The Sources of Spanish Regional Growth and Convergence

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ABSTRACT

This article reviews the patterns of growth in Spain and its 17 regions from a long term perspective. It starts with the basic features of growth in Spain, highlighting the poor performance of labour productivity. The analysis confirms that the slow advances of productivity are a common problem for all regions, although with different intensities. This problem is analyzed from two different perspectives: the structure of production by industry; and the decomposition of the sources of growth. We break down the labour factor into quantity and qualification levels, and we consider three types of capital: new technologies (ICT); infrastructures, and the rest of capital (non infrastructures, non ICT). The analysis uses β and σ convergence definitions to examine the degree of regional convergence of productivity and its determinants.

Key words: growth, convergence, regional, ICT, infrastructures
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Over the last twenty years, the Spanish economy has followed a sustained growth trend- with the exception of a very short recession in 1993- interrupted by the current global crisis initiated in the middle of 2007. Spain's growth has been driven both by a very intensive process of labour employment creation –accompanied by large improvements in qualification- and a great effort made in capital accumulation. Across the board the results have been positive, especially from the labour market perspective. The slashing of the unemployment rate (a chronic problem in Spain for more than twenty years) has been remarkably positive, concurrent with a fast increase in the participation of women in the labour force. The fact that Spain has turned from a country of emigrants into a country with immigrants clearly shows this process, indicating that in recent years foreigners have found good job and welfare opportunities in the country.

In spite of these undeniably positive results, Spain has also shown some weaknesses that threaten to condition its future recovery. Probably the most serious problem today is the poor performance of labour productivity. The origin of this problem is twofold: firstly, a product specialization in activities that are very intensive in labour and have low value added; and secondly, the inefficient use of the production factors capital and labour. Although both determinants are common to most of the other EU countries, they have been aggravated in the Spanish case by the high and increasing weight of the construction sector (including real estate activities) characterized by the intensive use of labour – particularly unqualified- slow penetration of technical progress; and with high risk of suffering cyclical speculative bubbles that sooner or later burst and cause the collapse of other key industries.

The two historical episodes that have probably been the most decisive in shaping the current territorial configuration of Spain are the *Stabilization Plan* of 1959 and the Constitution of 1978, which led to the creation of the State of the Autonomies[1] (Pérez 2007). The 1959 Plan put an end to the autarchy period that had started at the end of the Spanish Civil War in 1939. It was the beginning of new economic policies implying the external opening and modernization of the country. Up until then, Spain had basically been an agricultural country with a few industrial sites in Catalonia (textile and light industry), the Basque Country (steel and metallurgic), or Asturias (mining). These regions attracted the labour force expelled from the farming fields, while the capital of the nation, Madrid, attracted the most qualified workers to the Administrative Institutions of the Central State. In the mid sixties, two additional regions became an important focus for attracting population: the Balearic Islands and the Valencian Community. Both regions are located on the Mediterranean coast and given that they enjoy

[1] We will refer to them as regions.

good climate conditions and landscapes at good prices, many Europeans chose them as a favourite destination either for holidays or for retirement.

As a result of these changes, Spain suffered a territorial fracture over the sixties and seventies (Goerlich and Mas (dirs.) 2006). The Southern and the Western parts of the country lost population and the East, the Basque Country and Madrid concentrated the gains. There was an exodus from the central part of the country to the coastal provinces and also from the mountains to the valleys (Goerlich and Mas 2008).

After Franco's death in 1975, the new State of the Autonomies ended the former centralism of the dictatorship. With the creation of the new Autonomies, the regional governments were able to develop public expenditure policies favouring regional development. At the same time, the new welfare state created over the eighties made substantial improvements in unemployment benefit and the pension system, as well as greatly extending public education and health services all over the country. As a result, new public social guarantees improved all over the country, slowing down the process of the concentration of the population. In this way, public policies weakened the negative effects of the high unemployment rates, particularly in the poorest regions (Pérez 2007; de la Fuente 2008).

In 1986, with Spain's entry into the EU, the European and regional policies reinforced each other. At the beginning, the relatively backward position of Spain and most of its regions made them eligible for Cohesion and Structural Funds from the EU. Both funds have the objective of promoting economic growth as well as social and territorial cohesion. In fact, both goals can be subsumed into one: favouring territorial convergence, that is, reducing the distance between the rich and the poor regions (Garrido, Mancha and Cuadrado 2007). Two of the main instruments were very important for Spain: the European Regional Development Fund (ERDF) and the Cohesion Fund. Both funds have provided financial resources to improve public infrastructures, one of the main tools for promoting regional growth and convergence. Unquestionably, the great investment effort made by all regions as a result of the double boost of the decentralization process and the entry in the EU has changed the look of most of the cities and regions in Spain. The impact of public investment on regional growth and convergence has been analyzed by different authors and from different perspectives[2]. The starting point of most of the studies was the seminal contribution of Aschauer (1989) who

[2] Mas (2006), Mas, Maudos, Pérez and Uriel (1998, 1996, 1995), Draper and Herce (1994), de la Fuente (2001 and 2008).

blamed the public infrastructures for the deceleration of productivity growth experienced by the US economy after the mid seventies[3].

In addition to public investment, the improvement of young generations' access to education has played a key role in Spain, showing much higher ratios of enrolment in secondary school and university studies. After the discovery of Solow's residual in 1957, Schultz (1961) argued that what was important from the growth perspective was not the number of workers but their level of education and skills. These quality variables had a direct effect on labour productivity. This consideration was included in the concept of human capital developed at the end of the fifties and early sixties by Jacob Mincer (1958) and Gary Becker (1964). The role of this intangible asset on Spanish growth has been analyzed by different authors over the last two decades[4] .

The combination of public investment -both in infrastructures and human capital- with private investments -in machinery and equipment- comprises the process of accumulation of capital. This process allows the creation of employment and the improvement in productivity. From the mid seventies, labour productivity in European economies increased faster than in the United States. However, this trend was inverted in the mid nineties. The reason for this break was attributed initially to the development of new Information and Telecommunication Technologies (ICT). First, it was attributed to the ICT producing sector (Gordon 2000, 2002, and 2003). However, this effect was later extended to the ICT using sectors as well[5]. As a result, both the Lisbon 2000 and Barcelona 2002 EU summits placed the role of ICT in the core of the new growth strategy for the EU. The ambitious goals of the Lisbon Agenda depart from the results seen in the EU in recent years. In terms of productivity they differ even more from the performance of Spain and its regions, where labour productivity advances have been very small and total factor productivity gains have been negative for many years.

In the following pages we develop some empirical evidence on these preliminary ideas. Section 1 revises the behaviour of Spain over the last few years. It provides a general framework for checking the particular performance of individual regions which are analyzed in the following sections. Section 2 presents the basic facts of regional economic growth, highlighting the industry composition of output as well as the various sources of growth: namely, labour growth and capital accumulation and their corresponding composition. Section 3 analyzes the regional convergence process and section 4 concludes.

[3] Today the same idea has been used by President-elect Obama in his plan to promote growth after the great turbulence in which most of the western economies find themselves.
[4] Mas, Pérez, Uriel Serrano and Soler (2002); Pérez and Serrano (2000); Pérez and Serrano 2008); de la Fuente and Doménech (2006); de la Fuente (2008).
[5] Jorgenson (1999, 2000, 2001), Jorgenson and Stiroh (2000), Jorgenson, Ho and Stiroh (2002). See National Research Council (2007) for a review.

