

# Does Polycentric Urban Spatial Development Lead to Less Commuting: A Perspective of Jobs-housing Balance

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## 1. Introduction

The research of whether polycentric urban spatial development lead to less commuting has created many debates during last decades (Cervero & Landis 1991; Naess & Sandberg 1996; Gordon & Richardson 1997; Cervero & Duncan 2006). There are two major reasons for the debates. One reason is whether polycentric urban development could provide more opportunities to enhance spatial matches between the job and housing location selections of workers. Accordingly, employment decentralization and polycentric evolution would shorten workers' commuting distance and duration. Another reason is that whether jobs-housing balance policies save on workers' commuting duration in metropolitan areas (Nowlan & Stewart 1991; Giuliano 1991; Wachs et al. 1993; Frank & Pivo 1994; Peng 1997; Scott, Kanaroglou & Anderson 1997; Levine 1998; Levinson 1998; Sultana 2002; Horner 2004; Cervero & Duncan 2006; Wang & Chai 2009). This paper will review empirical studies in relation to this crucially important research topic. An understanding of how urban spatial structure and jobs-housing balance influence commuting patterns can improve the management and strategic planning of cities to ensure that urban spatial pattern optimises the aggregate travel behaviour of urban commuters.

## 2. Urban Spatial Structure and Commuting Patterns

In a monocentric city, since there is a highly concentrated employment centre and residents generally live in suburb, there would be high commuting flows on radial routes into the centre because the urban commuting would have many origins for work trips but a concentrated destination. In reality, a polycentric city functions in a similar manner to a monocentric city – people are attracted by jobs from all over the city. But the commuting patterns are different (Bertaud 2003). There are two commuting models of polycentric city. One model is that the city has some sub-centres of employment of a similar scale and in such a kind of polycentric city, each sub-centre generates trips from all over the city. The characteristics of commuting present a wide dispersion of origins and destinations, appearing almost random. Another model is that there are also different sub-centres of employment but one sub-centre is more concentrated and stronger than others. The urban commuting flows would be composite of both random and radial patterns (Ingram 1997; Ding 2007; Bertaud 2003, 2009). Accordingly, various models of spatial structure have diverse influences affecting people's patterns of commuting particularly in trip duration, distance as well as modal choice (see Figure 1).

