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Organizational capital, allocation of intangibles and firm performance: Evidence from Globalinto intangible survey ¹

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Abstract

This chapter examines the role of organizational capital investment in firm performance and how it is linked to other intangibles investments, human capital, organizational capabilities (agility), and the Covid pandemic. The Globalinto survey provides a broad set of intangibles, the organizational capabilities of firms, and how intangibles affect performance. Organizational capital (OC) as part of intangibles in general (including branding, design, and special-purpose ICT) is shown to improve productivity, profit margins, and financial solvency, while R&D has an independent positive effect in all these three ways to measure firm performance. OC and other types of intangible capital are found to be a substantial share of turnover and are essential for European growth, especially in knowledge-intensive services. OC is heterogeneous with a clear separation of internal and external OC, and also direct productivity effects can be more related to problem-solving consulting, i.e., to external OC. This result appears to support the capability-based theory in that internal OC also depends on how the organizational form has evolved. The results do not confirm the recent attention paid to high fixed costs due to OC and R&D investments since they, together with tangibles, generate more turnover than fixed costs.

1. Introduction

A productivity problem plagues Europe. Economic growth is slow, with a low productivity growth rate. Along with R&D, this paper studies whether organizational capital among intangibles can be a solution to the productivity problem of an aging Europe. The importance of internal R&D in innovation activity has been recognized since Schumpeter (1942). More recently, research has become aware of the critical role of organizational capital in innovation and firm performance. Organizational capital (OC) can be in the form of organizational practices, processes, systems, and culture. The economics and management literature has found OC important in improving firm-level efficiency and productivity and sustainable competitive advantage (Carlin et al. 2012; Eisefeldt and Papanikolaou 2013; Lev and Radhakrishnan 2005).

Firms face many challenges in implementing and capitalizing on their own intangible investments, and they often need to coordinate activities within complex global value chains. Factors influencing intangible investments include the use of tailored, customized solutions, the degree of digitalization, and whether its general purpose in nature or oriented to special type applications. Nerdrum and Erikson (2001) find intellectual capital, such as human capital and organizational capital, to be complementary and widely used in various forms of intangible capital (IC).

While much work has been done on the topic, the role of organizational capital for firm performance is complex, generating a number of questions concerning the role of organizational capital in its own right, differences between internally and externally sourced investments, the need for organizational investments to facilitate the implementation of new processes or technologies, complementarities with other intangibles

¹ The EU Horizon 2020 GLOBALINTO project funded this study for 2019–2022 [grant number 822229]. The title is "Capturing the value of intangible assets (IAs) in microdata to promote the EU's growth and competitiveness". GLOBALINTO (www.globalinto.eu) is a continuation of the FP7 INNODRIVE project that developed the INNODRIVE methodology for measuring intangible assets on the firm level.

investments, the ability to adjust to changing conditions, and incorporating high fixed costs from investments in new technology. Organizational capital is heterogeneous Arrighetti et al. (2015), and linked to various organizational capabilities and firm characteristics. It remains open whether organization capital is being embodied in the organization itself, i.e., rooted in organization practices, processes, and systems that remain intact even if the employees of the organization are replaced (e.g., Atkeson and Kehoe, 2005; Lev and Radhakrishnan, 2005).

This paper focuses on the role of this organizational capital investment in firm performance and how it is linked to other intangibles investments, human capital, organizational capabilities (agility), and the Covid pandemic. As varying intangibles (ICs) complement each other and OC relates to the management of them all, we consider them together in some parts of the analysis.

The Globalinto intangible survey was carried out in 2019-2020 as part of the EU Horizon 2020 program. It provided an ideal framework to identify different OC characteristics with detailed information on organizational capacities.² The Globalinto survey follows the ONS survey on intangibles (UK Office for National Statistics) (Awano et al. 2010). Other surveys include the 2009 & 2011 Eurobarometer surveys, and the INAPP survey in Italy, 2013 & 2020. The Globalinto survey focuses on six types of intangible activities as inputs rather than outputs (e.g., patents) information based on the shares of turnover that enterprises have invested in different intangible types in their respective innovation process.

The survey data is linked to Orbis balance sheet data on turnover, fixed assets and employment over 2017-2020. Therefore, the paper also analyses the efficient allocation of ICs by the sales to fixed asset ratio, productivity, and employment growth. Both ICs and tangibles are controlled for in the analysis of productivity effects. Performance depends on several factors besides ICs. The share of turnover due to new or significantly improved products and/or services is the usual way to measure innovation outcomes. It relates strongly to how ICs are considered to improve performance and are an important indicator of growth-orientation firms. We consider it also to measure the overall technological level of the firm rather than just the total capabilities gained from the alternative innovation processes.

Based on the questionnaire, the paper also defines organizational agility. It shows the opportunities in adapting best practices, paying attention to customer feedback, and having joint innovation strategies to exchange ideas. Firms also need external knowledge sourcing to see where the market is moving. Reactive agility shows the ability to source (radical) external knowledge on changes by competitors and market demand and quickly respond to changing market conditions. The survey was carried out during the Covid pandemic, and therefore, it is also important to account for how the pandemic affected employment growth and investment in intangibles.

OC is not widely analyzed in the context of being part of broad ICs, as in Corrado et al. (2021), or studies that use proxies, such as organizational complexity in Arrighetti et al. (2015). Part of the main intention of the Globalinto intangible capital survey is to provide and develop the measurement of a broad set of intangibles and to have a wide range of organizational or business process improvements that can be linked to OC. Based on the Orbis data, we also measure performance in terms of how ICs are related to employment and productivity growth. In chapter 4 of this book, Felix Roth finds economic competencies such as training, branding, and management to be the most critical and omitted elements of ICs that are still missing in national

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accounting. The GLOBALINTO firm survey is a welcome new initiative to analyze a broad data set on intangibles.

ICs are usually found to be scalable by lowering marginal costs while increasing fixed costs (Crouzet et al. 2022). On the other hand, Piekkola (2009) finds that a higher number of employees in the firm working abroad entails a greater amount of organizational capital needed to monitor the relationships between different production units and markets. In addition, the survey has information on foreign direct investment that may require more OC in the parent firms. If the firm has a high share of world markets, it may instead indicate that headquarter activities are located abroad (foreign ownership is not known in the data).

The chapter first examines determinants of investments in organizational capital using a Tobit model, both for total and internal and external investments. Next, we examine the role of other types of intangible capital, human capital, and fixed capital investments. Thereafter, the chapter analyses the contribution of organizational investments and other firm capabilities on productivity, the profit margin from intangibles, efficient fixed asset allocation, and growth in employment and productivity.