1. Spain's growth

Once the long crisis of the seventies was over, Spain started to grow at an annual average of 3.3% in real terms between 1985 and 2007 (table 1). The average growth rate of employment was 2.4% and labour productivity thus increased at a rate of 0.9%[6]. Around this long term growth trend there were cyclical oscillations with different characteristics. For this reason, it is interesting to split the entire period into four different sub periods with their specific features as shown in table 1 and figure 1. The second half of the eighties was characterized by a very high growth of GVA and employment, 4.5% and 3.2% respectively, and a similarly high advance of labour productivity (1.4%). These were *virtuous* years for Spain with high growth rates of GVA, accompanied by a large creation of employment and positive advances of productivity.

Table 1 and Figure 1

The first half of the nineties offers quite a different picture. Growth substantially decelerated, being slightly negative in 1993, and there was employment destruction (-0.4% annual rate) instead of creation. Over this period, labour productivity grew at the highest pace of the whole period, almost 2% (1.97%). This experience should warn us about interpreting in an excessively simplistic way the evolution of labour productivity since –in the short run- great advances of productivity can be the result of a great reduction of employment.

After 1995 Spain's growth was quite significant, although it slowed down from 3.8% in 1995-2000 to 3.2% in 2001-2007. The slow down of the rate of employment creation was even more intensive, falling from 4.0% to 2.7%. However, the intensity of productivity deceleration concentrated in the first half (-0.15%), whereas between 2001 and 2007 there was a slight annual improvement of 0.6%. The uncertainties currently present in the western economies do not allow us to forecast their future evolution. Nevertheless, in the near future we should expect a deceleration in GVA and employment growth, as well as an improvement of labour productivity in line with what happened at the beginning of the nineties.

Spanish growth has been driven by an intensive process of capital accumulation. The effort in investment –measured as the ratio between investment (gross capital formation) and the Gross Domestic Product (GDP) - has been one of the highest of the EU countries. A great part of this effort has been absorbed by the housing sector due to the high price increases of this asset. However, in real terms, the most intensive capital accumulation has taken place in non-residential assets, that is to say, assets that are part of the productive capital, including machinery and equipment (comprising ICT), and transport equipment[7]. The profiles of the

[6] More details in Maroto-Sánchez and Cuadrado-Roura (2006).
[7] Pérez (2008 y 2006).

accumulation of productive capital (excluding residential capital) over the last twenty years are shown in figure 2. Total capital shows a cyclical pattern around a very high average growth rate of 4%. ICT investment also shows a high average rate of accumulation, although it presented an intensive decrease during the short crisis of the early nineties. It was followed by a recovery period until 2000 and by a second downturn associated with the so called *dot com* crisis. Since then we have seen a period of stable investment effort.

Figure 2

The composition of capital is shown in table 2. We have considered three types of non residential capital: infrastructures, ICT capital and the rest (non infrastructures, non ICT). The bulk of capital is made up of this last category with a relative weight of around 75%. Infrastructures are approximately 20% of total capital and ICT represents the remaining 5%.

Table 2

With available data for different types of physical capital as well as for human capital, one can make a more precise analysis of the sources of labour productivity growth presented in table 3. The most recent approaches consider that from the perspective of growth, quality improvements are as important as quantity increases. The higher the input quality is, the larger the impact of this factor will be on productivity. The way to approximate factor quality indices is to consider the price that one is willing to pay for them. Highly qualified workers are better paid than unqualified ones because they are more valuable to the firm. In the same way, different types of capital have different user costs -to cover for depreciation, the interest rate as a proxy for the opportunity cost, and the devaluation o revaluation of the capital asset. These user costs are the prices that a firm would be willing to pay if the assets were rented and they are proportional to the expected productivities.

Table 3

With the adequate information, growth accounting allows the origin of the advances in labour productivity to be broken down into the contribution of the inputs used in the production process. It identifies the contributions of infrastructures; ICT capital; non-infrastructures non-ICT capital; labour qualification; and a residual factor or Total Factor Productivity (TFP) The exercise has been carried out only for the private sector, excluding the production of public services. In this way, we do not run into the problems of measuring the real output values and quality levels of publicly provided services.

Over the 1985-2006 period, the average growth rate of labour productivity in the private sector was 0.8% (table 3). The decomposition of this growth rate into its determining factors

attributes 0.07% to investment in infrastructures; 0.36 to ICT capital investment; 0.48 to investment in non-ICT non- Infrastructures capital; and, finally, 0.55 to the improvements in labour quality. Note the high contribution to labour productivity growth of factors that are intensive in knowledge; ICT explains 44.4% of this improvement but is only 5% of total net capital; human capital explains on its own 70% of the labour productivity growth. Additionally, non-ICT non-infrastructures representing 75% of total capital contribute 59.2% to potential growth. Finally, infrastructures representing 20% of total net capital only contribute 8.6% to productivity growth.

Clearly these percentage contributions to labour productivity add up to more than one hundred. This means that productive factors have not been actually used up because we find a residual with a large negative contribution (-0.61): the Total Factor Productivity term. This negative contribution can be interpreted as the result of an inefficient assignment of resources in the production process. Taking into consideration not only the quantities but the improvements in quality and composition, production has increased less than the resources used to generate it.

In the sub periods we find a decreasing role for infrastructures, a constant one for ICT and a very unstable one for non-ICT, non-infrastructure capital. We find a negative contribution of TFP in all sub periods that is particularly large in the last expansionary period, when labour productivity stagnates (even decreases) due to the intensive process of employment creation. This remarkable and persistent result cannot rule out the possibility that the growth accounting methodology overestimates the contribution of some of the productive factors. With this caveat in mind, we proceed with the regional analysis in the remaining sections.

2. Labour productivity in Spanish regions

In 2007, the levels of labour productivity in Spanish regions show differences which amount to 20% above and under the national average. The Community of Madrid and the Basque Country are the regions with the highest levels, whereas Extremadura, Castile-La Mancha and Murcia present the lowest values. The map of Spain is divided into three different geofigureical zones (map1). A central axis with low productivity levels running East to West through Extremadura, Castile-La Mancha, and Murcia. On both sides of this axis there are regions with productivity levels around the national average: on the southern part it comprises Andalusia, the Canary Islands, and the two autonomous cities; and on the other part the rest of the northern regions, the Valencian Community and the Balearic Islands. Finally, we find the Community of Madrid and the Basque Country as the regions with productivity levels significantly above the national average.

Map 1

It is important to identify not only the regional levels of productivity but also their dynamic behaviour. We find very significant differences over the period (figure 3). With the exception of the Balearic Islands, all regions improved their productivity over the period 1985-2007 although at different rates, from 0.4% to 2.6%. The highest growing region in terms of productivity was Galicia followed by Extremadura, Castile and Leon, and Castile-La Mancha. These are regions that experience productivity gains more as a result of a slow growing population than because of a fast growth of output. On the opposite side we find the Canary Islands, Murcia, and Andalusia, which are very dynamic communities in terms of population and employment growth. This high trend has more than reversed the growth of GVA, making the indices of productivity gains in these regions the lowest ones in the country.

Figure 3

In the remaining part of this section, we consider two relevant determinants of the regional evolution of productivity: the differences in industry specialization and in sources of growth.

2.1. The relevance of specialization

The aggregate growth of one region is a combination of the behaviour of firms and sectors in the economy. Industries can follow different patterns of growth depending upon the opportunities brought about by their product specialization, and the efficiency of their firms in exploiting the externalities associated to a specific location in a region. Following the proposal by Basu and Fernald (1995, 1997), and Stiroh (2002), table 4 decomposes labour productivity growth into the contribution of the growth experienced in each of the industries plus a reassignment factor of labour hours. While this latter element is positive whenever there is a movement of the labour force towards activities with higher value added, it is negative in the opposite case. At any rate, its importance at the aggregate level is very limited. The differences in productivity trends of each of the industries are much more relevant which, as shown, can be very substantial among economies.

