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The Contribution of Technological Inputs and Spillovers to Competitiveness and Economic Growth: The Case of the Spanish Regions

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Abstract: The aim of this study is to analyze the importance of various technological inputs in explaining the differences in competitiveness among Spanish regions. It quantifies the effect of R&D capital and ICT capital on economic activity, in addition to the externalities associated with R&D and ICTs. According to the results, R&D capital and ICT capital have a positive effect on production, with the latter having a bigger significant impact. Results also show the importance of spillover effects associated with both technological inputs.

Keywords: R&D, ICT, Spillovers, Growth

Introduction

THE IMPORTANCE OF analyzing the effect of technological activities on the competitiveness, social and economic progress of an advanced country is evident. Productivity growth is the basis of income growth and those countries or regions that are better equipped to grow are those that most easily incorporate R&D capital. Given that current economic scenarios are also affected by the intensification of the globalization phenomenon and the multiplication of new technologies, particularly of ICTs, our paper focuses on examining the role played by these two aspects of technology (ICT capital and R&D capital) in the competitiveness of the Spanish regions.

Competitive advantage resides in the capacity to innovate and to possess know-how, that is, being able to add exclusive specific knowledge from one's own productive experience to codified knowledge. The advantages of using superior technologies and know-how are evident: competing using the differentiation and qualification of the products and the utilization of all kinds of organizational innovations capable of coping with the globalization phenomenon and the increasing integration of markets. The newest theories of international trade are clear about this: the qualitative differentiation of products gives firms a certain market power, and consequently, they enhance their activity to develop more active strategies of competition in international markets. This paper uses R&D capital stock as a proxy for innovation and know-how. The reason is that when companies develop new production processes or invent new products the relevant input in a production function is the accumulated technological capital stock, that is, they use the R & D expenditure in the current year but also their technical knowledge and experience accumulated over the years.

But this is not the only channel of technological diffusion. The soft parts of technology, based on the intensive use of ICTs, are crucial in the production, administration, logistics

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and distribution of firms. For this reason, it is also essential to analyze the effect that the diffusion of technology from ICTs has on economic growth and competitiveness. Although in countries like the United States a positive relationship has been observed between ICT-based economic sectors and increased productivity, this relationship still has to be demonstrated in the case of the Spanish regions.

Although many papers have studied separately the effects of R&D and ICT on productivity, both factors are related and sometimes complementary: that is, both enable knowledge dissemination. In the case of ICT, in addition to generating network externalities, ICT producing sectors generate a large proportion of R&D and patenting activities, using digital technology in new research projects and scientific experiments. Furthermore, ICT is important because it facilitates the adoption of innovations and organizational changes in many firms, creating new ways to produce at less cost. Thus, both types of technology are expected to reinforce each other by increasing the growth impact of the other. For this reason, our paper analyzes the importance of ICT capital and R&D capital in explaining the differences in the growth in production in the specific case of the Spanish regions, additionally including the externalities of both types of capital.

The main contributions of this paper to the literature are: first to examine these two channels of knowledge transmission simultaneously, thus, the empirical results obtained are less likely to suffer omitted variable biases, which might be present in other previous work in the literature. Second, the inclusion of different types of spillovers and third, in the case of ICT capital, we use new data on investment and capital services from the EU Klems project: *EU Klems Growth and Productivity Accounts*.

The structure of the paper is as follows. In section 2 we provide an overview of the studies describing the connections between productivity and R&D capital and its spillovers and the connections between productivity and ICT capital and its spillovers. Section 3 presents the theoretical model on the basis of which we analyze the effect of R&D and ICT capital endowments on production. Section 4 examines the data and the main results, and section 5 offers the conclusions and recommendations for economic policy, with the aim of reinforcing the connections existing between economic growth and R&D capital and ICT capital endowments.

Related Literature

It has been argued that countries or regions can obtain dynamic gains from the technological knowledge developed inside or outside the region and that this can result in increased productivity growth. To support this argument, pioneer studies, like Romer (1990) stated that although internal R&D and Human capital determine a country growth rate, open economies obtain greater growth rates while Grossman and Helpman (1991) considered commercially oriented innovation efforts as the engine of technological progress and productivity growth. Eaton and Kortum (1999) explained the invention of new technologies and their diffusion across countries by the resources invested at home and abroad and applied the model to data from the five leading research economies, finding that research performed abroad is about two-thirds as potent as domestic research. Thus, together the United States and Japan drive at least two-thirds of the growth in each of the other countries in the sample. Also empirically, Keller (2002) analyzed the effects of R&D on the productivity of different industries concluding that technology is transmitted to other national or international industries through trade in differentiated intermediate goods.

