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Summary

Intangible capital has been studied in the literature for a long time, for more than 100 years. In 1908, Veblen defined intangible capital as an intangible source of wealth (Veblen, 1908). The modern literature predominantly uses the definition of Corrado et al. (2006), according to which intangible capital is a sum of three main components: 1) computerised information (computer software, computerised databases); 2) innovative capital (which mainly includes R&D, but also other innovative expenditures); and 3) economic competencies (brand equity, firm-specific human capital, and organisational structure). Globalinto has followed the recent debate and extended the measurement of ICT (software and databases) and R&D to organisational capital related to management and marketing, which refers to the third category of economic competencies. This study analyses comparable data from the public sector, highlighting cultural capital and heritage, as well as intangible capital contributing to institutional structure. Empirical analysis of intangible capital at the aggregate, sectoral and firm level, focusing on the market economy, has developed strongly, but on the other hand, the analysis of intangible capital in the public sector is much weaker.

This paper contributes to the discussion of intangibles in the public sector. Two central research questions guide the investigation in this paper:

(1) Is the quality of the institutional framework related to intangible capital in the public sector;
(2) What are the differences between intangible capital and its components in the public and private sectors and how might this affect the future development of the economy as a whole?

Methodologically, given the characteristics of the available data, the analysis is approached in two steps:

(1) The relationship between public sector intangibles and institutional quality is examined at the national level, using two established data sources: EU Klems and World Governance Indicators;
(2) A more detailed analysis of intangible capital is carried out for Slovenia using micro-level (organization-level) data provided by the Statistical Office of the Republic of Slovenia.

The results show that:

(1) In general, the accumulation of intangible capital per employee in the public sector is on average lower than the economy average, although it is higher, for example, in R&D.
(2) The dynamics of intangible capital in the public and private sectors differ significantly; in particular, intangibles in the public sector started to grow much more slowly after the 2009 crisis, although they increased steadily.
(3) We argue that intangible capital is directly related to "better institutions" as measured by the World Governance Indicators. These could be understood as public sector "outputs", where we argue that higher accumulation of intangible (knowledge) capital improves governance. And governance quality as a direct result of public sector intangible capital accumulation is a channel through which the public sector influences private sector productivity as well (as discussed in D 7.2 and D 7.5).

(4) An analysis of the organization-level data for Slovenia using the Globalinto methodology shows that there are differences in the accumulation of intangible capital between the three categories of the public sector (NACE O, P, Q), with organizational capital being particularly important relative to the others. The data also show that the accumulation of intangible capital in the public sector lags behind that in the private sector. However, we also point out the methodological challenge and ask whether the definition of the relevant occupations should be different for the public sector, especially for NACE O (Public Administration).

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1 Introduction

Intangible capital has been studied in the literature for a long time, for more than 100 years. In 1908, Veblen defined intangible capital as an intangible source of wealth (Veblen, 1908). A number of studies have shown that intangible capital positively affects the performance of companies, sectors and countries. In 1960 and 1970, the first empirical estimates of the role of intangible capital in economic performance at the aggregate level emerged (Connor, 1964; Eisner, 1978; Kendrick, 1972). On the other hand, the business literature increasingly began to examine various components of what is now understood as intangible capital, from branding and R&D to employee training and organisational structure (Bartelsman & Doms, 2000; Denicolai et al., 2019; Griliches & Mairesse, 1991; Griliches & Regev, 1995; Hong & Diep, 2016; Lyau & Pucel, 1995; Martinez-Noya et al., 2013; Merito et al., 2010; Ottersten et al., 1999).

The widely used definition of intangible capital by Corrado et al. (2006) accelerated the analysis of intangible capital and its role. It defined intangible capital as a sum of three key components: 1) computerised information (computer software, computerised databases); 2) innovative capital (which includes mainly R&D but also other innovative expenditures); and 3) economic competencies (brand equity, firm-specific human capital, and organisational structure). The original research by Corrado et al. (2006) focused on defining intangible capital in the private sector. Later, due to the characteristics of intangible capital in the public sector, a definition of public sector intangible capital also emerged, adapting selected categories of intangible capital to the characteristics of the public sector. Instead of R&D (broadly defined to include the cost of developing new products), basic and applied science research, industrial and defence R&D are used, culture and cultural heritage, including design, are also included in innovative property, while the category "Economic-Societal competencies" also includes "Societal competencies/Social infrastructure". Sub-components also include school-produced human capital, which as such can also be considered as human capital (Table 1).

Intangible capital in the public sector can have direct and indirect effects on economic performance. First, with more accumulated intangible capital, any organisation, including public organisations, can rationally be expected to be more productive and perform more efficiently and better. The public sector is the main creator of the superstructure (if one uses the Marxist term, (Marx, 2013))or the institutional environment in which formal institutions (Acemoglu et al., 2005) or much of the information institutions depend on intangible capital. Institutions have been shown to be very important for long-term growth (Acemoglu, 2010; Cavalcanti & Novo, 2005; Dawson, 1998; Eisner, 1978; Knack & Keefer, 1995; North, 1991; Rivera-Batiz, 2002). However, the question of what determines the quality of institutions remains unresolved. We argue that the quality of institutions also depends on the characteristics of intangible capital in the public sector.

Two central research questions guide the investigation in this paper:

(1) Is the quality of the institutional framework related to intangible capital in the public sector;

(2) What are the differences between the various components of intangible capital between the public and private sectors and how might this affect the future development of the economy as a whole?

Methodologically, given the characteristics of the available data, the analysis is approached in two steps:

(1) The relationship between public sector intangibles and institutional quality is examined at the national level, using two established data sources: EU Klems and World Governance Indicators;
(2) A more detailed analysis of intangible capital is conducted for Slovenia using micro-level (organization-level) data provided by the Statistical Office of the Republic of Slovenia. Due to the characteristics and availability of the data, only the differences between private and public sector intangibles are examined at this stage (methodological specifics and resulting analytical challenges are explained in the corresponding chapter), in order to identify major gaps or trends that could affect the performance of the sector in the future.

In the remainder of this paper, a brief theoretical chapter first defines the relationship between intangible investment in the public sector and its impact on the economy. Next, public sector intangible investment and institutional quality are examined at the national level, followed by a firm-level analysis. The paper ends with a discussion and challenges for future research.

2 Theoretical background: Intangible capital and public and private sector performance

Intangible capital is, as said, a relatively old category, however, empirical research gained momentum with the aforementioned definition of intangible capital by Corrado et al. (2006) (Table 1), which divided intangible capital into three broader, but more importantly, measurable categories. Later, the definition of intangible capital in the public sector was added (Corrado et al., 2017a).

Table 1: Market vs. non-market intangible capital

Market sector	Non-market sector
Computerised information	Information, scientific and cultural assets
1 Software	1 Software
2 Databases	2 Databases, including open data
Innovative property	
3 R&D broadly defined to include new product development costs	3 Basic and applied science research, industrial and defence R&D
4 Entertainment and artistic originals	4 Cultural capital and heritage, including design
5 Design	
6 Mineral exploration	5 Mineral exploration
Economic competencies	Economic-Societal competencies/Social infrastructure
7 Brands	6 Brands
8 Organizational capital	7 Organizational capital
8a Managerial capital	7a Professional/managerial capital
8b Purchased organizational services	7b Purchased organizational services
9 Firm-specific human capital (employer provided training)	8 Function-specific human capital (employer provided training)
	9 Schooling-produced human capital

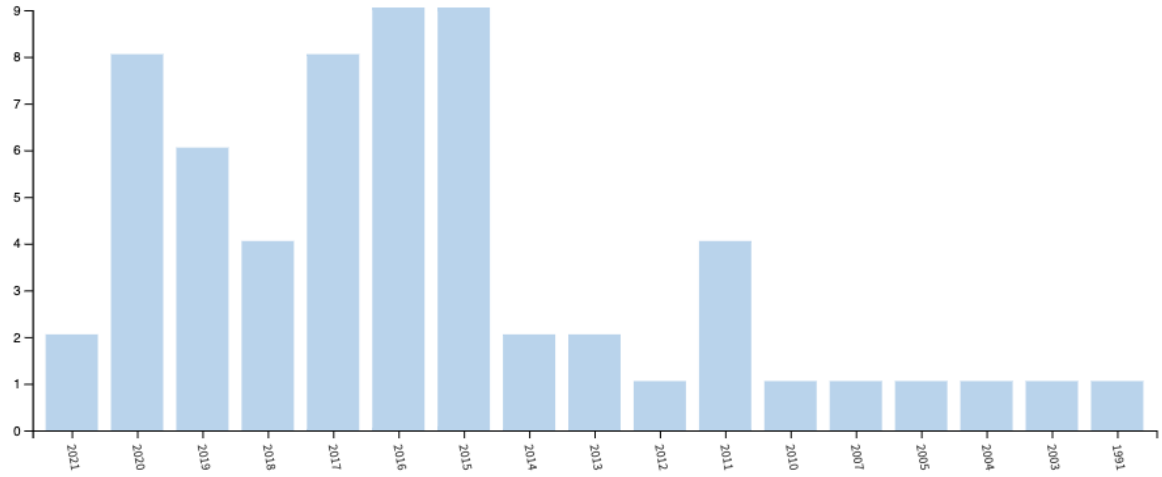
Source: (Corrado et al., 2017a).

The definition of intangible capital in the public sector differs from the definition in the private sector in selected categories. In the first category, which includes "Information, scientific and cultural goods" (not only Computerised information), open data is added. The fact that it includes "open" data already suggests that there will be spill-over effects of public intangible capital beyond the narrow institution that "holds" or "generates" the public intangibles. In the case of innovative property, there is the addition of cultural heritage, which was studied using an innovative text-mining approach and where the data revealed that cultural heritage is also important for tourism, which generates added value (Redek et al., 2020). The category of economic competencies is again broader and is referred to as Economic-Societal competencies. Importantly, it includes school-generated human capital, indicating that again public intangible capital is broader and has spill-over potential.

In this paper we are mainly interested in a somewhat narrower group of public sector intangibles. However, the "key outputs" of intangible capital or accumulated knowledge capital in the public sector considered are high-quality institutions that should (and do, as shown in deliverable 7.2 "Public sector intangibles and governance quality in the European Union") have an impact on private sector growth.

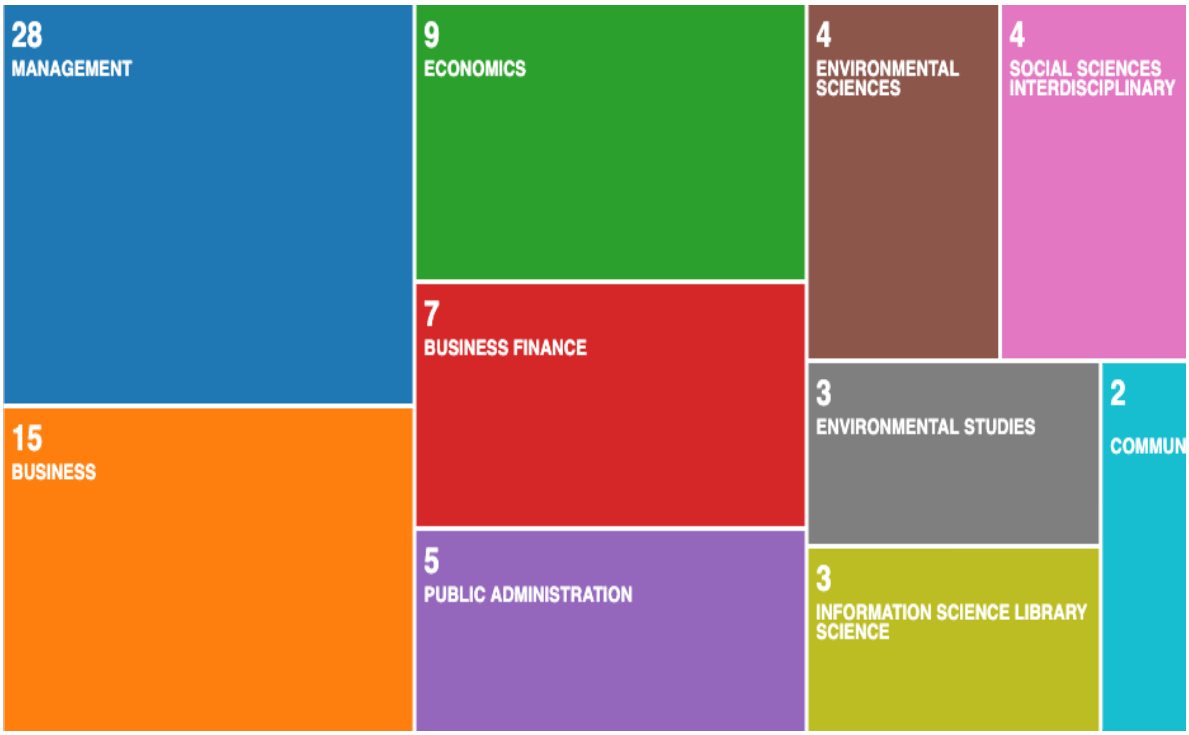
The relationship between intangible capital and public sector performance is largely unexplored in the literature. A "Web of Science Core Collection" search using the terms "intangible", "public sector" and "performance" yielded a total of 61 results published between 1991 and 2021 (Figure 1). The papers are predominantly from the fields of management and business, with a few from economics, finance and public administration (Figure 2).

Figure 1: Link between intangible capital, public sector and performance in the Web of Science Core collection – Timeline and number of published papers



Source: (Web of Science, 2021)

Figure 2: Link between intangible capital, public sector and performance in the Web of Science Core collection – the field of published papers



Source: (Web of Science, 2021)

While there is quite a few papers focusing on this link, very little is done with a focus on how actual intangible capital or its components affect performance in the public sector. For example, Buonomo et al. (2020) emphasize that the management of intangible assets improves the sustainable competitive advantage of public organizations as well as their performance. Such management leverages knowledge, relational capital within the organization and among users, emphasizes external image, and relies on loyalty and commitment. Similarly, Bunget et al. (Bunget et al., 2014) emphasize that "measurement and disclosure of intangible assets becomes a goal" to improve organizational performance. Laskari et al. (2016, 2017) argue that public organizations are " intellectual capital creators" either within the wider public management environment or within society and the economy as a whole. The management of intangible assets is seen as part of the process of 'intensive modernisation and restructuring'. Laskari et al. (2016, 2017) argue that intangible assets are not properly identified and managed, in particular also because their role in the public sector is not properly recognized. Several works also address the measurement of intangibles and the quantification of their impact in the public sector and their disclosure, with similar dilemmas as for intangibles in the private sector (Maduro et al., 2018; Martin et al., 2006; Ramírez, 2010; Redek & Prašnikar, 2019; United Nations, 1984; Yuan et al., 2015; Zigan et al., 2008).

Our study aims to broaden the discussion by offering a cross-national approach at the aggregate level and providing a comparative perspective. In addition, we provide a comparison with organisation-level data for Slovenia.

3 The role of intangible capital at the aggregate level

3.1 Methodology

The analysis relies on two data sources:

1) EU Klems data[1] (Adarov & Stehrer, 2019; The Vienna Institute for International Economic Studies, 2019; Vienna Institute for International Economic Studies, 2019)
2) Worldwide governance indicators (Kaufmann & Kraay, 2020)

The **EUKlems** data provides an abundance of variables that in detail present economic growth, productivity, employment, tangible and intangible capital formation with details on the components as well as growth contributions and the role of technological change at the industry level (NACE level 1 and partly level 2) for all European Union member states, but also for Japan and the US between 1995 and 2017. The data on EU Klems therefore also provide details on intangible investment for all key components also for the public sector, with the public sector defined at NACE Level 1:

- O Public administration and defence, compulsory social security
- P Education
- Q Human Health and Social Work Activities

The data provides the details on the standard variables required for growth accounting, i.e. value added, capital and labour inputs. The database also provides detailed insights into intangible and tangible investment:

- Intangible investment
    - Intangible Software and databases capital services, p.p.
    - Advertising, market research and branding
    - Design and other product developments
    - Purchased organisational capital
    - Vocational training
    - Own-account organisational capital
- Tangible investment
    - Computing equipment
    - Communications equipment
    - Computer software and databases
    - Transport Equipment
    - Other Machinery and Equipment
    - Total Non-residential investment
    - Residential structures
    - Cultivated assets

[1] The deliverable 7.2. "Public sector intangibles and governance quality in the European Union" relied on Globalinto dataset (Tsakanikas et al., 2020). In this case we use EU Klems because of the different composition of available variables.

- Research and development
- Other IPP assets

Worldwide governance indicators (Kaufmann & Kraay, 2020) are used to assess institutional quality, which is thought to be related to intangible capital in the public sector. The database provides details on governance quality in over 200 countries over the period between 1996 and 2019. We restrict the use of the indicators to the countries that are also included in EU Klems and the period between 1996 and 2017, as EU Klems is only available up to 2017.