The chapter shows that organizational capital complements most other ICs that generally improve productivity and profits. Protogerou (2023 et al.) show that OC increases the probability of all kinds of innovation output. We find differences in the internal or external sourcing for OC for various forms of firm performance, which is an essential difference to R&D. Moreover, OC precisely improves all kinds of innovations, and therefore ICs should also be considered as a whole. Section 2 reviews the literature on OC and its performance as part of a broad set of firm capabilities and characteristics. Section 3 describes the data. Section 4 provides results, and section 5 concludes.

2. OC and capabilities

Evenson and Westphal (1995) relate organizational capital to the following firm attributes (the specific examples are by Lev and Radhakrishnan, 2005): (a) firms' operating capabilities, such as product design systems, production management, and engineering (e.g., just-in-time inventory), input outsourcing (supply channels), and marketing technologies (e.g., on-line distribution channels); (b) investment capabilities, such as advanced project selection mechanisms (e.g., using real-options methodologies for project evaluation), personnel training, and financial engineering in fundraising and risk management (e.g., hedging assets, liabilities, and currency exposures with financial derivatives).

Wyatt (2005) emphasizes management's important role in defining the firm's set of ICs. Intangibles that involve considerable discretion by management are more valued than the others, such as purchased goodwill or R&D. Wyatt (2005) also finds that the assets with a shorter technology cycle are better recorded in accounts, and we indeed have to manually include ICs into fixed assets as they are not capitalized in firm balance sheets.

Teece (2015) criticizes the resource-based view in its original form as giving insufficient attention to management but appreciates the focus on organizational assets that are rare, difficult to imitate, and non-substitutable. Teece (2015) emphasizes that managerial skills perform multiple tasks, including the processes and skills needed for renewing the firm's resources. Crouzet et al. (2022) suggest that "non-rivalry in use" could also characterize the type of OC that relates to creating intangible goods or services specific to the firm. Organizational capital is also divided here into internal or external resources, such as relying on consulting, which affect performance differently. Firm-specific resources may even be diluted if firms rely too strongly on external knowledge, which is not novel and excludability is low, and competitors have good access (Grimpe and Kaiser 2010). Internal OC is, in turn, more closely related to the other ICs that the firm possesses.

De Ridder (2021) suggests the high fixed costs in connection with ICs to be one reason for decreased labor productivity since 2000. Crouzet et al. (2022) consider fixed costs with subsequent low marginal costs also to provide scalability: the broad intangibles can be used to expand a wide span of operations. The latter, high-fixed costs, can also lower rivalry and inhibit new competitors from entering that market. In contrast to other innovation activities, organizational innovations are usually more incremental to lower fixed costs. An important "fixed cost expense item" is, in any case, hoarding of R&D and OC labor since they are difficult to recruit. ICs are more resilient to business cycles than other fixed assets, emphasizing financial solvency's importance. A potential fixed cost is also that ICs work as poor collateral for debt finance, which is needed to create growth in the longer run (Landini et al. 2020).

Management practices have been found to contribute to higher firm productivity (Bloom and Van Reenen 2007; Syverson 2011; Bloom et al. 2013). Prior studies also discuss how firm valuation depends on marketing (e.g., Joshi and Hanssens 2010) and protecting marketing assets through trademarks (see Sandner and Block 2011). OC should lead to an increase in human capital, further enabling OC innovations. Business (organizational and marketing) innovations with innovative OC workers are also successful means efficiently using R&D to create product innovations (Caroli and Van Reenen 2001; Damanpour et al. 1989; Piva and Vivarelli 2002). Organizational and managerial practice and branding have led to new innovations (Bloom et al., 2012; Bresnahan et al., 2002). It is noteworthy that firms having any IC appear to have a substantial effect on economic performance, such as becoming a high-growth firm, although entrepreneurs with their own intangible capabilities are at least equally important in running the business (Norkio and Piekkola 2023).

Antonelli et al. (2023) argue that reducing the relative wages of skilled labor due to increased supply has favored generating new knowledge and its use as an input. Reducing the cost of human capital leads to a knowledge-intensive and capital-saving direction of technological change where knowledge substitutes physical capital. Antonelli et al. (2023) find that in the past 40 years, technological change has been increasingly knowledge-intensive and tangible capital-saving. Hence, information technology requires firm-specific investments in skills and organizational capabilities to enable the accumulation of intangible assets. These assets are not accounted for as capital in balance sheets but represent a significant source of productivity growth (Tambe et al., 2020). Chapter 4 of this book by Felix Roth shows that external OC, such as consulting, is closely the same amount as that of internal OC, while internal OC and entrepreneurial talent are the key elements of growth (Norkio and Piekkola 2023).

We examine the relation of OC to broader measures of organizational agility. Sull (2009) identifies three different types of agility: operational agility, portfolio agility, and strategic agility, which we narrow down to organization agility and reactive agility. Organizational agility is the ability to adapt best practices, pay attention to customer feedback, and have joint innovation strategies with the exchange of ideas. OC with organizational agility can be the ideal combination to produce organizational change and renew organizational structures to extend technology and organizational boundaries. Organizational agility is related to effectively responding to a changing environment while at the same time being productive. One idea is to serve ever-smaller niche markets and individual customers without the high cost traditionally associated with customization. Surveys can be used to measure such strategic or organizational agility, which refers to the ability to detect and decisively seize a long-term opportunity, thus being a game changer.

External knowledge sourcing is required in reactive agility, which helps firms to react to market or changes in customer demand. In new types of innovations, such as environmental innovations, external knowledge sources, such as consulting, can radically extend the knowledge boundaries. Reactive organizations are most typical in basic services, where we also found the firms to have the lowest turnover fixed asset ratio, thus, potentially vulnerable to financial constraints. These firms closely follow markets (demand competition, regulation, demography) and have rapid responses to competitors, and adjust to changes in the market.

Strategic agility is considered reactive agility, such as "...rapidly scaling up a new business, aggressively entering a new market, betting heavily on a new technology, or making significant investments in capacity" (Sull 2009, p. 83). It also fits Mathiassen and Pries-Heje (2006) organization agility measuring the speed with which the organization can respond to customer requests, market dynamics, and emerging technology options.

