

# **URBAN FORM AND COMMUTING: A CRITICAL REVIEW OF LITERATURE**

*AGUILERA, Anne*

*Université Paris Est, INRETS, LVMT*

*6-8 avenue Blaise Pascal*

*F-77455 Marne la Vallée*

*aguilera@inrets.fr*

## **ABSTRACT**

Over the years, extensive literature has highlighted the evolutionary trends of North American and European urban areas towards a less centralized and a more polycentric distribution of people and employment. Consequences for daily mobility, in terms of distance traveled and mode shares are important questions for both researchers and planners who seek ways to reduce greenhouse gas emissions in urban areas. This paper proposes a critical review of literature about the links between urban form, commuting distance and car use. Urban form is defined as the spatial organization of people and jobs within a urban areas.

The paper is organized into three parts. In the first part, I question the relationships between urban form and commuting by questioning the relationships between home to work distance and residential location. In the second part, I show how studies that compare commuting patterns in monocentric *versus* polycentric urban areas produce quite contradictory results. I then propose to explore, in the third part, the links between the form taken by polycentrism and commuting patterns. I conclude with some policy recommendations concerning both urban planning and transportation system.

*Keywords: Polycentrism, commuting distance, car use*

## **INTRODUCTION**

Over the years, extensive literature has highlighted the evolutionary trends of North American and European urban areas towards a less centralized and a more polycentric distribution of people and employment. Consequences for daily mobility, in terms of distance traveled and mode shares are important questions for both researchers and planners who seek ways to reduce greenhouse gas emissions in urban areas. Urban form is defined as the spatial organization of people and jobs within a urban areas.

This paper proposes a critical review of literature about the links between urban form, commuting distance and car use. Nonwork trips are not taken into account because, in this research field, most studies concern only commuting trips. Indeed, on the one hand, data are often more easily available (especially in France), and, on the other hand, commuting trips are supposed to be more sensitive to urban form than nonwork trips.

This paper is organized into three parts. In the first part, the analysis concerns the relationships between urban form and commuting distance. More precisely, I question the relationships between residential location and home to work distance. Indeed, if residential choice largely relies on individual socio-economic characteristics, especially income, household size, and gender, a number of studies also support the claim that urban form is also an important factor. However, this assumption has been regularly disputed. By considering mainly literature on excess commuting, and especially the most recent findings, I explain that if people do not try to minimize home to work distance when they choose a residence (or a job), home to work distance is taken into account.

The second and third parts question the differences between monocentrism and polycentrism in terms of commuting distance and car use. In the second part, I show how studies that compare commuting patterns in monocentric *versus* polycentric urban areas produce quite contradictory results. It is not surprising because, on the one hand, no urban area can be considered as fully monocentric, and, on the other hand, there are different forms of polycentrism: the number of employment subcenters, their size and location vary across urban areas. I then propose to explore, in the third part, the links between the form taken by polycentrism and commuting patterns. Results are mainly based on a recent research that has compared three French areas (Aguilera and Mignot, 2007). I show that the positioning of the employment subcenters in the transport system and their distance to the center influence commuting patterns. I conclude with some policy recommendations concerning both urban planning and transportation system.

## **HOME TO WORK DISTANCE AND RESIDENTIAL LOCATION**

The relationship between home to work distance and residential location at the intra-urban scale is disputed. Some argue that home to work distance does not matter anymore in a context of growing use of car which has increased average speed dramatically. However, other researchers claim that if people do not minimize home to work distance, they still try to live not too far from their place of employment.

These questions have in particular been discussed by the literature on excess commuting (or wasteful commuting). The later designates, for a given urban area, the difference between the observed home to work distance and the theoretical distance calculated by minimizing home to work distance, given the actual spatial organization of both people and jobs. The

difference is systematically positive, even if its importance varies across cities (Giuliano and Small, 1993 ; Frost and al., 1998 ; Hamilton, 1982 ; Ma and Banister, 2006 ; Merriman and al., 1995).

For some authors, and especially G. Giuliano and K.A. Small (1993), this result proves that people do not pay attention to home to work distance when they chose a residence or a job. Others have a different interpretation (White, 1999). On the one hand, several studies have introduced more realistic constraints in the reassignment process of people and jobs in order to take into account the fact there are differences in terms of qualification (O'Kelly and Lee, 2005), or that dual-earner household are composed by two persons having two job locations but only one place of residence (Kim, 1995). These studies conclude that excess commuting is significantly less important when those kind of constraints are taken into account. In other words, a part of excess commuting is explained by the fact that, for different reasons like the existence of two workers and then two employment locations, some people could not minimize home to work distance even if they would. For instance, for dual earner households, half of the excess commuting is explained by the existence of two places of employment (Kim, 1995).

