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GROWTH IN COMMUTING DISTANCES IN POLYCENTRIC METROPOLITAN AREAS: THE CASE OF PARIS[1]

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Summary

It has frequently been suggested in the literature that a polycentric distribution of employment and people shortens commuting distances because people locate within or close to their employment subcenter (co-location hypothesis). Having studied the three biggest French metropolitan areas over the last decade we have established that co-location affects only a minority of inhabitants, of whom there are fewer in 1999 than there were nine years earlier. Indeed, the majority of people living in a subcenter work outside their subcenter of residence. This situation was even more marked in 1999 than it was in 1990. In addition to this, the majority of jobs located in subcenters are held by non-residents who are generally living further and further from their place of work.

Key-words: polycentrism, commuting distance, Paris

JEL classification: R14, R49

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1- Polycentrism and commuting distance

People living and working within the same metropolitan area are increasingly living further and further from their place of work: the 1999 and 1990 French censuses emphasize that the average (intra-metropolitan) distance from home to work has grown by 16% over the last decade (Massot and Roy, 2004). In particular, the municipality of residence is becoming increasingly different from the municipality of work. Such changes in commuting patterns, especially in the development of inter-municipality commutes, are promoting increased regular car use.

These findings explain the growing interest in the relationship between *urban form* and commuting patterns (Giuliano and Small, 1993; Handy, 1996; Priemus, Nijkamp and Banister, 2001). Given that most metropolitan areas are becoming polycentric (Anas, Arnott and Small, 1998), a body of research investigates whether polycentric distribution of people and jobs would be likely to re-organize mobility patterns in a more sustainable way (Schwanen, Dieleman and Dijst, 2002). Polycentrism is indeed associated with specific commuting patterns (Levine, 1992): in centralized cities most commutes are into the central city, while in polycentric cities the suburbs attract a significant share of the commuters.

A key question is whether the development of employment subcenters would be likely to favor the *co-location* of workers and jobs (Gordon, Richardson and Jun, 1991) in the suburbs and then to counteract increasing home-to-work distances. Most polycentric urban models are indeed based on the premise that people tend to locate within or close to their employment subcenter (Sasaki, 1990), so the emergence of a polycentric model, either spontaneous or planned by *large agents* (private or public), is an answer to the non-sustainable growth of commuting distances - and costs – that characterize the monocentric city (Richardson, 1988). The empirical studies show more contradictory results.

R. Dubin (1991) has thus shown, in the case of Baltimore, that working in a subcenter was associated with longer commuting distances than working in the central city. Studying the San Francisco Bay Area, R. Cervero and K.L. Wu (1997) came to an opposite conclusion however: they found that the average home-to-work distance was shorter for people working in subcenters than for those with a job in the central city. P. Gordon, H.W. Richardson and H.L. Wong (1986) explained nevertheless that in the case of Los Angeles, people living in subcenters experienced a longer average home-to-work distance than those living in the central city, because a minority of those living in a subcenter had very long commutes (especially those who worked in the central city) while the majority of them worked in their

subcenter of residence and subsequently had very short commutes, even shorter than the central city residents. The authors thus concluded that polycentrism was associated with shorter work trips for a majority of the inhabitants.

In France, although many recent studies have underlined the development of subcenters inside most metropolitan areas and especially the biggest (Gaschet, 2002), links between polycentrism and commuting patterns have not been widely discussed. Urban sprawl in general is felt to be responsible for the growth of the average commuting distance insofar as the further the people live from the central city, the longer they spend commuting. But the specific impact of polycentrism and in particular the co-location hypothesis, *i.e.* the place of residence of those working in a subcenter, have not been questioned.

In this paper two specific questions are raised. Are the people who live in a subcenter also employed in this subcenter? And do the (other) people working in a subcenter live close to this subcenter? If we compare the answers to these two questions in 1990 and in 1999, we can assess whether the situation is better or worse (in terms of proximity to place of work) in 1999 than ten years previously. The empirical work focuses on the largest French metropolitan areas: Paris.

After a brief presentation of the data and the area of study, we identify and characterize the employment subcenters. We then analyze the location of jobs held by people living in a subcenter, firstly in 1999 and secondly between 1990 and 1999, then the location of people working in a subcenter. We then assess the impact in terms of commuting distance. The conclusion summarizes the main results and suggests guideline for future research.

