MODELLING BUSINESS LOCATION FOR THE MULTICENTRIC STRUCTURE: THE CASE OF ISTANBUL*

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1. Introduction

The trend for multicentric urban form has been strong for the USA cities since 1965 that the concept was first considered against the monocentric cities. Following, many empirical and theoretical studies, examining the employment subcenter formation have increased in last two decades.[2) - 5)] As the cities get larger, an urban form that diverges from a mono-centric city to a rather more complex spatial pattern of clusters would be expected. Given the emphasis in this article on urban employment distribution, a model was outlined for defining firm's locational preferences that fit when there are alternative locations to old CBD or downtown. The firms were categorized for their types and a separate profit function that also varies spatially for each desegregated business type was presumed. Probability that each business type will choose a location was expressed by discrete choice modeling approach following the similar way as of Shukla and Waddell.[6)] Despite that the topic is quite promising for real case applications, some of the theoretical work on modeling multicentric urban form had some practical difficulties and hence such proposed models are lacking the validity tests with the actual data.[3)] The purpose of this paper is to outline rather a practical business location model for polycentric form of large cities that also that fits with the cases where there is lack of precise data as it was in our case city, Istanbul. The case study is a rapidly growing city with more than 10 million people as one of the largest metropolises in Europe, and the largest settlement in Turkey. We first analyzed the business location and clustering dynamics in Istanbul and proposed a non monocentric business location model that can estimate the future firm location patterns in the city more accurately than conventional monocentric approach.

2. Why do the Subcenters Emerge?

The question "Why do the businesses prefer to cluster in subcenters?" lied at the heart of non monocentric models -either descriptive or predictive- since the challenges were to incorporate the deriving forces of subcenter formation into the defined models. The answer to the above question also shaped our modeling framework as summarized below with some brief introduction of the recent work;

a) Agglomeration economies, or external scale economies, define the benefits of accessibility among the firms since each economic unit enjoys some benefit from the spatial proxies when making transactions with the others. This was interpreted

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by many studies as the most important deriving force why high density CBD shaped the cities.[2)-3)] The exponential decay function was widely used as given by equation 1 where; M_i is the agglomeration benefit for firms in zone i; A_j is the ability of employment stock in zone j to exert influence on zone i; D_{ij} is a measure of spatial proxies either in terms of distance or time.

$$M_i = \sum_j A_j e^{-aD_{ij}} \quad (1)$$

b) The second factor is the capability of the considered zones to locate more bulks of jobs.. As the city gets larger, the CBD reaches to its physical capacity to accommodate more employment and the outer suburbs become more attractive than the old downtown. This is also related to the land prices, because the floor space scarcity will increase the rents and this idea formed the base for very famous early monocentric model developed by Alonso, 1964.

c) The third factor is a transportation-related issue. Conflict between agglomeration economies and diseconomies of transport is another reason why new business developments do not prefer city centers. In one of the recent surveys conducted in the Netherlands, the firms forwarded the inner city transport congestion problems as one of the reasons for them to move to the outskirts of the city. Many studies attempted to use wage rates and the transport cost relations of the workers to incorporate the repelling factor of less accessible zones. However traffic congestion and spatial accessibility impacts have received rather less research attention than the wage gradients.

d) The fourth is the spatial attributes of zones- that have been rarely considered particularly in more economic theoretical models. Some of the recent work have analyzed land use zoning policies, closeness to main highway junctions or railway stations as zonal spatial features and revealed noticeable relations.[6)]

3. Proposed Multicentric Business Location Model

(1) The Basic Premises

Different forms of firm production function have found great use in defining the firms' benefits in urban and regional studies and also in multicentric business location models. Equation 2 gives one of the widely used type- the additive type of production function.

$$\prod_{qy} = p_o(O_o) - p_i(I_i) + p_f F(x) - R(x)p_r - W(x)p_w \quad (2)$$

where; $\prod$ is the profit of the firm type q_y; O_o is the amount of output, p_o is the price of output; I_i is the amount of input other than labor and rent, and p_i is the price of such input; R(x) and W(x) are the land and labor inputs and p_r and p_w are the prices of land and labor; F(x) is the agglomeration economies effects and p_f is the constant for the conversion such benefits to the monetary term. The "x" indices denote that the parameters vary spatially.