On the other hand, the recent works of W. Horner (2002) and M. Charron (2007) have given new insights on the interpretation of excess commuting. They have proposed to consider not only the theoretical minimal home to work distance associated to a given urban form, but also the theoretical maximal distance. They have showed that the observed home to work distance was statistically correlated to these two theoretical distances. In other words, if people do not strictly minimize home to work distance, the later is taken into account when they choose a residence or a job.

Other studies, using other methodologies, tend to corroborate this assumption. In particular, the work of T. Schwanen and al. (2004) shows a correlation in several Dutch cities between home to work distance and urban form, even if other parameters, and especially socio-economic parameters, are of greater importance in explaining commuting distance. The analysis of home to work distance in French cities also highlights that only a minority of people live really far from their place of work (Massot and Aguiléra, 2009). However, women are more likely to live closer because they face more household responsibilities than men (Aguiléra and al., 2010; Sermons and Koppelman, 2001). In addition, people who are located very far from their place of employment often change their place of residence or their place of work quite rapidly in order to reduce commuting distance (Van Ommeren and al., 1997 and 2000).

## **MONOCENTRIC VERSUS POLYCENTRIC CITIES: A WRONG DEBATE?**

Models of economic geography suggest that the development of employment subcenters is accompanied by a diminution of home to work distance, because people tend to relocate within or close to their employment subcenter (Fujita and Ogawa, 1982). More precisely, cities evaluate from monocentric to polycentric forms when commuting costs tend to be too high both for firms and for employees. Thus, polycentric cities should be characterized by shorter commuting costs and especially commuting distances than monocentric ones

(Richardson, 1988). In addition, polycentric cities are sometimes supposed to be less favourable to the automobile (Sénécal and al., 2002). However, empirical works have produced quite contradictory results (Aguilera, 2005).

### **Commuting distance**

On the one hand, studies that compare home to work distance by type of job location (center versus subcenter) show that, in general, the distance is shorter for jobs located in a subcenter, which seems to confirm the superiority of polycentric forms of job location (Cervero and Wu, 1998; Giuliano and Small, 1991; Jun and Ha, 2002). For example, in the three French metropolitan areas analyzed by A. Aguilera (2005) nearly half of the subcenters' inhabitants live and work within the same subcenter. But the tendency in the past decades shows a significant diminishing in the number of people living and working within the same subcenter and in addition a significant sprawl of workers' housing always further from their subcenter of employment. In San Francisco R. Cervero and K.L. Wu (1998) observed thus that over their ten-year study period there has been increase of between 11% and 27% in average commuting distance for people working in the subcenters. By comparison the increase in commuting distance was just 9% for the jobs located in the city center. The same result has been highlighted in France in several metropolitan areas: a growing number of people live outside their subcenter of employment, in another subcenter or in peri-urban areas, and this tendency contributes to increase the average home-to-work distance of people working in the subcenter (Aguilera, 2005). Average distance to jobs tend to homogenise between the center and the subcenters (Cervero and Wu, 1998).

On the other hand, the study of T. Schwanen and al. (2004), which has compared the influence of urban form on commuting patterns in several Dutch monocentric and polycentric cities, has shown that, average home to work distance is shorter in monocentric city than in polycentric ones (all things being equal). Of course, this contradicts the initial hypothesis.

### **Car use**

Most studies suggest that polycentrism is associated with a greater use of car (Aguilera, 2005; Barbonne and al., 2008). Indeed, people who work in employment subcenters are actually more likely to use car for commuting purposes than people working in the center. The main reason is however the inadequacy of public transport, especially between the subcenters (Fillion, 2001). In fact public transport in most European and North American metropolitan areas is adapted to a monocentric distribution of employment and not to a polycentric one. Thus, monocentric cities The increase in car use is clearly related to the development of travels and especially home-to-work trips between the subcenters and also from the peri-urban areas to the subcenters (Aguilera, 2005). In the case of Istanbul, where public transport is more equally spread, P. Alpkokin et al. (2005) have demonstrated that polycentrism has contributed to maintaining the share of public transport journeys. This result may however be due to a smaller motorization rate.

