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Measuring urban form at community scale: Case study of Dublin, Ireland

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ABSTRACT

With a tradition of compact cities, generally strict planning controls, and variable growth rates, many cities in Europe have policies which aim to restrict low density growth patterns. However, there is clear evidence that low density growth is happening, and that it is essential to understand the nature, location, and extent of the urban forms emerging on the periphery of cities across Europe. In its extreme manifestation, such low density peripheral growth is labelled as sprawl and considered detrimental. Drawing on the extensive literature on defining and measuring urban form, we focus on the methodologies and measures applied in the European studies at the regional (metropolitan), city, and community level. Affirming that the assessment of urban form at the community level is undertaken only sporadically, we adapt the measures used by Knaap et al. (2007) in studying US urban form to explore their applicability and robustness in analysing the evolution of urban form in a European setting. We examine the change of urban form in the Dublin Region (Ireland) in terms of residential and commercial density, internal and external connectivity, and land use mix. We find that the measures used, when adjusted to meet availability and nature of local data, are strong in revealing the trends in urban development form. We conclude by discussing the significance of the trends revealed in the case of Dublin and point to the issues of data availability in terms of both spatial and temporal resolution. Finally, we speculate on how the measures at different scales are suited to inform different types of urban policies and planning approaches.

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1. Introduction

Over the course of time, cities inevitably tend to grow due to both the natural increase of population and immigration from other areas – rural and urban, internally or internationally. Due to the changing norms and ideals of what is the acceptable quality of life in cities many urban areas worldwide have seen a changing dynamic in urban growth, with the tendency toward suburban forms and lower densities (Hall, 2002; Barrington-Leigh & Millard-Ball, 2015). Brought to an extreme, the suburban low density developments could turn into urban sprawl – a phenomenon that emerged in the United States following WWII and subsequently extended to other world regions, ‘western’ countries in particular (Fishman, 1987; Jackson, 1985).

Urban sprawl started to emerge in Europe in 1950s with the appearance, extent and pace varying by region (Antrop, 2004; Fons, 2012). Despite the evidence of negative birth rates and urban shrinkage in some regions (Wiechmann & Pallagst, 2012), European cities are growing,

with population increases in the recent decades primarily based on the national born population, and identified as most intense in smaller, amenity-rich, lower density and affluent cities (Bosker & Marlet, 2006). However, the nature of such growth has been changing over the past six decades. Based on a sample of 24 cities European Environmental Agency (EEA, 2006) reports the trend of urban sprawl across European cities, including ‘countries or regions with high population density and economic activity (Belgium, the Netherlands, southern and western Germany, northern Italy, the Paris region) and/or rapid economic growth (Ireland, Portugal, eastern Germany, the Madrid region’ (p. 9). At the local level, in some of the sampled cities, 90% of development since mid-1950s is in form of low density residential development. In addition to countryside, mountainous and coastal regions are also under threat of sprawl. In the 1990–2000 decade alone, urbanisation of coastal areas surpasses urbanisation of inland areas by 30%, with Portugal, Ireland and Spain topping the list (EEA, 2006).

Clearly, suburban and somewhat dispersed growth is observed in some of the major and traditionally dense European urban areas. Concomitant with suburbanization is the decline of central cities, Hamidi and Ewing (2014) offer examples of both Barcelona and Milan experiencing substantial population loss – citing Barcelona with the largest loss of central city population in Europe in the last 25 years;

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Milan losing a population of 600,000 to urban periphery in the last 15 years. Rome provides an additional example in the southern European context, with its suburban population growth of 30% (i.e., over 100,000) between early 1990s and 2011, paralleled by a loss of population in historic city centre and its immediate surrounding (ISTAT, 2012). Interestingly, in post-communist eastern and central Europe too, suburban sprawl has been quick to replace high density housing estates as a desired development pattern at the periphery of major cities (Kok & Kovács, 1999; Krisjane & Berzins, 2012; Stanilov & Sýkora, 2014).

Overall, there is initial evidence that Europe is prone to sprawl and potentially affected by the related inefficient consumption of natural resources and energy and impacts in terms of environmental, economic, and social dynamics (EEA, 2006). However, valid and accurate measures of both the urban development patterns and the impacts on urban form resulting from those developments are not easy to establish. These observations are generally challenged by the complexity and multiplicity of factors and forces associated with urban growth and difficulties in assessing them. The breadth, multifaceted nature and the lack of universally accepted definitions are obstacles to the comprehensive treatment of the issue of sprawl, as well as to deriving consistent and comparable research findings (Wilson & Chakraborty, 2013). Johnson (2001) maintains that these difficulties hamper the research on methodological issues. However, regardless of the methodological difficulties, researchers in the USA have made significant progress in measuring urban sprawl and distinguishing it from other more traditional types of urban development (Brueckner, 2000; Galster et al., 2001; Nechyba & Walsh, 2004; Hamidi & Ewing, 2014). These sources also include works that measure urban form at community scale where the impact on quality of life is most strongly manifested and felt (Southworth & Owens, 1993; Wheeler, 2003; Song & Knaap, 2004; Knaap, Song, & Nedovic-Budic, 2007; Barrington-Leigh & Millard-Ball, 2015).

