
First-Stage F Statistic on Excluded IV [p-value]	…	12.47 [0.000]

Notes: * p < 0.1; ** p < .05; *** p < 0.01; **** p < 0.001. Standard errors are clustered at the regional level, and are shown in parentheses. All specifications include a constant term. (d) denotes a dummy variable. $\varphi^1(\cdot)$ denotes the third-order polynomial in age and total assets used as exclusion restriction in the selection equation.

TABLE D9: Social capital and firm labor productivity growth – Alternative operationalizations of the variable for regional social capital

Dependent Variable	$\Delta\text{Productivity}_{isrc}$							
Estimation Approach	OLS	Heckman	TSLS	IV-Heckman	OLS	Heckman	TSLS	IV-Heckman
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\text{A\_Social Capital}_{rc}^{2008}$	0.034***	0.036***	0.056**	0.061**	…	…	…	…
	(0.013)	(0.013)	(0.025)	(0.029)				
$\log(\text{B\_Social Capital}_{rc}^{2008})$	…	…	…	…	0.112***	0.118***	0.203**	0.218**
					(0.039)	(0.038)	(0.101)	(0.104)
$\log(\text{Productivity}_{isrc}^{2010})$	-0.487****	-0.482****	-0.489****	-0.486****	-0.487****	-0.483****	-0.490****	-0.486****
	(0.020)	(0.021)	(0.020)	(0.022)	(0.020)	(0.021)	(0.021)	(0.022)
$\log(\text{Capital Endowment}_{isrc}^{2010})$	0.038****	0.038****	0.039****	0.039****	0.038****	0.038****	0.039****	0.039****
	(0.005)	(0.005)	(0.006)	(0.006)	(0.005)	(0.005)	(0.006)	(0.006)
$\log(\text{Age}_{isrc}^{2010})$	-0.006	-0.005	-0.008	-0.006	-0.006	-0.005	-0.008	-0.006
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
$\text{Micro Firm}_{isrc}^{2010}$ (d)	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
$\text{Small Firm}_{isrc}^{2010}$ (d)	0.155****	0.163****	0.155****	0.163****	0.155****	0.163****	0.155****	0.163****
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
$\text{Medium Firm}_{isrc}^{2010}$ (d)	0.206****	0.226****	0.206****	0.225****	0.206****	0.226****	0.207****	0.225****
	(0.018)	(0.016)	(0.018)	(0.016)	(0.018)	(0.016)	(0.018)	(0.016)
$\text{Large Firm}_{isrc}^{2010}$ (d)	0.252****	0.272****	0.251****	0.268****	0.252****	0.272****	0.250****	0.267****
	(0.022)	(0.022)	(0.022)	(0.021)	(0.022)	(0.022)	(0.022)	(0.021)
$\log(\text{GDP Per Capita}_{rc}^{2010})$	-0.019	-0.020	-0.015	-0.014	-0.018	-0.019	-0.012	-0.010
	(0.012)	(0.012)	(0.014)	(0.016)	(0.012)	(0.012)	(0.015)	(0.018)
$\log(\text{Population Density}_{rc}^{2010})$	-0.011	-0.011	-0.011	-0.013	-0.010	-0.010	-0.009	-0.012
	(0.012)	(0.013)	(0.012)	(0.012)	(0.012)	(0.013)	(0.013)	(0.013)
$\log(\text{Human Capital}_{rc}^{2010})$	0.053	0.052	0.065	0.064	0.053	0.051	0.067	0.065
	(0.044)	(0.046)	(0.043)	(0.043)	(0.044)	(0.046)	(0.043)	(0.043)
$\text{Institutional Quality}_{rc}^{2010}$	0.158***	0.172***	0.154***	0.164***	0.158***	0.172***	0.153***	0.161***
	(0.055)	(0.058)	(0.057)	(0.060)	(0.055)	(0.058)	(0.056)	(0.060)
$\log(\text{GDP Per Capita}_{rc}^{1900})$	0.116****	0.113****	0.107***	0.105***	0.117****	0.114****	0.106***	0.105***
	(0.032)	(0.034)	(0.039)	(0.040)	(0.032)	(0.033)	(0.039)	(0.039)
Two-Digit Sector Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. Firms	17,396	17,396	17,396	17,396	17,396	17,396	17,396	17,396
Model F Statistic [p-value]	149.96 [0.000]	137.27 [0.000]	146.87 [0.000]	122.62 [0.000]	143.83 [0.000]	130.53 [0.000]	134.81 [0.000]	116.12 [0.000]
Selection Equation								
No. Firms	…	27,299	…	27,299	…	27,299	…	27,299
H_0: $\varphi(\cdot) = 0$ (χ^2 [p-value])	…	62.34 [0.000]	…	65.42 [0.000]	…	61.98 [0.000]	…	65.26 [0.000]
$\rho(\text{Survival}_{isrc}, \Delta\text{Productivity}_{isrc})$	…	0.167*** (0.054)	…	0.162*** (0.052)	…	0.168*** (0.054)	…	0.164*** (0.052)
First-Stage Equation (IV)								
$\text{Precipitation Variability}_{rc}^{1500-1750}$	…	…	0.076**** (0.019)	0.078**** (0.022)	…	…	0.021**** (0.006)	0.022*** (0.007)
First-Stage F Statistic on Excluded IV [p-value]	…	…	15.41 [0.000]	12.47 [0.000]	…	…	11.81 [0.001]	10.41 [0.002]

Notes: * p < 0.1; ** p < .05; *** p < 0.01; **** p < 0.001. Standard errors are clustered at the regional level, and are shown in parentheses. All specifications include a constant term. (d) denotes a dummy variable. $\varphi(\cdot)$ denotes the third-order polynomial in age and capital endowment used as exclusion restriction in the selection equation.

