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TRUST, INTANGIBLE ASSETS, AND PRODUCTIVITY

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ABSTRACT

Business environments dominated by information flows and autonomous tasks, typical of knowledge-intensive industries, are likely to require enough social capital to be viable and productive. In this paper, we use new EUKLEMS-INTANProd industry-level data (Bontadini et al., 2023a) covering a panel of 19 countries and 20 industries over the 1995-2018 period to investigate the influence of a key element of social capital – trust – on labour productivity in intangible-intensive industries, controlling for hiring and firing regulations that can constrain the ability of managers to implement best practices productively. We find that in such industries, productivity gains from high levels of trust are stronger than elsewhere, while too strict hiring and firing regulations are more damaging for productivity. Using a more limited sample for which data on management quality are available, we show that the positive impact of high trust on productivity in intangible-intensive industries is channeled by the ability to benefit from good management, a key element of organizational capital. Productivity gains from relatively high levels of trust in knowledge-rich environments are estimated to be sizeable and our estimates survive a number of robustness checks.

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A data appendix is available at <http://www.nber.org/data-appendix/w32513>

I. Introduction

Over the past three decades, a fundamental driver of growth in advanced economies has been the accumulation and exchange of knowledge, as embodied in so-called intangible assets – which include prominently organizational capital (Corrado *et al.*, 2022).¹ The positive impact of these assets on productivity, both directly as a production input and indirectly through the spillovers they generate on the efficient use of other production factors, has been highlighted by a multitude of economic and business studies (for a survey, see Roth, 2022), with many of them focusing on the role played by advanced management practices (Scur *et al.*, 2021), a key element of organizational capital.²

A knowledge-rich business environment is likely to require enough social capital to sustain reliable flows of information among economic agents (workers, managers, suppliers and customers alike) and confidence in their ability to implement tasks in an increasingly autonomous way. This is even more so in the digital age when production requires a substantial workforce undertaking tasks that are hard to monitor. In particular, a key element of social capital – trust – needs to be sufficiently high to ensure that cooperation rather than conflict characterizes relationships between agents, especially in large organizations (La Porta *et al.*, 1997).³ Indeed, trust can foster performance by both increasing commitment and facilitating organizational change, via easier management of collective action (Leana and van Buren, 2000).

Our paper empirically investigates how trust may affect the relationship between intangible asset accumulation and productivity. To our knowledge, research that directly investigates whether the productivity benefits of intangibles are influenced by the level of trust prevalent in society is still lacking. To fill this gap, we look at whether differences in levels of trust across countries can explain differences in the industry-specific productivity benefits of investing in a large set of intangibles.

We also explore whether the possible mediating role played by trust is channeled through the better ability to implement productivity-enhancing management practices in a business environment where trust is relatively high, e.g. by lowering the transaction costs associated with delegating responsibility (Bloom and van Reenen, 2010). This relates the growth effects of trust to the returns of investing in a subcomponent of intangibles, organizational capital. We are not aware of previous research that

¹ Corrado *et al.* (2009) have classified intangibles into three main categories: digitized information, innovative property and economic competencies. The latter include organizational capital.

² Recently, Corrado *et al.* (2023) have argued that the changing composition of intangible capital, with a growing share of their rival components (e.g. data), may have reduced spillovers – reconciling rising investment in intangibles with the persistent productivity slowdown

³ Social capital is typically characterized as including three components – social trust, shared norms and values and social networks (Bjornskov, 2017; Puskarova, 2022).

explores whether the influence of trust in knowledge-intensive industries may be due to better management.

Throughout the analysis we also account for the potential influence of certain labour market settings on the returns to intangible assets. To this end, we focus on hiring and firing regulations, which are likely to frame the ability to spread out productivity-enhancing management practices especially in intangible-intensive industries.

We base our empirical analysis on a sample of 19 countries over the 1995-2018 period for which the new vintage of EUKLEMS-INTANProd data (Bontadini *et al.*, 2023a) covers 20 manufacturing and service industries. A distinctive feature of these data is that they embody a full (and detailed) set of intangibles and ensure consistency between the production and value-added sides, which is an important requirement for our productivity analysis. In keeping with most previous research looking at the effects of trust on economic performance, we measure trust by drawing on individual responses to a global survey (the European Social Survey in our case).⁴ Similarly, we draw on the global management survey by Bloom and van Reenen (2010) to measure the quality of management practices in different countries, which however is only available for a subset of countries in our sample. Finally, we use the OECD indicator of employment protection legislation (OECD, 2020) to measure cross-country differences in the stringency of hiring and firing regulations. Using these data, we estimate a labour productivity model -- with productivity levels depending on capital deepening and the share of intangibles in capital -- in which we introduce a mediating role for trust and labour market regulations along with other controls.

Using a range of measures of intangible intensity, we find that the estimated productivity gains from the use of intangibles are boosted where trust is high. For instance, according to our estimates enhancing trust to the Finnish level (the country with the highest level of trust in our sample) would increase the productivity premium in the use of intangibles by 3.1% on average on our sample.⁵ The results are robust to controlling for the mediating role of hiring and firing regulations, which by contrast tend to lower the productivity gains from the use of intangibles in production when they are excessively strict.

⁴ In their meta-analysis of 65 studies of the relationship between social capital and economic performance Westlund and Adam (2010) report that "the single most used measure of social capital is the share of people having 'trust in other persons', for which the World Value Survey and other international surveys have been the source".

⁵ Note that to the extent that trust is related to other norms and values that are omitted from the equation (e.g. entrepreneurship, creativity, tolerance) the effect of trust can be overestimated, especially in the knowledge-intensive industries where these norms and values are likely to be more relevant.

Focusing on the reduced sample for which data on management practices are available, we also find suggestive evidence that the mediating effects of trust in the relationship between intangibles and productivity are channeled by the ability to reap stronger efficiency gains from implementing good management practices in a high trust environment than in a low trust environment. To reach this conclusion we first estimate to what extent management quality also mediates the effect of intangibles on productivity. According to our estimates, management quality in the US accounts for a 19.4% productivity premium in industries that use intangibles most intensively relative to Greece, where management quality is weakest in our sample. However, it is likely that management quality is endogenous to productivity, especially in intangible-intensive industries, either because of reverse causality (e.g. with high productivity industries attracting good managers) or because they are driven by common factors (such as adoption of digital technologies). We therefore instrument management quality with our proxy for trust, which is correlated with the quality of management practices but is less likely to be driven by the same factors that drive productivity or by productivity itself, particularly at the industry level. The interaction between trust and intangible intensity turns out to be a valid instrument for the interaction between management quality and intangible intensity and the results confirm the mediating role of (instrumented) management quality for boosting the productivity gains from intangibles. We interpret this as indirect evidence that the way in which trust affects productivity in intangible-intensive industries is through enabling the implementation of better management practices that lead to efficiency-enhancing organizational change.⁶

Our main results survive a number of robustness checks. First, we include three different measures of intangible intensity: country and industry-specific, industry-specific only (averaging across countries) and instrumenting with values observed in one country only (Germany). Second, we test for sensitivity to outliers by dropping one country and one industry at a time from the sample as well as by applying random subsampling methods (Tsao and Ling, 2012).⁷ Third, we replace trust with another measure of social capital, days of work lost due to strikes, which we view as a proxy for lack of trust in the workplace. Fourth, we supplement trust with days not worked and EPL as instruments to deal with the possible endogeneity of management quality to productivity. Our results survive to these robustness checks.

The rest of the paper is organized as follows. The next section briefly reviews the status of research and how we contribute to it. Section III describes our empirical approach and the data we use.

⁶ Of course, there may be other direct ways in which trust influences industry productivity but our results suggest that these do not go through differences in the intangible intensity of industries other than by enabling such management practices.

⁷ Subsampling methods consist in repeatedly fitting the regression model on a large number of randomly chosen subsamples to check the robustness of the results to changes in the underlying set of data.

Section IV provides the main findings. Section V discusses the economic relevance of the results as well as their robustness. Section VI concludes.

