Geographical Concentration of Service Activities across U.S. States and Counties, 1969-2000

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This paper inquires into the existence of concentration in the service sector. The principal characteristics of the concentration process in the period 1969-2000 in forty 2-digit SIC service sub-sectors for the U.S. states are examined. A similar analysis is carried out for five service sectors for the U.S. counties. We detect that concentration clearly takes place in some service sub-sectors, the level of sectoral disaggregation is relevant and the concentration patterns are maintained over time without relevant changes.

Concentration Géographique de l'activité de Services à travers les états et les comtés des États-Unis, 1969-2000

Cet article enquête sur l'existence de la concentration dans le secteur des services. Les principales caractéristiques du procès de concentration ont été analysées dans le période 1969-2000 comprenant 40 sous-secteurs de services (2-digit SIC). Une étude similaire a été menée concernant les secteurs de cinq services dans les comtés des États-Unis. Nous avons relevé que la concentration a clairement lieu dans certains secteurs de services, que le niveau de la désagrégation sectorielle est significatif et que les aspects de la concentration sont maintenus à travers le temps sans changements importants.

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1. INTRODUCTION

It is well known that economic activity is concentrated among space. This point has been studied for industry in many countries, however concentration of service activities have not received such interest by researchers. This paper inquires into the existence of concentration in the service sector. The principal characteristics of the concentration process in the period 1969-2000 in forty 2-digit SIC service sub-sectors for the U.S. states are examined. A similar analysis is performed for five service sectors for the U.S. counties during the same period.

The analysis is carried out from a perspective that not only considers the aggregate service sector but also distinguishes between different service sub-sectors, given that the agglomeration behaviour of different sub-sectors will not be reducible to a single pattern.

We think it is of value to examine whether U.S. service activity is concentrated across space and to analyse the dynamics of this process over time using the most appropriate statistical instruments.

We try to answer the following questions:

- Empirically test the existence of concentration in service activities.
- Study the dynamics of the concentration processes.
- Characterise the stylised facts of the concentration patterns.
- Test how the spatial and sectoral disaggregation levels affect the detection of concentration, the stylised facts and the dynamics.

The shortage of studies concerning services and their relationship with space does not reflect the enormous importance that this sector show in all developed economies nowadays. This scarcity of research allows us to contribute to new knowledge creation and evidence on spatial localization of service activities. Moreover, if we consider that the empirical application takes as geographical reference the world largest economy and that the dimension of the level of analysis (sectors, space and time) the interest of this paper can be appreciated even more.

The paper is organised as follows. In the following section we show a brief literature review about localization of service activities. In the section 3 we describe the database of employment data employed in this paper. In section 4 we approach to testing the existence of concentration through the construction of the Theil index in several different dimensions (absolute, relative and topographic). Besides we decompose it in within and between-state concentration. In section 5 we build the location quotient and give some stylised facts in subsection 5.1. We estimate kernel density functions of LQs to study the dynamics of the concentration patterns in subsection 5.2. We test the existence of concentration in service activities by means of the Standardized Location Quotient in subsection 5.3. Ultimately, section 6 conclude with some summary comments.

2. LITERATURE REVIEW

During the past two decades the Economic Geography has experienced a spectacular growth as shown by researchers like Fujita, Puga, Venables and mostly by Krugman. Together, those findings provide evidence of a field in expansion. However, the great majority of the contributions, both theoretical and empirical, have been concentrated in the analysis of the industrial sector. The issue of service concentration and localization is practically unexplored by the literature. Therefore, the potential contribution is quite remarkable.

The bibliographical review that we have carried out so far allows us to confirm that both theoretical and empirical references to services and localization, are not very numerous. The mainly theoretical papers are not more than a dozen. Daniels and Moulaert (1991) and Daniels *et al.* (1993) are monographs that collect diverse authors' contributions, some of them of theoretical character, mainly centred around conceptual aspects of service nature and the respective localization factors. Other papers only consider the localization factors and concentration of the services, both at intra and inter urban level (Airoldi *et at*., 1997, Coffey and Polèse, 1987, and O'Connor, 1987). Ultimately, there exist several pieces of work focused on specific theoretical aspects: how the access to information affects localization (Alonso-Villar and Chamorro-Rivas, 2001), the service commercialization and its geographical implications (de Vaal and van den Berg, 1999), the use of services by the industry (Hitchens *et al.*, 1994) and the importance that face to face contact holds in service activities and its consequences in localization (Goe *et al.*, 2000).

At empirical level there exist a larger number of papers, this can be partially explained by the fact that in many cases the topics related to concentration are jointly studied for industry and services. As a result of this practice a larger amount of contributions exists. In spite of this, empirical references are still not very numerous. Some authors focus on a specific sector as the financial (Brealey and Kaplanis, 1996, and Clark, 2002). Other scholars investigate the concentration phenomena in certain economies, however without analyzing the localization factors (Braunerhjelm and Borgman, 2004, for Sweden; Brülhart and Traeger, 2005, for European regions and Fingleton *et al.*, 2004, for United Kingdom). Rubalcaba and Cuadrado (1997) study the concentration of business services in several European countries, relating the volume of services per inhabitant to the disposable income. In Illeris (1996 and 1997) the research questions emphasize the descriptive aspects. The recent contribution of Desmet and Fafchamps (2005) is especially outstanding as they use the same database of American counties we employ. They neither empirically test the presence of service concentration (task that it is performed in this paper), nor identify the determinant factors of the service localization and space concentration of the service activities (as we intend to do in the nearest future).

It is also necessary to mention a special issue of the Service Industries Journal coordinated by Daniels *et al.* in 1993 entitled The Geography of Services, collecting a great amount of papers on this topic: Illeris and Philippe (1993), Senn (1993), Baró and Soy (1993), Sjøholt (1993), Cuadrado-Roura and Rubalcaba (1993), Bonamy and Daniels (1993), Mayère and Vinot (1993), Moulaert and Gallouj (1993), Monnoyer (1993), Bryson *et al.* (1993), Schneider (1993) and May (1993). Many of the contributions to this special issue have a partial character, either they concentrated on a sector or on a geographical area. In addition to that, some of the above mentioned papers treat topics related to geography and services not directly relevant for the aim of this paper, as for example the links between services and regional development.

3. DATABASE DESCRIPTION

We use the employment data reported in the Regional Economic Data Tables, published by the US Federal Government, Bureau of Economic Analysis. There are some reasons that have led us to choose employment instead of production data. Firstly, the greater availability of employment data. Secondly, as Illeris (1996) mentions, the ‘production’ of services must be considered an extremely crude statistic since it is not possible to measure the output of many service activities meaningfully. Thirdly, the belief that productivity differences between workers in the same sector in different geographical units are not significant and, thus, the number of employees is an effective

description of the degree of implantation of a sector in each zone. Fourthly, services are typically labour-intensive, so employment is a good proxy for service production.

The sample size covers the period 1969-2000. The geographical units considered in this paper are both states and counties. In the case of states, the 49 continental states plus Hawaii and the District of Columbia are considered. This makes 51 observations for each cross-section. The disaggregation level in the service sector is the two-digit SIC industries (Standard Industrial Classification) involving the following 40 sectors:

500 Transportation and public utilities
- 510 Railroad transportation
- 520 Trucking and warehousing
- 530 Water transportation
- 540 Other transportation
- 560 Communications
- 570 Electric, gas, and sanitary services

610 Wholesale trade

620 Retail trade
- 621 Building materials and garden equipment
- 622 General merchandise stores
- 623 Food stores
- 624 Automotive dealers and service stations
- 625 Apparel and accessory stores
- 626 Home furniture and furnishings stores
- 627 Eating and drinking places
- 628 Miscellaneous retail

700 Finance, insurance, and real estate (FIRE)
- 710 Depository and nondepository institutions
- 730 Other finance, insurance, and real estate
  - 731 Security and commodity brokers
  - 732 Insurance carriers
  - 733 Insurance agents, brokers, and services
  - 734 Real estate
  - 736 Holding and other investment offices

800 Services
- 805 Hotels and other lodging places
- 810 Personal services
- 815 Private households
- 820 Business services
- 825 Auto repair, services, and parking
- 830 Miscellaneous repair services
- 835 Amusement and recreation services
- 840 Motion pictures
- 845 Health services

850 Legal services

855 Education services

865 Museums, botanical, zoological gardens

870 Membership organizations

880 Miscellaneous services

The state level may be considered unsuitable because the vast size of some states could hide concentration processes at a lower level. We can go down to the county level, although that implies a trade-off in sub-sector availability. In this way we get data for more than 3,000 counties, for the same sample period but for only five service sectors:

500 Transportation and public utilities

610 Wholesale trade

620 Retail trade

700 Finance, insurance, and real estate (FIRE)

800 Other Services

In the case of counties, it is necessary to keep in mind that along the sample some few counties change definition (some appear as new counties and others disappear) as a result of which the number of counties is not fixed. These modifications in the definition of some spatial units are taken into account in the empirical work of this paper.

