International Journal of Sustainable Built Environment (2017) xxx, xxx–xxx

HOSTED BY

ELSEVIER

Gulf Organisation for Research and Development

International Journal of Sustainable Built Environment

ScienceDirect
www.sciencedirect.com

Original Article/Research

Investigating the spatio-temporal changes in major activity centres in the Sydney metropolitan area

Alireza Salahi Moghadam [a,*], Ali Soltani [b,c], Bruno Parolin [a]

[a] University of New South Wales, Sydney, Australia
[b] University of South Australia, Australia
[c] Shiraz University, Shiraz, Iran

Received 1 September 2017; received in revised form 2 November 2017; accepted 4 December 2017

Abstract

Every assessment of urban spatial structure requires determining the importance of activity centres. This paper gives an attempt to analyse the spatial and temporal changes experienced by major activity centres in the Sydney metropolitan area. The objectives of the research were first, to explore the role of main activity centres on the distribution of job opportunity across the metropolitan area, second to find out whether or not these key activity centres were influential in making the Sydney's urban structure more poly-centric rather than being a mono-centric. It also estimates how accessible these activity centres are for the workforce and what their corresponding labour catchment areas are. Eleven activity centres were chosen based on the preliminary analysis of Sydney's planning and development documents and exist evidences on living and working spots. A number of analysing techniques such as mapping of journeys to work in these centres, influence circles of centres, employment preference functions, and tabular data on the levels of employment were applied. The results of the analysis show that apart from the CBD, North Sydney, Parramatta and Inner City the remaining activity centres appear to exert slight impact on employment distribution across the metropolitan area. There does not seem to be evidence for a significant poly-centric structure in Sydney metropolitan area in regarding with employment recruitment, seeking and retention.

Keywords: Regional planning; Urban structure; Spatio-temporal change; Activity centre; Sydney

1. Introduction

1.1. Literature review

Cities and urban spatial structure have had a long history of research by economists, planners, geographers and others. The focus has been on the theoretical foundations of urban spatial structure and empirical foundations primarily through development and testing of various mono-centric and polycentric urban models (Baumont and Gallo, 1999). The understanding of urban spatial

* Corresponding author.
E-mail addresses: alireza_salahi@yahoo.com (A.S. Moghadam), ali.soltani@unisa.edu.au (A. Soltani), Bruno.parolin@unsw.edu.au (B. Parolin).
Peer review under responsibility of The Gulf Organisation for Research and Development.

https://doi.org/10.1016/j.ijsbe.2017.12.004

Please cite this article in press as: Moghadam, A.S. et al. Investigating the spatio-temporal changes in major activity centres in the Sydney metropolitan area. International Journal of Sustainable Built Environment (2017), https://doi.org/10.1016/j.ijsbe.2017.12.004

structure from these studies has been influential in the modelling of future growth patterns for cities (Clarke et al., 1997; Foot, 1981; Landis and Zhang, 1998; Spiekermann and Wegener, 2003; Waddell, 1998).

In the above models a key variable is distance from the CBD or distance to the urban fringe, and there are also other variables relevant to urban expansion such as income, agricultural land value and transportation costs, and so on. The theoretical principles of polycentric centres in urban space are found in the assumptions associated with urban growth strategies. For example, in A Plan for Growing Sydney, released in December 2014 is largely structured around the notion of a hierarchy of centres across the metropolitan area, and future spatial growth trajectories are targeted at existing and new centres thereby making use of both agglomeration and location economies. It could also be argued that many anti-sprawl strategies, smart growth and densification strategies now common in urban planning and policy (El-Garouania et al., 2016). But the reactions to the concept of urban expansion inherent in these models, are reflected in growth in central city core areas and in higher density urban villages – small islands of higher density development and mixed services (Torrens, 2008). The polycentric centres and the urban villages represent some of the bumps in the monotonic density decay curve with distance from the CBD that is typical of the mono-centric model.