On this topic, the study of T. Schwanen and al. (2004) has not produced convincing results. Indeed the authors only highlight that, all else being equal, women are more likely to go to

work by car in polycentric cities than in monocentric ones, which is of course difficult to explain. For the men, no statistical result can be established.

## **FORM OF POLYCENTRISM AND COMMUTING**

To summarize, studies that have tried to compare monocentric and polycentric cities in terms of commuting patterns or, within the same city, to compare the commuting patterns of people according to job location (center *versus* subcenters) have produced quite contradictory results.

However, some of these studies suggest that it could be more fruitful to characterize polycentrism in a more detailed way. The work of T. Schwanen and al. (2004) has proposed to distinguish between three categories of polycentric cities and has shown how this classification was relevant in terms of commuting patterns. Indeed, they have demonstrated that in one of these three categories the average home to work distance was as short as in monocentric ones, and that car use was also similar.

In this work, the classification of polycentric cities is based upon the organization of commuting flows between the center and the periphery, and comes from a previous work of N. Van Der Laan (1998). Three forms of polycentrism are distinguished: in the first one the center and the periphery are independent, insofar as people living in the center also work in the center and people living in the periphery work in the periphery. This corresponds to some extent to the “urban village” version of polycentrism, where each subcenter is relatively independent from the others and from the center (Bertaud and al., 2009). In the second form of polycentrism, people living in the center work in the periphery and inversely, and in the third form most commutes coming from the center and the periphery are attracted by the periphery (which means that the center has very few employment). The authors show that, all else being equal, polycentric cities in which the center and the subcenters are independent have shorter average commuting distances than in the two other forms of polycentrism. Polycentric cities in which the commutes are organized into several independent “villages” have the same characteristics than monocentric cities.

These results suggest that the right way to classify cities is not to binary oppose monocentric *versus* polycentric configuration, but rather to consider that polycentrism can take a variety of forms (Sarzynski et al., 2005) that can influence commuting patterns. By the way, this conclusion is consistent with that of M. Charron (2007) who has shown that polycentrism could be associated to either short or long commutes. It depends on the relative importance of internal commutes (i.e. internal to the center and to each subcenter), that are short, and commutes between the center and the subcenters, that are longer in average.

Empirical studies are still rare in this field. In France, a recent work has compared three cities representing three contrasted categories of polycentrism (Aguiléra and Mignot, 2007). The classification is different of that of T. Schwanen and al. (2004). Indeed, it is not based upon the analysis of commutes between the center and the periphery, but rather upon the number, location and relative importance of the subcenters in terms of jobs.

The three forms are the following. The first one has been qualified as “extended monocentrism” because the main employment subcenters are concentrated around the center. The city of Lyon, located in the south east of France, is representative of this form of polycentrism. In the two other forms, some or all of the most important subcenters are

located further from the center. Marseille, located in the south of France, is duocentric because there is only one important subcenter outside the center. Lille, in the north of France, is quadricentric cities because three important subcenters can be distinguished.

This study shows that at least two elements explain the differences in terms of home-to-work distance between cities. The first is the degree of concentration of people and jobs. Concentration of jobs and housing both in the center and in the subcenters leads to a smaller commuting distance. Indeed, whilst the job-housing balance does not automatically ensure self-containment, the proximity to a large number of jobs reduces commuting length (Wang, 2001). Thus, the number of individuals located very close to their workplace is the highest in the French metropolitan area of Marseille where the percentage of people living in the center and in the subcenters is the highest.

The second important element concerns the spatial positioning of the center and the subcenters. The distance and transport network between the center and the major(s) subcenter(s) together with their accessibility are fundamental. In the metropolitan area of Marseille, the long distance between Marseille and its major subcenter, Aix en Provence (duocentric form) and the fact that they are well connected by the highway network produces very long commutes. Similarly, in the Lille metropolitan area, the large number of commutes between the subcenters of Roubaix and Tourcoing on the one hand and the city center (Lille) and the subcenter of Villeneuve d'Ascq on the other hand (which are representative of a quadricentric form) explain that the Lille area has a higher average distance by radius ratio than in Marseille. In the metropolitan area of Lyon, the fact that no major subcenter is located far from the city center ("extended monocentrism") goes some way to explaining that the average distance is lowest than in Marseille although the sizes are comparable.

