

**ARE KNOWLEDGE INTENSIVE BUSINESS SERVICES
ALWAYS SO EFFICIENT AS THEY ARE SAID TO? AN
EMPIRICAL APPROACH TO THE EFFICIENCY ANALYSIS
OF KIBS IN A PERIPHERAL REGION**

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Abstract

The aim of this paper is to analyse the efficiency in knowledge intensive business services, also known by their acronym KIBS. The firms belonging to this sector are said to have high efficiency degrees due to their specialisation. Nevertheless, some authors claim that high efficiency scores only work for those firms located in central nodes of development. Within this context we analyse KIBS efficiency in a Spanish peripheral region. Results show important differences in efficiency levels between KIBS firms as well as a low average for the whole of these activities. These findings may imply differential externalisation gains for subcontracting firms, reinforcing, at the same time, the idea of the effect of spatial concentration over KIBS efficiency.

JEL Classification: L84, L87, O18, R19.

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1.- Introduction.

The demand for external intermediate services has become an increasingly frequent feature among companies from developed

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economies. Through these outsourcing strategies, firms try to profit from efficient and flexible gains. Such a process has transformed business services activities into a strategic branch. This strategic role of intermediate services is especially evident in those specific activities which are clearly intensive both in labour qualification and in technological recruitments, because they generate knowledge and innovation spill-overs. These kinds of services are usually known as *advanced business services* or *knowledge intensive business services* (KIBS).

One of the most important reasons which explain this behaviour, among others relevant factors such as regulations, searching of innovation ideas, new knowledge or tools for mastering new knowledge, is that the KIBS have greater efficiency degrees. Those companies are supposed to maintain a greater specialisation obtaining higher profits from scale economies or from labour division. However there are not enough studies to be sure about the existence of those greater degrees of efficiency in all cases.

The lack of more empirical analysis is a consequence of the difficulties in measuring the efficiency on a tertiary activity such as KIBS. Nevertheless, several studies (see Goe, 1999; Love and Roper, 2001 or Martínez and Rubiera, 2004 among others) suggest that only certain regions or companies might show this high efficiency levels. In fact this sector has a high spatial concentration (see Coffey, 2000, Illeris, 1996 or Daniels and Moulaert, 1991 as a representation of wide literature about this field), which could affect the efficiency of those KIBS firms located outside higher development nodes of central-Europe or USA, among others. Moreover, there might be strong intra-sectorial differences between companies, that is, firms with high degrees of efficiency coexisting with others with very low degrees of efficiency.

The aim of this paper is to analyse the efficiency of KIBS firms in a region located far away from the main centres of development of these

activities. However some problems must be faced to reach our goal. The first one is choosing a suitable methodology to measure the efficiency in KIBS. It is necessary to use a flexible formulation because we do not have precise knowledge of the technology used by these firms. So a non-parametric formulation must be used. Between the different non-parametric approaches we have chosen the DEA formulation (Data Envelopment Analysis), using a specification that does not require knowing the type of returns-to-scale of the sector (BCC approach). The second problem is the shortage of databases on this kind of activities. We have avoided this problem thanks to the availability of a database previously built by a team of researches belonging to University of Oviedo. The database provides information of KIBS firms in a region in northern Spain, Asturias, which is a highly industrialized area. This case of analysis reveals itself as very useful as it has several KIBS companies in phase of development, but far away from the main KIBS nodes in Spain (Madrid and Barcelona mainly) as well as in Europe (London, Paris, Bonn or other central cities of the European Union).

The conclusions derived from our analysis are of high interest, even taking into account the specificity of the database. They could help management decisions related with external demand and could also help regional policy designers. On the one hand, if we identify strong differences in efficiency between firms, this would imply that the subcontracting companies would need systems to identify the ideal provider to their needs. To put it in other words, the externalization profits, widely sustained on the literature about the topic, will not always be true, because they should be conditioned by the subcontracting company efficiency.

On the other hand, if we identify lower general levels of efficiency of KIBS in an outlying region, this might mean that efficiency levels are affected by spatial concentration. According to the European Commission (1998), these branches of advanced intermediate tertiary

consumption contribute in at least four basic ways to regional development: via the creation of competitive advantages, the acquisition of knowledge and innovation, the generation of dynamic relations between businesses and their contribution to the creation of employment. A non-efficient KIBS sector will imply that the region can not obtain all the profits derived from these activities.