The traditional urban economic theory relevant to the mono-centric model and to the concept of urban spatial structure is the model developed by Alonso (1964), Mills (1967) and Muth (1969), often referred to as the "A-M-M" (AMM) model. The non mono-centric theoretical approach to urban spatial structure, according to (Baumont and Gallo, 1999) is attributed to (Fujita and Ogawa, 1982; Odland, 1976; Ogawa and Fujita, 1980; White, 1976). Many empirical studies of these theoretical models are found in the literature (see Anas et al. (1998) and Mills (2000) for an excellent review of this literature).

These studies have occurred across individual cities, different city sizes and metropolitan systems in the US, Asia and Europe, and these models have also been recently estimated for cities in China (Deng et al., 2008). However, these model estimations have not been part of the Australian literature on urban spatial structure since the work of Patton (1970). Despite this, there continues to be research on understanding the formation of polycentric patterns (centres or sub-centres) and of emerging specialisations across centres in the Sydney metropolitan area in particular (Parolin and Kamara, 2003; Parolin, 2005).

The AMM model also serves as the core theoretical and empirical concept of urban land development studies within and across metropolitan areas (Paulsen, 2012), where remote sensing and satellite data are increasingly being used to examine urban growth, urban form and land use change over time (Sebego and Gwebu, 2013; Herold et al., 2005). In these studies the spatial unit of analysis is pixel-based, and of high resolution, due to the nature of the data from remotely sensed sources.

Data derived from these sources are various metrics that can describe land use, land cover, landscape features, urban growth and urban land development, in addition to urban ecological processes. Metrics such as size, shape, density, length and contagion, and so on, have been shown by Alberti and Waddell (2000) to be important in urban modelling given their effects on the spatial pattern of land use and cover on various social and ecological processes.

Paulsen's (2012) work in particular demonstrates effective calculation of urbanised land area from satellite imagery for 300 US cities over 3 decadal observations (1980–2000) and at a 30 m resolution. In this study, the data on what is urbanised land is consistently defined by classification through the multi-temporal data sets. Paulsen (2012) then relates changes in urbanised land area to three factors - population, household income and value of agricultural land. A key conclusion of the study was that the mono-centric, 3 variable, model continues to explain 75% of the variation in city sizes and that this offers some fundamental insights into the drivers of urban land markets. It is interesting to note that McGrath (2005) who undertook similar analysis, but only using 33 of the largest US metropolitan areas, came to similar conclusions about the continued relevance of the mono-centric model. However, McGrath (2005) used the US census definition of urbanised land area as the dependent variable of study not the pixel based definition.

In spite of the successful empirical work of Paulsen (2012), his study concludes that cities and regions in fact exhibit much more spatial heterogeneity of urban form and other features than the mono-centric, 3 variable model, allows for, and that these differences need to be better understood to make the mono-centric/polycentric models richer and relevant for policy.

What Paulsen (2012) is alluding to is that urban spatial structure is a more complex phenomenon than that captured by the empirical models of the AMM approach? As Troy (2004) noted, urban spatial structure is increasingly recognized as a complex phenomenon that is associated with cities as complex and adaptive systems. The main argument of this paper is that urban spatial structure is a multidimensional concept and falls into what Skupin and Agarwal (2007) call "truly n-dimensional data", a view also shared by Arribas-Bel and Schmidt (2011).

There are three implications of the multidimensional view of urban spatial structure pursued by this paper; one conceptual, one empirical and the other methodological. First, at a conceptual level, one must identify the dimensions that capture the complexity of urban spatial structure, and develop a conceptual model of the relations and inter-relations between and among these dimensions. A critical problem here is how to identify relevant and valid indices or spatial metrics to quantify the dimensions. Reliance on census data alone, or journey to work data alone,

Please cite this article in press as: Moghadam, A.S. et al. Investigating the spatio-temporal changes in major activity centres in the Sydney metropolitan area. International Journal of Sustainable Built Environment (2017), https://doi.org/10.1016/j.ijsbe.2017.12.004