However, in all three metropolitan areas, the average home-to-work distance has grown in the past decade for people working in subcenters. Several explanations can be given to this growth. The first is that not enough housing was being constructed in and around the employment subcenters. In addition, there is sometimes a lack of affordable housing for some categories of workers (Korsu and Massot, 2005). A second reason is the growing number of dual-earner households: in general they tend to locate close to the woman's workplace. A third reason is the location of some of the subcenters in low congested areas: it encourages people to live further from workplace in distance but not in time. Between 1990 and 1999, the number of people living in a subcenter has fallen between 1990 and 1999 in the three cities, while the number of jobs has increased dramatically. It has led to a development of commutes between the subcenters and also from the smallest municipalities, where jobs are rare, to the subcenters. The result is an important growth of commuting distance, and also a growing use of car.

## **CONCLUSION: SOME POLICY RECOMMENDATIONS**

Urban form is of course not the only, nor the most important factor that explains travel behaviour in cities. The everyday spatial and temporal organisation (and especially constraints, like the work schedules) that are faced by the individuals, are very important (Aguilera et al., 2009; Kwan, 2000). However, to a certain extent, urban form is one of the elements that determine the opportunities and constraints in terms of residential localization and localization of the different everyday activities (work, shopping, etc.).

However, the links between urban form and mobility are complex and still disputed. Undoubtedly, efforts have to be made on a methodological point of view in order to better modelize urban form and to identify and classify the parameters that really influence mobility patterns. It is in particular important to better take into account in the modelization of urban form the relative distance and positioning of the center and the subcenters in the transportation systems (public transport and roads and motorways).

The previous review of literature suggests three main findings that can be useful for transport and land-use policies.

- First, the debate between monocentrism and polycentrism is not fruitful. The real challenge concerns the spatial matching between housing and employment and/or their accessibility by public transport;

- Second, literature shows that people live further and further from their employment subcenter. To a certain extent this evolution is explained by a lack of affordable and/or appropriate housing (especially in terms of size) for some of the households and especially the lowest income group (Korsu et Massot, 2005). A quantitative and qualitative job-housing balance does not automatically mean that people work in their subcenter of residence (Peng, 1997). It is however a necessary (but not sufficient) condition that has to be accompanied by housing policies in terms of both revalorisation and construction (Van de Coevering et Schwanen, 2006). Moreover, the costs of residential mobility, especially in France, obviously limit the co-location of people and jobs. However, at medium or long term, economic crisis and higher oil prices will probably lead households to reduce spatial distance between home and work. Conversely, at short term, the crisis and its consequences in terms of redundancy and job insecurity can have the inverse effect.

- Third, empirical studies show that diminishing car use, especially for home to work trips, implies a development of public transport between the major employment subcenters and also between these subcenters and the city center. Another important issue is the limitation of car use within the subcenters as it is done in many city centers (Bouf and Hensher, 2007). These measures would in addition probably also reduce car use for non work trips. The development of electric cars could also contribute to a reduction of CO2 emissions. One can imagine policies that promote the development of transit systems between the main employment subcenters and the use of electric cars for the (shorter) trips that take place between the transit station and the place of residence, together with a limitation of urban sprawl around the subcenters and the development of houses that produce energy for electric cars. Such urban form would be more relevant from an environmental point of view.

## REFERENCES

Aguiléra, A. (2005). Growth in Commuting Distances in French Polycentric Metropolitan Areas : Paris, Lyon and Marseille. *Urban Studies*, 42, 1537-1547.

Aguiléra, A. and D. Mignot (2007). Formes urbaines et migrations alternantes : les enseignements d'une comparaison des aires urbaines de Lille, Lyon et Marseille. XLIII<sup>ème</sup> colloque de l'ASRDLF, 11-13 juillet.

Aguiléra A., M.H. Massot and L. Proulhac (2010). Exploring the relationship between work and travel behavior on weekdays : An analysis of the Paris Region Travel Survey over 20 years. *Transportation Research Record*, to be published.