In the following sections different analyses are carried out with a multiple purpose. First, a description of the stylized facts of the processes of concentration of services. Subsequently, the study of the dynamics of this process. Lastly, a contrast of the existence of concentration of these activities. It is necessary to consider that all the analyses are performed for both states and counties, as well as for the different available sub-sectors and years, according to the type of analysis (cross-section or time series) considered in each moment. Therefore, we have several dimensions for the analysis.

4. SYNTHETIC CONCENTRATION INDICES. AN APPROACH TO TESTING THE PRESENCE OF CONCENTRATION

As a starting point to study the existence or not of concentration in a sector, it is required to have an index that allows measuring the degree of presence of that sector in a geographical area during a certain period. The literature on these aspects has proposed different concentration and localization indices.

Typical indices used in the empirical literature are Gini coefficient, Theil index or Herfindahl index[3]. All of them have received some criticisms and present some problems, especially Gini and Herfindahl coefficients. Nevertheless, we must analyse at least one of them in order to obtain a first outlook of the concentration patterns. Additionally, the use of the Theil index grants its decomposition. This fact adds additional information about concentration since it allows us to distinguish among within and between group effects.

[3] The results shown in this paper are the obtained from the Theil index. Similar conclusions are reached with Gini coefficient, Herfindahl index or the Adjusted Geographic Concentration index proposed in OECD (2003). Results are available from the authors upon request.

4.1. Absolute, Relative and Topographic concentration

Concentration is the extent of over or under representation of an industry in each element of a set of regions. It can be measured by the Theil index[4]:

$$T^S = \sum_{i=1}^{N} \left(\frac{X_{si}}{X_s} \right) \ln \left(\frac{X_{si} / X_s}{n_i / n} \right)$$

where i is the spatial basic unit $i \in \{1, 2, ..., N\}$, s is the economic sector $s \in \{1, 2, ..., S\}$, X_{si} is the economic activity (employment or value added) for a particular sector (s) in a spatial unit (i), $\overline{X}_s = \frac{1}{N} \sum_{i=1}^{N} X_{si} = \frac{1}{N} X_s$ and X_s is the economic activity in sector s summed across all N basic units.

T^S compares for each region i the relative economic activity of industry s, X_{si} / X_s, with what it should have been on the basis of the relative number of basic units n_i / n. The logarithmic transformation and the weights guarantee that T^S increases in the inequality of the distribution of X_s with respect to n, and that its minimum value equals 0.

Since the Theil index measures the inequality of the distribution of X_s with respect to n, the choice of n determines the kind of concentration. If regions are chosen as basic units then we are not weighting the economic activity and that is the case of absolute concentration (it is about whether a few industries tend to account for a large share of economic activity of a region). If total economic activity is chosen as basic units we weight the economic activity by the amount of aggregate economic activity. This kind of concentration is called relative concentration (it is about whether industries tend to account for a large share in the economic activity of a region relative to their average share in all other regions). Finally, if square kilometres are chosen the kind of concentration is called topographic concentration (a term coined by Brühalrt and Traeger, 2005, where region size is not controlled for by total economic activity but by land mass). Table 1 gives a summary.

TABLE 1

Types of concentration

n_i	n	Type of concentration
1	N	Absolute concentration
km_i^2	$\sum_i km_i^2$	Topographic concentration
$\sum_s X_{si}$	$X = \sum_s \sum_i X_{si}$	Relative concentration

[4] For a complete review of the use of Theil index in spatial analysis and its decomposability see Brühalrt and Traeger (2005) and Brakman *et al.* (2005)

4.1.1. Concentration in main service sectors (U.S. states and counties)

Sectoral average Theil indices of absolute, relative and topographic concentration across the full spectrum of manufacturing and services in U.S. states and counties are reported in Table 2.

TABLE 2

Average concentration of main economic sectors

(Theil index, 1969-2000)

	Absolute concentration		Relative concentration		Topographic concentration	
Sector	States	Counties	States	Counties	States	Counties
Manufacturing	0.505	1.519	0.051	0.142	0.857	2.152
Durable goods	0.561	NA	0.077	NA	0.886	NA
Non durable goods	0.489	NA	0.077	NA	0.880	NA
Services	0.467	1.725	0.003	0.018	0.758	2.317
Transport and Public Utilities	0.450	1.738	0.009	0.088	0.724	2.438
Wholesale Trade	0.510	1.967	0.013	0.101	0.771	2.670
Retail Trade	0.428	1.469	0.003	0.017	0.705	1.979
FIRE	0.537	1.976	0.019	0.077	0.818	2.689
Other Services	0.478	1.759	0.007	0.032	0.794	2.391

From Table 2 we can conclude some stylised facts:

– Spatial disaggregation level matters: Counties always show higher concentration than states for each sector[5]. This result is coherent since, as it has been commented previously, the concentration indices can be affected by the level of spatial aggregation. As we ascend in the geographical level many concentration phenomena can be hidden and compensated.

– Type of concentration matters: Topographic concentration reaches the highest values, followed by absolute concentration. Whereas relative concentration is clearly low and far away from the other two ones. This fact shows a well-known styled fact in localization topics: economic activity tends to place where other activities are located because of the existence of inter and intra industrial linkages. Therefore, if we weight indices by the total economic activity lower magnitudes of those indices are expected. This is a result of the high correlation between the total economic activity and the activity of the sector we are analysing. High values of topographical indices show another commonplace in the characterization of economic landscapes. That is, the existence of both large economic deserts and small areas whit a great agglomeration of economic activity.

– In absolute concentration, manufacturing is more concentrated than services (except the cases of Wholesale Trade and FIRE) at the state level. However, at the county level services are more concentrated than manufacturing (except Retail Trade).

– Analogously, for topographic concentration manufacturing is more concentrated than services at the state level (but in this case there are not service sub-sectors more concentrated). The county level mimics the case of absolute concentration, but with a quite greater level of concentration.

[5] Calculations have been also executed for U.S. counties removing those ones that belong to non-contiguity states (Alaska and Hawai) as Desmet and Fafchamps (2005) proposed. Obtained results are practically identical.

– In the case of relative concentration, manufacturing is always the most concentrated sector, both in states and counties. This shows a coherent fact with the literature about service location. The localization of services is more related to the existing economic activity in an area than manufacturing. Localization of industrial factories can be affected by more factors than the presence of other economic activities, as for example the availability of natural resources or communication and transport infrastructures. Two remarkable cases are retail trade and business services. The localization of the first one is very related to the population (and therefore to the economic activity generated around population). Business services preferably place near their clients (both industrial and service companies)

– Considering the five service sectors it can be conclude a clear ranking of sectors according to level of concentration: The most concentrated sector for states is always FIRE, while in county level Wholesale trade and FIRE compete for the first positions and Transportation and Public Utilities follows them at a short distance. Retail trade is, without doubt, the most dispersed sector. The concentration reached by wholesale trade at county level can appear a bit striking. This can be due to the structure of U.S. commercial distribution in, although this fact requires a deeper analysis.

