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TECHNICAL UNIVERSITY OF LISBON

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WP 33/2009/DE/UECE

WORKING PAPERS

ISSN Nº 0874-4548

Does the location of manufacturing determine service sectors' location choices? Evidence from Portugal[1]

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Abstract: Considering the case of Portugal over the period 1995-2000, this paper analyses whether the location of market services is explained by the geographical proximity of the industrial sectors that use these services as intermediate inputs. A rather detailed level of regional disaggregation is used, namely the county level (275 counties). This influence is confirmed by the results of some location indices and by the regressions made for each sector. An alternative spatial unit is also used, consisting of the county itself combined with those with which it shares boundaries, showing the relevance of the level of regional disaggregation for the results obtained.

Keywords: services, manufacturing industry, location of economic activity, Portugal.

JEL Codes: R11, R12, R30.

1. Introduction

In analysing the location of services, it is of importance to evaluate the influence exerted by the geographical proximity of the manufacturing sectors that use the services as intermediate inputs. Besides the agglomeration economies proposed by the New Economic Geography which occur due to the proximity of diverse economic activities, the possibility of such an influence is based on the fact that most services are non-tradable, i.e., they cannot be traded at a distance; therefore, service-providers and their clients may need to be located close to each other. If the location choices of services are to a large extent determined by manufacturing location choices, then domestic services' production will change simultaneously with domestic manufacturing production.

However, empirical evidence on the complementarity between location choices in manufacturing and in services is very scarce. Indeed, while the location choices in the manufacturing sector are relatively well understood[2], the literature on the determinants of the location of services is only at an early stage of development. The scarcity of such research represents a serious gap, since services account for more than half of most countries' economic activity.

In a pioneering work, Midelfart-Knarvik et al. (2000), in a brief section dedicated to the analysis of service-sector location in the EU, concluded that «changing location of manufacturing industries therefore goes some way to explain the increasing dispersion of service sector employment» (Midelfart-Knarvik et al., 2000, p. 42). It is, however, merely a descriptive analysis, which does not find support for the expected causality. A crucial limitation of this study is that it considers only

[2] See for instance Head and Mayer (2004) and Amiti and Javorcik (2008).

five sectors. Indeed, with data that is excessively aggregated at the sectoral level, the analysis can mask a high share of intra-sectoral changes.

In the context of FDI location literature, Baside et al. (2009) and Nefussi and Schwellnus (2007) have provided some empirical evidence on the probability of FDI in business services increasing with the downstream demand generated by FDI in manufacturing. The first study evaluates the location determinants of foreign firms' business functions in the enlarged Europe over the 2003-7 period, while the second work builds a gravity type model for business services of affiliates of French multinational firms in 76 countries over the period 1994-2002. However, the spatial unit of these two studies (NUTS II regions and country level, respectively) is too vast to analyse the hypothesis of geographical proximity between services and their clients, which is the motivation for the present research.

This paper is a preliminary contribution to the issue of whether location choices of market services are determined by geographical proximity to downstream manufacturing demand in the case of Portugal[3] over the period 1995-2000[4], using a spatial unit built at an adequate level of disaggregation. Specifically, we consider the local administrative county level. At this level of disaggregation, we have 275 regions. The relation that we aim to capture will be evaluated for each sector at the 3-digit level of NACE.

Another purpose of this paper is to test whether the level of regional disaggregation impacts on the relation that we aim to analyse. Therefore, the estimations will also be conducted for a larger geographical space. The alternative

[3] Another approach to the location of services within a country can be found in Brodzicki and Ciolek (2008). The purpose is to estimate the determinants of the spatial concentration of both manufacturing and market services in Poland, over the period 1995-2006. Analysis is carried out for 16 NUTS II regions. One of the explanatory variables, which shows a positive and highly significant coefficient, depicts the intensity of linkages with other sectors (independently of their location). However, this is not the effect that we aim to estimate, which occurs only if both services and manufacturing are located in the same region.

[4] Data for services before 1995 are not compatible with the nomenclature adopted after this year.

spatial unit that we consider assumes that the economic agents of the services sectors, when deciding on the location of their activity, take into consideration the location of the industrial activity that uses services not only in the geographical space of their county of location, but also in all of the neighbouring area. Hence, we will consider an alternative spatial unit to the county, consisting of the county itself, combined with those with which it shares boundaries. This will be conducted for each county included in the analysis.

The paper is organised as follows. Section 2 describes the data and the location indices which will be used in the following section. Section 3 characterises the distribution of industry and services by counties, with a special focus on the case of the sectors individually considered. Section 4 aims to establish for each sector individually considered whether its location is determined by geographical proximity to downstream manufacturing demand. Finally, section 5 concludes.