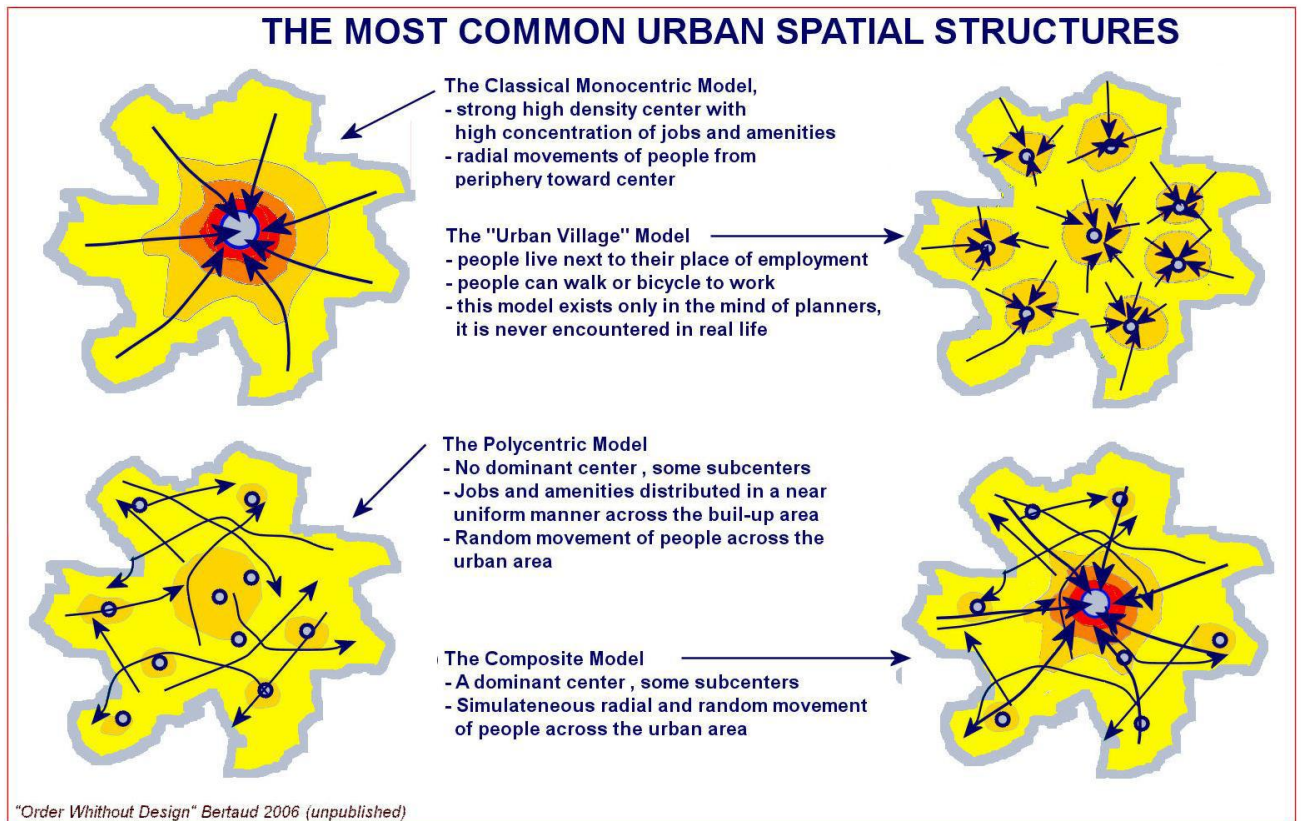


Figure 1: Commuting patterns in different models of urban spatial structure (Bertaud 2009)

### 3. Monocentric or Polycentric?

In the past twenty years, the issue of how employment decentralization and polycentric development in metropolitan areas has affected commuting patterns has led to many robust and continuing debates. Some scholars thought that a development pattern of highly concentrated employment centres in metropolitan areas is not as good as a dispersed and polycentric model for urban development. Suburbanization, as the main mechanism, has successfully reduced traffic congestion. It has altered roadway demand to routes with less congestion and away from central areas. With industry moves to the suburbs, the labour force has tended to follow, which has allowed many workers to enjoy reduced commuting times and less traffic congestion in traditional city centres (Gordon, Kumar & Richardson 1989; Giuliano & Small 1993; Gordon & Richardson 1997).

Previous studies based on analysis of detailed data of metropolitan travel from NPTS (Nationwide Personal Transportation Studies of U.S., 1977 and 1983-1984) and a commuting questionnaire included in the American Housing Surveys (1985) had showed that in monocentric or dense cities located in north east of the U.S such as Chicago and Baltimore, the commuting trips and time required tended to be longer as city size increased. But in some western coastal cities such as Los Angeles, the expansion of city size did not lead to an increase in trip distance. They also found that the trip distances of western cities were shorter than they were for north east cities in the morning peak time despite these cities' sizes being similar (Gordon & Wong 1985). There is another distinct difference in comparing commuting times for dense cities (New York, Chicago, Baltimore) with dispersed cities (Dallas, Phoenix, San Diego) - people who live in the downtown of a dense city spend 25% to 30% more time commuting (Gordon, Richardson & Jun 1991). Some scholars thought that dense cities result in much longer commuting times than decentralized cities (Gordon, Richardson & Jun 1991; Gordon & Richardson 1997). Hence, they believed that

this is an important point because it suggests that polycentric or dispersed metropolitan structures in western cities of the U.S. are especially suited to shortening trip distance and time. The reasons are that urban sprawl and polycentric development offer more and varied opportunities for faster commutes through changes of housing or employment, the relocation of enterprise, or the choice of uncongested roadways (Gordon, Richardson & Jun 1991).

There are also some similar case studies from European and Asian cities. One recent empirically based study from German urban regions based on data on commuter flows (German Census 1987 and German Social Security Statistics 2007) provides somewhat support for polycentric development. In their research they found that the polycentric city tends to be more travel-efficient when compared with a monocentric city. A polycentric city's commuting volumes are much higher than that of a monocentric city. The finding of their research shows that average distance of commuters in polycentric cities of Stuttgart (13.5 km) and Frankfurt (16.4 km) is lower than that experienced in the monocentric cities of Munich (19.0 km) and Hamburg (20.8 km) in 2007 (Guth, Holz-Rau & Maciolek 2009). There is another case study in Istanbul based on available data from 209 traffic analysis zones which showed that the average commuting time decreased in all the zones due to highway improvements with suburban clustered employment growth (polycentric development) in Istanbul from 1985 to 1997 (Alpkokin et al. 2008).