2.- Delimitation and classification of Knowledge Intensive Business Services (KIBS).

Business service activities may be defined as *real activities (not financial) that influence the competitiveness of companies through their use as intermediary inputs in the value chain, and via quality and innovation gains resulting from the interaction between supplier and client and service* (Rubalcaba, 1999). This definition allows us to clearly delimitate the tertiary activities belonging to this branch. However, the activities selected with this criterion are very heterogeneous. Under this approach we may find activities which have a lower degree of knowledge recruitments, with others that need higher levels of labor qualification. Thus, it is necessary to use a more specific delimitation.

Therefore, if we distinguish those business services which are characterized by important requirements with regards to technology and a need for highly trained workers, we obtain a more specific branch usually referred in the literature as Knowledge Intensive Business Services (KIBS). Thus, activities such as advanced management consultancy, human resources (training and selection), industrial or graphic design, advertising and communications, engineering, technical and environmental consultancy might be considered as KIBS. More specifically, we could use the classification presented on Table 1.

Those activities play an important role in both economic growth and regional development. Within this context, it is necessary to keep in mind

that according to the *Marshallian* idea of territory, this is to be understood as something more than an inert or passive element in which economic activities are located. In fact, the territory is the source of a set of fundamental competitive advantages such as qualified personnel, business culture, industrial fabric and proximity to markets, among others. One of these advantages, that is increasingly more important, is the presence of an extensive network of knowledge intensive business services (see, among others, Illeris, 1996). Besides their direct effects on both the creation of (highly-qualified and well-paid) employment and added value, these activities are of special strategic value due to their contribution to the economic attractiveness of the place where they are located. As Begg (1993) points out, business services, especially knowledge intensive business services, may play an infrastructural role similar to the one that good physical communications links may have.

Table 1: A proposal for the classification of Knowledge Intensive Business Services.

COMPUTING AND ICT	a) Implantation of advanced communications. b) Computer programming. c) Calculations center and databases.
ADVANCED MANAGEMENT CONSULTANCY	a) Business organization. b) Economic-financial consultancy. c) Management control. d) Strategic planning. e) Market surveys. f) Foreign trade consultancy. g) Logistics consultancy. h) Investment and feasibility studies. i) Socio-economic studies. j) Locating plants. k) Urban planning consultancy.
HUMAN RESOURCES	a) Personnel selection. b) Training. c) Safety and occupational health.
ENGINEERING, TECHNICAL AND ENVIRONMENTAL CONSULTANCY	a) Farming engineering. b) Civil engineering. c) Electrical engineering. d) Industrial engineering. e) Quality management. f) R&D consultancy. g) Time and motion. h) Cost-benefit studies. i) Energy saving. j) Waste treatment. k) Environmental impact assessment.

DESIGN, ADVERTISING AND COMMUNICATIONS	a) Industrial design. b) Graphic design. c) Publicity and communications
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Source: Own.

3.- Methodology: the Data Envelopment Analysis (DEA).

When studying efficiency, the first thing we must do is to clarify the meaning of this term. To do so, it is necessary to specify the differences between the concepts *efficacy* and *efficiency*. *Efficacy* consists in the achievement of a proposed goal; what is important is to *do things*, without considering the costs or returns of achieving them or whether alternative ways of doing so exist. *Efficiency*, however, consists of *doing things well*, i.e. of ensuring correct distribution of employed means with respect to achieved goals.

The measurement of efficiency in the business world is based on the comparison of the performance of the firm with respect to an optimum. The ideal situation would be to measure the efficiency of the firm by comparing its performance with what it should do to maximize its returns. This however is not possible, since we do not have perfect knowledge of the world in which each firm operates and we do not have precise knowledge of the technology or some of the restrictions that may affect the attainment of maximum returns (Álvarez, 2001). Thus, the best that can be done is to compare what the firm does with what other similar firms do. Farrell (1957) is the precursor in studies based on this idea. By means of algebraic calculations, this author empirically determines an efficient frontier, defined by the performance of the *best* firms observed.

