Towards decentralization: Spatial changes of employment and population in Tehran Metropolitan Region, Iran

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Hashem Dadashpoor[*], Mehdi Alidadi

Urban and Regional Planning Department, Faculty of Arts and Architecture, Tarbiat Modares University, Tehran, Iran

A B S T R A C T

Employment and population spatial structure of metropolitan regions have evolved in the era of post-industrialization. Empirical and theoretical debates have consensus that monocentric model is no longer explaining the phenomenon of population and employment distribution. One argument regards polycentricity as a permanent spatial structure beyond monocentricity; another idea believes that dispersion can explain spatial variation of employment and population too. This study investigated the level of monocentricity and primacy of principal city in Tehran Metropolitan Region (TMR), in addition to sub-centering and level of polycentrism. Dispersion of employment and population in TMR was also analyzed. The results revealed that standard monocentric model is not able to explain evolution of Tehran although it is dominant core of the region. The polycentric models illustrated that although the changes from 2006 to 2011 were not considerable, employment was more concentrated than population; they also showed that there is no distinction between polycentric and dispersion and regions may have some levels of polycentricity and dispersion.

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1. Introduction

Employment and population spatial structure of metropolitan regions have evolved in post-industrialization era. While most empirical and theoretical activities have consensus that monocentric model fails to properly explain the mechanism of population and employment distribution, its beyond is almost vague. Von Thünen model was the first endower to explain job location in the space in the beginning of 19th century; this model was a tradeoff between land rent and transportation cost (Fujita & Krugman, 1995). Later, in the middle of 20th, monocentric model of urban form developed by Alonso (1964), Mills (1969) and Muth (1969) had the same logic of tradeoff between land price in the Central Business District (CBD) and transportation costs from farther places to CBD, and also the way employment and population distribute in space (Smith, 2003). The main assumption of this model was that employment is concentrated in CBD or principal city (Parr, 2004, 2013) and land in the center have the highest price. People travel to CBD for work and adjust their costs according to land price and the travel cost. Despite the drawbacks of the model, the hegemony of the model lasted more than three decades, and its simplicity was one of the main reasons (Kraus, 2006).

However, qualitative changes in spatial structure of metropolitan regions (Anas, Arnott, & Small, 1998), suburbanization, decentralization (Shearmur, Coffey, Dube, & Barbonne, 2007) and dispersion of population and employment made scholars skeptical to monocentric model (Berry & Kim, 1993). In Muth's (1969) view, it is not logical to think that all jobs are located in CBD; he rather believed that jobs are also located in parts far from CBD; land price and wages are higher in the center than in the other places and concentration centers hardly have significant effect on their surroundings (Richardson, 1988). Various scholars criticized inefficiency of monocentric model (Boarnet, 1994) and empirical evidences challenged the key assumptions (Arribas-Bel & Sanz-Gracia, 2014). Gordon, Richardson, and Wong (1986) discussed that monocentric model is unable to explain commuting behavior. Although traffic congestion is getting worse, the travel time is shortened, so, the location of living or working or both of them have changed. Thus, the suburbanization (population) and decentralization (employment) are known as driving forces that contributed to non-monocentric spatial structures (Gordon, Richardson, & Jun 1991).

The second group discussed that jobs are not necessarily concentrated in CBD; they may have decentralized from principal city and recentralized in sub-centers (Garreau, 1991; Giuliano &

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* Corresponding author.
    E-mail addresses: H-dadashpoor@modares.ac.ir (H. Dadashpoor), alidadi902@gmail.com (M. Alidadi).

Small, 1991; McDonald & McMillen, 1990; McDonald & Prather, 1994; McDonald, 1987; Small & Song, 1994; White, 1976). This direction contributed to a vast array of studies conducted under the title of sub-centering, the way decentralization of employment would lead to concentration in secondary centers (Baumont, Ertur, & Gallo, 2004; Coffey & Shearmur, 2001, 2002; Guillain, Le Gallo, & Boiteux-Orain, 2006; McMillen & McDonald, 1998; McMillen & Smith, 2003; McMillen, 2001; Shearmur & Coffey, 2002), and its impact on suburbanization and the distribution of population in regions (Baumont et al., 2004; Cladera, Duarte, & Moix, 2009; Garcia-López, 2010; McMillen & Lester, 2003; Sun, Han, Wang, & Li, 2012). When diseconomies in principal city increases and agglomeration economies are found in some other centers, sub-centers or polycentrism would emerge (Duarte, Núñez, Tresserra, Mejía, & Prieto, 2011). Scholars employed different terms for the emerged spatial reality: *suburban sub-center* (Anas et al., 1998), *new city* (Fishman, 1990), *edge city* (Garreau, 1991), *suburban employment center* (Cervero, 1989), *employment sub-centers* (Giuliano & Small, 1991; B.; Lee, 2007) and so on. This decentralized concentration in the literature is called sub-center (Gordon & Richardson, 1996) that characterizes the concept of polycentrism in different ways. The concept of polycentrism in the 90s was not only the spatial outcome of the decentralization process (Grunfelder, Nielsen, & Groth, 2015) explained by bid-rent theory but it was also a policy agenda (Davoudi, 2003) that faded away the hierarchical relations by horizontal ones (Muñiz, García, & Galindo, 2005).

