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ORIGINAL PAPER

The importance of intangible assets in regional economic growth: a growth accounting approach

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Abstract

Spain is one of the few countries in the world that has information on investment in intangible assets with a regional breakdown, so providing evidence of its importance as a factor in regional growth is the main value added of this paper. Series of capital stock in intangible assets are constructed by regions, which incorporate not only those the national accounts consider as investments and are therefore included in gross value added (GVA), but also the intangible assets not included in GVA, which the recent literature understand to be an important source of economic growth. Using the growth accounting approach, the results show that intangible assets explain 14.3% of Spain's GVA growth, of which 9.4 pp correspond to the assets included in GVA (software, R&D and intellectual property rights) and 4.9 pp account for the rest (expenditure on design, advertising, market research, firm-provided worker training and improvements to companies' organizational structure). Notable differences are also seen across the country, with investment in intangibles explaining up to 20% of economic growth in some regions. The importance of the contribution from these intangible assets highlights the need for economic policy measures (including regional policies) that boost investment in intangible assets and improve conditions of access to financing.

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1 Introduction

Economists and policymakers are increasingly paying attention to the accumulation of intangibles as a new source of economic growth. During recent decades, information and communication technologies (ICTs) have led to previously unknown methods of production that require, in turn, huge changes in the organization of the company. They also force companies to create a brand image and to become more sophisticated through the design of new products and increased market knowledge, all of which requires trained workers. As well as their investment in ICT, companies must therefore make additional investment in the complementary intangible assets needed to take advantage of the full potential of ITC; moreover, this necessary expenditure on intangible assets should be as large as their expenses on tangibles.

When Corrado et al. (2005, 2009) measured intangible investment at the aggregate level in the USA for the first time, the concept of intangibles covered not only R&D but also software, copyrights, brands, firm-specific human capital and organizational change. However, even today many of these assets are not considered as investments, but as current expenses, and are therefore not included in gross value added (GVA), although R&D expenditure is now included in GVA as it is classified as an investment and not intermediate consumption.

In this study, we present regional evidence of the impact of intangible capital on economic growth and show that intangible assets emerge as powerful drivers of productivity gains in regional economies, providing empirical evidence for the specific case of the Spanish regions. The analysis of the Spanish case is of interest for several reasons: a) Spain is one of the few countries in the world that has a database on investment in intangibles broken down by regions (NUTS2) and by type of assets; b) the Spanish economy has suffered for decades from low productivity influenced by low investment efforts in intangibles (the latter will be analyzed in this paper); and c) the important differences among regions in terms of GDP per capita, which can be partly explained by the differences in the investment efforts made in intangible assets.

The data for the study were taken from the Cotec Foundation-Ivie database, which includes information on investment in intangible assets broken down by components. Based on these investment data, the corresponding capital stock is estimated to quantify the contribution of intangibles to economic growth. To this end, we use the growth accounting approach, which allows us to decompose GVA growth in the contribution of productive inputs and total factor productivity (TFP), one of these inputs being intangible capital stock. We compare the contribution of capital stock in intangibles with other types of capital stock such as tangible assets or human capital. The empirical application covers the period 2000–2016, which allows us to analyze whether the contribution of intangible capital stock varied throughout the economic cycle. Thus, while GDP grew at an average real annual rate of 4% from 2000 to 2007, it fell at a rate of -1,3% in the post-crisis subperiod from 2000 to

2013. Then, the recovery started at the end of 2013 with GDP growing at 2% from 2014 to 2016.

Taking advantage, as mentioned previously, of the fact that Spain is one of the few countries in the world with information by region on intangible investments, the main value of this paper is that it provides regional empirical evidence of the contribution intangible assets make to economic growth, both for the total stock of intangible assets and for each separate asset. In addition, not only do we quantify the contribution of intangible assets that, to date, the National Accounts classify as investment (and that are therefore accounted for in GVA), but we also analyze the importance of other assets considered to be intermediate consumption (and are therefore not included in GVA) to explain part of the growth in the extended GVA. Thus, we can identify which investment was the most "profitable" in terms of its contribution to the growth in value added.

The paper is organized as follows. In Sect. 2, we discuss the main features of the intangible assets and analyze the related literature. In Sect. 3, we describe the methodology and the variables used. In Sect. 4, we present the results of the growth accounting approach, focusing on the role of intangible assets. Section 5 offers some concluding remarks.

2 Literature review

Empirical studies of economic growth have traditionally focused on the contribution of tangible assets (plant and equipment). Several seminal papers have also analyzed the effects of some intangible assets on growth, particularly human capital or innovation. However, in many of these studies, the contribution of intangibles is hidden in the contributions of capital assets and total factor productivity.

The research interest on intangible assets started as part of an effort to explain the productivity puzzle. Since the 1970s, productivity growth in developed economies has been sluggish, in comparison with the post-war period, despite the advancements in ICT and other technologies. The lack of robust productivity growth remains unexplained.[1]

In fact, until recently, economists had excluded spending on intangible assets from national accounts, treating them as a current expense and not as an investment. This has resulted in an underestimation of investment in the economy by providing an incomplete picture of the main sources of economic growth and highlighting the need to correct the measurements. By expressly introducing intangible assets, we ensure that the contribution of these assets is not underestimated by omission or by erroneously attributing its contribution to other assets. More precisely, Corrado et al. (2005) consider that expenditures on product development, advertising and market research for the development of brands and trademarks, firm-specific workforce training and organizational development should also be considered as

[1] See Goodridge et al (2021) and (2013).

investment since these assets are created using current resources in order to increase future production.

In all likelihood, when an economy has a minimum endowment of tangible capital, it can devote more resources to intangible asset investment. In the last decades, intangible assets have gradually gained ground on tangible capital and authors such as Corrado et al. (2009), van Ark et al. (2009), Timmer et al. (2011), Muntean (2014) and Mas and Quesada (2019), among others, have shown that the increased investment in intangible assets accounts for a large proportion of unexplained growth in productivity as well as economic growth. In the same vein, Easterly and Levine (2001) report that more than 90% of the differences in growth rates among nations is explained by TFP rather than traditional factor accumulation. For this reason, additional factors must be sought that may help to account for such disparities. According to Strobel (2012), as intangible assets have rapidly risen in importance compared to tangible assets, intangible factors seem to be playing a key role in countries' growth. Melachroinos and Spence (2013) affirm that conventional growth accounting analyses have treated most intangibles as intermediate expenditures and thus fail to capture the full effect of intangibles on output and productivity growth. However, they find a positive and significant effect of intangibles on growth if they are considered as capital.

According to O'Mahony (2019), intangible assets have often been described as the "missing input," essentially because these investments have not generally been well measured in official economic statistics. However, intangibles have a large impact on raising output per worker, both directly by providing more capital per worker, and indirectly through knowledge spillovers on productivity. Meanwhile, O'Mahony et al. (2019) look at the impact of intangible capital on labor's share of value added, suggesting that the labor share falls, and labor is substituted by intangible assets. In particular, these authors argue that although investment in innovation, such as R&D, seems to complement human labor, investment in brands, firm-provided worker training and organizational capital appear to substitute human labor to a much greater extent. Finally, recent literature, such as Roth (2019, 2020), highlights the importance of business intangibles in explaining labor productivity growth dynamics, concluding that these intangibles have become the dominant source of labor productivity growth in the EU.

At the international level, several studies have demonstrated the importance of investment in intangibles in explaining the differential growth in productivity among countries or economic areas. For instance, Corrado et al. (2013), using a growth accounting framework, show that intangible capital accounted for 28% of labor productivity growth in the USA compared to 23% in the EU over the period 1995–2007. Also using a growth accounting approach, van Ark (2015) compares the sources of the growth gap between Europe and USA and finds that the intensity of intangible investment in Europe is still much lower than in the USA. However, Corrado et al. (2016) report that since the great recession, there has been a decline in TFP growth with both tangible and intangible capital playing relatively minor roles. Corrado et al. (2017) also find large magnitudes for the impact of intangible capital. Their results strongly support the possibility of productivity spillovers including a complementarity between intangible and ICT capital. In the same line, Archaya

(2016) analyzes OECD countries' TFP growth, finding evidence of a positive impact of intangible capital accumulation. When these assets are considered, the effect of ICT spillovers is reduced.