TABLE D10: Social capital and firm labor productivity levels

Dependent Variable	$\log(\text{Productivity}_{\text{isrc}}^{2010})$		$\log(\text{Productivity}_{\text{isrc}}^{2017})$			
Estimation Approach	OLS	TSLS	OLS	Heckman	TSLS	IV-Heckman
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{Social Capital}_{\text{rc}}^{2008}$	0.419****	0.734****	0.198***	0.169**	0.428**	0.436**
	(0.075)	(0.196)	(0.074)	(0.067)	(0.187)	(0.178)
$\log(\text{Productivity}_{\text{isrc}}^{2010})$	…	…	0.513****	0.501****	0.511****	0.499****
			(0.020)	(0.020)	(0.020)	(0.020)
$\log(\text{Capital Endowment}_{\text{isrc}}^{2010})$	0.178****	0.180****	0.038****	0.036****	0.039****	0.037****
	(0.006)	(0.006)	(0.005)	(0.005)	(0.006)	(0.005)
$\log(\text{Age}_{\text{isrc}}^{2010})$	0.042****	0.039****	-0.006	-0.011**	-0.008	-0.012**
	(0.006)	(0.007)	(0.005)	(0.005)	(0.005)	(0.005)
$\text{Micro Firm}_{\text{isrc}}^{2010}$ (d)	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
$\text{Small Firm}_{\text{isrc}}^{2010}$ (d)	0.030**	0.030**	0.155****	0.130****	0.155****	0.131****
	(0.013)	(0.013)	(0.011)	(0.019)	(0.011)	(0.019)
$\text{Medium Firm}_{\text{isrc}}^{2010}$ (d)	0.012	0.011	0.206****	0.150***	0.206****	0.150***
	(0.019)	(0.019)	(0.018)	(0.049)	(0.018)	(0.048)
$\text{Large Firm}_{\text{isrc}}^{2010}$ (d)	0.010	0.004	0.252****	0.196****	0.251****	0.194****
	(0.029)	(0.028)	(0.022)	(0.048)	(0.022)	(0.048)
$\log(\text{GDP Per Capita}_{\text{rc}}^{2010})$	0.006	0.018	-0.019	-0.016	-0.015	-0.012
	(0.015)	(0.019)	(0.012)	(0.012)	(0.014)	(0.014)
$\log(\text{Population Density}_{\text{rc}}^{2010})$	0.017	0.015	-0.011	-0.011	-0.011	-0.012
	(0.016)	(0.017)	(0.012)	(0.011)	(0.012)	(0.011)
$\log(\text{Human Capital}_{\text{rc}}^{2010})$	0.033	0.062	0.053	0.054	0.065	0.060
	(0.049)	(0.052)	(0.044)	(0.040)	(0.043)	(0.041)
$\text{Institutional Quality}_{\text{rc}}^{2010}$	0.277****	0.268****	0.158***	0.119**	0.154***	0.114**
	(0.078)	(0.081)	(0.055)	(0.052)	(0.057)	(0.052)
$\log(\text{GDP Per Capita}_{\text{rc}}^{1900})$	0.184****	0.164***	0.116****	0.125****	0.107***	0.121****
	(0.050)	(0.058)	(0.032)	(0.028)	(0.039)	(0.033)
Two-Digit Sector Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes	Yes	Yes	Yes
No. Firms	27,299	27,299	17,396	17,396	17,396	17,396
Model F Statistic [p-value]	345.62 [0.000]	286.87 [0.000]	620.37 [0.000]	392.72 [0.000]	658.92 [0.000]	566.42 [0.000]
Selection Equation						
No. Firms	…	…	…	27,299	…	27,299
H_0: $\varphi(\cdot) = 0$ (χ^2 [p-value])	…	…	…	42.15 [0.000]	…	45.04 [0.000]
$\rho[\text{Survival}_{\text{isrc}}, \log(\text{Productivity}_{\text{isrc}}^{2017})]$	…	…	…	-0.425*	…	-0.422*
				(0.218)		(0.215)
First-Stage Equation (IV)						
$\text{Precipitation Variability}_{\text{rc}}^{1500-1750}$	…	0.014****	…	…	0.013****	0.013****
		(0.004)			(0.003)	(0.004)
First-Stage F Statistic on Excluded IV [p-value]	…	12.24 [0.001]	…	…	15.41 [0.000]	12.47 [0.000]

Notes: * p < 0.1; ** p < .05; *** p < 0.01; **** p < 0.001. Standard errors are clustered at the regional level, and are shown in parentheses. All specifications include a constant term. (d) denotes a dummy variable. $\varphi(\cdot)$ denotes the third-order polynomial in age and capital endowment used as exclusion restriction in the selection equation.