The indicators in the World governance quality analysis are based on over 30 different data sources, including various institutes, responses and data from companies, international organizations and others. Governance quality is defined as a six-dimensional concep, which includes (Kaufmann & Kraay, 2020) (as also described earlier in D 7..2):

a. Voice and Accountability
b. Political Stability and Absence of Violence
c. Government Effectiveness
d. Regulatory Quality
e. Rule of Law
f. Control of Corruption

3.2 Selected highlights about the institutional quality

Intangible capital in the public sector is expected to have an impact on public sector performance. To start the discussion, we first present the differences in governance quality across the EU. The WGI indicators provide an assessment of regulatory quality based on six different criteria (Table 2), with different estimates for each category: from the value of the indicator to ranks, standard deviations, etc. (for details see Kaufmann & Kraay, 2020)). To represent differences in the quality of the institutional environment, we use percentile ranks as reported in the data. For further analysis, we also calculated an overall rank as a simple average of the individual ranks. Table 2 presents the details.[2]

Table 2: Governance quality in 2017 in selected countries (EU, Japan, USA) (green – top 2 with the highest ranking in a category, red - bottom 2 with the lowest ranking in a category) (ranking among 214 countries)

	Percentile rank						
	Voice and Accountability	Political Stability, Absence of Violence	Government Effectiveness	Regulatory Quality	Rule of Law	Control of Corruption	Overall rank *(mean rank)
FI	97,5	87,6	98,1	96,6	100,0	99,0	96,5
LU	97,0	95,2	93,8	93,8	95,2	96,2	95,2
SE	99,5	81,9	96,2	95,7	99,0	98,1	95,1
NL	99,0	80,5	96,6	98,6	97,1	95,2	94,5
DK	96,6	76,2	95,7	92,3	97,6	98,6	92,8
AT	93,6	86,7	91,8	90,9	96,2	90,9	91,7
DE	95,6	65,7	94,2	95,2	91,3	94,2	89,4
IE	90,6	85,2	87,0	91,8	88,9	91,3	89,2
UK	93,1	59,0	90,4	94,2	92,8	94,7	87,4
MT	87,2	93,8	80,8	88,0	85,1	76,9	85,3
PT	88,7	89,5	87,5	79,3	84,1	80,8	85,0
US	82,3	60,0	92,8	92,8	91,8	88,9	84,8
EE	89,7	69,0	82,7	93,3	86,5	87,0	84,7
BE	94,6	62,4	85,1	86,5	87,5	89,9	84,3
FR	85,7	55,7	88,0	83,7	89,4	87,5	81,7
Total	**83,7**	**71,5**	**83,4**	**84,4**	**82,5**	**79,5**	**80,8**
CZ	77,3	83,3	81,3	86,1	83,7	70,7	80,4
SI	80,3	76,7	84,6	72,1	82,7	79,3	79,3
CY	83,3	65,2	79,8	81,3	79,8	78,4	78,0
LT	78,3	72,9	80,3	83,2	80,8	70,2	77,6
ES	81,3	56,2	81,7	79,8	81,3	68,3	74,8
LV	73,9	62,9	78,8	82,7	80,3	69,7	74,7
SK	75,9	80,0	75,0	76,4	71,6	62,5	73,6
PL	72,9	64,3	74,0	78,8	68,3	76,0	72,4
IT	82,8	57,1	69,7	75,0	62,5	61,5	68,1
HU	58,1	74,8	70,2	73,1	70,2	59,1	67,6
HR	64,0	70,0	72,1	68,8	63,5	61,1	66,6
BG	58,6	59,5	63,5	72,6	51,9	51,0	59,5
EL	70,9	41,9	66,3	63,0	56,7	52,9	58,6

Data: (Kaufmann & Kraay, 2020).

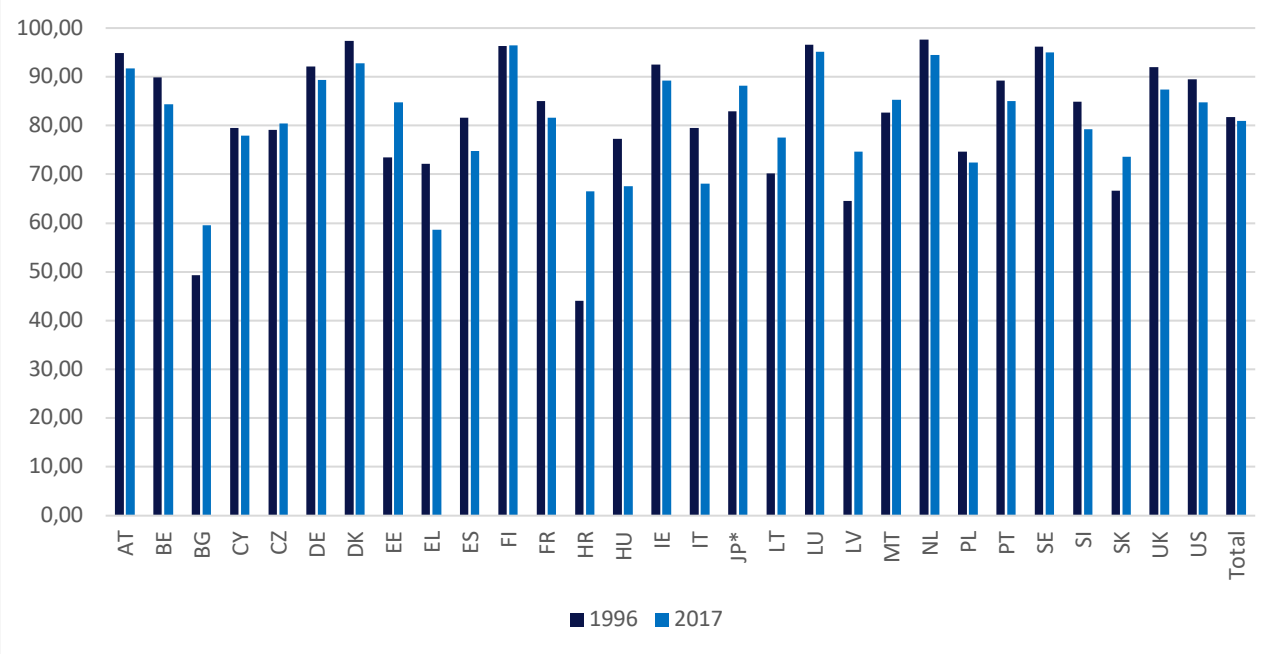
*Mean rank was calculated as a simple average of all sub-rankings. Sub-rankings are original data.

[2] In deliverable 7.2 "Public sector intangibles and governance quality in the European Union" (Redek & Kostevc, 2021)primarly the link between private sector intangibles and governance quality was investigated. Different measures were used (from estimates of governance quality to ranks) but to focus on the impact of governance on private intangible investments. Here, the focus is on explaining the link between the public intangibles and governance (intangibles being considered as input to governance, which could be considered as indicator of efficiency or output). Also, other (Globalinto data (Tsakanikas et al., 2020)) was used to measure intangibles.

Finland had the best quality of governance among the economies studied in 2017. In the category "Political stability, absence of violence", it ranked one of the two highest in 4 out of 6 indicators, ahead of Luxembourg, Sweden and the Netherlands. The data also show that the new members of the EU were in the lower half of the ranking (when looking only at EU economies), with the exception of Greece (EL), Italy and Spain, which are older members. In addition to Greece, which brought up the rear among EU economies and was in the bottom two on four indicators, Bulgaria was also in the bottom two on four indicators.

Figure 3 shows the median rank of a country in 1996 and 2017 among all studied economies in the world in the WGI. The data show that there is quite a lot of stability in terms of the global positioning of countries according to the calculated mean rank. The only more significant differences occurred among transition economies, in Bulgaria, Croatia (HR), Latvia, Lithuania and Slovakia, where it improved more significantly. Interestingly, it deteriorated quite strongly in Hungary - by 10 percentiles. The deterioration was also pronounced in Italy.

Figure 3: Governance quality in 1996 and 2017 in selected countries (EU, Japan, US): mean rank



Data: (Kaufmann & Kraay, 2020).
*Mean rank was calculated as a simple average of all sub-rankings. EL denotes Greece.

Table 3 rovides further details on the changes in the global percentile rankings of the economies studied. Improvements are highlighted in green. As shown in Figure 3, the deterioration was very pronounced in Hungary, which lost 18 percentage points in the Voice and Accountability category and 15 percentage points in the Control of corruption category. Greece lost 26 percentage points in the Rule of Law category and almost 21 percentage points in the Political Stability and Absence of Violence category. However, it should be noted that some old EU members (e.g. Belgium, Germany, Denmark) also lost a similar number of percentiles, which

could also be partly due to faster improvement in developing countries (the number of countries observed is stable and stands at 214).

Table 3: Changes in governance quality percentile rank between 1996 and 2017 in selected countries by type

	Voice and Accountability	Political Stability and Absence of Violence	Government Effectiveness	Regulatory Quality	Rule of Law	Control of Corruption
AT	0,10	-10,14	-1,07	-5,33	-1,33	-1,61
BE	2,08	-29,64	-6,16	1,76	-2,45	1,19
BG	-4,88	14,84	7,18	25,31	12,22	6,34
CY	4,75	5,13	-5,44	-5,71	1,42	-9,27
CZ	-0,66	-4,43	9,12	3,99	3,75	-4,06
DE	5,57	-26,31	2,43	4,43	-2,62	0,14
DK	0,55	-21,68	1,14	-5,52	-0,39	-1,44
EE	15,16	-3,82	11,11	7,40	20,21	17,13
EL	-5,56	-21,93	-11,25	-4,41	-26,69	-11,63
ES	-8,22	3,00	-7,89	-4,43	-9,20	-14,53
FI	2,54	-9,72	5,73	2,07	1,01	-0,42
FR	-3,29	-20,88	2,19	2,13	-2,54	2,55
HR	19,04	22,66	13,65	19,29	32,31	28,26
HU	-18,87	-4,49	-8,50	-2,47	-9,20	-15,06
IE	-0,86	-9,97	-3,14	-1,11	-4,02	-0,59
IT	-1,74	-29,56	-8,43	-1,09	-21,92	-5,67
LT	2,83	10,09	11,98	0,56	17,45	1,91
LU	0,54	-0,51	-5,70	-3,53	-0,79	1,53
LV	3,89	-2,57	11,09	5,52	23,50	19,71
MT	1,69	-0,34	-1,74	9,72	1,18	5,42
NL	2,01	-19,52	-1,73	0,19	1,64	-1,58
PL	-7,09	-9,65	-1,37	6,56	-2,59	0,16
PT	-5,83	-1,43	1,16	-6,00	-4,81	-8,48
SE	4,01	-17,56	-1,11	6,54	2,05	-0,85
SI	-7,20	-15,89	5,38	-11,58	-2,23	-2,39
SK	8,86	4,47	8,88	5,25	14,35	-0,40
UK	6,10	-19,68	-6,34	-5,23	-1,68	-0,45
US	-8,73	-17,66	3,72	-2,86	-0,64	-2,46

Data: (Kaufmann & Kraay, 2020).

3.3 Intangible investments in the public sector and institutional quality

It is to be expected that institutional quality and its improvement, considered in the previous section 3.2, is related to intangible public sector investment. In the remainder of this paper, we explore this in conjunction with the World governance indicators database EU Klems data, which provides information on intangible investments. We are interested in the following:

(1) What are the characteristics of intangible investments in the public sector?
(2) How are these investments or accumulated capital related to governance quality and which types of intangible investments or intangible capital are most important?

Table 4 presents selected data for the full dataset for 2017 to provide information on intangible investment in three different sectors: manufacturing (NACE C), private sector services (NACE H-N) and the public sector (NACE O-Q) and total economy. All data are calculated per employee.

The private sector services differ significantly already among themselves, primarily the knowledge intense services standing out. For example, finance and insurance and ICT stand out as well as real-estate, Finance performs a bit worse in product development (if compared to the economy average, bottom panel, Figure 4), but otherwise, the intangible investment in these sectors are twice or three times higher than the economy average. The public sector significantly lags behind these service sectors, exhibiting in the majority of types of intangible capital values below the economy average.

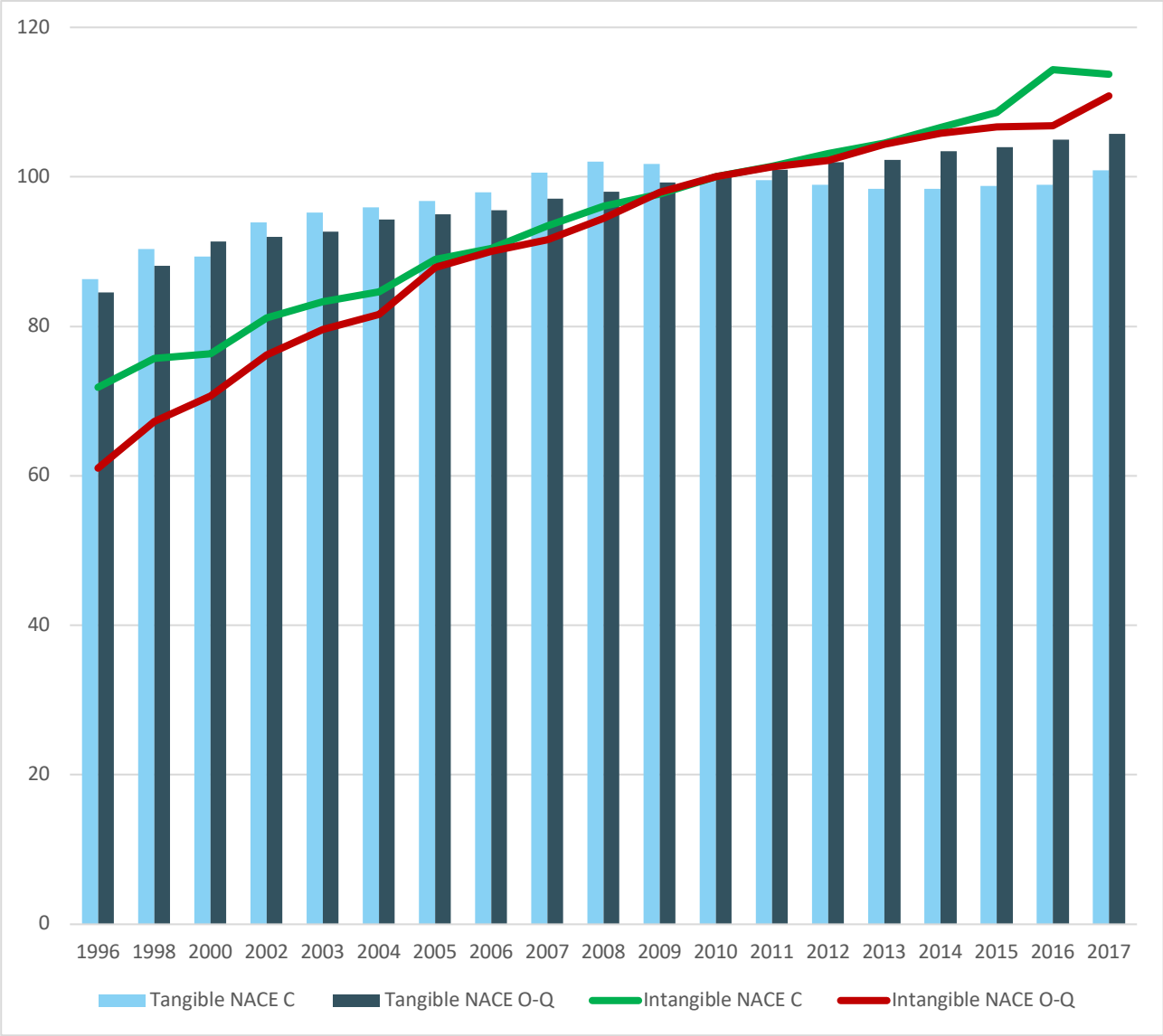
If comparing the public sector services to manufacturing, interestingly, in general, the composition of the public sector follows similar patterns to that of the manufacturing sector, in terms of both tangible and intangible capital. However, comparing both sectors with the economy average (right panel of the table), it is clear that the public sectors also lag significantly behind the economy average, with the sole exception of R&D. Of course, this analysis does not take into account cross-country differences or the specificities of the sectors according to their needs. However, for example, vocational training is very important in all sectors, as are organizational improvements. In the public sector, improved economic competencies (to which the components contribute) could contribute to better governance, efficiency, etc. Therefore, the observation implies that lagging behind both the economic average and the manufacturing sector means that the public sectors should invest more in these components.