2. Data and measurement

We use employment data at the 3-digit level of the *Classificação das Actividades Económicas* (CAE), revision 2, for market services[5] (74 sectors, from 401 to 748) [6]. The data is from *Quadros de Pessoal* - Ministry of Employment. In spatial terms, Portugal[7] consists of 5 NUTS II, 28 NUTS III and 275 counties. The highest level of disaggregation is used in this paper.

With the aim of obtaining as comprehensive a view as possible of the location of economic activity, we use four alternative concentration concepts: absolute, relative, topographic and geographical. The absolute and the relative concentration

[5] At this level of aggregation, this nomenclature is fully compatible with NACE-Eurostat.
[6] It was necessary to eliminate from the analysis sector 623, because, according to the data base used, this sector was not found to be present in any of the counties of continental Portugal during the period of the analysis.
[7] We exclude Madeira and Azores.

concepts are the most used, particularly the former. Nevertheless, adding the topographic and the geographical concepts allows a more complete picture of this topic to be obtained. Subsequently, we start by presenting the indices related to these four concepts.

The starting point of the analysis is the consideration of a matrix X for each year, containing the volume of employment of each region, at a sectoral level. Matrix X has a generic element x_{ji} representing the employment in sector j (j = 1, 2, …, J) in region i (i = 1, 2, …, I) .

Based on the information of matrix X, we calculate, as an intermediate step to obtaining spatial concentration indices, the matrix S, with generic element $s_{ji} = x_{ji}/x_j$ where x_j is the total employment in sector j. Thus, s_{ji} represents the share of region i in the locational distribution of j.

(i) Absolute concentration

The concept of absolute spatial concentration only takes into consideration the distribution of sector j by the different regions. Spatial concentration of sector j will reach the maximum value when this sector is totally concentrated in only one region and the minimum value when it is equally distributed by all regions.

In order to capture this concept of concentration, we apply the commonly used Gini index ($G_j^{(A)}$). Its calculation implies the following procedure: (i) to rank the values of s_{ji} in an increasing order, designating them by $a_{j(h)}$ with h (h = 1, 2, …, I) indicating the order; (ii) to obtain the partial accumulated values $d_{j(h)}$ such that $d_{j(1)} = a_{j(1)}$, $d_{j(2)} = d_{j(1)} + a_{j(2)}$, …, $d_{j(I)} = d_{j(I-1)} + a_{j(h)}$; (iii) to define $c_{j(h)} = (h/I)$. The absolute Gini index for sector j is then given by:

$$G_j(A) = 1 - \frac{\sum_{h=1}^{I-1} d_j(h)}{\sum_{h=1}^{I-1} c_j(h)} \quad ; \quad G_j(A) \in [0;1] \qquad [1]$$

The index $G_j^{(A)}$ will be equal to 1 when sector j is located in only one region. When sector j is distributed equally across all regions, $G_j^{(A)}$ will be 0.

(ii) Relative concentration

The relative indices compare the spatial distribution of sector j with the distribution of a sector taken as reference. As is the usual practice, we use as the reference "sector" the manufacturing industry as a whole, a consequence of this choice being that the relative index used in this study is appropriate only to analyse the spatial concentration of individual industries.

A commonly used measure of relative concentration is the so-called Krugman index (E_j), which can be expressed as:

$$E_j = \beta \sum_{i=1}^{I} \left| s_{ji} - s_{qi} \right| \quad ; \quad E_j \in [0;2\beta[\qquad [2]$$

We consider $\beta = ½$ as, in this case, E_j ranges between 0 and 1. If $E_j = 0$, the spatial distribution of sector j is identical to that of the services activity as a whole (q).

E_j increases with the degree of dissimilarity between the two distributions considered.[8]

(iii) Topographic concentration

The two concentration concepts analysed above correspond, as explained earlier, to the most commonly adopted in the empirical analysis. In the evaluation of absolute concentration, all regions are considered as equal, whereas the analysis of relative concentration assumes that the dimension of the regions has an economic character given by the importance of the economic activity as a whole located in the different regions. A complementary approach consists of the consideration of the spatial dimension of the regions, evaluated by their area, which characterises the topographic concentration concept.[9]

To evaluate the level of topographic concentration, we propose an approach based on the adaptation of the relative indices.[10] Let us define the area of region i as ψ_i. We can then calculate the share of the area of i in the total area of the country:

$$\varphi_i = \frac{\psi_i}{\sum_{i=1}^{I} \psi_i} \qquad [3]$$

Using the Krugman index as reference (once again with $\beta = ½$), the degree of topographic concentration of sector j (TOP_j) can be measured as follows:

[8] When the "sector" of reference is the services activity at the aggregate level, E_j never reaches 1.
[9] This concept is more relevant if the dissimilarity between the regions is significant in terms of their dimension, which is the case in the present analysis: the area of the Portuguese counties ranges from 7.97 Km^2 (São João da Madeira) to 1721.42 Km^2 (Odemira).
[10] For an alternative perspective, see Brülhart and Traeger (2005).

