Public and Private Sector Intangible Investments in the European Economies: Preliminary Results from the SPINTAN* Project

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Abstract

Previous research on the impact of intangible assets on growth was confined to the Business sectors. This paper reports on a project recently funded by the EU, SPINTAN, which aims to calculate intangible investments and intangible capital for non-market sectors. It presents an overview of the conceptual issues in measuring public sector intangibles. This is followed by a discussion of some preliminary estimates for the three broad categories of intangible assets, economic competencies, computerised information and innovative property. These estimates suggest that public sector intangible investments intensity is likely to be lower than for the private sector, but is still sizeable.

JEL H4, L8, O4,

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1. Introduction

It is now widely recognized that intangible investments are a major determinant of innovation, growth and employment in the "knowledge economy". However, our understanding of the contribution of intangibles assets to economic performance remains incomplete. The vast majority of the research undertaken to date is confined to the Business Sector of the economy, ignoring the potentially important role played by Public Sector intangibles.

Any study about intangibles must start with a definition of what is included within its boundaries. Among the different alternative versions available, probably the most comprehensive one is the work of Corrado, Hulten and Sichel, 2005, 2009 (CHS). In defining intangible assets, they refer to a standard inter-temporal framework that leads to the conclusion that "any use of resources that reduces current consumption in order to increase it in the future […] qualifies as investment". Then, all types of capital should be treated symmetrically, for example, "investment in knowledge capital should be placed on the same footing as that of investment in plant and equipment".

The COINVEST and INNODRIVE projects[1] are the two main initiatives undertaken at the European level to measure the importance of intangible assets and their impact on economic performance and growth. Both of these EC-funded research projects follow the CHS framework to estimate the amount of investment in intangible assets for EU countries, but the estimates differ in terms of underlying data series and the proxies used for different expenditures that count as intangible investment. The INTAN-Invest project[2] brings together the results of these two projects to produce harmonised estimates for a range of European countries and the US. These European projects, however, only cover the 'market' sectors and omit the difficult to measure NACErev 1 industries, Public Administration (L), Education (M) and Health and Social Work (N), as the original focus was on understanding the impact of intangible assets on business sector growth and productivity. By doing so, however, the project databases miss about 20% of aggregate economic activity and possibly important external benefits from public sector intangibles to business sector performance.

The primary objective of the EC funded SPINTAN (Smart Public Intangibles) project[3] is to extend both the theoretical and the empirical approach introduced by CHS to include Public Sector intangible assets. The project will analyze key issues with regard to the boundaries of public intangibles between different public and private categories, such as R&D, skill formation and IT investment. The project will also propose new ways to measure Public Sector intangible capital services, and especially the rate of return on public intangibles. The aim is to construct a database for 22 EU countries and some additional countries such as the

[1] See http://innodrive.org/; and http://www.coinvest.org.uk/bin/view/CoInvest
[2] See http://www.intan-invest.net
[3] See http://www.spintan.net. The project runs from Dec 2013 to Nov 2016.

United States, China and India. These data will then be used to evaluate the impact of public intangibles on aggregate growth.

The purpose of this paper is to present some preliminary conceptual and empirical results from the SPINTAN project. It starts with an overview of some of the conceptual issues that need to be addressed in the project, concentrating on the boundary issue but also lists some additional conceptual problems that need to be addressed by the project. Preliminary comparisons between the private and public sectors for a range of intangible assets are then discussed. CHS divided intangible assets into three broad categories, computerised information, innovative property and economic competencies. The first estimates using data collected directly for the SPINTAN project on economic competencies are presented first. These are then supplemented by estimates, taken from work on previous EC-funded projects, on other assets that allow a preliminary overview of their importance in the non-market sectors relative to production industries and market services. These latter estimates will be superseded by SPINTAN data in due course. The final section describes additional issues that will be addressed by the project.

2. Measuring intangible investment in the Public sector

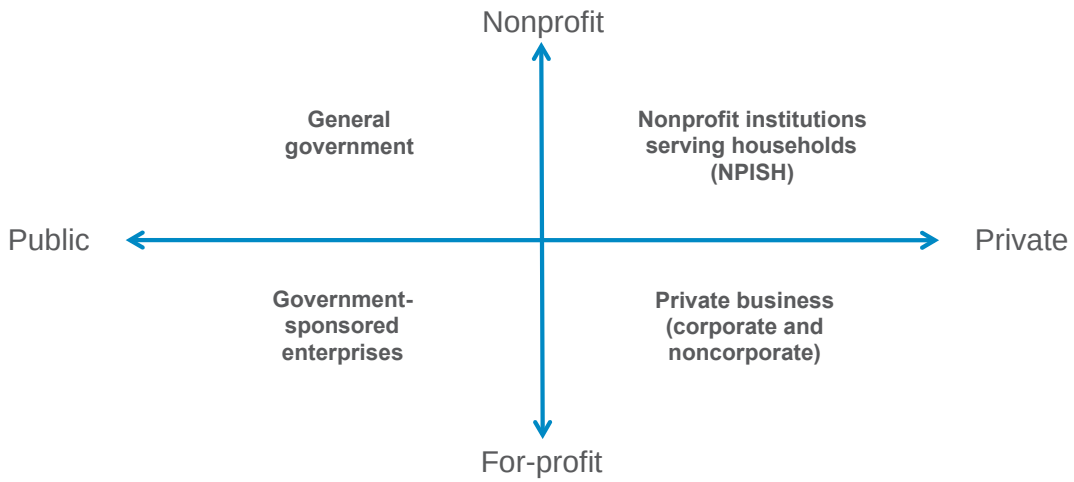
Policy analysis of an economy's performance requires data on public investment and knowledge of how such investments impact private sector outcomes. There are many challenges to providing data on public investment in intangible assets. Indeed there are challenges to defining what we mean by public investment and how we identify the *Public sector*. Measurement of intangible investment in the Public sector therefore requires an analysis of the asset boundaries identified to capitalize intangibles in the business sector (Corrado, Hulten and Sichel, 2005, 2009) and a careful exploration of all the entities to be classified as Public.