According to this literature, the more backward countries could grow more quickly if they develop their capacity for imitation or absorption of other countries' technological capital. In this study we will try to verify whether regions are more productive as a result of capturing spillovers from outside the region and will define different measures of spillovers.

Several authors consider that distance among regions is important to measure the relevance of spillovers. Krugman (1991a and b) and Glaeser et al. (1992) affirm that transmission of technological knowledge occurs within a limited geographical unit and Bottazzi and Peri (2003) find that spillovers are very localized and exist only within a distance of 300 kilometers even when simultaneity problems, omitted variable bias, different specifications of distance functions and country and border effects are considered. That is to say, location and the closeness of the productive agents matter given that the cost of transmitting information might be invariable with distance, while the cost of transmitting new technological knowledge, which is not generally done explicitly, does vary with distance.

However, according to Grossman and Helpman (1994) and Coe and Helpman (1995), trade is the transmission mechanism that links a country's productivity gain with the economic development of its trade partner. More precisely, a region's productivity depends not only on its own technological research, but also on the technology of its trade partners, i.e. foreign R&D may have a stronger effect on domestic productivity the more open an economy is to trade.

This paper adds to the above literature by also examining technology diffusion through ICT. Since the late nineties, authors such as Bailey (2003), Colechia and Schreyer (2001), Jorgenson and Stiroh (2000), O'Mahony and Van Ark (2003), Pilat (2003), Stiroh (2002) and Van Ark and Timmer (2004) have studied the role played by ICT in the reversal of the TFP slow down. Thus, in the United States there exists a broad consensus that the expansion of ICT products has clearly driven the productivity growth of recent years, when most of the economic growth was attributable to high technology sectors. However, although investments in ICT have also accelerated the growth of production in Europe, they have not reinforced productivity with the same intensity as in the United States. For these ICT investments to be effective beyond the impact generated in their own production activities, it is necessary to generate a sufficiently broad process of dissemination of such technologies among the different economic agents.

In the case of Spain there are also authors who have analyzed the relationship between productivity and ICT. Hernando and Núñez (2004) examine the role played by ICT capital as an input factor and show how this input clearly affects the output and productivity growth of a sample of Spanish firms. Although they find that ICT capital growth rates have been notable, they are still well below those observed in the US economy and thus are not sufficiently high to narrow the gap in new technology capital observed between the Spanish and the US economies. However, they do not draw conclusions regarding the link between ICT growth and TFP growth rates.

Mas and Quesada (2005) compute the contribution to output and labor productivity growth of employment, non-ICT and ICT capital, labor qualification and TFP. The main conclusion they reach is that the presumably beneficial effects of ICT capital on TFP growth in Spain are not observed in the period 1985-2002 but there is evidence of a more positive influence in increasing output and labor productivity.

More recently, Badescu and Garcés (2009) focus on the relationship between ICT and labor productivity using a sample of medium and large firms for Spain and conclude that, after controlling for firm and time specific effects, there is a moderate output elasticity value relative to the ICT capital input. The results obtained by these authors show that "although the firms in the sample saw an improvement in labor productivity in the period considered, this improvement was not significantly generated by IT investment".

The Model

The economic growth of countries or regions differs according to their different growth rates in terms of factors of production and technological innovation. And the most important way for countries or regions to access technology is through their own R&D capital. However, scientific and technical advances cannot always be used by the entity that makes the expenditure, and therefore generates externalities (spillovers). In this sense, the R&D activities generated by other nearby agents and the imports of foreign innovations through trade in goods and services are also a way of accessing technology, and consequently favor economic growth.