Figures 1 and 2 show the evolution of relative concentration of main service sectors across states and counties, respectively. The scale of the vertical axis of both graphs is the same in order to emphasize the differences in concentration between state and county levels. These graphs also allow us to observe that the concentration of all sectors is quite stable along time especially at state level. At county level, as can be seen in Figure 2, Wholesale trade decreases considerably. Therefore, US service concentration remains constant, but some sectors are becoming more dispersed. Later on, these conclusions will be outlined with the estimation of kernel density functions.

FIGURE 1

Relative concentration of main service sectors (Theil index, employment, US states) 1969-2000

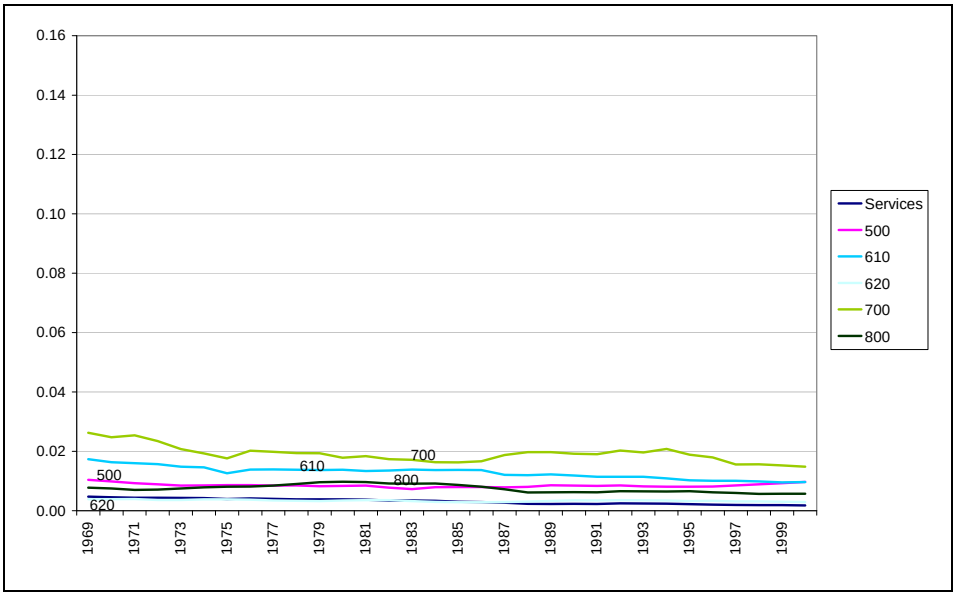
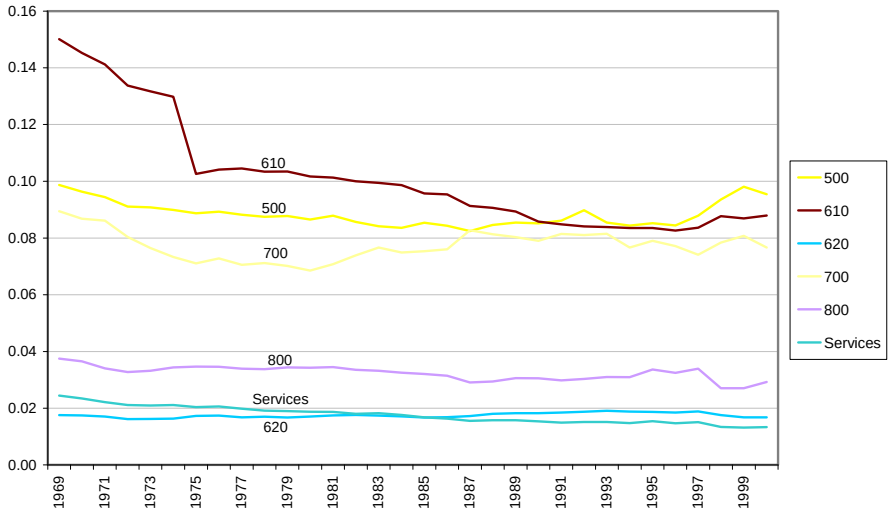


FIGURE 2

Relative concentration of all service sectors (Theil index, employment, US counties) 1969-2000



4.1.2. Concentration in service sub-sectors (only U.S. states)

In Table 3, we report the average indices of concentration for disaggregated service sub-sectors across U.S. states. As it has been explained before there is a trade-off between sectoral and spatial disaggregation level. Going down in the sectoral disaggregation implies losing county availability.

TABLE 3

Average concentration (U.S. states, Theil index, 1969-2000)

	Absolute	Relative	Topographic
Manufacturing	0.505	0.051	0.857
Durable goods	0.561	0.077	0.886
Non durable goods	0.489	0.077	0.880
Services	0.467	0.003	0.758
500 Transportation and public utilities	0.450	0.009	0.724
510 Railroad transportation	0.390	0.171	0.589
520 Trucking and warehousing	0.391	0.039	0.671
530 Water transportation	0.898	0.435	1.257
540 Other transportation	0.613	0.093	0.893
560 Communications	0.508	0.022	0.815
570 Electric, gas, and sanitary services	0.395	0.038	0.676
610 Wholesale trade	0.510	0.013	0.771
620 Retail trade	0.428	0.003	0.705
621 Building materials and garden equipment	0.382	0.024	0.623
622 General merchandise stores	0.451	0.011	0.733
623 Food stores	0.442	0.009	0.756
624 Automotive dealers and service stations	0.380	0.017	0.617
625 Apparel and accessory stores	0.513	0.013	0.844
626 Home furniture and furnishings stores	0.466	0.008	0.727
627 Eating and drinking places	0.441	0.009	0.708

628 Miscellaneous retail	0.423	0.006	0.704
700 Finance, insurance, and real estate	0.537	0.019	0.818
710 Depository and nondepository institutions	0.518	0.016	0.813
730 Other finance, insurance, and real estate	0.545	0.023	0.823
731 Security and commodity brokers	1.100	0.335	1.474
732 Insurance carriers	0.559	0.058	0.983
733 Insurance agents, brokers, and services	0.468	0.012	0.700
734 Real estate	0.549	0.035	0.776
736 Holding and other investment offices	0.625	0.092	0.867
800 Services	0.478	0.007	0.794
805 Hotels and other lodging places	0.422	0.184	0.688
810 Personal services	0.448	0.003	0.707
815 Private households	0.556	0.062	0.761
820 Business services	0.599	0.036	0.905
825 Auto repair, services, and parking	0.464	0.009	0.681
830 Miscellaneous repair services	0.449	0.015	0.644
835 Amusement and recreation services	0.513	0.071	0.760
840 Motion pictures	0.988	0.190	1.015
845 Health services	0.478	0.018	0.829
850 Legal services	0.580	0.052	1.017
855 Education services	0.581	0.089	1.128
865 Museums, botanical, zoological gardens	0.847	0.259	1.359
870 Membership organizations	0.419	0.020	0.805
880 Miscellaneous services	0.475	0.031	0.714

Main conclusions:

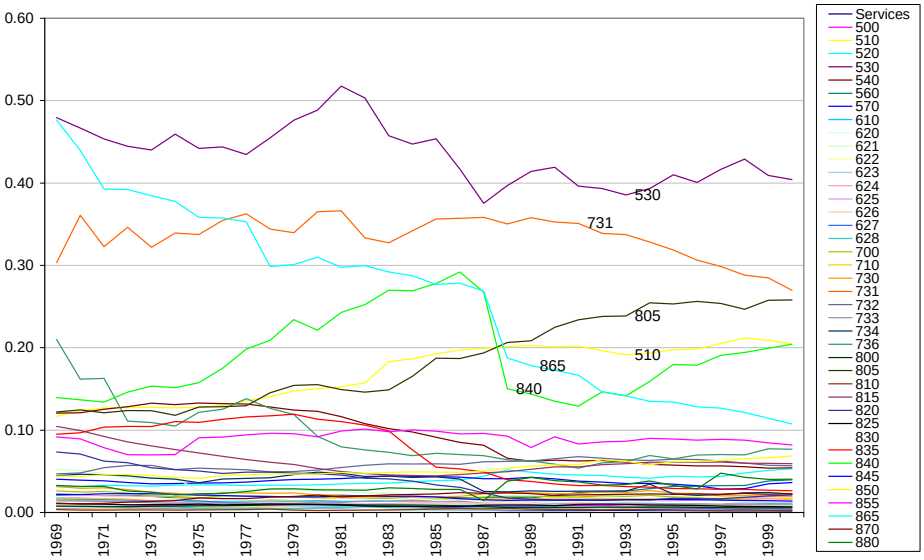
– Sub-sectors of retail trade (620) are invariably the most dispersed. Retail trade localization is much related to population, its main client. So, the great relative dispersion in retail trade was expected.