Generally speaking, multicentric business location models are categorized in two main groups. In the first one, each firm behaves to equalize its profit that varies spatially as a result of the varying parameters of wage, rent and external scale of economies[2)]; whereas the second group of models adopted the discrete choice specification through the similar varying parameters but also added some other spatial zonal attributes as mentioned in section 2[6)]. In this article, following the existing works on the second type, the probability that each disaggregated business type will choose a location was expressed by logit specification of the firms, profit functions that vary for each Transport Analyze Zones (TAZ) specified as discrete space. There were 4 major types of business considered for Istanbul; a) commercial and service, b) heavy industry) light industry, d) others within the limitation of data availability. Each disaggregated type of firm was assumed to be acting identically and thus described 4 distinct profit functions for each type. The output price and input factor prices including labor force in the

production function assumed to be spatially invariant. The only varying cost of input was taken as the price of land and the only varying benefit was the agglomeration economies benefits of the production function given by equation 2.

(2) The Agglomeration Economies

By some means of a different form of the function given by equation 1 for the benefits that the firms gain from the accessibility in between them was introduced here. The macro economic input output table was utilized to define weighted spatial interaction proxies in order to incorporate the varying interactions among the disaggregated firms as given by equation 3.

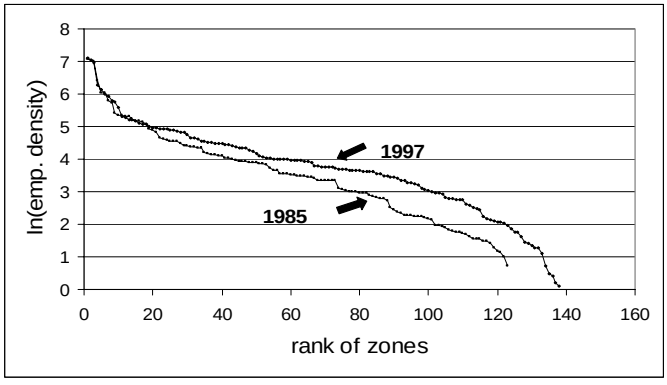
$$A_{qy,i} = \sum_{j=1}^{n} \sum_{z=1}^{k} K_{qz,qy} Q_{qz,j} e^{-aD_{ij}} \qquad (3)$$

where; n is the number of zones; k is the number of business types; q_z and q_y stand for the business types; D_{ij} is the average off peak hour trip time between zones i and j; a is the distance decay parameter; $Q_{qz,j}$ is the ability of business type q_z at location j to exert influence on the business q_y at location i and is defined by the number of employment of the type at zone j; $K_{qz,qy}$ is the transaction ratio between business type q_y and q_z and given as derived from the input output table and $A_{qy,i}$ is the agglomeration benefits that q_y type business enjoys at location i.

(3) The Land Prices

It is evident that, when the city takes the multicentric structure, there will be some local land rent peaks in the emerging subcenters. In some of the studies, examining the bid rent functions for the polycentric form, the rent gradients were derived from the of firm's profit function as maximization problem. We followed the similar idea and assumed that the factors shaping the profit function also determines the bid rents. Hence, land price was not separately embodied as possible hedonic bid rent function in order to omit the double counting. This also provides an ease to the cases where the land price data is poor that was also the troublesome for Istanbul. We also incorporated the land availability into the profit function since some work on multicentric rent gradients, though very few, mentioned the fact of land scarcity in CBD for higher rents. The land availability outside the CBD also proved as a very influential factor when examining the employment cluster dynamics in Istanbul. For this, the rank size distribution (figure 1) was drawn against the logarithmic employment density with the available data for 1985 and 1997 and it was revealed that somehow different employment dynamics would be observed for different groups of ranks; namely rather large growth occurred in medium density zones- cluster 2 and 3- (for further details see Alpkokin et al, 2005[1)]). Four employment clusters were defined using the rank size distribution for 1997 as graphed off in figure 2. The clustering of the employment density was included into the firms' profit function for incorporating the land availability impacts as given by equation 4. C_i's are the clusters incorporated as dummy variables taking "1" for the considered zone if it belongs to given cluster, otherwise "0"; and the k_i's are the parameters that will be estimated.