Simultaneously, we examine if apart from these channels of knowledge transmission, the substantial ICT capital invested in the Spanish economy during the last few years has been another way of accessing technology. ICTs can influence economic growth through different paths or mechanisms of transmission, the first of which is the production of the ICT sector itself. The effect of technological progress on the ICT sector with its consequent reduction of prices and increase in the productivity of the products of the sector brings, in turn, an increase in the TFP of the country or region where the sector is located, in proportion to the importance of that sector. The second path is the use of ICTs or accumulation of ICT capital as a contribution to the process of production, independently of whether or not the equipment and software are produced in that country or region. Thus, a bigger and better investment in ICT will improve the productivity of the country or region. And the third path is that of the externalities or spillovers derived from the use of ICT. Thus, those sectors that most use ICT capital will also be the ones that incorporate more technological progress, and go on to obtain greater productivity gains, primarily in the form of savings in search and transport costs. Because data on the ICT-producing sector is not available, the analysis in this paper is limited to the impact of the new technologies on the ICT-using sector. However, as pointed out by Mas and Quesada (2005), the fact that Spain in not an important ICT producing country could mean that the significant impact on productivity may arise from its use in other branches of the economy.

To make our estimations, we consider R&D capital and ICT capital as ordinary inputs in the production function. If we assume that the technology underlying the production function is of the Cobb-Douglas type, the production function for the Spanish regions is:

$$Y_{it} = A_{it} L_{it}^{\alpha} K_{it}^{\beta} T_{it}^{\varepsilon} R_{it}^{\gamma} \quad (1)$$

where:

Y_{it} = private production of region i in year t.

$A_{it} = A_{i0}e^{\mu t}$

A_{i0} = initial level of efficiency or productivity for each region i in year 0

μ= rate of disembodied technical progress

L_{it} = employment in region i in year t

K_{it} = physical capital of region i in year t.

T_{it} = Information and Communications Technology capital of region i in year t.

R_{it} = R&D capital of region i in year t.

The innovative capacity of each region is formed by the R&D capital generated in that region, but we also will include the spillovers associated with R&D capital produced outside the region but absorbed by each region. Also, ICT capital can generate growth of production due to its contribution to the growth of production as one more input of the production function and to the externalities that the ICT capital of other regions may generate towards the region being studied through their spillover effects. We therefore aim to estimate an expanded production function including both spillover effects. Taking logarithms and including the different types of capital we can estimate the following equation:

$$LnY_{it} = LnA_{i0} + \mu t + \alpha LnL_{it} + \beta LnK_{it} + \varepsilon LnT_{it} + \delta LnS_T + \gamma LnR_{it} + \lambda LnS_R + u_{it} \qquad (2)$$

where S_T and S_R are, respectively, the spillovers of ICT capital and R&D capital.

Data and Variables Used

This section presents the variables used in the empirical analysis corresponding to the seventeen regions of Spain (Comunidades Autónomas) in the period 1987-2004 and are expressed in euros of 1990. The variable Production has been deflated using the deflator of national production, since a deflator at regional level is not available. The R&D capital series have been deflated by the deflator of the Gross Formation of Fixed Capital provided by the *Instituto Nacional de Estadística* (INE). The variables and statistical sources used are the following:

i) Production of each region (Y): measured by private Gross Value Added (at factor cost) and obtained from the INE Regional Accounts of Spain (1986 database). Since the INE only offers regional information on GVA until 1996, the values of total GVA until 2004 have been estimated using the growth rates of FUNCAS.

ii) Employment (L): obtained, as above, from the INE Regional Accounts of Spain (1986 database).

iii) Private capital (K): obtained from the estimations made by the IVIE for the FBBVA Foundation. As usual, residential capital is not considered. The latest information currently available at regional level is for 2004.

iv) R&D capital (R): we consider that this input is accumulated, according to the perpetual inventory method, as follows:

$$R_{i,t} = (1-\delta)R_{i,t-1} + I_{i,t-\theta} \qquad (3)$$

where R_t is the capital stock of period t, δ is the depreciation rate of technological capital and I_t the annual investment in R&D. Annual investment in R&D comes from the INE's publication "Statistics on Activities in Scientific Research and Technological Development". Details about the generation of the series can be found in Gumbau and Maudos (2006).

v) ICT capital (T): we use new data on investment and capital services from the EU Klems project: *EU Klems Growth and Productivity Accounts*.