2- Area of study and data

We referred to the functional definition of the *urban areas* recently proposed by the French National Institute for Statistics and Economic Studies (INSEE). Each urban area is composed of a dense zone, concentrating at least 2,000 inhabitants and 5,000 jobs, and of all the municipalities in which at least 40% of the working residents have a job. The boundary of each urban area naturally changes over time, but we needed a fixed boundary so we took 1999 as our boundary. The central city is defined by the INSEE as the most important municipality and is of course located inside the dense zone. In 1999, the urban area of Paris was composed of 1,583 municipalities and concentrated more than 11 million inhabitants in 5.1 million jobs.

Data used was taken from the 1990 and 1999 censuses which indicate the municipality of residence and the municipality of work. Concerning inter-municipality trips, as is often the case in this type of study we have kept the distance between the central nuclei of the

municipalities weighted by a factor of 1.3. Concerning intra-municipality commutes it was necessary to take the size of the municipality into account because of huge differences. We therefore regarded each municipality as being a circle, taking as commuting distance its radius also weighted by a factor of 1.3. Given that we focused on the co-location hypothesis at an intra-metropolitan level, only intra-metropolitan commutes have been taken into account.

3- Subcenters defined by the polarization of inter-municipality commutes

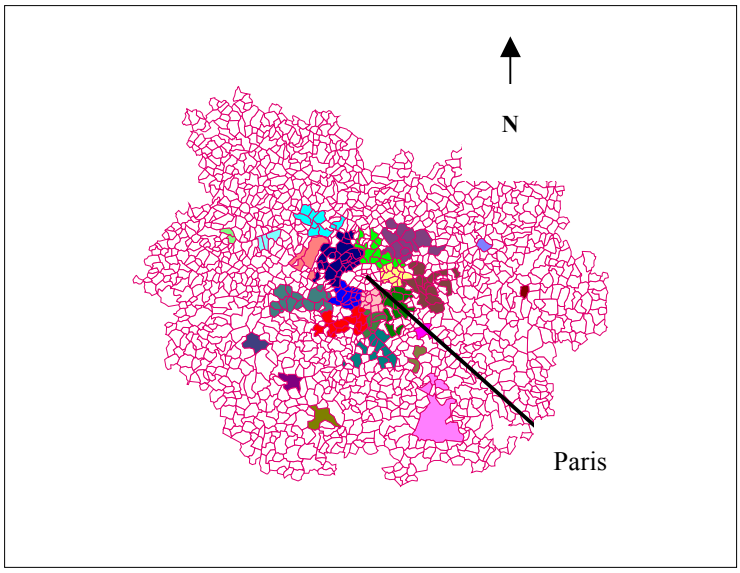
Polycentrism means that most jobs that are located in the suburbs are concentrated within one or more subcenters. The consequence is that the vast majority of trips to the suburbs are in fact to one of these subcenters, the subcenters can therefore be defined as areas that attract a major proportion of the commuters who work outside the central city (Bourne, 1989; Berroir, Mathian and Saint-Julien, 2002). Few studies have used such a criterion however, the most common criterion being the number and/or density of jobs (Mc Donald, 1987 ; Giuliano and Small, 1991).

To identify subcenters in Paris we referred to the attractiveness of work trips. The method involved two phases. The first identifies those suburban municipalities which are the most attractive to the non-resident workers, *i.e.* people working outside their municipality of residence. We then selected the set of municipalities which in 1999 attracted 85% of these commuters. There is no contradiction between this methodology and criteria based on job numbers: the selected municipalities concentrated 80% of the jobs located outside the central city.

In the second phase, given that the selected municipalities formed units of neighboring or close municipalities, we used a functional criterion to group adjacent municipalities: the boundaries of each subcenter were chosen to maximize the inter-municipality commutes that took place within the subcenter. This means that a municipality (selected in phase 1) is grouped with the (selected) municipalities that attracted the largest proportion of its working residents.

25 subcenters were identified for 1999 in the Paris urban area (Figure 1). If we compare with 1990, it appears that their number and location have not changed between 1990 and 1999, though 22 relatively small adjacent municipalities situated along the motorways have emerged in the majority of the subcenters.

Figure 1: Subcenters in the Paris urban area (1999)



Furthermore, the boundaries of each subcenter are fixed and we are using the 1999 definition. The subcenters are mainly concentrated around the central city, but some are also located further afield and along the motorways, confirming previous findings concerning the importance of access to the main transport links for firms (Aguilera and Mignot, 2003).

We can distinguish two kinds of subcenters based on their location: those located very close to the central city, and which are known as *closer-in subcenters*, and those located further afield and which are referred to as *outlying subcenters* (Table 1). This distinction is important because in France, as mentioned above, the further people live from the central city, the longer their average commuting distance: we can then expect to see outlying subcenters emerging, following the co-location hypothesis, to offer jobs to the growing number of people who live far from the central city and also far from the closer-in subcenters.

