



Residential density change: Densification and urban expansion



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ABSTRACT

The development of residential areas over time is a complex process that is characterised by substantial spatial and temporal variation. In essence, residential growth processes lead to two types of development: the construction of new housing units within existing residential areas (densification) or the development of new residential areas on land that was formerly open (expansion). This paper aims to understand the dynamic balance between these two processes and does so by analysing local changes in housing stock over time.

The analysis is carried out for urban areas in the Netherlands, a country where urban concentration ambitions were adjusted in recent years. This changing planning context adds to the uncertainty about future residential development processes. Using detailed geographical data about land use and residential densities from 2000 onwards we study residential development and density changes in relation to prevailing spatially explicit policies. The observed changes are statistically linked to geographic and policy variables, such as the availability of developable land and the presence of restrictive or stimulating spatial policies.

Residential densification is shown to occur in almost all regions of the country and is generally lower when demand for new dwellings is high and a limited amount of land is available within cities. Residential development zones are influential in shifting pressure from city cores while prescribing relatively high densities in expansions. At the local level we observe great variation in residential density development, but we find that densities increase within designated urban development zones and areas that rich in amenities. Restrictive planning regulations related to natural and landscape values tend to limit residential densities, as do initial high densities.

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1. Introduction

Just over half of the world's population lives in cities today, and the number of city dwellers is expected to increase considerably in the coming years (UN, 2011). This urban growth process is steered by forces of agglomeration related to the attraction of urban areas for, employment and residences and dispersion stemming from excessive crowding (Anas, Arnott, & Small, 1998). If enough space for new buildings is available within the city or higher densities can be achieved by other means, a share of the continuing demand for housing units can be accommodated within existing urban areas. Otherwise, cities expand outwards claiming new areas in their surroundings. Both processes imply residential density changes: the former is referred as urban densification and the latter as urban expansion. This paper aims at understanding the dynamic balance between these two processes and does so by analysing local changes in housing stock over time.

The classic theory-based descriptions of the spatial structure of cities presume a mono-centric urban layout around a central business district (Alonso, 1964; Mills, 1967; Muth, 1969). In this view, land rents and densities at central locations are higher and decline monotonically with increasing distance. Empirical efforts following these theoretical models, have documented decreasing urban densities generally in terms of population (Alperovich, 1983; Mills, 1970), employment densities and the identification of spatial job agglomerations (McDonald, 1987; McMillen, 2004). Theoretically, urban density gradients are expected to flatten with higher incomes and decreasing transportation costs (Alperovich, 1983) and this property was demonstrated in a number of empirical studies (Jordon, Ross, & Usowski, 1998; Mills, 1970). These results suggest that cities extend over time and experience decreasing densities, but they do not directly address densification processes within them. Only a limited number of models explicitly address the simultaneous occurrence of urban densification, through redevelopment processes, and urban expansion in the city fringe (Wheaton, 1982). Possible drivers for residential density changes at specific locations are not explained by these models.

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Residential expansion processes have received some attention in urban economic literature (Bruekner, 2000; Bruekner & Helsley, 2011) but feature more frequently in planning and land-use change literature. These studies tend to focus on urban sprawl and are concerned with the extent and the velocity at which low-density residential areas spread around cities (Frenkel & Ashkenazi, 2008; Irwin & Bockstael, 2007; Mubareka, Koomen, Estreguil, & Lavalle, 2011; Torrens & Alberti, 2000; Yu & Ng, 2007). The urban–rural fringe and its land-change dynamics form another research topic that is closely related to urban expansion (Bell & Irwin, 2002; Irwin & Bockstael, 2004). Data acquisition and measurement methods regarding residential expansion are discussed in literature, proposing new GIS-based techniques and detailed data sets for urban growth monitoring (Irwin, Bockstael, & Cho, 2006; Sim, 2011). These studies mainly focus on the spatial patterns and densities of non-urban land that is converted to residential uses but do not address urban densification.

A few empirical papers look at both density changes in residential areas and residential expansion in very instructive but specific case studies related to Leipzig and Orlando (Haase & Nuissl, 2010; Sim, 2011). Others focus on changes in land cover (land converted to urban uses) rather than land-use intensity. This is partly because they are based on satellite images (Sheppard, 2011) or predefined land-use types (Irwin et al., 2006) that lack a clear description of density. Another line of research monitors the degree to which urban uses are mixed, and the relative density of each use within urban areas (Harts, Maat, & van Emmichoven, 2000; Ritsema Van Eck & Koomen, 2008).

