Beyond the Early Stage of Post-suburbanization: Evidence from Urban Spatial Transformation in Jabodetabek Metropolitan Area

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Abstract. In the theory of urban transformation, there has been growing attention to the development of metropolitan outskirts. While the debate of the post-suburbanization process has already settled, the knowledge on the development beyond is still questionable. This paper examines the urban spatial pattern transformation beyond the Jabodetabek Metropolitan Area post-suburbanization. We use the medium and large enterprise (MLE) data from the economic census (EC) and population data from village potential census (PODES) with two cross sectional times of reference. The 2005 and 2006 data are assumed to represent the post-suburbia situation, and the 2014 and 2016 data represents the situation beyond. We analyzed the extent of which post-suburban spatial pattern in JMA would develop by utilizing the Exploratory Spatial Data Analysis (ESDA) method. The result shows that the polycentric urban structure of JMA has strengthened. The low order service function which was previously clustered in suburban areas is recentralized in the urban core, leaving the manufacturing sector as the main function in the post-suburbia. It is implied that the post-suburban status has reached a steady state for a long term before its next transformation. Those transformations are followed by the shift in population dynamics, whereas workers tend to polarize based on the proximity to their job location. The findings recall further study regarding the post-suburban commuting pattern.

1. Introduction

Globalization and changes in socioeconomic conditions have shaped the appearance of the urban region. The emerging urban development and its postmodern society result in the urban spatial transformation of metropolitan areas. Regarding this issue, current attention is focused on the transformation dynamics in metropolitan outskirts. Many evidence show that what was formerly known as suburban areas have become more obsolete as the dichotomy of urban and suburban areas is increasingly blurred. Urban development has been turned inside out, whereas suburbs are becoming more attractive, and the traditional urban core is losing its importance. This phenomenon has been coined in several terms, such as ‘edge city’, ‘edgeless city’, or ‘technoburb’, but Wu and Phelps [1] argued that the term ‘post-suburban’ is the most comprehensive concept, as it generally encompasses the previous. It cannot be seen as a single definition, but rather as a signal of various processes of potential change at the metropolitan periphery [2].

Post-suburbanization can occur in any location with different scale and manner [3]. Phelps and Wu [4] argued that in their relationship with settlement typology, the urban development process can be divided into three scenarios. The first stage is termed as modern city, in which urban fringes grow and develop into suburban areas. The second stage, termed as late modern city region, describes the situation of suburbs that had resulted from the first trajectory is transformed into post-suburban. In the third
trajectory, termed as the city region of second modernity, there are five different probabilities of transformation: (1) from post-suburban developed into city; (2) developing suburbs, growing into post-suburban and then becoming new cities; (3) a surviving prosperous and stable suburb; (4) the suburbs shrink into sub suburbs; and (5) the city decentralizing into suburbs. While the first two stages describe the urban transformation into post-suburbia, the last stage is an assumption of what could happen beyond. The difference in transformation patterns resulted in the question of whether post-suburbanization would result in a series of new cities with a relatively steady polycentric pattern, or if it's just a transitory phase leading into a scattered intra-metropolitan urban form [5]. Thus, the geographical aspect of post-suburbia has become more important since its different forms or appearance in different locations may obscure valid points of comparison [2].

Urban transformation implies changes over time, so that the understanding of present development requires some reflection on the past course of a city’s growth and development [6, p. 2]. But the concept of urban growth itself is far from clear. Reis et al [7] argued that there are at least three different and widely used concepts of urban growth in the urban and regional planning literature: population change, economic performance, and the spatial expansion of urban areas. Such concepts in which several characteristics can be identified as the elements of global post-suburbia (see [1], [8]–[10]). However, Bontje [11] argued that the main purpose of understanding post-suburbanization is to explore the possible contribution of new employment centers in the ‘metropolitan periphery’ to a more sustainable development of metropolitan regions. Without neglecting the importance of population factors and spatial expansion, this perspective led recent research on post-suburbanization to focus on its relation to economics aspects (for examples see [12]–[15]).