Table 4

The last two rows in table 4 contain information on the EU-15 and the United States for the most recent period 2000-2005. They are a useful reference to compare the performance of Spain and its regions. Over this period, labour productivity increased in the US twice as fast as in the EU-15 and five times more than in Spain. This higher dynamism originated in the ICT producing sector (*Electric machinery, post and telecommunication*) rather than in the rest of *Manufacturing*. But indeed the main differences occurred in the service sectors. Note that in *Trade and Transport*

industries, US productivity growth was 3.5 times higher than in Europe; in *Financial Intermediation and Business Services,* 6.6 times; and in *Personal and Social Services* US growth was positive (0.3 pp), while it was negative in the EU (-0.1pp). Consequently, the great difference in productivity growth between the US and the EU-15 lies in the higher dynamism of the US service sectors and not so much in the manufacturing sectors, if one excludes the ICT producing sectors.

Data for Spain and its regions clearly show, once more, that advance in productivity has indeed been slow over the last period. In none of the regions did productivity grow at a rate close to the EU-15 average and much less to that of the US. Industry contributions to this modest advance in productivity are very striking. In nearly all regions, ICT producing industries (*Electric Machinery, Post and Telecommunications*) contributed positively to productivity enhancement. Note the positive contribution in the Community of Madrid, with 0.28 pp, as opposed to the rest of the regions where in most cases it is small or even negative. In all regions without exception, *Manufacturing* contributed positively to productivity growth with Catalonia, the Basque Country, and Navarre as the regions with the highest contributions. On the other hand, the *Construction* sector contributed negatively in most of the regions. The highest positive contribution was in Aragon and the most negative one in Murcia.

The three sub sectors of services show completely different patterns of behaviour. *Financial Intermediation and Business Services* contributed positively in all regions without exception, being highest in the Community of Madrid but also relevant in other regions. On the contrary, *Personal and Social Services* contributed negatively in nearly all regions, with Extremadura being the only exception, although very marginally. Note that this sub sector is the sector that has contributed most negatively to productivity growth not only in Spain but also in the EU-15. By contrast, the US shows a positive contribution over the last few years. Finally, *Trade and Transport* presents weak advances in productivity in comparison with what happened in the EU and the US; at the regional level it has shown a pattern somewhat more favourable in regions such as Extremadura and Aragon, and negative in others (Cantabria and Murcia).

In conclusion, Spain and its regions show generalized weaknesses in productivity behaviour in practically all productive activities: with the exception of *Financial Intermediation*, productivity improvements in each of the industries are much smaller than those of the EU-15 and the US. These results can be due both to an inefficient use of productive factors or to the industry composition of each of the sectors. Both explanations may be related to one another, since intra industry specialization can be responsible for the inefficient use of productive factors, in particular those that are knowledge intensive.

2.2. Growth accounting

Growth accounting allows the decomposition of productivity growth into the contributions of the capital per worker endowments, and a residual term which captures all factors different from capital deepening. We have mentioned how important it is to distinguish between the different types of capital because of their different impact on productivity. In this sense, available data for Spanish regions[8] allow us to evaluate the contribution to productivity of improvements in capital endowments (human; infrastructures; ICT; and non-ICT non-infrastructures). Before showing the results of the growth accounting exercise, we briefly describe the regional endowments of the relevant variables.

Infrastructure capital is distributed in an irregular form between different regions (Mas, Quesada and Robledo 2007), although it is necessary to look at the indices of demand[9]. It is very common to use the level of employment, or the size of the territory, to normalize these indicators. In the first case, we get the capital labour ratio which directly influences productivity growth. The size of the region is meaningful because a great part of infrastructures are related with the location of activities and the level of communications. However, Spain shows a radial structure for many of the transport infrastructures. This makes the region of Madrid -located in the centre of the country- the core connecting region for most of the territory. In 2006, using the capital labour ratio indicator, the regions with the highest endowments were Asturias, Aragon, Castile-La Mancha, Castile and Leon, and Extremadura. On the opposite side we find the Balearic Islands, Madrid, Catalonia, Murcia, and the Valencian Community (figure 4a).

Figure 4

When we use the indicator of capital per square kilometre –excluding the two autonomous cities of Ceuta and Melilla- the rank changes very significantly. The Community of Madrid, a small region in geographical terms, ranks first, well ahead of the second community, the Basque Country, followed by the Canary Islands and Catalonia. On the opposite side we find Extremadura, Castile-La Mancha, Castile and Leon, and Aragon, all of which are very large regions with a very low population density.

ICT capital includes three different assets: computer equipment referred to as *hardware*; *software*; and equipment and network lines of transport for voice and data associated with *telecommunications.* ICT capital per worker is an indicator similar to the capital labour ratio

[8] See Mas, Pérez and Uriel (2007) for capital stock and Mas, Pérez, Uriel, Serrano and Soler (2008) for human capital.

[9] The permanent inventory procedure used in the estimates of FBBVA-Ivie considers the investment made in the corresponding region, although its use –as in the case of the infrastructures of transport- is not limited to its residents or to the firms operating in the area. This fact makes the comparison of infrastructures among regions difficult.

defined earlier for infrastructures. Figure 5a shows the relative position of the Spanish regions in 2006. We find the highest level in the Canary Islands, followed by the most developed regions like Madrid, the Basque Country and Navarre, and also by Aragon and Extremadura.

The relative weight of the ICT capital services with respect to the total productive capital services is a complementary indicator of the degree of penetration of the new technologies by region (figure 5b). Above the national average, we find communities such as the Balearic Islands, Madrid, the Canary Islands, and the Valencian Community (besides Ceuta and Melilla). With a lower than the national average ICT capital labour ratio, we find the communities of Asturias, Castile-La Mancha, Extremadura, Castile and Leon, Cantabria and Aragon.

Figure 5

To evaluate the endowments in human capital, we have built a synthetic index which considers the average years of workers' education in the different regions. As shown in figure 6, the human capital endowments are highest in Madrid and the northern regions, and lowest along the belt of lowest productivity regions crossing the centre of the country, as shown in map 1 above.

Figure 6

The growth accounting results provide a very different pattern among Spanish regions. These differences are more quantitative than qualitative. Table 5, referring to the period 1995-2006, shows the retrogressive movement of labour productivity in most of the regions, and substantial improvements only in Galicia, Extremadura, Castile-La Mancha, and Asturias. In all regions, without exception, TFP contribution to labour productivity was negative. The regions with the lowest negative values were the Balearic Islands, the Canary Islands, Castile-La Mancha, La Rioja, and Murcia.

Table 5

With regard to the factor contributions the results are as follows:

a) Changes in the composition of the labour force have shown positive -although uneven- effects in all regions, with the exception of the Basque Country and marginally Navarre. The regions affected most significantly are Galicia, Castile-La Mancha, the Valencian Community and La Rioja. The regions with lower intensity are Catalonia, Cantabria, Navarre, the Balearic Islands and Aragon, together with the two already mentioned Basque Country and Navarre.

b) The contribution of infrastructures to productivity growth has been positive in general but small. It has been much lower than the attention received by public policies or their relative weight in total capital. While in seven regions the contribution was negative, it was only positive and significant in Asturias and Galicia.

c) The share of regional growth explained by the use of productive capital that is neither ICT nor infrastructures is positive and homogeneous among Spanish regions, with the exception of Cantabria and Extremadura. This result confirms that, in all regions, a significant and stable part of productivity growth is due to traditional firm investment in plant and equipment (non ICT).

d) Additionally, it is worth noting that in many regions, the contribution of ICT capital is higher –and in some cases much higher- than that of infrastructures and the rest of capital. This higher contribution is still more significant if one compares the relative weight of ICT with respect to total capital. Thus, the new technologies associated to intensive ICT use are more favourable to improvements in labour productivity. Consequently, a constant effort in ICT investment should be reflected sooner or later in productivity gains (Mas and Quesada 2005a and b).