APPENDIX E – Full tables of the results presented in the main text

Appendix E reports the full set of results presented in Table 2 (sub-section "4.3. Assessing the individual dimensions of social capital") and Tables 3 to 7 (sub-section "4.4. Accounting for firm-level heterogeneity") in the manuscript. Specifically, Table E1 reports the full set of the estimated coefficients corresponding to Table 2 in the manuscript. Table E2 reports the full set of the estimated coefficients corresponding to Table 3 in the manuscript; Table E3 reports the full set of the estimated coefficients corresponding to Table 4 in the manuscript; Table E4 reports the full set of the estimated coefficients corresponding to Table 5 in the manuscript; Table E5 reports the full set of the estimated coefficients corresponding to Table 6 in the manuscript; and Table E6 reports the full set of the estimated coefficients corresponding to Table 7 in the manuscript.

In addition, Table E7 reports the difference in the estimated coefficient of regional social capital for the five different sub-samples considered in sub-section "4.4. Accounting for firm-level heterogeneity", with inference on the difference in the estimated coefficient of regional social capital obtained through permutation.

TABLE E1: Individual components of social capital and firm labor productivity growth

Dependent Variable	$\Delta\text{Productivity}_{\text{isrc}}$		
Estimation Approach	IV-Heckman		
	(1)	(2)	(3)
$\text{Genralized Trust}_{\text{rc}}^{2008}$	0.128*	…	…
	(0.073)		
$\text{Active Participation}_{\text{rc}}^{2008}$	…	0.481**	…
		(0.229)	
$\text{Social Norms}_{\text{rc}}^{2008}$	…	…	0.159**
			(0.072)
$\log\left(\text{Productivity}_{\text{isrc}}^{2010}\right)$	-0.481****	-0.481****	-0.482****
	(0.021)	(0.022)	(0.021)
$\log\left(\text{Capital Endowment}_{\text{isrc}}^{2010}\right)$	0.037****	0.036****	0.037****
	(0.005)	(0.005)	(0.005)
$\log\left(\text{Age}_{\text{isrc}}^{2010}\right)$	-0.003	-0.002	-0.003
	(0.005)	(0.006)	(0.005)
$\text{Micro Firm}_{\text{isrc}}^{2010}$ (d)	Ref.	Ref.	Ref.
$\text{Small Firm}_{\text{isrc}}^{2010}$ (d)	0.161****	0.159****	0.161****
	(0.011)	(0.012)	(0.011)
$\text{Medium Firm}_{\text{isrc}}^{2010}$ (d)	0.222****	0.216****	0.221****
	(0.016)	(0.017)	(0.016)
$\text{Large Firm}_{\text{isrc}}^{2010}$ (d)	0.273****	0.266****	0.270****
	(0.022)	(0.022)	(0.022)
$\log(\text{GDP Per Capita}_{\text{rc}}^{2010})$	-0.015	-0.041**	-0.022*
	(0.014)	(0.016)	(0.012)
$\log(\text{Population Density}_{\text{rc}}^{2010})$	-0.012	-0.024	-0.006
	(0.014)	(0.015)	(0.014)
$\log(\text{Human Capital}_{\text{rc}}^{2010})$	0.036	0.085	0.041
	(0.052)	(0.059)	(0.049)
$\text{Institutional Quality}_{\text{rc}}^{2010}$	0.087	0.061	0.084
	(0.086)	(0.104)	(0.082)
$\log(\text{GDP Per Capita}_{\text{rc}}^{1900})$	0.112****	0.050	0.067
	(0.033)	(0.061)	(0.045)
Two-Digit Sector Dummies	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes
No. Firms	17,396	17,396	17,396
Model F Statistic [p-value]	193.02 [0.000]	259.35 [0.000]	186.08 [0.000]
Selection Equation			
No. Firms	27,299	27,299	27,299
H_0: $\varphi(\cdot) = 0$ (χ^2 [p-value])	61.88 [0.000]	62.90 [0.000]	61.13 [0.000]
$\rho\left[\text{Survival}_{\text{isrc}}, \log\left(\text{Productivity}_{\text{isrc}}^{2017}\right)\right]$	0.160***	0.161***	0.155***
	(0.051)	(0.051)	(0.051)
First-Stage Equation (IV)			
$\text{Precipitation Variability}_{\text{rc}}^{1500-1750}$	0.039****	0.009***	0.027****
	(0.005)	(0.003)	(0.004)
First-Stage F Statistic on Excluded IV [p-value]	67.11 [0.000]	18.95 [0.000]	46.75 [0.000]

Notes: * p < 0.1; ** p < .05; *** p < 0.01; **** p < 0.001. Standard errors are clustered at the regional level, and are shown in parentheses. All specifications include a constant term. (d) denotes a dummy variable. $\varphi(\cdot)$ denotes the third-order polynomial in age and capital endowment used as exclusion restriction in the selection equation.