Differences in the intensity of investment in intangible assets are also relevant to explain the differences in growth among sectors. Fox et al. (2017) assess the contribution of intangibles to productivity growth in industries of ten EU countries based on growth accounting and econometric estimation of production functions. Their results show, on the one hand, that the estimated output elasticity of intangibles lies between 0.1 and 0.2 and, on the other hand, that the contribution of intangibles to labor productivity growth is generally higher in manufacturing and finance industries. McGrattan (2017) investigates the impact of intangible assets (such as R&D, software and brands) on aggregate and industry-level US data and concludes that changes in measured GVA, which does not include all intangible investments, understate the actual changes in total output. This means that if firms invest almost as heavily in intangible assets as they do in tangible assets, actual changes in total output can leave out a significant amount of investment.

At the regional level, various studies have also confirmed the importance of investment in intangible assets as a source of economic growth. Marrocu et al. (2012) evaluate the role of internal intangible capital on firms' productivity as well as the role played by traditional inputs and external socioeconomic conditions such as regional and infrastructural endowments. Their results confirm the role played by intangible assets at the regional level. Suriñach and Moreno (2011) summarize the IAREG (Intangible Assets and Regional Economic Growth) European project, which analyzed the role of intangible assets on regional economic growth. Authors conclude that to improve the analysis of the effects of the intangible assets in regional economic growth it is necessary to develop more and better databases. Dettori et al. (2012) analyze the determinants of efficiency levels across the European regions, highlighting the role of intangible factors (human capital, social and technological capital) in TFP levels. They conclude that TFP differences across the European regions are explained by the disparities in the endowments of these intangible assets and, at the same time, call attention to the lack of systematic studies examining the effects of different kinds of intangible assets on economic performance at the regional level. Peiró (2016) shows that the regional stocks of the different intangible assets considered have some power for explaining convergence tendencies in European regions during the period 2000–2011.

In the specific case of the Spanish regions, although numerous studies have analyzed the evolution of inequalities in terms of growth and per capita income and their explanatory factors (such as human capital, infrastructures, R&D, productivity and employment rate.),[2] none have examined the role of intangibles, possibly influenced by the fact that until recently no databases had information by region.

[2] De la Fuente (2019) explores regional convergence in per capita income and analyzes the explanatory factors, focusing on demographics, employment rate and productivity. Another recent study is that of Echevarria and Filip (2020) which analyzes regional convergence for the 2000-18 period and provides a summary of the available evidence for the Spanish case.

3 Methodological approach and variables used

We adopt the growth accounting approach to quantify the importance of intangible assets in economic growth. In this approach, GVA growth is a function of the accumulation of inputs and improvements in productivity or the efficiency with which these inputs are used. This degree of efficiency may be due to changes in the quality of production factors, technological innovations, demand fluctuations, scale effects, variations in labor use intensity, and even errors in measuring the variables. All these factors that we cannot isolate form part of what is known as the Solow residual, which is a measure of our ignorance.

Solow's (1957) seminal work provides the foundations for this approach, which was later added to by Jorgenson and Griliches (1967), Jorgenson et al. (1987) and Jorgenson et al. (2005). As these authors have shown, under certain assumptions (perfect competition in the production factors and goods and services markets, constant returns to scale, and optimizing behavior of economic agents), the income growth rate (Y) is broken down into the sum of the growth rates of the production factors (weighted by the income share contributed by each factor to total income) and the residual growth rate of the TFP:

$$\Delta LnY_{it} = \alpha_{it}^{L}\Delta LnL_{it} + \alpha_{it}^{K}\Delta LnK_{it} + \Delta LnPTF_{it} \quad (1)$$

where α represents the share contributed by the production factors (capital and labor) to total income. The last term gathers the part of the variation in income not explained by the variation in the production factors, which is why it is called the Solow residual. By definition, the factor shares in the total income will sum to unity.

As this is an accounting breakdown, we can separate the tangible assets (*TK*) from the intangible assets (*IK*) in the capital stock. In turn, each intangible asset's contribution to income growth can be quantified separately. And within the labor factor we can separate the contribution of the number of hours worked (*H*) from the quality of those hours or human capital (*HK*). To do this, we have data on workforce composition by educational level, and the average remuneration for each of these levels (information taken from the National Institute of Statistics Active Population Survey). We can therefore analyze the changes in the contribution of the labor factor due to changes in the composition of employees by educational level, which is our proxy for human capital.

With this breakdown, the decomposition of GVA growth (Y) is as follows:

$$\Delta LnY_{it} = \alpha_{it}^{H}\Delta LnH_{it} + \alpha_{it}^{HK}\Delta LnHK_{it} + \alpha_{it}^{TK}\Delta LnTK_{it} + \alpha_{it}^{IK}\Delta LnIK_{it} + LnPTF_{it} \quad (2)$$

The growth accounting approach has some advantages over other approaches such as the econometric estimation of a production function since: a) it allows to quantify for each region the contribution of each growth factor, unlike the econometric estimation that offers the same elasticity for all regions; b) it avoids the problem of having a high number of parameters to estimate when quantifying the contribution of the different types of assets (8 intangible assets, in addition to the

quantity and quality of work); and c) it quantifies the contribution of TFP to the growth of each of the regions. All these reasons make this methodology a widely used approach to analyze the sources of economic growth.

The data on value added and hours worked as a proxy for the labor input are taken from the Regional Accounts produced by the National Institute of Statistics (INE); tangible capital (*TK*) comes from the BBVA Foundation-Ivie capital stock database (2016 being the last year for which data is available); and the changes in labor composition (difference between labor services and hours worked) of the hours worked and remuneration are from the Regional Accounts and the Salary Structure Survey (EES) and the INE's Active Population Survey (EPA).

The data on investment in intangible assets are taken from the Cotec Foundation-Ivie database. The estimations offered in this database follow an international methodology widely accepted by most countries (see Corrado et al. 2005). The database contains information on intangible investment for the period 1995–2016 disaggregated by regions and sectors of activity.[3]

One of the contributions of the Cotec Foundation-Ivie's research that underpins the database is the information it provides on investment in the intangible assets included in GVA (classified as investment in the National Accounts, and therefore regarded as value added). These are: 1) R&D; 2) software and databases; and 3) entertainment, artistic and literary originals + mineral exploitations. A further contribution of this research is its estimations of investment in other intangible assets that the National Accounts do not classify as investments, but as intermediate consumption. This is the case of the following investments: 1) design; 2) advertising; 3) market research; 4) vocational training; and 5) organizational capital. Consequently, when we report the results, we distinguish between the intangible assets included in the GVA (*IK_GVA*) and the rest of the intangible assets (*IK_no GVA*).

The rest of the tangible assets (both the investment series and the capital stock series) are taken from the BBVA Foundation-Ivie database.

The Cotec Foundation-Ivie database provides information on investment in intangible assets but not on capital stock, which is the relevant variable to explain intangibles' contribution to GVA growth. We estimated capital stock accumulated in intangible assets following the OECD (2009) recommendations on measuring capital stock, which most commonly uses the permanent inventory method with a geometric depreciation rate and distinguishes between net capital or wealth and productive capital. The former reflects the market value of the assets, and the latter is a quantitative (or volume) concept that takes into account the loss of efficiency resulting from the aging of the asset.

Based on the investment series from the Cotec Foundation-Ivie database, the net capital stock of asset *i*, valued at constant prices at moment *t*, (IK_{it}), is calculated as:

$$IK_{it} = IK_{it-1} + IR_{it} - d_i\left(IR_{it}/2 + IK_{it-1}\right) \tag{3}$$

[3] Given that a homogeneous series of GVA at the regional level was first made available in 2000, the period analyzed in this paper is 2000–2016.

where *IR* is the investment in real terms and *d* is the geometric depreciation rate which is assumed to be different for different assets.[4] The real investment *IR* is defined as:

$$IR_{it} = IN_{it} / P_{it} \tag{4}$$

where P_{it} is the asset price, *IN* the nominal investment and d_i the depreciation rate.