$$TOP_j = 1/2\sum_{i=1}^{I}\left|s_{ji} - \varphi_i\right| \;\; ; \;\; TOP_j \in [0;1[\qquad [4]$$

The topographic index requires, for each region i, the comparison of the share of sector j located in region i (s_{ji}) with the share of region i in total area (φ_i). The minimum value of the admissible range corresponds to a uniform distribution of j, i.e. when each region has a proportion of j equal to its share in terms of area.[11] Any other case leads to an increase of topographic concentration. Top_j assumes its maximum value, converging to 1, when all the activity of sector j is located in the smallest region.[12]

(iv) Geographical concentration

The absolute, relative and topographic indices ignore the geographical situation of the regions, i.e. they do not consider inter-regional distances. Nevertheless, it is also important to investigate if concentration occurs in close or distant regions. In order to control this factor, Midelfart-Knarvik et al. (2000, 2002) propose an index of geographical separation. However, this index does not consider the internal dimension of the regions, taking the value 0 if sector j is fully concentrated in only one region, whatever it is. To overcome this weakness, we use an amplified version of this geographical index by incorporating the intra-regional dimension. For each sector j, it is expressed as follows:

[11] Obviously, a uniform intra-regional distribution is assumed. Therefore, the real topographic concentration is sub-evaluated. A way to minimise this problem is to use very disaggregated geographical information. The development of more sophisticated indices considering this type of information is an interesting research topic. On this question, see Brülhart and Traeger (2005).

[12] Top_j never reaches 1 since this would imply that all the activity of sector j is located in a region with area equal to zero.

$$GL_j = \gamma \sum_{i=1}^{I} \sum_{k=1}^{I} (s_{ji} \times s_{jk} \times \delta_{ik}) \; ; \; GL_j \in]0;+\infty[\qquad [5]$$

where γ is a constant (assumed to be equal to 1) and δ_{ik} represents the distance between regions i and k. GL_j is a weighted average of the bilateral distances between all the regions, taking as weight the share of each sector located in regions i and k.

A rigorous use of this last index requires data that is rather disaggregated at the geographical level, which led us to use it only in the case of the spatial dissagregation by counties. The calculation of GL_j considers the bilateral distances between all the counties (75350 inter-regional and 275 intra-regional distances). These distances are obtained from the program ROUTE 66. We calculate distances as the time (in minutes) needed to travel that distance by car, taking into consideration the characteristics of the different roads (based on speeds pre-defined by the program) – GL(min). Following Keeble et al. (1988) and Brülhart (2001), we use the expression $\delta_{ii} = 1/3 \; (\psi_i \; /\pi)^{1/2}$ to calculate intra-regional distances where δ_{ii} is a measure of internal distance and ψ_i is the area of region i.

3. Spatial concentration of manufacturing activity and services

This section provides evidence on the location of economic activity in Portugal between 1995-2000, based on the indices above presented. We will consider the services activity and, as a reference term, also the total manufacturing activity (sectors 15 to 37 of the CAE revision 2), i. e. at the aggregate level.

Table 1 shows the results based on a spatial disaggregation at the county level for manufacturing and services at the aggregate level. Note that we use the absolute, the

topographic indices and the geographical index, but not the relative index since the latter is adequate only for individual sectors.

[Table 1 here]

In Table 1, a decrease of the absolute and topographic concentration between 1995 and 2000 is evident both for manufacturing activity and services as respectively shown by $G_q^{(A)}$ and TOP_q. In fact, according to the two indices considered, the maximum value is registered in 1995 and the minimum in 2000.

In its turn, the geographical concentration index reveals different tendencies in both sectors of activity: decreasing in the case of manufacturing and increasing in the case of services. To interpret this evidence it is necessary to take into consideration that the evolution of this index points to different readings. The decreasing tendency of manufacturing is compatible with a more uniform distribution in the national territory, but it can also express a stronger concentration in regions in close proximity. The increasing tendency of services is compatible with a less uniform distribution in the national space and with a stronger concentration in distant regions. When we consider the information provided simultaneously by the three indices, the possible conclusion regarding the structural adjustments observed in both sectors of activity is that manufacturing industry registered a more uniform distribution in the national space, while services became more dispersed (as shown by $G_q^{(A)}$ and TOP_q), but in regions relatively distant from each other.

During the period analysed, it is possible to observe in Table 2 that both manufacturing and services are mainly concentrated in two major regions: the metropolitan areas of Lisboa in the south (which includes the political centre of the

country and is among the major financial and economic centres of the Iberian Peninsula) and another in the north, which includes Porto, the second-largest city of the country, together with neighbouring counties such as Guimarães, Vila Nova de Gaia, Vila Nova de Famalicão and Santa Maria da Feira. However, the main difference is that services are mainly located specifically in the main city of each of the above mentioned regions, while manufacturing activity is more dispersed in these two metropolitan regions.