– There are some sub-sectors that show a strong concentration with all types of concentration: Water transportation (530), Security and commodity brokers (731), Museums, botanical, zoological gardens (865) and Motion pictures (840). In relative concentration, in addition to the previous ones, we also have to mention Hotels and other lodging places (805) and Railroad transportation (510). If we weight by land area (topographic concentration) we can add three sectors that also show a high concentration: Education services (855), Legal services (850) and Insurance carriers (732).

Although all these indices seem considerably high with regard to other sectors, we advance one important question; does concentration really take place in sectors with high values of the LQs? If so, in which counties and states does economic activity actually concentrate? Up to now, we have been able to describe some stylized facts of the concentration patterns by the means of the Theil index. However, we have not statistically tested the presence of concentration. This issue is solved in subsection 5.3 by the Standardized Location Quotient.

FIGURE 3

Relative concentration of all service sectors (Theil index, employment, US states) 1969-2000



From Figure 3 some time patterns can be concluded. Most of the sectors and sub-sectors of services show a constant concentration along time. However, a few of them show a decreasing tendency. Museums, botanical, zoological gardens (865) has the most clear decreasing trend, becoming more dispersed at the end of the sample period. Water transportation (530), after reaching a maximum value of concentration in the beginning of the 80's, starts to disperse. In a similar way, Security and commodity brokers (731) maintains its level of concentration until 1991, afterwards it starts decreasing. Motion pictures (840) shows a singular pattern, becoming more concentrated in the first half of the sample (until the middle 80's), dispersing from then until the beginning of the 90's and gaining concentration again to the end of the sample, but without reaching the maximum values achieved before. On the other hand, some sectors such as Hotels and other lodging places (805) and Railroad transportation (510) become more concentrated along the sample.

4.2. Decomposition: Within and Between Concentration

4.2.1. Decomposability of entropy indices:

General entropy indices (Theil index is a particular case of them) are especially interesting because they allow for decomposition analysis. This permits us to compare within-state concentration to between-state concentration.

Each Theil index (Entropy index with $\alpha = 1 \Rightarrow GE(1)_s$) can be decomposed additively as:

$$GE(1)_s = GE_w(1)_s + GE_b(1)_s$$

where $GE_w(1)_s$ and $GE_b(1)_s$ stand for within-subgroups and between-subgroups general entropy, respectively. In this paper basic units are counties that are grouped in states. Between-states concentration, $GE_b(1)_s$, is computed by applying :

$$GE_b(1)_s = \frac{1}{K}\sum_{k=1}^{K}\left(\frac{\overline{X}_{sk}}{\overline{X}_s / K}\right)\ln\left(\frac{\overline{X}_{sk}}{\overline{X}_s / K}\right)$$

The contribution of within-state concentration is computed as follows:

$$GE_w(1)_s = \sum_{k=1}^{K}\left(\frac{X_{sk}}{X_s}\right)GE(1)_{sk}$$

$$GE(1)_{sk} = \frac{1}{n_k}\sum_{\substack{i=1 \\ i\in k}}^{n_k}\left(\frac{X_{si}}{\overline{X}_r}\right)\ln\left(\frac{X_{si}}{\overline{X}_r}\right)$$

4.2.1. Between-state and within-state components:

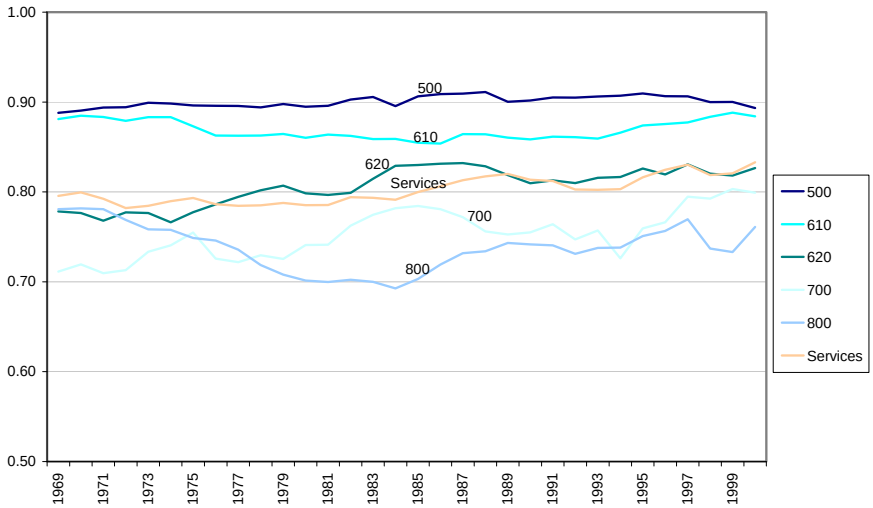
We have computed within-state shares of concentration $\left(GE_w(1)_s / GE(1)_s\right)$ across all sectors. The results are reported in Figures 4 and 5 for relative and topographic concentration, respectively.

The concentration of services is more within-state rather than between-state since within shares are always higher than fifty percentage (more than 70% in relative concentration and 60% in topographic one). Thus, within-state concentration largely dominates between-state concentration. This result is much related to the fact previously commented about the importance of using as geographical reference unit the smallest one available. It is coherent that the concentration is more caused by differences between counties of the same state (within-state concentration) rather than by differences between states.

On the other hand, slightly lower within-shares in topographical concentration indicate that the large size of states meaningfully weights in the determination of geographical concentration. As an example the areas of Alaska or Texas against District of Columbia or Hawaii can be compared

FIGURE 4

Within-state share in overall relative concentration, 1969-2000

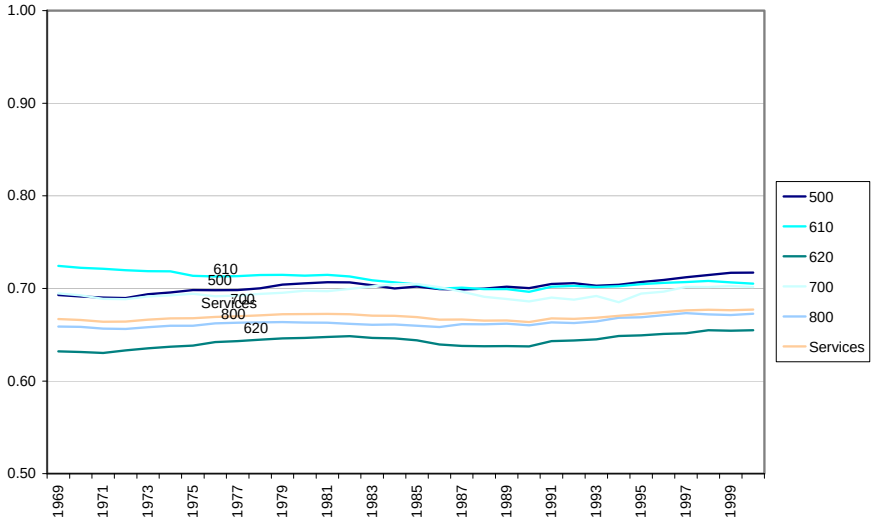


In terms of changes over time, most sectors do not exhibit definite time patterns. We observe that within-state share of relative and topographic concentration has maintained quite constant or slightly increased. Some sectors

(Wholesale trade and Other Services) show a u-shape time profile in relative concentration –declining until the middle 80's but increasing since then.

FIGURE 5

Within-state share in overall topographic concentration, 1969-2000



5. DOES CONCENTRATION EXIST IN SERVICE ACTIVITIES?

5.1. Location quotient

An advantage and at the same time inconvenience of the Theil index (and similar indices) is that they reduce the concentration to a scalar for the whole sample of geographical units. If we want to carry out some analysis more in depth and be able to locate in which geographical units the concentration is located we must use other indices such as the Location Quotient.