Having delimited the concept of efficiency, the next step is to distinguish between technical efficiency and allocative efficiency. The former consists in obtaining maximum production given a specific combination of resources or in employing the strictly necessary resources to obtain a particular level of production. The latter measures

the use of resources in the adequate proportion taking into account their prices, and will thus be given by the equality of the ratio of marginal productivities with the ratio of prices. It is difficult to talk of allocative efficiency, since an important factor for producers is their aversion to risk. Thus, although the firm is not situated at the point where the ratio of marginal productivities equals the ratio of prices, it may be situated at an optimum point from the viewpoint of the producer's aversion to risk (Álvarez, 2001). For this reason, the analysis of efficiency we are dealing with will focus on technical efficiency.

Starting out from a set of homogeneous observations to be evaluated, the technical efficiency of each firm will be estimated by its approximation to the efficient production frontier. The empirical calculation of the frontier may be made by means of parametric or non-parametric approximations. The main advantage of the latter is the fact that it is not necessary to assume a concrete functional form of the frontier, giving greater flexibility to the analysis.

Among non-parametric techniques, DEA method may be highlighted for two fundamental reasons: its greater standardization (with respect to other methods) and because it permits multiple inputs and outputs to be considered (the DEA method was originally proposed by Charnes, Cooper and Rhodes in 1978). In DEA, two simultaneous processes are carried out by means of linear programming algorithms: the obtaining of the efficient frontier and the estimation of efficiency. The efficient frontier may be calculated by maximizing the output given a level of inputs (*output orientation*), or by minimizing the input given a level of outputs (*input orientation*). The estimation of efficiency depends on the orientation used and is calculated as the distance to the frontier of each evaluated firm, comparing each firm with another technologically similar firm.

Thus, the efficiency of each Decision Making Unit (DMU_o) is estimated by comparing it with a unit on the frontier that maintains the

same proportions of inputs or outputs, i.e., with a technologically similar unit to the one being evaluated. Hence, the rate of efficiency of the DMU_0 will be calculated as:

$$DMU_0 = \frac{\text{Distance from the origin to the frontier}}{\text{Distance from the origin to the } DMU_0}$$

There exist a variety of models within DEA method for obtaining the set of production possibilities. The basic mathematical programming models of DEA are: the CCR model (Charnes, Cooper and Rhodes, 1978) and the BCC model (Banker, Charnes and Cooper, 1984). These models are based on the postulates of convexity and free availability of inputs and outputs. What distinguishes the CCR model from the BCC model is that the former considers constant returns-to-scale while the latter considers variable returns-to-scale.

In our case of analysis we have opted to use the BCC model output orientation. This model is used given that we do not know the type of returns-to-scale in KIBS. Besides variable returns-to-scale postulated by the BCC model allow to construct a more flexible production frontier than that obtained by means of the CCR model. What is more, the BCC model establishes comparisons between firms by exclusively measuring inefficiencies due to management and establishes comparisons with respect to units that operate on a similar scale, and may be adapted to the individual behavior of each firm. Then, we use an output orientation, i.e., the maximum possible increment is determined for each DMU , given the level of inputs. In mathematical terms:

$$E_o(DMU_0) = \text{Max}\{f / (X_0, fY_0) \in T\},$$

f being the maximum possible increase in the outputs vector maintaining the inputs vector unchanged; X_0 is the inputs vector; Y_0 is the outputs

vector and T represents the empirical set of production possibilities.

Assuming variable returns-to-scale and an output orientation, the following linear program is solved for each of the DMU analyzed (Banker, Charnes and Cooper, 1984):

$$\begin{aligned}
 & \text{Max} \quad f + e(1S_r^+ + 1S_i^-) \\
 & \text{s.t.} \quad X_0 - S_i^- = \sum_{j=1}^n l_j X_j \\
 & \quad \quad fY_0 + S_r^+ = \sum_{j=1}^n l_j Y_j \\
 & \quad \quad \sum_{j=1}^n l_j = 1 \\
 & \quad \quad l_j \geq 0, \quad j = 1, 2, \dots, n,
 \end{aligned} \tag{3}$$

where f is the efficiency coefficient, and $(f-1)*100$ is the percentage in which the outputs may increase given the level of inputs of each evaluated unit. Thus, when $f=1$, the evaluated unit will be situated on the efficient frontier.