3. Data and methods

The Globalinto survey was undertaken using CATI (computer-assisted telephone interviewing) in the autumn 2020 - spring 2021 period covering 1796 firms in Finland, Denmark, France, Greece, Germany, Slovenia, and the UK (215 firms in the smaller countries, 315 in France, 312 in Germany and 312 in the UK) (Caloghirou et al. 2021). Compared with the official community innovation survey (CIS), new elements are added to identify organizational capital, ICT, and other forms of intangible investments. In addition, it records both internal and external R&D and other intangibles investments. Given that the focus is on the role of intangibles activities, we limit the sample to firms with at least one form of intangibles (OC, R&D, ICT, training), in all 1522 out of 1796 firms. The analysis thus follows the approach adopted in the probit analysis in (Caloghirou et al. 2021). Around 60% of firms are in manufacturing, and one-fourth are large, with at least 250 employees (headcount number of full-time employees at the end of 2019). Of these 1522 firms, 713 have investments in OC, 928 in R&D, 359 in internal design, and 349 in external design. The service sample consists mainly of knowledge-intensive service (KIS) industries.

Given the large 11% share of R&D workers, 25% share of university-educated (skilled) workers, and 63% of firms having product innovations, the sample can be considered to cover mainly knowledge-intensive firms. Around 30% of firms are within KIS industries, while 10% are from other service industries. R&D service (NACE 71-72) and organizational service (NACE 69,70,73) industries make up about one-third of KIS, ICT service (NACE 62-63) one-fourth and 16% are other KIS (mainly transport other than land).

Independent variables

The definition of organization capital in the OSLO manual (OECD/Eurostat 2018) identifies the following economic competencies: brand equity, firm-specific human capital, and organizational capital (Corrado et al. 2005). The Globalinto survey measures organizational capital investments by asking, "Which percentage of the enterprise's turnover (market sales of goods and services including all taxes except VAT in 2019) was spent on organization or business process improvement carried out by a) external providers (consultants) or b) using internal sources?". The other ICs cover survey branding, training, design, R&D, and ICT (database and software) Business process improvement is the main task of management besides just running an existing business. Chapter 6 describes an alternative method to proxy organizational capital investments using occupation and wage income data, where 40% of management time is assumed to go to producing OC and thus not running just existing operations. Corrado et al. (2005) considers this share to be 20%.

Changes in ICs, and performance due to the pandemic were asked in relation to the pre-pandemic period in 2019, i.e., before WHO declared Covid-19 be characterized as a pandemic. An important observation is that the distribution of ICs is skewed; see Table 8.3 in Chapter 8.

Digitalization is a log of the averaged value on a Likert scale of 1 to 5 of past three years (2017-2019) to what extent the enterprise made investments in the following in innovation technologies in the following items

- a) Hardware technologies
- b) Digital technologies
- c) Bioinformatics-related technologies

Organizational agility is a composite variable including four dimensions: active scanning for the best practices in the sector, change of practices based on customer feedback, joint development of innovation strategies across the enterprise's functional areas, and exchange of new ideas openly across the firm. Each dimension was assessed by survey respondents on a five-point Likert scale (1 strongly disagree to 5 strongly agree). The values of individual variables were averaged (total value divided by the number of components used) to estimate the value of the organizational agility for each firm.

Reactive agility which shows the firm's ability to source external knowledge is also a composite variable encompassing three dimensions: rapid response to competitive moves, regular consideration of the consequences of changing market demand for the enterprise's new products and services, and quick recognition of changes in the market (e.g., competition, regulation, demography). Each dimension was assessed by respondents on a five-point Likert scale (1 strongly disagree to 5 strongly agree). The values of individual variables were averaged to estimate the value of the reactive agility for each firm. Appendix 1 shows other explaining variables (which are less obvious) (the questions phrased for internal and external R&D and specific and general (general purpose and databases combined) ICT).

Measures of firm performance

We apply productivity (turnover per employee) and three years of productivity and employment growth as one of our several ways to assess the firm performance. Employment is also less sensitive to pandemics than sales. A sampling of firms for productivity and employment growth is done mainly from Orbis, where we have data for employment growth for 1296 firms. Besides labor productivity (turnover per employee), our second firm performance measure is profit margins from intangibles, which is obtained from the following question in the Likert scale:

Q.43 Please indicate to what extent the enterprise benefited from investments in intangible assets made in 2017-2019 in terms of profit margin

The third performance measure of efficient allocation of fixed assets is assessed by the transformation of fixed asset turnover to FAT given by $S/(S+F) = 1/(1+F/S)$, where S is turnover and fixed asset ratio F/S covers tangibles (from Orbis) per turnover (from survey) and OC/S and R&D/S ratios are directly available from the survey. The modified fixed asset turnover (FAT) reveals how efficiently a company generates turnover from its existing fixed assets. Including organizational capital (OC) and R&D makes manufacturing and services more comparable, the latter being more OC-intensive. The questions phrased for internal and external R&D, and specific and general ICT (general combines general purpose and database ICT) are in Annex A.

Table 1 summarizes variables for the sample of 1522 firms having some of the specified intangibles (OC, R&D, ICT, training). The intangible investments are obtained by multiplying their assessed turnover rate (value is set to zero if missing). These figures are also used per turnover (original values) or employee. For example, OC/S is organisational investments as a share of turnover. OC/L is measured as the ratio of OC/S multiplied by turnover to L (survey variable: number of employees). Log values of intangibles are set to zero if not known or missing. One argument in including these observations in the analysis is that mean intangible intensity is very high as few report zero value of any intangibles. In the empirical analysis later, the logarithmic value of employees and changes in R&D and employment due to Covid are used due to high variation (again set at zero if do not know or missing). The fixed assets (706 non-zero values) are from Orbit data and are referred to as tangibles in the summary table. It is well known that firms underreport R&D and exclude any OC in fixed assets, reported as part of goodwill, if their value has been evaluated in mergers and acquisitions. ICs show investment rather than any attempt to measure stocks; see Table 1 below and Figure 1 later. 47% of the sample have a positive amount of internal or external OC, and the average value is 61 thousand € per employee. Among firms with a positive amount of R&D, the average value of R&D is 64 thousand € per

employee (with a median value of 5). Results here imply that firms have about an equal amount of R&D than OC.

Efficient allocation of fixed assets is assessed by the transformation of fixed asset turnover to $S/(S+F)$, where S is turnover and fixed assets F include OC and R&D separately assessed. The transformed fixed asset turnover (FAT) reveals how efficiently a company generates turnover from its existing fixed assets.