$$\prod_{qy} = k_0 A_{qy,i} + k_1 C_1 + k_2 C_2 + k_3 C_3 + k_4 C_4 \qquad (4)$$



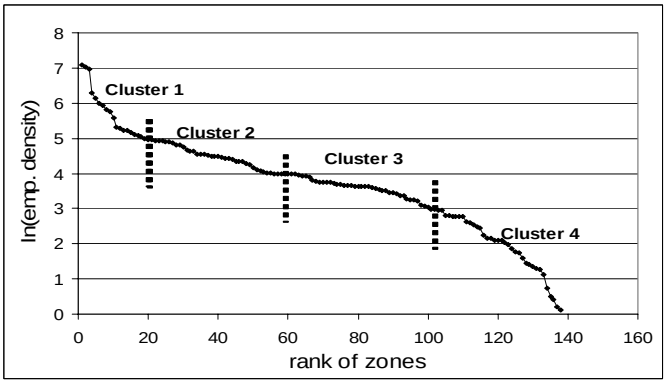


Figure 1: Rank size distribution for 1985 and 1997 Figure 2: Employment density clusters for 1997

(4) The Zonal attributes

The final shape of the firms' profit function was given by further adding the zonal attributes. For Istanbul, we considered two features –first is the relative labor force accessibility and the second is the land use zoning policies. In an early study[4] for the Washington D.C metropolitan area, the impact of accessibility for job opportunities on how the urban structure evolves proved to be strong. Following, we also calculated normalized accessibility indices (T_i^*) for each zone by using the below very general equation 5 given the weighted labor force accessibility of zone i (T_i). P_T is the total metropolitan population, P_j is the population in zone j and t_{ij} is the generalized cost of peak hour composite private and public transport trips between zones i - j.

$$T_i = \frac{1}{P_T} \sum_{j=1}^{n} P_j t_{ij}^{-b} \quad (5)$$

The Land use Master Plan,1995 for Istanbul set out general principles for planning that are of relevance to employment sub-centers and the achievement of the specifically, new "wing-attraction centers". The impacts of zoning policies were added by including the zones that were envisaged to accommodate bulks of employment as dummy variable (Z_i).

Then the very final form of firms' profit function for business type q_y in zone i subject to logit specification[1] was written as;

$$\prod_{qy,i} = k_0 A_{qy,i} + t_o T_i^* + k_1 C_1 + k_2 C_2 + k_3 C_3 + k_4 C_4 + k_5 Z_i \quad (6)$$

4. Conclusions

The work here challenged to arrange a multicentric business location model for a large and still rapidly growing city with its structure where the jobs were clustering outside the old CBD since the last three decades. Though the model is set on some assumptions, and accommodating some statistical and modeling deficiencies such as the multicolinearity, the authors believe that it may derive attention for its simplicity and applicability to other cases especially similarly growing cities in the developing world with some lack of precise data. Furthermore, the model is open to improvements by further disaggregating or adding more factors to the utility function when there is precise data. Yet, three contributions were made. First, model was designed after analyzing the 12 years time span (1985-1997) urban dynamics in Istanbul thus enhancing the existing literature that may guide to some other similar cities. Next, the model was not highly theoretical and purely economic but incorporating some spatial features that was lacking in some previous studies. Finally, as for future research work, the proposed model will be further used as a tool for evaluating the land use and transport policies in the city for sustainable development.

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[1] $Pq_{z,i} = \exp(\Pi q_{z,i}) / \sum_i \exp(\Pi q_{z,i})$ (Pqz,i is the probability that q_z type of firm will choose zone i)