Table 4: Selected tangible and intangible capital components per employee in manufacturing (Nace C), public sector (Nace O-Q) and an index of the sector to the average (all economies combined)

	Median value of tangible and intangible capital categories per employee in comparison to economy average (2010 prices)								
	C	H	I	J	K	L	M_N	O-Q	Total
Computing equipment	1,21	1,50	0,32	7,26	6,14	2,57	1,48	0,97	1,34
Communications equipment	0,69	1,36	0,56	30,04	1,66	1,95	1,04	0,52	1,17
Computer software and databases	3,73	2,52	0,42	19,12	13,16	2,89	3,77	1,47	3,65
Transport Equipment	2,84	48,26	1,02	3,20	4,66	9,76	14,14	2,32	4,31
Other Machinery and Equipment	66,36	21,06	8,05	21,05	9,95	34,81	9,70	13,17	35,22
Total Non-residential investment	50,31	141,12	39,78	76,59	91,64	1605,69	20,63	121,36	81,76
R&D	37,96	0,35	0,02	11,60	2,81	0,39	9,51	8,05	5,04
Design and other product developments	3,75	2,18	0,38	5,28	2,48	9,85	7,37	0,68	2,72
Purchased organisational capital	1,96	1,62	0,78	4,47	5,49	7,23	4,27	0,51	2,13
Vocational training	0,37	0,35	0,11	0,71	1,39	0,50	0,55	0,28	0,39
Own-account organisational capital	0,54	0,55	0,31	1,11	2,66	1,41	0,70	0,52	0,76
Gross fixed capital formation	187,25	269,32	59,12	188,21	160,61	15366,42	85,53	161,09	211,72
	Index of tangible and intangible capital categories per employee in comparison to economy average								
	C	H	I	J	K	L	M_N	O-Q	Total
Computing equipment	89,7	111,8	23,6	540,1	457,1	191,3	110,1	72,2	100
Communications equipment	58,6	116,1	47,9	2558,9	141,8	165,7	88,6	44,4	100
Computer software and databases	102,3	69,1	11,6	523,9	360,8	79,2	103,2	40,3	100
Transport Equipment	66,0	1119,5	23,7	74,3	108,1	226,4	328,1	53,9	100
Other Machinery and Equipment	188,4	59,8	22,9	59,8	28,2	98,9	27,5	37,4	100
Total Non-residential investment	61,5	172,6	48,7	93,7	112,1	1963,9	25,2	148,4	100
R&D	753,6	6,9	0,3	230,3	55,9	7,7	188,8	159,8	100
Design and other product developments	138,0	80,3	14,0	194,4	91,2	362,7	271,2	25,0	100
Purchased organisational capital	92,2	76,1	36,7	209,9	257,5	339,6	200,3	24,1	100
Vocational training	93,7	89,1	28,6	183,0	356,9	127,3	141,9	70,7	100
Own-account organisational capital	71,2	71,9	40,2	145,4	349,6	185,2	92,2	67,8	100
Gross fixed capital formation	88,4	127,2	27,9	88,9	75,9	7258,0	40,4	76,1	100

Data: (The Vienna Institute for International Economic Studies, 2019).

Figure 4: Index of tangible and intangible capital in manufacturing (NACE C) and public sector (NACE O-Q) between 1996 and 2017 (2010=100)



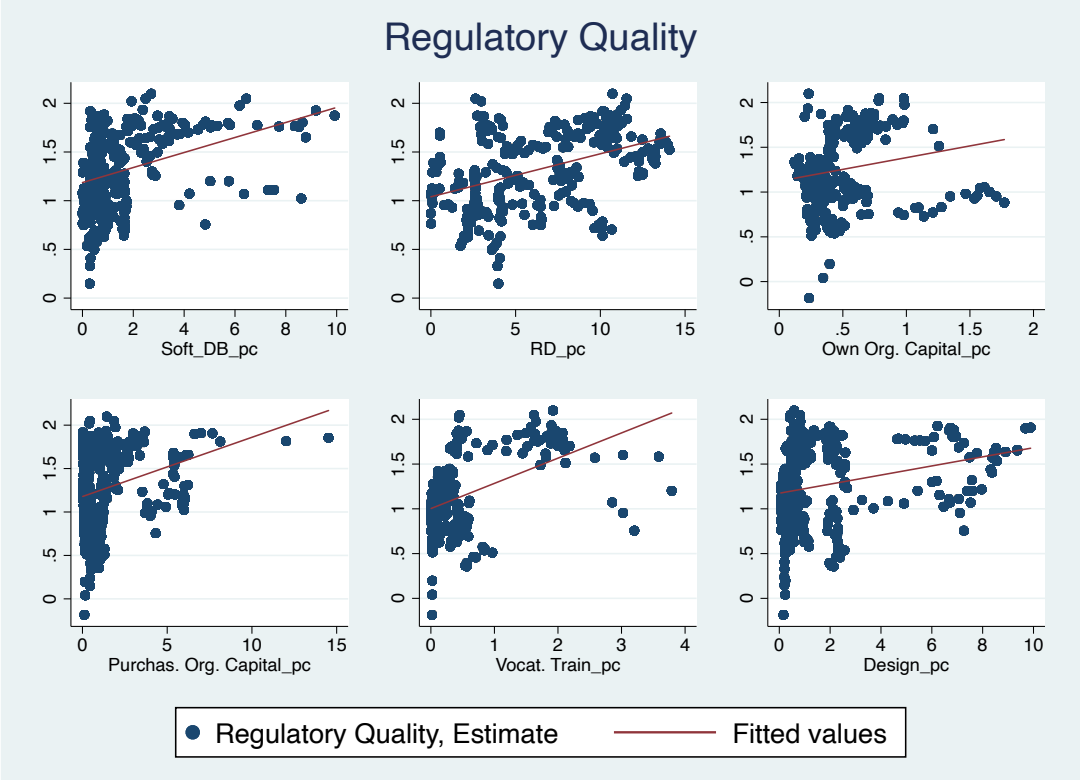
Data: (The Vienna Institute for International Economic Studies, 2019).

Figure 4 presents the dynamics of tangible and intangible capital in the economies studied between 1996 and 2017. Overall, tangible capital grew more slowly than intangible capital in both sectors. In the private sector, especially in manufacturing, the impact of the 2009 crisis is more pronounced in terms of the stock of tangible capital, as in the public sectors (NACE O-Q) tangible capital continues to grow even during the 2009 crisis. In contrast, intangible capital continues to grow in both sectors despite the crisis, but at a more moderate rate after the 2009-2017 crisis, which is consistent with other estimates (Roth, 2020; Tsakanikas et al., 2020). While intangible capital grew faster in the public sectors than in the private sector before 2008, the situation reversed and manufacturing gained momentum, overtaking the dynamics of intangible capital accumulation in the public sector. A natural explanation for this is the austerity policies practised in the public sector after the financial crises, but the effects vary across countries.

From the analytical perspective, the key question is whether the quality of institutions is related to intangible capital in the public sector. Intangible capital is crucial as an input in the public sector, as knowledge is a key determinant of the quality of institutions created by governments, or the efficiency of the state apparatus (D 7.2, D 7.5).

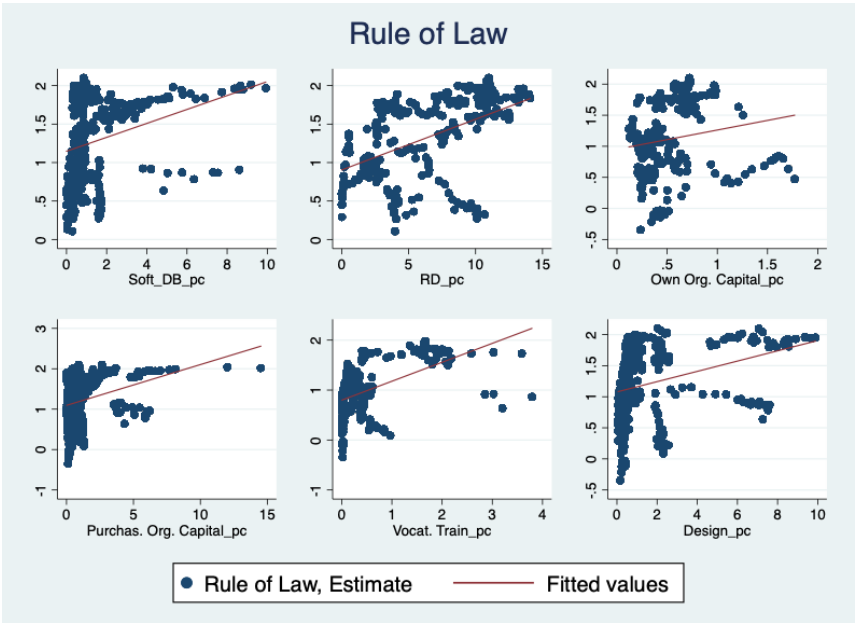
To explore this relationship, we examined the quality of institutions, as measured by the World Governance Indicators, in relation to the components of intangible capital, with all components of intangible capital converted to a per capita level. Figure 5 to Figure 10 show the relationships through simple scatter plots with fitted lines to give a sense of the relationship. It can be seen from the figures that the relationships between intangible investment and the components of governance, as measured by the World Governance Indicators score (in this case we rely on the actual estimate instead of rankings), are positive in all cases, although the strength of the relationship varies. Accumulated design capital has the weakest relationship with governance indicators, while the strength of the relationship with other intangible capital components and specific governance indicators varies across indicators.

Figure 5: Regulatory quality and intangible capital components (intangible capital component per employee)



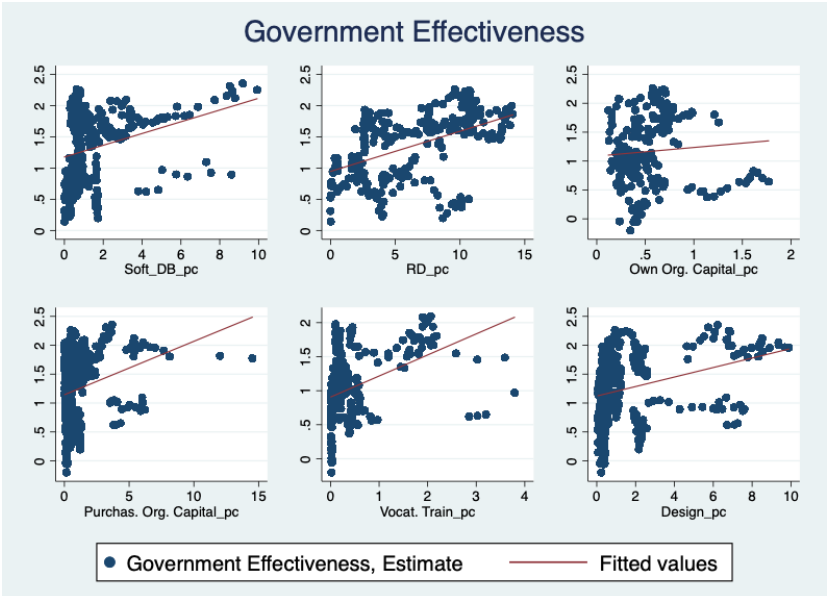
Notes: Soft_DB_pc denotes Intangible Software and databases capital services; RD_pc denotes Research and development, Own Org. Capital_pc denotes Own-account organisational capital, Purchas. Org. Capital_pc denotes Purchased organisational capital; Vocat. Tranin_pc denotes Vocational training; Design_pc denotes Design and other product developments.
Data: (Kaufmann & Kraay, 2020; The Vienna Institute for International Economic Studies, 2019).

Figure 6: Rule of law and intangible capital components (intangible capital component per employee)



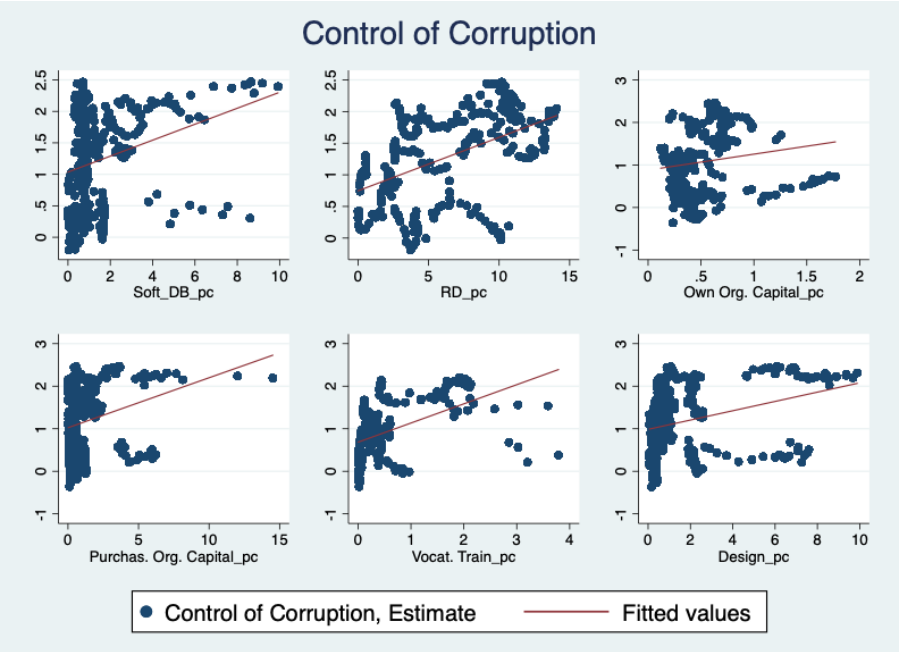
Notes: Soft_DB_pc denotes Intangible Software and databases capital services; RD_pc denotes Research and development, Own Org. Capital_pc denotes Own-account organisational capital, Purchas. Org. Capital_pc denotes Purchased organisational capital; Vocat. Tranin_pc denotes Vocational training; Design_pc denotes Design and other product developments.
Data: (Kaufmann & Kraay, 2020; The Vienna Institute for International Economic Studies, 2019).

Figure 7: Government effectiveness and intangible capital components (intangible capital component per employee)



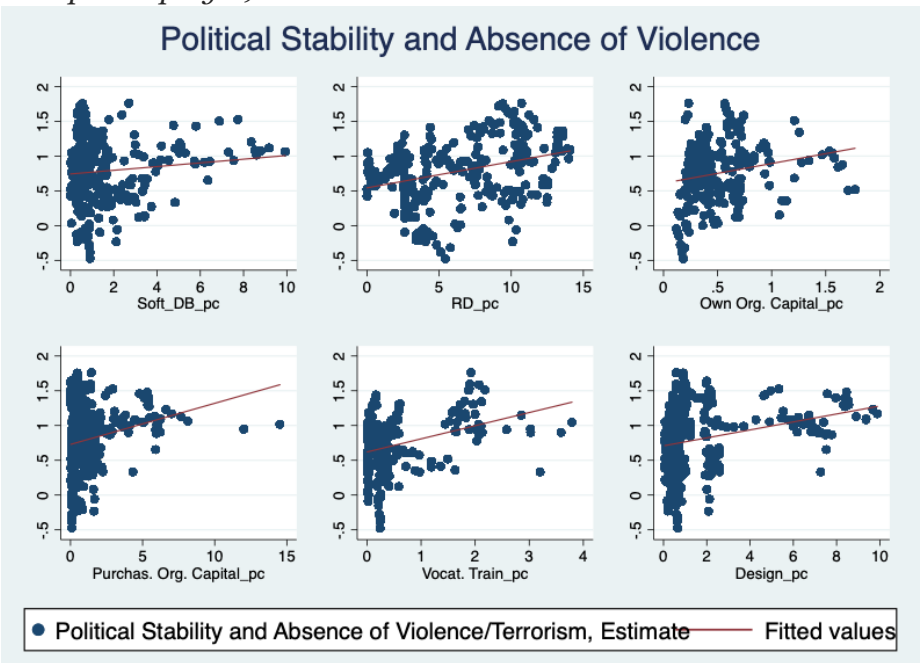
Notes: Soft_DB_pc denotes Intangible Software and databases capital services; RD_pc denotes Research and development, Own Org. Capital_pc denotes Own-account organisational capital, Purchas. Org. Capital_pc denotes Purchased organisational capital; Vocat. Tranin_pc denotes Vocational training; Design_pc denotes Design and other product developments.
Data: (Kaufmann & Kraay, 2020; The Vienna Institute for International Economic Studies, 2019).