The net capital stock at current prices, (IK^C), is calculated according to (5):

$$IK^c_{it} = IK_{it} \cdot P_{it} \tag{5}$$

Productive capital is an intermediate step to measure capital services, as it can be interpreted as the stock that generates flows of capital services, which are the inputs involved in production. Therefore, the value of capital services—provided by the productive capital—can be calculated by multiplying the productive capital by the cost of its use, which acts as a weighting of the contributions of each asset. By assigning a greater weight to assets with a shorter life (those with a higher depreciation rate), we assume that the cost of use measures the marginal productivity of the different asset types. Hence, the value of the capital services of asset i at moment t (VCS_{it}) can be calculated by the following equation:

$$VCS_{it} = \mu_{it} \cdot KP_{it} \tag{6}$$

where μ_{it} is the cost of using asset *i* at moment *t*. In general terms, and if we ignore the influence of fiscal variables, the cost of use is given by:

$$\mu_{it} O \tag{7}$$

where $i_t$is the nominal interest rate; q_{it} is the price variation rate of asset *i*; and P^B_{it} is the price of asset *i* at the start of period *t*, given by:

$$P^B_{it} = \left(P_{it} + P_{it-1}\right)/2 \tag{8}$$

The practical implementation of Eq. (8) requires the selection of the most appropriate rates of return on capital, *i;* however, economic theory does not throw much light on this decision. This variable attempts to capture the cost of using capital, which can be interpreted either as the borrowing cost or as the opportunity cost of investing rather than lending a given amount. In practice, there are two procedures to calculate the term *i*, one exogenous and the other endogenous.

In this case, and to maintain consistency with the estimations of capital stock by types of (fixed) assets for the Spanish economy published by BBVA Foundation-Ivie, and following the OECD (2009) recommendations, we use the exogenous procedure. In addition, price variations in the cost of use expression are eliminated since lack of information prevented their calculation. Therefore, in the estimations

[4] We used the Telefónica Foundation-Ivie (2015) depreciation rates.

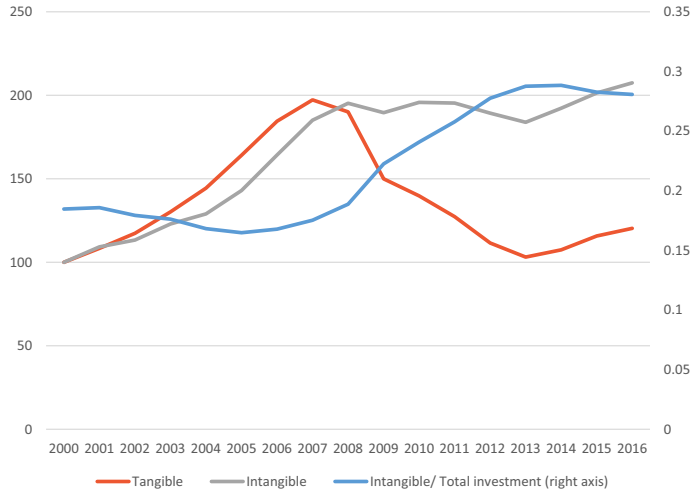

Fig. 1 Evolution of investment in Spain: tangible vs. intangible. 2000 = 100 and share of intangible investment in total investment (%) Source: BBVA Foundation-Ivie and Cotec Foundation-Ivie

used here, we also assume that the cost of use only has two terms, the real interest rate, r, which is assumed to be constant and equal to 4%, and the depreciation rate[5]:

$$\mu_{it} = P_{it}^{B} \cdot (r + d_i) \tag{9}$$

4 Results

4.1 Investment in tangible vs. intangible assets

Before quantifying the impact that capital stock of intangible assets has on economic growth in the Spanish regions, it is of interest to compare the information on the evolution of investment in tangible assets with that of intangible assets over the period studied, and also analyze the composition of investment by type of asset and differences among regions.

When interpreting the following analyses, it is important to bear in mind that the period considered, 2000–2016, comprises an initial subperiod of expansion until 2007, when GVA in the Spanish economy grew at an average annual rate

[5] Although a real interest rate of 4% is currently high, it is the one generally used, as recommended by the OECD. It is important to note that this is a long-term average rate that applies to investment series from many years ago. In addition, in order to ensure the comparability of intangible assets with tangible assets, it is necessary to use this 4% rate, since it is the same rate used by the BBVA Foundation and the Ivie in the estimation of the tangible capital stock series. It should also be noted that according to the OECD, the results are barely sensitive to the interest rate used, contrary to what happens with the capital depreciation rate.

Table 1 Share of intangible asset investment in total investment. Percentage (average for each period) Source: Cotec Foundation-Ivie

	2000–16(%)	2000–07(%)	2008–13(%)	2014–16(%)
Andalusia	17.8	14.6	19.6	24.0
Aragon	18.2	15.6	19.5	22.4
Asturias	18.4	15.3	19.7	25.5
Balearic Islands	14.0	11.0	16.1	18.7
Canary Islands	17.8	14.7	20.9	23.2
Cantabria	18.6	15.2	19.8	26.9
Castille-Leon	16.3	13.6	18.2	20.8
Castille-La Mancha	12.9	10.3	14.2	18.5
Catalonia	24.5	19.8	27.0	31.5
Valencian Community	19.7	15.7	21.5	28.5
Extremadura	14.7	11.8	17.3	18.6
Galicia	18.9	15.4	20.7	25.4
Madrid	30.4	24.4	34.1	36.6
Murcia	18.5	15.1	20.4	24.5
Navarra	22.9	18.3	27.6	28.1
Basque Country	24.5	21.0	26.9	28.3
La Rioja	15.4	13.1	16.0	20.3
Spain	21.6	17.4	24.0	28.4

of 3.5%, followed by a sharply contrasting period of deep crisis until mid-2013, after which the economy began to climb out of recession. For that reason, we differentiate three subperiods—pre-crisis, 2000–2007, post-crisis, 2008–2013—and recovery, 2014–2016.

Figure 1 shows the evolution over the analyzed period of investment in tangible assets versus intangible assets (both those included to date in GVA and those described above). On the one hand, in the pre-crisis period Spain saw a gradual increase in investment in both tangible and intangible assets. More specifically, both types of investment grew by almost 50% in real terms between the start of the period analyzed and the onset of the crisis (2007). As a result of the crisis, investment in tangible assets plummeted and did not recover until the end of the period, whereas investment in intangible assets continued to grow, although with peaks and troughs, throughout the whole period. Therefore, compared to its impact on tangible asset investment, the economic crisis that swept through the Spanish economy did not seriously affect investment in intangible assets, but rather had the opposite effect of boosting its growth. Considering the two types of investment together across the whole period, the relative weight of intangible investment in total investment increased from 18% in 2000 to 28% in 2016. These data show that companies recognize the importance of investing in intangibles as a way of moving towards the knowledge economy, although its share of total

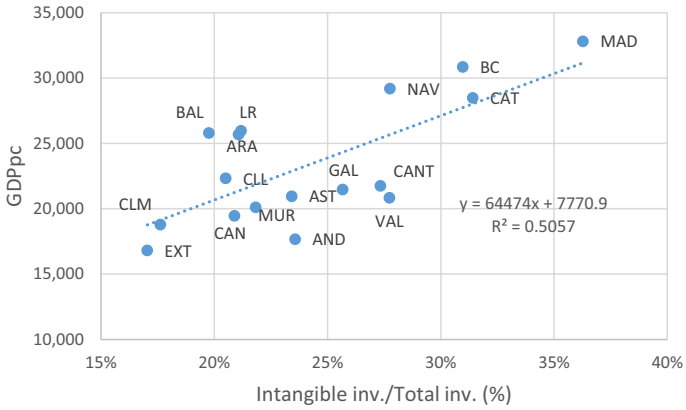

Fig. 2 GDP per capita (euros 2015) and share of intangible asset investment in total investment. 2016 Source: INE and Cotec Foundation-Ivie

investment remains much lower than that of more advanced countries, some of which now invest more in intangible than in tangible assets.[6]

Table 1 shows the share of intangible investment in total investment by Spanish regions[7] for the total period and the three subperiods. The differences among the regions are striking; in the total period regions such as Madrid (30.4%), Catalonia and the Basque Country (24.5%) and Navarra (22%) have a share of intangibles above the average for Spain (21%), in sharp contrast to much lower percentages in the Balearic Islands (14%) and Extremadura (12%). When we examine the breakdown by subperiods, the picture is more positive: investment in intangibles increased in all the regions, although with important differences in intensity. Thus, while the ratio increased 12.7 pp in the Valencian Community, the growth was 6.7 pp in Aragon. The differences among regions have increased with a variation range of 18.1 pp in the 2014–16 subperiod, compared to 14.1 pp in the 2000–07 subperiod. The most recent data for the 2014–16 subperiod places Madrid and Catalonia at the top of the ranking with the highest weight of intangible assets (over 30%) and places the Balearic Islands, Castille-La Mancha and Extremadura at the bottom (below 20%).