The Jakarta Metropolitan Area (JMA) is widely known as an Emerging Mega Region (EMR), but the existence of post-suburban elements have been increasingly visible within its development process since the early of 2000’s [16]. The post-suburbanization process in JMA involves a planned deconcentration of high technology industry and multinational companies, creating a spatial implication that emerged from the change of agricultural restructurization into manufacturing sectors [12]. Such processes make an impact on mixed settlements and change its commuting pattern, which is considered to be at the early stages of post-suburbia [17]. It is further assumed that the post-suburbanization process in JMA would be followed by service sectors [12], leading to the development country post-suburban trajectory. In other words, the JMA hinterland would develop into multifunctional areas with more independence from the traditional core, resulting in a new city. Such situation is argued to be the sign of the end of a desakota region, which is unfavorable because it would threaten the JMA regional sustainability cantilever [18]. Although the theoretical foundation of spatial transformation towards a post-suburban form is already known, the extent to which urban transformation towards beyond is still questionable. Recent evidence insufficiently covers only a limited location which is considered to be post-suburbia (see [12], [16], [17]). Furthermore, various researches measuring urban spatial pattern in JMA are often limited to population and land use aspects (see [19], [20]). There is little known about the actual JMA urban spatial structure and its transformation in terms of economic activities.

This paper aims to make a contribution in the discourse of urban spatial transformation by exploring the spatial pattern resulted from the process beyond post-suburbanization. We explore Hudalah and Firman’s [12] hypothesis of whether post-suburban areas in JMA would follow the developed country trajectory. We address three questions regarding the urban transformation of JMA. The first is to reveal the actual recent urban form of JMA and its alteration. The second is questioning whether post-suburbia in JMA would be developed into a new city or just maintain or strengthen its current form. The last question concerns population dynamics regarding the urban transformation, the extent of which could explain the next stage of post-suburbanization in the context of a developing country such as Indonesia.

We assess the urban transformation process of JMA by comparing the distribution of some socio-economic characteristics at the village level from two census periods within 2005-2016. The village level usage is very useful because it can provide analysis up to the smallest level of geographical area. We utilize the data from the 2006 and 2016 Economic Census (EC) to recognize the spatial behavior alteration of non-agricultural medium and large enterprises (MLE) in JMA, whereas the 2005 and 2014
village potential census (PODES) data are used to identify some village characteristics including its population. The comparative study is conducted using Exploratory Spatial Data Analysis (ESDA) method.

This paper is organized into five parts. The first part introduces the urban development trajectory discourse and its current situation in JMA. In the second part we review the literature about post-suburbia and how it relates to its urban form and spatial structure. In the third part we make a brief explanation about the data and methodology used in this research. In the fourth part we discuss the transformation of the JMA urban form and spatial structure in the last decade. The last part will present the conclusion and its implication.

2. Post-suburbanization and urban spatial transformation

2.1. Towards post-suburbanization

In the stage of urban transformation, many experts agree that in most metropolitan areas, the existence of "suburbia" is now increasingly difficult to find. The landscape between urban and rural areas has undergone a fundamental change, in which traditional forms of urban and rural areas no longer exist [21]. Bontje [11] argued that suburbia is gradually changing into an increasingly detached location from traditional urban centers. The low-density settlements are increasingly mingling with densely populated settlements, jobs, shopping locations and recreational facilities. In modern urban areas, the growth and development move out of the city center to the surrounding area. But in the postmodern era, the logic seems to be reversed, with the growing development of new urban centers in the metropolitan outskirts [22]. The result is a different look from what was previously recognized as suburbia but is described as neither urban nor suburban.

Kling et al [8] coined the term post-suburban to refer to a region that has several centers of activity which are mutually exclusive and different between settlements, shopping malls, or industrial estates, and provide specific attractions. Each center has a special function and is separated by a travel distance of 15-30 minutes by car, with a balanced frequency of within and intercity trips. A post-suburban territory is integrated into the global capitalist market system and transformed from an agricultural area into a society dominated by industrial and post-industrial workers in a relatively short time. The development that occurs in a post-suburban area occurs in three phases of the village network in rural areas, transformed into suburban areas, then changed into a complex and decentralized area that is a mix of urban, suburban, and rural.

One trigger for the shift from suburbia to post-suburbia in America and other developed countries is the technology revolution that began in the early 20th century. The development of cars made people able to travel from one corner of the metropolis to another corner on a regular basis every day. Advances in telecommunications and computer technology have the potential to replace face-to-face needs as well as other physical movements. This made decentralization work even more so that the American suburbs gradually began to lose detachment to the established city center [12]. Ongoing decentralization occurred in major cities in the United States, such as Portland, Oregon, Philadelphia, and Pennsylvania. But in those cities, the transition from a monocentric structure to polycentric then diffusion, did not occur linearly, but had local differences [23].