TABLE E2: Social capital and firm labor productivity growth, accounting for heterogeneity in firm-level labor productivity

Dependent Variable	$\Delta\text{Productivity}_{\text{isrc}}$			
Growth-Initial Labor Productivity Level	Low (≤ Sample Mean)		High (> Sample Mean)	
Estimation Approach	TSLS	IV-Heckman	TSLS	IV-Heckman
	(1)	(2)	(3)	(4)
$\text{Social Capital}_{\text{rc}}^{2008}$	0.539**	0.538**	0.191	0.211
	(0.243)	(0.239)	(0.170)	(0.175)
$\log(\text{Productivity}_{\text{isrc}}^{2010})$	-0.713****	-0.710****	-0.395****	-0.396****
	(0.029)	(0.030)	(0.034)	(0.035)
$\log(\text{Capital Endowment}_{\text{isrc}}^{2010})$	0.049****	0.049****	0.018***	0.019****
	(0.007)	(0.007)	(0.006)	(0.006)
$\log(\text{Age}_{\text{isrc}}^{2010})$	-0.014**	-0.014**	0.006	0.008
	(0.007)	(0.007)	(0.006)	(0.006)
$\text{Micro Firm}_{\text{isrc}}^{2010}$ (d)	Ref.	Ref.	Ref.	Ref.
$\text{Small Firm}_{\text{isrc}}^{2010}$ (d)	0.131****	0.134****	0.199****	0.206****
	(0.015)	(0.015)	(0.015)	(0.016)
$\text{Medium Firm}_{\text{isrc}}^{2010}$ (d)	0.245****	0.250****	0.214****	0.229****
	(0.020)	(0.019)	(0.020)	(0.019)
$\text{Large Firm}_{\text{isrc}}^{2010}$ (d)	0.243****	0.249****	0.268****	0.282****
	(0.039)	(0.040)	(0.022)	(0.023)
$\log(\text{GDP Per Capita}_{\text{rc}}^{2010})$	-0.010	-0.008	-0.014	-0.014
	(0.020)	(0.020)	(0.015)	(0.016)
$\log(\text{Population Density}_{\text{rc}}^{2010})$	-0.007	-0.010	-0.012	-0.013
	(0.016)	(0.016)	(0.014)	(0.013)
$\log(\text{Human Capital}_{\text{rc}}^{2010})$	0.037	0.039	0.071*	0.073*
	(0.068)	(0.066)	(0.041)	(0.043)
$\text{Institutional Quality}_{\text{rc}}^{2010}$	0.238***	0.240***	0.090*	0.097*
	(0.079)	(0.079)	(0.053)	(0.055)
$\log(\text{GDP Per Capita}_{\text{rc}}^{1900})$	0.139**	0.139**	0.072*	0.070*
	(0.054)	(0.055)	(0.042)	(0.040)
Two-Digit Sector Dummies	Yes	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes	Yes
No. Firms	7,949	7,949	9,447	9,447
Model F Statistic [p-value]	191.10 [0.000]	187.73 [0.000]	50.71 [0.000]	54.21 [0.000]
Selection Equation				
No. Firms	…	13,003	…	14,296
H_0: $\varphi(\cdot) = 0$ (χ^2 [p-value])	…	35.87 [0.000]	…	41.67 [0.000]
$\rho(\text{Survival}_{\text{isrc}}, \Delta\text{Productivity}_{\text{isrc}})$	…	0.068*	...	0.139***
		(0.039)		(0.051)
First-Stage Equation (IV)				
$\text{Precipitation Variability}_{\text{rc}}^{1500-1750}$	0.012****	0.013****	0.014****	0.014****
	(0.003)	(0.004)	(0.004)	(0.004)
First-Stage F Statistic on Excluded IV [p-value]	15.85 [0.000]	12.23 [0.000]	14.46 [0.000]	12.31 [0.001]

Notes: * p < 0.1; ** p < .05; *** p < 0.01; **** p < 0.001. Standard errors are clustered at the regional level, and are shown in parentheses. All specifications include a constant term. (d) denotes a dummy variable. $\varphi(\cdot)$ denotes the third-order polynomial in age and capital endowment used as exclusion restriction in the selection equation.