II. Social capital, trust and growth: a short review and our contribution

Following the seminal studies by Coleman (1988) and Putnam (1993), social scientists explored extensively the role played by social capital in development, growth and well-being (see, for instance, the meta-analysis by Westlund and Adam, 2010), with research on trust becoming a major field in management and the social sciences (Bachmann and Zaher, 2006; Algan and Cahuc, 2014). Over the past two decades, some social studies have also hinted at the possibility that trust may have become increasingly relevant in the context of the knowledge economy, where openness and resilience to organizational change and innovation in business models is crucial (Adler, 2001; Westlund, 2006).⁸ Indeed, a number of features of the knowledge economy including for instance the rising role played by data and information exchanges, tacit knowledge and trade secrets, teamwork (including remotely) and the related fiduciary interactions both among workers and with suppliers and customers, would seem to require considerable levels of trust.

There has been extensive research on how differences in the level of trust can explain differential performance outcomes across countries, regions and firms (Bjornskov, 2017, provides a critical survey).⁹ Empirical results are not always univocal -- as they often depend on the unit of observation chosen (countries, regions or firms) and on the interaction of proxies for social capital with formal institutions (such as market regulations and the quality of government). While the empirical link between trust and growth is overwhelmingly positive at firm level, results are mixed (though with a predominance of positive ones) in regional and country level studies (Westlund and Adam, 2010). One reason is that there might be a “dark side” to excessive trust, whereby blind faith, complacency and rigidities implied by informal obligations lead to coordination failures, information bottlenecks and lack of corrective action in teams (Gargiulo and Ertug, 2006). Also, a hotly debated issue is whether trust is a complement or substitute for formal institutions (Westlund, 2006), with some results indicating that, in a high-quality institutional environment, improvements in trust have no effect on growth (Ahlerup *et al.*, 2009). A handful of empirical studies has also investigated the channels through which trust may

⁸ Adler (2001) notes that “the effect of growing knowledge-intensity may indeed be a trend toward greater reliance on trust” as “compared to trust, price and authority are relatively ineffective means of dealing with knowledge-based assets”.

⁹ Cross-country and cross-regional studies usually adopt standardized measures of trust and performance. The former include Knack and Keefer (1997), Zak and Knack (2001), Beugelsdijk *et al.* (2004) and Algan and Cahuc (2014); the latter include Akçomak and ter Weel (2009), Dincer and Uslaner (2009), Dincer (2010), Tabellini (2010) and Puskarova (2022). Firm-level studies use a variety of study-specific measures of trust and performance. Westlund and Adam (2010) provide a useful survey of their results.

affect performance in a knowledge-intensive context -- including by facilitating innovation (Açkomaç and ter Weel, 2009), enabling the execution of autonomous tasks (van Hoorn, 2017) and interacting with skill endowments (Puskarova, 2022). Overall there is consensus that the trust component of social capital has a caUSI effect on growth (Bjornskov, 2017).

Research has also been extensive on how accumulation of intangible assets has influenced productivity and growth over the past three decades (see e.g. the survey by Roth, 2022b), often singling out the special role played by organizational capital (and its management component) in the context of the ICT and digital transformations (Scur *et al.*, 2021). Findings have generally pointed to strong effects of intangibles on productivity, notably via complementarities with the growing use of ICT and digital technologies that spurs new business models.

Our analysis brings together these two different strands of research: the link between trust and economic performance and the link between intangible assets and productivity, with a focus on the management element of organizational capital. To our knowledge, the possible nexus between investment in the knowledge-based assets necessary for exploiting at best new technologies and trust has not yet been investigated empirically. Moreover, with the exception of van Hoorn (2017), we are not aware of other studies linking trust to performance that have focused on hourly productivity at the industry level.

We contribute to both these literature strands in two ways. First, we provide original and solid cross-country evidence that, in industries that are dominated by intangibles, social trust is becoming an increasingly relevant source of comparative advantage, boosting the productivity gains from intangible capital deepening. This finding complements and generalizes previous cross-country results by Akçomaç and ter Weel (2009) -- who find that the effects of trust on growth come about via fostering innovation -- and cross-regional results by Puskarova (2022) -- who finds that trust generates growth benefits especially in skill-rich environments. Second, we provide suggestive evidence on the channels at work. We find that trust boosts the returns from intangibles most likely because there is a link between the performance impact of one of their organizational capital components (management) and levels of trust. This finding may be seen as generalizing previous industry-level results by van Hoorn (2017), who finds that the benefits of trust are particularly high in industries where workers' tasks require some degree of autonomy.

The link we uncover may operate via more commitment, more flexibility and easier management of collective action, which in turn lead to lower monitoring costs and operation at larger scale and scope. These factors probably allow managers to smoothly implement the organizational changes and the delegation of responsibility that are needed to make the best of new technologies. This interpretation

is also supported *a contrario* by our ancillary results concerning the negative influence of excessively tight hiring and firing restrictions, which curb the productivity-enhancing effects of intangible, probably by constraining the ability of managers to implement organizational changes.

III. Empirical approach

Regression model

We empirically investigate whether social capital is more important in economies with high intangible intensity (i.e. the share of intangible assets in the total tangible and intangible capital stock). To this end, we use a regression model that allows estimating on country*industry panel data the average effect of intangible intensity on labour productivity and then how this effect may depend on social capital:

$$\log(LP_{cit}) = \gamma \cdot \log(k_{cit}) + \lambda \cdot \log(Intan_{cit}) + \sum_j [\beta^j \cdot X_c^j \times \log(Intan_{cit})] + \phi_{ct} + \phi_{it} + u_{cit} \quad (1)$$

Where LP_{cit} is the average labor productivity per hour in country c , industry i and year t ; k is total (tangible and intangible) capital per hour in each country, sector and period; $Intan$ is intangible intensity, i.e. the share of intangible assets in total capital; X are country-level measures of social capital and institutional characteristics (such as hiring and firing regulations); ϕ_{ct} and ϕ_{it} are country*year and industry*year fixed effects; u is the residual term.

Relative to a more traditional production function approach distinguishing the influence of tangible and intangible capital, regressing productivity on intangible intensity is a parsimonious way to test at the same time the direct effect of intangibles and the hypothesis that trust is more important for the efficient use of intangibles in production than for the use of tangibles. However, given our conjecture that trust enhances returns from intangibles, it is also highly likely that our measure of trust is correlated with intangible intensity itself, making it difficult to correctly identify the mediating influence of trust on productivity. Therefore, in regressions we also instrument country and sector-specific intangible intensities with their values in a single representative country or alternatively for the average country, each time dropping the relevant country from the sample.¹⁰

We then check whether one of the channels through which social capital influences productivity especially in intangible-intensive industries is by allowing the implementation of high-quality management practices. To this end, we interact intangible intensity with management quality and

¹⁰ More precisely, in the first case we run a 2SLS instrumenting intangible intensity with the values observed in a representative country, while in the second case we run a Bartik instrumental variable approach (Bartik, 1991; Goldsmith-Pinkham *et al.*, 2020).

instrument the latter with our measure of social capital. The instrumentation also allows to correct for possible endogeneity bias originating either from confounding factors driving both productivity and management quality (e.g. country and sector-specific technology adoption) or from reverse causality (e.g. if highly-productive industries attract better managers).

Country*year and industry*year fixed effects are included in order to deal with several potential sources of omission bias, notably industry-specific technical change or country-specific macroeconomic developments. With the fixed effects accounting for the average effects of the country-level measures of social capital and hiring and firing regulations, the investigation only looks at whether and how these variables mediate the relationship between intangible intensity and labour productivity.

We measure social capital by the mutual confidence among citizens (henceforth called “trust”) and the quality of management practices by median scores from a firm-level survey of such practices. We also introduce a measure of labour market regulations as a control variable, as these regulations may directly influence the ability to use efficiently intangible assets and may also depend on or influence confidence as well as the ability to implement high quality management, which requires delegation and autonomy of tasks. The data selected to proxy for trust, management quality and labour market regulation, are described below.