- Alpkokin, P., Y. Hayashi, J. Black and H. Gercek (2005). Polycentric employment and impacts on urban commuting patterns: case study of Istanbul, *Journal of the Eastern Asia Society for Transportation Studies*, 6, 3835-3850.
- Barbonne, R., R. Shearmur and W.J. Coffey (2008). Les nouvelles dynamiques intra-métropolitaines de l'emploi favorisent-elles des migrations pendulaires plus « durables » ? Le cas de la région métropolitaine de Montréal, 1998-2003. *Géographie, économie, société*, 10, 103-120.
- Bertaud, A., B. Lefèvre and B. Yuen (2009). GHG Emissions, Urban Mobility and Efficiency of Urban Morphology: A Hypothesis. *Urban Research Symposium*, Marseille, 28-30 juin.
- Cervero, R. and K.L. Wu (1998). Sub-centring and commuting: evidence from the San Francisco bay Area. *Urban studies*, 35, 1059-1076.
- Charron, M. (2007). La relation entre la forme urbaine et la distance de navettage : les apports du concept de « possibilité de navettage. Thèse de Doctorat en Etudes Urbaines.
- Fillion, P. (2001) Suburban mixed-use centres and urban dispersion: what difference do they make? *Environment and Planning A*, 33, 141-160.
- Frost, M., B. Linneker and N. Spence (1998). Excess or wasteful commuting in a selection of British cities. *Transportation Research Part A*, 32, 529-538.
- Fujita, M., H. Ogawa (1982). Multiple equilibria and structural transition of non-monocentric urban configuration. *Regional science and Urban Economics*, 12, 161-196.
- Giuliano, G. and K.A. Small K.A. (1991). Subcenters in the Los Angeles Region. *Regional Science and Urban Economics*, 21, 163-182.
- Giuliano, G. and K.A. Small (1993). Is the Journey to Work Explained by Urban Structure?. *Urban Studies*, 30, 1485-1500.
- Hamilton, B.W. (1982). Wasteful commuting", *The Journal of Political Economy*. 90, 1035-1053.
- Horner, M.W. (2002). Extensions to the concept of excess commuting. *Environment and Planning A*, 34, 543-566.
- Jun, M.J. and S.K. Ha (2002). Evolution of Employment Centers in Seoul. *Review of urban and regional development studies*, 15,2, 170-186.
- Kim, S. (1995). Excess commuting for two-workers household in the Los Angeles metropolitan area. *Journal of Urban Economics*, 32, 166-182.
- Ma, K.R. and D. Banister D. (2006). Excess commuting: A critical review. *Transport Reviews*, 26, 749-767.
- Massot M.H. and A. Aguiléra (2009). Recompositions urbaines et distance à l'emploi. In : *Métropolisation et ségrégation* (F. Gaschet and C. Lacour, eds), Presses Universitaires de Bordeaux.
- O'Keely, M.E. and W. Lee W. (2005). Disaggregate journey to work data: implications for excess commuting and jobs-housing balance. *Environment and Planning A*, 37, 2233-2252.
- Richardson, H. W. (1988). Monocentric vs. Polycentric Models : the Future of Urban Economics in *Regional Science*. *Annals of regional Science*, 22, 1-12.
- Sarzynski, A., R. Hanson and H. Wolman H. (2005). All Centers Are Not Equal: An Exploration of the Polycentric Metropolis. *GWIPP Working Paper Series n°015*.

- Sénécal, G., R. Haf, P.J. Hamel, C. Poitras and N. Vachon (2002). La forme de l'agglomération montréalaise et la réduction des gaz à effet de serre : la polycentralité est-elle durable ?. *Canadian Journal of Regional Science*, 25, 135-152.
- Sermons, M.W. and F.S. Koppelman (2001). Representing the differences between female and male commute behavior in residential location choice models. *J. of Transport Geography*, 9, 101–110.
- Schwanen, T., F.M. Dieleman and M. Dijst M. (2004). The impact of metropolitan structure on commute behavior in the Netherlands. A multilevel approach. *Growth and Change*, 35, 304-333.
- Van Der Laan, N. (1998). Changing urban systems: an empirical analysis at two spatial levels. *Regional Studies*, 32, 235-247.
- Van Ommeren, J., P. Rietveld and P. Nijkamp (1997). Commuting: in search of jobs and residences. *Journal of Urban Economics*, 42, 402-421.
- Van Ommeren, J., P. Rietveld and P. Nijkamp (2000). Job mobility, residential mobility and commuting: A theoretical analysis using search theory. *The Annals of regional Science*, 34, 213-232.
- Wang, F. (2001) Explaining intraurban variations of commuting by job proximity and workers' characteristics. *Environment and Planning B: Planning and Design*, 28, 169-182.
- White, M.J. (1999). Urban areas with decentralized employment: theory and empirical work. In *Handbook of Regional and Urban Economics* (E.S. Mills and P. Cheshire, eds), pp.1375-1412.