However, all these contributions, although positive, end up not being reflected in labour productivity gains. They are accompanied by generalized and almost always intensive falls of TFP. Thus we found –in the former section- a weak advance in labour productivity in all sectors of the regions. And now we see that given the improvements in the quantity and quality of factors used in the production function, there is also a loss in production efficiency in all regions. As mentioned before, this finding on the last decade is quite striking and requires a deeper explanation of its causes.

3. Regional convergence

The neoclassical growth model[10] predicts productivity convergence among different territories if regions share production technology, savings and depreciation rates, and employment creation. Thus, the confirmation of this prediction depends upon the accomplishment of the conditions of such parameters, something that should be validated empirically. One should expect the convergence result to be more likely among regions than between different countries, since regions share a common economic and institutional system.

In empirical tests of the convergence hypothesis the literature has defined two basic concepts, σ-convergence and β-convergence. The first one analyzes whether regions become more or less alike with the passing of time, for instance in productivity levels. To test for the presence of

[10] Solow (1956). Also the growth accounting methodology, used above, in Solow (1957).

convergence a measure of dispersion -like the coefficient of variation- is computed over time for the 17 regions and the two cities.

Over the last 20 years in Spain we find a process of regional convergence in productivity levels (figure 7a). Regions are more alike in 2006 than they were in 1985.

Figure 7

It is equally interesting to check whether regional differences in the productive resources that improve productivity over time. Over the last 21 years, we find a process of regional convergence both in total productive capital (excluding residential capital) per worker and in the level of qualification of the labour force (figure 7b). Thus, regions are more alike now than they were before in productive capital endowments, and also in the education, experience and productivity of their labour force. Notice that regional differences are smallest in the human capital variable.

Figure 7c complements the previous one. It verifies whether there is convergence in the endowments of each of the assets considered in the definition of capital: infrastructures, ICT capital and the rest. ICT capital endowments show the most intensive convergence process as reflected in a strong decrease of the coefficient of variation. While in non- ICT non-infrastructures capital the process of convergence is equally positive, it shows less intensity. By contrast, infrastructures do not show any sign of convergence between regions. Over the last two decades, the existing differences in infrastructures between regions have not disappeared. They are even greater (as seen previously in figure 4) in those regions with large territories, and low employment and production. Therefore, it is likely that there has not been much progress in gaining an equal endowment of resources by region, and particularly in those with high population density and activity levels which show congestion problems. However, one should bear in mind the different picture that one gets of regional endowments in infrastructures depending upon the indicator used. In this case we use labour employment as a normalizing variable, which is the relevant variable for *growth accounting*.

An alternative way of analyzing regional convergence, complementary to σ-convergence, is β-convergence. This is a concept that defines regional convergence whenever regions that are initially placed in an unfavourable position –with a lower initial level of the variable under investigation- show the highest rates of growth. If this is the case for a sufficiently long period of time, one should expect that the poorest regions will end up catching up with the richest ones. However, this result is not guaranteed if the initial differences are large enough and the differences in the growth rates are small.

Figure 8a shows the labour productivity level in 1985 on the horizontal axis and the annual growth rate over the period 1985-2006 on the vertical one. The resulting relation

is a negative one, as shown by the adjusted regression line, which gives significant values for the explanatory power of the equation as well as for the confidence of the estimated parameter. The decreasing line indicates that the communities which were in the lower part of the set of Spanish regions in terms of labour productivity levels of the private sector, were those enjoying the highest growth rates of productivity. In other words, those regions in the worst positions at the beginning of the period were also the fastest improving regions. This is the case of Galicia, Extremadura, and Castile-La Mancha. On the other hand, communities that initially were in better positions like the Balearic Islands, Madrid, and the Basque Country are showing the lowest improvement. This analysis confirms the presence of a convergence process of productivity among Spanish regions.

Figure 8b presents a similar exercise carried out for capital endowments (excluding residential capital) per worker, that is to say, the capital labour ratio. Again we obtain a negative and statistically significant relation. This result is replicated in the case of the labour force qualification, as measured by the years of schooling, a variable that has also shown a convergent trend as shown in figure 8c.

Figure 8

The remaining parts of figure 8 show the β-convergence analysis applied to the capital labour ratio defined for the three types of capital considered. First, we observe an intensive convergence process of the different ICT capital per hour worked (figure 8d). This confirms the σ-convergence result obtained above (figure 7c). Therefore, it seems that the convergence in the endowments of ICT capital is one of the determinant forces in the convergence of labour productivity in Spanish regions.

In infrastructures we observe (figure 8e) a much weaker process of convergence than that of the other productive capital assets. The coefficient of determination and the value of the slope of the adjusted regression line tell us that the initial position does not explain a great deal of the variance, and that the dependency relation is not very strong. At any rate, this β-convergence has not been able to reduce the existing dispersion in endowments (σ-convergence).

Finally, we find convergence between the Spanish regions in terms of capital labour ratio when capital is formed by all capital assets that are not ICT or infrastructures (figure 8f). This relationship is decreasing and significant, and the coefficient of determination is high. Regions like Galicia, the Valencian Community, and the Balearic Islands - initially in the

lowest levels of endowments- are also the regions that improved more over the period, with rates of growth twice as large as those of the best situated regions.

4. Conclusions

Before the start of the current crisis, the performance of the Spanish economy was quite remarkable over the last twenty years, in terms of output growth and particularly outstanding in employment. This latter achievement brought to an end the extremely chronic problem of unemployment that started with the first energy crisis. Growth was general in all Spanish regions, although with different rates. Spain attracted migrating population flows from other countries, especially from Latin America and Eastern Europe. However, after the slow down of growth in 2007, unemployment has made a powerful return rising more than 50% in only one year.

Over these years, the darkest side of Spain was the overall presence of a very slow growth of productivity. Although the regions enjoy different levels of productivity, all of them share a slow progress of this variable; lower than the average of EU-15 and much lower than the United States. The slow gain in labour productivity is the result, in part at least, of a product specialization biased towards activities with low added value. These are industries like *construction, hotel and restaurants* and *personal services*, three great reservoirs of jobs. However, given the intensity of the accumulation of productive capital in all activities and regions over these years, there also exists a problem of inefficiency in the use of resources, as shown by the reversion of labour productivity in many regions, and the persistence of a negative Total Factor Productivity (TFP) in all of them. Growth has been more the result of the effort made in creating employment and keeping a high rate of capital accumulation –*transpiration*- than the outcome of *inspiration*. Until now, the externalities derived from the accumulation of physical and human capital have not emerged, technical progress has been very slow and the combination of the factors of production utilized has been hardly efficient.

There are two complementary explanations for this poor performance of productivity. First, as in many other European economies, some service industries have shown very weak productivity gains, in particular in comparison with the dynamism of the United States. In this country, the services of *Wholesale Trade, Transport* and *Business Services* have been the winners in productivity gains since the mid nineties. An additional contributing factor to the dynamism of the United States was the fast development of the ICT production sectors.

As with the majority of countries, Spain and most of its regions do not have a powerful ICT producing sector. This is different from what we see in the United States, Sweden, Finland or the UK. Only in the region of Madrid does this ICT producing sector present a significant contribution. Furthermore, the construction sector –where productivity gains are very slow- stands for a very

large weight in the GDP of many regions. This high contribution of the construction industry has contrasted with the negative effects on productivity, with significant negative growth rates in regions like Murcia. Finally, services industries –with the exception of *Financial Intermediation*- have shown slower advances in Spanish regions than in the EU-15, and in some regions they have contributed even negatively.