Turning to the share of investment in intangible assets out of total investment, there is a clear positive relationship between this share and levels of per capita income and productivity in the Spanish regions. With more recent data from 2016 (see Fig. 2 and 3), the regions with the highest per capita income and productivity (Madrid, the Basque Country, Navarra and Catalonia) are also those with the highest shares of intangible investment. Likewise, the regions at the other end of the ranking for these two development indicators are also those with the lowest investments

[6] See Mas and Quesada (2019).

[7] Information for the autonomous cities of Ceuta and Melilla is not included in the analysis given their small size and institutional singularities as compared to the 17 autonomous communities.

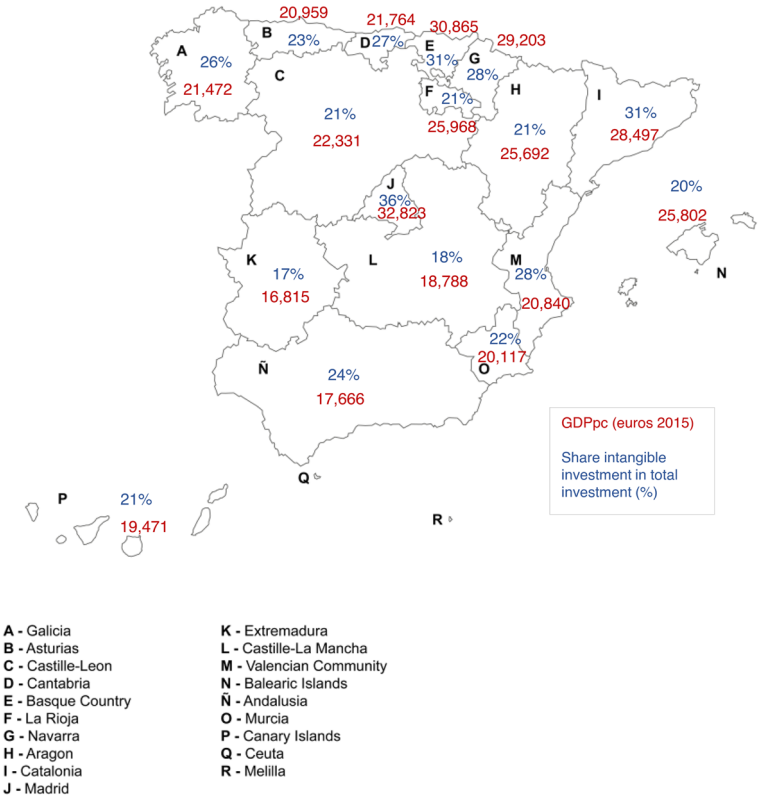

Fig. 3 GDP per capita (euros of 2015) and share of intangible investment in total investment (%) in the Spanish autonomous communities. Source: BBVA Foundation-Ivie, Cotec Foundation-Ivie and INE

in intangible assets in relation to tangible assets (Castille-La Mancha, Extremadura, the Balearic Islands). Consequently, evidence shows that intangibles are an engine of economic growth. Therefore, reducing regional inequalities in investment efforts in intangibles (which have increased in the period analyzed) would contribute to regional convergence in terms of productivity and per capita income.

Figure 4 reports the regional differences in average investment effort (ratio investment/extended GVA) in intangible assets for the period 2000–2016. As we can see, the investment effort for the region that invests the most (Madrid) is twice that of the region with the lowest investment (Balearic Islands). The regions with the greatest investment effort, as mentioned above, are those with the highest levels of GVA per capita and per employed individual, as is the case of Madrid, Navarra and Catalonia. The table also shows that for all the regions, investment in the intangible assets not included in GVA is higher than the rest of the assets classified as investment in the National Accounts, which highlights the importance of including these assets when quantifying their contribution to economic growth.

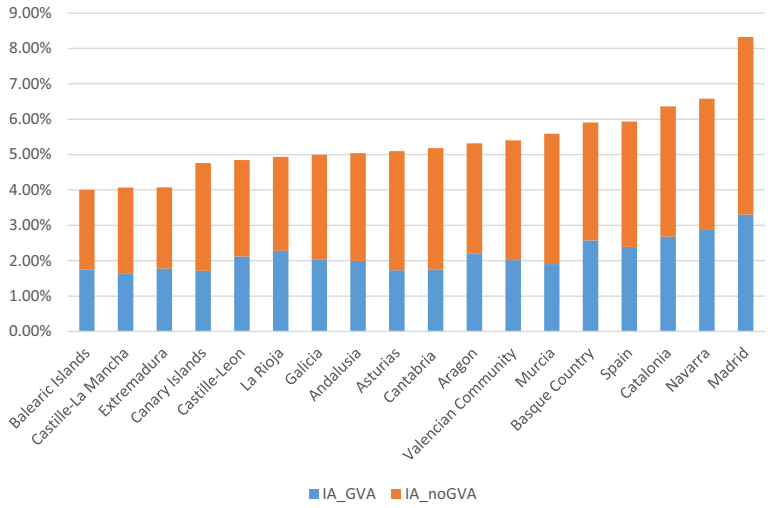

Fig. 4 Investment effort in intangible assets (ratio investment/extended GVA). 2000–2016 average (percentage) Source: BBVA Foundation-Ivie, Cotec Foundation-Ivie and INE

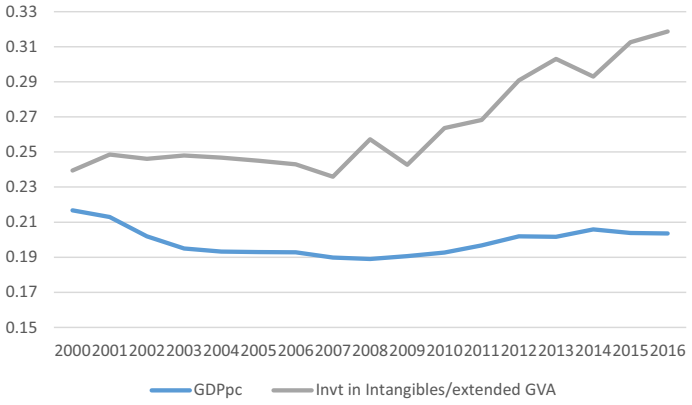

Fig. 5 Variation coefficient of investment effort in intangible assets (ratio investment/extended GVA) and GDP per capita. 2000–2016 Source: BBVA Foundation-Ivie, Cotec Foundation-Ivie and INE

One aspect of interest to be analyzed is the role of investment in intangibles as a factor of regional economic convergence. In the period considered, there has been some convergence in terms of GDP per capita (Fig. 5). Thus, using the coefficient of variation as an indicator of dispersion, the value for 2016 is 6.7% lower than in 2000. In the 2000–07 growth subperiod, the differences were reduced by 14%, while increasing by 9% in the crisis subperiod, and then slightly converging in the recovery years (the coefficient of variation fell 1%). During those same years, regional differences in the investment effort in intangibles increased. Thus, the coefficient of variation of the investment/extended GVA ratio increased by 33%, so that investment

Table 2 Regional differences in composition of investment in intangible assets. 2000–2016 average (percentages) Source: BBVA Foundation-Ivie, Cotec Foundation-Ivie and INE

	Software and database(%)	R&D(%)	Entertainment, Artistic and Literary Originals + Mineral Explorations(%)	Total IA_ GVA(%)	Design(%)	Advertising(%)	Market research	Vocational Training(%)	Organi-zational Capital(%)	Total IA_ noGVA(%)
Spain	18.4	18.2	3.7	**40.3**	14.4	14.8	3.5	11.8	15.3	59.7
Andalusia	18.4	17.4	3.7	**39.6**	14.8	14.6	3.6	13.6	13.8	60.4
Aragon	20.1	17.0	4.2	**41.2**	13.6	14.9	3.0	13.0	14.4	58.8
Asturias	17.0	14.0	2.9	**33.9**	19.7	13.7	4.1	13.9	14.7	66.1
Balearic Islands	28.9	7.5	7.5	**43.9**	10.3	9.4	2.4	16.9	17.0	56.1
Canary Islands	21.1	11.1	3.9	**36.1**	16.3	13.4	3.7	14.6	15.9	63.9
Cantabria	16.7	14.2	2.7	**33.6**	18.5	15.7	3.9	13.2	15.2	66.4
Castille-Leon	20.8	18.3	4.5	**43.7**	13.0	14.9	2.8	13.6	12.0	56.3
Castille-La Mancha	22.8	13.4	4.2	**40.4**	13.1	13.7	2.9	16.6	13.3	59.6
Catalonia	17.4	21.2	3.6	**42.2**	13.3	15.6	3.1	11.2	14.6	57.8
Valencian Com-munity	16.9	17.1	3.3	**37.3**	12.5	17.9	4.3	12.5	15.4	62.7
Extremadura	24.9	14.2	4.5	**43.6**	11.2	11.3	2.9	16.5	14.4	56.4
Galicia	20.6	16.6	3.6	**40.8**	15.1	15.0	3.2	13.5	12.4	59.2
Madrid	18.2	18.1	3.4	**39.6**	15.4	14.4	3.7	8.9	18.0	60.4
Murcia	16.8	13.5	3.8	**34.1**	13.0	21.2	4.1	12.1	15.4	65.9
Navarra	16.3	23.6	3.7	**43.6**	15.1	14.9	2.8	10.8	12.8	56.4
Basque Country	15.3	25.2	3.0	**43.5**	15.7	10.8	3.3	12.3	14.4	56.5
La Rioja	22.9	14.3	9.0	**46.2**	10.9	12.2	2.3	12.9	15.6	53.8

in intangibles is not a factor that has driven the observed regional convergence, but quite the opposite. Inequalities have increased in investment efforts since the outbreak of the crisis in 2007.