vi) Spillovers associated with R&D and ICT capital: For each region, the spillover effects are constructed as a weighted sum of the technological inputs (R&D capital or ICT capital) of the rest of the regions. We use two alternative matrices of weightings and each term of the matrix is constructed as follows:

$$f_{ij}^{1} = \frac{F_{ij}}{\sum_{j=1}^{N} F_{ij}} \qquad (4)$$

$$f_{ij}^{2} = \frac{KM_{ij}}{\sum_{j=1}^{N} KM_{ij}} \qquad (5)$$

where F_{ij} measures the flow of trade between regions i and j, and KM is the distance in kilometers between regions i and j. Then, we obtain four different types of spillovers: (*R&D-KM*) and (*ICT-KM*), that measure spillovers taking into account the geographical proximity between regions, so that the nearer the other region, the greater the weighting given to its R&D or ICT capital, respectively. And (*R&D-TF*) and (ICT-*TF*), that measure spillovers taking into account the intensity of the trade flows between regions, so that the greater the value of the trade flows with another region, the greater the weighting given to its R&D capital and ICT capital, respectively. This specification implies that the more a region trades from a foreign region, the more R&D spillover benefits are received by the importing region. The same analysis is applied to ICT capital.

Results

R&D Capital and ICT Capital

In this section, we start by presenting the main indicators of technological activities. Figure 1 illustrates the evolution of the different types of capital considered (private capital, ICT capital and technological capital), each variable taking the value of 100 in the starting year (1987). The table shows that in the 17 years considered all the variables grew at a considerable rate. While technological capital multiplied (in real terms) by more than 3.5, ICT capital multiplied by 4.20. The investment effort in both types of capital was therefore considerable, despite the starting levels being very low. The private capital in the economy experienced lesser growth, multiplying by only 2.2 between 1987 and 2004.

Figure 2 shows us the average annual growth rates of ICT capital and R&D capital. We can appreciate that the average annual growth rate of ICT capital for the whole country is

8.93%, slightly higher than the average annual growth rate of R&D capital (8.93%). In both cases, we can see the intensive investment made by all the regions during the period considered. The ranking shows significant differences among regions, which are more pronounced in the case of R&D capital.

Table 1 contains the regional distribution of R&D capital, with three regions (Madrid, Catalonia and the Basque Country) concentrating more than 75% of total R&D capital in 1987, while some regions did not even reach 1% of the total (the case of the Balearics, the Canaries, Cantabria, Castilla-La Mancha, Extremadura, Murcia, Navarra and La Rioja). However, in 2004 Madrid, Catalonia and the Basque Country concentrated a lower percentage of R&D capital (around 63,5%), while the regions that started from less favorable positions have improved.

In table 1 we can also observe the regional distribution of ICT capital. Various points stand out, the first being that although there is a substantial concentration of ICT capital in certain regions, this concentration is not as marked as in the case of R&D capital. Secondly, four regions (Andalusia, Catalonia, C.Valenciana and Madrid) each possessed more than 10% of the ICT capital in 1987, the most outstanding among them being Catalonia which came close to 20% of the whole of Spain's ICT capital. Finally, La Rioja was the only region which had a percentage of ICT capital of less than 1%. When the variable is analyzed across time we observe that in most regions the percentage represented by ICT capital in the total for Spain remains stable.

The evolution of ICT capital and R&D capital stock per worker is presented in Table 2. We can observe that ICT capital increased considerably per worker in all regions between 1987 and 2004 and the regional differences regarding R&D capital per worker were much greater than in the above case. For example, in 2004, the difference between the maximum and minimum value of capital stock per worker was 1,187 euros for ITC capital and 4,237 for R&D capital.

The Effect of ICT Capital and R&D Capital on Regional Production

In this section we present the results corresponding to the effect of technological assets (R&D capital and ICT capital) on the production of Spain's regions. We therefore estimate a production function incorporating ICT capital, R&D capital and their spillovers. Given the data panel structure of the sample used, we introduce fixed and time effects into the estimation.

Table 3 presents the effects of each of the potential channels of technology diffusion on regional production. Firstly, all columns suggest a positive elasticity of production with respect to either R&D capital and ICT capital, the latter having a more significant effect on production. Concretely, the elasticities of production in the case of ICT capital vary between 0.05 and 0.1, while the elasticities of production in the case of R&D capital vary between 0.01 and 0.02.