There is a significant difference between post-suburbia characteristics in North America, Europe, and Asia. This could not be separated from the influence of the culture and the political system chosen in development. The development of metropolitan suburbs in mainland Europe differs from that in North America because their urban core remains a dominant center compared to America. The revitalization of urban centers and productive zones keep urban areas in Europe attractive and capable of promoting urbanization [24]. The Netherlands experience shows how spatial planning provides the initiative of the population to live in urban suburbs [21]. From 1960 to the mid-1980’s, the Dutch spatial planning policy of 'concentrated deconcentration' has supported the development of growth centers around big cities.

The growth center was basically intended to provide a suburban housing area for those who wanted to get out of the big city to prevent an urban sprawl by collecting the construction of suburban housing at a limited number of locations. The growth center that lied farthest from the urban core had the
additional function to build an economic center of an independent new urban area, and to promote economic growth in marginalized suburbs. However, Bontje [11] found that the new job location actually had the following characteristics. First, the new location was relatively close to the city and the suburban limits were closest to the city limits. As a result, the new growth center was close to the big city at a location that was originally intended only for the provision of suburban settlements and necessary services. Second, the opportunity for inhabitants of the suburb to find a job near their home was only found by highly skilled workers. Third, most of the new job sites built in the last few periods were located close to the highway, so there was a tendency to increase the use of cars as a mode of transportation.

In a global perspective, Wu and Phelps [1] summarized post-suburbia traits into six characteristics. First, there is a separation, or fragmentation, of the suburbanization process, which mainly comes from the construction of settlements. Second, post-suburbia is characterized by land use as well as mixed urban morphological elements. Third, the dynamics of urban development do not seem to be seen if it happens to be bordered by the boundaries of local government. Fourth, local governments on certain aspects play an important 'entrepreneurial' role in post-suburbia development. Fifth, post-suburbia has a balance of work location and a larger residence compared to suburbia. Sixth, the post-suburban form is associated with extensive and conflicting land use between housing, manufacturing and services industries, open land, agriculture, and parks that are characterized by the expansion of metropolitan areas in Southeast Asia. Although these six characteristics can be said to be comprehensive, Phelps and Wu [2] found that this phenomenon could have varying values in different location settings.

2.2. Urban spatial transformation

Post-suburbia has three dimensions, which can be distinguished from other terms in urban transformation [25], since two of them are closely related with changes in spatial form. First, based on the process, post-suburbia is an indication of breaking the linkage with the pattern or process of previous suburbanization. Second, post-suburban can be distinguished based on the spatial shape of the concentrations contained in the suburbs and edge cities. Third, in terms of politics, post-suburban represents the function of the city, where the role of the business organization's interest in post-suburban politics is often greater than expected. Generally, post-suburban spatial forms lead to a multi-centered metropolitan region [8]. Therefore, the polycentric spatial structure becomes an important element in the existence of post-suburbia [1], [3], [12], [23].

The traditional urban spatial structure is assumed to be monocentric, consisting of a traditional urban core or central business district (CBD) as a production center location, and all workers living around the area and commuting to work. The monocentric model explains that population density and land rent costs will decrease monotonically as distance away from the center of the city [26]. Economic agglomeration will function well in the CBD area, and its influence will decrease with increasing distance from the CBD [27]. As a result, the CBD is dominated by mature companies. The a priori assumption of a centralized CBD form, fueling the ease and flexibility of a monocentric model use in analysis, and made it the most dominant urban economic development paradigm of the 20th century [28]. However, the assumptions used are judged to be no longer in accordance with the development of modern cities [26]. Davoudi [29] argues that contemporary urban systems show a multi-nodal structure.