TABLE E3: Social capital and firm labor productivity growth, accounting for heterogeneity in firm-level capital endowment

Dependent Variable	$\Delta\text{Productivity}_{\text{isrc}}$			
Growth-Initial Capital Endowment Level	Low (≤ Sample Mean)		High (> Sample Mean)	
Estimation Approach	TSLS	IV-Heckman	TSLS	IV-Heckman
	(1)	(2)	(3)	(4)
$\text{Social Capital}_{\text{rc}}^{2008}$	0.547**	0.635**	0.206	0.218
	(0.270)	(0.320)	(0.171)	(0.164)
$\log(\text{Productivity}_{\text{isrc}}^{2010})$	-0.533****	-0.514****	-0.486****	-0.485****
	(0.021)	(0.030)	(0.025)	(0.025)
$\log(\text{Capital Endowment}_{\text{isrc}}^{2010})$	0.015**	0.023***	0.077****	0.076****
	(0.007)	(0.008)	(0.013)	(0.013)
$\log(\text{Age}_{\text{isrc}}^{2010})$	-0.010*	-0.009	0.000	0.001
	(0.006)	(0.007)	(0.007)	(0.007)
$\text{Micro Firm}_{\text{isrc}}^{2010}$ (d)	Ref.	Ref.	Ref.	Ref.
$\text{Small Firm}_{\text{isrc}}^{2010}$ (d)	0.136****	0.160****	0.180****	0.183****
	(0.014)	(0.015)	(0.013)	(0.013)
$\text{Medium Firm}_{\text{isrc}}^{2010}$ (d)	0.205****	0.279****	0.222****	0.227****
	(0.022)	(0.034)	(0.020)	(0.019)
$\text{Large Firm}_{\text{isrc}}^{2010}$ (d)	0.207****	0.304****	0.294****	0.298****
	(0.028)	(0.042)	(0.027)	(0.028)
$\log(\text{GDP Per Capita}_{\text{rc}}^{2010})$	-0.022	-0.020	-0.013	-0.013
	(0.021)	(0.024)	(0.013)	(0.014)
$\log(\text{Population Density}_{\text{rc}}^{2010})$	-0.030	-0.036*	0.003	0.004
	(0.019)	(0.020)	(0.012)	(0.012)
$\log(\text{Human Capital}_{\text{rc}}^{2010})$	0.073	0.068	0.049	0.050
	(0.056)	(0.060)	(0.048)	(0.048)
$\text{Institutional Quality}_{\text{rc}}^{2010}$	0.188**	0.230**	0.150****	0.153****
	(0.092)	(0.107)	(0.045)	(0.046)
$\log(\text{GDP Per Capita}_{\text{rc}}^{1900})$	0.102	0.109	0.114***	0.111***
	(0.067)	(0.071)	(0.035)	(0.035)
Two-Digit Sector Dummies	Yes	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes	Yes
No. Firms	7,643	7,643	9,753	9,753
Model F Statistic [p-value]	166.44 [0.000]	129.63 [0.000]	104.69 [0.000]	104.50 [0.000]
Selection Equation				
No. Firms	…	13,067	…	14,232
H_0: $\varphi(\cdot) = 0$ (χ^2 [p-value])	…	37.49 [0.000]	…	33.14 [0.000]
$\rho(\text{Survival}_{\text{isrc}}, \Delta\text{Productivity}_{\text{isrc}})$	…	0.486***	…	0.052**
		(0.169)		(0.022)
First-Stage Equation (IV)				
$\text{Precipitation Variability}_{\text{rc}}^{1500-1750}$	0.011****	0.011****	0.015****	0.015****
	(0.003)	(0.003)	(0.004)	(0.004)
First-Stage F Statistic on Excluded IV [p-value]	18.07 [0.000]	13.08 [0.000]	14.49 [0.000]	12.62 [0.000]

Notes: * p < 0.1; ** p < .05; *** p < 0.01; **** p < 0.001. Standard errors are clustered at the regional level, and are shown in parentheses. All specifications include a constant term. (d) denotes a dummy variable. $\varphi(\cdot)$ denotes the third-order polynomial in age and capital endowment used as exclusion restriction in the selection equation.

TABLE E4: Social capital and firm labor productivity growth, accounting for heterogeneity in firm-level size