Data

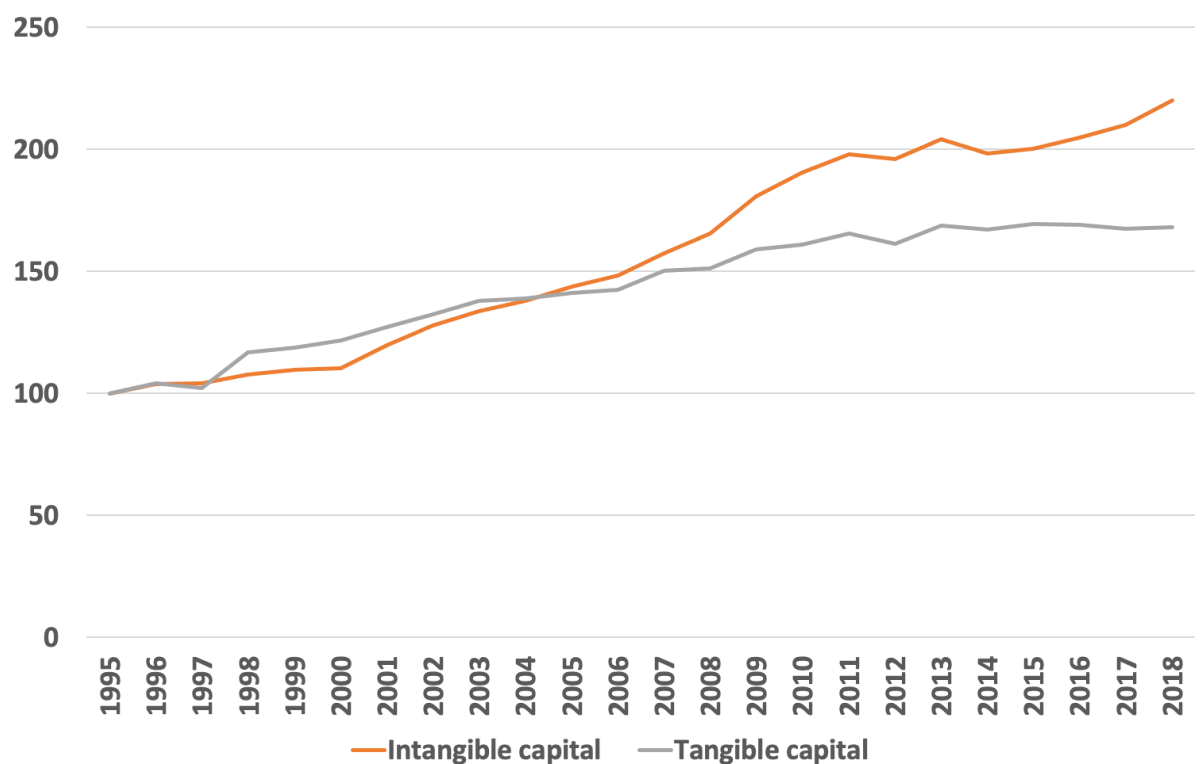
Our analysis requires data that are hard to measure: tangible and intangible capital stocks, trust, labour market regulation and management quality. To build our estimation sample we use 4 databases that are presented in this section. Merging these databases, we finally get an unbalanced country-industry panel of 6 603 observations covering up to 20 industries in 19 countries over the period 1995-2018. Industry coverage varies across countries. The number of countries shrinks to 8 when investigating the management quality impact, more than halving the number of observations (3117). Trust, labour market regulation and management quality are measured at country level only, due to data limitations, but estimates using time-varying measures of these variables are also provided. Results are robust to using the time dimension of these variables as they are quite stable over time and their cross-country dispersion strongly dominates their overall variance.

Our measures of labour productivity per hour, total capital per hour and intangible intensity are based on data from the EUKLEMS & INTANProd database (Bontadini *et al.*, 2023a). The labour productivity variable uses a measure of Gross Value Added consistent with the inclusion of intangibles in the capital stock. Our measure of total capital per hour includes the “total tangible capital stock”,

excluding non-residential buildings, and “total intangible capital stock”, both measured in 2015 constant price US PPPs, while the intangible intensity is the share of the latter in the total capital stock. Possible measurement error in labour productivity levels, which are notoriously difficult to compare across countries, are partly captured by our fixed effects and in any case would not bias our estimates but only make them less efficient. Table A1 in the appendix provides descriptive statistics for all the variables we use in regressions.

Chart 1 shows the evolution of the sample averages (over countries and industries) of the stocks of tangible and intangible capital (per hour worked) over our sample period. Both tangible and intangible capital stocks per hour are growing over time, but intangible intensity is increasing reflecting faster accumulation of intangible assets relative to tangibles especially in this century: the stock of intangibles more than doubled since 1995 while the stock of tangibles increased by around 60%. Chart 2 shows the averages of intangible intensity for the industries (2A) and countries (2B) in 2017. There are strong differences among both manufacturing and non-manufacturing industries: unsurprisingly, intangible intensity is highest in knowledge-intensive industries -- such as IT, electronics, audiovisual and professional services – and lowest in industries where physical assets are key – such as transport and storage and utilities. It is also worth noting the large differences between countries, with intangible intensities above 30% in Finland, France and US, but below 10% in Estonia, Hungary, Latvia, Lithuania, Slovakia and Spain.

Chart 1: Tangible and intangible capital per hour worked, sample averages over time (1995=100)

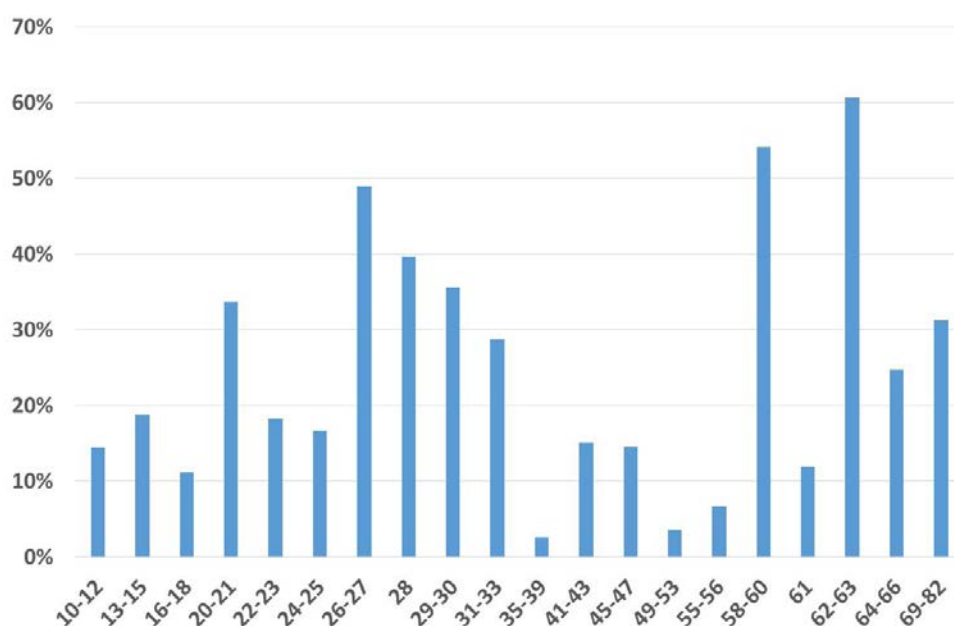


Note: Average of capital stocks per hour worked across industries and countries, 1995=100.

Source: Authors calculation from EUKLEMS-INTANProd database, <https://euklems-intanprod-ilee.luiss.it/> (accessed June 2023).