Generally, Solis [30] distinguished the production of post-industrial urban regions' emerging spatial forms in four ways. The first type is generated from the generation of new employment centers or subcenters. The second is generated by the integration of large or big cities and their surrounding suburban hinterlands. The third is generated by a functional network of a series of cities and towns which are physically separated. The last is generated by the intertwining of a metropolitan urban system and a medium sized city. Urban transformation occurs when sub-urban areas experience rapid population growth so that the number exceeds the city center [31]. In its process grew two types of sub-centers i.e. coherent additional urban areas and edge city [29], which can be considered as parts of a post-suburban form.
2.3. The JMA development dynamics

The Jakarta metropolitan area (JMA) is an administrative definition of the urban area of Jakarta and its surrounding area. The region plays important role in the development of Indonesia, not only socially, but also economically. With an area of 6.392 km², the JMA population in 2015 is estimated at 30.97 million, making it the largest metropolitan in Indonesia and one of the largest in the world. In economy, 25 percent of the 2010 national GDP was contributed by JMA [18]. As the capital of Indonesia, and also the center of national governance, politics, business, education, and culture, Jakarta plays the main role as the traditional urban core of JMA. However, Firman and Fahmi [17] has shown that the development of JMA has a tendency of moving towards its peripheral area.

The urban spatial pattern transformations in JMA and other Asian metropolitans are different from those in Europe and America. It is not only a mega-urban functional system [18], but also a city-region dominated by Jakarta as a Mega-city [32]. As one of the largest metropolitan areas in Southeast Asia, the development of industrial land is the key to urbanization in the Greater Jakarta area [33]. In 1985, nearly 60 percent of the oil manufacturing industry was located in the region [34]. But recent evidence has shown that there has been industrial deconcentration process from the JMA core towards suburban areas, not only the large industries [12] but also for the small industries [35]. The urban transformation is driven by economic expansion in the form of new industrial complexes and satellite cities, which produce peri-urban areas with mixed land use [20]. High demand for land has encouraged private developers to do land banking, causing development to become less controlled. Decentralization of population and economic activity continue towards the peri-urban and sub-urban areas, even further into the desakota zone, thus forming additional metropolitan areas or mega-region cities [36].

The urban development dynamics in JMA is strongly influenced by different planning policies but are similar in the lack of government role. Various studies conducted in the JMA showed that during the New Order regime (1966-1997) urban development was marked by the absence of planning and regulation [37]. Towards a liberal economy, policies have produced the duality of urban forms: planned and unplanned [38]. By the time of post New Order era, the JMA urban development was marked by a decentralized euphoria that encouraged fragmentation and land use conflicts [17]. As of today, the JMA region governance is a combination of 10 cities and 3 regencies from three provinces. Weaknesses in terms of governance institutions make land development very much controlled by the private sector [33], [39], [40]. Consequently, development in the peri-urban region undergoes spatial segregation and occupation [40], thus encouraging the early phases of the post-suburbia phenomenon [17].

Firman [16] was among the first to show several important elements which indicated the existence of post-suburbia at JMA. First, population and urban localities grew rapidly in the outskirts since the beginning of 2000, while Jakarta itself was experiencing the opposite. Large-scale residential development conducted by the private sector in the periphery also encouraged the occurrence of this phenomenon, resulting in a satellite city that has a strong economic base. Second, the swift FDI flow in the aftermath of the economic crisis, has encouraged the growth of industrial estates to cover a very wide area on the outskirts of Jakarta, such as Bekasi in the early to mid-2000’s. Third, the change in commuting patterns, show the movement of Jakarta residents to the surrounding small towns at the beginning of 2002. Although urban transformation in JMA began much earlier, it can be said that it was not until the middle of 2000 that the existence of these elements became noticeable.

3. Data and Method

Various researches aimed at measuring the spatial structure of JMA were often limited by data availability. In terms of economy, the most complete information of non-agricultural economic activity in Indonesia was gathered by the Economic Census (EC). The census was held by BPS (Indonesian Statistical Agency) every 10 years since 1986. From the location perspective, the data resulted could provide precise locations of several important establishment population characteristics. Although the data has been widely utilized for regional economic analysis, but these advantages has surprisingly a lack of use in exploring the economic activity pattern on the urban scale. This research would be among the first to utilize EC data to measure the urban transformation process in Indonesia.
To measure the transformation in urban form, we examined the change on spatial pattern of non-agricultural economic activities (establishment and its employment) density and distribution of 1501 village areas in JMA. Village level is the smallest geographical area in which EC aggregated data were available. The economic activities which referred to the International Standard of Industrial Classification (ISIC) were divided into three categories: manufacturing industry, low order services (LOS), and high order services (HOS). The industrial category consisted of manufacture and recycling activities. While we used the low order services category, which consisted of other non-agricultural activities as comparison, we were also interested on following Coffey et al. [41] to explore high order service distribution, which consisted of financial, insurance, and real estate (FIRE) activities. We compared EC data from two periods of reference: 2006 and 2016. Following the findings of Firman [16], the 2006 condition represented the post-suburbanization condition, while the latter represented the situation beyond. Furthermore, we not only explored the change in economic activity, but also identified its impact on population dynamics. Since EC does not provide information of population characteristics, we made a different approach to the data using the village potential data (PODES). PODES was collected every three years, right before the government conducted the census, to obtain information of the targeted location characteristics at the village level. We utilized PODES data from 2005 and 2014, both conducted as part of prior preparation for EC.