In accordance with this approach we specify a model considering one output and four inputs, all referring to the year 2000. The output used was the turnover of each firm measured in Euros. The inputs considered were related to employment and investment. Thus, we use the number of employees with and without a higher university degree, the investment made in capturing new clients and the investment made in improving quality, both measured in Euros. Due to the afore mentioned lack of accurate data for KIBS all this information comes from a database built *ad hoc* to know about KIBS in our area of study.

This database was constructed on the basis of a series on surveys of firms belonging to KIBS, which were carried out in-person. The universe was made up of 240 firms, obtaining a response rate of 72.5 per cent (174 firms). Nevertheless, after a filtering of the data, we got a final sample of 111 firms (46.25 per cent of the total number of KIBS firms).

4.- Empirical results.

Our efficiency analysis was carried out in two stages. Firstly, an aggregate study was carried out considering all the firms belonging to the sector and comparing them with one another. Subsequently, the sample was divided into five groups so as to carry out the efficiency analysis according to the different branch activities (see the classification in Table 1), comparing each firm solely with those of its own branch.

As a general rule for obtaining reliable results in DEA, Banker *et. al.* (1989) establish that the number of firms studied is to be at least three-times the number of variables included in the model. Two branches, management consultancy and human resources, are found on the borderline of this criterion, and hence the results obtained in the de-aggregate analysis of these branches are not interpreted. In the rest of the cases, as in the aggregate analysis, the aforementioned criterion of Banker *et. al.* is more than fulfilled. In the aggregate study only 20 firms were found to be totally efficient (one hundred per cent efficient), representing 18.02 per cent of the total. It can be seen that the firms qualified as inefficient, i.e. those that are not 100 per cent efficient, present a low average efficiency of 26.41 per cent.

In order to give consistency to our results when considering the five branches of KIBS, we have used the chi-squared test to check the homogeneity of the results obtained for each branch. This test yields a

value of 0.002, based on which one can assume different distributions for each branch.

Beginning with the aggregate analysis it can be appreciated in Table 2 that the greatest percentage of totally efficient firms is to be found in the engineering, technical and environmental consultancy branch, namely 6.31 per cent. Behind them, design, advertising and communications services and computing and ICT services, in which 4.5 per cent of the firms are 100 per cent efficient; while the lowest percentages of totally efficient firms are to be found in the branches of advanced management consultancy and human resources, only 2.7 per cent (0.9 per cent of consultancy firms and 1.8 per cent of human resources companies).