Dependent Variable	$\Delta\text{Productivity}_{isrc}$			
Growth-Initial Size Class	Micro and Small Firms		Medium and Large Firms	
Estimation Approach	TSLS	IV-Heckman	TSLS	IV-Heckman
	(1)	(2)	(3)	(4)
$\text{Social Capital}_{rc}^{2008}$	0.430**	0.451**	0.217**	0.243***
	(0.187)	(0.191)	(0.095)	(0.087)
$\log(\text{Productivity}_{isrc}^{2010})$	-0.495****	-0.493****	-0.499****	-0.494****
	(0.021)	(0.022)	(0.032)	(0.033)
$\log(\text{Capital Endowment}_{isrc}^{2010})$	0.038****	0.039****	0.037****	0.036****
	(0.006)	(0.006)	(0.006)	(0.007)
$\log(\text{Age}_{isrc}^{2010})$	-0.006	-0.005	-0.009	-0.007
	(0.007)	(0.007)	(0.006)	(0.007)
$\text{Micro Firm}_{isrc}^{2010}$ (d)	Ref.	Ref.	…	…
$\text{Small Firm}_{isrc}^{2010}$ (d)	0.147****	0.153****	…	…
	(0.011)	(0.011)		
$\text{Medium Firm}_{isrc}^{2010}$ (d)	…	…	Ref.	Ref.
$\text{Large Firm}_{isrc}^{2010}$ (d)	…	…	0.055****	0.054***
			(0.016)	(0.017)
$\log(\text{GDP Per Capita}_{rc}^{2010})$	-0.018	-0.016	-0.011	-0.010
	(0.021)	(0.021)	(0.012)	(0.012)
$\log(\text{Population Density}_{rc}^{2010})$	-0.019	-0.023	0.006	0.007
	(0.017)	(0.015)	(0.011)	(0.011)
$\log(\text{Human Capital}_{rc}^{2010})$	0.054	0.057	0.067	0.070
	(0.068)	(0.064)	(0.041)	(0.044)
$\text{Institutional Quality}_{rc}^{2010}$	0.174**	0.176**	-0.007	0.002
	(0.086)	(0.088)	(0.062)	(0.061)
$\log(\text{GDP Per Capita}_{rc}^{1900})$	0.112**	0.116**	0.075*	0.068*
	(0.054)	(0.051)	(0.040)	(0.041)
Two-Digit Sector Dummies	Yes	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes	Yes
No. Firms	12,276	12,276	5,120	5,120
Model F Statistic [p-value]	159.89 [0.000]	157.37 [0.000]	74.99 [0.000]	75.01 [0.000]
Selection Equation				
No. Firms	…	19,462	…	7,837
H_0: $\varphi(\cdot) = 0$ (χ^2 [p-value])	…	109.86 [0.000]	…	27.86 [0.001]
$\rho(\text{Survival}_{isrc}, \Delta\text{Productivity}_{isrc})$	…	0.100***	…	0.175
		(0.037)		(0.217)
First-Stage Equation (IV)				
$\text{Precipitation Variability}_{rc}^{1500-1750}$	0.008****	0.008****	0.023****	0.025****
	(0.002)	(0.002)	(0.006)	(0.007)
First-Stage F Statistic on Excluded IV [p-value]	16.38 [0.000]	16.35 [0.000]	13.76 [0.000]	13.43 [0.000]

Notes: * p < 0.1; ** p < .05; *** p < 0.01; **** p < 0.001. Standard errors are clustered at the regional level, and are shown in parentheses. All specifications include a constant term. (d) denotes a dummy variable. $\varphi(\cdot)$ denotes the third-order polynomial in age and capital endowment used as exclusion restriction in the selection equation.

TABLE E5: Social capital and firm labor productivity growth, accounting for heterogeneity in firm-level age

Dependent Variable	$\Delta\text{Productivity}_{\text{isrc}}$			
Growth-Initial Age Group (in Years)	$1 \leq \text{Age} \leq 5$		$\text{Age} > 6$	
Estimation Approach	TSLS	IV-Heckman	TSLS	IV-Heckman
	(1)	(2)	(3)	(4)
$\text{Social Capital}_{\text{rc}}^{2008}$	0.390*	0.385*	0.318*	0.345*
	(0.207)	(0.205)	(0.176)	(0.181)
$\log(\text{Productivity}_{\text{isrc}}^{2010})$	-0.639****	-0.632****	-0.461****	-0.458****
	(0.038)	(0.038)	(0.020)	(0.022)
$\log(\text{Capital Endowment}_{\text{isrc}}^{2010})$	0.048****	0.049****	0.038****	0.038****
	(0.010)	(0.011)	(0.006)	(0.006)
$\log(\text{Age}_{\text{isrc}}^{2010})$	-0.077**	-0.073*	0.003	0.004
	(0.037)	(0.039)	(0.007)	(0.007)
$\text{Micro Firm}_{\text{isrc}}^{2010}$ (d)	Ref.	Ref.	Ref.	Ref.
$\text{Small Firm}_{\text{isrc}}^{2010}$ (d)	0.215****	0.224****	0.142****	0.150****
	(0.028)	(0.028)	(0.011)	(0.012)
$\text{Medium Firm}_{\text{isrc}}^{2010}$ (d)	0.285****	0.311****	0.189****	0.207****
	(0.046)	(0.052)	(0.018)	(0.016)
$\text{Large Firm}_{\text{isrc}}^{2010}$ (d)	0.307****	0.339****	0.231****	0.247****
	(0.075)	(0.081)	(0.022)	(0.021)
$\log(\text{GDP Per Capita}_{\text{rc}}^{2010})$	-0.037	-0.038	-0.013	-0.011
	(0.027)	(0.029)	(0.013)	(0.015)
$\log(\text{Population Density}_{\text{rc}}^{2010})$	0.009	0.009	-0.013	-0.015
	(0.031)	(0.030)	(0.012)	(0.012)
$\log(\text{Human Capital}_{\text{rc}}^{2010})$	-0.024	-0.043	0.076*	0.077*
	(0.113)	(0.113)	(0.042)	(0.042)
$\text{Institutional Quality}_{\text{rc}}^{2010}$	0.183	0.217*	0.158***	0.164***
	(0.130)	(0.131)	(0.052)	(0.055)
$\log(\text{GDP Per Capita}_{\text{rc}}^{1900})$	0.124	0.130	0.099***	0.098***
	(0.123)	(0.121)	(0.033)	(0.033)
Two-Digit Sector Dummies	Yes	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes	Yes
No. Firms	1,978	1,978	15,418	15,418
Model F Statistic [p-value]	146.29 [0.000]	137.96 [0.000]	137.57 [0.000]	101.32 [0.000]
Selection Equation				
No. Firms	…	3,308	…	23,991
H_0: $\varphi(\cdot) = 0$ (χ^2 [p-value])	…	14.96 [0.092]	…	51.13 [0.000]
$\rho(\text{Survival}_{\text{isrc}}, \Delta\text{Productivity}_{\text{isrc}})$	…	0.171*	…	0.160***
		(0.092)		(0.059)
First-Stage Equation (IV)				
$\text{Precipitation Variability}_{\text{rc}}^{1500-1750}$	0.011****	0.012****	0.013****	0.014****
	(0.003)	(0.003)	(0.003)	(0.004)
First-Stage F Statistic on Excluded IV [p-value]	17.73 [0.000]	13.50 [0.000]	15.34 [0.000]	12.58 [0.000]