Existing estimates of intangible assets cover a subset of the economy (often referred to as the "market" sector of the total economy, e.g. by EUKLEMS architects and users). The SPINTAN goal at its most practical level, then, is to complete the coverage of intangible investment by industry sector, making possible the generation of total economy growth accounts with intangibles as productive assets.

However, the identification of the "non market " industry sector, necessary to cover the whole economy, is not straightforward since many industries can reflect a mix of institutions as shown in Figure 1. Traditionally the dichotomy market/non-market is industry based. That is for example the Health industry can be a mix of market and non-market units belonging to different institutional sectors (for example General government and Non financial corporations) but belonging to a unique industry "Health". Our aim, in SPINTAN is

to adopt a cross-industry-institutional sector classification to identify a broader definition of the Public sector that takes into account the multiple dimensions of public sector activities.

Figure 1: Enterprises according to ownership (private, public) and legal form (nonprofit and for-profit)



In a first stage, we start looking at the definition of the Public Sector in National Accounts and we try to identify the boundaries of the non-market sector taking into account both the industry and the institutional sector dimensions.

Definition of the Public Sector in National Accounts

National accounts data are available according to two different classification criteria: by institutional sector and by industry (or branch). In the System of National Accounts 2008, the Public Sector is represented according to both criteria. All units engaged in the same kind of production are classified in the same industry, whether the institutional units to which they belong are market producers or not. The reason being that the distinction between market and non-market production is based on a different criterion, independent of the nature of the activity itself. However, it is possible to cross-classify units by type of activity and depending if they are market producers, non-market producers, or producers for own final use (SNA 2008 par 5.47).

The fundamental units identified in the SNA are the economic units that can engage in the full range of transactions and are capable of owning assets and incurring liabilities on their own behalf. These units are called institutional units that are grouped together to form

institutional sectors, on the basis of their principal functions, behavior and objectives. General government consists of institutional units that, in addition to fulfilling their political responsibilities and their role of economic regulation, produce services (and possibly goods) for individual or collective consumption mainly on a non-market basis and redistribute income and wealth (SNA 2008 par 2.16). In addition to Government units, it includes Non Profit Institutions engaged in non-market production that are controlled by government units or social security funds (SNA 2008 par 4.30). Non-market output is output undertaken by general government (and NPISHs) that takes place in the absence of economically significant prices. A price is said to be not economically significant when it has little or no influence on how much the producer is prepared to supply and is expected to have only a marginal influence on the quantities demanded (SNA 2008 par 6.128)

Note two important implications of this classification criteria: i) institutional units included in the Government sector can potentially be engaged in production (goods and services); public enterprises (e.g. enterprises that are controlled by the Government but sell their output at economically significant prices) are not included in the General Government sector but in the Financial Corporations or in the Non-Financial Corporations sectors. As an illustration consider three hospitals: one that is a private hospital that sells its services at economically significant prices; another that is controlled by the Government but that sells its services at economically significant prices; a third one that is controlled by the Government but provides its services for free: only the last one is included in the Government sector, while both the first and the second are included in the sector of non-financial corporations.

From a practical point of view, the distinction between data by Institutional Sector and by industry is very important because the information provided by the set of data is quite different. Data by institutional sector are available for the whole sequence of National Accounts (thus providing a comprehensive description of the economic activity of a country) but only with a more aggregated information on the production activity (e.g. only data on total output and total intermediate costs, with no information on the products that are produced and purchased).

Other conceptual issues

In addition to defining the public sector, the conceptual and methodological issues which the SPINTAN project will address can be organized in the following tasks:

i. Defining the boundaries of public intangibles The Public Sector can produce two different categories of intangibles. The first reflects intangibles that are owned and used by the Public Sector or made available (usually via payment) to households and businesses. The second

reflects intangibles that are made freely available to the rest of the economy. The first category includes a number of intangibles, such as public R&D and software that are already recognised in the asset boundary of the 2008 System of National Accounts (SNA, 2008). But for a number of, chiefly practical, reasons the SNA asset boundary does not cover many intangibles that also provide economic benefits to the owner. One common example is human capital (where the exclusion in the SNA primarily reflects accounting challenges whereas of course the economics literature assumes benefits accrue to households/workers). Within a now more commonly used, larger framework of a human capital production account (Jorgenson and Fraumeni 1989, Fraumeni 2011), a country's educational system may be viewed as a public intangible. If that comprehensive framework, and especially the computation of human capital on the basis of a lifetime income approach, is not fully applied because it moves current account boundaries very far out, even a more traditional cost approach will significantly increase the education impact on output (Kendrick 1976).

The second type of intangible (the public good intangible) presents more important challenges, both practical and theoretical. Some public goods, such as roads, are already captured in the SNA production boundary. Clearly, these provide economic benefits to the public at large. Competitiveness across countries is clearly affected by public goods infrastructure, such as roads and fibre network, but there is evidence that public goods intangible infrastructure, also plays a role. But, arguably, many intangibles such as public health, safety or cultural expenditures warrant inclusion for similar reasons. The SPINTAN project will consider this boundary issue in more detail.

ii. Capitalization of public intangibles. Two important issues that will also be addressed are *i)* the evaluation of adequate services lives, and *ii)* the selection of the rate of return on Public Sector assets. The discussion on service lives for intangible capital has just started, but shows remarkable differences depending on the approach chosen (CHS; INNODRIVE; Squicciarini and Le Mouel, 2012). Hence the project needs to evaluate the sensitivity of our estimates to alternative assumptions on service lives. In relation to the most appropriate rate of return for public assets we will first review the literature and current practices of using rates on return in Public Sector accounts. One way is to rely on the concept of opportunity cost using private sector rates of return (Jorgenson and Landefeld, 2006). Alternatively we can rely on estimates of output elasticities from public relative to private investments in intangibles to proxy returns on capital (as applied in van Ark and Jaeger, 2010).We will then define a set of rates of return for sensitivity analysis and use them to aggregate the data generated for individual asset categories created in the SPINTAN project.