Table 2 presents more detailed information on intangibles by type of asset, both for the national average and for each of the regions. In the case of Spain, the asset with the greatest share of total investment in intangibles is software, 18.4% of the total, which is very similar to investment in R&D (18.2%). These two assets are followed by companies' spending on improvements to organizational structure (15.3%), which in turn is very close to investment in design (14.4%) and advertising (14.8%). Spending on employer-provided training for workers has a slightly lower share (11.8%), while expenditure on intellectual property (3.7%) and market research (3.5%) is much lower. By regions, the largest differences are seen in the share of investment in R&D, with a variation of almost 18 points between the highest (Basque Country) and lowest (Balearic Islands) investors.

4.2 Contribution of capital stock in intangibles to economic growth

Following the growth accounting approach, Table 3 shows the contribution of capital stock in intangibles to GVA growth for Spain and for each of the regions over the total period 2000–2016. Of total GVA growth (1.509% annual growth) in Spain, the factor that most contributes to economic growth is capital stock (0.953 pp), which accounts for almost two thirds (63%). Number of hours worked makes the second largest contribution (0.485 pp, representing a third), followed by human capital (proxied by the variation in workforce composition according to educational level), which contributes 17% (0.254 pp). The fact that growth of production factors is higher than GVA growth implies a loss of productivity, with TFP contributing -0.183 pp (-12%).

Of the total contribution of capital (0.953%), intangible assets (0.216%) make up almost a quarter (0.23%) and thus explain 14% of the growth in the Spanish economy, on average, for the period 2000–2016. The breakdown by asset type shows that the contribution by assets considered as investment in the National Accounts is twice that of the other assets: those included in GVA (0.142%) explain 9.4% of economic growth, whereas the rest (0.074%) account for 4.9%.

The information by regions (Fig. 6) reflects a considerable disparity in both the GVA growth rate and in the sources of growth. Thus, compared with an average annual growth of 2.029% in Madrid, the rate is just 0.688% in Asturias. In the case of contributions from the production factors and the TFP, in all the regions capital stock is the main source of economic growth, which explains more than 100% in some cases (Cantabria and Asturias) and implies a significant loss of TFP. Employment (hours worked) is, in general, the second source of growth, although in some regions labor quality contributes more than labor quantity. In turn, the TFP contribution is negative in 10 of the 17 Spanish regions; the Balearic Islands and Asturias are the regions with the greatest decline in productivity.

Turning to intangible assets, which we have seen explain 14% of GVA growth in Spain, the region of Madrid is where the highest contribution is found,

Table 3 Growth accounting approach. Annual growth rates (%). 2000–2016

			Contribution of total capital															
				Contribution of intangible capital														
	GVA	TFP	TOTAL	Total IK	IK_ GVA	Software and database	R&D	Entertainment, Artistic and Literary Originals + Mineral Explorations	IK_ no-GVA	Design	Advertising	Market research	Vocational Training	Organizational Capital	Organisational Capital	Organisational Capital (own)	H	HK
Spain	**1.509**	**−0.183**	**0.953**	**0.216**	**0.142**	**0.071**	**0.056**	**0.014**	**0.074**	**0.035**	**−0.011**	**−0.006**	**0.028**	**0.029**	**0.017**	**0.012**	**0.485**	**0.254**
2000–2016																		
Andalusia	1.462	−0.290	1.000	0.169	0.107	0.048	0.048	0.011	0.062	0.027	−0.011	−0.005	0.028	0.023	0.012	0.011	0.576	0.176
Aragon	1.473	0.159	0.989	0.145	0.109	0.059	0.039	0.012	0.036	0.025	−0.024	−0.007	0.024	0.017	0.011	0.007	0.190	0.136
Asturias	0.688	−0.499	0.770	0.130	0.082	0.048	0.028	0.006	0.048	0.031	−0.023	−0.011	0.022	0.029	0.006	0.023	0.114	0.302
Balearic Islands	1.215	−1.002	1.157	0.166	0.105	0.081	0.013	0.011	0.061	0.017	−0.007	−0.003	0.030	0.023	0.009	0.014	0.855	0.205
Canary Islands	1.193	−0.572	0.792	0.088	0.082	0.044	0.028	0.010	0.006	0.002	−0.020	−0.011	0.028	0.007	0.004	0.004	0.725	0.247
Cantabria	0.747	−0.450	0.754	0.110	0.071	0.031	0.034	0.007	0.039	0.033	−0.025	−0.011	0.025	0.017	0.007	0.010	0.194	0.249
Castille-Leon	0.998	−0.059	0.818	0.117	0.080	0.032	0.041	0.007	0.037	0.023	−0.016	−0.005	0.021	0.013	0.008	0.005	0.073	0.165
Castille-La Mancha	1.880	0.247	1.099	0.145	0.075	0.032	0.035	0.007	0.070	0.029	−0.005	−0.002	0.028	0.021	0.010	0.011	0.318	0.217
Catalonia	1.467	0.047	0.827	0.212	0.149	0.067	0.067	0.015	0.063	0.036	−0.019	−0.007	0.029	0.024	0.018	0.006	0.352	0.240
Valencian Community	1.256	−0.099	0.859	0.194	0.112	0.051	0.050	0.011	0.083	0.032	0.006	−0.006	0.024	0.027	0.023	0.004	0.248	0.247
Extremadura	1.371	0.482	0.651	0.093	0.069	0.030	0.034	0.005	0.024	0.010	−0.014	−0.007	0.025	0.010	0.003	0.007	0.176	0.063

Table 3 (continued)

			Contribution of total capital															
				Contribution of intangible capital														
	GVA	TFP	TOTAL	Total IK	IK_ GVA	Software and database	R&D	Entertainment, Artistic and Literary Originals + Mineral Explorations	IK_ no-GVA	Design	Advertising	Market research	Vocational Training	Organizational Capital	Organisational Capital	Organisational Capital (own)	H	HK
Galicia	1.576	0.022	0.860	0.163	0.097	0.050	0.039	0.007	0.066	0.035	−0.012	−0.005	0.025	0.023	0.014	0.010	0.375	0.320
Madrid	2.029	−0.563	1.281	0.422	0.266	0.158	0.081	0.027	0.155	0.063	−0.002	−0.004	0.033	0.066	0.034	0.033	0.986	0.325
Murcia	1.976	−0.322	1.086	0.164	0.094	0.035	0.046	0.013	0.070	0.037	−0.021	−0.006	0.032	0.028	0.017	0.011	1.008	0.204
Navarra	1.496	0.605	0.629	0.141	0.102	0.009	0.086	0.007	0.040	0.030	−0.023	−0.006	0.022	0.017	0.009	0.008	0.093	0.169
Basque Country	1.349	0.174	0.817	0.214	0.161	0.062	0.087	0.012	0.053	0.032	−0.012	−0.009	0.027	0.016	0.011	0.005	0.177	0.181
La Rioja	1.179	−0.150	1.025	0.144	0.122	0.047	0.049	0.026	0.022	0.012	−0.030	−0.004	0.020	0.023	0.006	0.017	0.117	0.187