The Location Quotient (LQ) is a measurement of the relative concentration of a sector in an area (subject economy) compared to the same sector in another, usually larger, area (benchmark economy). The location quotient is defined by the expression:

$$LQ_{ij_t} = \frac{\frac{E_{ij_t}}{E_{j_t}}}{\frac{E_{ir_t}}{E_{r_t}}}$$

where E_{ij} is employment in sector *i* of state/county *j*, E_j is the total service employment in state/county *j*, E_{ir} represents employment in sector *i* in the geographical area of reference, in this case the U.S., and E_r is the total service employment in the area of reference. All the variables are referred to a generic time period t.

This index always takes non-negative values. If it adopts values close to one, this indicates that the representation or presence of the sector analysed in both economies (subject and benchmark) is similar. Values of

the index significantly different from one correspond to an over or under-representation of the subject economy in comparison with the average of the units being studied. A situation of complete dispersion of a sector during a period of time would be identified with a unitary value of the index for all the states in this period. On the other hand, index values very different from one for a significant number of states strongly indicate a more varied and concentrated economic landscape. The construction of this quotient allows us to avoid the problem of summarizing the information for the whole sample of spatial units in a scalar, since one LQ is built for each geographical unit.

The benchmark economy of this study is the United States, whilst the subject economies are the states (or the counties) that comprise it. For each year and sector, we calculate the LQ of the corresponding state (or county). Thus, a panel data set of LQs is obtained which is characterised by the size of each cross-section (N: states or counties) being significantly larger than the total number of periods (T: 1969-2000).

Before turning to more sophisticated statistics we build three-dimension graphs that show the level of LQs and its time evolution across U.S. states. In Figure 6 four notable sectors are shown. Some notes on these graphs and other not shown here because the lack of space:

– Sector of railroad transportation (510) show two states (Nebraska and Wyoming) with high values of LQs (about 7-7.5) with an increasing concentration.

– As it was expected Louisiana show LQ values higher than 10 in Water transportation (530).

– Financial activity such sector (731) Security and commodity brokers (731) concentrates in New York, reaching values of 4.5 for its LQ.

– Alaska and Hawaii shoq concentration in Holding and other investment offices with LQs that exceed 5.00.

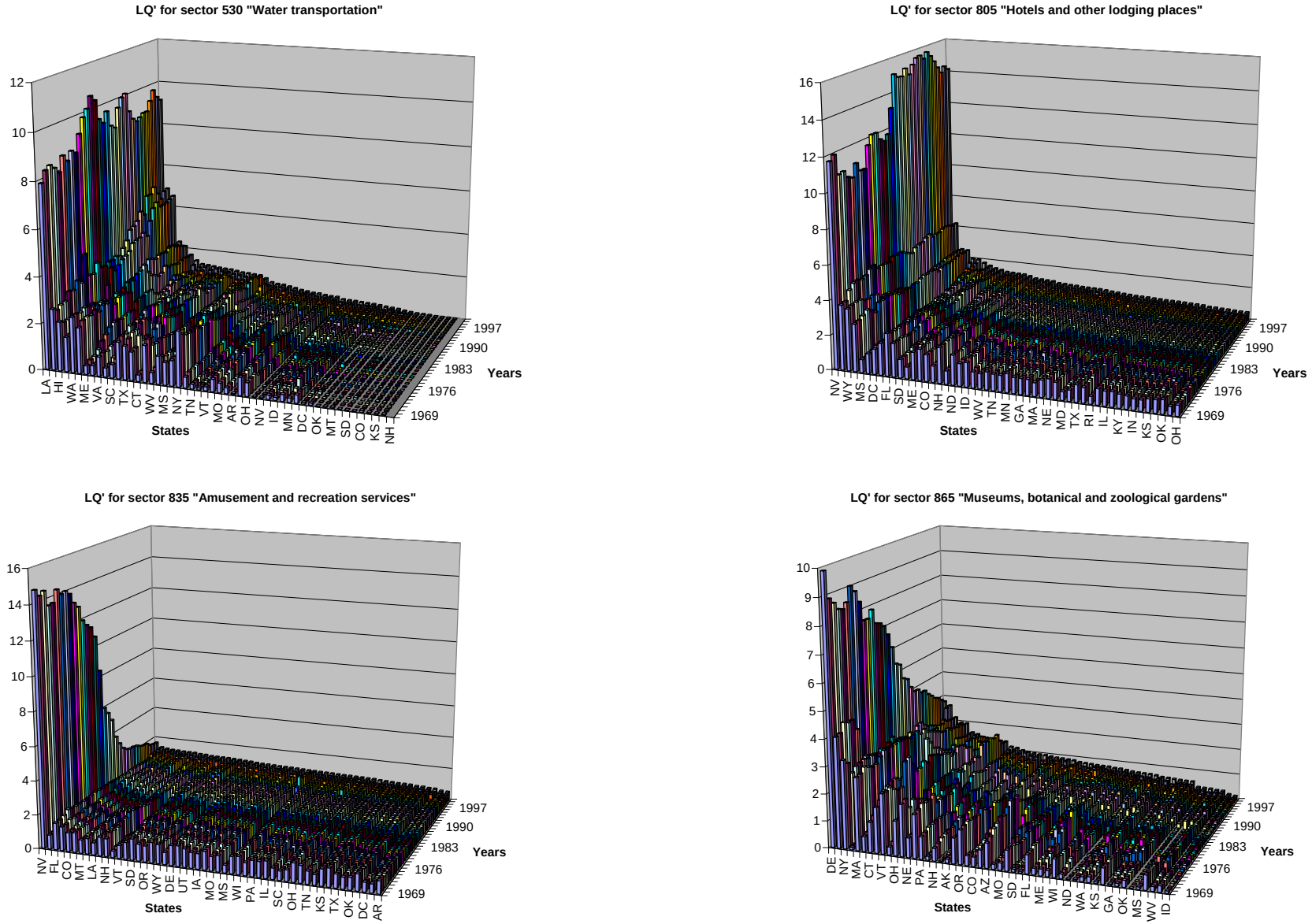
– Nevada state constitutes a noteworthy case with a high concentration in several service sector quite interrelated: Hotels and other lodging places (805) with LQs up to 16 and Amusement and recreation services (835) with LQs up to 14. These activities are especially concentrated in cities such as Las Vegas or Reno. It is well known that Nevada economy depends on tourism and, particularly, on games.

– Legal services (850) are concentrated in the District of Columbia that shows a large concentration in this kind of services with a value of LQ close to 7.

– Delaware has a number of places of interest such as botanical gardens, museums, wildlife refuges, parks, houses, lighthouses, and other historic places. That is why it presents a LQ of 10 at the beginning of the sample for the sector Museums, botanical, zoological gardens (865). However, as the economy of this state has grown, the relative importance of the 865 sector has lost weight and for this reason the LQ has gradually decreased along time.

FIGURE 6

Location quotients for U.S. states, 1969-2000



5.2. Kernel density estimation

In this stage we analyse whether the concentration of different services has grown, or otherwise, with the passage of time. The methodological instrument is the study of the kernels, and thereafter the analysis of the mean and standard deviation. The method consists on estimating the density functions of the LQs distributions through an adaptative Gaussian kernel.

From this exercise it can be observed that out of 40 service sectors, 17 show signs of an increase in dispersion, 12 have continued to concentrate, while 11 sub-sectors have remained in a similar level of concentration[6]. These results lead us to the conclusion that an important pattern of behaviour is a tendency towards a lessening in the differences between states, whereas there exists also two other important tendencies among some sectors, one of them to increase their concentration and the other one to keep it stable.