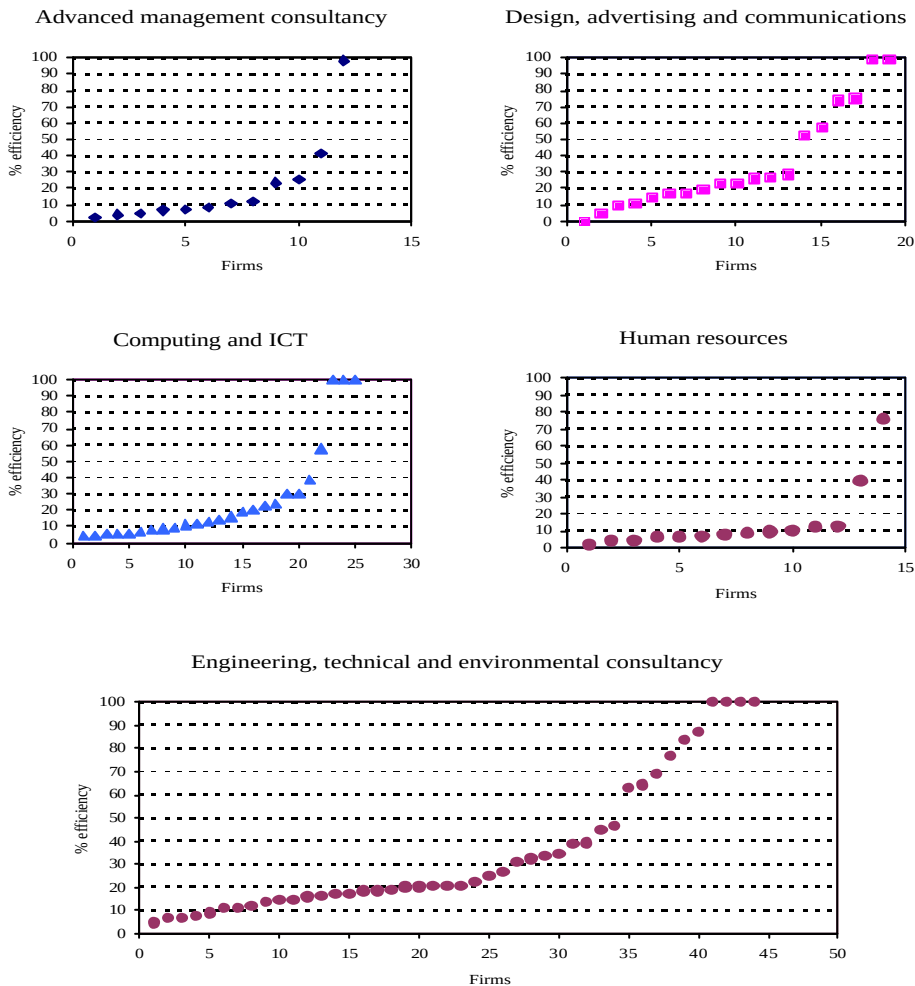
As regards the inefficient firms, low average efficiencies are found in all branches of activity. Once again, the engineering, technical and environmental consultancy branch stands out, in which the highest percentage in the sector is to be found, namely 34.2 per cent. This is followed by design, advertising and communications with an average efficiency level of 33.52 per cent, and computing and ICT with an average efficiency of 22.49 per cent. The branches of advanced management consultancy and human resources present the lowest levels of average efficiency in the sector, at 15.81 per cent and 11.25 per cent respectively (see Figure 1).

Table 2: Efficiency in KIBS in the region of Asturias (2000).

	Efficient (%)	Inefficient (%)	Number of firms	Efficient with respect to the totality of firms percentage	Average efficiency percentage (*)
Advanced management consultancy	1 (8.33)	11 (91.67)	12	0.9	15.81
Design, advertising and communications	5 (29.41)	12 (70.59)	17	4.5	33.52
Computing and ICT	5 (20.83)	19 (79.17)	24	4.5	22.49
Engineering, technical and environmental consultancy	7 (15.91)	37 (84.09)	44	6.31	34.2
Human resources	2 (14.29)	12 (85.71)	14	1.8	11.25
Total number of firms	20 (18.02)	91 (81.98)	111	-	26.41

(*) Figures calculated with respect to the total number of inefficient units.
Source: Own.

Figure 1: Efficiency in KIBS in the region of Asturias (2000).



It should also be stressed that the descriptive analysis of the less efficient branches in the sector points in the same direction as that of the efficiency analysis. Thus, for instance, the advanced management consultancy branch, presents a low average turnover (in the year 2000,

this came to only 350 thousand Euros). The same thing occurs with the number of workers, the average workforce being made up of 6 employees. More than 40 per cent of these firms devote less than 18,000 Euros to investment aimed at capturing new clients. Besides these firms show little interest in obtaining quality certification, since 56 per cent have no certification. Moreover, 40 per cent declare to not having invested any sum in quality during the year prior to the carrying out of the survey. As regards the human resources branch, descriptive data points to the fact that they are in a developing stage, which limits its activity for the meantime to the regional market, with low levels of investment in quality or in capturing new clients.

When carrying out the analysis by branches it is necessary to take into account the fact that the number of firms considered in mentioned analysis decreases. This leads to an increase in the level of efficiency due to the methodology employed. Moreover, as mentioned above, the branches of advanced management consultancy and human resources are found on the borderline of Banker *et. al.*'s criterion, and so the results obtained in the de-aggregate analysis of these branches are not interpreted.