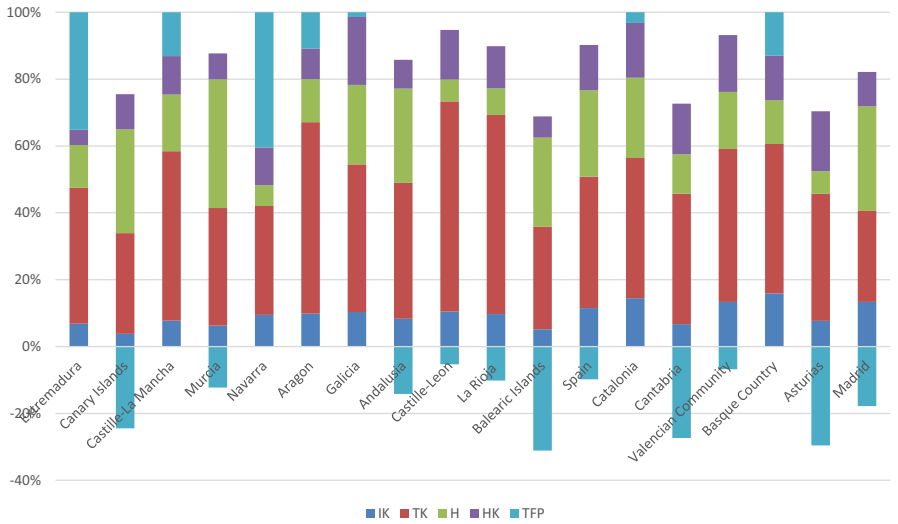

Fig. 6 Decomposition of GVA growth. Percentage structure. 2000–2016 average Source: BBVA Foundation-Ivie, Cotec Foundation-Ivie and INE

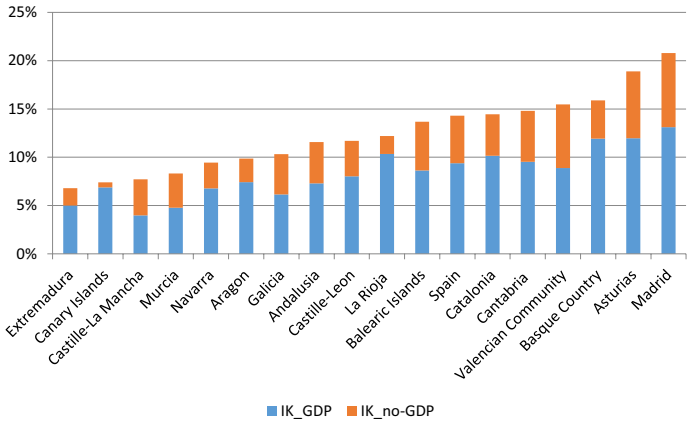

Fig. 7 Contribution of intangible capital stock to GVA growth. 2000–2016 average. Percentage Source: BBVA Foundation-Ivie, Cotec Foundation-Ivie and INE

explaining 21% of economic growth (Fig. 7). This percentage is three times that of the contribution of intangibles in Extremadura and the Canary Islands. Contributions in six regions are higher than the national average: Catalonia, Cantabria, the Valencian Community, the Basque Country, Asturias and Madrid. In all the regions, the assets that the National Accounts include in GVA contribute most to explaining economic growth, although the contribution of those not included in GVA is very low in the Canary Islands and Extremadura. Madrid stands out

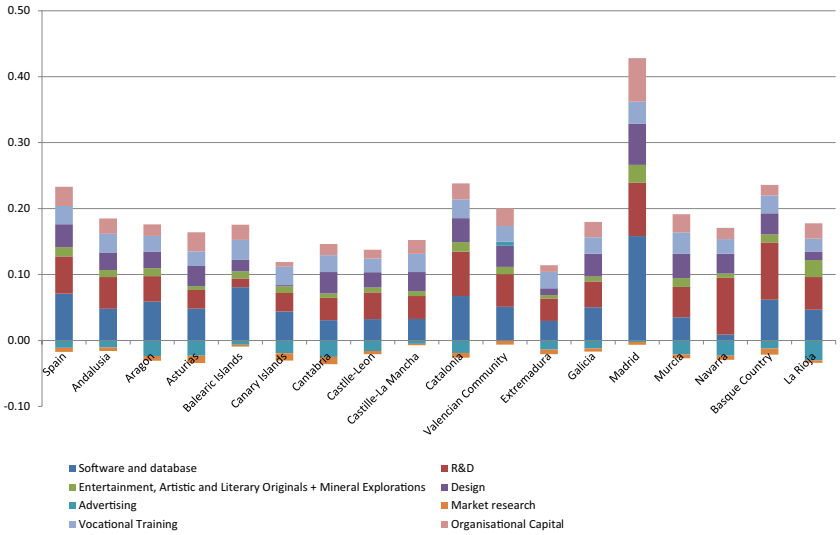

Fig. 8 Contribution of intangible assets to GVA growth: breakdown by assets. 2000–2016 average. Percentage Source: BBVA Foundation-Ivie, Cotec Foundation-Ivie and INE

as the Spanish region where both the intangible assets included in GVA and the other intangibles contribute most to economic growth.

The breakdown of contributions by intangible asset type presented in Fig. 8 shows there is no common pattern across the Spanish regions, as there are notable differences in the contribution of each asset. While in some regions, investment in software contributes the most to GVA growth, in others it is investment in R&D. In some regions, some elements of intangible capital make negative contributions to economic growth; these tend to be assets on which spending is highly sensitive to the economic cycle (such as advertising or market research).

Tables 4, 5 and 6 reports the accounting of economic growth in Spain and its regions in the pre-crisis (2000–2007), post-crisis (2007–2013) and recovery (2013–2016) subperiods. The tables show a considerable shrinkage in the rate of GVA growth after the crisis (from 3.474% in the pre-crisis period to -1.240% in the post-crisis period), which is explained by the fall in total capital stock and hours worked (as a consequence of the massive destruction of jobs). However, results show that the growth of intangible assets is much less affected by the crisis, since their contribution to GVA growth rises from 0.285 to 0.177 pp. In both subperiods, the contribution of intangible assets not included in GVA is greater than the rest of intangible assets.

In the 2013–16 recovery subperiod (Table 6) unlike the crisis subperiod, TFP has a positive contribution to GVA growth since it accounts for 26%. In all regions, without exception, TFP gains are produced, although with a very different contribution to GVA growth by region. Employment (hours worked) is the largest contributor to economic growth (given the strong recovery in employment), explaining 56% of GVA growth for the national average. Intangible capital slows down its

Table 4 Growth accounting approach. Annual growth rates (%). 2000–2007

			Contribution of total capital													
				Contribution of intangible capital												
	GVA	TFP	TOTAL	Total IK	IK_ GVA	Soft-ware and database	R&D	Entertain-ment, Artistic and Literary Origi-nals + Min-eral Explo-rations	IK_no-GVA	Design	Adver-tising	Market research	Voca-tional Train-ing	Organi-zational Capital	H	HK
Spain	**3.474**	**−0.307**	**1.505**	**0.285**	**0.161**	**0.081**	**0.064**	**0.016**	**0.124**	**0.060**	**0.003**	**−0.004**	**0.024**	**0.041**	**1.994**	**0.283**
Andalusia	3.811	−0.469	1.755	0.324	0.175	0.102	0.051	0.021	0.149	0.070	0.008	0.003	0.029	0.039	2.363	0.161
Aragon	3.635	0.289	1.653	0.207	0.164	0.103	0.039	0.022	0.043	0.039	−0.034	−0.009	0.018	0.028	1.492	0.201
Asturias	2.877	−0.340	1.222	0.194	0.126	0.075	0.041	0.010	0.068	0.053	−0.017	−0.014	0.017	0.029	1.673	0.322
Balearic Islands	2.217	−2.223	1.869	0.231	0.154	0.111	0.017	0.027	0.077	0.028	0.000	−0.001	0.026	0.023	2.413	0.158
Canary Islands	3.025	−1.373	1.869	0.298	0.165	0.111	0.046	0.008	0.133	0.066	0.009	−0.002	0.026	0.035	2.259	0.270
Cantabria	2.616	−0.787	1.247	0.138	0.072	0.050	0.011	0.010	0.067	0.053	−0.023	−0.013	0.024	0.025	1.803	0.353
Cas-tille−Leon	2.766	−0.091	1.420	0.214	0.164	0.082	0.063	0.020	0.050	0.032	−0.016	−0.004	0.016	0.021	1.235	0.201
Castille−La Mancha	4.584	0.489	1.790	0.265	0.155	0.106	0.029	0.020	0.110	0.044	0.000	0.003	0.030	0.033	1.995	0.310
Catalonia	3.332	0.263	1.195	0.212	0.131	0.048	0.071	0.012	0.081	0.050	−0.018	−0.010	0.026	0.033	1.679	0.195
Valencian Community	3.490	−0.284	1.547	0.313	0.166	0.086	0.060	0.020	0.147	0.059	0.023	−0.003	0.025	0.043	1.938	0.290
Extremadura	3.342	0.540	1.311	0.161	0.130	0.075	0.041	0.014	0.031	0.016	−0.005	−0.009	0.020	0.009	1.423	0.067
Galicia	3.571	−0.375	1.366	0.229	0.164	0.092	0.059	0.013	0.065	0.049	−0.019	−0.007	0.018	0.024	2.109	0.472
Madrid	3.906	−0.600	1.649	0.419	0.192	0.085	0.091	0.015	0.228	0.096	0.035	−0.001	0.025	0.073	2.492	0.364