Figure 8: Control of corruption and intangible capital components (intangible capital component per employee)



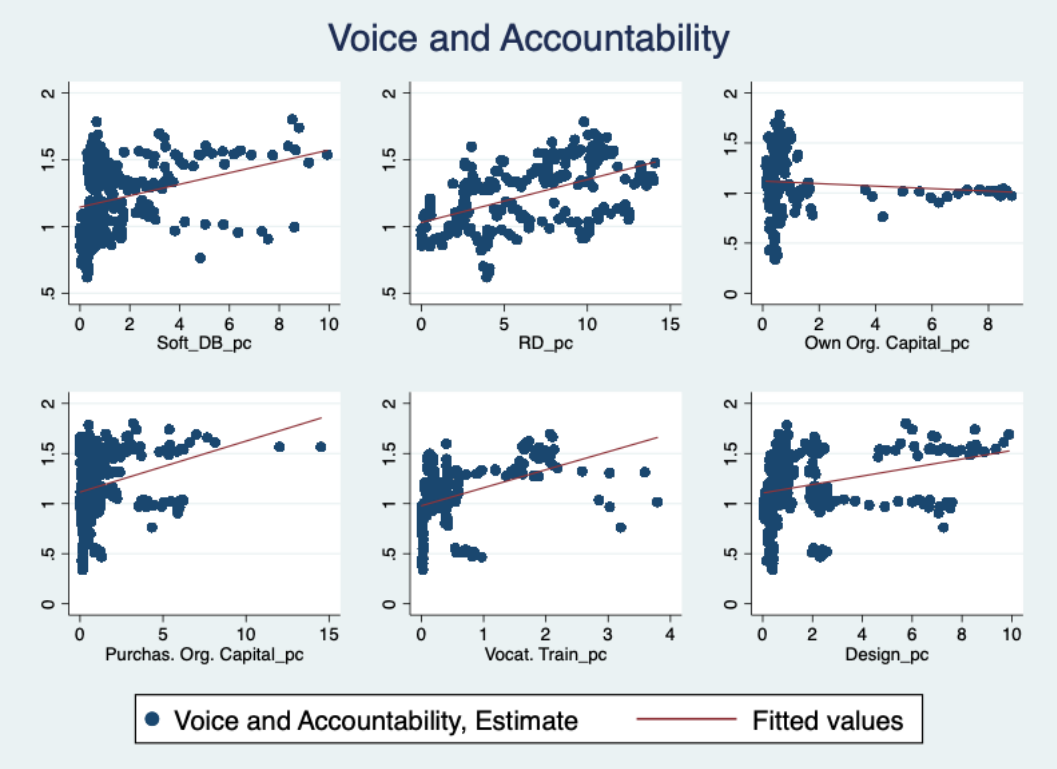
Notes: Soft_DB_pc denotes Intangible Software and databases capital services; RD_pc denotes Research and development, Own Org. Capital_pc denotes Own-account organisational capital, Purchas. Org. Capital_pc denotes Purchased organisational capital; Vocat. Tranin_pc denotes Vocational training; Design_pc denotes Design and other product developments.
Data: (Kaufmann & Kraay, 2020; The Vienna Institute for International Economic Studies, 2019).

Figure 9: Political stability and absence of violence and intangible capital components (intangible capital component per employee)



Notes: Soft_DB_pc denotes Intangible Software and databases capital services; RD_pc denotes Research and development, Own Org. Capital_pc denotes Own-account organisational capital, Purchas. Org. Capital_pc denotes Purchased organisational capital; Vocat. Tranin_pc denotes Vocational training; Design_pc denotes Design and other product developments.
Data: (Kaufmann & Kraay, 2020; The Vienna Institute for International Economic Studies, 2019).

Figure 10: Voice and accountability and absence of violence and intangible capital components (intangible capital component per employee)



Notes: Soft_DB_pc denotes Intangible Software and databases capital services; RD_pc denotes Research and development, Own Org. Capital_pc denotes Own-account organisational capital, Purchas. Org. Capital_pc denotes Purchased organisational capital; Vocat. Tranin_pc denotes Vocational training; Design_pc denotes Design and other product developments.
Data: (Kaufmann & Kraay, 2020; The Vienna Institute for International Economic Studies, 2019).

4 The characteristics of intangible capital in the public sector at the organizational level: The case of Slovenia

Public sector intangible capital is examined using occupational data and applying the same methodology as private sector intangible capital to gain deeper insight into how private and public sector intangible capital accumulation compares. As the first part of this discussion has shown (as well as deliverable 7.2 & 7.5), public sector intangibles are important to overall economic performance for two main reasons:

1) They affect the performance of the economy as a whole. The accumulation of intangible capital at the national level determines the quality of the national institutional framework in a very broad context, where institutions include both formal and informal institutions in a society (Acemoglu, 2010; Acemoglu et al., 2005).
2) It also directly affects the performance of the public sector (Corrado et al., 2017b; SPINTAN project, 2017).

4.1 Research design

Research goal. The purpose of this chapter is to analyse the following:

1) The characteristics of intangibles in the public sector in Slovenia in the period between 2005 and 2017, focusing on the accumulation of intangible capital, gender and age structure of intangibles in the public sector;
2) Comparison of the structure of intangibles in the public sector with the structure of intangibles in the private sector both by size and by structure of each intangible capital component (R&D capital, organizational capital and ICT capital), examination of the dynamics in the accumulation of intangibles in both sectors.

The analysis was conducted using a merged micro-level dataset that contained information from two main sources:

- Statistical registry of the active population in Slovenia;
- Income tax data

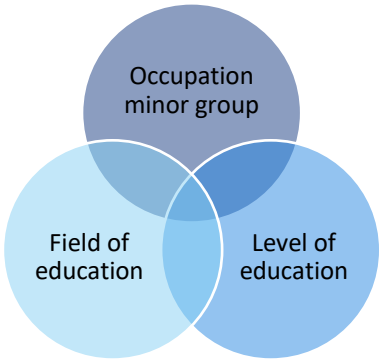
Data source. Data were provided by Statistical Office of the Republic of Slovenia, which provides access to protected microdata sets for research purposes.

Methodology. ***Specification of relevant occupations, education and field of education.*** he Globalinto methodology is based on the use of occupational data to identify individuals who fit into one of three categories of intangible capital: Information Capital, Innovative Capital, and Organizational Capital. The

methodology used has already been described in deliverable 3.5, we provide a brief methodological summary here.

First, for each type of intangible capital, we identify the individuals who have both a corresponding occupation and a corresponding level and field of education. That is, the stock of intangible capital is identified using three dimensions: (1) occupation, (2) field of education, (3) level of education (Figure 11).

Figure 11: Micro-level dimensions for the identification of the stock of intangible capital



Source: (Piekkola et al., 2020), own presentation.

Table 6 shows the list of occupations examined in the intangible capital analysis, as described earlier in Deliverable 3.5. While Deliverable 3.5. provides several methodological approaches to measuring intangible capital in the public sector using different definitions of occupations and education (as described in D 3.5), in this report we have opted for a more general definition that is appropriate for both the public and private sectors. Given the increasing proportion of people with tertiary education in the public sector in particular, reflecting the increasing proportion of people with tertiary education in society in general (and in organizational and administrative occupations in particular), but not necessarily also reflecting 'intangible capital', we have chosen to also the field of education as an additional constraint.

Following Box 4.1 from D3.4. "Measuring intangible assets at the firm level – development of an occupation based approach" by Bloch, Piekkola, Rybalka, Eklund, van Criekingen (2021) in Globalinto provides the occupation categories used in Globalinto (Table 6). Table 5 provides the list of the education fields, with details on the use in the public sector provided in D 3.5.

Table 5: ISCED-F 2013 fields of education by type of intangible capital

ISCED-F 2013 Code	Description
ORGANISATIONAL INTAGIBLE CAPITAL	
03	Social sciences, journalism and information
04	Business, administration and law
R&D INTANGIBLE CAPITAL	
05	Natural sciences, mathematics and statistics
ICT INTANGIBLE CAPITAL	
06	Information and Communication Technologies

Source: (Piekkola et al., 2020)

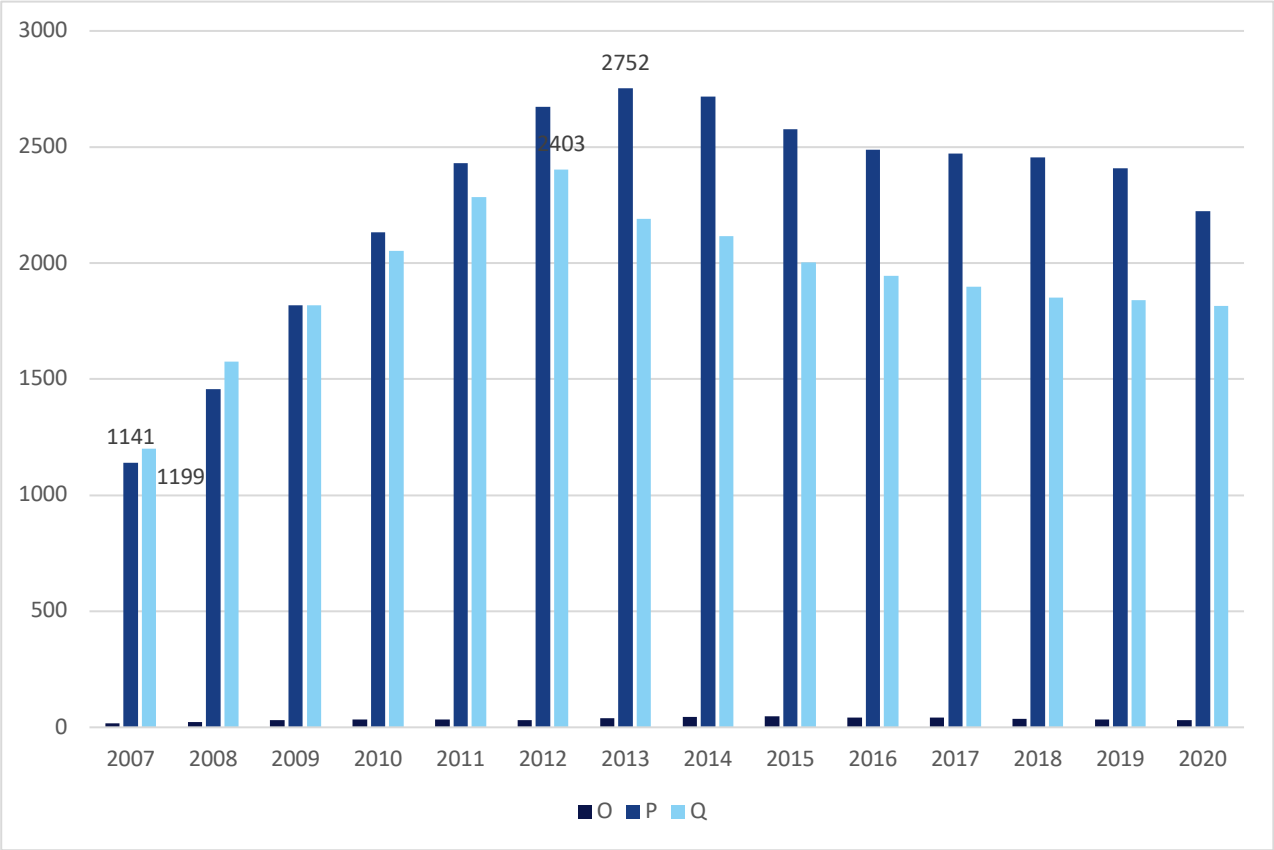
Table 6: GLOBALINTO Intangibles Assets occupations (based on ISCO08 Occupation classification)

1 Managers **112 OC** Managing Directors and Chief Executives **12 OC** Administrative and Commercial Managers **121 OC** Business Services and Administration Managers 122 Sales, Marketing and Development Managers **1221 OC** Sales and Marketing Managers **1222 OC** Advertising and Public Relations Managers **1223 R&D** Research and Development Managers 13 Production and Specialized Services Managers **131 OC** Production Managers in Agriculture, Forestry and Fisheries **132 OC** Manufacturing, Mining, Construction and Distribution Managers **133 ICT** Information and Communications Technology Services Managers **134 OC** Professional Services Managers 14 Hospitality, Retail and Other Services Managers 2 Professionals 21 Science and Engineering Professionals **211 R&D** Physical and Earth Science Professionals **212 R&D** Mathematicians, Actuaries and Statisticians **213 R&D** Life Science Professionals **214 R&D** Engineering Professionals (excluding Electrotechnology) **215 R&D** Electrotechnology Engineers 2151 Electrical Engineers **2152 R&D** Electronics Engineers R&D **2153 ICT** Telecommunications Engineers	**216 R&D** Architects, Planners, Surveyors and Designers 22 Health Professionals **221 R&D** Medical Doctors **222 R&D** Nursing and Midwifery Professionals 223 Trad. and Complementary Medicine Professionals; 224 Paramedical Practitioners **226 R&D** Other Health Professionals 23 Teaching Professionals 24 Business and Administration Professionals **241 OC** Finance Professionals **242 OC** Administration Professionals 243 Sales, Marketing and Public Relations Professionals **25 ICT** Information and Communications Technology Professionals 26 Legal, Social and Cultural Professionals 3 Technicians and Associate Professionals 31 Science and Engineering Associate Professionals **311 R&D** Physical and Engineering Science Technicians 312 Mining, Manufacturing and Construction Supervisors; 313 Process Control Technicians **314 R&D** Life Science Technicians and Related Associate Professionals 315 Ship and Aircraft Controllers and Technicians 32 Health Associate Professionals **321** R&D Medical and Pharmaceutical Technicians 33 Business and Adm. Associate Professionals; 34 Legal, Social, Cultural Associate Professionals; **35 ICT** Information and Communications Technicians

Source: Bloch, Piekkola, Rybalka, Eklund, van Criekingen (2021)

Specification of the public sector. One of the challenges that empirical investigation imposes on the research is also the definition of "what the public sector is" or how to define it within empirical research. Generally, according to Hugree et al. (2015), the "public sector refers to all workers whose job fulfils public interest functions". This, according to the authors, based on the Statistical Classification of Economic Activities in the European Community (NACE, 2008 edition), includes those employees working in the government and defence, education, health and social services sectors. However, a look at the firm level data in Slovenia shows that, for example, the number of private enterprises has increased in these typically 'public' sectors, the increase was evident in the P and Q, education and health sectors. The number of private enterprises in the health sector increased from 1,141 to 2,752 in just 6 years, while the number of private enterprises in education roughly doubled.

Figure 12: The number of private companies in the NACE sectors O, P, Q



Data: (Agencija Republike Slovenije Za Javnopravne Evidence In Storitve, 2021)

The analysis of employment also confirms that, especially in the health sector, the role of the "private" in the typically public sector in Slovenia has increased significantly. Total employment is only available up to 2017, but already from 2007 to 2017 employment has increased significantly, from 5.5% to 9.25% (Table 7). The fact that the share of the "private" in the public sector has increased should be taken into account especially when interpreting the trends and poses a particular methodological challenge, as will be discussed later.

Table 7: Total employment in private companies that operate within NACE O, P, Q, total employment in NACE, O, P, Q and share of "private employment" in the public sectors, and average size of private company in "public sector" (by average employment)

		Employment "private companies in NACE O,P,Q"			Total employment			Share of private in total employment		
Year		O	P	Q	**O**	**P**	**Q**	**O**	**P**	**Q**
2007	Number of employees	313.5	1406.8	2771.6	50667	59564	49997	0.62	2.36	5.54
	Average size of private company	17.4	1.2	2.3						
2008	Number of employees	293.0	1431.1	3088.4	50835	60999	51502	0.58	2.35	6.00
	Average size of private company	12.7	1.0	2.0						
2009	Number of employees	255.2	1470.4	3348.6	51558	62602	52002	0.49	2.35	6.44
	Average size of private company	8.0	0.8	1.8						
2010	Number of employees	252.0	1454.4	3599.7	51465	64319	53216	0.49	2.26	6.76
	Average size of private company	7.6	0.7	1.8						
2011	Number of employees	245.5	1525.3	3890.5	51192	65473	54659	0.48	2.33	7.12
	Average size of private company	7.0	0.6	1.7						
2012	Number of employees	232.8	1416.8	4183.5	49635	65279	55214	0.47	2.17	7.58
	Average size of private company	7.3	0.5	1.7						
2013	Number of employees	242.9	1478.9	4470.3	48879	65649	55561	0.50	2.25	8.05
	Average size of private company	6.4	0.5	2.0						
2014	Number of employees	250.1	1485.6	4732.9	48321	66450	56568	0.52	2.24	8.37
	Average size of private company	5.4	0.5	2.2						
2015	Number of employees	277.8	1552.8	5065.8	47959	67320	58076	0.58	2.31	8.72
	Average size of private company	5.9	0.6	2.5						
2016	Number of employees	280.4	1696.8	5549.3	48404	69279	60716	0.58	2.45	9.14
	Average size of private company	6.5	0.7	2.9						
2017	Number of employees	292.1	1664.5	5761.2	48812	71293	62260	0.60	2.33	9.25
	Average size of private company	7.1	0.7	3.0						
2018	Number of employees	278.0	1799.5	6021.0						
	Average size of private company	7.5	0.7	3.3						
2019	Number of employees	276.4	1769.1	6329.9						
	Average size of private company	8.1	0.7	3.4						
2020	Number of employees	274.2	1662.3	6603.4						
	Average size of private company	8.6	0.7	3.6						

Data: (Agencija Republike Slovenije Za Javnopravne Evidence In Storitve, 2021), (Statistical Office of the Republic of Slovenia, 2020), own calculations

Because of the problems with the delineation between the public and private sectors, we use two alternative definitions of the public sector. However, some of the organizations operating outside the O, P and Q sectors are actually funded by the state and are subject to the rules that apply to the public sector. In Slovenia, for example, the legislation on public sector wages also includes e.g. workers in museums, etc. Therefore, we propose an extended definition of sectors (Table 8, as presented also in D 3.5).