Chart 2: Intangible intensity in 2017

A – Industry averages

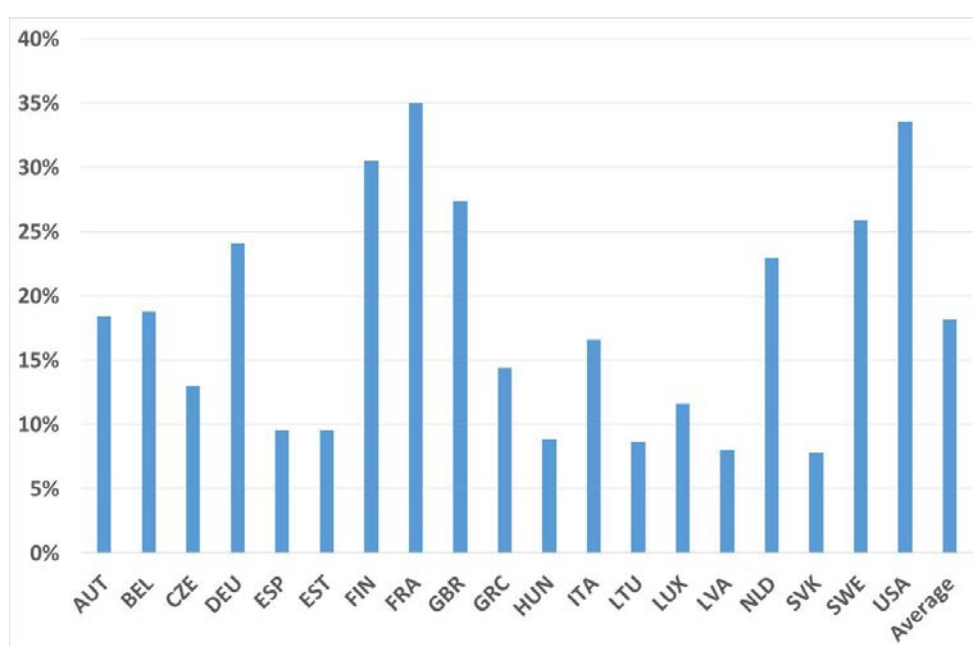


Note: Intangible intensity is the percentage share of intangible capital in total capital. Industry list (ISIC rev. 4 codes between parenthesis): Food products, beverages and tobacco (10-12); Textiles, wearing apparel, leather

and related products (13-15); Wood and paper products, and printing (16-18); Chemical and pharmaceutical products (20-21); Rubber and plastics products, and other non-metallic mineral products (22-23); Basic metals and fabricated metal products, except machinery and equipment (24-25); Electrical, electronic and optical equipment (26-27); Machinery and equipment n.e.c. (28); Transport equipment (29-30); Furniture; other manufacturing; repair and installation of machinery and equipment (31-33); Electricity, gas and water supply; sewerage, waste management and remediation activities (35-39); Construction (41-43); Wholesale and retail trade, repair of motor vehicles and motorcycles (45-47); Transportation and storage (49-53); Accommodation and food service activities (55-56); Publishing, audiovisual and broadcasting activities (58-60); Telecommunications (61); IT and other information services (62-63); Financial and insurance activities (64-66); Professional, scientific and technical activities (69-82).

Source: Authors calculation from EUKLEMS-INTANProd database, <https://euklems-intanprod-ilee.luiss.it/> (accessed June 2023).

B – Country averages



Note: The panel is unbalanced

Source: Authors calculation from EUKLEMS-INTANProd database, <https://euklems-intanprod-ilee.luiss.it/> (accessed June 2023).

Our main measure of social capital is the country average value of the answers to the following question from the European Social Survey (ESS): “... do you think that most people would try to take advantage of you if they got the chance, or would they try to be fair?”. As much of previous research on social capital (Westlund and Adam, 2006), we assume that answers to this question reflect the mutual confidence among citizens of a country and therefore call this variable ‘trust’. Our estimations use country-specific values calculated over the whole data availability period (2002-2018) rather than country*year specific values because there is very little variation in answers to this question over time. It suggests that, consistent with the slow-moving cultural trait it is supposed to reflect, our measure of trust is exogenous and remained broadly unaffected at country level even in the aftermath of a large shock such as the Great Recession.

We then measure management quality using the data provided by Bloom *et al.* (2014), who use survey data reporting ‘good’ and ‘bad’ practices and the diffusion of these practices among firms. As management practices may be contingent upon firms’ specific environment, Bloom *et al.* (2014) focus their survey on practices that can be deemed ‘good’ or ‘bad’ irrespective of their environment. Their survey includes eighteen questions asked to medium to large-sized manufacturing firms (with 50 to 10.000 workers) from which they calculate a composite indicator at the firm level. The dearth of data makes it impossible to meaningfully measure management quality at the industry level but provides some basis for assessing it at the country level using the median of the firm level measures.¹¹

Finally, we measure the regulatory environment in the labour market by using the OECD Employment Protection Legislation (EPL) indicator (OECD, 2020). EPL evaluates the stringency of regulations on the hiring and firing of workers on both regular and temporary contracts, including in the wake of collective dismissals. EPL can act as an additional mediating factor in the relationship between intangible intensity and productivity, potentially affecting the way in which certain intangible assets (e.g. organizational capital) can be used. These regulations also appear to be related to social capital as they can at the same time reflect and influence the degree of confidence among workers and managers on the workplace. For instance, tight EPL could historically result from mistrust of workers vis à vis employers’ hiring and firing motivations and procedures in a highly conflictual working environment. Alternatively, tight EPL could result from trustworthy agreements between social partners in a highly cooperative working environment. EPL regimes are likely to affect the ability of firms to implement high-quality management practices, as they frame contractual relations between staff and managers.¹²

While we remain agnostic about the direction of causality and the nature of the linkages between EPL and our measures of trust and management quality, controlling for EPL in our regressions eliminates a potential source of estimation bias due to omitted institutional variables (see Ahlerup *et al.*, 2009) and possible confounding drivers of productivity. We therefore account for the possibility that EPL also acts as a mediating factor in the intangible intensity/productivity nexus. To facilitate comparisons between the estimated coefficients of the trust, labor market regulations and management quality variables, we normalize all of them to vary in the 0-1 range. In this range, the

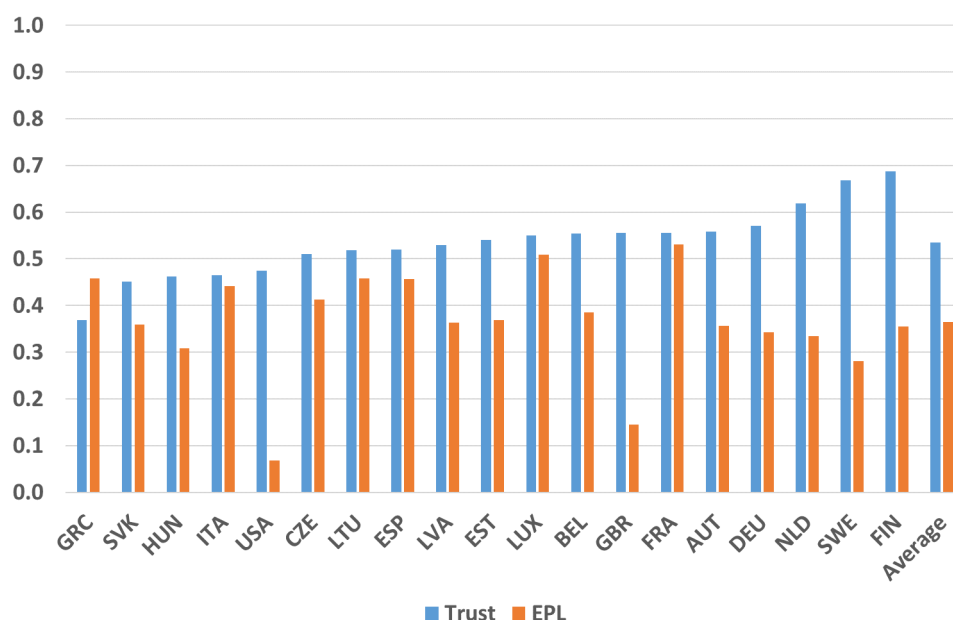
¹¹ Bloom *et al.* (2014) survey concerned manufacturing firms, while our sample covers both manufacturing industries and market services. Therefore, our country-level measure of management quality implicitly assumes that median management practices in the manufacturing sector are also representative of those prevailing in services.

¹² There is a negative and statistically significant cross-country correlation between EPL and our measure of management quality (-0.66), in line with the idea that tight EPL can hinder the diffusion of modern management practices. Conversely, the cross-country correlation between EPL and our measure of trust is very low and not significant, perhaps reflecting the different ways in which the two variables can be linked.

