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Regional diversity in residential development: a decade of urban and peri-urban housing dynamics in The Netherlands

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Abstract Residential development is a dynamic process, as changes in housing stock vary substantially over space and time. These spatiotemporal dynamics are expected to differ in various hierarchical levels of urban areas. Urban cores, peri-urban areas and predominantly rural areas are likely to experience different housing development processes as the economic and demographic drivers of change are different in these areas. To obtain a deeper understanding of recent changes in urban development, we analyse the residential stock development in the Netherlands, measured as the number of housing units available. At the national level housing stock is continuously growing at a fairly stable rate of 1.1 %. Disaggregating the national data into different hierarchical levels we find that in absolute numbers urban cores are growing more than peri-urban areas. However, in relative terms, peri-urban areas are growing faster than urban cores. At the regional level we find substantial differences between different geographical zones. The Randstad—the western and most urbanized region of the country—is growing more than the other regions. This is the only region, however, where residential stock in peri-urban zones grew faster than their associated urban cores. Testing the different regions and hierarchical levels for their correspondence with the generally accepted Gibrat's law of proportionate growth, we find that the urban cores in the Randstad are growing less than could be expected from their initial size. Their peri-urban areas, on the other hand, are growing faster than their initial size would suggest. These findings hint a degree of saturation of the current urban cores in this region and a spill-over of residential development into their peri-urban areas. The study is complemented by an explanatory analysis linking socio-economic indicators and physical planning criteria (such as the amount of land available for the development and the presence of restrictive policies) to the observed residential stock development.

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1 Introduction

Residential development shows great variability over time and space (Orenstein and Hamburg 2010; Angel et al. 2011; Inostroza et al. 2013). These spatiotemporal dynamics are likely to vary for regions with different economic and demographic conditions and for different hierarchical levels. For example, in a single geographical area, urban cores, smaller settlements subordinate to them and predominantly rural areas that are loosely connected to central cities are likely to experience different residential development processes. We hypothesize that economic and demographic processes relate differently to residential change at these hierarchical levels. In addition, the production of housing units is a process that typically reacts slowly to societal changes due to its long preparation time. This reaction is, furthermore, influenced by the market's perception of opportunities and government intervention (Glaeser et al. 2006). The latter usually takes the form of regulations and restrictions in some areas and development incentives in others (Koomen et al. 2008).

Yet, Gibrat's law for cities, sometimes called 'The law of proportionate effect', states that the growth rate of a city of a certain size has a distribution function with mean and variance that are independent of its size. If Gibrat's law holds for city growth processes in a country, it means that their growth rates are identically distributed (independently of city size) with a mean equal to the national urban growth mean (Gabaix and Ioannides 2003; Eeckhout 2004).

This paper attempts to analyse residential stock development over time and space in The Netherlands, disaggregating it into clearly differentiated regions and a set of urban-hierarchy related functional categories (urban cores and peri-urban areas). An additional objective is to analyse its correspondence with the generally accepted Gibrat's law of proportionate growth. Using this combination of regions and hierarchical levels we aim to shed light on residential stock changes in the past decade. The paper includes an explanatory analysis linking socio-economic indicators (as regional GDP and employment growth) and physical planning criteria (such as the presence of dwelling extension plans or restrictive policies) in an effort to explain observed changes in the residential stock.