iii. Using occupation data to measure own account organisational capital. The expenditure approach to measuring own account organisational capital pioneered by CHS (2005, 2009) assumes that a percentage of managers time can be used as a proxy for these intangible investments. A recent paper by the OECD (Squicciarini and Le Mouel, 2012) suggests confining attention to managers may miss some important organisational capital. In fact in their analysis by industry using task based data for the US, the authors show that other occupations account for a greater share of organisational tasks in 'public service' industries such as hospitals, other health care, education and public administration, than in market sector activities. Therefore, we propose that rather than rely solely on managers time it might make more sense to use an alternative measure based on professionals (e.g. doctors, teachers). For example in the Higher Education sector many academics also perform organisational tasks but they would not be classified as managers. The recent release of the OECD Programme for the International Assessment of Adult Competencies (PIAAC) dataset on skills will be useful in dealing with this issue.

3. Public versus Business sector intangibles

This section presents some preliminary estimates of the extent of public sector investments, for the three broad CHS categories, comparing where appropriate with the Business sector (Corrado et al, 2012). We first present results based on preliminary data gathered by the SPINTAN partners on purchased organisational capital and advertising and marketing expenditures, both components of economic competencies. We then discuss firm specific human capital, another component of economic competencies, using data from O'Mahony, 2012. Computerised information consists primarily of software investments which is one of the assets distinguished in the EU KLEMS capital database. Estimates on innovative property are not yet available in SPINTAN so here we just consider one indicator, R&D workers as a percent of total employment. In general, this first analysis uses the EU KLEMS 'non-market' sector definition of Public Administration, Education and Health, but a few tables below contain information for a broader group that includes sectors with significant non-market output.

Organisational Capital – purchased component

The purchased component of organisational capital was defined in INTANInvest as the amount of the output of NACE rev1 industry group 7414 (business and management consultancy activities) purchased by Business Enterprises that is considered to be investments. A similar assumption to that employed by Corrado et al. (2012) is used in SPINTAN, i.e. that 80% of purchases is investment. The underlying data sources are the

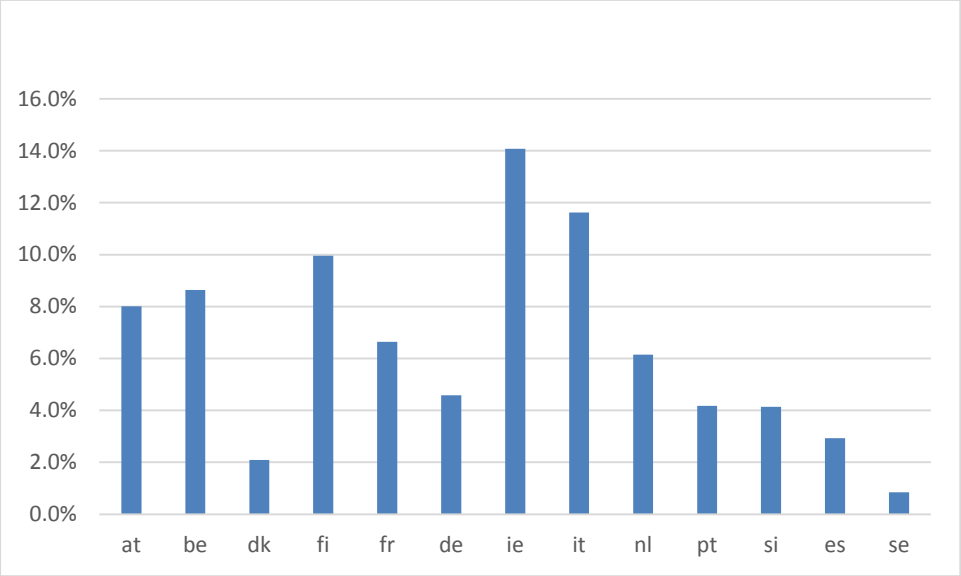
supply use tables and structural business statistics for estimating the total output of industry 7414.

We first ask what is the relative importance of the market and non-market sector in gfcf in purchased Organisational Capital? This is shown in table 1 and Figure 1. In table 1 we include for some countries, the ratio of non-market non-residential GFCF to total GFCF for 2007 from EU KLEMS – this is mostly tangible capital, but also includes software. Comparing the two columns suggests that this component of OC has a relatively low share in non-market sectors, at least relative to this sector's share of more traditional forms of capital investments. Comparing across countries, Finland, Ireland, and somewhat surprisingly, Italy, all show quite high shares while these are very low in Denmark and Sweden.

Table 1 Share of non-market in total gfcf, 2009, Organisation capital (OC) and tangible capital (TC)

Country			
Eurostat code	Eurostat name	OC	TC
AT	Austria	8.0%	9.1%
BE	Belgium	8.6%	Na
DK	Denmark	2.1%	10.4%
FI	Finland	10.0%	11.3%
FR	France	6.6%	20.9%
DE	Germany	4.6%	17.9%
IE	Ireland	14.1%	19.5%
IT	Italy	11.6%	13.3%
NL	Netherlands	6.1%	24.2%
PT	Portugal	4.2%	Na
SL	Slovenia	4.1%	16.3%
ES	Spain	2.9%	18.5%
SE	Sweden	0.8%	15.5%

Figure 1. purchased organisational capital, non-market as a % of total economy.