Table 8: Additional NACE M, S, R which comprise institutions/organizations of "public nature"

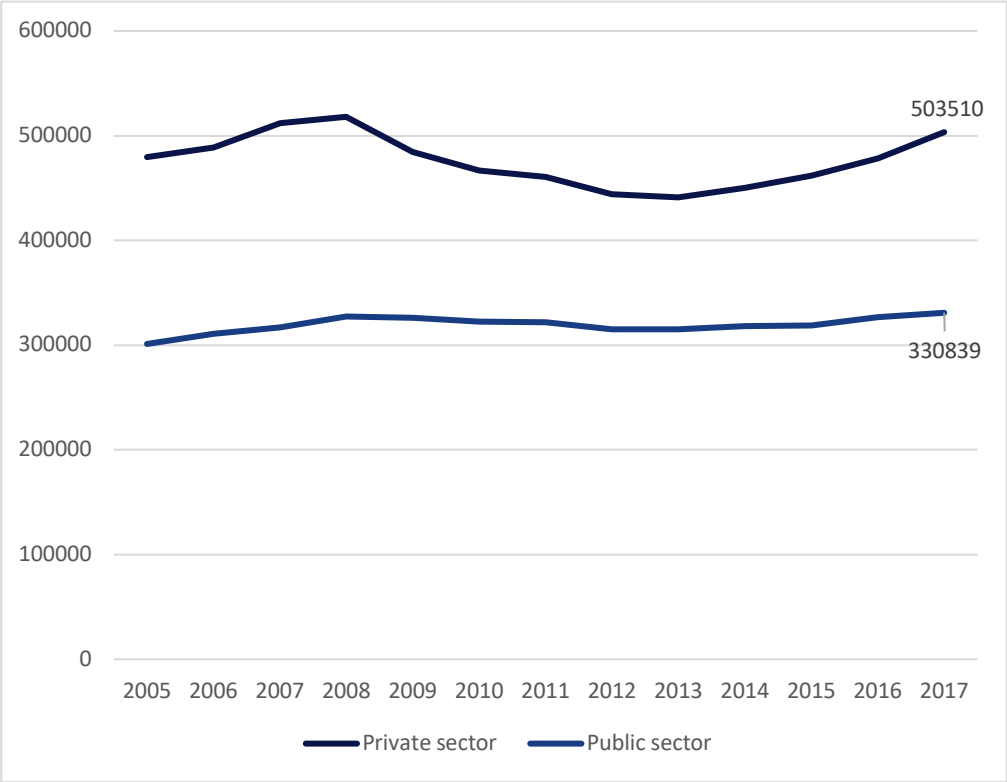
M Professional, scientific and technical activities	M72	Scientific research and development
	M72.1	Research and experimental development on natural sciences and engineering
	M72.1.1	Research and experimental development on biotechnology
	M72.1.9	Other research and experimental development on natural sciences and engineering
	M72.2	Research and experimental development on social sciences and humanities
	M72.2.0	Research and experimental development on social sciences and humanities
R Arts, entertainment and recreation	R90	Creative, arts and entertainment activities
	R90.0	Creative, arts and entertainment activities
	R90.0.1	Performing arts
	R90.0.2	Support activities to performing arts
	R90.0.3	Artistic creation
	R90.0.4	Operation of arts facilities
	R91	Libraries, archives, museums and other cultural activities
	R91.0	Libraries, archives, museums and other cultural activities
	R91.0.1	Library and archives activities
	R91.0.2	Museums activities
	R91.0.3	Operation of historical sites and buildings and similar visitor attractions
	R91.0.4	Botanical and zoological gardens and nature reserves activities
	R93.1.1	Operation of sports facilities
S Other services activities	S94	Activities of membership organisations
	S94.1	Activities of business, employers and professional membership organisations
	S94.1.1	Activities of business and employers membership organisations
	S94.1.2	Activities of professional membership organisations
	S94.2	Activities of trade unions
	S94.2.0	Activities of trade unions
	S94.9	Activities of other membership organisations
	S94.9.1	Activities of religious organisations
	S94.9.2	Activities of political organisations
	S94.9.9	Activities of other membership organisations n.e.c.

*NACE code obtained from Eurostat (Eurostat, 2008).

In addition, we also have data on the source of funding (governmental or not), which allows us to determine the legal status of the public sector, given the third definition of the public sector. Accordingly, the public sector includes both public-law (slo. Pravne osebe javnega prava) and non-profit institutions and associations, which are also (at least partially) financed with public funds.

Figure 13 shows the structure of employees in the private and "public" sectors according to the criteria "institutions under public law" between 2005 and 2017. The number of employees in the private sector varies significantly more than in the institutions that fall under the category "institutions under public law". Out of about 830 thousand employees in 2017, about 331 were employed in the institutions falling under the category of "institutions under public law". The number of employees in this sector is relatively stable, increasing slowly over 12 years from around 300 thousand to 331 thousand.

Figure 13: The number of employees in the public sector by "Institutions of public law" criteria



Data: (Statistical Office of the Republic of Slovenia, 2020), own calculations.

n the following we present selected statistics on the structure of employment and thus the "accumulation" of intangible capital in the public sector according to the three definitions and in the private sector.

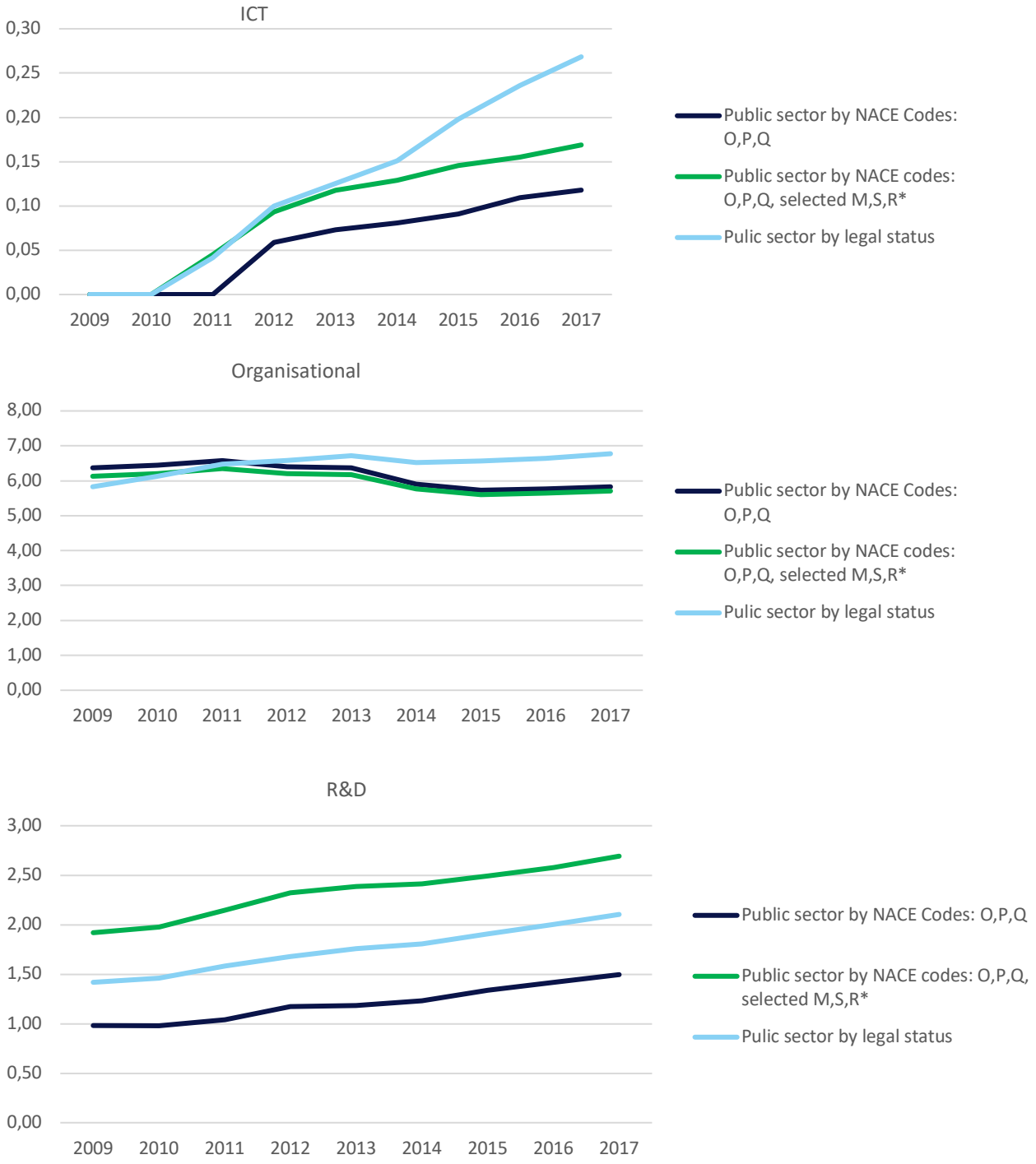
4.2 Results

4.2.1 The characteristics of intangible capital in the public sector

The number of all public sector employees has increased in all three definitions (Figure 14). Similarly, the share of intangible capital in the public sector has also steadily increased under all three definitions. However, when looking at the characteristics of the categories of intangible capital in the public sector, the shares of specific intangible capital differ significantly. Organizational capital is most prevalent in the public sector, accounting for between 5.8% and 6.7% of all public sector employees. However, the share of organizational capital is increasing very slowly, especially compared to ICT capital. ICT capital represented only 0.17% of all employees in 2017, when the latest data were available, if the public sector is defined by the NACE code. This represents 215 professionals who have the relevant ICT occupation, the appropriate field of education and also at least a tertiary education. Considering the increasing importance of digitisation, especially in the public sector, this low number is a challenge. However, it should be added that in reality the tasks of data analysts, ICT specialists, are also taken on by people with other professions or field of education, who had several of the necessary

courses during their studies (e.g. business administration graduates specializing in business informatics and the like).

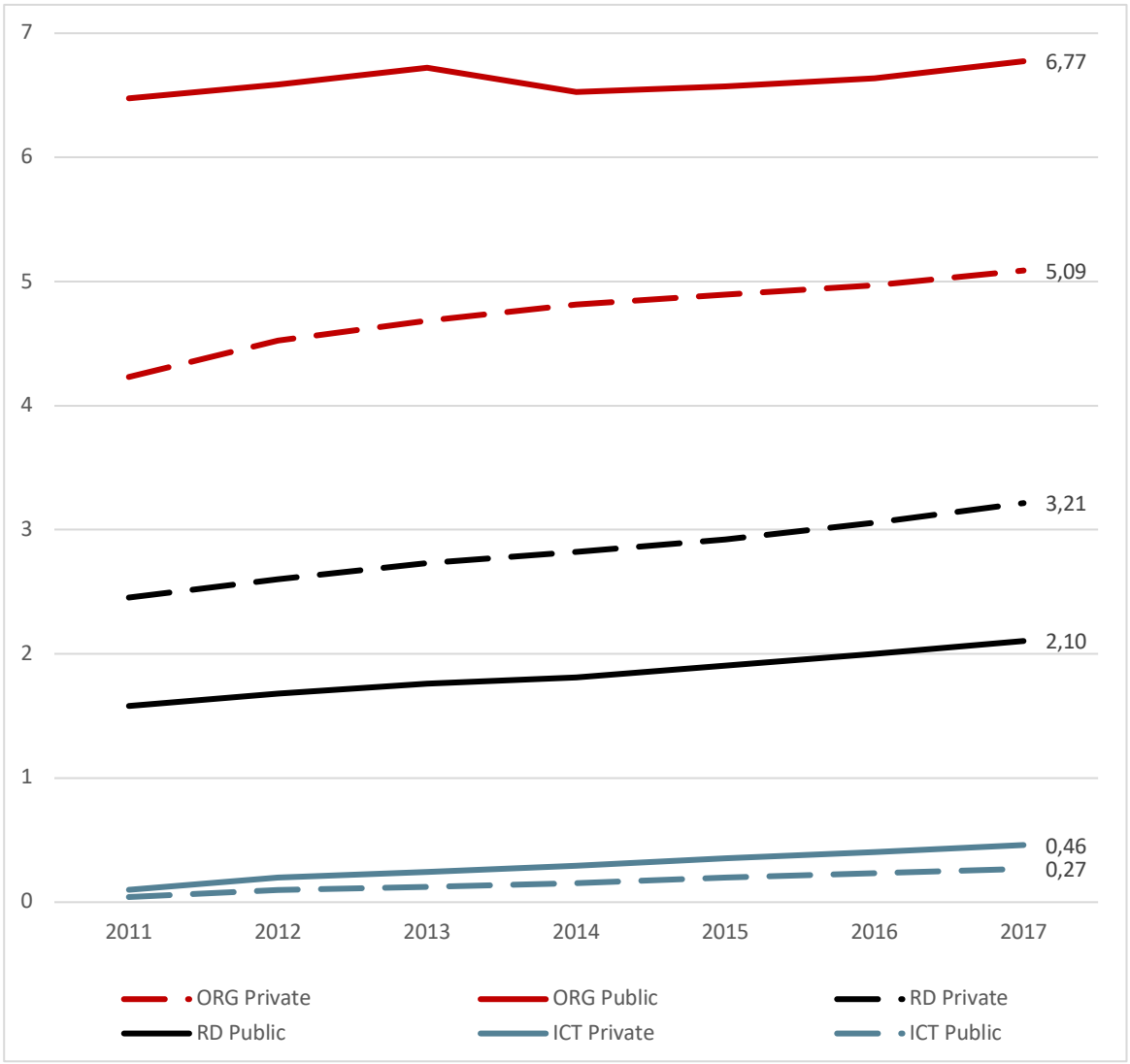
Figure 14: Share of employees in a specific intangible occupation as percentage of all employees) by type of intangible capital, and by identification of public sector, 2009-2017, Slovenia, (in %)



Notes: * Specific identification of sub-sectors identified as public sector is in Table 8. Data for ICT intangible capital in 2009 and 2010 is missing due to low number of observation that can not be reported.
Data: (Statistical Office of the Republic of Slovenia, 2020), own calculations.

The ICT component of intangible capital is also the only component where the public sector lags significantly behind the private sectors. Figure 15 hows a comparison between the public and private sectors by the "public-law" criterion. Although the share of ICT specialists (or ICT intangible workers) is almost twice as high as in the public sector, the share of ICT intangible workers is also low in the private sector, at only 0.46% of the workforce with relevant qualifications. But the share of R&D workers is much higher in the private sector, 3.21% in 2017 compared to 2.1% in the public sector, reflecting the research intensity of the private sector and the fact that public spending on R&D is low compared to private spending on R&D. Nevertheless, the government supports an important segment of R&D within research institutions, universities, etc., which is very important especially from the perspective of basic research, which involves more risk but also high potential reward.