It is clear that the elasticities obtained are strikingly low. However, there may be many reasons for this. First, investment in R&D and ICTs is still on a small scale in many of the Spanish regions even though, in recent years, there has been considerable investment in ICT in many of these regions. Second, there possibly still exists a lack of connection between the ICT sector and the rest of the economy, i.e. there may be greater availability of mobile phones or assets such as Internet, but the penetration of these technologies has not yet propitiated major organizational changes in numerous firms, particularly small ones. The fact is that firms and their managers have not always exploited the enormous possibilities offered by ICT to improve the management and control of businesses, and hence to increase production. Thirdly, the low R&D may have made it difficult for regions to absorb productively the technology incorporated, even when the investments in physical capital have been considerable thanks to both national and international investment. Finally, low elasticities usually occur when the territorial areas are of small size, as in the case of the Spanish regions, given the high degree of spillover effects between geographically close areas. Therefore, we will focus on such spillover effects[1].

These results are comparable to other previous and recent papers in the literature that use Spanish data, although all of them use a sample of firms. Regarding R&D capital, Dorazelski and Jaumandreu (2008) find that the link between R&D and productivity is subject to a high degree of uncertainty, non linearity and heterogeneity and obtain an R&D elasticity that varies between 0.017 and 0.075. In the case of ICT capital, Lopez Sanchez et al. (2006) estimate a Cobb-Douglas production function using ICT as an input and obtain an elasticity of labor productivity relative to the input of 7.36% in a cross-section for analysis. Badescu and Garcés (2009) estimate the impact of ICT on productivity and the estimated coefficient of ICT capital shows an elasticity of 0.9% using a panel data, although the significance of this variable disappears when both fixed effects and intra-period effects are considered.

Results of columns 2 and 3 show that R&D capital spillovers and ICT capital spillovers are positive across all specifications. This indicates that the more significant other regions' investment in R&D capital and ICT capital, the faster production grows, although the last one is not always statistically significant. The moderate effect that the region's own two channels of diffusion of technology, in isolation, have on production is therefore notable, whereas the spillover effects on production are wide-ranging and significant.

When we compare the different types of spillover effects, results vary. In the case of R&D spillover effects, we find that these are significant when weighted by the distance in kilometers, and that spillovers tend to be limited in clusters or areas in the close vicinity of the source. We could say that part of the knowledge that generates externalities relies on formal contacts and remains more localized (Audrestch and Feldman 2004, Sonn and Storper 2008, Charlot and Duranton 2006, Ianmarino and McCann 2006). We also find trade-related interregional R&D spillovers, confirming that the more commercial regions improve their production compared to those that have few trading relationships. It is therefore confirmed that trade partners are an important means of spreading knowledge among regions.

In the case of ICT capital spillover effects, we observe that they are not significant when weighted by trade flows. The diffusion of ICT technologies may have been relevant in some segments (increased penetration of Internet, spread of mobile phones, etc) but the low level of such investment compared to the size of trade flows and the paucity of telematics work in many Spanish regions implies that a higher proportion of trade between regions does not translate into a greater effect of ICT capital on production. It could be affirmed that the capacity of the environment to take advantage of the new technologies has failed, i.e. there is a lack of connection between investment in ICT and utilization of such technologies for trade. On the other hand, the ICT capital of the neighboring regions does generate a positive effect on the region. In this case, the same reasoning can be applied as in the case of R&D

[1] Nevertheless, authors like Eaton and Kortum (1999) also find that when the five leading world economies are analyzed, knowledge spillovers are almost as important as domestic knowledge.

spillovers. It can be said that having ICT capital is not automatically equivalent to economically useful knowledge diffusion. Codified information can be transmitted over increasingly large distances, but tacit knowledge tends to be geographically bounded and a key factor behind the concentration of new communication infrastructures.

Conclusions

In this paper we present the results corresponding to the effect of technology based assets (R&D capital, ICT capital and their spillovers) on regional production. We estimate a production function by using the regional information provided by the INE and Ivie-FBBVA from 1987 to 2004 as well as new data on investment and capital services from the EU-Klems project. Although as a whole their contribution to production growth is moderate, the results show that R&D capital and ICT capital have a positive effect on production, with the latter having a more significant impact.

We also find evidence of a greater effect of the spillovers of R&D capital and ICT capital on regional production. Spillovers are always significant when they come from nearby regions thus confirming, as do other authors in the literature, the existence of clusters or technological districts. When spillovers are weighted by the importance of trade between regions, these are found to affect production positively in the case of R&D capital; however, we do not find evidence of significant effects of inter-regional trade in the case of ICT capital.