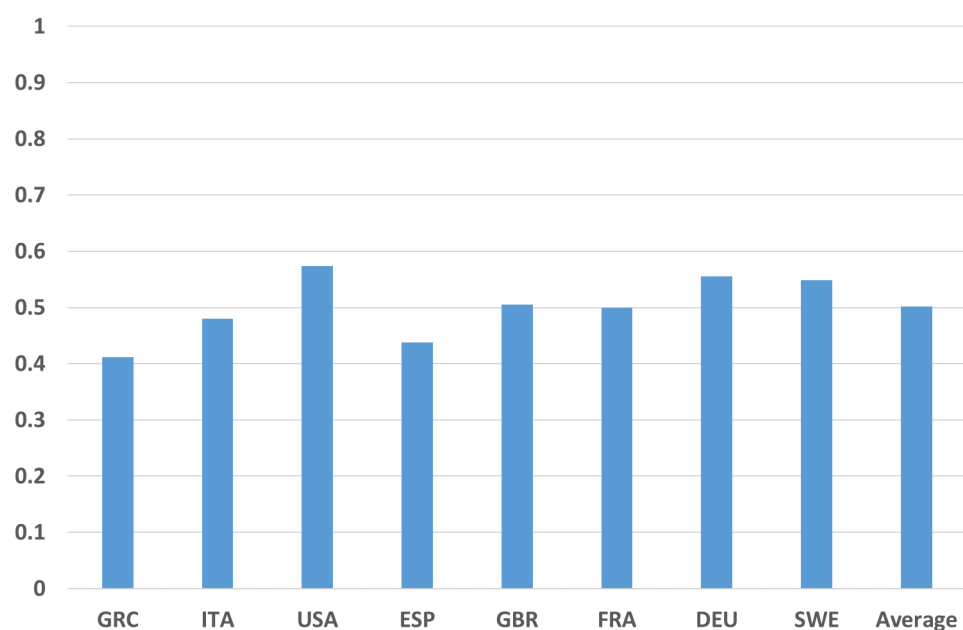
trust and management quality variables are increasing with the confidence of citizens and the quality of practices, respectively, while EPL is decreasing with the ease of hiring and firing. Chart 3A and 3B show the values of these three variables, averaged over the 1995-2018 period. Somewhat predictably, trust is high in Northern European countries (Finland and Sweden) and low in some Southern (Greece, Italy) or Eastern (Slovakia, Hungary) European countries; hiring and firing restrictions are low in United-Kingdom and the US but high in France; management quality is high in the US, followed by Germany and Sweden, and low in Greece.

Chart 3: Economic environment

A – Trust and EPL (19 countries)



B – Management Quality (8 countries)



Note: Period averages normalized over the 0-1 range.

Source: Authors' calculations based on OECD, Bloom *et al.* (2014) and European Social Surveys.

IV. Results

Estimation results of different specifications of the labour productivity model (1) are presented in Tables 1, 2 and 3. In Table 1, we use as explanatory variables the capital-labor ratio, intangible intensity and the interaction between intangible intensity and trust, in order to test for the mediating effect of the latter. In Table 2, the interaction between intangible intensity and EPL is added as an explanatory variable in order to control for the possible mediating role of labour market institutions. Table 3 explores whether the role of trust in mediating the influence of intangibles on productivity is explained by the management channel, as using intangible capital efficiently may involve some specific management processes that require mutual confidence between workers and managers. Accordingly, we introduce the interaction of intangible intensity with management quality as an explanatory variable, instrumenting the latter with our measure of trust.¹³ However, as management quality data are available for fewer countries, the corresponding dataset is smaller.

Throughout our estimations, we check the robustness of the estimates to interacting trust with various measures of intangible intensity. First, we use the country and sector-specific intensities. However, these could lead to biased estimates for a number of reasons.

¹³ In the appendix (Table B3 and B4) we show that results are robust to extending the management instrument set to two further variables, EPL and days not worked due to strikes.

First, they could suffer from endogeneity bias as productivity and intangible intensity could be driven by common industry-level factors that our fixed effects structure is unable to capture (such as digital technology adoption) and intangible intensity could even be related to productivity levels in ways that are not obvious. For instance, some low productivity industries (such as professional services) may structurally have relatively high intangible intensity, corresponding to their productive technology and specialization. Alternatively, high productivity industries, which can more easily meet the fixed cost associated with certain types of intangible (e.g. skills or R&D) and better weather the delayed returns associated with them (Brynjolfsson *et al.*, 2021), may have relatively high intangible intensity.

Second, another drawback of country and sector-specific intangible intensities is that they could be affected by measurement error due to the well-known difficulty of estimating intangibles and the associated cross-country comparability issues (Corrado and Hulten, 2010; Corrado *et al.*, 2012). While to our knowledge the database we use is currently the most advanced effort to measure intangibles across countries in a consistent way, we cannot exclude that remaining measurement errors could affect regression estimates leading for instance to attenuation bias.

Finally, if our conjecture that trust mediates the returns of investing in intangibles is correct, the two components of the interaction – trust and intangible intensity – may be correlated across countries, making it difficult to identify precisely the effects of trust due to multicollinearity. Using a country-free measure of intangible intensity could help better identify the mediating effect of trust.

We therefore take two different instrumental variables approaches to deal with such possible biases. First, in our base regressions we instrument intangible intensities by the values observed in Germany, dropping this country from the estimation sample. We choose Germany as a representative country as the distribution of intangible intensity across industries closely replicates the average distribution across countries (the correlation coefficient is 0.9). Second, in results shown in the appendix (Table B2), we replace the country and sector-specific intensities with sector-specific intensities averaged over all the countries in our sample, each time excluding the country for which we measure productivity.¹⁴ Both these instrumentation approaches can be seen as providing a characterization of industries according their “typical” intangible intensity in each period (see the 2018 characterization in Chart 2).

Trust and productivity in intangible-intensive industries

¹⁴ This instrumentation is in the spirit of Bartik (1991), where the exogenous part of the treatment variable is isolated.

In Table 1, the estimated elasticity of labor productivity to total (tangible and intangible) capital per hour (γ) ranges from 0.28 to 0.35, depending on specifications. Therefore, this parameter appears quite robust to the inclusion of different explanatory variables and different ways of measuring intangible intensity. The estimated elasticity also remains stable across the specifications estimated in Tables 2 and 3. It corresponds more or less, as expected, to the capital share in value added (computed while taking into account investment in intangibles) and is broadly consistent with other research using the same data (e.g. Corrado *et al.*, 2017; Bontadini *et al.*, 2023b).

The estimated elasticity of labor productivity to intangible intensity (λ) also appears very stable across the different specifications.¹⁵ It suggests that an increase (a decrease) of intangible intensity by 1% would be associated to an increase (a decrease) of labour productivity by about 0.18%. Such a positive impact on productivity of shifting towards intangible capital is consistent with the existing literature (for a survey, see Corrado *et al.*, 2022) and can be explained *inter alia* by the knowledge spillovers that characterize many intangibles.

Most importantly for our purposes, the impact of intangible intensity increases with the level of our measure of trust: the higher the trust, the higher the positive impact of intangible intensity on labor productivity, as the total effect of intangibles on productivity is the sum of the coefficient on intangible intensity (λ) plus the coefficient of the interaction term (β) multiplied by the level of intangible intensity prevailing in each country and industry (see Table 1, column 3). This finding is original and suggests that countries with a high level of trust are able to reap higher industry-level productivity benefits from intangible assets than those where trust is lower. Put differently, trust appears to have more synergies with intangibles than with tangible capital as regards productivity outcomes.