Some empirical studies from China also certified that polycentric development based on well planned sub-centres and regional policies would be beneficial to workers' commuting patterns. In research based on a household interview survey conducted in Beijing in 2006, Zhao, Lu & Roo (2011) argued that employment decentralization and polycentric development in Beijing would be beneficial to the jobs and housing relationship. Regional policies could impact on commuting patterns via the supply of various types of housing. The appropriate regional policies could be beneficial to polycentric development and control the dispersion of development and then achieve the aim of reducing commuting distances particularly for long distance commuters.

Several researchers have proposed a 'co-location hypothesis', that is, employment dispersion would enhance opportunities of residents and workers to change their housing or jobs locations as well as travel mode in order to avoid the congestion that lengthens commuting distance and travel time (Gordon, Kumar & Richardson 1989; Gordon, Richardson & Jun 1991). Accordingly, dispersion would reduce the phenomenon of urban congestion. One recent study from Italy corresponds with the findings from Gordon et al. It shows that the formation of a sub centre would enhance the probability of finding a job near the home. This in turn, allows a decrease both in workers' commuting distances and travel times (Veneri 2010).

This contrasts with some empirical studies show that polycentric development, dispersed metropolitan structures and suburbanization barely ameliorate the urban congestion phenomenon in metropolitan areas and indeed, actually increase workers' longer commuting distances and travel times (Cervero & Landis 1991; Levinson & Kumar 1994; Naess & Sandberg 1996; Cervero & Wu 1998; Aguilera 2005).

In research on submarket analysis of the San Francisco Bay Area, Cervero and Landis (1991) compared two subgroups of workers depending on whether their housing location at the time of job relocation was located either in the downtown area (i.e. city centre) or a suburb. The first sub group were those workers whose jobs moved from the downtown area but who retained a central city home address. Thus their commuting pattern changed from a central city commute to a downtown to suburb commute. With job relocation, the average commuting distance increased 477% and average trip duration increased by 75%. Another sub group are suburban workers whose housing was relocated to the suburbs. Generally, the results were that average commuting distances almost doubled, and commuting travel times

were also much more the same as before. And in further research, Cervero and Wu (1998) adopted two indices namely average one-way commute distance and average one-way commuting durations to examine the relationship between employment centres' growth and workers' commuting patterns during the 1980s. He found that among all 22 employment centres in the San Francisco Bay Area, from 1980 to 1990, average one-way commuting distances rose 12% and average one-way commuting time increased by 5%. These results show that, contrary to the co-location hypothesis, dispersed urban structure has not been related with shorter average commuting distances and time. In another similar study regarding how urban dispersion impact commuting patterns in U.S. metropolitan areas, after analysis detailed personal travel surveys data which were conducted by the Metropolitan Washington Council of Governments, it indicated that metropolitan Washington region's average work to home travel distance had increased from 6.6 miles in 1968 to 8.2 miles in 1988. The researcher thus supposed that the phenomenon of dispersion caused increase of commuting distance (Levinson & Kumar 1994).

Besides U.S. empirical studies, investigation of cities in Europe have also reached similar conclusions. Research of six companies in Greater Oslo, Norway showed that the distance from downtown Oslo to the workplace independently influenced the work commuting distance when other variables such as commuter train accessibility stayed constant. The further that companies were away from downtown Oslo, the longer the average commuting distance became. Analysis of data showed that when the distance from a company to downtown Oslo rose from 2 km to 12 km, the average work commuting trip increased from 10.5 km to 12.4 km. This study of the long-term effect of job relocations within Oslo's metropolitan area shows the obvious rise in average commuting trip length of a job location moving to the urban periphery (Naess & Sandberg 1996). A study based on census data of French metropolitan areas (Paris, Lyon and Marseille) in 1990 and 1999 showed that co-location hypothesis only can affect a minority of residents, of whom there were fewer in 1999 than there were in 1990. The majority of workers living in a sub-centre worked outside their sub-centre of living. This phenomenon was even more severe in 1999 than nine years earlier. In other words, the majority of jobs located in sub-centres are occupied by non-residents. Consequently the average distance of commuters increased during the past decade (Aguilera 2005).

#### **4. The Role of Changing of Jobs-housing Relationship**

From supporters of monocentric structure in above section, one key viewpoint of them is that polycentric development is associated with employment decentralization, and would easily create a jobs-housing imbalance within a given geographic area. Such an imbalance would cause rising transportation congestion and workers' commuting duration in metropolitan areas.