Secondly, growth accounting has allowed us to test that in all Spanish regions, without exception, TFP contribution has been negative. That is to say, the slow advances in labour productivity have taken place in spite of the intensive process of –physical and human- capital accumulation. This high rate of investment has not been accompanied by technical progress or efficiency improvements in the utilization of factors. The improvements of the qualification of the labour force and the important accumulation of ICT capital have given rise to a contribution to labour productivity which is larger than the productivity gain, without the effect of the negative contribution of the TFP. To the question of why we get this result we propose, at least, two possible answers: first, knowledge investments are not worthwhile unless there is a strong specialization of the economy in knowledge intensive industries; second, investments in knowledge mature very slowly.

Finally, the work has analyzed regional convergence using the concepts of σ and β convergence. We have found that there is convergence in labour productivity among the Spanish regions. The most intensive convergence process takes place in ICT capital endowments, followed by the educational levels of the workers and by the rest of capital (non ICT, non infrastructures). In contrast, infrastructures endowments do not show a profile of convergence, a great discrepancy from the rest of the sources of growth.

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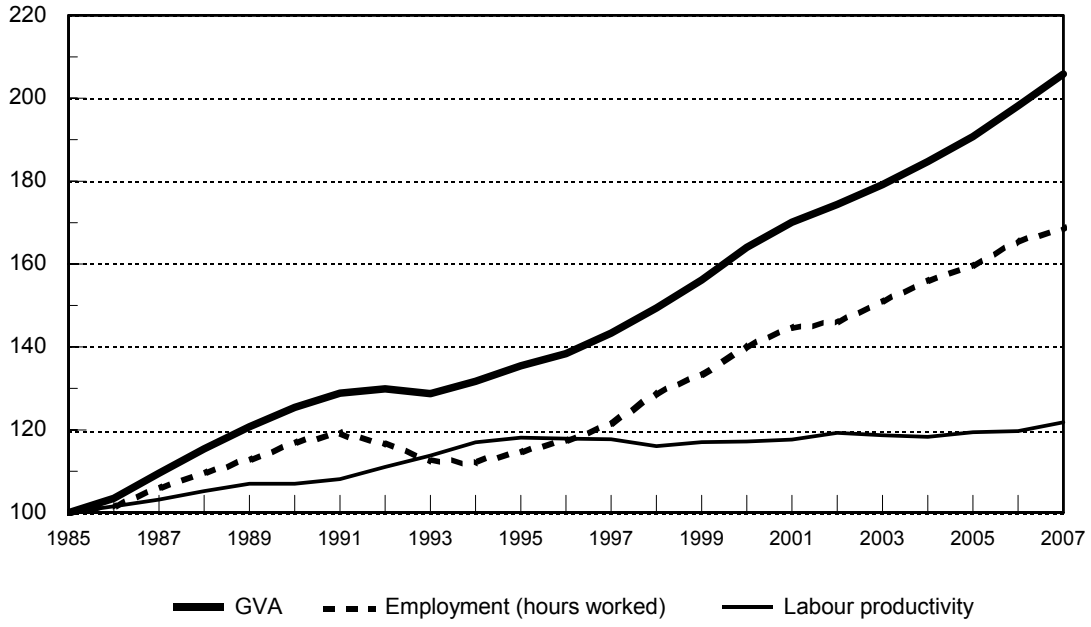
Tables and figures

Table 1. Rates of growth of real GVA, employment (hours worked) and labour productivity. Total economy
Percentage

	1985-2007	1985-1990	1990-1995	1995-2007	1995-2000	2000-2007
Real GVA	3.28	4.53	1.53	3.49	3.83	3.24
Employment (hours worked)	2.38	3.17	-0.44	3.23	3.99	2.69
Labour productivity	0.90	1.36	1.97	0.26	-0.15	0.55

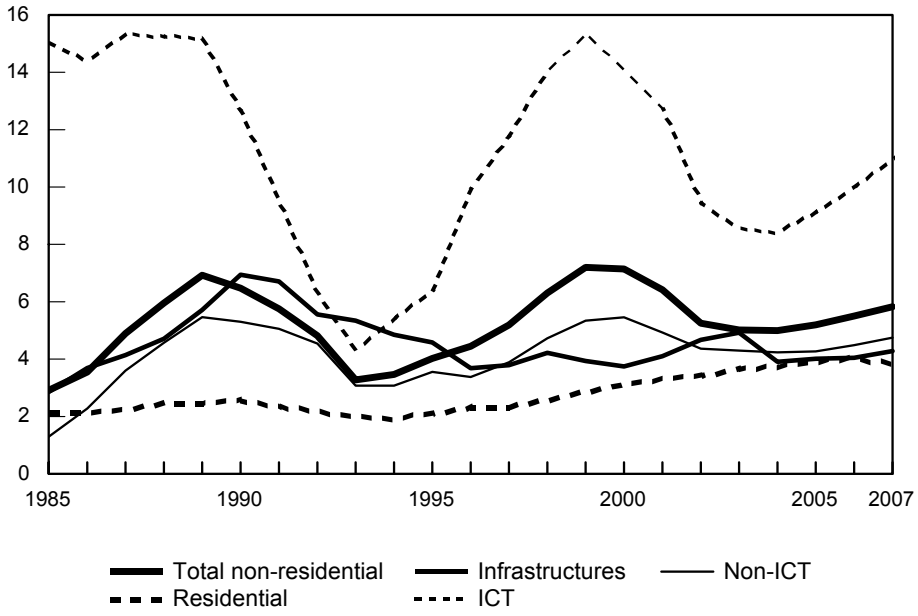
Source: INE and own elaboration.

Figure 1. Real GVA, employment (hours worked) and labour productivity. 1985-2007 (1985=100)



Source: INE and own elaboration

Figure 2. Rates of growth of productive capital in Spain. 1985-2007
(Percentages)



Source: Foundation BBVA-Ivie and own elaboration

Table 2. Composition of net Non-Residential capital stock. Spain
Percentage

	1985	1995	2000	2007
Total Non-Residential capital	100.00	100.00	100.00	100.00
Infrastructures	18.22	19.93	19.74	20.34
ICT	4.67	4.74	4.60	4.31
Non-Infrastructures, Non-ICT	77.11	75.33	75.66	75.35

Source: Foundation BBVA-Ivie and own elaboration.