These results are qualitatively robust to changing the measure of intangible intensity to account for three factors: potential endogeneity of productivity and intangible intensity, measurement error in intangibles and multicollinearity between intangible intensity and trust. In column 4 we instrument with intangible intensities across German industries (dropping Germany from the sample), while in column 5 we use as instrument the average industry values across the countries in the sample, dropping the country for which productivity is observed (we henceforth call these averages the ‘Bartik’ intangible intensity). Here, we can only estimate the differential effect of trust levels on the returns from intangibles at different levels of intangible intensity as the average effect of intangible intensity is absorbed by our fixed effects. In both cases, the role of trust in boosting the effects of intangibles is confirmed: the interactions are positive and significant. In these regressions, the estimated coefficient

¹⁵ It is only slightly lower (0.14) in Table 3, on a smaller dataset and when the interaction between management quality and intangible intensity is introduced as an explanatory variable.

of the interaction term (β) is roughly four times bigger than in column 3, reflecting the correction for the various sources of bias.¹⁶

Table 1: The mediating role of trust

Dependent variable: Labor productivity per hour (log)

	(1)	(2)	(3)	(4)	(5)
Estimator	OLS	OLS	OLS	IV	IV
Total capital per hour (log)	0.284*** [0.0107]	0.355*** [0.0114]	0.354*** [0.0114]	0.281*** [0.0104]	0.281*** [0.0101]
Intangible intensity (log)		0.177*** [0.00957]	0.178*** [0.00954]		
Trust * Intangible intensity (log)			0.108** [0.0441]	0.407*** [0.0573]	0.380*** [0.0510]
Instruments				Trust * German intangible intensity (log)	Trust * Bartik intangible intensity (log)
Weak instrument test (partial R-squared)				0.66	7269
Durbin-Wu-Hausman test (p-value)				<0.0001	<0.0001
Observations	6,603	6,603	6,603	6,123	6,603
R-squared	0.963	0.967	0.967	0.964	0.963
Robust standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1; Country, industry, year, country*year and industry*year fixed effects					

As mentioned above, the impact of intangible intensity on productivity may also depend on some labor market institutions, which for instance can influence the ability of firms to reorganize the working environment to accommodate the rising role of intangible assets (such as skills and organizational

¹⁶ Formal tests for instrument validity and endogeneity confirm that intangible intensity is endogenous and Germany's values as well as 'Bartik' averages are valid instruments (Col. 4).

capital).¹⁷ To ensure that our findings about the interaction of trust with intangible intensity are not capturing these relationships, we control for the potential role played by hiring and firing regulations in mediating the effects of intangible intensity on productivity.

Table 2 shows estimation results that take into account differences in the OECD indicator of Employment Protection Legislation (EPL). There is evidence that EPL as well plays a mediating role vis-à-vis the productivity impact of intangibles, with EPL stringency curbing the positive effects of intangible intensity (Table 2, columns 2 to 5). Both the sign and the size of the estimates of this mediating effect are quite robust across specifications. Thus, intangibles would appear to need more labor market flexibility than tangible capital to fully exert their positive influence on productivity outcomes.

Results in Table 2 show that, even when we control for the additional mediating effects of EPL, the positive role of trust in boosting the productivity impact of increasing intangible intensity persists, especially when we control for endogeneity, measurement error and multicollinearity issues (columns 4-5). Although the coefficient estimates of the interaction term get somewhat smaller than in Table 1, they remain largely unaffected.¹⁸ As intangible intensity increases, measured differences in trust levels across countries (see Chart 2) translate into a rising productivity premium. For instance, our results imply a productivity premium for Finland (the country with the highest trust level) relative to Greece (the country with the lowest trust level) of 0,12% for each percentage increase in intangible intensity, according to column (4) estimates. Figure 4 illustrates these results graphically taking estimates in Table 2 (column 4) as a reference.

¹⁷ At the same time, there are complex relationships between labour market institutions and the level of trust in the society, as the design of the former may partly reflect the degree of mutual confidence between workers and employers.

¹⁸ In the sequel, we will use the most conservative specification in column 4 to assess the economic significance of the trust-intangibles nexus and perform various robustness analyses.

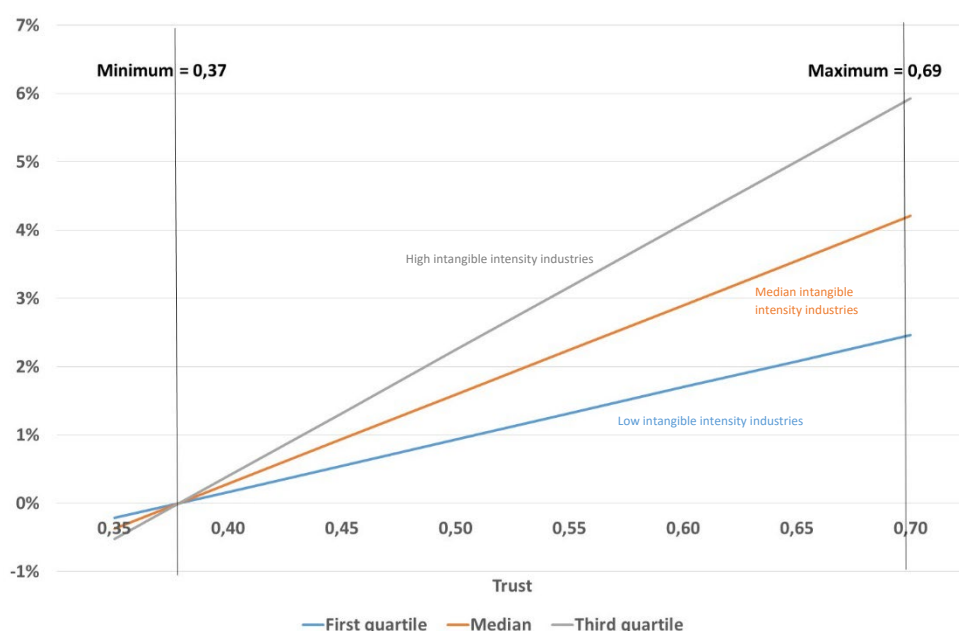
Table 2: Sensitivity to the introduction of EPL

Dependent variable: Labor productivity per hour (log)

	(1)	(2)	(3)	(4)	(5)
Estimator	OLS	OLS	OLS	IV	IV
Total capital per hour (log)	0.354*** [0.0114]	0.358*** [0.0113]	0.357*** [0.0114]	0.282*** [0.0105]	0.281*** [0.0102]
Intangible intensity (log)	0.177*** [0.00954]	0.185*** [0.00957]	0.184*** [0.00955]		
Trust * Intangible intensity (log)	0.108** [0.0441]		0.0725* [0.0431]	0.375*** [0.0566]	0.358*** [0.0500]
EPL * Intangible intensity (log)		-0.163*** [0.0314]	-0.152*** [0.0304]	-0.187*** [0.0400]	-0.132*** [0.0318]
Instruments				Trust/EPL * German intangible intensity (log)	Trust/EPL * Bartik intangible intensity (log)
Weak instrument test (partial R-squared)					
Trust * Intangible intensity (log)				0.66	0.81
EPL * Intangible intensity (log)				0.68	0.82
Durbin-Wu-Hausman test (p-value)				<0.0001	<0.0001
Observations	6,603	6,603	6,603	6,123	6,603
R-squared	0.967	0.967	0.967	0.964	0.963

Robust standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1;
Country, industry, year, country*year and industry*year fixed effects

Chart 4: Intangible-related gains in labour productivity depending on trust levels



Note: The productivity premium of the maximum Trust (0.69) relatively to the minimum Trust (0.37) in term of intangible impact is of 2.4% for industries at the first quartile of intangible intensity, 4.2% at the medium intensity and 5.9% at the maximum intensity (the reference for these calculations is the impact of intangible intensity relatively to an industry at the first decile of intensity).

Source: Authors' calculations based on results in column 4 of Table 2.

The management channel

A prominent channel through which levels of trust are likely to affect the productivity gains of investing in intangibles is management. Indeed, management is an important component of organizational capital, which in turn accounted for one fourth of intangible assets on average across countries in 2018 according to recent estimates (Bontadini *et al.*, 2023b). However, for investment in management skills to produce the expected productivity gains, managers should be able to implement high-quality management practices. Especially in intangible-intensive industries that are dominated by information flows, tacit knowledge, trade secrets and autonomous tasks, implementing such practices is likely to require high levels of trust. Put differently, exchanges of information, ideas and experiences and the effective use of skills to perform tasks in an autonomous way require a cooperative and non-rival environment that is facilitated by mutual confidence among staff and between staff and managers. Thus, the influence of trust on the productivity impact of intangibles unveiled in Tables 1 and 2 may arise from the possibility that in a trustful environment managers are better able to implement the organizational changes required by a working environment dominated by knowledge flows than in an environment where trust is lacking (Hassan *et al.*, 2012; Bulinska-Stangrecka and Bagienska, 2019).