Another direction of studies acclaimed that sub-centering was a reality of metropolitan regions but not the only one (Lang, 2003). In response to weaknesses of monocentric model, researchers focused on polycentric spatial structure and developed substantial theoretical and empirical methodologies in sub-center identification. However, the distribution of jobs in dispersed concentrations (not important sub-centers), development corridors, and dispersion through whole metropolitan region were ignored (Waddell & Shukla, 1993). One of the main factors which explains concentration of jobs in metropolitan regions was agglomeration economies; the spatial range of agglomeration increased in the era of technological advances in accessibility to infrastructures (Lee, 2007; Lee, Seo, & Webster, 2006) and firms could benefit from most parts of the regions (Gordon & Richardson, 1996); the evolution of automobile allowed people to work and live in dispersed territories (Garcia-López & Muñiz, 2010). Thus, we have *edgeless cities* (Lang, 2003), which refers to generalized dispersion and no significant spatial concentration of employment or population (Hajrasouliha & Hamidi, 2017).

In the era of post-industrial economy and globalization process, metropolitan regions are going to function as economic, social, and management centers in both national and international scales (Malý, 2016). Thus, this study analyzed the discussed changes of spatial structure in Tehran Metropolitan Region (TMR). Spatial changes has two main aspects: recognizing the changes and understanding their specifies (Lee, 2007). Various studies conducted in TMR have investigated different dimension of its spatial structure; however, lack of specific population and employment analysis is tangible. For this reason, the present study investigated spatial changes of employment and population of TMR. Due to limitations on data availability, the focus was on the changes during 2006–2011. The hypothesis was that TMR is no longer monocentric; thus, the polycentricity and dispersion of the region were tested to identify the spatial distribution of population and employment.

2. Study area

Although functional boundary of TMR is more than 200 km around the principal city (Tehran city) according to interactive data (Sharifzadegan & Fathi Farzaneh, 2016). This region has a total

population over 14.9 million and around 4 million jobs in 2011 (Dadashpoor & Nateghi, 2017). TMR administratively includes two provinces: Tehran and Alborz centered by Tehran and Karaj respectively (Fig. 1). TMR shares 1.1% of the country's total area, but, as shown in Fig. 1, only 10% of TMR is built and settled by 19% of Iran's population.

The concentration of population and employment (see Fig. 2) in the principal city has been a problematic issue not only for regional policy makers but also for national authorities. In 2006, 56% of population resided in principal city, which declined by 53% in 2011. On the other hand, employment share of Tehran was 71% in 2006; this share reduced to 68% of total jobs in 2011. Ziari, Fotouhi and Farhadi Khah (2016) reviewed empirical and theoretical arguments on the change of TMR spatial structure, and the way various factors contributed to this state. At first step, they showed that despite the increasing growth of total population in the TMR, the share of population of principal city declined from 1956 to 2006. They also investigated the employment changes and revealed that GDP share of principal city had declined. Secondly, based on their data, in average, 30% of total GDP was produced in TMR while 19% of population was settled in this region. Alongside that, around 55–60% of total bank deposits of Iran were stored in TMR banks. The government has had various plans to organize the spatial structure of TMR in last decades (see Table 1):

3. Material and methods

3.1. Data acquisition

Employment and population data were obtained from Statistical Center of Iran (SCI) based on 2006 and 2011 census (due to lack of data available in sub-district level for previous years we focused on a 5-year period). These data are in sub-district level, the finest scale of data available for regions in Iran. Shapefiles (spatial unit of sub-districts) are provided by SCI and corrected by authors for presentations. Employment data refers to jobs based on the place of residences, not location of work. So, the location of almost 15% of jobs were not determined and all employment data were calculated for 85% of total employment in TMR. SCI has a specific form for gathering individual's information; one of the questions is "do you work in the same place you live?" Thus, the mobility of people for work is ignored.

3.2. Methodology

3.2.1. Monocentricity

Various methodologies are provided in the literature to understand the level of monocentricity, two of which are more common: standard density function of Alonso (1964) that have currency in previous studies (Cladera et al., 2009; Giuliano & Small, 1991; Muth, 1969; Small & Song, 1994; Smith, 2003) and centrality measurement indexes (Hajrasouliha & Hamidi, 2017; B.; Lee, 2007; Pereira, Nadalin, Monasterio, & Albuquerque, 2013).

Alonso (1964) parametric monocentric model developed by Small and Song (1994) three decades later in exponential form is applicable to analyze the level of monocentricity of employment (Cladera et al., 2009; Kim, Yeo, & Kwon, 2014) and population (Feng, Wang, & Zhou, 2009). However, we apply Baumont et al. (2004) logarithmic to have a linear form (Baumont et al., 2004):

$$D(u) = D(c)e^{-\gamma u + \varepsilon}$$

$$\ln D(u) = \ln D(c) - \gamma u + \varepsilon$$

$D(u)$ is population or employment density at distance u from main