Table 3. Growth accounting. Labour productivity. Spain. Private Sector
Percentage

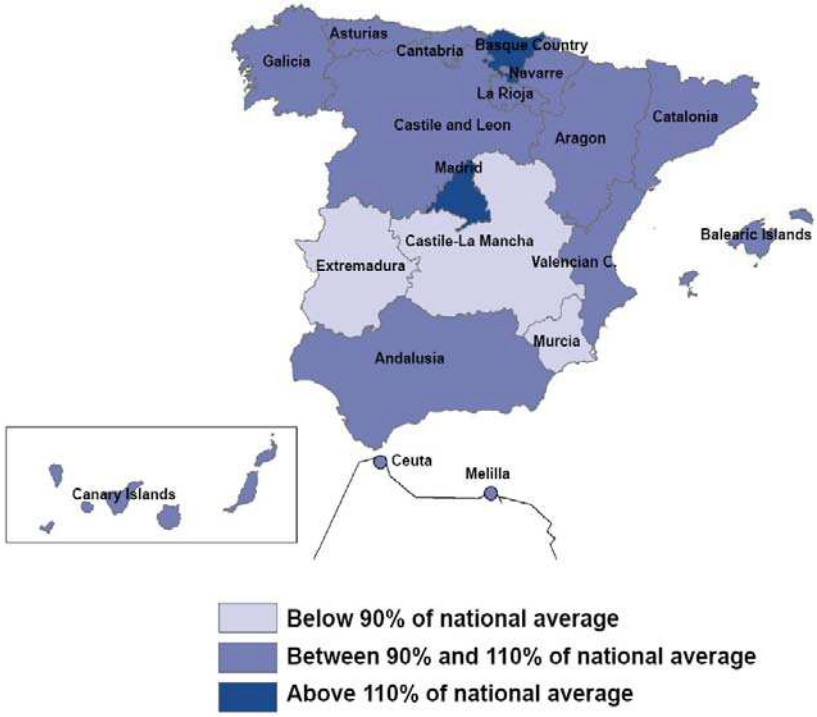
	1985-2006	1985-1995	1995-2000	2000-2006
Labour productivity growth	0.81	1.87	-0.51	0.14
Contribution of:				
Infrastructures	0.07	0.15	-0.02	0.05
ICT capital	0.36	0.38	0.40	0.35
Non-Infrastructures, Non-ICT capital	0.48	0.70	0.05	0.39
Labour force qualification	0.51	0.71	0.34	0.82
Total Factor Productivity (TFP)	-0.61	-0.06	-1.28	-1.47

Source: Own elaboration.

Map 1. Labour productivity. 2007.

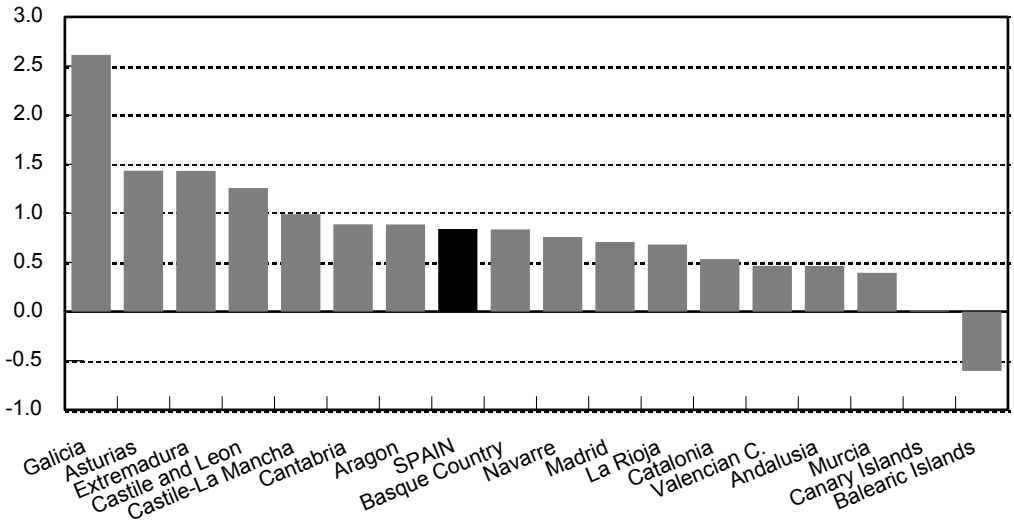
Euros per hour worked

National average = 20,37



Source: INE and own elaboration.

Figure 3. Labour productivity. Rates of variation. 1985-2007
(Percentages)



Source: INE and own elaboration

Table 4. Industries contribution to labour productivity growth. 2000-2005

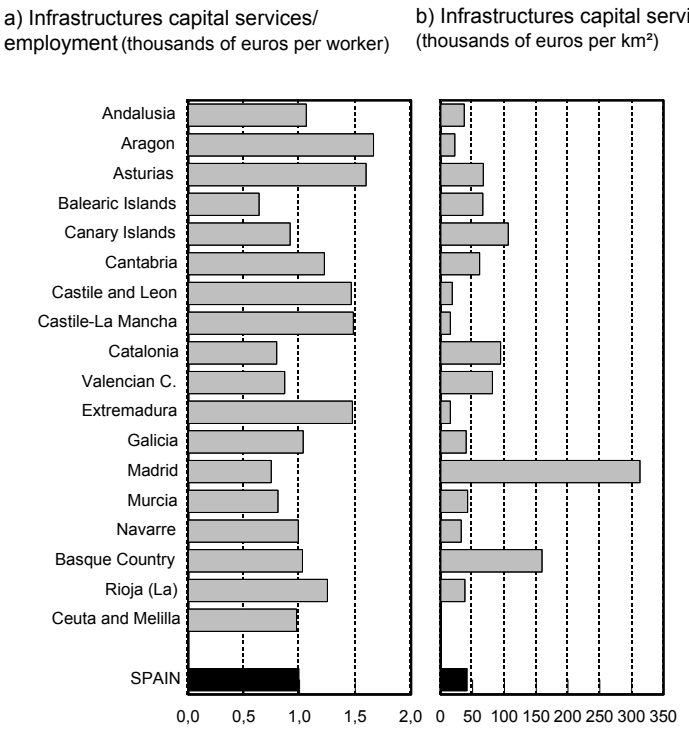
Percentage

	Labour productivity	Industries contribution							
		ICT producing industries[1]	Manufacturing, excluding electrical	Construction	Other production	Distribution	Finance and Business Services	Personal services	Reallocation of labour effect
Aragon	1.33	0.17	0.46	0.30	-0.06	0.27	0.26	-0.14	0.07
Castile and Leon	1.23	0.10	0.24	0.19	0.12	0.20	0.23	-0.04	0.19
Basque Country	1.22	0.13	0.50	-0.09	0.15	0.19	0.34	-0.07	0.07
Extremadura	1.05	0.07	0.11	0.07	-0.09	0.32	0.19	0.10	0.28
Catalonia	1.01	0.12	0.48	0.21	0.05	0.03	0.45	-0.29	-0.04
Asturias	0.96	0.03	0.10	0.12	0.48	0.23	0.16	-0.21	0.04
Navarre	0.73	-0.01	0.54	-0.05	0.20	-0.14	0.37	-0.18	0.00
Madrid	0.73	0.28	0.39	-0.15	0.05	0.00	0.50	-0.26	-0.08
Galicia	0.66	0.03	0.21	0.05	0.21	-0.08	0.18	-0.10	0.16
Castile-La Mancha	0.66	0.03	0.14	0.05	0.25	-0.15	0.19	-0.10	0.25
SPAIN	**0.61**	**0.07**	**0.27**	**-0.03**	**0.12**	**0.10**	**0.27**	**-0.18**	**-0.01**
Andalusia	0.39	0.07	0.14	-0.20	0.08	0.11	0.24	-0.22	0.18
Valencian C.	0.27	0.05	0.32	-0.17	0.09	-0.07	0.17	-0.23	0.10
La Rioja	0.24	0.02	0.37	-0.08	-0.17	-0.03	0.21	-0.19	0.11
Cantabria	0.07	-0.01	0.22	-0.07	-0.08	-0.18	0.17	-0.02	0.05
Canary Islands	-0.10	-0.01	0.06	-0.14	0.14	-0.10	0.13	-0.18	0.00
Murcia	-0.62	0.01	0.23	-0.62	-0.07	-0.17	0.17	-0.21	0.04
Balearic Islands	-0.92	-0.04	0.15	-0.41	0.09	-0.11	0.17	-0.82	0.05
EU-15	**1.36**	**0.25**	**0.45**	**0.04**	**0.24**	**0.34**	**0.09**	**-0.10**	**0.05**
United States	**3.18**	**0.53**	**0.75**	**-0.08**	**0.00**	**1.16**	**0.60**	**0.33**	**-0.11**

[1] Electrical machinery, post and communication services

Source: EU KLEMS Database, March 2008, http://www.euklems.net, INE and own elaboration.