Table 1: The different types of employment subcenters in Paris in 1999

	Paris
Number of subcenters	25
% of municipalities	13%
Nb of closer-in subcenters	6
Nb of outlying subcenters	19

4- Subcenters and the co-location hypothesis: the location and commuting distance of people working in a subcenter in 1999

In 1999 the subcenters concentrated 80% of jobs and 70% of workers whose place of residence was located outside the central city. In closer-in as well as in outlying subcenters, the number of jobs was greater than the number of working residents: the ratio is 1.1 on average. However, less than half of workers living in a subcenter have a job in the same subcenter (Table 2). This proportion is very similar in the three urban areas and in the two kinds of subcenters.

Table 2: Location of jobs held by people living in a subcenter in 1999

	closer-in	outlying
Central city	29.8%	18.8%
Same subcenter	42.2%	42.1%
Other subcenter	24.6%	29.9%
Other municipality	3.4%	3.2%
total	100%	100%

About 30% of those living in a closer-in subcenter have a job in the central city, although residents of outlying subcenters depend more upon jobs located in other subcenters (Table 2) and especially on jobs located in the closer-in subcenter(s) to which they are connected by motorway or by train.

If we now consider the jobs located in the subcenters (Table 3) we note that more than half are filled by non-residents. Jobs are mainly held by people living in another subcenter and also (especially for the outlying subcenters) in the suburban municipalities which do not belong to a subcenter.

Table 3: Place of residence of people working in a subcenter in 1999

	closer-in	outlying
Central city	13.1%	5.6%
Same subcenter	43.0%	39.9%
Other subcenter	28.1%	23.6%
Other municipality	15.8%	30.9%
total	100%	100%

We therefore have two types of spatial imbalances between jobs and inhabitants: on one hand the majority of people living in a subcenter work outside and on the other hand the majority of jobs concentrated within these subcenters are filled by non-residents. In other words, co-location is not the rule for a majority of people.

However people living in a subcenter have shorter commutes on average than those living outside (Table 4), because the average commuting distance is very short for the 42% of those working in their subcenter of residence (Table 5). This result confirms the previous findings of (Gordon, Richardson and Wong, 1986). Moreover in closer-in subcenters, a large proportion of residents benefit from proximity to central city jobs: the average commuting distance is then less for those living in closer-in subcenters compared with outlying subcenters where many residents work in a closer-in subcenter and therefore have longer commutes.

Table 4: Average distance to work (km) in relation to place of residence in 1999

Place of residence	Distance to work (km)
Central city	9.9
Subcenter	12.8
Closer-in subcenter	9.9
Outlying subcenter	15.2
Other municipality	20.2
Whole urban area	11.3

Table 5: Average distance to work (km) in relation to place of residence and location of job in 1999

Place of residence	Place of work	Distance to work (km)
Central city	Central city	7.5
Central city	Subcenter	14.5
Central city	Other municipality	33.2
Subcenter	Central city	16.9
Subcenter	Same subcenter	4.0
Subcenter	Other subcenter	18.6
Subcenter	Other municipality	15.3
Other municipality	Subcenter	37.2
Other municipality	Subcenter	22.2
Other municipality	Other municipality	8.7

As regards the municipalities situated outside the subcenters: approximately two thirds of residents work in the central city or in a subcenter and the associated commuting distance is long, especially for those who have a job in the central city (Table 5): 37.2 km. When the job is located in a subcenter, the average distance is shorter but remains considerable nonetheless: 22.2 km. However, this later result means that the existence of employment subcenters allows a large proportion of inhabitants to live in the suburbs and to have shorter commuting distances than in a monocentric model where they would rely exclusively on central jobs. However, these people do not live very close to their employment subcenter as is often hypothesized in the models.

Our findings also confirm that the central city residents have the shortest average commuting distance because the vast majority of them (70%) work in the central city while the rest benefit from proximity to the closer-in subcenters.

5- Changes in people and job distribution and growth in commuting distances between 1990 and 1999

Over the last decade, the number of jobs and working residents in the central city has fallen while this number has increased in the suburbs (Table 6). Jobs in subcenters but also outside them have increased but the proportion of suburban jobs located in the subcenters has remained stable (80%). However, subcenters have lost many working residents whilst numbers of workers has significantly increased outside subcenters: about 27% of workers living in the suburbs were located outside a subcenter in 1990, this compares to 30% nine years later.