[Table 2 here]

The county of *Lisboa* is clearly dominant in respect of its representation in the total national distribution of services, with a share of 33.80% in 1995, decreasing to 29.36% in 2000. It is also noteworthy that the counties with the highest share of services at the beginning of the period analysed (Lisboa and Porto) register the highest reduction of their share between 1995 and 2000.

Overall, we can conclude that there is a spatial trend of dispersion for both manufacturing industry and services, in spite of the differences mentioned above. In fact, the correlation coefficient between the variation of the share of manufacturing industry located in each region and the analogous variation for the service sector in the period analysed was positive (0.67), pointing to a similar spatial location trend in both cases.

Next we analyse the spatial distribution of the various sectors individually considered. Table 3 presents the results. For a description of each sector see the Appendix.

[Table 3 here]

The results presented in Table 3 reveal that sectors 452 and 454 are among the most dispersed in absolute and topographical terms, while sector 523 is found to have the highest level of spatial dispersion, according to the indication given by $G_j^{(R)}$. Sectors 601, 621, 641 and 603 are the most geographically concentrated, the first three situated in Lisbon and the fourth in Matosinhos.

4. Does the location of manufacturing activity determine services sectors' location choices?

The aim of this section is to determine whether the location of services is explained by the geographical proximity of the industrial sectors that use these services as intermediate inputs.

Location externalities, which occur due to the proximity of various economic activities, may explain this spatial concentration. They encompass market size effects, employment density and the presence of infrastructures, among other factors. In the case of Portugal, as observed in the previous section, services are in fact mainly located in the regions of greatest economic importance. In order to control for this possible effect, in addition to the variable related to the demand of the industrial sectors, we use the Report into Counties' Purchasing Power (elaborated and published by the INE- Portuguese Institute of Statistics) to build the variable *CPP*[13], which measures the weight of the purchasing power of every county in the country.

Two spatial units will be alternatively considered: the county (region A) and the region which comprises the county itself together with all of the directly neighbouring counties (region B).

[13] This variable is constructed from another – the per-capita indicator – which compares the purchasing power of the counties in per-capita terms.

For each of the 74 services sectors considered, we have a base consisting of 1,650 observations (275 counties X 6 years). The analysis is conducted by means of a Probit model, in which the dependent variable considered assumes the value 1 when the sector j under analysis is located in region i, at time t, that is, when $l_{jit} > 0$. In all other cases, the dependent variable assumes the value 0.

With regard to Region A, the explanatory variable that measures the downstream demand of services generated by the manufacturing – *Indust* – constitutes a weighted average of the magnitude of the presence, in i, of the industrial sectors using sector j, represented as:

$$Indust_{jit} = \sum_{k=1}^{K} l_{kit}\, \lambda_{jkt} \qquad [5.2]$$

where l_{kit} represents the proportion of the industrial sector k that is located in county i in year t. In turn, λ_{jkt} constitute the weights. They are obtained by means of a series of steps and the establishment of some hypotheses is required. The first step calls for the construction of a matrix that informs us of the dimension of the relations established between the manufacturing and services sectors. However, the matrix referring to the intermediate consumption of the different sectors presents data at a level of disaggregation of only 2 digits. Thus, given our aim of extending the analysis to the level of sectoral disaggregation desired (i.e., 3 digits), the hypothesis must be assumed that the weight of each sector at the 3-digit level in the sector at the 2-digit level is proportional to its relative importance in terms of employment.

Once we have obtained the matrix that indicates, for every year of the period studied, the dimension of the relations between the industrial and services sectors at a 3-digit level, it is possible to obtain, for each service sector, the relative importance of

each industrial sector that uses the service sector in question. Hence, λ_{jkt} represents the proportion of service sector j that is used, in the form of intermediate consumption, by industrial sector k in time t.

Next, taking the spatial unit designated as region B as the reference, we will consider a new variable – *Indust2* – which seeks to capture the presence of industrial-sector service users in this particular geographical area. The method involves the consideration of the variable *Indust* according to the weight, in terms of population, of every county situated within this new geographical space.

The results obtained for each service sector considered individually are found in columns [1] to [3] of Table 4 with regard to the spatial unit defined as region A. Columns [4] to [6] display the results for region B. For the purpose of simplifying the reading of the table, only the signs of the estimated coefficients are presented, together with the corresponding level of statistical significance.

[Table 4 here]

The evidence obtained permits us to identify the importance of the location of manufacturing sectors that use the services sector for the location of a significant group of sectors. In effect, the presence of these industrial sectors exerts a positive and significant impact on 36 sectors in the case of region A and 33 sectors in region B.