Therefore, the greater availability of telecommunications infrastructures has not propitiated organizational changes at a general level, with firms not always exploiting the enormous possibilities offered by ICT to improve their management and control, and, consequently, to increase production.

In terms of economic policy, given the existence of wide spillover effects, we defend a common, not only regional, policy of innovation to take advantage of the interconnections among regions. In addition, measures must be taken to create an environment that can exploit the new technologies, especially in improving education and training with the aim of absorbing the rapid diffusion of these new technologies.

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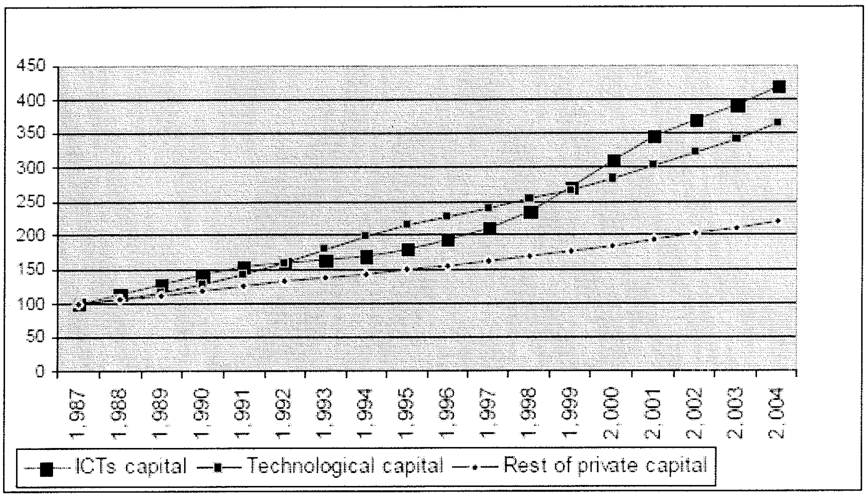
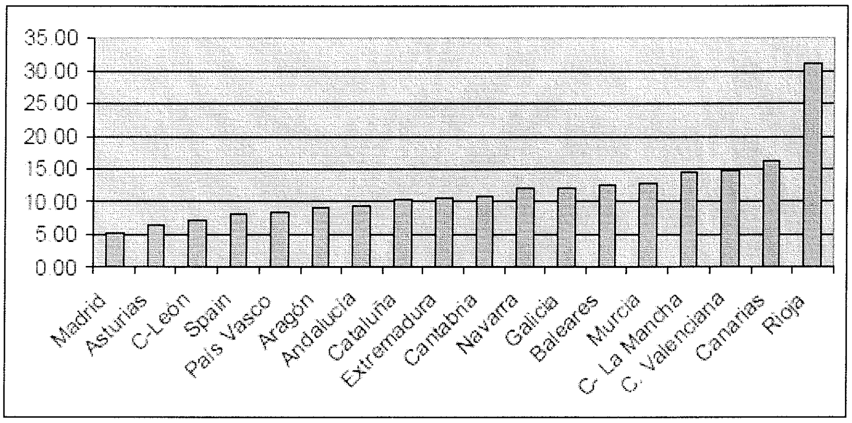
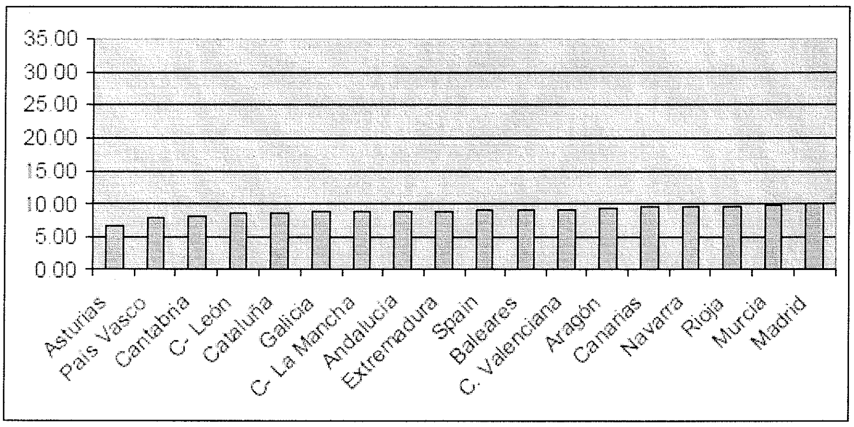