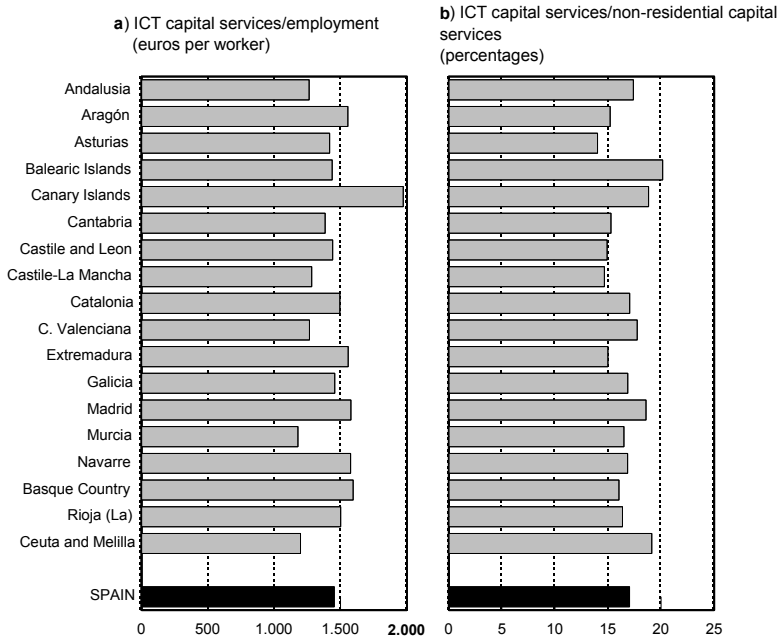
Figure 4. Infrastructure capital services in the Spanish regions. 2006



[1] Ceuta and Melilla have not been included in the figure, with a value of 2 million euros per km²

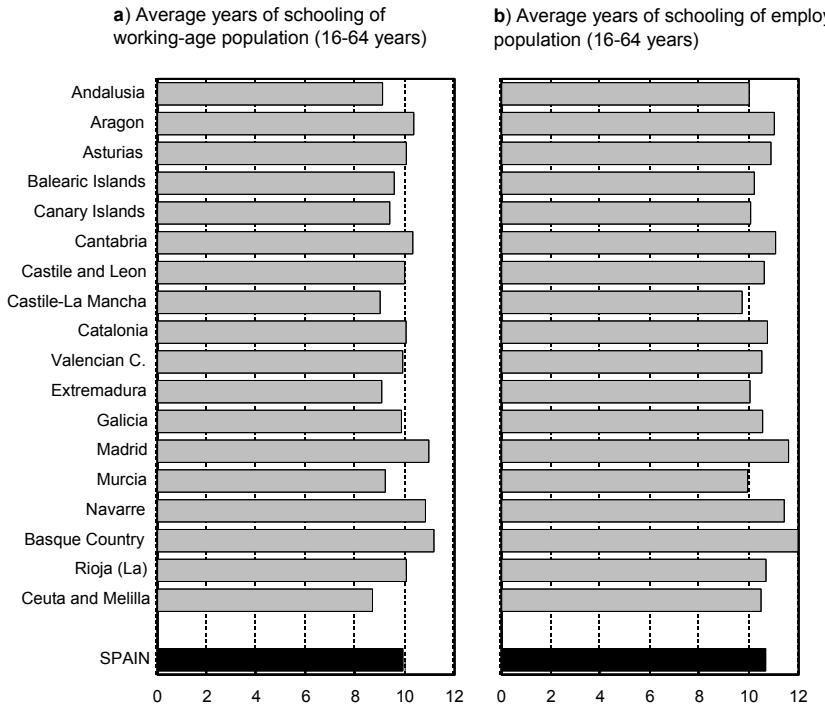
Source: Foundation BBVA-Ivie, INE and own elaboration.

Figure 5. ICT capital services in the Spanish regions. 2006



Source: Foundation BBVA-Ivie, INE and own elaboration.

Figure 6. Human capital in spanish regions. 2006



Source: INE and own elaboration.

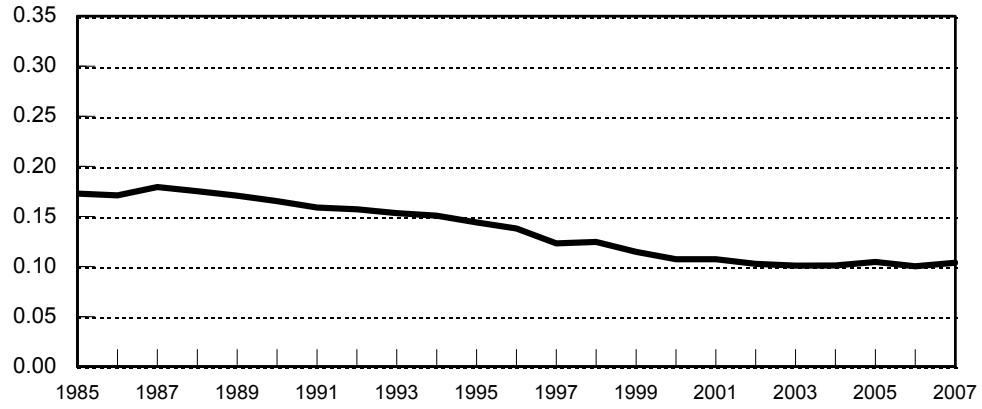
Table 5. Growth accounting. Labour productivity. Private Sector (1995-2006)

	Labour productivity	Capital per hour worked			Labour force qualification	TFP
		ICT	Infrastructures	Non-infrastructures, Non-ICT		
Andalusia	-0.37	0.43	-0.04	0.31	0.75	-1.83
Aragon	0.06	0.41	0.07	0.45	0.17	-1.04
Asturias	0.78	0.36	0.14	0.21	0.45	-0.38
Balearic Islands	-2.86	0.45	-0.03	0.19	0.17	-3.64
Canary Islands	-0.95	0.41	-0.01	0.10	0.77	-2.22
Cantabria	-0.70	0.34	0.03	-0.13	0.11	-1.05
Castile and Leon	0.60	0.41	0.09	0.39	0.55	-0.85
Castile-La Mancha	-0.40	0.40	0.02	0.23	1.01	-2.05
Catalonia	-0.56	0.31	0.01	0.11	0.14	-1.12
Valencian C.	0.16	0.43	0.02	0.49	1.01	-1.78
Extremadura	0.72	0.38	0.01	-0.18	0.89	-0.38
Galicia	1.95	0.50	0.14	0.68	1.23	-0.59
Madrid	-0.57	0.29	0.04	0.22	0.50	-1.63
Murcia	-0.35	0.41	-0.02	0.58	0.84	-2.16
Navarre	-0.42	0.41	-0.05	0.42	-0.01	-1.18
Basque Country	-0.02	0.36	-0.02	0.05	-0.23	-0.17
La Rioja	-0.16	0.45	-0.08	0.46	1.21	-2.20
SPAIN	**-0.16**	**0.37**	**0.02**	**0.26**	**0.52**	**-1.33**