In this context, it is noteworthy that many sectors for which this relation between the industrial location and the location of the services that serve the industrial sectors is not confirmed are characterised by the fact that essentially they serve the final demand. This is the case, for example, for various sectors in sections 50, 52 and 60.

Another relevant conclusion that emerges from the results obtained is that, comparing the evidence for the two regions that we have considered, they are not coincident in the case of 32 sectors, i.e. 45 % of the total. Thus, the level of spatial disaggregation matters for the results obtained, raising some doubts about those results which only consider as reference geographical units which are excessively large.

5. Conclusions

This paper provides evidence that the geographical proximity of services to industrial activity is related to the downward demand for services by manufacturing activity, at a rather detailed level of regional disaggregation. This evidence is suggested by the results of the location indices and is corroborated by the regressions made for each sector, after controlling for possible agglomeration effects as another cause of services location.

This evidence may have important consequences in terms of the alteration of the present interregional division of labour in Portugal, to the extent to which it is to be expected that movements of industrial relocation exert a certain degree of knock-on effects on the number of relocations of services. A natural interest of this type of analysis comes out by providing guidance for regional policies aiming to promote regional growth.

Another important result of this study is to show, as expected, that the level of regional disagregation matters for the effect evaluated in this paper.

Further research may be pursued in three main directions. First, it is possible to capture more rigorously the influence of distance on the location choices of services. Secondly, new factors for the location of services could be incorporated into

the model, in particular, factors that are related to the characteristics of the regions. Finally, another possible extension would comprise the analysis of factors that explain the spatial concentration of services, following the line of Brodzicki and Ciolek (2008), but applying the analysis to a similar level of regional disaggregation to that of the present study.

Appendix

NACE Nomenclature

401 – Production and distribution of electricity
402 – Manufacture of gas; distribution of gaseous fuels through mains
403 – Steam and hot water supply
410 – Collection, purification and distribution of water
451 – Site preparation
452 – Building of complete constructions or parts thereof; civil engineering
453 – Building installation
454 – Building completion
455 – Renting of construction or demolition equipment with operator
501 – Sale of motor vehicles
502 – Maintenance and repair of motor vehicles
503 – Sale of motor vehicle parts and accessories
504 – Sale, maintenance and repair of motorcycles and related parts and accessories
505 – Retail sale of automotive fuel
511 – Wholesale on a fee or contract basis
512 – Wholesale of agricultural raw materials and live animals
513 – Wholesale of food, beverages and tobacco
514 – Wholesale of household goods
515 – Wholesale of non-agricultural intermediate products, waste and scrap
516 – Wholesale of machinery, equipment and supplies
517 – Other wholesale
521 – Retail sale in non-specialized stores
522 – Retail sale of food, beverages and tobacco in specialized stores
523 – Retail sale of pharmaceutical and medical goods, cosmetic and toilet articles
524 – Other retail sale of new goods in specialized stores
525 – Retail sale of second-hand goods in stores
526 – Retail sale not in stores
527 – Repair of personal and household goods
551 – Hotels
552 – Camping sites and other provision of short-stay accommodation
553 – Restaurants
554 – Bars
555 – Canteens and catering
601 – Transport via railways

602 – Other land transport
603 – Transport via pipelines
611 – Sea and coastal water transport
612 – Inland water transport
621 – Scheduled air transport
622 – Non-scheduled air transport
623 – Space transport
631 – Cargo handling and storage
632 – Other supporting transport activities
633 – Activities of travel agencies and tour operators; tourist assistance activities n.e.c.
634 – Activities of other transport agencies
641 – Post and courier activities
642 – Telecommunications
651 – Monetary intermediation
652 – Other financial intermediation
660 – Insurance and pension funding, except compulsory social security
671 – Activities auxiliary to financial intermediation, except insurance and pension funding
672 – Activities auxiliary to insurance and pension funding
701 – Real estate activities with own property
702 – Letting of own property
703 – Real estate activities on a fee or contract basis
711 – Renting of automobiles
712 – Renting of other transport equipment
713 – Renting of other machinery and equipment
714 – Renting of personal and household goods n.e.c.
721 – Hardware consultancy
722 – Software consultancy and supply
723 – Data processing
724 – Database activities
725 – Maintenance and repair of office, accounting and computing machinery
726 – Other computer related activities
731 – Research and experimental development on natural sciences and engineering
732 – Research and experimental development on social sciences and humanities
741 – Legal, accounting, book-keeping and auditing activities; tax consultancy; market research and public opinion polling; business and management consultancy; holdings
742 – Architectural and engineering activities and related technical consultancy
743 – Technical testing and analysis
744 – Advertising
745 – Labour recruitment and provision of personnel
746 – Investigation and security activities
747 – Industrial cleaning
748 – Miscellaneous business activities n.e.c.