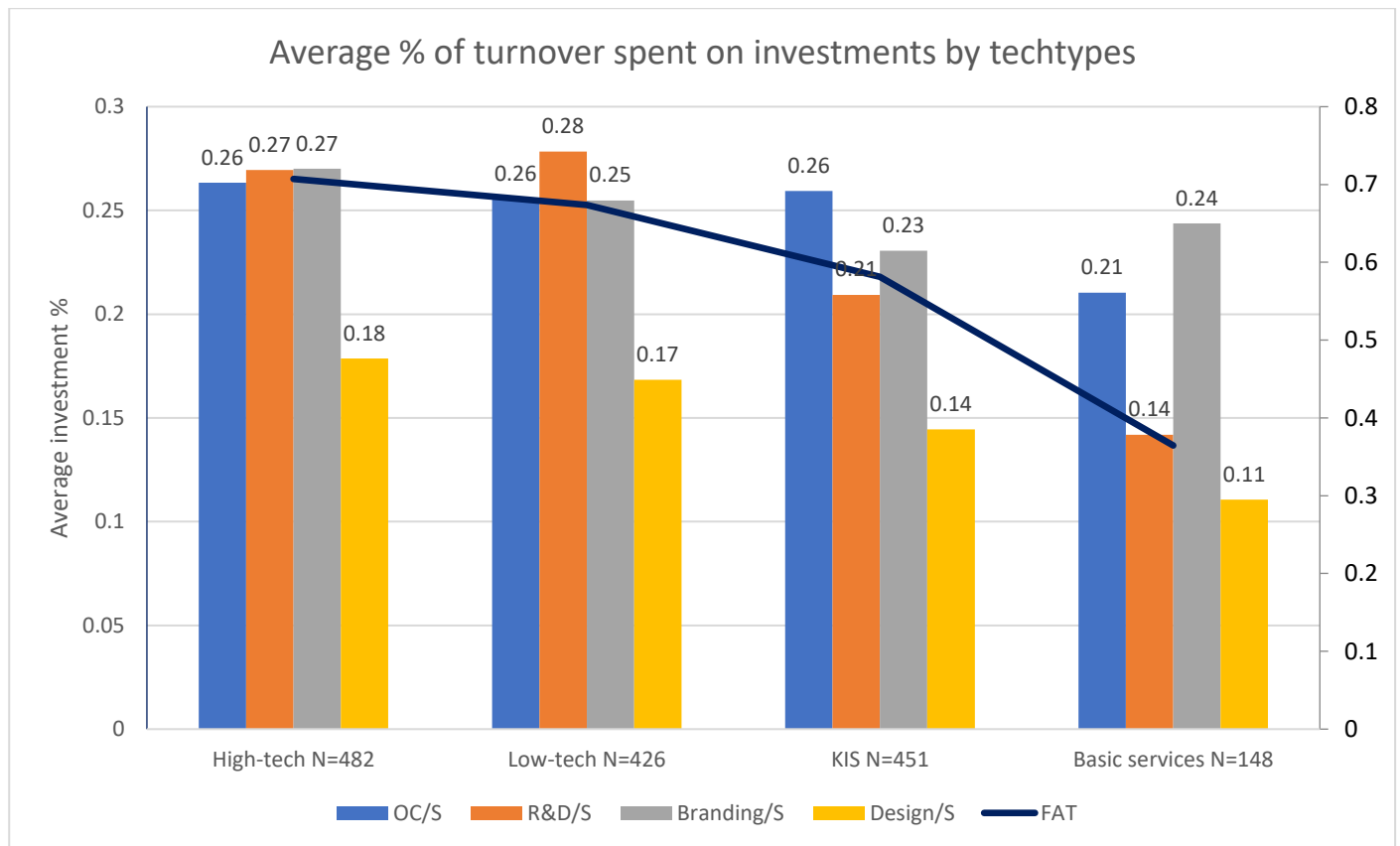
Table 1 Descriptive statistics of model variables (N=1522)

Variables	Mean	Median	Std
Productivity (S/L)	284	156	640
FAT Fixed asset turnover transformed (S/(S+F))	0.65	0.50	0.62
Employee	255	64	985
Employee skilled	53	10	536
Significantly improved new products and services/S	0.15	0.07	0.24
OC/S	0.25	0.00	0.45
OC Internal/S	0.13	0.00	0.28
OC External/S	0.12	0.00	0.27
OC/L	60.3	0.0	201.0
OC internal/L	31.0	0.0	126.0
OC external/L	29.3	0.00	119.0
R&D/S	0.53	0.05	1.53
R&D/L	120.0	7.8	447.0
IC/L	1.03	0.53	1.66
Tangibles/L (from Orbis data)	30	0	88
Design internal/S	0.08	0.00	0.22
Design external/S	0.08	0.00	0.22
Branding/S	0.09	0.00	0.15
ICT special purpose	0.46	0.00	0.50
ICT general purpose	0.43	0.00	0.50
Digitalization	1.67	1.67	0.73
Organisational agility	3.63	3.50	0.69
Reactive agility	3.76	3.67	0.77
Skilled worker share	0.23	0.14	0.24
Process innovation	0.55	1.00	0.50
Foreign direct investment	0.14	0.00	0.35
World market share	11.60	1.00	19.60
Production industry dummy	0.60	1.00	0.49
Pandemia: employment change	0.07	0.00	0.14
Pandemia: Development of tailored solutions	0.39	0.00	0.49
Pandemia: R&D change, %	0.03	0.10	0.34

In FAT tangible investment in fixed asset F is from Orbis, R&D, OC, Turnover from the Globalintangible survey.

Including OC and R&D makes it more comparable between manufacturing and services, the latter being more OC intensive. Higher FAT implies that management is using its fixed assets more effectively. The mean value of FAT is 0.59, the median value is 0.38, and satisfies the normal distribution's statistical properties better than the S/F ratio. Skewness is low compared to the original fixed asset turnover S/F. Tangible assets per employee have a mean value of 30 thousand € so the stock value is less than the sum of OC and R&D. Including other ICs (branding, design, training) would more than double the ratio of total IC to turnover to be closer to 62-82%. This well exceeds the ratio of business IC to value added found in industrial analysis (about 12% for EU10 in (Roth and Sen 2021)). This also suggests clear overlap between the ICs. About one-third of firms developed tailored solutions for customers, while the mean decrease in the number of employees or R&D in 2020 relative to the pre-pandemic 2017 So was about 5% (or 2% in the table, including missing values with zero value). In general, R&D activity also decreased due to Covid. Figure 1 shows the main ICs per turnover and transformed FAT in the right axes in four technology types: high-tech manufacturing, low-tech production (including utilities), KIS, and basic services.³

Figure 1. Intangibles per turnover and FAT by technology type



FAT decreases as we move from high-tech manufacturing from the left to basic services to the right. A lower share in services suggests a less efficient allocation of fixed assets. A deeper look at this would also pay attention to fixed asset composition. In KIS, tangibles take the smallest share while being relatively more collateralizable than intangible assets. IC/S is also lower than in manufacturing, implying that the financial allocation of intangibles is also efficient. Manufacturing is, thus, potentially the industry that should also