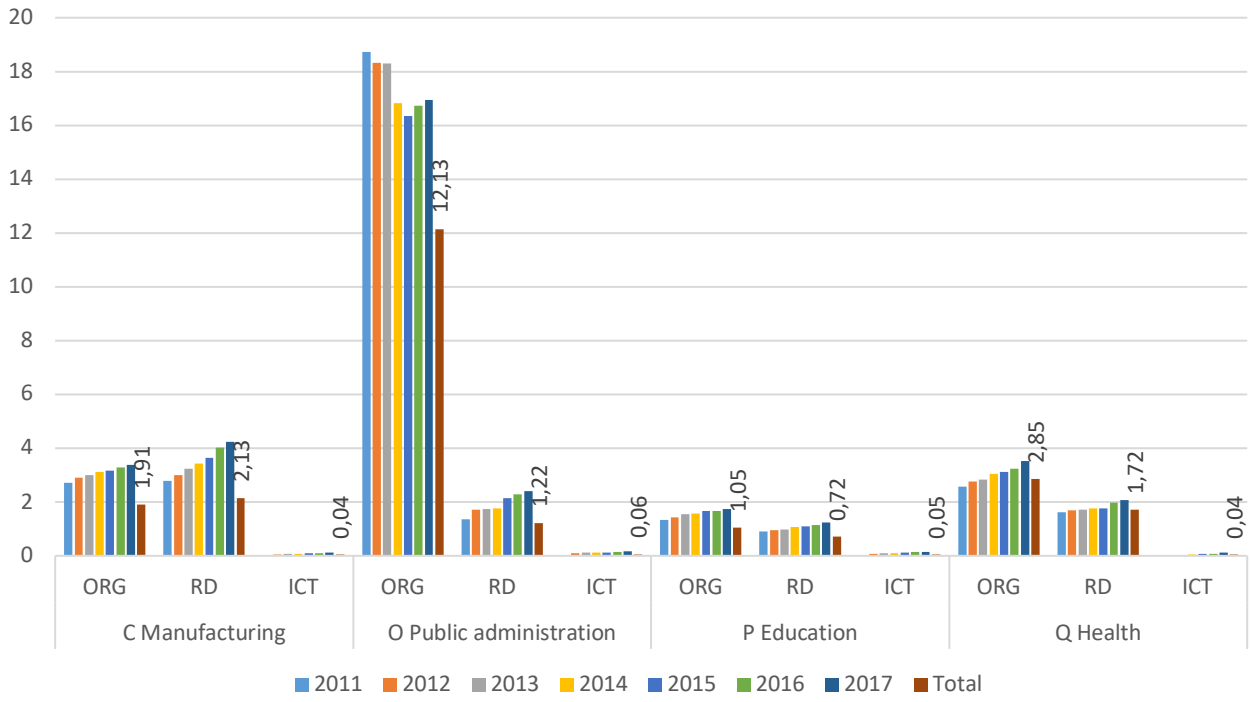
Figure 15: Intangible occupations in the private and public sector as defined by "public law criteria": share of employees in a specific intangible occupation as percentage of all employees



Data: (Statistical Office of the Republic of Slovenia, 2020), own calculations.

With respect to organizational capital, the situation is reversed. In the public sector, the proportion of those recognized as having 'organizational capital' is significantly higher than in the private sector. This is partly a reflection of the tasks that are the 'core' tasks in both sectors and the skills required. In particular, in public administration, the proportion of occupations such as Administration professionals, Managing directors and chief executives, Business services and administration managers, Legal professionals would naturally much higher than elsewhere, where, for example, the 'core' business is production. This is also confirmed by Figure 16, which shows that the sector"O public administration" significantly differs from the other sectors. The figure compares the three "public" sectors with manufacturing as a representative of the private sector. It can be seen that the overall percentage of organizational employees is 12.13%, which is more than 6 times higher than the manufacturing sector during the period under study. However, with regard to R&D, the manufacturing sector employs significantly more such workers.

Figure 16: Intangible capital in the private and public sector as defined by NACE sector: share of employees in a specific intangible occupation as percentage of all employees

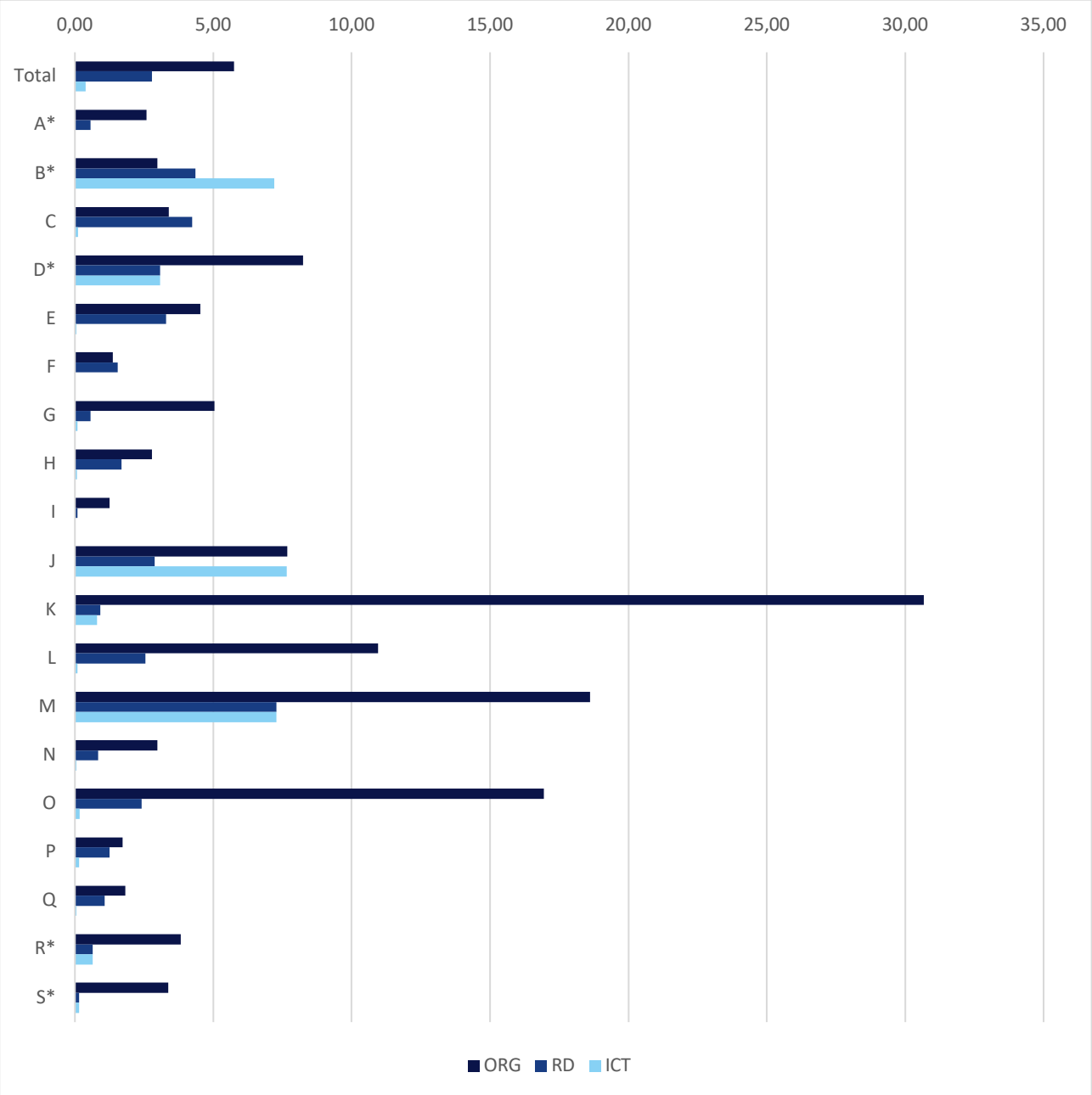


Data: (Statistical Office of the Republic of Slovenia, 2020), own calculations.

These results are not surprising for several reasons. First, much of the explanation lies in the sectoral perspective and the core tasks of each sector. Second, in terms of new hires or replacements, due to the nature of production, where most workers are less skilled (72% of workers do not have a tertiary education in 2017). And if hiring or replacing employees does not significantly change the structure of the tasks (which was not the case), the structure of the employees will not change significantly due to the economic reasons. On the other hand, many of the tasks in the public sector require higher education. Moreover, the proportion of workers with tertiary education has increased rapidly over the last 15 years due to changes in labour markets and the

desire of young people to achieve higher education. The share of the population with tertiary education in Slovenia increased from about 15% in 2011 to 20% (307 to 435 thousand people out of a population of 2 million) (Statistični urad Republike Slovenije, 2021). The structure of employment has also changed significantly. In 2011, the share of employees with tertiary education was 28.5 %, while in 2020 it was already 43 % (Eurostat, 2021).

*Figure 17: Intangible capital in the private and public sector as defined by NACE sector: share of employees in a specific intangible occupation as percentage of all employees**



*indicates that data on individual category was not allowed to be exported in more detail due to data protection. Consequently, the sum of both protected intangible categories was calculated from the total and split to half to get estimates of each individual category. This is also why two categories have the same value.
Data: (Statistical Office of the Republic of Slovenia, 2020), own calculations.

Figure 17 provides additional insight into the structure of employment in Slovenia by category of intangible capital. While public administration has a very high share of organizational capital employees, (as expected) the Finance and insurance sector (NACE K) has by far the highest share of organizational capital employees with almost 31%. Professional services also have a very high share. As expected, the ICT sector (NACE J), together with professional services, has one of the highest shares of ICT employees. Unfortunately, due to data protection regulations, the details for some sectors were masked out for a small number of observations.

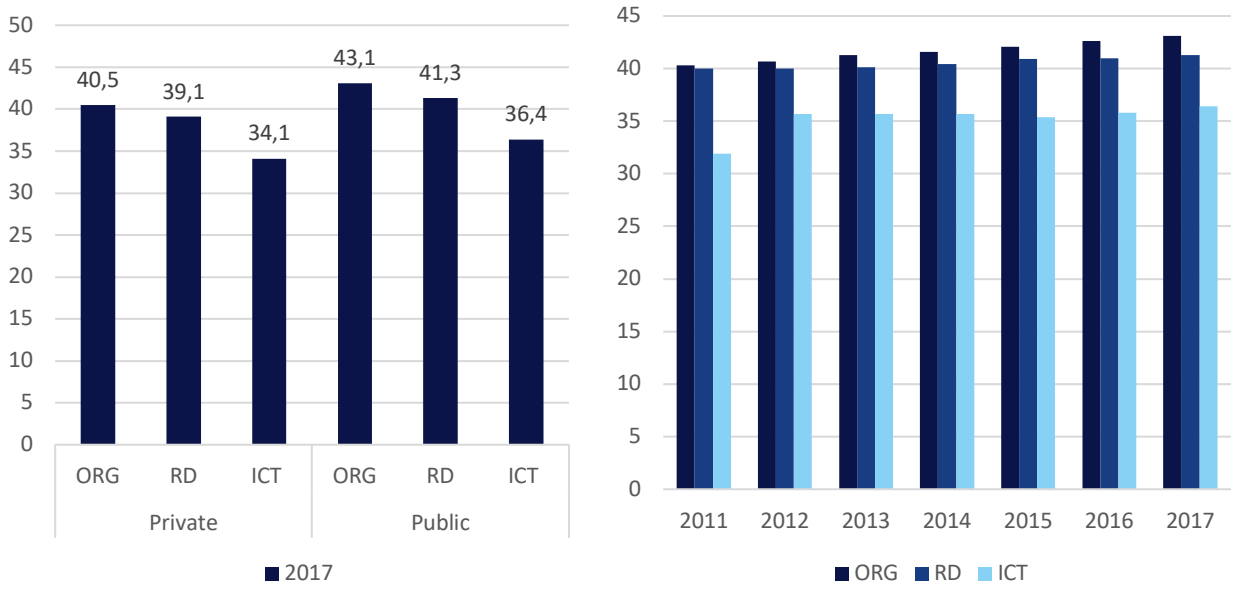
The public sector also differs from the private sector in the age and gender structure of employees in the intangible categories. Table 9 shows the data on the average age of employees in different categories of intangible capital. The data for 2017 are presented separately to present the differences more efficiently.

Table 9: Average age of intangible capital workers

	Private			Public		
Year	ORG	RD	ICT	ORG	RD	ICT
2009	37.5			39.8		
2010	37.8			39.9		
2011	38.2	38.9	31.9	40.3	40.0	31.9
2012	38.4	38.8	33.9	40.7	40.0	35.7
2013	38.9	39.0	33.8	41.3	40.1	35.7
2014	39.3	39.1	33.5	41.6	40.4	35.7
2015	39.7	39.1	33.5	42.1	40.9	35.4
2016	40.1	39.1	33.7	42.6	41.0	35.8
2017	40.5	39.1	34.1	43.1	41.3	36.4

Data: (Statistical Office of the Republic of Slovenia, 2020), own calculations.

Figure 18: Average age of intangible workers in the private and public sector in 2017 (left panel) and the average age by category of intangible workers in the public sector (right panel)



Data: (Statistical Office of the Republic of Slovenia, 2020), own calculations

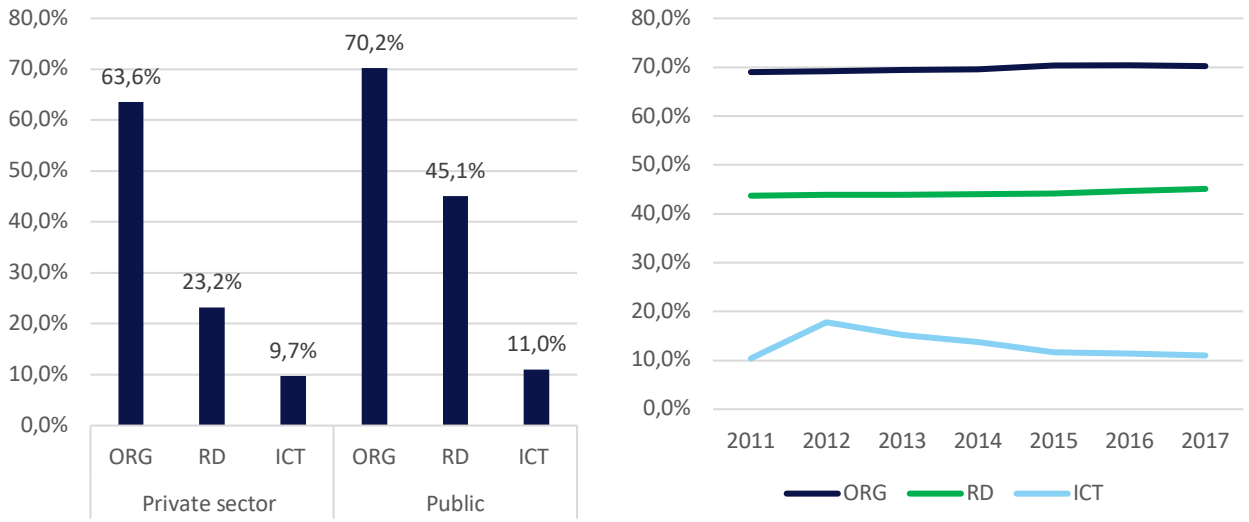
Figure 18 shows the data. The average age of all types of intangible workers is significantly higher in the public sector, 2.6 years for organizational workers, 2.2 years for R&D workers, and 2.3 years for ICT workers. Of particular interest is the increase in the average age between 2011 and 2012 for ICT workers in the public sector (right panel), which can be explained by the "austerity period" due to the 2009 crisis and the government's attempts to manage public finances. Consequently, the government was constrained in hiring new workers. In the context of the impact of intangible capital and its structure, it will be interesting to observe the longer-term evolution and the potential impact that the age gap could have on performance, for example the pace of digitalisation.

Table 10: Share of women in the private and public sector by categories of intangible capital workers

	Private sector			Public		
Year	ORG	RD	ICT	ORG	RD	ICT
2009	0.623			0.681		
2010	0.627			0.685		
2011	0.627	0.235	0.057	0.690	0.437	0.104
2012	0.632	0.238	0.100	0.692	0.439	0.178
2013	0.634	0.231	0.103	0.694	0.439	0.152
2014	0.633	0.230	0.098	0.696	0.440	0.138
2015	0.635	0.231	0.096	0.703	0.441	0.117
2016	0.634	0.230	0.095	0.704	0.447	0.114
2017	0.636	0.232	0.097	0.702	0.451	0.110

Data: (Statistical Office of the Republic of Slovenia, 2020), own calculations.

Figure 19: Average share of women by categories of intangible workers in the private and public sector in 2017 (left panel) and the average age by category of intangible workers in the public sector (right panel)



Data: (Statistical Office of the Republic of Slovenia, 2020), own calculations.

The data (Figure 19, Table 10) show that the share of women in the public sector is significantly higher than in the private sector in all categories of intangible capital workers. In the organizational capital category, the share of women is 70% compared to 63% in the private sector. In R&D, the share of women in the public sector is even twice as high as in the private sector, and it is also higher in ICT. There could be several reasons for this gender difference. Public sector jobs are more stable and also have more stable working hours, which is especially important if you have a family with young children. Stability has also been observed as an advantage in the literature, although wages for the same job are lower in many cases (Pfeifer, 2011).

4.2.2 Relative wages of intangible workers in the private and public sector

In the remainder of this paper, we examine the differences in the compensation (wages) of the three intangible worker types in the private and public sectors. From a long-term development perspective, it is important to understand these differences because comparatively lower wages in one sector lead to a "brain drain" from that sector to the sector with comparatively better pay (*Health Workers and Teachers Ready to Join Brain Drain as Prospects Deteriorate*, 2010; Möller & Eppelsheimer, 2016; Ross, 2013). Although actual job quality depends on many factors, including job stability, wages are a very important component, and research and anecdotal evidence show that comparatively low wages encourage workers to change jobs and move to other regions or countries. This is particularly important for higher-skilled workers, which include the 'intangible worker' categories. From the perspective of the public sector, which is the focus of the research here, systematically lower wages could lead to a deterioration of intangible capital in the public sector and also influence young people's decisions about what to study (e.g. doctors) and where to look for jobs. Therefore, from the long-term perspective of development and in view of the "Balassa-Samuelson effect"(Asea & Mendoza, 1994; Gubler & Sax, 2019), when applied to the public sector problem and relatively lower productivity, it is important that public sector wages are competitive with those in the private sector..