Acknowledgements

The financial support received from Fundação para a Ciência e a Tecnologia (FCT), Portugal is gratefully acknowledged. This article is part of the Multi-annual Funding Project (POCI/UO436/2006). The usual disclaimer applies.

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Table 1: Level of spatial concentration of manufacturing by NUTS III and counties, 1985 - 2000

Year	Manufacturing industry			Services		
	Absolute concentration ($G_g^{(A)}$)	Topographic concentration (Top_g)	Geographical concentration (GL_g(min))	Absolute concentration ($G_g^{(A)}$)	Topographic concentration (Top_g)	Geographical concentration (GL_g(min))
1995	0.777	0.714	124.59	0.821	0.718	129.05
1996	0.775	0.711	124.45	0.818	0.713	130.01
1997	0.765	0.702	123.67	0.808	0.705	131.44
1998	0.764	0.702	123.71	0.805	0.702	131.16
1999	0.761	0.703	124.33	0.799	0.699	133.03
2000	0.758	0.698	123.75	0.791	0.689	133.64

Table 2: Location of manufacturing activity and services: main counties

	Manufacturing industry		Services	
	Counties	Share	Counties	Share
	1995			
1	Lisboa	6.79%	Lisboa	33.80%
2	Guimarães	5.39%	Porto	8.96%
3	Vila Nova de Gaia	3.85%	Oeiras	3.00%
4	Vila Nova de Famalicão	3.83%	Loures	2.66%
5	Santa Maria da Feira	3.36%	Matosinhos	2.45%
	2000			
1	Guimarães	5.34%	Lisboa	29.36%
2	Lisboa	3.94%	Porto	6.27%
3	Vila Nova de Famalicão	3.90%	Oeiras	4.02%
4	Vila Nova de Gaia	3.77%	Matosinhos	2.92%
5	Sintra	3.45%	Loures	2.59%

Table 3: Indices of location at the county level by sector of services (3 digits)

Sector	1995				2000			
	$G_i^{(A)}$	$E_i(0,5)$	Top_i	$GL2_i$(min.)	$G_i^{(A)}$	$E_i(0,5)$	Top_i	$GL2_i$(min.)
401	0.994	0.532	0.968	93.54	0.997	0.662	0.962	20.02
402	1.000	0.653	0.994	17.95	0.992	0.635	0.979	69.10
403	0.988	0.735	0.990	98.81	0.986	0.611	0.987	119.38
410	0.999	0.632	0.986	11.85	0.992	0.585	0.962	86.65
451	0.875	0.595	0.735	138.34	0.801	0.501	0.695	150.81
452	0.736	0.279	0.657	144.99	0.666	0.303	0.596	155.21
453	0.839	0.258	0.743	134.73	0.797	0.247	0.705	138.39
454	0.820	0.439	0.743	136.02	0.743	0.432	0.675	148.39
455	0.921	0.766	0.812	149.63	0.841	0.559	0.678	156.67
501	0.868	0.331	0.744	140.34	0.855	0.327	0.731	141.17
502	0.709	0.318	0.615	147.77	0.675	0.313	0.597	149.82
503	0.843	0.277	0.720	132.88	0.787	0.303	0.674	139.56
504	0.776	0.424	0.674	145.91	0.733	0.401	0.650	154.65
505	0.697	0.322	0.605	153.62	0.696	0.240	0.598	148.57
511	0.887	0.211	0.783	124.75	0.894	0.329	0.794	126.23
512	0.805	0.352	0.682	133.45	0.759	0.444	0.640	144.90
513	0.752	0.348	0.650	148.50	0.744	0.304	0.649	144.73
514	0.924	0.210	0.846	111.23	0.908	0.291	0.831	115.11
515	0.828	0.240	0.732	127.68	0.782	0.282	0.690	135.89
516	0.914	0.189	0.810	104.94	0.883	0.223	0.779	116.00
517	0.901	0.181	0.806	115.92	0.878	0.235	0.792	118.25
521	0.856	0.249	0.755	125.79	0.847	0.315	0.734	130.02
522	0.751	0.252	0.657	147.03	0.709	0.269	0.630	155.06
523	0.703	0.214	0.606	148.32	0.706	0.183	0.610	148.02
524	0.790	0.176	0.684	144.83	0.766	0.158	0.669	146.81
525	0.967	0.363	0.893	100.52	0.953	0.379	0.852	108.07
526	0.893	0.513	0.792	125.16	0.862	0.307	0.751	129.39
527	0.842	0.279	0.731	142.58	0.819	0.310	0.719	146.96
551	0.908	0.368	0.791	159.53	0.893	0.389	0.764	165.06
552	0.955	0.479	0.848	121.43	0.864	0.454	0.701	153.74
553	0.794	0.170	0.690	147.58	0.772	0.167	0.673	154.36
554	0.775	0.187	0.674	145.70	0.731	0.206	0.640	152.41
555	0.991	0.532	0.959	24.64	0.984	0.536	0.940	35.03
601	1.000	0.662	0.999	2.08	1.000	0.694	0.998	2.40
602	0.859	0.213	0.756	124.73	0.801	0.247	0.708	129.76
603	1.000	0.975	0.999	1.78	1.000	0.969	0.993	4.88
611	0.998	0.617	0.984	36.75	0.996	0.614	0.974	83.96
612	0.997	0.621	0.978	44.18	0.995	0.638	0.976	64.33
621	1.000	0.659	0.996	3.12	1.000	0.706	0.999	2.08
622	0.992	0.523	0.994	97.08	0.993	0.641	0.985	26.67