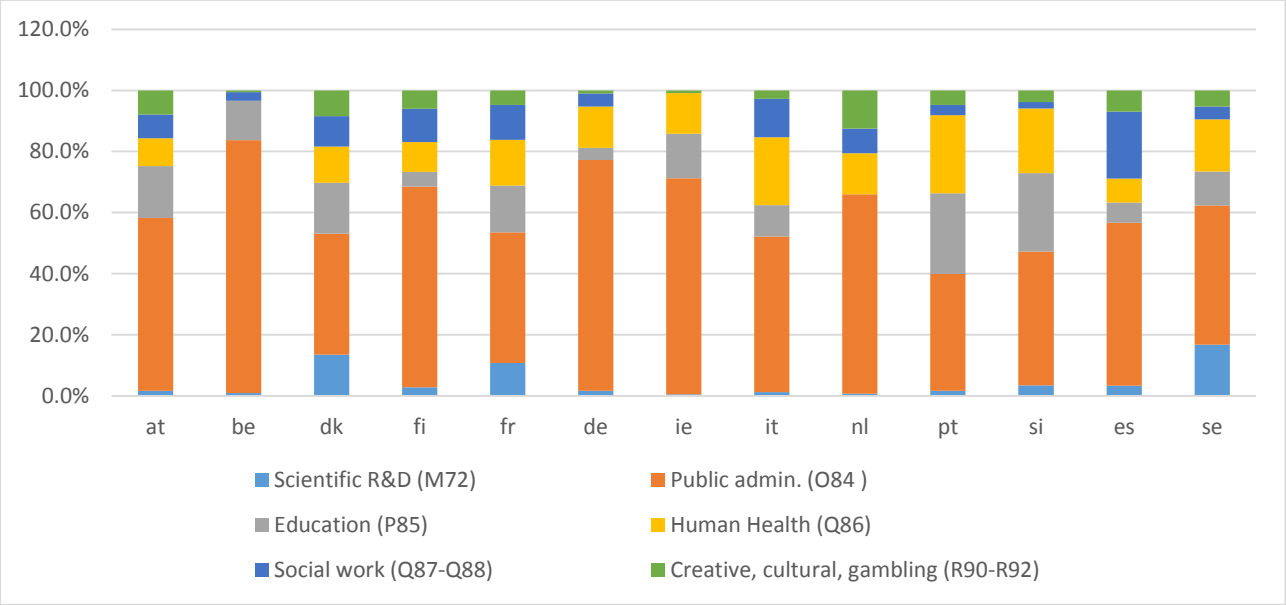


We next ask what is the relative importance of each industry in total non-market purchased OC GFCF? Table 2 and Figure 2 present the shares of purchased OC by industries that will be included in the SPINTAN calculations, and so also includes scientific R&D and the Creative, cultural and gambling industries that both contain a significant public component. Public administration accounts for the highest share of purchased OC in all countries but the remaining sectors vary in importance. Education has the second highest share in seven countries whereas human health is second in importance in four countries.

Table 2 industry distribution of non-market gfcf, 2009, percent

Industry	AT	BE	DK	FI	FR	DE	IE	IT	NL	PT	SL	ES	SE
Scientific R&D (M72)	1.6	0.9	13.5	2.8	10.7	1.7	0.5	1.3	0.7	1.6	3.5	3.4	16.7
Public admin. (O84)	56.6	82.8	39.7	65.7	42.8	75.5	70.7	50.9	65.2	38.3	43.8	53.3	45.6
Education (P85)	17.0	13.0	16.7	4.8	15.3	4.0	14.5	10.3	0.0	26.4	25.7	6.6	11.1
Human Health (Q86)	9.1	0.0	11.7	9.8	15.0	13.4	13.3	22.2	13.4	25.5	21.1	7.8	17.0
Social work (Q87-Q88)	7.7	2.7	10.0	10.9	11.4	4.3	0.0	12.5	8.1	3.4	2.1	22.0	4.2
Creative, cultural, gambling (R90-R92)	8.0	0.6	8.4	6.0	4.8	1.0	0.9	2.8	12.6	4.8	3.8	6.9	5.3

Figure 2. Purchased OC by industry

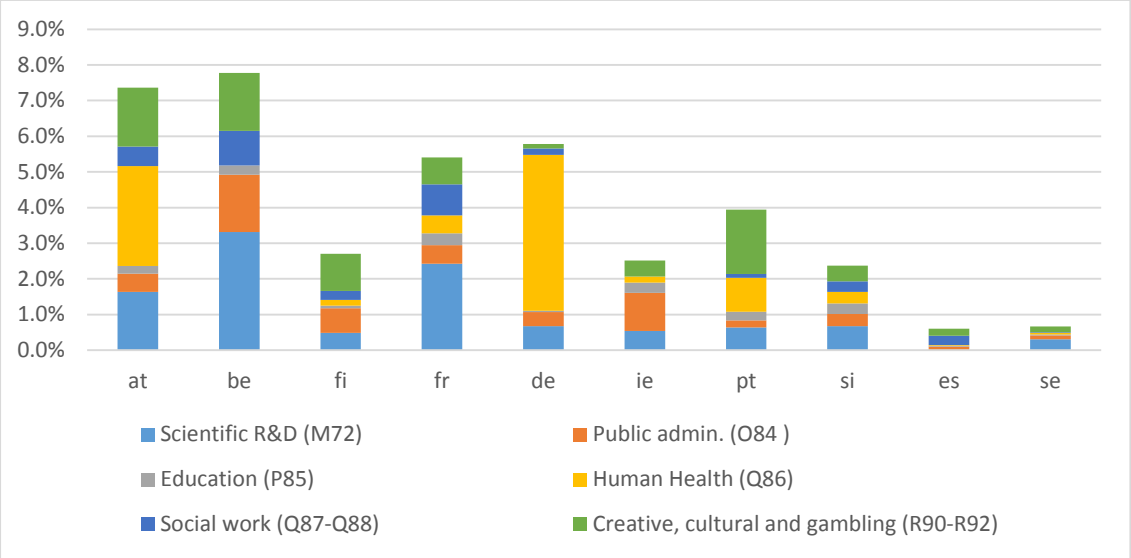


An alternative way of depicting the importance of purchased OC across industries in the non-market sector is to look at ratios of gfcf in this asset relative to output – this is shown in Table 3 and Figure 3. Note that in this case non market output = "0ther non market output" (P13) available from Supply tables (data not available for Italy and Denmark) .We have calculated the ratio to Non market output instead of to value added because non market value added at the industry level is not available (except for Public Administration industry, O84). The most intensive purchased OC industries vary considerably by country. Here in general purchased OC tends to be highest relative to output in Scientific R&D but is also quite large in some countries in human health and creative, cultural and gambling. In contrast, purchased OC intensity is relatively small in public administration in most countries.