In the European context, empirical studies at intra-urban scale are rare for reasons including but not limited to a lack of detailed datasets and focus on regional level indicators and scales (e.g., by ESPON¹), widely varying methodologies and definitions between European countries of what represents an urban settlement, and possibly some disregard for the serious nature of the problem (EEA's 2006 report terms urban sprawl issue as an 'ignored challenge'). To contribute to a better understanding of the nature of European urban sprawl, we review the existing methodological work on measuring urban form and focus on the community level to test a selection of indicators in a case study of Dublin, Ireland. This case is chosen for its substantial suburban and dispersed development at the urban–rural interface observed over the past two decades (Ellis & Kim, 2001; EEA, 2006; Gkartzios & Scott, 2009; McInerney & Walsh, 2009). To measure the change in Dublin's urban form, we trace the developments from pre-1950 to 2006 using land cover data along with topographic maps and local scale postal and socio-economic data. Toward that end we apply five measures adapted from the methodology used by Knaap et al. (2007) – internal and external street network connectivity, residential and commercial density, and land use mix. We conclude the paper by discussing the nuances of understanding and measuring urban sprawl at the community scale in the European context and by suggesting that measurements at different levels are informative and suitable for different types of urban planning and policy interventions.

2. Urban form and sprawl: alternative perspectives, definitions and measures

Urban form is primarily a spatial construct inextricably related to the patterns of development and human activity. It is often defined in terms

of connectivity (street network, transportation); land use types, intensity, mix and proximity; population and employment density and distribution (concentration, centralisation, clustering); and contiguity (dispersion, fragmentation) and shape of the built environment. The various characteristics of urban form are measured either individually or combined as indexes or coefficients. The form could be assessed with a range of methods, including: remote sensing, density gradients and gravity measures, fractals, entropy measures, surface-based approaches, geometrical techniques, architectural and photogrammetric techniques, measurements of landscape composition and spatial configuration, and accessibility calculations (Torrens & Alberti, 2000; Tsai, 2005). Along with various processes and functions associated with urban morphology, the social aspect of urban form is also recognised as important for understanding urban experience and for pursuing various actions in urban environments (Le Goix, 2005; Kirby, 2008; Chakraborty, 2009).

Urban sprawl refers to a specific type of urban form, often mentioned under various terms, such as discontinuous suburban growth, linear patterns of development (strip), leapfrogging or dispersed (scattered) development (Ewing, 1994; Ewing, 1997; Peiser, 2001; Hamidi & Ewing, 2014). Chin (2002) maintains that urban sprawl is the anti-thesis of the compact city, which is characterised by high density, centralised development and a mix of spatial functions. The author outlines four different types of definitions of urban sprawl based on: urban form, land use, impacts and density. Galster et al. (2001) find in various sources that the term sprawl relates to pattern, process, causes and consequences, and that a number of definitions are available. Besussi, Chin, Batty, and Longley (2010) define sprawl as the rapid and uncontrolled spreading of urban settlements at their fringes.

In the European context, a comprehensive definition of urban sprawl is given by the European Environment Agency (EEA, 2006):

“Urban sprawl is commonly used to describe physically expanding urban areas. The European Environment Agency (EEA) has described sprawl as the physical pattern of low-density expansion of large urban areas, under market conditions, mainly into the surrounding agricultural areas. Sprawl is the leading edge of urban growth and implies little planning control of land subdivision. Development is patchy, scattered and strung out, with a tendency for discontinuity. It leap-frogs over areas, leaving agricultural enclaves. Sprawling cities are the opposite of compact cities – full of empty spaces that indicate the inefficiencies in development and highlight the consequences of uncontrolled growth.” (p. 6)

The EEA's definition, although not elegant, encompasses a description of the physical appearance of sprawl as a particular type of urban form and suggests conditions that lead to it as well as the ensuing inefficiencies. Inherently, urban sprawl is connected to the process of development, which aligns with Couch, Leontidou, and Petschel-Held (2007) view of sprawl as not only a spatial pattern of urbanisation, but as a process of urban change. Even with many alternative perspectives on sprawl the European and non-European sources seem to agree on the main characteristics of urban sprawl, summarised by Nedovic-Budic, Slaev, Krunic, and Petric (2015) in Table 1. These characteristics include: a) decreasing overall densities, and low and/or falling suburban densities; b) dispersed, leapfrogging or ribbon suburban form; c) over-developed road networks, car dependence, and poor access; and d) poor mix of uses, and lack of well-defined centres with services and public amenities.

Clifton, Ewing, Knaap, and Song (2008) provide a comprehensive review and classification of perspectives used to characterise urban form: landscape ecology, economic structure, transportation planning, community design, and urban design. The dimensions of urban form associated each of these perspectives are variably manifest at community (neighbourhood, block), citywide and metropolitan scales

¹ European Spatial Planning Observation Network – <http://www.espon.eu/>.

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