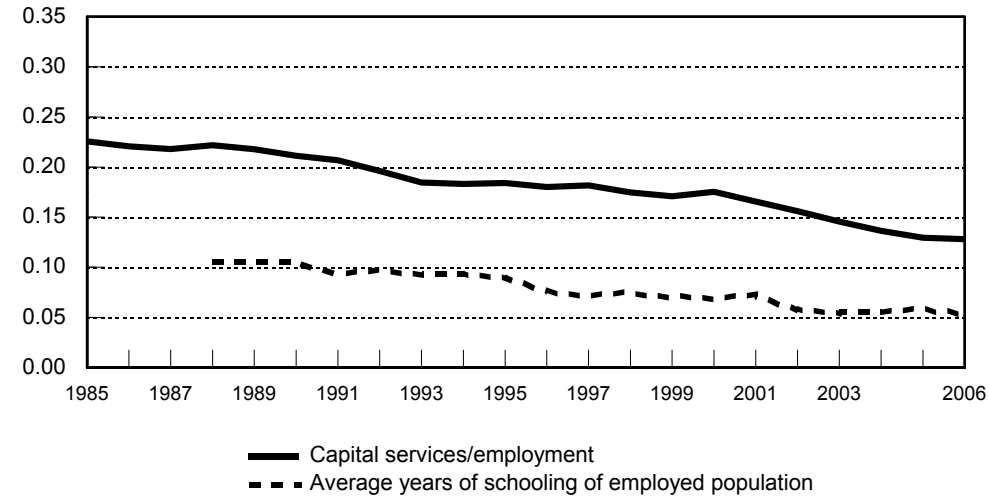
Source: Own elaboration.

Figure 7. σ-convergence
(Coefficient of variation)

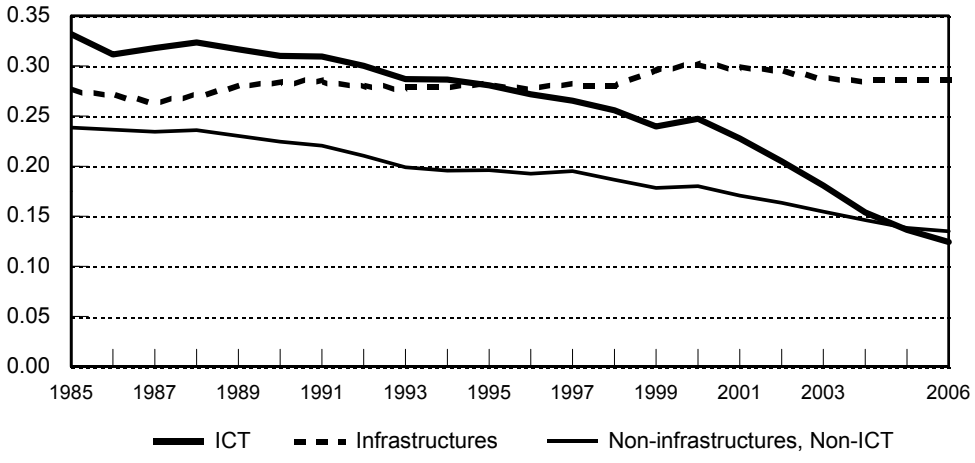
a) Labour productivity



b) Capital services and average years of schooling



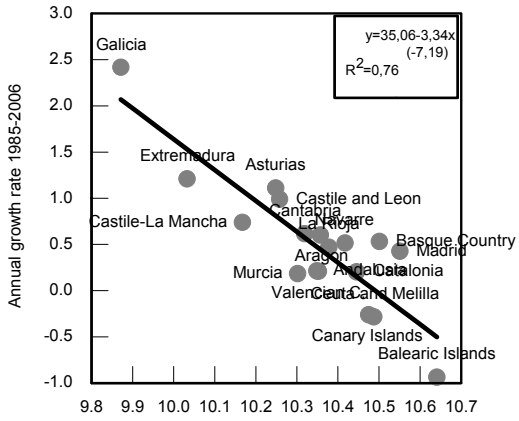
c) Capital services/employment



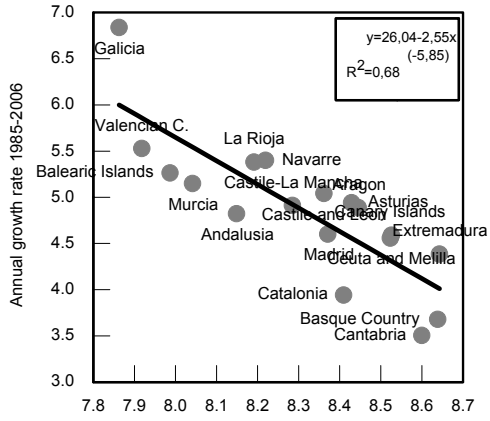
Source: Foundation BBVA-Ivie, INE and own elaboration

Figure 8. β-convergence

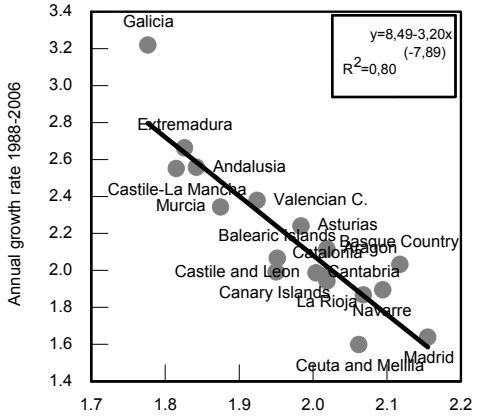
a) Labour productivity. Private Sector



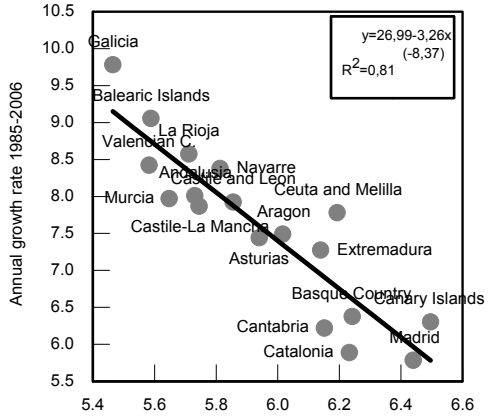
b) Capital services/private employment



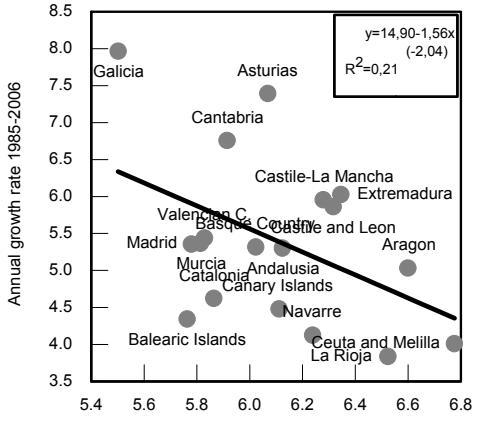
c) Average years of schooling of employed population (16-64 years)



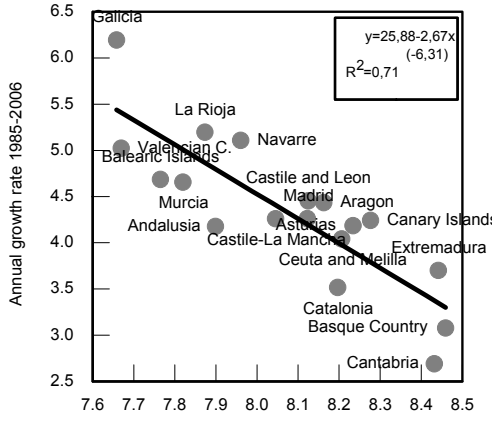
d) ICT capital services/private employment



e) Infrastructures capital services/private employment



f) Non-Infrastructures, non-ICT capital services/private employment



t-stadistic in brackets.
Source: Foundation BBVA-Ivie, INE and own elaboration.