Table 3 (cont.): Indices of location at the county level by sector of services (3 digits)

Sector	1995				2000			
	$G_i^{(A)}$	$E_i(0,5)$	Top_i	$GL2_i$(min.)	$G_i^{(A)}$	$E_i(0,5)$	Top_i	$GL2_i$(min.)
623								
631	0.980	0.520	0.957	102.70	0.979	0.539	0.951	93.94
632	0.997	0.590	0.975	18.17	0.995	0.626	0.965	17.57
633	0.945	0.356	0.848	135.63	0.935	0.422	0.834	149.12
634	0.988	0.459	0.953	103.37	0.979	0.477	0.936	106.06
641	1.000	0.652	0.995	4.86	1.000	0.698	0.992	3.32
642	1.000	0.651	0.997	3.16	0.996	0.634	0.970	25.97
651	0.986	0.535	0.960	84.19	0.981	0.589	0.942	91.41
652	0.997	0.521	0.982	52.99	0.995	0.569	0.978	64.50
660	0.999	0.568	0.993	42.24	0.999	0.639	0.993	38.09
671	0.994	0.525	0.969	103.01	0.997	0.596	0.977	64.88
672	0.929	0.280	0.827	99.77	0.862	0.224	0.755	117.06
701	0.917	0.277	0.821	160.83	0.846	0.222	0.748	154.41
702	0.983	0.431	0.944	117.23	0.958	0.422	0.895	137.26
703	0.929	0.275	0.841	145.67	0.897	0.227	0.812	145.00
711	0.982	0.451	0.936	121.98	0.971	0.498	0.907	114.34
712	0.991	0.550	0.965	62.56	0.980	0.557	0.926	89.30
713	0.871	0.462	0.695	140.52	0.833	0.342	0.673	133.21
714	0.923	0.343	0.844	114.63	0.897	0.470	0.811	144.86
721	0.980	0.442	0.959	99.45	0.970	0.513	0.916	72.96
722	0.975	0.372	0.929	72.08	0.968	0.363	0.910	85.07
723	0.973	0.341	0.909	76.53	0.977	0.415	0.918	63.71
724	0.995	0.629	0.996	35.26	0.993	0.629	0.976	49.52
725	0.982	0.438	0.961	112.52	0.971	0.381	0.928	87.68
726	0.981	0.449	0.960	120.44	0.980	0.454	0.918	65.72
731	0.992	0.555	0.966	56.59	0.980	0.519	0.975	107.11
732	0.998	0.583	0.991	61.07	0.995	0.604	0.990	99.63
741	0.825	0.123	0.719	126.04	0.823	0.108	0.718	123.91
742	0.942	0.242	0.848	100.44	0.899	0.199	0.797	112.72
743	0.947	0.485	0.842	84.28	0.924	0.458	0.818	122.64
744	0.966	0.330	0.889	72.25	0.950	0.327	0.869	78.27
745	0.977	0.417	0.920	95.26	0.976	0.501	0.917	53.35
746	0.990	0.486	0.957	52.64	0.988	0.492	0.955	50.80
747	0.961	0.354	0.895	89.34	0.961	0.417	0.880	85.99
748	0.913	0.232	0.813	114.90	0.911	0.305	0.817	95.48

Table 4: Downward demand of manufacturing activity and services location by sector