Table 3 Ratio of non-market gfcf to non-market output, 2009

Industry	at	Be	fi	fr	de	ie	pt	si	es	se
Scientific R&D (M72)	1.6%	3.3%	0.5%	2.4%	0.7%	0.5%	0.6%	0.7%	-	0.3%
Public admin. (O84)	0.5%	1.6%	0.7%	0.5%	0.4%	1.1%	0.2%	0.3%	0.1%	0.1%
Education (P85)	0.2%	0.3%	0.1%	0.3%	0.0%	0.3%	0.2%	0.3%	0.0%	0.0%
Human Health (Q86)	2.8%	-	0.2%	0.5%	4.4%	0.2%	1.0%	0.3%	0.0%	0.0%
Social work (Q87-Q88)	0.5%	1.0%	0.3%	0.9%	0.2%	-	0.1%	0.3%	0.3%	0.0%
Creative, cultural and gambling (R90-R92)	1.7%	1.6%	1.0%	0.8%	0.1%	0.4%	1.8%	0.4%	0.2%	0.2%

Figure 3. Purchased OC as a percent of output by sector, 2009



Advertising + Market research (Adv_MktRes) – purchased component

A similar descriptive exercise is carried out for purchased advertising and market research, again using the same methodology as employed for the market sector in INTANInvest (see Corrado et al., 2012) We first ask what is the relative importance of market and non-market sector in gfcf in purchased Adv_MktRes? For comparison purposes we reproduce the purchased OC results from Table 1. The share of the non-market sector in investment in this asset is smaller than for purchased OC in all countries other than Ireland and Spain. By implication this again suggests that this asset is less important than traditional investment in the non-market relative to the market sector.

Table 4: Adv_MktRes :Share of non-market gfcf over total gfcf, 2009

	Country	Adv_MktRes	OC
AT	Austria	3.6%	8.0%
BE	Belgium	1.2%	8.6%
DK	Denmark	0.4%	2.1%
FI	Finland	4.1%	10.0%
FF	France	2.1%	6.6%
DE	Germany	1.1%	4.6%
IE	Ireland	15.8%	14.1%
IT	Italy	2.2%	11.6%
NL	Netherlands	1.9%	6.1%
PT	Portugal	3.4%	4.2%
SL	Slovenia	1.5%	4.1%
ES	Spain	14.2%	2.9%
SE	Sweden	0.5%	0.8%

Similarly to purchased OC, public administration has the largest share of purchased Adv_MktRes within the non-market sector (Table 5 and Figure 4) but has a relatively low intensity (table 6 and Figure 5). In some countries education and human health have substantial shares but intensity tends to be highest in the creative, cultural and gambling industry.

Table 5 Adv_MktRes: industry distribution of non-market gfcf, 2009, percent

Industry	AT	BE	DK	FI	FR	DE	IE	IT	NL	PT	SL	ES	SE
Scientific R&D (M72)	0.0	0.6	3.8	11.2	1.6	0.9	1.0	1.0	2.1	0.1	0.7	1.2	11.1
Public admin. (O84)	73.3	74.0	20.6	32.4	47.5	80.4	44.9	39.8	75.6	68.4	52.4	84.2	41.7
Education (P85)	14.0	19.8	15.0	18.5	10.8	6.4	7.4	14.8	0.0	21.9	20.0	1.9	9.1
Human Health (Q86)	3.5	0.0	5.3	28.2	17.5	5.0	44.5	13.2	2.7	4.4	2.1	1.1	24.8
Social work (Q87-Q88)	2.6	0.4	11.6	3.0	3.0	1.6	0.0	13.8	1.0	1.2	0.7	7.2	1.8
Creative, cultural and gambling (R90-R92)	6.6	5.2	43.7	6.7	19.7	5.7	2.1	17.3	18.6	4.0	24.1	4.3	11.6