Table 4 (continued)

			Contribution of total capital													
				Contribution of intangible capital												
	GVA	TFP	TOTAL	Total IK	IK_ GVA	Soft-ware and database	R&D	Entertain-ment, Artistic and Literary Origi-nals + Min-eral Explo-rations	IK_no-GVA	Design	Adver-tising	Market research	Voca-tional Train-ing	Organi-zational Capital	H	HK
Murcia	4.094	−0.994	1.925	0.334	0.183	0.109	0.051	0.023	0.151	0.061	0.012	0.001	0.034	0.043	2.998	0.165
Navarra	3.126	0.555	1.484	0.270	0.186	0.051	0.116	0.018	0.085	0.054	−0.019	−0.006	0.015	0.040	0.878	0.209
Basque Country	2.863	0.174	1.140	0.271	0.151	0.057	0.081	0.013	0.120	0.060	0.007	−0.010	0.020	0.043	1.305	0.243
La Rioja	3.349	0.237	1.634	0.196	0.162	0.079	0.057	0.026	0.034	0.023	−0.033	−0.003	0.018	0.029	1.232	0.246

Table 5 Growth accounting approach. Annual growth rates (%). 2007–2013

			Contribution of total capital															
				Contribution of intangible capital														
	GVA	TFP	TOTAL	Total IK	IK_ GVA	Soft-ware and data-base	R&D	Entertain-ment, Artistic and Literary Origi-nals + Min-eral Explo-rations	IK_ no−GVA	Design	Adver-tising	Market research	Voca-tional Train-ing	Organi-zational Capital	Organi-sational Capital	Organi-sational Capital (own)	H	HK
Spain	**−1.240**	**−0.449**	**0.633**	**0.177**	**0.132**	**0.058**	**0.063**	**0.011**	**0.046**	**0.024**	**−0.040**	**−0.006**	**0.035**	**0.034**			**−1.705**	**0.281**
Andalusia	−1.687	−0.559	0.573	0.055	0.052	−0.006	0.058	0.000	0.004	0.003	−0.039	−0.012	0.033	0.018			−1.954	0.254
Aragon	−1.160	−0.082	0.557	0.084	0.062	0.017	0.046	0.000	0.021	0.018	−0.032	−0.006	0.034	0.008			−1.725	0.091
Asturias	−1.972	−1.065	0.783	0.162	0.088	0.050	0.037	0.001	0.074	0.031	−0.033	−0.004	0.033	0.046			−2.035	0.345
Balearic Islands	−0.980	−0.410	0.615	0.112	0.053	0.046	0.014	−0.007	0.060	0.010	−0.022	−0.005	0.036	0.040			−1.428	0.242
Canary Islands	−1.374	−0.254	0.133	−0.024	0.080	0.037	0.023	0.019	−0.103	−0.040	−0.062	−0.021	0.033	−0.013			−1.502	0.249
Cantabria	−1.924	−0.922	0.723	0.178	0.119	0.044	0.069	0.006	0.059	0.036	−0.037	−0.004	0.031	0.034			−1.986	0.261
Cas-tille−Leon	−1.386	−0.388	0.491	0.066	0.009	−0.017	0.034	−0.008	0.057	0.030	−0.022	−0.002	0.029	0.022			−1.714	0.225
Castille−La Mancha	−1.285	−0.395	0.806	0.089	0.023	−0.026	0.054	−0.004	0.065	0.026	−0.015	−0.005	0.034	0.025			−1.915	0.220
Catalonia	−1.425	−0.478	0.591	0.195	0.154	0.066	0.073	0.015	0.041	0.024	−0.042	−0.004	0.034	0.028			−1.785	0.248
Valencian Commu-nity	−2.020	−0.298	0.402	0.060	0.054	0.005	0.049	0.000	0.006	0.021	−0.046	−0.011	0.025	0.018			−2.372	0.248
Extremadura	−0.824	0.581	0.215	0.070	0.022	−0.008	0.040	−0.009	0.048	0.017	−0.022	−0.003	0.034	0.022			−1.753	0.132
Galicia	−1.114	−0.073	0.692	0.178	0.083	0.044	0.035	0.004	0.095	0.038	−0.011	0.000	0.035	0.033			−1.908	0.175
Madrid	−0.424	−0.902	1.045	0.458	0.337	0.209	0.090	0.038	0.121	0.051	−0.057	−0.002	0.045	0.084			−1.014	0.446
Murcia	−1.408	−0.927	0.676	0.083	0.045	−0.008	0.046	0.007	0.038	0.031	−0.066	−0.008	0.038	0.044			−1.407	0.250

Table 5 (continued)

			Contribution of total capital															
				Contribution of intangible capital														
	GVA	TFP	TOTAL	Total IK	IK_ GVA	Software and database	R&D	Entertainment, Artistic and Literary Originals + Mineral Explorations	IK_ no−GVA	Design	Advertising	Market research	Vocational Training	Organizational Capital	Organisational Capital	Organisational Capital (own)	H	HK
Navarra	−0.856	0.514	0.011	0.065	0.033	−0.054	0.096	−0.009	0.032	0.027	−0.047	−0.004	0.031	0.025			−1.507	0.125
Basque Country	−0.927	−0.113	0.669	0.230	0.189	0.070	0.106	0.014	0.041	0.020	−0.033	−0.004	0.037	0.020			−1.638	0.155
La Rioja	−1.718	−0.966	0.623	0.092	0.094	0.024	0.051	0.020	−0.002	0.005	−0.048	−0.005	0.026	0.020			−1.644	0.268

Table 6 Growth accounting approach. Annual growth rates (%). 2013–2016

			Contribution of total capital													
				Contribution of intangible capital												
	GVA	TFP	TOTAL	Total IK	IK_GVA	Software and database	R&D	Entertainment, Artistic and Literary Originals + Mineral Explorations	IK_no−GVA	Design	Advertising	Market research	Vocational Training	Organizational Capital	H	HK
Spain	**2.420**	**0.636**	**0.306**	**0.133**	**0.117**	**0.075**	**0.027**	**0.015**	**0.016**	**−0.002**	**0.014**	**−0.011**	**0.022**	**−0.006**	**1.346**	**0.133**
Andalusia	2.279	0.665	0.091	0.035	0.058	0.029	0.022	0.007	−0.023	−0.028	0.003	−0.011	0.018	−0.004	1.465	0.057
Aragon	1.695	0.338	0.303	0.124	0.076	0.039	0.023	0.014	0.049	0.010	0.018	−0.006	0.016	0.010	0.982	0.072
Asturias	0.899	0.264	−0.311	−0.084	−0.030	−0.018	−0.018	0.006	−0.054	−0.024	−0.018	−0.018	0.011	−0.005	0.777	0.170
Balearic Islands	3.267	0.660	0.578	0.123	0.094	0.081	0.002	0.010	0.029	0.006	0.008	−0.002	0.029	−0.012	1.788	0.242
Canary Islands	2.053	0.660	−0.400	−0.176	−0.106	−0.099	−0.005	−0.001	−0.069	−0.065	0.001	−0.010	0.024	−0.018	1.602	0.191
Cantabria	1.727	1.278	−0.334	−0.089	−0.025	−0.041	0.016	−0.001	−0.063	−0.022	−0.005	−0.020	0.017	−0.034	0.799	−0.016
Castille−Leon	1.640	0.674	0.067	−0.009	0.027	0.015	0.003	0.009	−0.036	−0.010	−0.005	−0.012	0.014	−0.023	0.937	−0.038
Castille−La Mancha	1.902	0.964	0.072	−0.021	−0.009	−0.021	0.012	0.000	−0.012	−0.001	0.002	−0.009	0.010	−0.015	0.873	−0.007
Catalonia	2.896	0.592	0.442	0.247	0.181	0.114	0.045	0.021	0.066	0.029	0.025	−0.009	0.024	−0.003	1.529	0.332
Valencian Community	2.594	0.732	0.170	0.186	0.100	0.062	0.026	0.012	0.086	−0.008	0.071	−0.005	0.019	0.008	1.545	0.148
Extremadura	1.165	0.149	−0.020	−0.018	0.020	0.000	0.006	0.014	−0.038	−0.016	−0.020	−0.010	0.020	−0.012	1.123	−0.088
Galicia	2.302	1.141	0.013	−0.024	−0.032	−0.035	0.002	0.001	0.008	−0.006	0.003	−0.010	0.021	0.001	0.894	0.255
Madrid	2.557	0.202	0.891	0.354	0.298	0.227	0.038	0.032	0.056	0.010	0.020	−0.017	0.029	0.014	1.472	−0.009
Murcia	3.801	2.457	−0.050	−0.067	−0.013	−0.051	0.035	0.004	−0.054	−0.008	−0.008	−0.017	0.019	−0.040	1.194	0.200
Navarra	2.398	0.905	−0.128	−0.007	0.042	0.037	−0.005	0.011	−0.049	−0.019	0.014	−0.012	0.021	−0.053	1.460	0.162