³Techtypes are (NACE 2-digit classifications) High-tech manufacturing: 20, 21, 26, 27, 28, 29, other transport 3; Low-tech production: rest of manufacturing + energy 35. KIS: ICT62-63, OC70-71, 73, R&D72; other KIS 50, 51, 58-59, 60-61, 64, 69, 74, 90. Basic services: Trade46-47, 49, 52, 56, 68.

analyze intangibles concerning financial solvency, although a higher share of tangible assets can make it less vulnerable to liquidity constraints. Figure 1 also shows that the turnover shares of OC and R&D were about equal in general, while R&D takes a slightly more prominent role in manufacturing and OC in services. Expenditures on branding are evaluated to be almost the same as OC and together correspond to about 50% of turnover, except in basic services. The heterogeneity in the composition of intangibles by technology type shows heterogeneity in intangible asset accumulation (Arrighetti et al., 2015).

4. Results

We are first interested in how OC relates to other ICs or to a technological level, which is proxied by the turnover share of significantly improved products and services and process innovations. A positive association between intangible investments and innovation would reveal a cause-effect phenomenon over the longer term; however, in the short term, as observed in the data, the correlation is low between innovative products and services turnover ratio and any of the intangible items. The literature also finds both occupational capabilities such as agility and human capital such as educational skill to be related to OC. The relevant explaining variables of OC are also dichotomous values of investments either to special-purpose ICT, which 44% of firms have (have ICT applications in accounting management software, control of production flows, business intelligence tools), or general ICT which 43% of firms have. The latter general ICT covers both general-purpose ICT and occurrence of database and other computerized information.

The estimation applies the maximum likelihood (ML) Tobit model with the log OC per turnover as the dependent variable since the values are concentrated at the lower limit of zero (report zero or no OC). Table 2 also explains external OC per turnover in column 2 and internal OC per turnover in column 3. The turnover share of significantly new products and services has a positive but insignificant relation to OC/S. Process innovations and special-purpose ICT are positively related to external OC, while internal design and the share of skilled employees are positively related to internal OC. OC can also be considered to be heterogeneous in that internal OC relates to a higher number of highly educated employees, while special-purpose ICT is positively related to external OC. Arrighetti et al. (2015) suggest that intangibles also serve purposes that are purely organizational (to run a complex organization's business). The capability-based theory argues that firms evolve over time and are only marginally affected by exogenous technological contingencies (Dosi et al. 2000). External OC related to management consulting is more specific in enhancing technological advances and depends little on the firm's history. External OC is used for problem-solving activities. R&D and branding per turnover are positively related to both external and internal OC. A 100% increase in branding per turnover relates to a 68% increase in OC turnover share, so there appears to be a linkage between these two types of intangibles.

Both internal and external OC are increasing in foreign direct investment and falling in the share of world market turnover. This supports the argument that globalized firms have more OC because of foreign operations like FDI. On the other hand, the negative effect of world market turnover shares may indicate that OC is concentrated more in another parent country with headquarter operations.

Next, we study firm performance from three different angles. We first explain productivity (turnover per employee) controlling for tangible assets per employee. Productivity is hence not measured by total factor productivity since it is generally well-known that tangibles are imprecisely measured. This imprecise measurement also applies to ICs. Another performance measure is a 5-point Likert scale from the question, "To what extent the enterprise benefitted from investments in intangible assets made in 2017-2019 and in terms of turnover or profit margin". A positive effect of explanatory variables such as internal or external OC (or R&D, other firm characteristics) likely implies that OC is also valued in improving profit margins. Here we apply a generalized ordered logit model where heterogeneity is created by the four main technology types with low-tech manufacturing as the reference.

Table 2 Tobit model for organizational investment (OC) per turnover

	OC/S	OC internal /S	OC external /S
Significantly improved products and services/S	0.16 (0.09)	0.11 (0.07)	0.08 -0.06
Process innovation	0.12* (0.05)	0.07* (0.03)	0.10** (0.04)
R&D/S	0 (0.02)	-0.01 (0.01)	0.01 (0.01)
Branding/S	0.73*** (0.15)	0.55*** (0.11)	0.45*** (0.11)
Design internal/S	0.22* (0.11)	0.23** (0.08)	0.04 (0.08)
Design external/S	0.05 (0.11)	-0.01 (0.08)	0.06 (0.09)
ICT special purpose	0.16** (0.06)	0.06 (0.04)	0.16*** (0.04)
ICT general (general purpose, database)	-0.11 (0.06)	0 (0.04)	-0.13** (0.04)
Organisational agility	0.06 (0.03)	0.04 (0.03)	0.05 (0.03)
Skilled employee share	0.17 (0.09)	0.15* (0.07)	0.03 (0.08)
Foreign direct investment	0.23*** (0.06)	0.15** (0.05)	0.14** (0.05)
World market share %	-0.30* (0.12)	-0.24** (0.09)	-0.16 (0.09)
Log likelihood	-1321.67	-967.27	-943.96
LR(X ²)	120.51	114.02	106.66
R Squared pseudo	0.044	0.056	0.053

1522 observations. Tobit with lower limit 0. Estimation includes manufacturing and country dummies and constant.

*** significant at 1% level, ** significant at 5% level, * significant at 10% level

Finally, as discussed, we measure the allocation efficiency of various types of fixed assets by $S/(S+F)$, where ICs play a prominent part. Thereby we have a clear interpretation of the performance effects, where we are not only interested in productivity (first column) but in profitability (second column) and the efficient (financial) allocation of fixed assets, including ICs (third column). We also show the respective performance effects of total IC (OC, R&D, Branding, Design) in the last three columns, 4-6. These columns show how OC can improve performance by being part of the total IC, as Table 2 shows OC being closely related to other ICs.