Figure 4. Adv_MktRes shares by sector, 2009

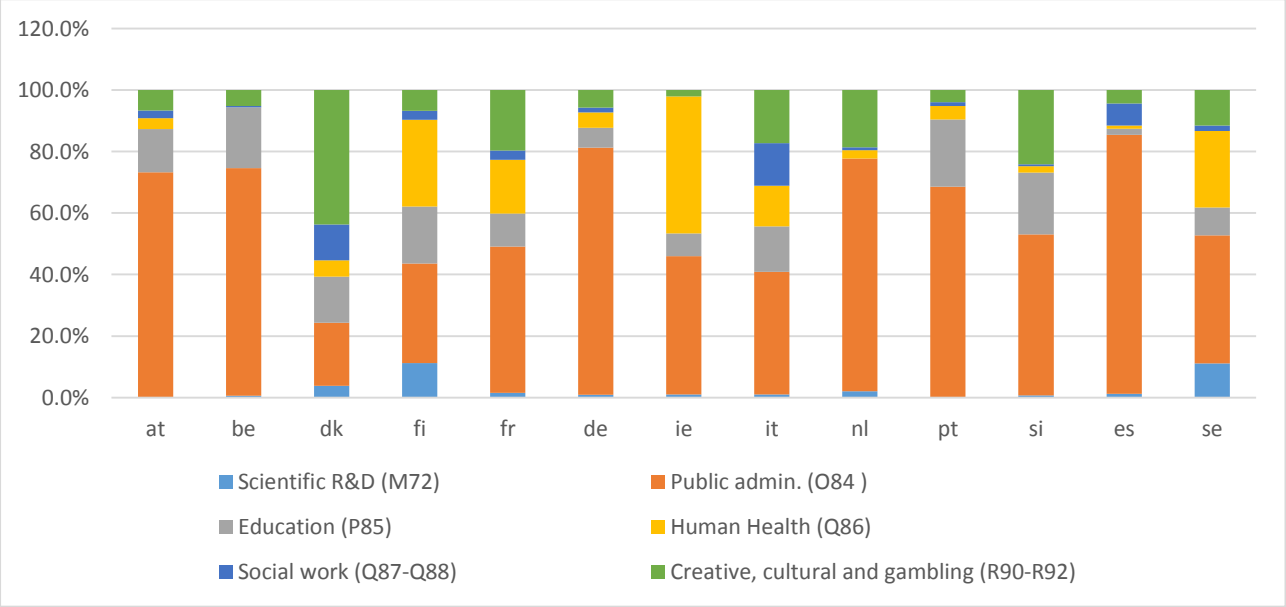
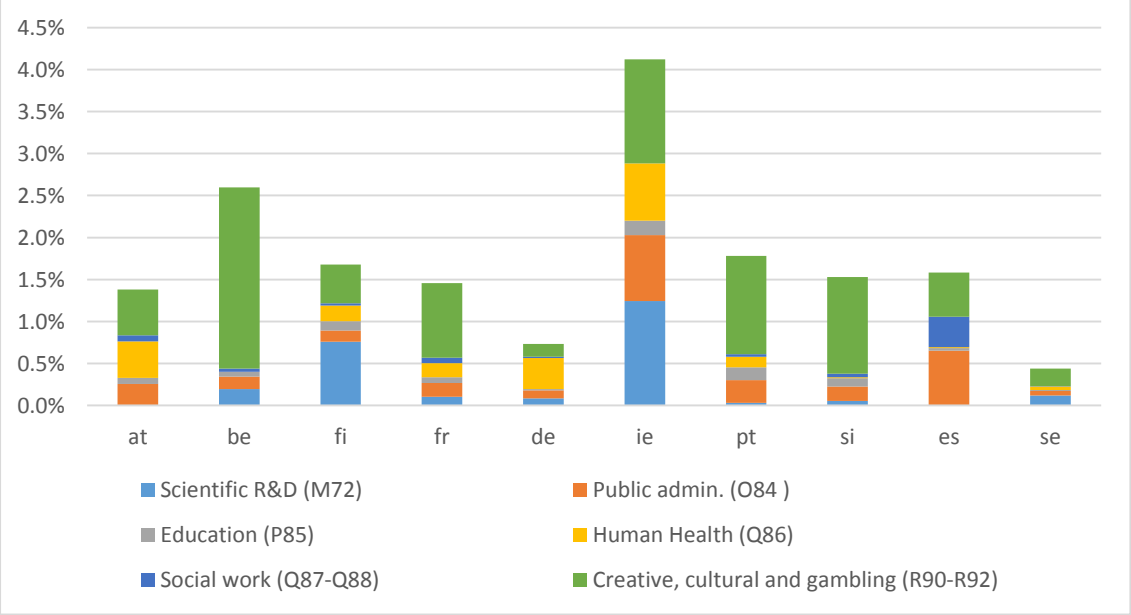


Table 6 Ratio of non-market gfcf to non-market output, 2009

Industry	AT	BE	FI	FR	DE	IE	PT	SL	ES	SE
Scientific R&D (M72)	0.0	0.2	0.8	0.1	0.1	1.2	0.0	0.1	-	0.1
Public admin. (O84)	0.3	0.1	0.1	0.2	0.1	0.8	0.3	0.2	0.7	0.1
Education (P85)	0.1	0.1	0.1	0.1	0.0	0.2	0.2	0.1	0.0	0.0
Human Health (Q86)	0.4	-	0.2	0.2	0.4	0.7	0.1	0.0	0.0	0.0
Social work (Q87-Q88)	0.1	0.0	0.0	0.1	0.0	-	0.0	0.0	0.4	0.0
Creative, cultural and gambling (R90-R92)	0.5	2.2	0.5	0.9	0.2	1.2	1.2	1.1	0.5	0.2

Figure 6. Ratio of purchased Adv_MktRes gfcg to sector output.



In the final SPINTAN estimates, own account organisational capital and advertising and marketing will need to be added to the purchased components. The estimates for the business sector in INTANInvest suggest that the nominal value of own account investments tend to be higher than purchased ones. How to accurately measure the own account component in the public sector is an issue which the project will address (see further discussion below).

Firm specific Human capital

We now turn to a description of the use and importance of other intangible assets using information from related projects that will feed into SPINTAN. In the remaining descriptions the data refer to NACE rev1 so that the non-market sector comprises public administration (L), education (M) and Health and social work (N).

First we examine another part of economic competencies, firm specific human capital. A more complete picture across countries emerges when considering this asset. Estimates by industry and country are provided in O'Mahony (2012). This work, carried out for the INDICSER project[4], uses data from the harmonised European Labour Force surveys (EU LFS) on the proportion of employees who receive training and duration of training, combined with estimates of the direct costs of providing training from the EU Continuous Vocational Training Survey and the indirect opportunity costs using earnings from EU KLEMS. Table 7 shows training investments as a percent of value added in the EU by broad sector. Here it is clear that these investments are much higher for non-market services than for market services or production. The highest investment intensity within non-market services are in public administration but these are also sizeable in education and health. Investments in continuous training are much lower in the new member states than in the EU15 group of countries.