These results could seem contradictory to the previous ones in some way. For example, sector 865 showed the most clear decreasing trend with the relative Theil index. However, its concentration remains stable through the study of the kernel density functions of LQs. Which is the reason for this contradictory pattern? If we observe the three dimensional graph of the LQ for sector 865 in Figure 6, we can conclude that Delaware LQs show an important fall, whereas the rest of states do not significantly change their values and relative positions. If Theil indices in 1969 and 2000 are compared they show important differences in values. However, the kernel system consists on estimating the density function of the LQ distribution. As the only changes in the distribution are those related to Delaware, which represents an extreme value of the sample, it can be expected that the density function has not significatively changed.

In the first three graphs of Figure 7 the estimated density functions for 1969 and 2000 of Wholesale, FIRE and other services are shown. Those sectors are representative of the three main detected tendencies. Wholesale trade concentration decreases along time, FIRE shows an stable pattern of concentration and Other services become more concentrated.

Fourth graph of Figure 7 shows the density function of sectors in counties for the whole time period (1969-2000). It is clearly observed that Retail trade density is concentrated around 1, pointed out a great dispersion. Something quite similar takes place in total services. On the other hand, the rest of sectors show a larger concentration of density around values lower than unity, indicating that there exist an important number of counties underrepresented in those sectors and, therefore, there exists concentration in a few spatial units.

TABLE 4

Mean and standard deviation of the LQs (status)

	1969		2000	
	Mean	Std. Deviation	Mean	Std. Deviation
Services	0.972	0.108	0.979	0.067
500 Transportation and public utilities	0.974	0.167	0.988	0.180
510 Railroad transportation	1.147	0.709	1.351	1.446
520 Trucking and warehousing	0.981	0.213	1.056	0.362
530 Water transportation	0.774	1.261	1.024	1.525

[6] Sectors that show a decrease in concentration are: 500, 610, 620, 540, 621, 622, 627, 628, 734, 736, 810, 815, 820, 825, 835, 840 and 845. Sectors with an increase in concentration: 800, 510, 520, 530, 560, 623, 625, 626, 830, 850, 870 and 880. Sectors that remain stable are: Total services, 700, 570, 624, 710, 730, 731, 732, 733, 805, 855 and 865.

540 Other transportation	0.900	0.561	0.941	0.445
560 Communications	0.958	0.197	0.938	0.302
570 Electric, gas, and sanitary services	1.062	0.323	1.095	0.336
610 Wholesale trade	0.882	0.190	0.922	0.185
620 Retail trade	0.997	0.114	1.016	0.104
621 Building materials and garden equipment	1.158	0.503	1.037	0.221
622 General merchandise stores	0.908	0.166	1.031	0.265
623 Food stores	0.959	0.152	1.004	0.180
624 Automotive dealers and service stations	1.093	0.241	1.080	0.242
625 Apparel and accessory stores	0.889	0.180	0.905	0.230
626 Home furniture and furnishings stores	0.990	0.131	0.942	0.169
627 Eating and drinking places	0.997	0.206	1.010	0.105
628 Miscellaneous retail	1.036	0.153	1.035	0.166
700 Finance, insurance, and real estate	0.912	0.201	0.946	0.213
710 Depository and nondepository institutions	0.925	0.135	1.022	0.456
730 Other finance, insurance, and real estate	0.908	0.233	0.926	0.210
731 Security and commodity brokers	0.707	0.506	0.761	0.632
732 Insurance carriers	0.831	0.362	0.934	0.463
733 Insurance agents, brokers, and services	1.001	0.213	0.973	0.203
734 Real estate	0.920	0.310	0.938	0.225
736 Holding and other investment offices	1.030	0.957	0.939	0.518
800 Services	0.995	0.200	0.973	0.126
805 Hotels and other lodging places	1.394	1.637	1.349	1.948
810 Personal services	0.955	0.116	0.979	0.102
815 Private households	1.060	0.533	0.875	0.283
820 Business services	0.861	0.420	0.877	0.220
825 Auto repair, services, and parking	0.997	0.148	0.979	0.123
830 Miscellaneous repair services	0.995	0.230	1.031	0.213
835 Amusement and recreation services	1.193	1.958	0.992	0.235
840 Motion pictures	0.843	0.352	0.732	0.380
845 Health services	0.956	0.253	0.988	0.186
850 Legal services	0.913	0.282	0.964	0.794
855 Education services	0.915	0.553	0.999	0.532
865 Museums, botanical, zoological gardens	0.865	1.554	0.965	0.575
870 Membership organizations	1.029	0.231	1.043	0.395
880 Miscellaneous services	0.917	0.246	1.125	0.382

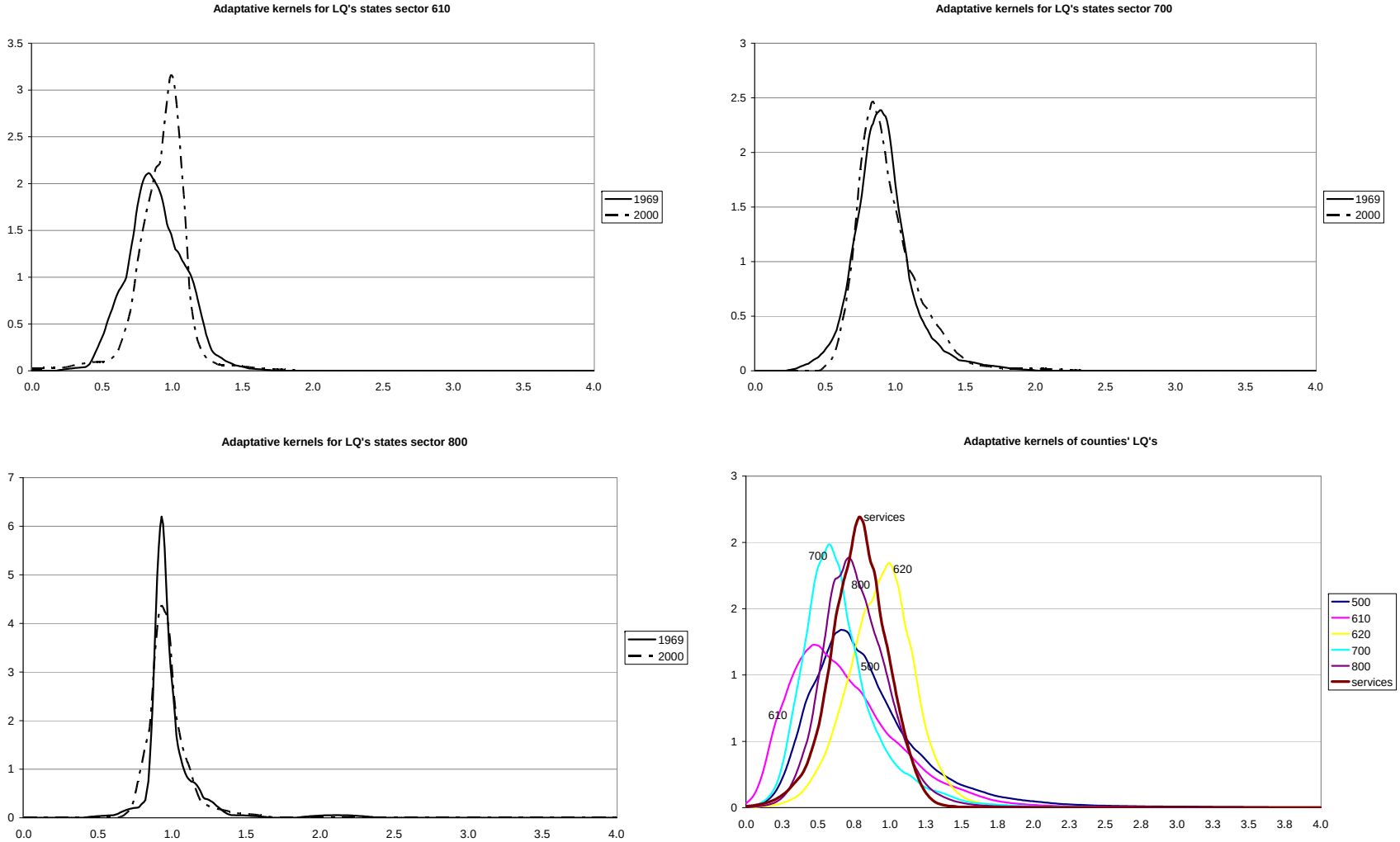
Graphics comparing kernels of counties and states are not displayed in this paper. However, it can be outlined that kernels of states for all main sectors show a larger density around unity than kernels of counties. Then, a higher concentration in counties is again proved.