The 2016 EC data has captured more than 2.80 million non-agricultural economic activities in JMA. This number has increased by 7.88 percent from a decade earlier. Nearly 99.95 percent of the numbers were dominated by micro and small enterprises (MSE). But since worldwide post-suburbanization processes were driven mainly by global economic interaction (see [1], [8], [10], [12]), we decided to limit the research only on medium and large enterprises (MLE). Such an approach was used by Hudalah et al. [33] to map major suburban industrial centers in the Greater Jakarta area. However, we couldn't utilize the whole 2016 EC data because the data processing completion was still in the finishing stage. Therefore, while the 2006 EC data was used completely, we used only 127,010 units, or nearly 98.31 percent of the total MLE population in 2016. The utilization of MLE data has an advantage, since it has the ability to provide a large number of employment and generate a higher value compared to MSE. Table 1 shows that the existence of 3 to 4 percent of MLE in JMA could provide up to 30 percent employment for its working population. Moreover, the overall existence of MLE is established based on long term strategic decisions, so that the change in its location decision behavior is more easily observed.

**Table 1. Some characteristics comparison of JMA.**

| Characteristics                        | 2006      | 2016      |
|----------------------------------------|-----------|-----------|
| Number of village                      | 1,493     | 1,501     |
| Population                             | 24,287,420| 32,409,811|
| Working population                     | 9,045,651 | 13,823,856|
| Non-Agriculture economic activity (unit)| 2,519,292 | 2,801,893 |
| Non-Agriculture MLE unit               | 80,966    | 129,187   |
| Non-Agriculture MLE employment         | 2,713,133 | 4,845,641 |
| Average per capita GDRP (000 Rp.)      | 35,587    | 133,621   |

Following the regulation, BPS distinguished the definition of non-agricultural businesses in EC 2006 into industry-based and non-industrial. For the industrial sector, MLE is a business that has more than 20 laborers, while in the non-industrial sector, business is classified based on annual turnover. MLE is a business that has a turnover above 1 billion. By 2016, the definition difference occurs only in non-industrialized UMB where the turnover limit used increases to 2.5 billion rupiah. This change is done as a form of adjustment to the current economic situation without losing its comparability.
There are several approaches to measuring the changes in urban form, both qualitative and quantitatively. We used a quantitative approach to measure spatial patterns because it is proven to be able to provide more objective, less ambiguous results, and contributed a better understanding of these suburban phenomena [19]. Among several quantitative methods which have been used, spatial statistics is important in resolving another study’s main gap [42]. It tests whether certain types of areas (e.g. density, land use types, activities) are evenly (or randomly) distributed across the urban area. Reis et al [7] argue that spatial autocorrelation metrics are very useful to measure some important properties of urban decentralization and re-urbanization patterns and various urban sprawl studies. In the context of urban areas, positive spatial autocorrelation means that zones with high employment are clustered together, while spatial heterogeneity means that economic behaviors are not stable over space [43].