Table 7. Investments in Continuous Training as a percent of value added[1], average 2003-07

	Total	***Production Industries***	***Market Services***	***Non-market services***	***Public Admin***	***Education***	***Health and Social work***
EU24[2]	1.07	0.74	0.95	1.86	2.04	1.71	1.80
EU15	1.20	0.86	1.06	2.03	2.26	1.89	1.92
EU9[2]	0.52	0.27	0.46	1.26	0.64	0.45	0.36

Notes: 1. Adjusted to include investments in continuous training; 2. excluding Malta.

Table 8 shows the comparable figures by country and broad sector. In all 24 countries the shares of continuous training investment in value added is higher in the non-market services

[4] www.indicser.com

than in either market services or production. In the EU15 the shares are very large in the Scandinavian countries and the UK and relatively low in Southern European countries.

In summary, as regards economic competencies, relative to the market economy, the higher intensity of continuous training in the non-market sector is likely to compensate for the lower intensity in purchased organisational capital and advertising. In INTANInvest, for the EU as a whole, firm specific human capital in the market sector is about half the value of organisational capital (purchased and own account). Given the much higher training intensity in the non-market sectors, on balance the value of investments in economic competencies is likely to be similar in market and non-market sectors.

Table 8 investments in continuous training as a % of GDP, average 2003-07

	Total		***Production***	***Market services***	***Non-market services***
Austria (AT)	0.82		0.54	0.72	1.61
Belgium (BE)	0.54		0.47	0.43	0.87
Germany (DE)	0.83		0.60	0.71	1.49
Denmark (DK)	2.06		1.45	1.74	3.33
Spain (ES)	0.85		0.60	0.69	1.75
Finland (FI)	1.67		1.01	1.46	3.29
France (FR)	1.23		1.32	1.02	1.56
Greece (GR)	0.07		0.04	0.05	0.18
Ireland (IE)	0.34		0.15	0.28	0.95
Italy (IT)	0.16		0.13	0.10	0.38
Luxembourg (LU)	0.77		0.48	0.78	1.08
Netherlands (NL)	1.36		0.75	1.37	2.14
Portugal (PT)	0.24		0.12	0.18	0.51
Sweden (SE)	1.66		1.15	1.58	2.47
United Kingdom (UK)	2.97		2.21	2.57	4.99
Cyprus (CY)	0.31		0.11	0.29	0.58
Czech Republic (CZ)	0.18		0.12	0.15	0.43
Estonia (EE)	0.42		0.10	0.32	1.50
Hungary (HU)	0.07		0.03	0.08	0.11
Lithuania (LT)	0.27		0.09	0.25	0.85
Latvia (LV)	0.54		0.18	0.36	1.75
Poland (PL)	0.23		0.15	0.18	0.56
Slovenia (SI)	0.54		0.34	0.50	1.07
Slovakia (SK)	0.30		0.18	0.35	0.53

Source: Based on data from EU LFS, EU KLEMS and Eurostat CVTS

Computerised Information – software

Series on software investment are taken from EU KLEMS. Table 9 shows software investment as a share of value added, averaged across the period 1995-2007. In the EU and each individual country the share of software in value added is significantly lower in non-market services than in market services. Relative to production industries, the software share is also generally lower in non-market sectors; the exceptions are the Czech Republic, Spain and Finland.

Table 9 Software investment as a share of value added, average 1995-07

	Production	Market services	Nonmarket services
EU*	0.89	1.50	0.78
Austria	0.67	1.07	0.23
Czech	0.55	1.24	0.69
Germany	0.99	0.92	0.71
Denmark	1.34	2.86	0.77
Spain	0.27	1.70	0.51
Finland	1.02	1.82	1.42
France	1.42	2.03	0.82
Italy	0.72	1,02	0.47
Netherlands	1.27	1.65	1.07
Sweden	2.25	2.76	1.71
UK	1.29	2.25	1.09

*Sum over countries included in table

Table 10 presents information on software intensity across one digit industries and time. The software share for public administration is sizeable and on a par with other sectors such as manufacturing and Business services. Software intensity is lower in education than public administration but it is the health sector that appears to have a particularly low intensity, not much more than in labour intensive sectors such as construction and hotels and catering. Looking across time, in the EU as a whole there appears to be similar growth in the share of software in value added across the three broad sectors. However there is wide diversity in countries with a number (Austria, Denmark and the UK) showing much higher growth in market than in non-market services.

Table 10 Software investment as a share of value added, EU

		1995-2007	1995-97	2000-2	2005-7
A	AGRICULTURE, HUNTING, FORESTRY AND FISHING	0.15	0.09	0.17	0.21
C	MINING AND QUARRYING	0.39	0.31	0.39	0.38
D	TOTAL MANUFACTURING	1.13	0.91	1.19	1.24
E	ELECTRICITY, GAS AND WATER SUPPLY	1.25	0.91	1.59	1.12
F	CONSTRUCTION	0.30	0.25	0.34	0.29
G	WHOLESALE AND RETAIL TRADE	0.96	0.74	0.99	1.10
H	HOTELS AND RESTAURANTS	0.33	0.29	0.33	0.34
I	TRANSPORT AND STORAGE AND COMMUNICATION	1.96	1.33	2.48	2.12
J	FINANCIAL INTERMEDIATION	3.93	3.10	4.54	4.08
K	REAL ESTATE, RENTING AND BUSINESS ACTIVITIES	1.34	1.05	1.52	1.40
L	PUBLIC ADMIN AND DEFENCE; COMPULSORY SOCIAL SECURITY	1.23	0.90	1.32	1.40
M	EDUCATION	0.62	0.48	0.65	0.72
N	HEALTH AND SOCIAL WORK	0.45	0.32	0.48	0.53
O	OTHER COMMUNITY, SOCIAL AND PERSONAL SERVICES	0.94	0.71	1.06	0.91
	Production	0.89	0.70	0.96	0.95
	Market services	1.50	1.15	1.70	1.60
	Non-Market Services	0.78	0.58	0.83	0.89

Innovative Property - R&D workers

R&D workers are measured by employees in 3-digit occupation group using information from the EULFS. The occupation groups are ISCO88 groups 211 (physicists, chemists and related professionals), 212 (Mathematicians, Statisticians and related professionals), 214 (architects, engineers and related professionals), 221 (Life science professionals), 311 (Physical and engineering science technicians) and 321 (Life science technicians and related associate professionals). These were the occupation groups used by Niebel et al. (2013) in constructing R&D by industry estimates for the market sector, excluding group 222 (Health care professionals).