Table 3. Performance: productivity, profit margin from IC and fixed asset turnover (FAT)

	Log of productivity	Profit margin from IC	FAT	Log of productivity	Profit margin from IC	FAT
Significantly improved products and services/S	-0.248* (0.101)	0.417* (0.206)	-0.122* (0.049)	-0.241* (0.101)	0.433* (0.206)	-0.072 (0.06)
Log of OC internal/L	-0.01 (0.006)	0.003 (0.012)	0.036*** (0.003)			
Log of OC external/L	0.016** (0.006)	0.014 (0.012)	0.037*** (0.003)			
Log of R&D/L	0.020*** (0.005)	0.029** (0.01)	0.064*** (0.003)			
Log of IC/L				0.013** (0.004)	0.018* (0.008)	0.068*** (0.003)
Log of digitalisation	-0.107 (0.063)	0.875*** (0.139)	0.015 (0.031)	-0.087 (0.062)	0.919*** (0.138)	0.099** (0.037)
ICT special purpose	0.058 (0.059)	0.344** (0.12)	-0.005 (0.029)	0.069 (0.059)	0.356** (0.119)	0.047 (0.035)
ICT general (general purpose, database)	-0.003 (0.06)	0.114 (0.122)	-0.027 (0.03)	0.002 (0.06)	0.126 (0.121)	-0.01 (0.036)
Tangibles/S	-0.391*** (0.089)	-0.002 (0.185)	1.069*** (0.06)	-0.384*** (0.089)	-0.002 (0.184)	1.035*** (0.071)
Skilled worker share	-0.093 (0.11)	-0.449* (0.227)	0.005 (0.054)	-0.097 (0.11)	-0.448* (0.226)	0.033 (0.066)
Log of L (employee)	-0.021 (0.02)	-0.191*** (0.043)	0.020* (0.01)	-0.014 (0.02)	-0.179*** (0.042)	0.046*** (0.012)
Organizational agility	-0.146*** (0.04)	0.463*** (0.086)	0.017 (0.019)	-0.135*** (0.04)	0.481*** (0.086)	0.072** (0.024)
Reactive agility	0.121*** (0.035)	0.217** (0.076)	-0.01 (0.017)	0.124*** (0.036)	0.219** (0.075)	-0.013 (0.021)
Pandemic: Development of taylored solutions	-0.054 (0.05)	0.182 (0.101)	-0.048 (0.024)	-0.041 (0.05)	0.202* (0.1)	-0.016 (0.03)
Pandemic: log of R&D change %	0.045 (0.07)	0.119 (0.145)	0.001 (0.034)	0.026 (0.07)	0.089 (0.143)	-0.058 (0.041)
Observations	1548	1474	1548	1548	1474	1548
Log likelihood	-2041.4	-2060.6	-823.3	-2049.9	-2064.3	-1077.8
LR(C ²)		319.6	1488.8		312.2	979.8
R-Squared (Pseudo ordered logit)	0.102	0.072	0.475	0.000	0.070	0.312

In columns 1, 4 OLS, In columns 2, 5 generalized ordered probit, technology types heterogeneous. In columns 3, 6 Tobit estimate with lower limit 0. Includes production and country dummies.

*** significant at 1% level, ** significant at 5% level, * significant at 10% level

The share of turnover due to significantly improved products and services has a negative or insignificant effect on productivity in column 1 but a positive effect on profit margins in column 2. This shows that technological advance improves the positive effects of ICs on profit margins (also holds for how ICs are considered to improve turnover, not shown here). Given the Covid pandemic, the profits from ICs are possibly expected to materialize in the longer run, while immediate productivity improvement is lacking. As a result, investments in IC rise in value in order to increase profitability and hence the firm's survival probability. Following Antonelli and Scellato (2011), firms' exit is a threat during the pandemic, and their innovation and technology represent a crucial leverage to survive.

Internal OC does not improve productivity or profit margins from ICs in columns 1-2, but ICs as a whole in columns 3-4 do. External OC has a direct positive effect on productivity but not profit margins. We noticed earlier that external OC accompanies well special-purpose ICT, which here strengthens the positive effect of IC on profitability. We can see again the heterogeneity in OC both in effects on productivity and how ICs affect profits. As regards R&D, there is no ambiguity as both internal and external R&D improve performance. One reason can be that R&D is always conducted with the long run in view but depreciates at a lower rate, so existing R&D also matters. However, the pandemic did not lead to new investment in R&D.

Shares of skilled employees generally have an insignificant negative effect on performance. The insignificance is likely explained by a minority of skilled workers not engaged in producing ICs, as seen in the occupational intangible capital approach. Non-IC professions among university-educated staff are relatively low-paid jobs, and the positive effects of ICs are already controlled for.

The introduction considered agility also to give important organizational capabilities. Organizational agility is unrelated to productivity in column 1, but it positively affects firm performance in all other cases. Reactive agility improves productivity performance but not the efficient allocation of fixed assets (columns 3 and 6) and becomes insignificant for productivity when all ICs enter the analysis (column 4). IS as whole clearly has a positive effect on all performance measures. The relevant ICs in this respect can be branding or design, while OC improves profitability in the longer term as it is typically more gradual in nature. During the pandemic, tailoring new products or services also makes IC investments yield higher profits, but otherwise, it does not improve performance. Firms needed to tailor and customize their product during the pandemic, as 36% of firms report this as one of the most important ways to adjust to the pandemic.

ICs are usually found to be scalable by lowering marginal costs while increasing fixed costs (Crouzet et al. 2022). De Ridder (2021) even suggests high fixed costs as one reason for the decrease in labor productivity since 2000. However, relatively little is known about financial solvency. Table 3 shows the determinants of FAT, which is also improved by ICs, digitalization, and organizational agility. ICs appear to improve financial solvency rather than deteriorating it. One reason is scalability. Crouzet et al. (2022) also view fixed costs with subsequent low marginal costs to provide scalability when the same ICs, including OC, can be used to expand the range of operations. High fixed costs, in turn, inhibit market entrants. This positive growth impulse offsets the adverse effects. Next, we relate ICs to annualized employment and productivity growth over the three years 2017-2020 and during the pandemic 2019-2020, where the growth variables employment, turnover per employee are from Orbis data. We do not analyze OC separately as it is not found to be directly related to productivity (which also applies to growth).