Sector	[1]	[2]	[3]	[4]	[5]	[6]
	CPP	*Indust*	R^2	*CPP*	*Indust2*	R^2
401	+***	+***	0.1857	+***	+***	0.1686
402	+**	n.s.	0.1828	+***	n.s.	0.1772
403	+***	-**	0.1257	+***	-**	0.1325
410	+***	n.s.	0.1458	+***	n.s.	0.1456
451	+***	+**	0.1871	+***	+*	0.1892
452	+***	-***	0.1924	+***	n.s.	0.1478
453	+***	+*	0.2511	+***	+**	0.2530
454	+***	+***	0.3515	+***	+***	0.3510
455	+***	+***	0.0727	+**	-*	0.0714
501	+***	+**	0.4900	+***	+***	0.4890
502	+***	n.s.	0.2910	+***	n.s.	0.2868
503	+***	+**	0.3164	+***	n.s.	0.3164
504	+***	n.s.	0.3933	+***	+**	0.3948
505	+***	n.s.	0.1664	+***	n.s.	0.1642
511	+***	+***	0.2453	+***	+***	0.2499
512	+***	+**	0.2788	+***	+**	0.2834
513	+**	n.s.	0.1598	+***	+**	0.1701
514	+***	+***	0.3342	+***	+***	0.3321
515	+***	+**	0.3103	+***	n.s.	0.2996
516	+***	n.s.	0.2267	+**	+*	0.2297
517	+***	+*	0.2365	+***	+**	0.2411
521	+***	n.s.	0.0564	+***	n.s.	0.0593
522	+***	n.s.	0.1765	+***	+**	0.1821
523	+***	n.s.	0.0732	+***	+**	0.0971
524	+***	n.s.	0.2184	+***	n.s.	0.2073
525	+***	n.s.	0.2391	+***	-***	0.2470
526	+***	+***	0.3278	+***	+***	0.3254
527	+***	+*	0.4326	+***	n.s.	0.4334
551	+***	n.s.	0.1749	+***	n.s.	0.1779
552	+***	n.s.	0.0759	+***	-***	0.0869
553	+***	n.s.	0.2047	+***	+**	0.2350
554	+***	n.s.	0.0557	+***	n.s.	0.0528
555	+***	+***	0.4074	+***	+*	0.3987
601	+**	n.s.	0.8346	n.s.	n.s.	0.8393
602	+***	n.s	0.2826	+***	+***	0.2881
603	n.s.	n.s	0.0033	n.s.	n.s.	0.0083

Note: */**/*** = statistically significant at the 10%, 5% and 1% levels, respectively.

Table 4 (cont.): Downward demand of manufacturing activity and services location by sector

Sector	[1]	[2]	[3]	[4]	[5]	[6]
	CPP	*Indust*	R^2	*CPP*	*Indust2*	R^2
611	+***	n.s.	0.1317	+***	n.s.	0.1306
612	+***	+***	0.1949	+***	-**	0.1865
621	+***	n.s.	0.4469	+***	n.s.	0.4504
622	+***	+*	0.1957	+***	+***	0.2100
623						
631	+***	+***	0.2366	+***	n.s.	0.2314
632	+***	n.s.	0.5040	+***	-***	0.5200
633	+***	+***	0.3650	+***	+***	0.3773
634	+***	+***	0.3723	+***	+***	0.3695
641	+***	n.s.	0.4155	+***	-***	0.4172
642	+***	+**	0.2126	+***	+**	0.2151
651	n.s.	+***	0.0291	+***	n.s.	0.0223
652	+***	+***	0.4206	+***	+***	0.4180
660	+***	+***	0.1937	+***	+**	0.1802
671	+***	n.s.	0.1297	+***	-***	0.1443
672	+***	n.s.	0.3674	+***	+***	0.3881
701	+***	n.s.	0.4682	+***	+***	0.4729
702	+***	n.s.	0.2630	+***	n.s.	0.2609
703	+***	+***	0.4779	+***	+***	0.4900
711	+***	+***	0.3507	+***	+***	0.3491
712	+***	+**	0.2874	+***	+**	0.2867
713	+***	+**	0.3742	+***	n.s.	0.3598
714	+**	n.s.	0.1963	+**	+*	0.2002
721	+***	+***	0.3941	+***	n.s.	0.3304
722	+***	+***	0.4096	+***	+***	0.4004
723	+***	n.s.	0.4164	+***	n.s.	0.4157
724	+***	n.s.	0.1853	+***	n.s.	0.1758
725	+***	n.s.	0.3482	+***	n.s.	0.3468
726	+***	+***	0.3676	+***	n.s.	0.3351
731	+***	-*	0.2801	+***	-**	0.2719
732	+***	+***	0.4971	+***	n.s.	0.3707
741	+***	n.s.	0.2257	+***	+*	0.2262
742	+***	n.s.	0.4315	+***	n.s.	0.4306
743	+***	+***	0.2362	+***	n.s.	0.2080
744	+***	+***	0.4799	+***	+***	0.4683
745	+***	+**	0.3101	+***	n.s.	0.3114
746	+***	n.s.	0.3567	+***	n.s.	0.3560
747	+***	n.s.	0.3648	+***	-***	0.3695
748	+***	+**	0.3669	+***	n.s.	0.3657

Note: */**/*** = statistically significant at the 10%, 5% and 1% levels, respectively.