Exploratory Spatial Data Analysis (ESDA) is the most important method in this group [42], whereas the Moran’s coefficient (I) and local Moran coefficient (Ii) are the two most used autocorrelation measures [7]. This method has been used in several researches of urban spatial pattern such as [42], [44]–[47]. To implement ESDA tools, spatial interdependence between observations need to be modelled using the means of a spatial weight matrix [43]. In this research, we implemented a simple contiguity-based weight matrix using the queen method. It considers an area related to each other if they share the same borders. Building from the work of Anselin [48], Moran’s I is defined as:

\[
I = \frac{n}{S_0} \sum_{i=1}^{n} \sum_{j=1}^{n} W_{ij} (x_i - \mu)(x_j - \mu) 
\]

(1)

Where n is the number of observation, \(S_0\) is the sum of spatial weight matrix \(w_{ij}\), which is equivalent to a binary matrix with ones in position \(i,j\) whenever observation \(i\) is a neighbor of observation \(j\), and zero otherwise.

\[
S_0 = \sum_i \sum_j W_{ij} 
\]

(2)

where \(x_i\) is the observation unit \(i\), and \(\mu\) is the mean of all observation across spatial unit in which summation over \(j\) so that only neighbor values of \(j\) are included. The local version of Moran’s I statistic for each observation \(i\) can be written as:

\[
I_i = \frac{(x_i - \mu)}{m} \sum_j W_{ij} (x_j - \mu) \text{ with } m = \sum_i (x_i - \mu)^2 
\]

(3)

then,
The local Moran’s I value, which has a positive spatial correlation relative to mean (high-high/HH or low-low/LL) suggests the existence of spatial cluster, whereas location, which has a negative spatial correlation relative to mean (high-low/HL or low-high/LH) suggests the existence of spatial outlier [49]. We calculate the spatial association index by utilizing GeoDa [50].

4. Urban Spatial Transformation of JMA
4.1. The amplification of polycentric urban form
The growth in the number of MLE in JMA began to show a very rapid increase after the emergence of the New Order regime. The national development policies implemented through economic and trade liberalization as well as foreign direct investment have been established for MLE growth in JMA (Figure 2.a.). In 1976, the number of new MLE were less than 3,500 units, of which 74 percent of shares were concentrated in Jakarta as the core. Until the 80’s, the growth in the number of MLE was still concentrated in the core area, but since the period of 1990 there were also significant development in the nearest fringe area.

![Figure 2. The spatial pattern of MLE development in JMA 1976-2016.](image)

The development of the toll road to Bogor in the south, the Merak direction in the east, and the Cikampek direction in the west has helped the growth pattern of MLE expand to the nearest fringe along the main transportation route. After the year 2000, MLE growth began to occur massively in the suburbs, whereas some even developed in the edge area. Previously, agricultural areas on the JMA, edge such as Cikarang in the east and Cikupa in the west, have turned into new MLE concentrations. Nearly 40 decades later the number of MLE has reached more than 129 thousand units, or had an average increase rate of 93 percent per year. The MLE expansion occurring in JMA has a pattern similar to the pattern of land use change proposed by Rustiadi et al. [18].
In terms of polycentric urban structure existence, JMA has entered the post-suburban since 2000. Even though every administrative area within JMA has its own multifunctional economic center, but in terms of MLE, the scale is not sufficient enough to be identified as sub-center. In this research, sub-center is defined as the center of MLE employment. During that time, the urban structure was characterized by the emergence of urban polycentric structures resulting from the growth of new employment centers. The urban structure in JMA transformed into a stronger polycentric form, indicated by the increasing value of Moran’s index from 0.31 to 0.49 in 2016. This finding would strengthen the earlier emerging polycentric metropolitan structure thesis of Hudalah et al [33].

![Employment distribution 2006](image1)
![Employment distribution 2016](image2)
![I(i) map of employment distribution 2006](image3)
![I(i) map of employment distribution 2016](image4)

**Figure 3.** Comparative spatial pattern of employment distribution in JMA.

Although Jakarta as the core remains the largest employment concentration, but several other sub-centers have also grown in the suburbs. In 2006, there were at least 12 sub-centers of employment of various sizes. The majority were located in the eastern and southeastern parts of Jakarta. A decade later, there were processes of re-concentration, resulting to six significant employment sub-center. Several small sub-centers began to lose its significance, whereas in some sub-centers such as Cikarang the employment concentration became even larger. Another interesting point is that the emergence of the Cikupa sub-center as one of the new employment centers showed that the expansion of development during this period was shifting westward.