We explore this conjecture in two steps: first, we check whether the productivity gains from good management are particularly relevant in an intangible-intensive context; second, we check whether high levels of trust are enabling the implementation of the good management practices that are relevant in such context. In practice, we introduce an interaction term between management quality and intangible intensity in the productivity model to check whether management quality mediates the productivity impact of intangibles. Then we use trust as an instrument for management quality, which serves two purposes. On the one hand, it addresses the reverse causality issues raised by the possibility that highly-productive sectors are those that are also able to implement high-quality management practices. For instance, this may reflect the better ability of such sectors to attract the best managers and meet the costs of hiring them. On the other hand, if trust is a valid instrument for the mediating influence of management quality on productivity, management quality can be interpreted as one channel through which trust increases the productivity returns of raising the intangible intensity of production.

Table 3 presents estimates of the productivity model that account for the management channel by exploiting differences in management quality across countries. Due to the limited availability of information on management quality, the cross-country sample over which this estimation could be run is significantly smaller than the one used to establish the mediating role of trust (in Tables 1 and 2). Hence, results can only be considered suggestive of a channel through which trust affects the productivity impact of intangibles.

In columns 1 and 2 we present regression estimates obtained by OLS and by instrumenting management quality with trust, respectively, using country and sector specific intangible intensities in the interaction term. In the remaining columns, we also control for possible endogeneity and measurement error of these intensities by instrumenting with German intangible intensities (column 3) and “typical” industry intensities obtained averaging across countries, each time omitting the country for which productivity is measured from the average (column 4).

The estimation results suggest that management quality boosts the effects of intangible intensity on productivity: across all specifications the coefficient of the interaction term is positive and significant at 1% level. Put differently, to fully exert their positive influence on productivity, intangibles appear to require a broader diffusion of high-quality management practices than tangible capital. For instance, the IV estimates (from column 2) would suggest that the US (the country with the highest level of management quality) benefits on average across industries from a productivity premium of 0.15% compared to Greece (the country with the lowest level) for each percentage increase in intangible intensity.

Most importantly for our purposes, trust appears to be a strong and valid instrument for management quality in the interaction term, according to the first-stage partial R-squared and the Durbin-Wu-Hausman test.¹⁹ These results survive the further instrumentation of intangible intensity as well (Column 4). Thus, as conjectured, there is evidence that management is one channel through which trust exerts an influence on productivity via intangible intensity. This is consistent with the idea that, especially in a knowledge-rich environment, trust enables management practices that are aimed at enhancing productivity through organizational change. Of course, there may be other direct ways in which trust may influence industry productivity but our results suggest that these do not go through differences in the intangible intensity of industries other than by enabling such practices.

¹⁹ In the appendix we show that these results are robust to controlling for EPL as well as to using EPL as an additional instrument for management quality. Having EPL as an additional instrument allows to apply Sargan's test for overidentifying restrictions, which our IV specification passes as well.

Table 3: The mediating role of management

Dependent variable: Labor productivity per hour (log)

	(1)	(2)	(3)	(4)
Estimator	OLS	IV	IV	IV
Total capital per hour (log)	0.270*** [0.0188]	0.275*** [0.0168]	0.192*** [0.0193]	0.194*** [0.0173]
Intangible intensity (log)	0.140*** [0.0143]	0.139*** [0.0128]		
Management * Intangible intensity (log)	0.708*** [0.103]	0.474*** [0.122]	0.905*** [0.222]	1.141*** [0.160]
Instruments		Trust * Intangible intensity (log)	Trust * German intangible intensity (log)	Trust * Bartik intangible intensity (log)
Weak instrument test (partial R-square)		0.66	0.24	0.35
Durbin-Wu-Hausman test (p-value)		<0.0001	0.09	<0.0001
Observations	3,117	3,117	2,637	3,117
R-squared	0.949	0.949	0.949	0.946

Robust standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1;

Country, industry, year, country*year and industry*year fixed effects

V. Sensitivity analysis and economic relevance*Sensitivity analysis*

In addition to controlling for possible measurement errors, endogeneity to productivity, and multicollinearity with trust of intangible intensities, we perform a number of robustness checks on our estimates of the mediating role of trust in the link between intangibles and productivity. First, we test for sensitivity to outliers by dropping one country and one industry at a time from the sample as well

as by applying random subsampling methods (Tsao and Ling, 2012).²⁰ Second, we lag explanatory variables to further control for endogeneity. Third, we replace country-industry-year intangible intensity by industry-year averages in order to attenuate possible endogeneity. Fourth, we test the robustness of the management channel in two ways: we control for the possible mediating role of EPL and we supplement trust with both days not worked and EPL as further instruments to deal with the possible endogeneity of management quality.²¹ Finally, we replace trust with another country-level measure of social capital, days of work lost due to strikes, which we view as a result and then a proxy for lack of trust in the workplace.

Our estimates survive all these robustness checks. Notably, omitting countries or sectors and lagging variables affect the size of the coefficient of the interaction between trust and intangible intensity, but leave its sign and significance unchanged. Random subsampling confirms that the bootstrapping estimate of the coefficient is clustered around our IV estimate (Figure B1). Replacing trust by another (inverse) measure of mutual confidence between workers and managers -- days per year not worked due to strikes -- does not change the sign and significance of the coefficient of the interaction: countries where days lost are lower enjoy a productivity premium from investing in intangibles relative to countries where tensions on the workplace are stronger (Appendix Table B4).²² Finally, in the regressions exploring the management channel, controlling for the mediating role of EPL and expanding the instrument set for management quality by including EPL and days not worked due to strikes does not change the results (Appendix Table B3). Moreover, the choice of instruments is validated by the various IV tests (partial R-squared for strong instrument, Durbin-Wu-Hausman test and Sargan test).

Economic relevance

To illustrate the economic relevance of our results, we use the coefficient estimates to compute the productivity gains from the use of intangibles that are missed by the different countries in our dataset compared to Finland (the country with the highest level of trust in our sample) or to the US (the country with the lowest level of EPL in our sample) because of a lower level of trust or a higher level of EPL. In other words, we evaluate the potential productivity gains that would follow from enhancing trust to Finnish levels or from decreasing labor market regulation to US levels.

²⁰ Subsampling methods consist in repeatedly fitting the regression model on a large number of randomly chosen subsamples to check the robustness of the results to changes in the underlying set of data.

²¹ We consider days lost and EPL as two potentially valid instruments for management quality as they are both negatively related to it at the country level, and affect productivity per hour via intangible intensity through their effect on management quality.

²² These regressions had to be run on a reduced number of observations as days of work lost due to strikes are not available for all countries in our sample.

Any change in trust levels requires deep cultural and structural changes, which need time to unfold and are only partly (if at all) resulting from changes in public policies. Hence, these simulations should be considered as illustrative outcomes of a very long-term process. Conversely, changes in EPL can be implemented by policy makers, though neither easily nor quickly as they can raise political and social opposition (from unions for instance).²³ Hence, the corresponding simulations can be considered as illustrative outcomes of a medium-term process. Moreover, over time both changes in trust and EPL are likely to influence positively a number of other economic variables that directly impinge on productivity (regardless of intangible intensity). For instance, trust can influence investment (including in intangibles), worker effort, innovation and knowledge spillovers, and EPL can influence ICT investment and the skill composition of employees (Cette *et al.*, 2018). Therefore, the simulation outcomes should be considered as lower bound estimates of the potential productivity gains, limited to those channeled by a better use of existing intangibles.

To compute the productivity gains from intangible capital that could be reaped by enhancing trust or easing EPL, we use the estimates in which we control for both the endogeneity of intangible intensities (Table 2, column 4). These gains, in turn, depend on the country and sector-specific differences in intangible intensity with respect to the first decile of their distribution, calculated in 2017.²⁴ Industry-level productivity gains are then aggregated over the industries covered by our dataset using the industry shares in total value added for each country. The results of these simulations are presented in Charts 5 and 6.

Potential productivity gains from raising trust to the Finnish level, which come from better use of intangibles, appear to be particularly high in countries where either intangible intensity is particularly high (France, UK, the US) or trust is particularly low (Greece). By contrast, productivity gains are the smallest in Sweden, where trust level is estimated to be closest to the Finnish level, or in Latvia and Slovakia, where the intangible intensity is low. On average over all the countries of our dataset, the potential productivity gains from enhancing trust appear to be around 3.1%.