Table 6: Changes in the number of jobs and workers in each urban area between 1990 and 1999

	Central city	Subcenters	Other municipalities
workers	-3.6%	-2.9%	+11.5%
jobs	-7.8%	+4.0%	+7.0%

The consequence of this increase in jobs and decrease in working residents in the subcenters is the creation of a growing jobs-housing imbalance: the number of jobs per working resident has grown on average from 0.9 to 1.1 over the decade. As a result, subcenters are beginning to specialize as employment areas because more jobs are being created there while more and more people are living in the suburbs but outside these subcenters.

Although there were more jobs per resident in the subcenters in 1999 than there were in 1990, the proportion of people living and working in the same subcenter has fallen during the last decade for both types of subcenters (Table 7). In other words, there were less working residents in the subcenters in 1999 than in 1990 and a higher proportion of them were working outside. The explanation for this lies in the increase in exchange-commutes between the different subcenters but also in commutes from the subcenters to the municipalities located outside, where we have noted that job numbers have increased significantly. The number (and proportion) of commutes from a subcenter to the central city has in the same time period fallen dramatically because of the diminishing number of jobs located in the central city.

Table 7: Changes in the number of people living and working in the same subcenter between 1990 and 1999

	People living and working in the same subcenter
Subcenters	-13.7%
Closer-in subcenters	-15.8%
Outlying subcenters	-9.9%

In the subcenters, the proportion of jobs held by the residents has diminished. A growing proportion of the jobs are thus held by people living in another subcenter, outside a subcenter and also in the central city.

In other words, the changes in the distribution of people and jobs has led to a rise in the number of commutes between the subcenters, but also from the subcenters to the other suburban municipalities and from the central city to the subcenters.

These changes partly explain the growth in the average commuting distance (+14.4%) that characterized the three urban areas (Table 8). Moreover, commutes have become longer regardless of where people live: in the central city, in a subcenter or outside a subcenter.

Table 8: Increase in the commuting distance in relation to place of residence between 1990 and 1999

Place of residence	Increase in the commuting distance
Central city	6.5%
Subcenter	10.6%
Closer-in subcenter	12.8%
Outlying subcenter	9.6%
Other municipality	15.6%
Whole urban area	14.4%

The average increase was less significant for central city residents however, because most of them have benefited from the proximity of jobs located in the closer-in subcenters. The increase was also less marked for people living in a subcenter than for those living outside. Indeed between 1990 and 1999 the main change for people living outside the subcenters was

the drastic decrease in the proportion of those working outside a subcenter, and particularly those whose job was located in the same municipality, who had very short commutes (Table 7). Over the same period, the average commuting distance for those living outside a subcenter but working in a subcenter (and also for those working in the central city) and who are becoming more and more numerous has risen, especially in the case of Paris.

For people living in a subcenter the first change was the decrease in the number of those working in the central city and especially a decrease in the number of residents living in an outlying subcenter with a central job, whose commutes were very lengthy. This change heralded a decrease in the average commuting distance. However, the second major change was an increase in the number of residents whose job was located outside their subcenter of residence, which led on the contrary to a significant growth in average commuting distances.

6- Conclusion

This paper has investigated the development of population and employment location and its consequences in terms of commuting distance between 1990 and 1999 in the urban area of Paris Indeed, it has frequently been suggested in the literature that the polycentric urban model could contribute to reducing commuting distance by allowing people to locate within or close to their employment subcenter (*co-location hypothesis*).

However, our findings emphasize that, although there are more jobs than working residents in all the subcenters, most people living in a subcenter work outside their subcenter of residence. This situation was also more marked by 1999 than it previously was in 1990. As a result, average commuting distances have increased for people living in a subcenter. In addition to this, the majority of jobs located in subcenters are filled by non-residents who generally live quite far from their employment subcenter, and indeed further in 1999 than they did in 1990.

Over the last decade, changes in location of jobs and people led to a growth in jobs in the subcenters, but a fall in the number of working residents, whilst resident workers as well as jobs have increased in the other suburban municipalities. Results in terms of commuting patterns showed a growth in the number of commuting trips between the subcenters and also between the subcenters and the municipalities located outside, so the average commuting distance has increased regardless of where people live. Even central city residents rely increasingly on jobs located in subcenters, but also outside them: consequently their average distance to work has also increased over the last decade.

Future research will investigate the premise that a growing number of inhabitants cannot live within or close to their employment subcenter because of a growing mismatch between the

nature of jobs and type of housing available. Some studies have thus emphasized that long commuting distances were associated with a lack of certain types of housing, especially for people on lower incomes, within or close to most employment subcenters (Levine, 1999; Wachs, Taylor and Levine, 1993).

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