4.2. **Towards a long term industrial post-suburban of JMA**

While it has been known that there is a change of urban structure during the 2006-2016 period, the next question emerged, of whether this situation will encourage the growth of new cities, or instead perpetuate the existence of post-suburbia in JMA?. Hudalah and Firman [12] argued that the development of post-suburbanization in JMA initiated by the industrial sector will be followed by the service sector. To answer this question, it is important to know whether the sub-centers identified in 2016 are multifunctional areas or have limited functionality. In other words, will the industry agglomeration in the suburbs be followed by the service sectors? Figure 4 shows that in 2006 there were
polycentric structures of every economic sector: manufacturing, LOS, and HOS. The industrial centers are mainly located in the north and western parts of Jakarta, with an equal magnitude in Gunung Putri and Citeureup. There were several other cluster of manufacturers in Cikarang and Cikupa, but both covered only limited areas. The LOS clusters are spread uniformly in Jakarta, whereas some other clusters are located in Cikarang, Tambun, and eastern parts of Bekasi City. Meanwhile, HOS is located mainly in the golden triangle of Jakarta and its adjacent areas, while a limited area of cluster is also found near Tambun in Bekasi. The coexistence of manufacture and LOS cluster in the neighboring area of eastern parts of Bekasi and Cikarang emphasized the presence of functionally-specific suburban areas. At that moment, such areas have become the only existing post-suburbia in JMA.

![Figure 4. The spatial pattern of MLE sectoral employment in JMA 2006.](image)

In 2016 there was a significant change of urban structure in the whole economic sector. The manufacturing sector, originally concentrated in four locations of JMA, have now grown into seven sub-centers. The decline of the Sentul cluster was followed by strengthening agglomeration in Cikarang and the rise of the Cikupa sub-center. While the economic reurbanization into the JMA core was experienced by LOS clusters, the HOS cluster haven’t changed much. The LOS employment has a strengthening agglomeration in Jakarta as a JMA core, decreasing its significance in the suburbs and leaving only small contributions. The assumption of how Jakarta has reach its saturated point for further land development holds [12], but it is only true for manufacturing growth rather than for the whole economic activities. Such a situation illustrates that the transformation in the suburbs, which are encouraged by economic activities, is heterogeneous in its process.
Figure 5. The spatial pattern of the MLE sectoral employment in JMA 2016

Table 2 shows the agglomeration of the whole sectors that are getting stronger, indicated by the increase of 2016 Moran's I index compared to 2006. Figure 5, however, shows that agglomeration does not lead in the same direction. It was assumed that the growth of LOS and HOS would occur in the suburbs where manufacturing sites did exist in the past, but that has changed in a decade. What happened was the reurbanization of LOS in the core, reflecting the need for a more suitable environment with other globally organized firms, related institution, and associated amenities. This increasingly substantiates Jakarta’s existence as a global city. In this case, the post-suburban form has transformed from a multifunctional suburb into a monofunctional one. The remaining significant subcenters which are left on the outskirts of JMA currently hold the main function as a manufacturing location only. Musil [14] argued that such phenomenon illustrates what Kunzmann called the Urban Archipelago, in which suburban areas hold the role as the functional backstage of a metropolis, which provides the whole support for the urban core. It would take a long time for the JMA post-suburban before its next spatial transformation.
### Table 2. Comparative spatial autocorrelation statistics of the MLE sectoral employment distribution in JMA 2006 and 2016.

| Index Value       | 2006       | 2016       |
|-------------------|------------|------------|
|                   | Manufacture| LOS  | HOS  | Manufacture| LOS  | HOS  |
| Moran’s I         |            |      |      |            |      |      |
| Not significant   | 0.19       | 0.31 | 0.21 | 0.26       | 0.55 | 0.44 |
| High-High (H-H)   |            |      |      |            |      |      |
|                   | 1.009      | 877  | 1.105| 1.044      | 841  | 965  |
| Low-Low (L-L)     |            |      |      |            |      |      |
|                   | 67         | 118  | 60   | 70         | 155  | 91   |
| Low-High (L-H)    |            |      |      |            |      |      |
|                   | 381        | 465  | 305  | 341        | 491  | 425  |
| High-Low (H-L)    |            |      |      |            |      |      |
|                   | 38         | 36   | 29   | 44         | 14   | 17   |
|                   | 6          | 5    | 2    | 2          | 0    | 3    |

4.3. Towards a polarized population

It is argued that the transformation which occurs through the decentralization of economic activities will have an important impact on population dynamics. The post-suburbanization process takes place when employment is decentralized to the suburbs and creates a certain functional landscape. This encourages the population to adapt through one of two ways: adjusting the residential location closer to their working location or changing their job to reduce the duration of work commute. Such a situation is reflected in the shift of the dominant population job in each village of JMA. During 2006-2016, the population in JMA grew rapidly at an average rate of 3.3 percent annually. This growth caused pressure on population density, which rose from 6,552 people/km² to 7,999 people/km². Figure 6 (a) and (b) shows that the population density hotspot is increasing eastward with rapid growth in areas that are adjacent to the industrial cluster. This explains why the JMA population exhibit a similar spatial pattern as identified by Rustiadi et al [18] and Asri and Hidayat [51].