Table 6 (continued)

			Contribution of total capital													
				Contribution of intangible capital												
	GVA	TFP	TOTAL	Total IK	IK_GVA	Software and database	R&D	Entertainment, Artistic and Literary Originals + Mineral Explorations	IK_no−GVA	Design	Advertising	Market research	Vocational Training	Organizational Capital	H	HK
Basque Country	2.368	0.746	0.359	0.052	0.127	0.056	0.063	0.008	−0.075	−0.011	−0.016	−0.017	0.023	−0.053	1.176	0.086
La Rioja	1.909	0.578	0.407	0.124	0.083	0.017	0.029	0.037	0.041	0.003	0.012	−0.002	0.013	0.015	1.039	−0.115

Source: Cotec Foundation-Ivie, BBVA Foundation-Ivie, INE and the authors

growth rate, with much more intensity for those that are not included in the GVA. It is worth noting the drop in the growth of advertising capital, which contrasts with the increase in organizational capital. In any case, a general feature is the significant regional differences in the contribution of production factors to economic growth.

Focusing on intangible assets, it is worth noting that despite the crisis, both those included in GVA and the rest of the intangible assets continued to make a positive contribution to economic growth. Nonetheless, the contribution of the intangibles not included in GVA was heavily affected by the crisis, as some of them, such as spending on advertising and market research, are particularly sensitive to the economic cycle and, therefore, to company sales. The contribution of assets included in GVA (investment in software and R&D) were more resistant to the effect of the crisis.

One feature common to the three subperiods is that investment in human capital is the most productive, as it makes a higher contribution to economic growth than technological capital (proxied by the contribution of investment in R&D) and the rest of intangible assets. This is a relevant result from the economic policy perspective as it demonstrates that investment in education in particular should be protected from the peaks and troughs of the economic cycle. Similarly, of the intangible capital stock components, investments in software and in R&D are the most relevant.

5 Conclusions and policy implications

This study provides empirical evidence of the importance of intangible asset investment in explaining economic growth, using the case of the Spanish regions as a testing ground taking advantage of the fact that Spain is one of the few countries (perhaps the only one) that has information by region on investment in intangibles. To this end, we constructed series of capital stock in intangible assets, incorporating not only those classified in the National Accounts as investment (such as software and R&D), and which are therefore included in GVA, but also other "expenses" that the recent literature also considers as investment, even though for the purposes of National Accounts they are classed as intermediate consumption (design, advertising, employer-provided worker training, etc.).

The results show that while investment in tangibles fell and only recovered at the end of the period analyzed, investment in intangibles continued to rise throughout the whole period. Nonetheless, investment in tangible assets in the Spanish regions is still higher than investment in intangibles, which demonstrates that the regions still have a way to go before their knowledge economy can be consolidated. We also demonstrated that different intangible asset investment strategies contribute in different ways to regional growth, with the result that some regions have a more favorable performance than others. Another notable result is that, when all the intangible assets are considered, the share of those included in GVA (40.3%) is lower than that of the intangible assets not included in GVA (59.7%), which clearly demonstrates that by excluding them from the accounting process, the role of intangibles in regional performance is underestimated.

The results show that there is a high positive correlation between the level of economic development (approximated by GDP per capita) and the investment effort in intangibles in the Spanish regions, which shows the importance of intangibles as a factor of economic growth. Consequently, in the design of regional policies it is important to promote investment in human and technological capital, but also in intangible assets, as it also plays a role in economic growth.

The growth accounting approach that we use in this paper shows that, throughout the period analyzed 2000–2016, the annual contribution of capital in intangible assets is 0.21%, (which implies that it explains 14% of GDP growth), of which two-thirds (0.142%) corresponds to the intangible assets included in GVA and one-third (0.074%), to those not included in GVA. Thus, intangible assets not included in GVA must be seen as a new source of growth.

The analysis at the regional level shows considerable differences in the importance of intangible assets in explaining economic growth. In the regional analysis, the case of Madrid is noteworthy as intangible assets explain 21% of GVA growth, 6.5 pp above the national average, in stark contrast to contributions below 8% in the Canary Islands, Castille-La Mancha and Extremadura.

One aspect worth highlighting is that in the period analyzed, the differences in investment effort in intangibles among the 17 Spanish autonomous communities have increased, so this has not been a factor that has contributed to regional convergence, but rather the opposite. Consequently, to achieve the desirable objective of reducing regional inequality in well-being, it is necessary to implement measures to encourage investment in intangibles, especially in those regions already in disadvantage.

These results reveal that the regions that possess intangibles and manage them better have a comparative advantage. It is therefore crucial to design economic and fiscal policies to stimulate the accumulation of intangible capital stocks internal to companies and to create a favorable external environment based on high endowments of human capital and technological capital. While investment in intangibles is most commonly incentivized through subsidies or tax relief measures, it is also important to incentivize financing for such investment.

In the first case, public aid can be helpful for the financing of intangibles, whether in the form of transfers, grants, or tax incentives. Although there are R&D tax incentive schemes in Spain, there are none for other intangibles, such as software, databases, design, or training. It is an avenue that should be explored by both the State and regional governments, especially considering that in the coming years the degree of digitization should increase and this requires investment in intangibles.

Access to finance is a major barrier to investment in intangibles. In Spain, with a productive fabric that is dominated by SMEs, bank credit is by far the main means of financing for companies. However, investing in intangibles can be very risky due to the difficulty of obtaining real guarantees. In this context, it is necessary to promote other forms of non-bank financing such as venture capital, whose weight is very low in Spain. Another option is for the Official Credit Institute (the Spanish public bank) to grant guarantees to banks, as it did during the Covid-19 crisis in support to companies.

Furthermore, an additional way to encourage investment in intangibles is to implement aid through the financial agencies of the autonomous communities. Certain Spanish regions have a type of public bank that offers financing to sectors of activity that are considered a priority, as has recently been the case with those sectors hit hardest by Covid-19 (such as commerce, restaurants and transportation). These same regional institutions could include among their priority objectives the investment in intangible assets of the companies in their territories, a task that can be reinforced through the regional mutual guarantee companies (there are 18 in Spain), whose mission is to provide loan guarantees to its participating shareholders (SMEs).

Regional industrial policies also have an important role to play in encouraging investment in intangibles, not only by specifying the most appropriate financial and tax incentives for each sector, but also by promoting the creation of clusters to attract new knowledge-intensive companies. There are already good examples in this regard, such as the Valencian Community's Digital District, Catalonia's Digital Cluster or Malaga's Smart City Cluster.

Following the impact of Covid-19, the European Union has approved a € 750 billion aid package (Next Generation European Union), of which € 140 billion are destined for Spain, approximately half in the form of subsidies. One third of the amount for Spain is aimed to advance in the degree of digitalization, so that part of the investments will be made in intangible assets. The participation of the autonomous communities in the distribution of funds and in the selection of projects is important since they have more detailed information on their territory than the central government.

Finally, it is important to raise awareness among entrepreneurs of the importance of intangible assets for gaining competitiveness. The European Union has opted for digitalization as a way to define a new growth model based on knowledge. This awareness campaign must be carried out by the regional governments, dedicating part of the European funds to the acquisition of digital skills, since it is of little use to invest in new technologies if the necessary skills are not available to make full use of it.

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