Engineering, technical and environmental consultancy and computing and ICT activities have low average efficiencies. This might be explained by the existence of a high degree of polarization of the internal efficiency of these branches, which means that there are some very efficient firms that coexist with a majority that is not so efficient. The clearest example in this sense is that of the engineering, technical and environmental consultancy branch, where 13 of the 44 firms studied were found to be totally efficient (29.55 per cent of the totality), the firms being qualified as inefficient presenting an average efficiency of 38.53 per cent (see Table 3 and Figure 2). The descriptive analysis fits these results, since there are some very competitive engineering, technical and environmental consultancy firms with an international scope that coexist with small-sized firms with a lower competitive

capacity that operate within the regional market. The case of the computing and ICT branch is very similar though not so marked, in which 8 of the 24 firms studied were found to be 100 per cent efficient (33 per cent), the inefficient firms presenting an average efficiency of 48.59 per cent (see Table 3 and Figure 2).

Table 3: Efficiency in KIBS branches in the region of Asturias, 2000

	Efficient (%)	Inefficient (%)	Total	Average efficiency percentage *
Advanced management consultancy	6 (50)	6 (50)	12	62.31
Design, advertising and communications	9 (52.94)	8 (47.06)	17	49.55
Computing and ICT	8 (33.33)	16 (66.67)	24	48.59
Engineering, technical and environmental consultancy	13 (29.55)	3 (70.45)	44	38.53
Human resources	6 (42.86)	8 (57.14)	14	56.93

(*) Figures calculated with respect to the total number of inefficient units. Source: Own.

As regards the design, advertising and communications branch, 9 of the 17 firms studied were found to be totally efficient (52.94 per cent), the inefficient firms presenting an average efficiency of 49.55 per cent (see Table 3 and Figure 2). This result coincides with other figures from the sector characterized by an average turnover of 1,214 thousand Euros and an average workforce of 9 employees. Moreover these firms have a competitive capacity strictly tailored to the regional market, though with very high levels of turnover. To conclude, once the technical efficiency analysis has been carried out both in an aggregate and de-aggregate way for each branch, the goal will be to identify the

variables with the greatest influence on the levels of efficiency obtained. This may be done by calculating four new BCC models in each of which one of the inputs of the original model has been eliminated.

Table 4: Average Efficiency Scores in KIBS in the region of Asturias with different DEA model formulations.

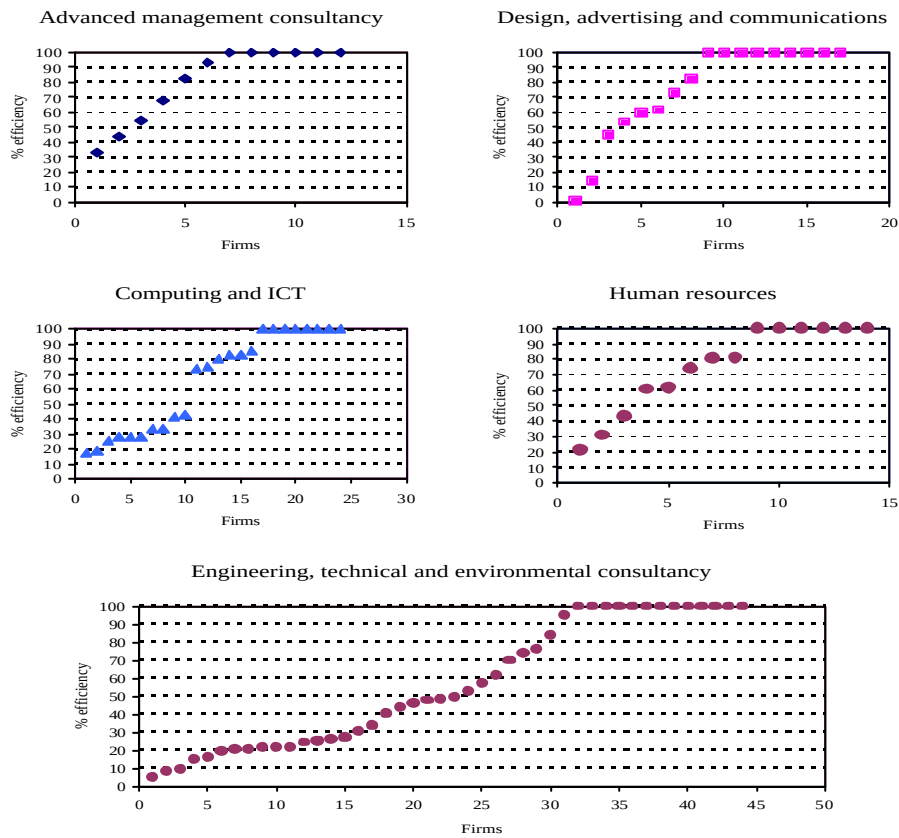
	Original model (%)	DEA without investment in quality (%)	DEA without investment in clients (%)	DEA without employees without a higher degree (%)	DEA without employees with a higher degree (%)
Advanced management consultancy	22.82	21.44	12.00	7.03	13.35
Design, advertising and communications	53.07	52.26	47.54	38.26	19.50
Computing and ICT	38.64	36.49	26.76	22.02	21.85
Engineering, technical and environmental consultancy	44.67	43.72	38.44	27.68	29.79
Human resources	23.93	23.67	10.52	5.69	13.52
Total number of firms	39.67	38.53	30.93	23.07	22.67