Accordingly, some urban and regional planners are turning to the jobs-housing relationship as a planning tool for seeking remedies for growing urban congestion phenomenon. And the concept of 'jobs-housing balance' has also become an urban policy in some local governments (Cervero 1996). Some scholars argued that jobs-housing imbalance is a key reason explaining how the problems of metropolitan congestion are induced and suggested that the government adopt policy to improve urban mobility. Cervero (1989) investigated cases of Chicago and San Francisco before confirming that two issues namely the high housing costs and housing shortages of suburbs were key reasons for suburban workers' longer commuting distance. In particular, many low income workers were excluded from the local residential market because of high housing prices. Moreover, data from 42 major sub-centres in metropolitan areas of the U.S. indicated that suburban job locations with jobs-housing imbalances tended to generate a low proportion of pedestrian and cycling trips and high levels of congestion on linking highways. Thereby, he suggested local governments adopt policies for reducing jobs-housing mismatches to improve regional mobility.

There were some other empirical studies to certify Cervero's opinion. Frank and Pivo (1994) revealed that both workers' commuting distance and time of jobs-housing balance's areas are less than that of imbalanced areas based on a case study of central Puget Sound Region of Washington State. On the aspect of commuting distance, the average distance of work trips ending in balanced areas was 29% shorter than that of ending in unbalanced areas. They also found that balance reduced workers' average trip time. The average time required for journey to work to balanced areas was 24% less than that of to unbalanced areas. Research by Ewing, Deanna and Li (1996) showed that locating jobs and housing in close proximity should rationalize patterns of commuting by reducing cross-haul travel. Research revealed that jobs-housing balance can reduce a region's vehicle miles travelled (VMT) by more than 15%. Another study using travel diary data from metropolitan Portland, Oregon, supposed that in areas with high accessibility to jobs, the average VMT was lower but trip frequency was higher (Sun, Wilmot & Kasturi 1998). Some more recent research done by Cervero & Duncan (2006) and Sarzynski et al. (2006) generated results consistent with the concept that jobs-housing proximity is inversely relevant to subsequent commuting time. And thus achieving jobs-housing balance is one of the most significant approaches that land use planning can contribute to decreasing commuting and congestion. There have been some jobs-housing balance policies launched by local governments for improving urban congestion phenomenon.

Wang and Chai (2009) conducted research from the view of China's housing reform to explore the relationship between commuting and jobs-housing balance in Beijing. They believed that jobs-housing imbalance has been become a main dynamic for congestion and air pollution issues in China's metropolitan areas along with China's economy and housing reforms. In Wang's research, after a data analysis of a household interview survey in Beijing in 2001, he found that Chinese '*danwei*' housing commuters have shorter commuting distance and duration as well as higher usage of non-motorized travel mode than those who live in housing obtained from the market sources. He believed that a good jobs-housing relationship may reduce travel demand and improve Beijing's urban environments. Accordingly, they believed that China's '*danwei*' housing reform and the market-oriented reforms induced a decrease of '*danwei*' housing and an increase of houses from market sources would deepen local jobs-housing imbalance and bring more severe urban congestion and pollution issues to China's mega cities.

Nevertheless, the concept of jobs-housing balance or co-location hypothesis remains greatly controversial. Critics of this view suggested that there were many other factors that caused the increase of urban congestion which is probably more significant than the jobs-housing imbalance. Jobs-housing relationship hardly influenced individual commuting behaviour (Giuliano 1991; Wachs et al. 1993; Giuliano & Small 1993; Scott, Kanaroglou & Anderson 1997; Levine 1998). Even jobs-housing balance policies possibly would generate subsequent urban issues (Levine 1995; Peng 1997; Bertaud 2003).

Some scholars argue that the link between where people choose housing and jobs is complicated, and may have little to do with job accessibility consideration. Insufficient evidence suggested that jobs-housing imbalance had vitally affected patterns of commuting. Furthermore, adopting a related policy of jobs-housing balance is not an effective way for reducing commuting in metropolitan areas.

Altshuler and Gomez-Ibanez (1993) think the implementation of jobs-housing balancing policies to be 'more of a romantic dream than a practical reality'. Giuliano and Small (1993) concluded that other factors must be more decisive for location choice than commuting expense, and that policies whose purpose is to change the jobs-housing balance will weakly affect commuting. Wachs et al. (1993) supported Giuliano's opinion. They supposed that workers' choice on housing location were based upon considerable factors besides the jobs-

housing relationship, such as the quality of neighbourhood and educational facilities and perceived safety. Their empirical studies also added credence to the arguments of those who doubt the effectiveness of policy proposals which encouraged changing the jobs-housing relationship as a principal policy for the release of urban congestion.