Slovenia introduced the system of “public sector wages” in 2002, when the first law on public sector wages was officially adopted (Uradni List, 2002). It has been updated several times, most recently in 2009. Wages in the public sector are on average lower than those in the private sector at comparable levels of education, although the average wage in the public sector is actually higher (due to the comparatively higher educational structure of public sector workers).

To examine the "comparative advantage" of working in the public sector for intangible workers, we examine the relative wage performance of these occupations compared to the national average. We compare the three public sectors (NACE O, P, Q) with manufacturing, also comparing the position of each sector with the national average.

We observed the behaviour of relative wages from a total of 3.70 million data points for manufacturing workers, 880 thousand observations from NACE O, another 1.1 million from NACE P, and 950 thousand from Q (Table 11).

Table 11: The observed population of workers in the three sectors (number of employees)

	NACE			
	C	O	P	Q
2008	216,286	50,835	60,999	51,502
2009	190,544	51,558	62,602	52,002
2010	183,997	51,465	64,319	53,216
2011	185,012	51,192	65,473	54,659
2012	178,236	49,635	65,279	55,214
2013	176,844	48,879	65,649	55,561
2014	178,454	48,321	66,450	56,568
2015	182,906	47,959	67,320	58,076
2016	188,502	48,404	69,279	60,716
2017	198,054	48,812	71,293	62,260
Total	3,699,915	881,591	1,113,694	952,029

Data: (Statistical Office of the Republic of Slovenia, 2020), own calculations.

Table 12 presents data on the real mean and median wages of workers in the intangible category for the economy as a whole. On average, the gross wages of organizational workers ranged from 27.9 to 28.7 thousand euros per year, while the median wage ranged from 23 to 23.7 thousand. The gross wages of R&D workers were comparable, while the average and median wages of ICT workers were lower, especially the average wage was around 3 thousand euros lower in 2017. The last column also shows the average wage in the economy, which ranged from 15 to 17.9 thousand euros (gross wage excluding employer contributions). Table 13 also shows the data on the average wage of all workers (not only intangible) in the studied sectors (C, O, P, Q). On average, the wage is highest in NACE O (Public Administration) due to the educational structure.

Table 12: Mean and median yearly gross wage (without employers' social contribution payments) of intangible category workers (constant prices, 2015), in euros

Year	Organizational workers		R&D workers		ICT workers		**Average wage in the economy**
	Average wage	Median wage	Average wage	Median wage	Average wage	Median wage	**All workers**
2008	27,947	23,045	23,569	19,865	22,709	20,378	**15,311**
2009	27,535	23,153	24,931	20,874	23,432	21,142	**16,079**
2010	27,505	23,020	25,377	21,424	23,760	21,540	**16,542**
2011	28,210	23,876	25,676	21,902	24,177	22,015	**16,990**
2012	27,618	23,540	25,688	21,969	24,426	22,355	**17,589**
2013	27,591	23,407	25,414	21,974	24,399	22,319	**17,058**
2014	27,605	23,146	25,885	22,495	24,516	22,452	**17,253**
2015	27,815	23,021	25,668	22,467	24,676	22,546	**17,363**
2016	28,219	23,350	25,913	22,810	24,876	22,681	**17,579**
2017	28,729	23,736	26,300	23,167	25,446	23,133	**17,903**

Data: (Statistical Office of the Republic of Slovenia, 2020), own calculations.

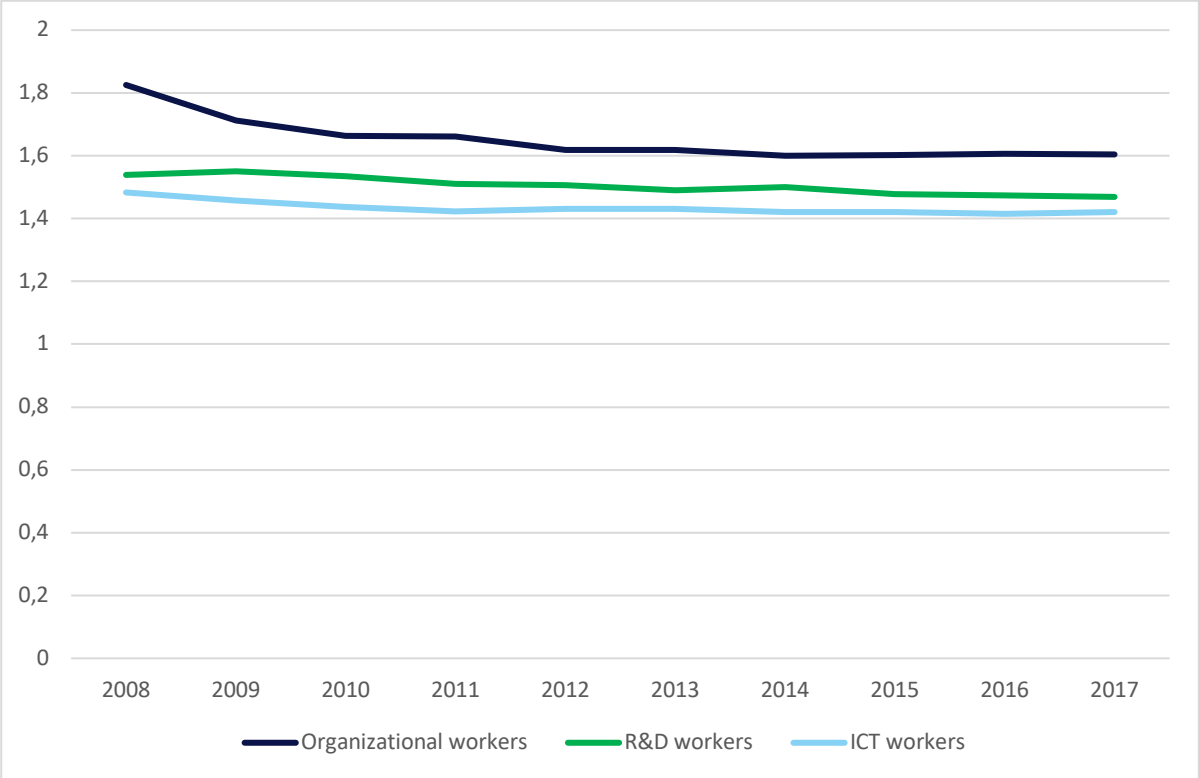
Table 13: Mean yearly gross wage (without employers' social contribution payments) in the sectors NACE C, O, P, Q (constant prices, 2015), in euros

	C	O	P	Q
2008	13,796	19,680	18,968	17,572
2009	14,081	20,779	19,803	20,039
2010	14,944	20,803	19,746	19,701
2011	15,719	21,045	20,004	19,783
2012	16,177	20,720	19,444	19,458
2013	16,451	20,352	18,844	19,204
2014	16,912	20,717	19,041	19,722
2015	17,253	20,882	18,846	19,071
2016	17,564	21,896	19,021	19,513
2017	17,821	22,784	19,440	20,139

Data: (Statistical Office of the Republic of Slovenia, 2020), own calculations.

Figure 20 shows the wage ratio of intangible workers (average wage from Table 12) to the general average gross wage in the economy. The ratio has deteriorated slightly, especially for organization workers, who in 2008 received a wage 1.82 times higher than the average gross wage, while in 2017 the ratio was "only" 1.6.

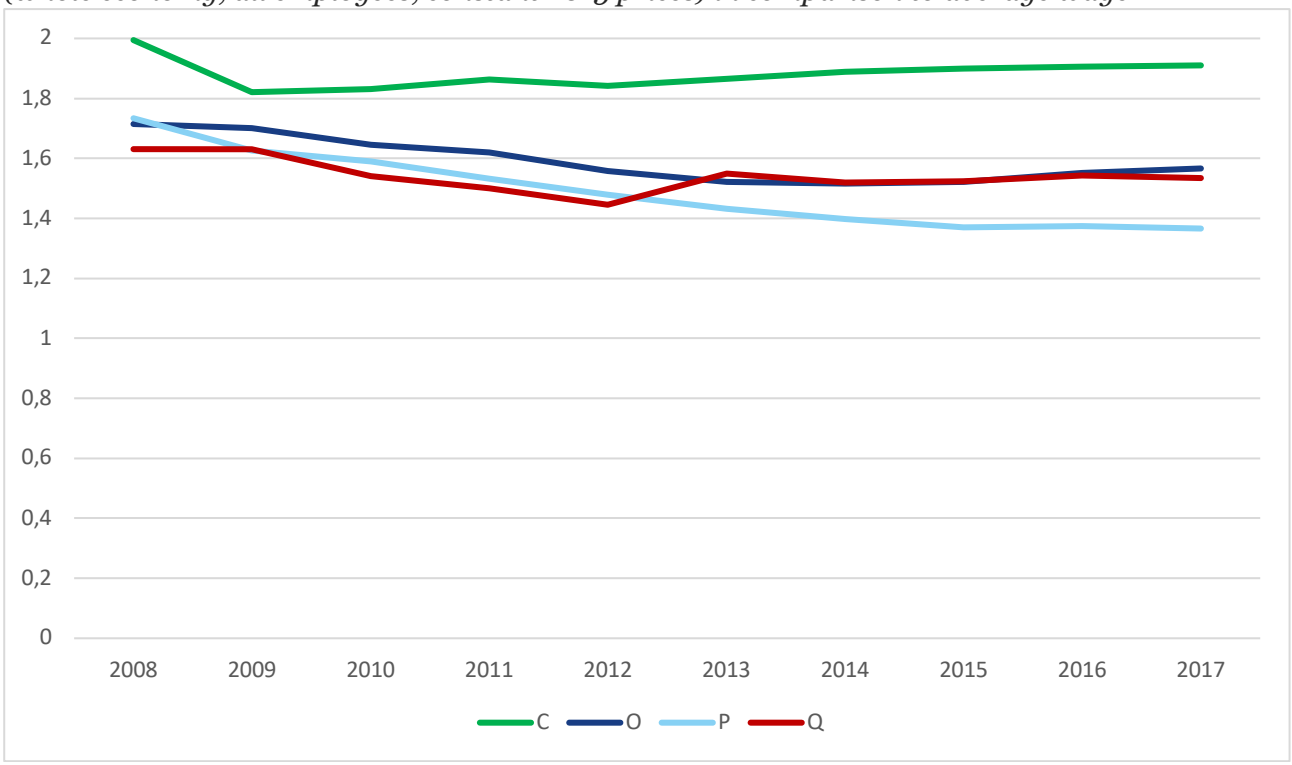
Figure 20: Relative wage of intangible workers in Slovenia between 208 and 2017 (whole economy, all employees, constant 2015 prices)



Data: (Statistical Office of the Republic of Slovenia, 2020), own calculations

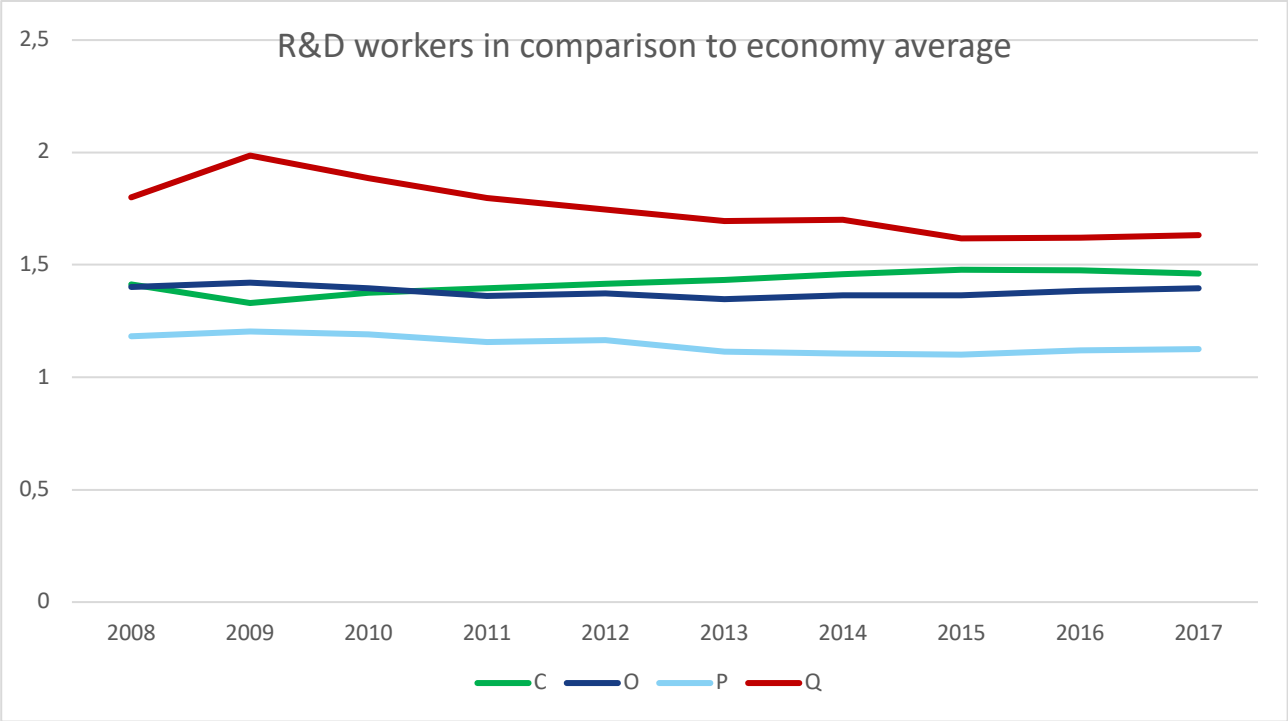
We further compared the wages of intangible workers in the three sectors with the intangible wages of the economy as a whole (Figure 21, Figure 22, Figure 23). The data show that the wage ratio in the public sector is on average worse than in the private sector from the perspective of the "intangible worker categories" when compared to NACE C (Manufacturing). In general, the wage ratio compared to the average wage in the economy is highest for organizational workers, followed by R&D workers, followed by ICT workers, who in the education sector receive, on average, a wage that is quite comparable to the average wage in the economy. This is partly due to the fact that wages in the public sector depend on position/title, level of education and also years of service (years of experience). ICT workers are on average support workers, not heads of department etc., are on average younger and the data is based on occupation only. Nevertheless, these data shed additional light on the general shortage of (good) ICT professionals in the public sector: in the real economy (manufacturing) the pay ratio is much higher. In Education, the pay ratio for R&D employees is significantly higher than elsewhere, which can be explained by the fact that the majority of highly educated university researchers work in this sector and, according to the occupational classification, also belong to R&D employees. Teachers with high experience would also have a good wage on average.

Figure 21: Relative wage of "organizational" intangible workers in Slovenia between 208 and 2017 (whole economy, all employees, constant 2015 prices) in comparison to average wage



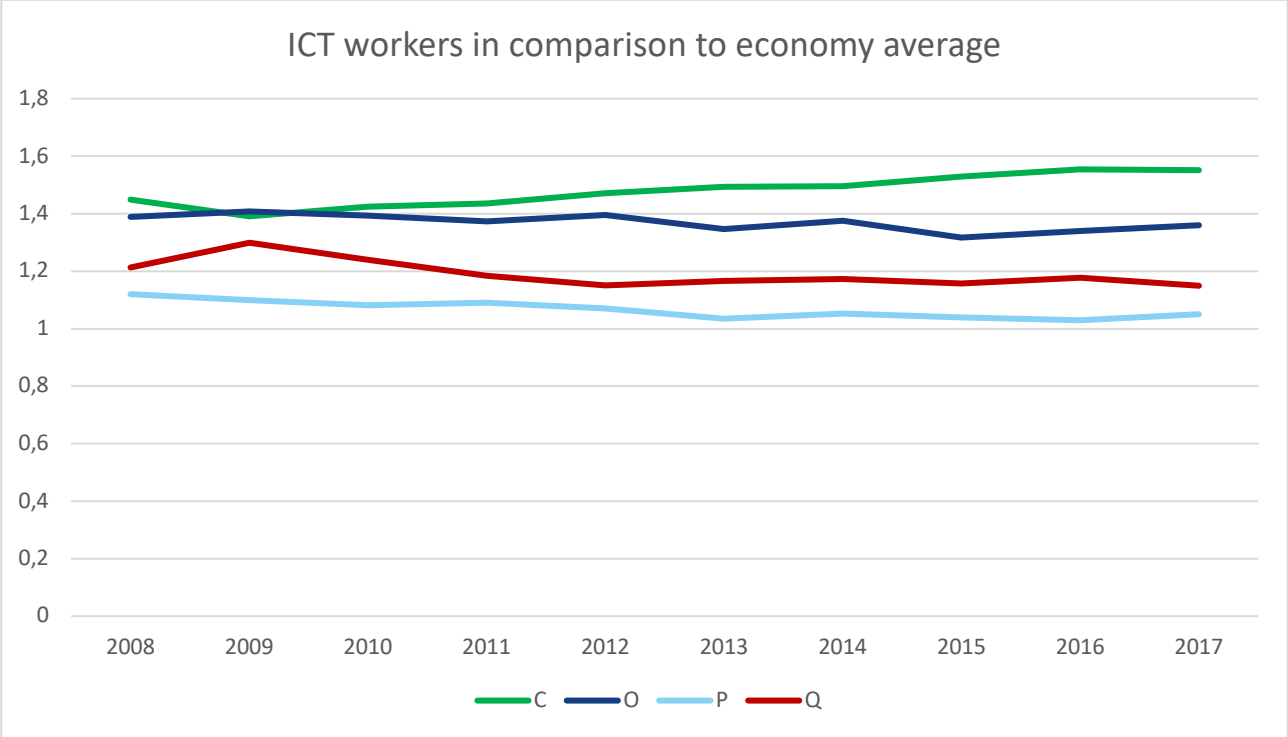
Data: (Statistical Office of the Republic of Slovenia, 2020), own calculations.