Ranking and evolution of concentration patterns derived from kernels considerably coincide with the conclusions reached from Theil index. At the state level, Wholesale and FIRE show a large concentration, whereas Retail trade and Total services show a high dispersion. Besides, Transportation and Public Utilities, Wholesale trade and Retail trade exhibit a falling concentration tendency; FIRE remains quite stable and Other services becomes more concentrated. At the county level, the ranking obtained from kernels, from larger to smaller concentration, states as: Wholesale trade, Transport and Public Utilities, FIRE, Other services and Retail trade. Time evolution shows that

Transport and FIRE diminishes it concentration level, whereas Wholesale trade increases it and Retail and Other services remain stable.

FIGURE 7

Estimated density functions for several sectors, U.S. states and counties



5.3. Standardized Location Quotient

The previous indices give us an idea of the patterns of concentration and its evolution in the different sectors across states and counties. However, they do not determine beyond which value the sectors can be considered concentrated. Therefore, the main limitation of using the LQ for this purpose is that there are no commonly agreed empirical or theoretical LQ cut-off values for defining a cluster (Martin and Sunley, 2003). The Standardized Location Quotient, proposed in O'Donoghue and Gleave (2004), recognizes agglomerations as being comprised of locations with statistically significant (rather than arbitrarily defined) location quotient values for the activity under analysis. So, we compute this statistical test to check the existence of agglomerations in services.

TABLE 5

Percentage distribution of Standardised Location Quotients, U.S. counties, 1969-2000

	No concentration	Concentration (SLQ>1.65)	Low Concentration (1.65<SLQ<1.96)	Quite concentration (1.96<SLQ<2.33)	High concentration (2.33<SLQ<4.66)	Very high concentration (SLQ>4.66)
Services	99.3	0.7	0.6	0.1		
Transport and Public Utilities	95.5	4.5	2.0	1.3	1.0	0.2
Wholesale Trade	97.3	2.7	1.7	0.7	0.3	
Retail Trade	98.2	1.8	1.1	0.6	0.2	
FIRE	94.9	5.1	2.3	1.5	1.1	0.1
Other Services	97.0	3.0	1.5	0.7	0.6	0.1

The measure identifies those locations that have exceptional concentrations of activity as represented by statistically significant residuals (outliers) at the 5% confidence level. It is calculated in three steps. First, LQ values are calculated for the activity under analysis. Secondly, it is necessary to check that the LQ values are normally distributed. Thirdly, LQs are converted into z-values. We can identify those locations, which have exceptional concentrations, or agglomerations, of activity by examining residual values that lie beyond 1.65 (due to asymmetric nature of LQ distributions)

Table 5 shows the percentage distribution of SLQ across counties for the main service sectors. The column named "Concentration" represents the percentage of cases that have a SLQ higher than 1.65. Table 6 also shows this percentage distribution but for the case of states that allows higher sector availability.

TABLE 6

Percentage distribution of Standardised Location Quotients, U.S. states, 1969-2000

	No concentration	Concentration (SLQ>1.65)	Low Concentration (1.65<SLQ<1.96)	Quite concentration (1.96<SLQ<2.33)	High concentration (2.33<SLQ<4.66)	Very high concentration (SLQ>4.66)
SLQServices	95.7	4.3	1.8	0.6	0.9	1.0
500 Transportation and public utilities	93.5	6.5	2.6	2.3	1.0	0.5
510 Railroad transportation	99.2	0.8	0.3	0.1	0.5	
520 Trucking and warehousing	96.8	3.2	1.3	0.7	1.2	
530 Water transportation	96.9	3.1	1.3	1.4	0.3	
540 Other transportation	95.4	4.6	0.5	0.1	3.3	0.8
560 Communications	92.8	7.2	1.8	2.8	2.2	0.4
570 Electric, gas, and sanitary services	94.6	5.4	1.1	2.0	1.7	0.5
610 Wholesale trade	95.5	4.5	2.6	0.8	1.1	

620 Retail trade	99.7	0.3	0.3			
621 Building materials and garden equipment	96.2	3.8	2.8	0.8	0.2	
622 General merchandise stores	96.3	3.7	1.5	1.4	0.6	0.2
623 Food stores	95.6	4.4	2.8	0.9	0.7	
624 Automotive dealers and service stations	96.9	3.1	1.2	0.9	0.9	
625 Apparel and accessory stores	93.6	6.4	2.1	1.4	2.8	0.1
626 Home furniture and furnishings stores	96.1	3.9	1.8	1.3	0.8	
627 Eating and drinking places	96.0	4.0	1.9	0.9	1.2	
628 Miscellaneous retail	97.1	2.9	1.5	0.9	0.6	
700 Finance, insurance, and real estate	92.6	7.4	2.2	2.5	2.3	0.3
710 Depository and nondepository institutions	95.7	4.3	1.2	0.7	0.4	2.0
730 Other finance, insurance, and real estate	92.2	7.8	2.8	3.0	2.0	0.1
731 Security and commodity brokers	94.7	5.3	1.2	2.0	0.7	1.4
732 Insurance carriers	97.6	2.4	0.4		2.0	
733 Insurance agents, brokers, and services	94.4	5.6	2.6	2.3	0.7	
734 Real estate	93.3	6.7	2.7	2.8	1.2	
736 Holding and other investment offices	94.1	5.9	2.1	2.4	1.5	
800 Services	95.8	4.2	0.3	1.1	1.1	1.7
805 Hotels and other lodging places	94.4	5.6	1.3	0.5	1.8	2.0
810 Personal services	97.4	2.6	1.8	0.6	0.2	
815 Private households	92.5	7.5	4.2	3.0	0.3	
820 Business services	93.0	7.0	4.3	2.0	0.7	
825 Auto repair, services, and parking	95.3	4.7	2.3	1.2	1.1	
830 Miscellaneous repair services	96.1	3.9	2.3	0.9	0.7	
835 Amusement and recreation services	97.5	2.5	0.6	0.4	1.5	
840 Motion pictures	94.4	5.6	1.2	1.0	1.3	2.0
845 Health services	95.1	4.9	2.6	1.9	0.4	
850 Legal services	96.7	3.3	0.4	0.4	0.6	2.0
855 Education services	92.8	7.2	3.2	1.6	2.5	
865 Museums, botanical, zoological gardens	97.0	3.0	1.0	1.3	0.7	
870 Membership organizations	97.9	2.1	0.2			2.0
880 Miscellaneous services	93.8	6.3	3.2	1.7	1.2	0.2

At the county level it can be observed that Transport and FIRE present 4.5% and 5.1% of statistically significative cases with presence of concentration, respectively. Moreover, even though with very small percentages, but there exist 0.2% and 0.1% of cases in those sectors with very high concentration. Maps in Figure 8 do not display intensity of SLQ, but number of times that each county presents significative SLQ (SLQ larger than 1.65). Although these maps show a summary of the whole sample some spatial clusters can be found. For example, financial activities (FIRE) incline to concentrate in counties placed in three main locations: East Coast (New York and contiguous states), Florida and West coast (mainly California and Colorado states).

Sub-sectors showing largest percentages of cases with significative SLQs at the state level are (in this order): Private households (815), Education services (855), Communications (560), Business services (820), Real estate (734), Apparel and accessory stores (625), Miscellaneous services (880), Holding and other investment offices (736), Insurance agents, brokers and services (733), Hotels and other lodging places (805), Motion Pictures (840), Electric, gas and sanitary services (570) and Security and commodity brokers (731). Some sub-sectors show 2.0% of

cases with very high concentration. It results quite easy to guess which states cause that high concentration: Depository and non depository institutions, in New York and Colorado; Hotels and other lodging places, in Nevada and Hawaii; Motion pictures, in California and New York; Legal services, in New York and District of Columbia and Membership organizations, in District of Columbia.