Table 4. OLS for annual employment and productivity growth over three years, 2017-2020 and 2019-2020, %

	Growth three years 2017-2020		Growth 2019-2020	
	Employment	Productivity	Employment	Productivity
Significantly improved products and services/S	0.038* (0.018)	0.079** (0.025)	0.018 (0.023)	0.062* (0.031)
Log of IC	-0.004 (0.003)	-0.005 (0.004)	-0.005 (0.004)	-0.009 (0.005)
Log of IC, KIS	0.014** (0.004)	0.019*** (0.005)	0.011* (0.005)	0.019** (0.007)
Log of digitalization	-0.017 (0.011)	0.001 (0.014)	-0.012 (0.014)	0.003 (0.018)
ICT general (general purpose, database)	0.022* (0.009)	0.025* (0.012)	0.008 (0.012)	0.016 (0.016)
Organizational agility	0.005 (0.006)	-0.002 (0.009)	-0.002 (0.008)	-0.005 (0.012)
Pandemic: Log of Employment change %	0.087 (0.045)	0.227*** (0.058)	0.001 (0.058)	0.209** (0.074)
Pandemic: Development of tailored solutions	0.052 (0.053)	-0.114 (0.067)	0.067 (0.07)	-0.103 (0.086)
Pandemic: Log of R&D change %	0.011 (0.009)	0.011 (0.012)	0.003 (0.012)	-0.012 (0.016)
Observations	1001	601	1050	623
R-Squared	0.063	0.127	0.020	0.088

Includes country dummies. Firms with either improved product and services or intangibles are included

*** significant at 1% level, ** significant at 5% level, * significant at 10% level

Research shows that companies that introduce new or significantly improved products and services experience higher rates of employment and productivity growth over a three-year period. The same trend holds true for companies that implement internal changes (ICs) within their Knowledge Intensive Services (KIS). Interestingly, firms that reported employment growth during the pandemic also saw a boost in productivity growth over both the three-year period and between 2019 and 2020. However, expected employment growth during the pandemic did not always match actual growth rates. Among firms that reported employment growth opportunities during the Covid pandemic, the average increase was 15%, which was also related to improved productivity. Interestingly, tailored solutions during the pandemic did not generate much growth, and higher R&D investments during the pandemic did not necessarily lead to high productivity or employee growth. It is possible that companies invested in R&D to secure long-term survival. However, according to Piekola (2023), when controlling for R&D, adjustments made in response to the pandemic had a positive effect on productivity.

5. Conclusion

We show that organizational capital (OC) as part of intangibles in general (including branding, design, and special-purpose ICT) improves productivity, profit margins, and financial solvency, while R&D has an independent positive effect. OC is heterogeneous in nature, with external consulting more clearly related to

problem-solving activities such as special-purpose ICT. This appears to support the capability-based theory in that internal OC also depends on how the organizational form has evolved over time (Dosi et al. 2000). Protojerou (2023 et al.) find that OC increases the probability of all kinds of innovation output, and here we find ICs as a whole to better measure the positive performance effects.

An important and significant finding is that particularly intangibles in KIS are positively related to productivity growth over the recent three years, 2017-2020. In data-intensive and information-driven KIS, Europe lags behind the United States despite recent growth, and OC represents the highest share of all intangibles. Organizational capital can thus play a decisive role in explaining and bridging the productivity gap between the US and Europe. KIS has also been the fastest growing industry with 4% annual growth in employment and 8% in productivity over the three years 2017-2020, which leads to mismeasurement of productivity growth as this increase in turnover is not capitalized. Crouzet and Eberly (2021) found that capitalizing on three service industry groups - Professional, Scientific and Technical Services, Administrative and Support Services, and Management of Companies and Enterprises - could lead to a cumulative adjustment of GDP of approximately 10% in 1997, increasing to around 13% by 2018 in Europe.

A significant 15% of the company's turnover is due to new and significantly improved products and services. This shows the technological level of the firm is an important factor in the growth of employment and productivity. This is naturally explained by intangible investments that increase innovations. However, the technological know-how of the work brought by intangible capital has not improved sufficiently (Piekkola et al. 2021) and it is precisely this that needs to be invested in, which also emphasizes the qualitative factors of intangible capital.

The Globalintangible survey also highlights the importance of companies' own research and development activities compared to those purchased from outside, although, for OC, external OC plays an important role (Piekkola 2023). The corona crisis did not weaken investments in intangible capital in most companies, but R&D activities have been concentrated in fewer companies with an overall decrease in R&D. Such polarization of intangible investments in fewer firms has been a general trend since 2002 (Arrighetti et al. 2015). Investing in many different types of intangible capital and tailored solutions seemed to protect the profit development of companies during the corona crisis.

Overall, higher growth over a longer period appears to be related to the firm being able to increase employment during the pandemic. The increase in digitalization due to Covid was likely concentrated in firms that had already adopted new digital tools before the pandemic. Special-purpose ICT especially supports high productivity, and a substantial part of this may have been used to complement external OC. On the other hand, general purpose and database ICT relates positively but insignificantly to higher productivity and employment growth, which term is significant when accompanying it with R&D investment in (Piekkola 2023). Organizational capital has yet to be mapped precisely in previous surveys. In addition to companies, our research helps statistical centers and Eurostat to prepare their own surveys related to national accounts, in which intangible capital can be examined more broadly. Given the heterogeneity, organizational capital shows its role in augmenting the set of ICs that together have a productivity elasticity of 8%. Insignificant direct effects are thereby argued not only to be explained by the pandemic but due to OC's heterogeneous nature. All ICs, including OC, increase turnover more than fixed costs, thereby improving finance allocation between tangibles and IC. OC is a crucial element in how ICs are believed to improve profit margins.

We have also evaluated organizational capabilities such as organizational and reactive agility. Organizational agility strengthens the relationship between ICs and profitability, which should be taken as an additional aspect of developing the organization further. Reactive agility improves productivity performance during a pandemic, and the most relevant ICs in this respect will likely be branding and design. Growth effects are more driven by technology, such as how innovative the firm believes its goods and services to be, while only KIS ICs have clearly generated higher growth.

A caveat in the CEOs' and CFS self-evaluation is that IC per turnover can be overvalued. In any case, a CATI-type survey with a personal telephone interview can be considered one of the most appropriate methods for this kind of survey, but where precise figures on the turnover shares of ICs are intended to be rough estimates. There is a natural overlap between OC and branding, as both are vital tasks for management.

In the future, OC can also be linked more sharply to separate management and marketing work or time used to create alternative intangible goods and services, as done in Chapter 6, which considers intangible occupational capital. One can also aim at controlling characteristics of ICs where they exhibit “non-rivalry in use”, a concept suggested by Crouzet et al. (2022) to define ICs. Finally, firms also generate entrepreneurial incomes, and entrepreneurial talent is an essential element of overall management and supervision. In intangible capital surveys, this would require separate data like self-evaluation of entrepreneurial talents, including running and conducting the business.