Based on a case study of Minneapolis Metropolitan Area, Levine (1998) certified that there was the potential for jobs-housing balance to change housing locations, but the potential was obviously restricted. Commuting time remained a dominant factor for determining housing location at the regional scale. The provision of affordable housing near employment centres can affect the choice of housing location for the households with low-to-moderate income and single-worker. But achieving a jobs-housing balance has hardly achieved releasing traffic congestion. Another study utilised aggregate data of measuring areas to examine the relationship between jobs and housing in the Portland, Oregon metropolitan area, found that it was only in greatly imbalanced neighbourhoods, in particular job-poor communities, where average VMT per capita was high. Accordingly, researcher argued that land-use policies for balancing jobs and housing, which targeted extremely jobs-poor and housing-poor areas, only had an impact on a very small part of the metropolitan area and thus the influence of the policies were very restricted in influencing the overall commuting patterns in the region. Researcher also concluded that changing the jobs-housing ratio is hard due to barriers from local authorities' land-use policies (Peng 1997).

Moreover, some scholars believed that jobs-housing balance strategy was not only ineffective in reducing commuting time and distance in metropolitan areas, but would also induce more urban problems such as urban sprawl and labour market fragmentation (Levine 1995; Peng 1997; Bertaud 2003). Bertaud (2003) commented influence of jobs-housing balance policy for urban development from an economics view. He argued that some scholars of urban studies often assumed that in polycentric cities, jobs-housing balanced communities were likely to grow around an employment cluster. Accordingly, considerable jobs-housing balanced economic clusters would then integrate a large polycentric city and in this kind of metropolis, workers' commuting trips would be very short. However, such a concept of metropolitan structure would conflict with the classical theory for the existence and continuous growth of metropolitan areas and ultimately caused labour market fragmentation.

## 5. Conclusion

The findings of advocates of monocentric structure as previously discussed, one common and significant viewpoint is that both urban dispersion and polycentric development are associated with employment decentralization, which would easily create a jobs-housing imbalance within a given geographic area. Such an 'imbalance' would lead to increasing trip commuting distances and time in metropolitan areas. Conversely, some scholars argued that sub-centres or given geographic areas of a polycentric or a dispersed city provide sufficient housing choices and jobs that are matched in both quantity and quality (when measured by their social-economic characteristics), then these areas could be considered as 'balanced' thereby resulting in workers selecting residential locations as close to their jobs' location as possible. Some economists doubted the need for public policies that promote jobs-housing balance and believed that government intervention may cause labour market fragmentation. They argued that over time the 'natural processes' of the market has the capacity to balance jobs and housing without government intervention (Bookout 1990). Imbalances are supposedly 'self-correcting' phenomena (Altshuler and Gomez-Ibanez 1993). However, crucial studies certified that government intervention and institutionally influenced jobs-housing balance do play a positive role in reducing commuting in polycentric metropolitan areas of both the United States and China (Weitz 2003; Zhao, Lu & Roo 2011).

In addition to the jobs and housing relationship, some other factors such as mixed land use, residential densities, regional policy as well as improvements of transport infrastructure and services appear to influence commuting patterns in a polycentric city. On one hand, in the dispersed cities of developed countries, mixed land uses and residential densities of sub centres and suburbs play a role in influencing commuting distances. On the other hand, managed and planned polycentric urban structure whereby urban growth is directed towards dispersed activity centres could potentially reduce commuting trip distances and time (Dieleman, Dijst & Burghouwt 2002; Buliung & Kanaroglou 2006; Zhao, Lu & Roo 2011a). In particular, some empirical studies show that regional policies and improvements of transport in a polycentric city would have an effect on people's commuting trip patterns (Alpkokin et al. 2008; Zhao, Lu & Roo 2011a). The argument in this regard, is that commuting trip distances could potentially be substantially reduced due to improvements in transport infrastructure and services that serve the sub centres of polycentric cities. Furthermore, a polycentric city in which all of its centre nodes are networked would provide greater overall metropolitan trip efficiencies through a networked transit infrastructure than could be achieved with a monocentric focused transit network. Crucially, regional policies can also play a significant role in reducing commuting distances via the supply of various types of housing that would be beneficial for optimising the ratio of jobs-housing balance.

#### Notes

1. *Danwei* is a generic term denoting the socialist working place in China (Bray 2005). Apart from salary, danwei used to provide workers a comprehensive package of welfare including housing (Chai 1996). Before the launch of economic reforms, danwei were encouraged to become self-sufficient communities within the city, providing not only work, but also housing, health care, food distribution and other social services (Gaubatz 1999).

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