Notes: * p < 0.1; ** p < .05; *** p < 0.01; **** p < 0.001. Standard errors are clustered at the regional level, and are shown in parentheses. All specifications include a constant term. (d) denotes a dummy variable. $\varphi(\cdot)$ denotes the third-order polynomial in age and capital endowment used as exclusion restriction in the selection equation.

TABLE E6: Social capital and firm labor productivity growth, accounting for heterogeneity in firm-level technological level

Dependent Variable	$\Delta\text{Productivity}_{\text{isrc}}$			
Technological Level	Low- and Mid-Low-Technology		High- and Mid-High-Technology	
Estimation Approach	TSLS	IV-Heckman	TSLS	IV-Heckman
	(1)	(2)	(3)	(4)
$\text{Social Capital}_{\text{rc}}^{2008}$	0.415**	0.443**	0.152	0.203
	(0.203)	(0.211)	(0.228)	(0.219)
$\log(\text{Productivity}_{\text{isrc}}^{2010})$	-0.495****	-0.492****	-0.484****	-0.479****
	(0.021)	(0.022)	(0.027)	(0.031)
$\log(\text{Capital Endowment}_{\text{isrc}}^{2010})$	0.044****	0.045****	0.023**	0.026**
	(0.005)	(0.006)	(0.010)	(0.011)
$\log(\text{Age}_{\text{isrc}}^{2010})$	-0.007	-0.005	-0.011	-0.006
	(0.005)	(0.005)	(0.011)	(0.012)
$\text{Micro Firm}_{\text{isrc}}^{2010}$ (d)	Ref.	Ref.	Ref.	Ref.
$\text{Small Firm}_{\text{isrc}}^{2010}$ (d)	0.149****	0.157****	0.172****	0.184****
	(0.011)	(0.011)	(0.026)	(0.028)
$\text{Medium Firm}_{\text{isrc}}^{2010}$ (d)	0.201****	0.216****	0.221****	0.261****
	(0.017)	(0.017)	(0.040)	(0.045)
$\text{Large Firm}_{\text{isrc}}^{2010}$ (d)	0.208****	0.224****	0.309****	0.342****
	(0.026)	(0.028)	(0.039)	(0.046)
$\log(\text{GDP Per Capita}_{\text{rc}}^{2010})$	-0.003	-0.001	-0.048**	-0.045*
	(0.015)	(0.017)	(0.023)	(0.024)
$\log(\text{Population Density}_{\text{rc}}^{2010})$	-0.009	-0.014	-0.007	-0.001
	(0.013)	(0.013)	(0.020)	(0.020)
$\log(\text{Human Capital}_{\text{rc}}^{2010})$	0.040	0.037	0.098	0.093
	(0.045)	(0.044)	(0.070)	(0.076)
$\text{Institutional Quality}_{\text{rc}}^{2010}$	0.174***	0.181***	0.111	0.127
	(0.062)	(0.065)	(0.086)	(0.092)
$\log(\text{GDP Per Capita}_{\text{rc}}^{1900})$	0.121***	0.124***	0.041	0.019
	(0.041)	(0.041)	(0.052)	(0.054)
Two-Digit Sector Dummies	Yes	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes	Yes
No. Firms	12,509	12,509	4,887	4,887
Model F Statistic [p-value]	92.12 [0.000]	120.45 [0.000]	77.64 [0.000]	85.72 [0.000]
Selection Equation				
No. Firms	…	19,952	…	7,347
H_0: $\varphi(\cdot) = 0$ (χ^2 [p-value])	…	33.19 [0.000]	…	70.26 [0.000]
$\rho(\text{Survival}_{\text{isrc}}, \Delta\text{Productivity}_{\text{isrc}})$	…	0.135***	…	0.355
		(0.042)		(0.259)
First-Stage Equation (IV)				
$\text{Precipitation Variability}_{\text{rc}}^{1500-1750}$	0.012****	0.013****	0.014****	0.015***
	(0.003)	(0.003)	(0.004)	(0.005)
First-Stage F Statistic on Excluded IV [p-value]	16.48 [0.000]	13.64 [0.000]	12.91 [0.001]	10.15 [0.001]

Notes: * p < 0.1; ** p < .05; *** p < 0.01; **** p < 0.001. Standard errors are clustered at the regional level, and are shown in parentheses. All specifications include a constant term. (d) denotes a dummy variable. $\varphi(\cdot)$ denotes the third-order polynomial in age and capital endowment used as exclusion restriction in the selection equation.