FIGURE 8

Maps of U.S. counties with number of years with statistically significant SLQs

Fig. 1: Concentration of service activity. Sector 500 (Transportation and Public Utilities). 1969-2000

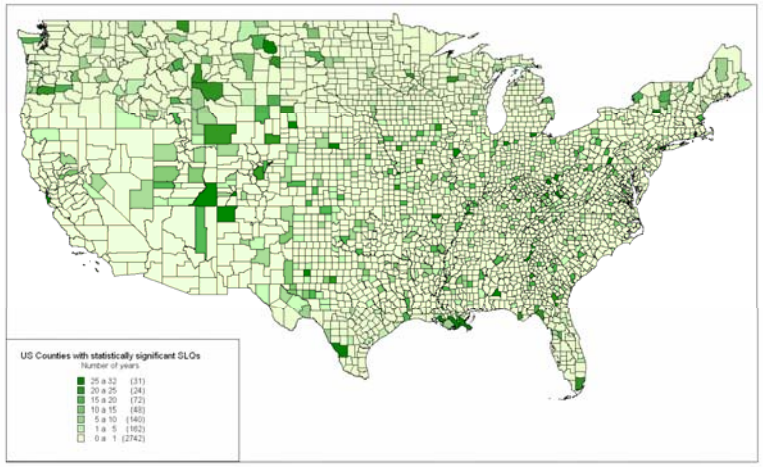


Fig. 2: Concentration of service activity. Sector 610 (Wholesale Trade). 1969-2000

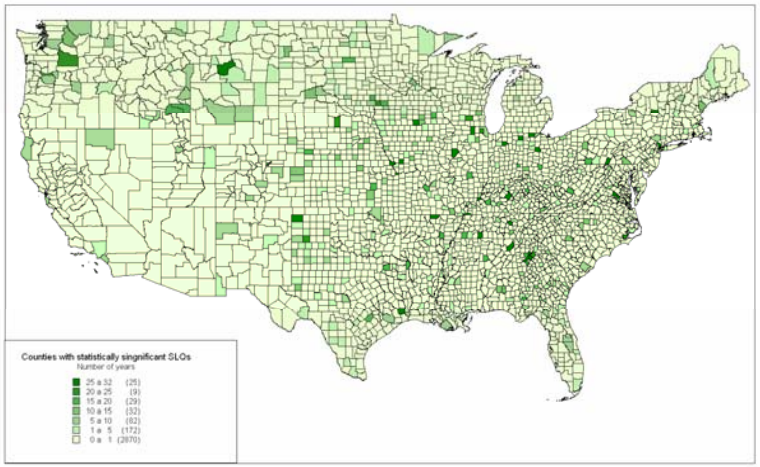


Fig. 4: Concentration of service activity. Sector 700 (FIRE). 1969-2000

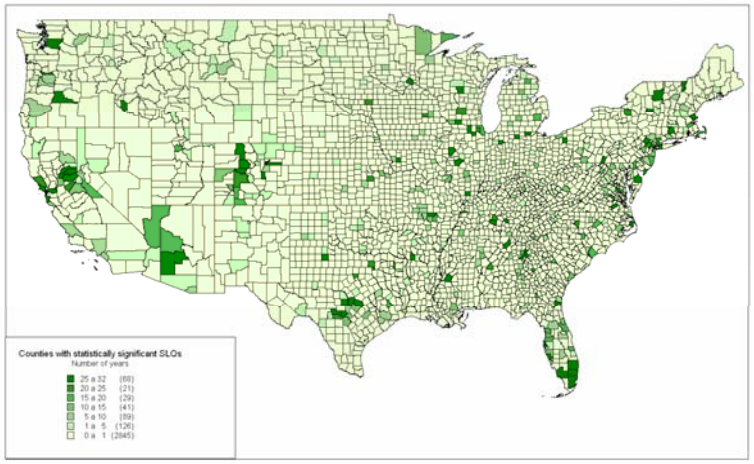
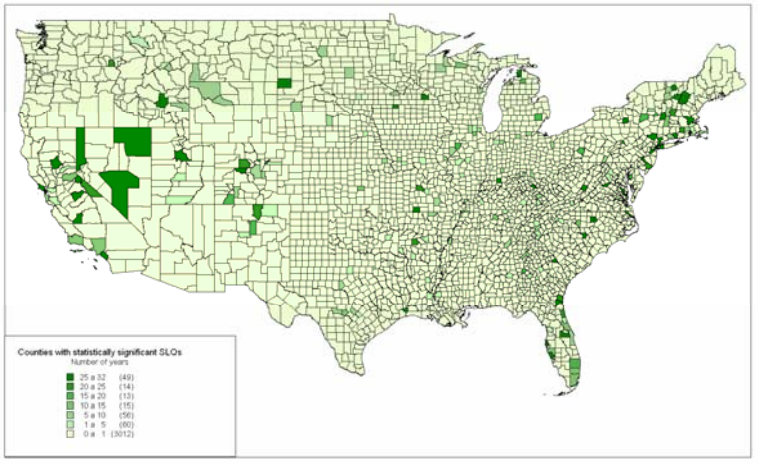


Fig. 5: Concentration of service activity. Sector 800 (Other services). 1969-2000



6. CONCLUSIONS

This paper shows a work in progress to study the existence and patterns of concentration in service activities across U.S. states and counties during the period 1969-2000. We have used different statistical instruments and indices to get our aims: Theil indices, Location Quotients, kernel density estimation and Standardized Location Quotients. The estimation of kernel density functions has allowed us to reach similar conclusions and to outline some of the conclusions obtained from Theil indices.

We have described some stylised facts about concentration at state and county level for the main service sectors (Transportation and Public Utilities, Wholesale trade, Retail trade, FIRE and Other services). Firstly, spatial disaggregation level matters (counties always show higher concentration that states for all service sectors). Secondly, type of concentration also matters: topographic concentration reaches the largest values, whereas relative concentration is clearly low. Thirdly, if we compare concentration in manufacturing and services we observe that manufacturing is more concentrated than services at the state level for absolute and topographic concentration, whereas services are more concentrated at the county level. In relative concentration, manufacturing is always more concentrated both at state level and at county level. Fourthly, FIRE shows the greatest concentration followed closely by Wholesale trade. Whereas, Retail trade always displays the largest dispersion. Ultimately, concentration remains quite stable along time, except for Wholesale trade across counties that shows a decreasing concentration.

If we go down to sub-sectors of services we get up to 40 sub-sectors information, but only at state level. We can offer some conclusions from their analysis. Sub-sectors of retail trade are invariably the most dispersed. The greatest part of sub-sectors exhibit a low degree of concentration, nevertheless some of them display a strong concentration (Water transportation; Security and commodity brokers; Museums, botanical and zoological gardens; Motion pictures; Hotels and other lodging places; Railroad transportation; Education services; Legal services and Insurance carriers). Most of the sub-sectors show a constant concentration pattern along time, except some particular cases that display a decreasing or increasing pattern (Museums, botanical and zoological gardens; Water transportation; Security and commodity brokers; Motion pictures; Hotels and other lodging places or Railroad transportation).

The decomposition in within-state and between-state of the Theil indices leads us to confirm that concentration of services is more within-state rather than between-state.

Finally, we statistically test the existence of concentration in several service sectors and sub-sectors by means of the Standardized Location Quotient. Sub-sectors showing the largest percentages of cases with significative SLQs at the state level are: Private households (815), Education services (855), Communications (560), Business services (820), Real estate (734), Apparel and accessory stores (625), Miscellaneous services (880), Holding and other investment offices (736), Insurance agents, brokers and services (733), Hotels and other lodging places (805), Motion Pictures (840), Electric, gas and sanitary services (570) and Security and commodity brokers (731).

Our next research step is to identify the determinants of location and spatial concentration of services. We will estimate a panel data model to identify those factors. The dependent variable will be the location quotient for each sector and the explanatory variables the ones proposed in several papers such as Coffey and Polèse (1987), Daniels *et al.* (1993), Illeris (1996, 1997), Moulaert and Gallouj (1993), Rubalcaba and Cuadrado (1997) and Rubalcaba and Gago (2003), among others.

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