Figure 1: Evolution of Capital Stocks in Spain. 1987=100,
Source: INE, Ivie-FBBVA, Euklemss and Own Elaboration



a) R&D Capital



b) ITC Capital

Figure 2: Annual Growth Rates of Capital Stocks in the Spanish Regions: 1987-2004, *Source: INE, Euklems and own elaboration*

Table 1: Regional Distribution of ICT Capital and R&D Capital (Percentages)

	ICT Capital			R&D capital		
	1,987	1,995	2,004	1,987	1,995	2,004
Andalucía	13.3	13.3	13.1	7.1	8.0	8.9
Aragón	3.2	3.3	3.4	2.0	2.4	2.3
Asturias	3.3	2.5	2.2	2.0	1.7	1.6
Baleares	2.7	3.0	2.7	0.3	0.3	0.6
Canarias	4.3	4.8	4.7	0.6	1.4	2.1
Cantabria	1.5	1.3	1.3	0.5	0.7	0.8
C - La Mancha	3.9	3.8	3.8	0.5	0.7	1.5
C- León	6.2	5.8	5.7	4.8	4.2	4.2
Cataluña	19.4	19.1	18.5	15.2	18.9	21.6
C. Valenciana	10.0	9.9	10.3	2.3	4.7	6.7
Extremadura	2.0	2.0	1.9	0.6	0.7	0.9
Galicia	5.6	5.5	5.4	1.8	2.4	3.5
Madrid	13.1	15.3	16.0	52.5	42.6	33.4
Murcia	2.2	2.1	2.5	0.7	1.3	1.5
Navarra	1.6	1.8	1.8	0.9	1.5	1.7
País Vasco	7.2	6.0	6.0	8.2	8.4	8.5
Rioja	0.7	0.7	0.7	0.0	0.2	0.4
Spain	100.0	100.0	100.0	100.0	100.0	100.0

Source: INE, Euklems and own elaboration

Table 2: Capital Stock per Worker (euros)

	ICT Capital			R&D capital		
	1,987	1,995	2,004	1,987	1,995	2,004
Andalucía	1,874	3,115	4,856	470	1,067	1,353
Aragón	1,740	3,132	5,572	507	1,281	1,575
Asturias	1,999	3,059	5,599	583	1,186	1,621
Baleares	2,629	4,401	5,645	131	247	487
Canarias	2,323	4,010	5,983	149	682	1,101
Cantabria	2,109	3,217	5,382	326	971	1,294
C - La Mancha	1,758	3,125	5,005	111	328	792
C- León	1,601	2,903	5,371	579	1,178	1,608
Cataluña	2,079	3,206	4,983	763	1,798	2,379
C. Valenciana	1,762	2,875	4,972	188	769	1,328
Extremadura	1,530	3,043	5,416	215	556	1,001
Galicia	1,158	2,285	5,003	177	574	1,314
Madrid	1,957	3,634	5,520	3,665	5,747	4,724
Murcia	1,691	2,630	4,796	257	900	1,164
Navarra	1,878	3,405	5,500	493	1,621	2,127
País Vasco	2,385	3,370	5,593	1,266	2,661	3,256
Rioja	1,461	2,759	4,911	9	340	976
Spain	1,867	3,168	5,212	871	1,787	2,126

Source: INE, Euklems and own elaboration

Table 3: The Effect of R&D Capital and ICT Capital on Regional Production

	(1)	(2)	(3)
LnL	0.232 (0.023)***	0.215 (0.022)***	0.205 (0.020)***
LnK	0.197 (0.041)***	0.123 (0.043)***	0.057 (0.039)
LnT	0.081 (1.965)	0.055 (0.040)	0.115 (0.036)***
LnR	0.008 (0.004)**	0.016 (0.004)***	0.025 (0.004)***
LnS_T(ICT-TF)		0.145 (0.109)	
LnS_R(R&D-TF)		0.158 (0.035)***	
LnS_T(ICT-KM)			0.407 (0.150)***
LnS_R(R&D-KM)			0.337 (0.041)***
R2	0.99	0.99	0.99
Hausman test p-value	0.00	0.00	0.00

V. dep: Ln(Y)
Standard errors in parentheses
Estimation with fixed effects and time effects
*, **, *** statistically significant at the 10%, 5% and 1% level.

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