TABLE E7: Difference in firm-level labor productivity growth returns of regional social capital by sub-samples

Estimation Approach	TSLS		IV-Heckman	
	Difference	P-Value	Difference	P-Value
Low vs. High Growth-Initial Labor Productivity Level	0.349	0.000	0.327	0.000
Low vs. High Growth-Initial Capital Endowment Level	0.341	0.027	0.417	0.000
Micro & Small vs. Medium & Large Growth-Initial Size Class	0.213	0.000	0.208	0.000
Young vs. Old Growth-Initial Age Group	0.071	0.102	0.040	0.295
Low- and Mid-Low- vs. High- and Mid-High-Technology	0.263	0.000	0.240	0.000

Notes: The table reports the difference in the estimated coefficients of regional social capital for each sub-sample of firms. Inference on the difference in the estimated coefficient of regional social capital is obtained through permutation. Values referring to the TSLS estimation approach are based on the comparison of the regional social capital coefficients from Specifications (1) and (3) in Online Appendix Tables E2, E3, E4, E5, and E6. Values referring to the IV-Heckman estimation approach are based on the comparison of the regional social capital coefficients from Specifications (2) and (4) in Online Appendix Tables E2, E3, E4, E5, and E6.

APPENDIX F – The aggregate region-level effects of social capital

Appendix F provides further regional level evidence to analyze the aggregate effects of social capital on labor productivity growth. To this aim, we consider the region-specific average value of firm-level labor productivity growth over the period 2010-2017 as the dependent variable ($\Delta\overline{Productivity_{rc}}$). We estimate the effects of regional social capital via Ordinary Least Squares (OLS) and Two-Stage Least Squares (TSLS) by controlling for the region-specific average value of firm-level labor productivity in the year 2010 ($\overline{Productivity_{rc}^{2010}}$). We also include regional controls for current and historical Gross Domestic Product (GDP) per capita in the regression model, as well as current variables for population density, human capital endowment, and institutional quality. The model is completed with country dummies. As for the firm-level analysis, we attempt to identify the causal effect of social capital by relying on the instrumental variable (IV) capturing regional precipitation variability during the growing season between 1500 and 1750.

The OLS and TSLS results are reported in Table F1. They fully corroborate our micro-level evidence. Indeed, we find that social capital matters at the aggregate regional level for labor productivity growth.

TABLE F1: Social capital and regional labor productivity growth

Dependent Variable	$\Delta\overline{\text{Productivity}}_{rc}$			
Estimation Approach	OLS	TSLS	OLS	TSLS
	(1)	(2)	(3)	(4)
$\text{Social Capital}_{rc}^{2008}$	0.198*	0.417*	0.198*	0.423*
	(0.103)	(0.252)	(0.103)	(0.249)
$\log(\overline{\text{Productivity}_{rc}^{2010}})$	-0.670****	-0.745****	-0.671****	-0.748****
	(0.103)	(0.126)	(0.106)	(0.127)
$\log(\text{GDP Per Capita}_{rc}^{2010})$	…	…	-0.002	-0.004
			(0.021)	(0.019)
$\log(\text{GDP Per Capita}_{rc}^{1900})$	0.018	0.008	0.018	0.010
	(0.089)	(0.092)	(0.092)	(0.093)
$\log(\text{Population Density}_{rc}^{2010})$	0.026	0.026	0.026	0.025
	(0.024)	(0.022)	(0.026)	(0.024)
$\log(\text{Human Capital}_{rc}^{2010})$	0.203**	0.245***	0.204**	0.247***
	(0.082)	(0.091)	(0.083)	(0.092)
$\text{Institutional Quality}_{rc}^{2010}$	-0.148	-0.149	-0.144	-0.139
	(0.133)	(0.128)	(0.145)	(0.138)
Country Dummies	Yes	Yes	Yes	Yes
No. Regions	76	76	76	76
R^2	0.62	0.60	0.62	0.60
Adjusted R^2	0.56	0.54	0.55	0.53
Model F Statistic [p-value]	10.15 [0.000]	9.46 [0.000]	9.22 [0.000]	8.67 [0.000]
First-Stage Equation (IV)				
$\text{Precipitation Variability}_{rc}^{1500-1750}$	…	0.019****	…	0.019****
		(0.004)		(0.005)
First-Stage F Statistic on Excluded IV [p-value]	…	17.27 [0.000]	…	16.29 [0.000]

Notes: * p < 0.1; ** p < .05; *** p < 0.01; **** p < 0.001. Robust standard errors are shown in parentheses. All specifications include a constant term.