Dividing the total economy into production, market services and non-market sectors, table 11 shows R&D workers as a % of all workers, averaged across the period 1995-2007. In the EU, and in almost all countries included in the table, the share of R&D workers in total

employment is much higher in production industries than in services. In the aggregate EU the share of R&D workers is marginally higher in non-market than in market services. This hides significant diversity across countries. In Germany, Italy, the Netherlands and the UK, the R&D share is significantly higher in non-market services whereas market services have a much higher share in Belgium, Denmark, France and Sweden. There is not much difference in the R&D share between the two services sectors in the remaining countries.

Table 11 Share of R&D workers in total employment

	Production	Market services	Nonmarket services
EU*	13.8	7.9	8.1
Austria	8.2	7.7	4.4
Belgium	22.4	11.7	9.0
Czech	25.9	14.8	14.0
Germany	16.0	8.5	10.2
Denmark	18.8	13.5	7.8
Spain	8.9	6.5	7.0
France	16.9	9.5	4.8
Hungary	12.0	9.5	5.8
Italy	9.8	5.5	8.8
Netherlands	11.0	7.5	12.1
Sweden	19.5	13.3	6.1
UK	11.6	6.1	8.0

*Sum over countries included in table

Within the non-market services group, R&D workers represent a greater share of employment in public administration than either education or health (Table 12), presumably due to defence. All three major sectors show a similar high growth in R&D worker shares across time.

Table 12 Share of R&D workers in total employment, EU

		1995-07	1995-97	2000-2	2005-7
A	AGRICULTURE, HUNTING, FORESTRY AND FISHING	4.7	2.2	4.1	7.2
C	MINING AND QUARRYING	45.4	21.9	44.1	68.6
D	TOTAL MANUFACTURING	27.9	10.8	21.2	44.7
E	ELECTRICITY, GAS AND WATER SUPPLY	63.1	25.2	50.2	97.2
F	CONSTRUCTION	18.0	7.5	15.3	25.2
G	WHOLESALE AND RETAIL TRADE	4.0	1.4	2.8	6.3
H	HOTELS AND RESTAURANTS	0.4	0.2	0.3	0.6
I	TRANSPORT AND STORAGE AND COMMUNICATION	11.1	5.5	10.9	14.7
J	FINANCIAL INTERMEDIATION	2.5	1.0	2.2	3.4
K	REAL ESTATE, RENTING AND BUSINESS ACTIVITIES	17.7	7.5	15.3	24.0
L	PUBLIC ADMIN AND DEFENCE; COMPULSORY SOCIAL SECURITY	12.9	5.2	11.8	18.5
M	EDUCATION	5.8	2.4	4.9	8.2
N	HEALTH AND SOCIAL WORK	6.3	2.7	5.3	8.7
O	OTHER COMMUNITY, SOCIAL AND PERSONAL SERVICES	5.3	2.3	3.9	7.8
	Production	13.8	5.7	11.2	20.2
	Market services	7.9	3.2	6.7	11.2
	Non-Market Services	8.1	3.4	7.1	11.3

This first descriptive look at intangible assets in the non-market sectors, although incomplete, leads to the (tentative) conclusion that these assets might represent a lower share of output than in the market sectors. Some intangible assets included in the CHS list, namely mineral oil exploration and new financial products are by definition only used in the market sector. Nevertheless the estimates suggest that intangible assets are still likely to be sizeable in the public sector, especially in public administration.

4. Future work on the SPINTAN database

Since the CHS (2005) seminal work a considerable effort has been devoted to extend their methodology to other economies besides the US. Much recent work on intangibles focuses on Europe and is comparative in nature (Hao, Manole and van Ark, 2009; Corrado *et al.* 2012). Other studies instead encouraged country-specific approaches: Barnes and McClure

(2009), Barnes (2010) for Australia, Baldwin, Gu and Macdonald (2011) for Canada, Jalava, Aulin-Ahmavaara and Alanen (2007) for Finland, Fukao *et al.* (2009) for Japan, van Rooijen-Horsten *et al.* (2008) for the Netherlands, Edquist (2011a, b) for Sweden and Marrano, Haskel and Wallis (2009) for the UK. For emerging markets, previous intangibles studies were done by TCBE for China (Hulten and Hao, 2012), India (Hulten, Hao and Jaeger, 2012), and for Brazil by the World Bank (Dutz 2012).

A primary objective of SPINTAN is to develop a database on Public Sector intangibles according to a general framework that will take into account also country-specific information, and building up on earlier work on public intangibles (such as Van Ark and Jaeger, 2012, for the Netherlands). SPINTAN estimates of public intangibles will cover 22 EU countries and the US over the period 1995-2011. Besides the estimates for the EU member economies and the US, we will produce comparable estimates for China, India, and possibly Brazil.

The SPINTAN database will be a cross-country harmonized database of Public Sector intangibles consistent with the System of National Accounts (SNA) principles, coherent with other SNA aggregates (output, tangible gross fixed capital formation, intermediate costs) and with the Business Sector estimates of intangibles developed by INTAN-Invest (Corrado *et al.*, 2012). We will resort as much as possible to official data sources to ensure cross-country comparability, reproducibility and update of the estimates in the future. The SPINTAN database will be made publicly available on the project web page.

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