Source: Own.

In the original overall analysis of efficiency, an average efficiency of 39.7 per cent was obtained. Excluding the input “employees with a higher degree” from the model, the average level of efficiency becomes 22.67 per cent; leaving out “employees without a higher degree”, it becomes 23.07 per cent; without “investment in clients”, the average efficiency is 30.93 per cent; and finally, when not considering

“investment in quality”, an average efficiency of 38.53 per cent is obtained (see Table 4). Therefore, the variable that appears to have the most influence on efficiency is that of employees with a higher degree, followed very closely by employees without a higher degree. This result coincides with the definition of the sector (see Section 2), whose activities are characterized by high requirements in human capital, thus highlighting the fact that this is the most important resource that they possess.

Figure 2: Efficiency in KIBS branches in the region of Asturias (2000).



5.- Conclusions.

The aim of this research is to carry out an efficiency analysis in KIBS. In particular we are interested in the behavior of KIBS firms in regions with a medium degree of development in these activities. The most important problem to face in an analysis like this is given by the lack of data. To avoid this difficulty we have built an own database for the area of analysis, which is a region with a growing KIBS sector.

The technique for the efficiency analysis has been Data Envelopment Analysis (DEA) in its output-oriented, BCC formulation. This approach allows greater flexibility as it is not necessary to know neither the technology used by the service firms nor their type of returns-to-scale.

The results show that many KIBS companies of the analyzed peripheral region present very low general levels of efficiency as an internal sector comparison could be inferred. The following branches, engineering consultancies, computing and ICT services, design and advertising firms, have the highest number of efficient firms. Moreover the efficiency analysis within branches shows a high degree of polarization both for engineering, technical and environmental consultancy and computing and ICT activities.

This high degree of polarization means that there are some very efficient firms that coexist with a majority that is not so efficient. In design and advertising firms, efficiency levels are quite acceptable (around 50 per cent for the inefficient firms). Within human resources services and advanced consultancy branches there are very few efficient firms, which is in accordance with other data and denotes certain tardiness in their development.

These important differences on efficiency scores imply that KIBS subcontracting strategies might lead to different efficiency gains for subcontracting companies. Thus, the intensity of the gains depends on the efficiency level of the subcontracted firm. Although this is quite an

obvious conclusion, it is important to highlight this fact because in the analysis made on this paper, we identify strong differences inside a territory. At the same time, it is probable that in the outlying regions, like the one analyzed in this study, there exists a greater number of firms with low degrees of efficiency.

On the other hand, the efficiency results may help guide the course of action of public institutions involved in promoting regional development, since they identify the weakest branches and the need to stimulate competitiveness in the majority of firms belonging to the sector, though via different procedures depending on each case. For instance, in the branch of advanced consultancy and human resources, it would seem appropriate to implement policies that stimulate investment in the sector in general. Whereas in engineering, technical and environmental consultancies and computing and ICT activities, it would seem more appropriate, given the results, to implement actions that stimulate cooperation and the generation of relations between firms.

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