Literature

- Antonelli, Cristiano and Scellato, Giuseppe (2011), 'Out-of-equilibrium profit and innovation', *Economics of Innovation and New Technology*, 20 (5), 405-21.
- Antonelli, Cristiano, Orsatti, Gianluca, and Piali, Guido (2023), 'The knowledge-intensive direction of technological change', *Eurasian Business Review*, 1-27.
- Arrighetti, Alessandro, Landini, Fabio, and Lasagni, Andrea (2015), 'Intangible Asset Dynamics and Firm Behaviour', *Industry and Innovation*, 22 (5), 402-22.
- Awano, Gaganan, et al. (2010), 'Measuring investment in intangible assets in the UK: results from a new survey', *Economic & Labour Market Review*, 4 (7), 66-71.
- Caloghirou, Yannis , et al. (2021), 'Final report describing the survey results and methodology ', *Globalinto deliverable 4.4* (National Technical University of Athens (NTUA)).
- Carlin, Bruce Ian, Chowdhry, Bhagwan, and Garmaise, Mark J (2012), 'Investment in organization capital', *Journal of Financial Intermediation*, 21 (2), 268-86.
- Caroli, Eve and Van Reenen, John (2001), 'Skill-biased organizational change? Evidence from a panel of British and French establishments', *The Quarterly Journal of Economics*, 116 (4), 1449-92.
- Corrado, Carol, Hulten, Charles, and Sichel, Daniel (2005), 'Measuring capital and technology: an expanded framework', in Carol Corrado, John Haltiwanger, and Dan Sichel (eds.), *Measuring capital in the new economy* (University of Chicago Press), 11-46.
- Corrado, Carol, et al. (2021), 'New evidence on intangibles, diffusion and productivity', *IARIW-ESCoE Conference November 11-12* (London).
- Crouzet, Nicolas, et al. (2022), 'The economics of intangible capital', *Journal of Economic Perspectives*, 36 (3), 29-52.
- Damanpour, Fariborz, Szabat, Kathryn A, and Evan, William M (1989), 'The relationship between types of innovation and organizational performance', *Journal of Management studies*, 26 (6), 587-602.
- De Ridder, Maarten (2021), 'Market power and innovation in the intangible economy'.
- Dosi, Giovanni, Nelson, Richard R, and Winter, Sidney G (2000), *The nature and dynamics of organizational capabilities* (Oxford university press).
- Eisfeldt, Andrea L and Papanikolaou, Dimitris (2013), 'Organization capital and the cross-section of expected returns', *The Journal of Finance*, 68 (4), 1365-406.
- Evenson, Robert E and Westphal, Larry E (1995), 'Technological change and technology strategy', *Handbook of development economics*, 3, 2209-99.

- Grimpe, Christoph and Kaiser, Ulrich (2010), 'Balancing internal and external knowledge acquisition: the gains and pains from R&D outsourcing', *Journal of management studies*, 47 (8), 1483-509.
- Landini, Fabio, Arrighetti, Alessandro, and Lasagni, Andrea (2020), 'Economic crisis and firm exit: do intangibles matter?', *Industry and Innovation*, 27 (5), 445-79.
- Lev, Baruch and Radhakrishnan, Suresh (2005), 'The valuation of organization capital', *Measuring capital in the new economy* (University of Chicago Press), 73-110.
- Mathiassen, Lars and Pries-Heje, Jan (2006), 'Business agility and diffusion of information technology', (Taylor & Francis).
- Nerdrum, Lars and Erikson, Truls (2001), 'Intellectual capital: a human capital perspective', *Journal of intellectual capital*.
- Norkio, Antti and Piekkola, Hannu (2023), 'Entrepreneurial Talent and Intangibles Explaining High-Growth Firms', *Economics of Innovation and New Technology*, submitted under third revision.
- OECD/Eurostat (2018), *Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation, 4th Edition* (OECD/Eurostat; Paris).
- Piekkola, Hannu (2010), 'Intangibles: Can they explain the unexplained'. University of Vaasa Department of Economics Working Paper, 15.
- (2024), 'R&D effort and knowledge sourcing: Searching for better profitability and high growth', *under review in Science and Public Policy* (Special Issue on New Spectrum of Intangible Assets).
- Piekkola, Hannu, et al. (2021), 'Intangibles from innovative work – their valuation and technological change', *IARIW-ESCoE Conference November 11-12* (London).
- Piekkola, Hannu (2024), ' R&D effort and knowledge sourcing: Searching for better profitability and high growth ', *under review in Science and Public Policy* (Special Issue on New Spectrum of Intangibles).
- Piva, Mariacristina and Vivarelli, Marco (2002), 'The skill bias: comparative evidence and an econometric test', *International review of applied economics*, 16 (3), 347-57.
- Protogerou , Aimilia (2024), 'Intangible Assets Investment and Firm Innovation Performance: Evidence from Europe', *Science and Public Policy under review*, (Special Issue on Intangibles).
- Roth, Felix and Sen, Ali (2021), 'Intangible Capital and Labor Productivity Growth: Revisiting the Evidence', (Hamburg Discussion Papers in International Economics).
- Schumpeter, Joseph A (1942), *Socialism, capitalism and democracy* (Harper and Brothers).
- Teece, David J (2015), *Intangible assets and a theory of heterogeneous firms* (Springer).
- Wyatt, Anne (2005), 'Accounting recognition of intangible assets: theory and evidence on economic determinants', *The accounting review*, 80 (3), 967-1003.

Appendix A. Survey questions not shown in Section 3.1 on data

Q.4 At the end of 2019, what was the total headcount number of full-time employees in the enterprise?

Q.5 In 2019, what was the enterprise's total turnover (market sales of goods and services including all taxes except VAT)? (Euros)

Q.8 In 2019, which percentage of the enterprise's turnover was spent on in-house R&D?

Q.8 In 2019, which percentage of the enterprise's turnover was spent on R&D carried out by external providers (including enterprises in your own group)?

Dichotomous response

Q.18 In 2019, did the enterprise purchase or fund in-house work on software and databases?

Q19 Which types of software and databases did this include?

- 1) General purpose office applications (e.g. word processing)
- 2) Special purpose applications (e.g. accounting management software, control of production flows, business intelligence tools)
- 3) Databases and other computerised information (including big data)

In this study, the general purpose of ICT is having either 1) or 3) or both.

Questions related to pandemic

Q.10 Because of the Covid-19 crisis, will spending on R&D in 2020 compared to 2019:

1 Decrease, 2 No Impact, 3 Increase 4, Don't know"

Q10a By approximately what percentage?

Q.29b Please indicate which of the following areas are the most important during the Covid-19 crisis: b Development of tailored, customised solutions (other non-exclusive alternative are a) Rapid development of new products or services, d) Ensuring lower prices, e) Decreasing labor costs, f) other (write down)

Q.47_3 Please indicate the impact, if any, of the Covid-19 crisis on the level of economic performance. Because of the Covid-19 crisis, will employment in 2020 as compared to the employment of 2019:

1 Decrease, 2 No change, 3 Increase, 4 Don't know

Q.47_3a By approximately what percentage?