Potential productivity gains due to easing EPL to the US level, which come from better use of intangibles, appear to be particularly high in France, where EPL is estimated to be the most restrictive among countries in our sample. By contrast, productivity gains are quite small in the UK, where the

²³ Alesina *et al.* (2023) show that liberal reforms are electorally costly to democratic incumbents, especially when they are implemented close to elections. Partly for this reason, the electoral cost of easing EPL is a major disincentive for policy makers. For instance, the Hartz reforms implemented in Germany in the early 2000s have contributed to the subsequent decrease in the German unemployment rate (see among others Hochmuth *et al.*, 2021) but also contributed to the electoral failure of their promoters in 2005.

²⁴ In other words, we assess how the impact on productivity of a change of intangible intensity from the first decile to the observed value depends on the lack of trust. The forgone productivity gains are calculated according to the following formula: $0.358 \times (\log(Intan_{ci17}) - \log(Intan_{17}^{first})) \times (Trust_{Fin} - Trust_c)$, with $Intan_{17}^{first}$ the first decile of intangible intensity in 2017 and $Trust_{Fin}$ the Finnish level of Trust.

value of the OECD EPL indicator is closest to the US, and the smallest again in Latvia and Slovakia because of their low intangible intensity. The average gain of easing EPL across the countries in our dataset are of a similar magnitude 3.7%.

Chart 5: Intangible-related gains in labour productivity from raising trust to Finnish levels

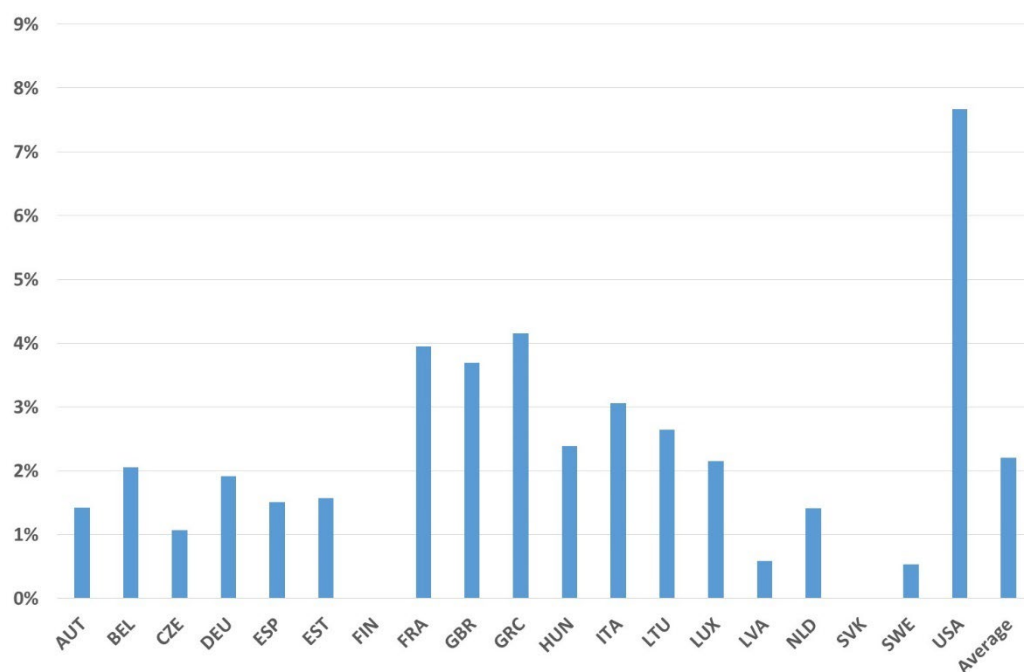
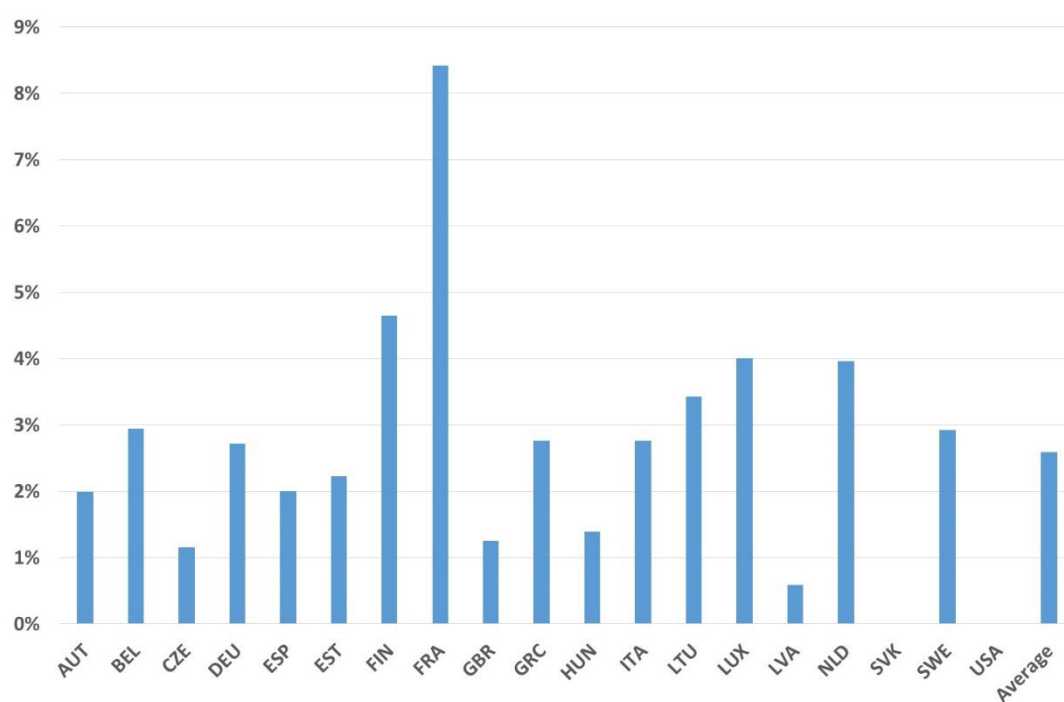


Chart 6: Intangible-related gains in labour productivity from switching EPL to US levels



VI. Conclusions and suggestions for further research

Based on a sample of 19 countries over the 1995-2018 period spanning 20 manufacturing and service industries, the results of the estimation of a simple productivity model show that the productivity gains stemming from the use of intangibles are boosted where social trust is high and where hiring and firing restrictions are low. We also find that the mediating effects of trust in the relationship between intangibles and productivity are most likely channeled by the better ability to implement efficiency-enhancing management practices in a high trust environment than in a low trust one. While these results are novel and survive a number of robustness checks, further analysis in this area would benefit from the development of datasets that cover more countries and have a finer level of disaggregation, especially as regards measures of trust and management quality.

Our findings suggest that in order to benefit mostly from the potential productivity gains associated with the increasing importance of intangibles in the economy, public policies should couple reforms that increase social trust, as expressed in the degree of confidence among citizens, with the easing of hiring and firing regulations. Labor market regulations can be changed by legislators but any attempt to reform employment protection may face high social and political opposition, which may also originate from lack of trust in the workplace.

At the same time, the degree of mutual confidence among citizens (including between workers and managers) is influenced by a range of historical, cultural and institutional factors over which policy makers have only a limited immediate leverage. In the workplace, such confidence is also affected by historical developments in industrial relations. Therefore, any attempt by policy makers to boost social trust involves changes in institutional architectures (e.g. tax and benefit regimes, the composition of public spending, the rule of law, the role of unions, etc.) and their interactions with social relations and values, which are complex and long-term goals. Some hints in this direction are provided by the studies of psychologists and sociologists, who highlight the individual and community drivers of trust, respectively. However, given the stakes, more economic research on the determinants of social trust, with a focus on drivers that could be influenced by policy, would be highly desirable. This research would seem especially relevant as our economies are increasingly characterized by production processes that are knowledge intensive and where trust is likely to play an important role. Indeed, recent developments in generative AI and its potential economic applications are likely to exacerbate the impact of trust on productivity via knowledge-based assets.

Finally, given the difficulties involved in understanding the policy factors that may affect trust, a useful strand of research could also be to explore how the negative effects of lack of social trust on the productivity impact of intangible capital might be compensated by other structural factors -- such as skill levels or innovation incentives -- that are more directly influenced by public policies.

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