![Figure 6. The spatial pattern of MLE population characteristics in JMA 2016.](image-url)
The dominant occupation, which originally revolved around retail, accommodation, and service, has changed into manufacture in a decade. Populations working in the manufacturing sector are becoming increasingly dominant to occupy locations adjacent to the new existing manufacturing sub-centers, while those working in the service sector tend to get closer to the core. It is not surprising, since manufacturing employment has the most rapid growth compared to trade, whereas service sector employment remains constant. This implies that the available employment can only be absorbed by low skill workers. Urban transformation beyond post-suburbanization has created suburban population dynamics in JMA which tends to polarize based on its sub-center specialization. With regards to its commuting pattern, this phenomenon should have influenced a more efficient urban structure but has the potential to increase social segregation.

5. Conclusion
The post-suburbanization process has occurred in urban transformations worldwide. Nevertheless, there are varied understandings regarding its process across different locations. This suggests that geographic and location settings hold an important factor in the post-suburbanization process. While there has been much knowledge about post-suburbanization process, the urban transformation beyond post-suburbia is still lack of attention. Using JMA as a case study, we addressed three questions regarding urban transformation. The first is to reveal the actual recent urban form of JMA and its alteration. The second is to identify whether post-suburbia in JMA would rather develop into a new city or maintain its current form. The last question concerns population dynamics in regards to urban transformation. We make a contribution in the discourse of urban spatial transformation by providing empirical evidence of the spatial pattern beyond post-suburbanization, the extent of which could explain the next stage of post-suburbanization in the context of a developing country such as Indonesia.

Beyond the post-suburbanization era, research shows that JMA already consists of a polycentric urban structure since 2006. The manufacturing MLE decentralization is still ongoing outward Jakarta as the urban core. Further transformations suggest that those structures are getting stronger. There is an increase in the number of manufacturing jobs in industrial clusters in the edges of the metropolitan, resulting on a new significant manufacturing cluster in Cikarang, Bekasi and Cikupa, Tangerang. On the other hand, the spatial transformation of LOS shows opposite behavior. Though there was an increase in the number of MLE outward Jakarta, but the overall jobs provided is highly concentrated in the urban core. Such conditions make the cluster of suburban LOS formed in 2006 become insignificant a decade later. This recentralization symptom indicate that both sectors are still bound to the urban core, as it provides a more suitable environment with other globally organized firms, related institutions, and associated amenities. Jakarta is becoming a more global city and its hinterland is likely to form a steady state post-suburbia, which specializes in manufacturing sectors. Contrary to Hudalah and Firman [12], the urban transformation in JMA is characterized as a second modernity urban region, whereas a multifunctional city has decentralize into a mono functional post-suburban. Such phenomenon depicts an urban archipelago notion.

The recentralization of both sectors was also followed with workers adjusting their settlement towards the nearest suburban area from Jakarta. The population dynamics of JMA is dominated by the rapid growth of industrial workers in the fringe area, whereas commercial and service workers agglomerate in the core. Such a pattern creates a polarized population based on its sub-center specialization, which should contribute to a more efficient commuting pattern and better environment quality. But Hellbich and Leitner [9] argue that post-suburbanization spatial impact would affect not only the mix of population but also the change in commuting pattern, and the latest evidence shows that JMA is facing chronic traffic congestion that could worsen in the future [51]. These conflicting facts arise the question about the impact of urban transformation beyond post-suburbanization on job-housing balance. Several evidence suggests that there is a possibility of employment decentralization which doesn’t took place in the suburban area where workers reside [52]. Thus, the spatial mismatch would increase commuting duration and create environment problems. Therefore, future research should be
directed to study how beyond post-suburbanization transformation affects suburban commuting patterns.

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