In planning literature, residential densification is discussed extensively as a possible way to achieve compact cities, combat sprawl and create urban sustainability (Daneshpour & Shakibamanesh, 2011; Gordon & Richardson, 1997). In the US context this ambition is referred to as smart growth policy (APA, 2002) that generally intends to restrain urban sprawl, by prescribing high densities in existing urban areas (Ye, Mandpe, & Meyer, 2005).

In past decades, European cities showed a continuous increase in the amount of land they use. In many cities the need to accommodate more people is the main driver, but even in the face of a stabilising or declining population the urban area often continues to grow. In the latter case, an increase in living space per capita more than compensates the possible reduction in urban land use that could result from population shrinkage (Haase, Kabisch, & Haase, 2013). In parallel, many city centres in Europe seem to regain their residential attractiveness, leading to reurbanisation processes in inner-city areas (Haase et al., 2010). This process is claimed to be closely related to the amenities offered in cities (e.g., Brueckner, Thisse, & Zenou, 1999; Clark, Lloyd, Wong, & Jain, 2002; Glaeser, Gyourko, & Saks, 2006). Densification trends in city centres, along with new dense suburban developments were recently also documented for the US (Delmelle, Zhou, & Thill, 2014).

This paper analyses the degree to which current urban development is in line with the general objective of increasing the efficient use of land. By looking at actual urban development we want to step beyond general theoretical notions on density gradients and obtain an empirics-based understanding of urban densification and expansion processes. More precisely, we aim to answer to the following research questions:

1. How are the processes of densification (adding housing units to existing urban areas) and urban expansion related?
2. Which drivers help explain these processes and how do they steer them?
3. Do the observed relations differ across different spatial analysis levels?
4. What is the role of policy instruments in steering residential densification and expansion processes?

With answers to the research questions we hope to provide understanding about ongoing developments in the urban structure, and the degree to which policy measures help influence such changes. In our explanatory work we therefore deliberately include reference to implemented residential development policies, aiming to assess their impact on steering urban development.

This paper is structured as follows: Section 2 describes the case study area, data and methods used in the research. Section 3 then presents the results obtained in the explanatory analysis. Section 4 summarises and concludes with respect to the four research questions.

2. Data and methods

2.1. Case study area and spatial policy context

The Netherlands is one of the most densely populated countries in Europe, with more than 400 inhabitants per square kilometre. Considering that the major Dutch cities are relatively small (Amsterdam, the largest city, has less than 1 million inhabitants), urban development is dispersed, putting substantial pressure on the open spaces in this polycentric network of cities. Therefore, the governing concept in the national planning reports issued by the authorities responsible for spatial planning in the last 50 years was to accommodate the anticipated urban growth while preserving rural and open areas, especially in the highly urbanised western part of the country, the Randstad (Faludi & Van Der Valk, 1994). Residential development was steered using an array of policies and mechanisms. In densely populated areas, restrictive zoning was implemented using two elements to prevent the creation of large urbanised belts. On one hand, bundled de-concentration initiated the formation of new towns outside of the existing ring of cities that form the Randstad. This planning concept was defined to concentrate suburbanisation in appointed agglomerations along main infrastructure in light of the anticipated population growth (Sap, 2007). On the other hand, buffer zones between the major cities of the Randstad were defined in order to preserve open spaces. These policies were aimed at open space preservation but also helped steering development towards existing urban areas (Koomen, Dekkers, & Van Dijk, 2008; Van Rij, Dekkers, & Koomen, 2008). More recent national policy strived to steer residential development towards large-scale urban development zones near existing urban areas and stimulate development within existing urban areas (VROM, 1993; VROM et al., 2004). Nature conservation policies act as additional restrictions on residential development. Natura 2000 is a European network of protected areas in the European Union member state's territory. This network is the cornerstone of the EU policy for restoration of biodiversity and Dutch authorities are obliged to follow it. At the national level, the National Ecological Network (NEN) is a cohesive network of existing and new, to be developed nature reserves, composed of core areas and corridors connecting them. The NEN and Natura 2000 network are expected to contribute to the preservation and enhancement of the biodiversity in the Netherlands (Jongman, 1995).

The Dutch spatial planning system is generally considered to be successful in terms of, for example open space conservation and the provision of land for urban development (Alterman, 1997; Faludi & Van Der Valk, 1994; Mori, 1998), although some criticised its legitimacy and partial effectiveness in, for example, limiting mobility through compact urban development (Alpkokin, 2012; Hajer & Zonneveld, 2000). Large-scale residential development zones (VROM, 1993) are regarded as highly successful in steering urbanisation, since a substantial proportion of the total Dutch housing production in the last two decades was realised at these

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