Figure 22: Relative wage of "R&D" intangible workers in Slovenia between 2008 and 2017 (whole economy, all employees, constant 2015 prices) in comparison to average wage



Data: (Statistical Office of the Republic of Slovenia, 2020), own calculations.

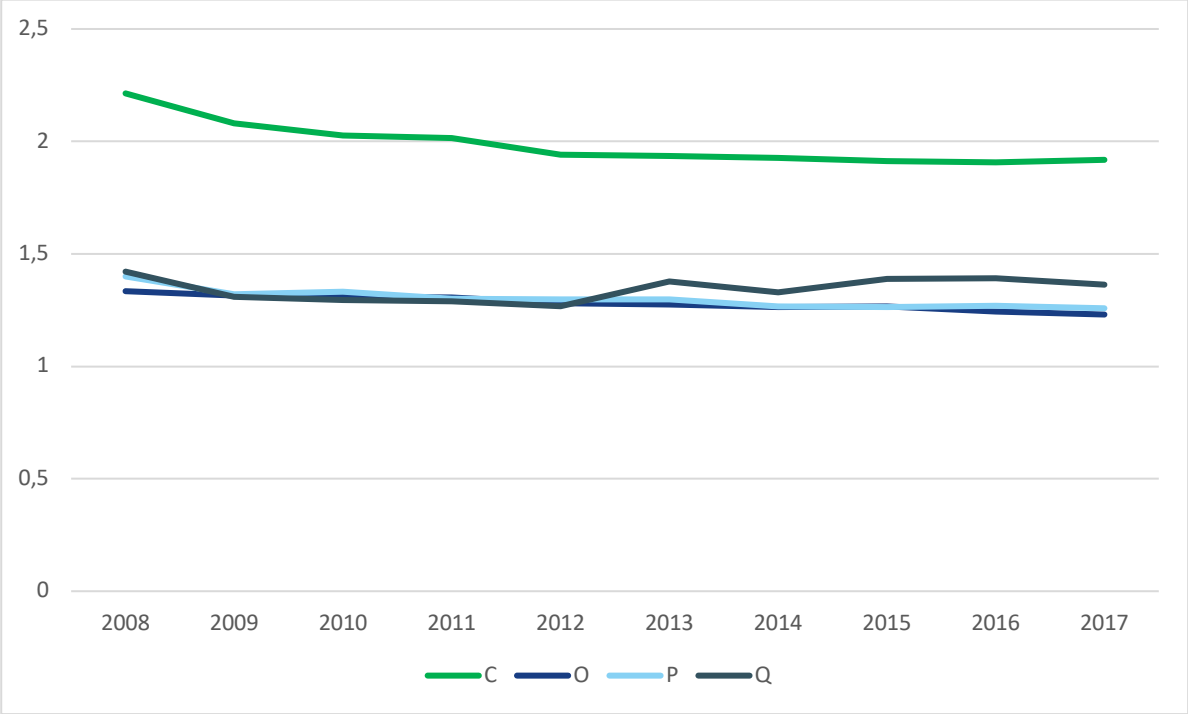
Figure 23: Relative wage of "ICT" intangible workers in Slovenia between 208 and 2017 (whole economy, all employees, constant 2015 prices) in comparison to average wage



Data: (Statistical Office of the Republic of Slovenia, 2020), own calculations

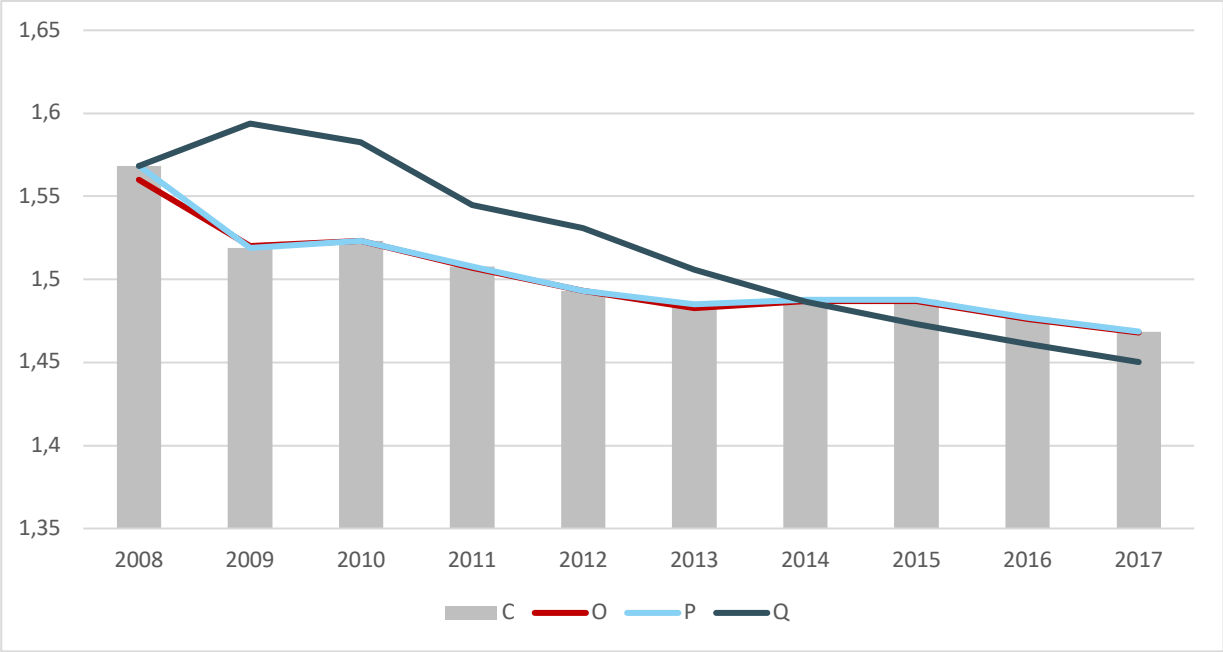
Figure 24, Figure 25, and Figure 26 show the relative wages of intangible occupations in relation to the sector average. This is particularly interesting from the perspective of the motivations of different groups of occupations in a given sector. Wages of organizational workers are on average much higher than in manufacturing in general, with wages about 2 times higher than the average wage in manufacturing. In the public sector, wages of organization workers are very comparable, due to the statutory basis of wages, and there is also very little variation between sectors (for the same reason). Interestingly, the wages of R&D workers have fallen somewhat, and in all the sectors studied relative to their respective sectoral average wages. Only the health sector (NACE Q) had a specific curve. Other sectors followed a very similar trend. ICT workers in the manufacturing sector earned on average about 1.6 times the average manufacturing wage. The ratios in the public sector are again much lower, partly due to legal requirements and partly due to the higher wages in these sectors in general (especially in education, where ICT workers actually earned slightly less than average due to the high average wage, again due to supporting technicians in many organizations (schools, universities).

Figure 24: Relative wage of "organizational" intangible workers in Slovenia between 2008 and 2017 (whole economy, all employees, constant 2015 prices) in comparison to average wage of the sector



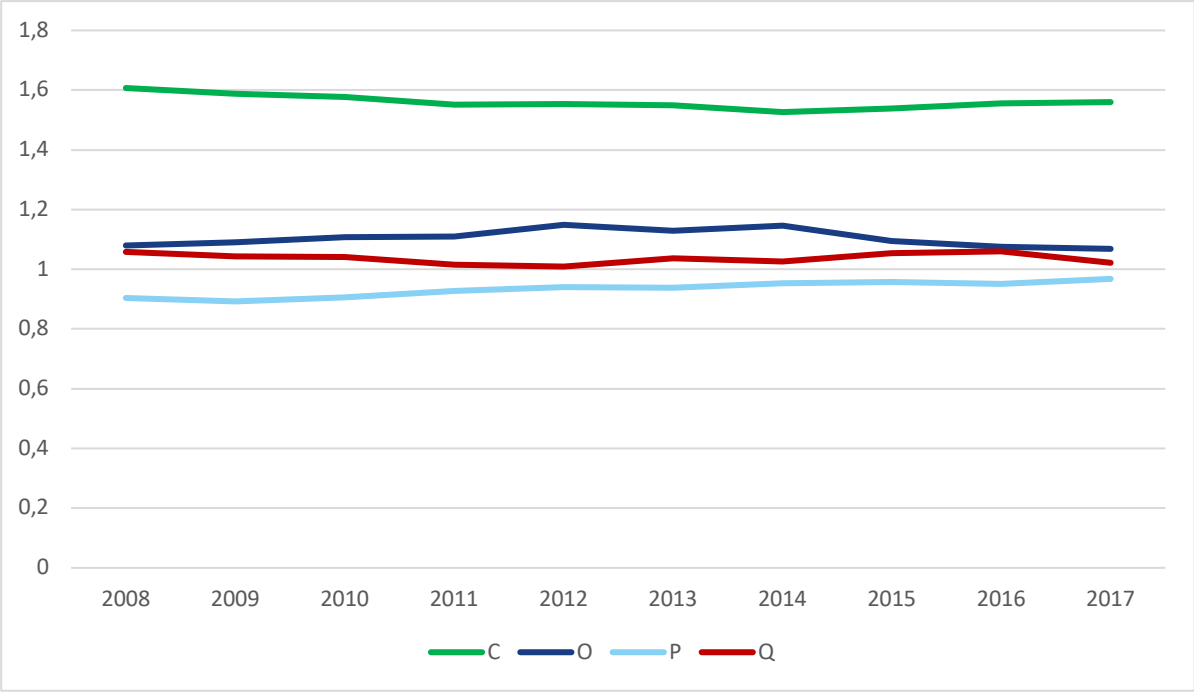
Data: (Statistical Office of the Republic of Slovenia, 2020), own calculations

*Figure 25: Relative wage of "R&D" intangible workers in Slovenia between 2008 and 2017 (whole economy, all employees, constant 2015 prices) in comparison to average wage of the sector**



*Due to almost complete overlap, NACE C is for clarity purposes presented using bars.
Data: (Statistical Office of the Republic of Slovenia, 2020), own calculations

Figure 26: Relative wage of "ICT" intangible workers in Slovenia between 2008 and 2017 (whole economy, all employees, constant 2015 prices) in comparison to average wage of the sector



Data: (Statistical Office of the Republic of Slovenia, 2020), own calculations

5 Discussion and challenges for future research

Intangible capital has been studied in the literature for a long time, for more than 100 years. More recently, the definition of Corrado et al. (2006), according to which intangible capital is a sum of three main components: 1) computerised information (computer software, computerised databases); 2) innovative capital (which includes mainly R&D but also other innovative expenditures); and 3) economic competencies (brand equity, firm-specific human capital, and organisational structure), has gained acceptance, spurring the rise of empirical research on the contribution of intangibles to economic performance. While the empirical literature focusing on the market economy has developed strongly, the analysis of intangible capital in the public sector is much weaker.

This paper contributes to the discussion of intangible capital in the public sector. Two key research questions guide the investigation in this paper:

(1) Is the quality of the institutional framework related to intangible capital in the public sector;

(2) What are the differences between the components of intangible capital in the public and private sectors and how might this affect the future development of the economy as a whole?

Methodologically, given the characteristics of the available data, the analysis is approached in two steps:

(1) The relationship between public sector intangibles and institutional quality is examined at the national level, using two established data sources: EU Klems and World Governance Indicators;
(2) A more detailed analysis of intangible capital is carried out for Slovenia using micro-level (organization-level) data provided by the Statistical Office of the Republic of Slovenia.

The results show that:

(1) In general, intangible capital accumulation per employee in the public sector, as shown by the EU-Klems data, is on average below the economy average, although it is above it, e.g. for R&D. Firm-level analysis using Globalinto approach also showed that organizational capital is more abundant in the public sector than in the private (but stress should be put on the fact that data and methodology is different). This highlights the importance of methodology selection for both measurement of intangible capital as well as for interpretation of diferences.

(2) The dynamics of intangible capital in the public and private sectors differ significantly, especially intangibles in the public sector started to grow much more slowly after the 2009 crisis, although they have been increasing steadily. A comparison of the accumulation of intangible capital types per employee in the manufacturing sector (NACE C), the public sector (NACE O-Q) and the economy as a whole shows that the public sector generally lags behind the manufacturing sector in both selected tangible and intangible capital components. Moreover, comparing both sectors to the average of the economy (right panel of the table), it is clear that the public sectors also lag significantly behind the average of the economy, with the sole exception of R&D.

(3) We argue that intangible capital is directly related to "better institutions" as measured by the World Governance Indicators. These could be understood as public sector "outputs", where we argue that higher accumulation of intangible (knowledge) capital improves governance. And governance quality, as a direct result of public sector intangible capital accumulation, is a channel through which the public sector also influences private sector productivity (as discussed in D 7.2 and D 7.5).

(4) There are significant differences in the quality of governance as measured by the World Governance Indicators. Finland had the best quality of governance among the economies studied in 2017. It ranked in the top two in 4 out of 6 indicators, ahead of Luxembourg, Sweden and the Netherlands, which scored significantly lower than Finland, especially in the Political Stability and Absence of Violence category. The data also show that the new members of the EU were in the lower half of the rankings (when looking only at EU economies), with the exception of Greece, Italy and Spain, which are older members. An analysis of the changes over the period studied shows that not all countries have made progress over the last 20 years, and in some there has even been a marked deterioration in the rankings. The deterioration was particularly marked in Hungary, which lost 18 percentage points in the voice and accountability category and 15 percentage points in the control of corruption category. Greece lost 26 percentage points in the Rule of Law category and nearly 21 percentage points in the Political Stability and Absence of Violence category. It should be noted, however, that some old EU members (e.g. Belgium, Germany, Denmark) also lost a similar number of percentage points.

(5) An analysis based on a combination of EU-Klems data and World Governance Indicators shows that the relationships between intangible investment and components of governance, as measured by the World Governance Indicators score, are positive, although the strength of the relationship varies.

(6) An analysis of organization level data for Slovenia using the Globalinto methodology shows that there are differences in the accumulation of intangible capital between the three public sectors (NACE 0, P, Q), that especially organizational capital is important compared to others. The data also show that the accumulation of intangible capital in the public sector lags behind the private sector. However, we also point out the methodological challenge and ask whether the definition of the relevant occupations should be different for the public sector, especially NACE 0 (Public Administration). The wage analysis also shows a gap between the private and public sectors, which could have a negative impact on the quality of intangible capital in the public sector..

In terms of future research, two main challenges remain:

(1) Methodological challenge, which involves two aspects:

a. The definition of the public sector. The definition of public sector in the literature remains open to several criteria that can be used. While we have primarily used the NACE classification, keeping in mind that "public" NACE is O-Q, the source of funding could also be used, or an adjusted definition based on the actual characteristics of a country. If micro data are analyzed, the accounting standards used could also help distinguish private from public.

b. Definition of intangibles in the public sector. It is a major challenge to formulate a definition of intangible capital based on occupations, especially given the diversity of tasks in the many sectors of the economy. While comparison between organizations in the same sector is easier, applying the same methodology to different sectors could present challenges, as in the case of Public Administration, where the share of highly educated workers in organizational occupations is logically very high. So, in this case, it should be considered whether it is better to avoid comparison with other sectors or to adjust the definition (which would again make comparison very difficult).

(2) Moreover, the analysis of the contribution of intangibles to organizational performance in Slovenia is problematic because wages are not set independently of organizations and are not linked to their productivity. Rather, there is a system of wages in the public sector that prescribes wages in detail by "wage" class.

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