2 Case study

Residential stock in the Netherlands has been growing at a fairly stable rate of about 1.1 % per year in the last 25 years (Fig. 1, left). This growth rate does not show a direct relation with the much more volatile GDP growth rates (Fig. 1, right). The 2010 economic decline and preceding dips in economic growth (for example following the burst of the dotcom bubble in 2002) clearly did not affect the development of new
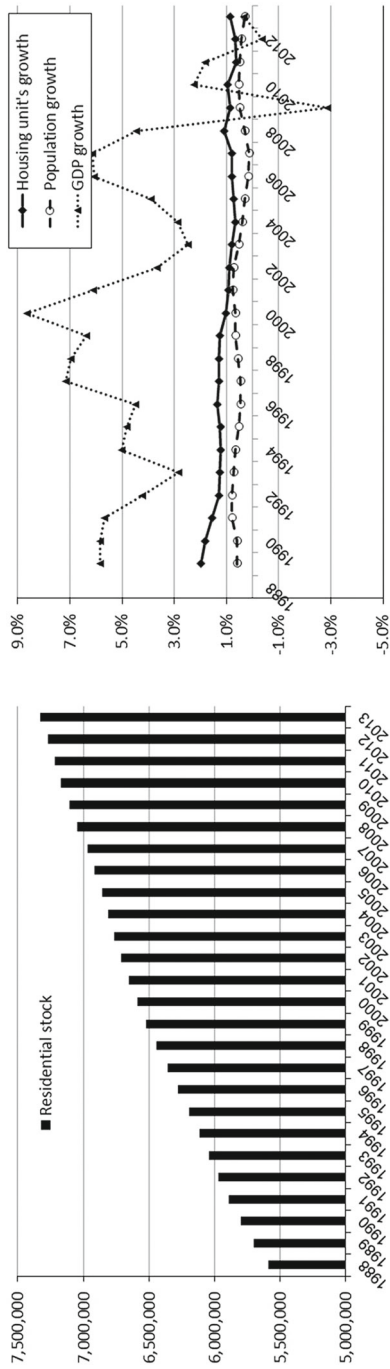
Fig. 1 Residential stock development (*left*) and its growth rate compared with GDP and population growth (*right*) in The Netherlands, 1998–2013

residences so much as it did in countries such as the US, Ireland or Spain (Duca et al. 2010). A potential driver for residential development in the last 25 years is the continuous, albeit limited growth of population that is strongly related to migration (Bijl et al. 2011).

The Netherlands is known for its relatively successful spatial planning system, managing urban development and open space preservation (Alpkokin 2012; Alterman 1997). In the last 50 years, the governing concept in the national spatial planning reports was to accommodate the anticipated urban growth while preserving rural and open areas (Faludi and Van Der Valk 1994). Residential development was steered during the analysed period through a set of complimentary restrictive and stimulating spatially explicit policies. Buffer zones were defined to preserve open spaces in the most urbanized area of the country, the Randstad, between the major cities of Amsterdam, The Hague, Utrecht and Rotterdam (Koomen et al. 2008). Nature preservation and biodiversity enhancement are expected to be achieved by the National Ecological Network (NEN) and Natura 2000, which are networks of nature reserves, composed by core areas and corridors connecting them (Jongman 1995). Plans implemented in order to protect open spaces and to preserve biodiversity are referred collectively as restrictive policies. In parallel, specific and carefully planned areas near the edge of the cities were designated by the government for large scale housing developments (e.g., VROM et al. 2004). Since a substantial proportion of the total housing production in the Netherlands has been realized in these locations, these efforts can be regarded as highly successful in steering urban development (Zonneveld and Evers 2014).

3 Data and analysis

To study residential stock development in the Netherlands in detail we used spatial data describing the number of houses units per hectare for the period 2000–2010. This raster data with a resolution of 100 m was provided by PBL Netherlands Environmental Assessment Agency. It is based on a combination of information sources regarding the location of population and housing units (Evers et al. 2005). In addition, a spatially explicit population database from Statistics Netherlands (CBS 2013a) is used, at the same resolution and for the same period. Using such fine rasterised spatial data allows for the application of various spatial aggregation units and bypasses the problem of municipal revisions that usually hampers this type of time-series analysis.

Two different administrative divisions of the country are used in the analysis. The coarsest one is the NUTS-3 (Nomenclature of Units for Territorial Statistics) level, commonly used in European statistical reports. There are 40 NUTS-3 regions in the country, and basic economic data, as GDP and employment, are usually collected at this level. However, the main analysis will be performed using municipal administrative borders. In 2011 there were 443 municipalities which covered the entire national territory (Fig. 2). The population and dwelling data, as well as the planning policy maps were aggregated to the level of municipalities.

A clear-cut distinction between urban and rural areas is characteristic in the traditional planning doctrine in the Netherlands (Van der Cammen and De Klerk 2003). Yet, many scholars question the relevance of this dichotomy, especially from a soci-
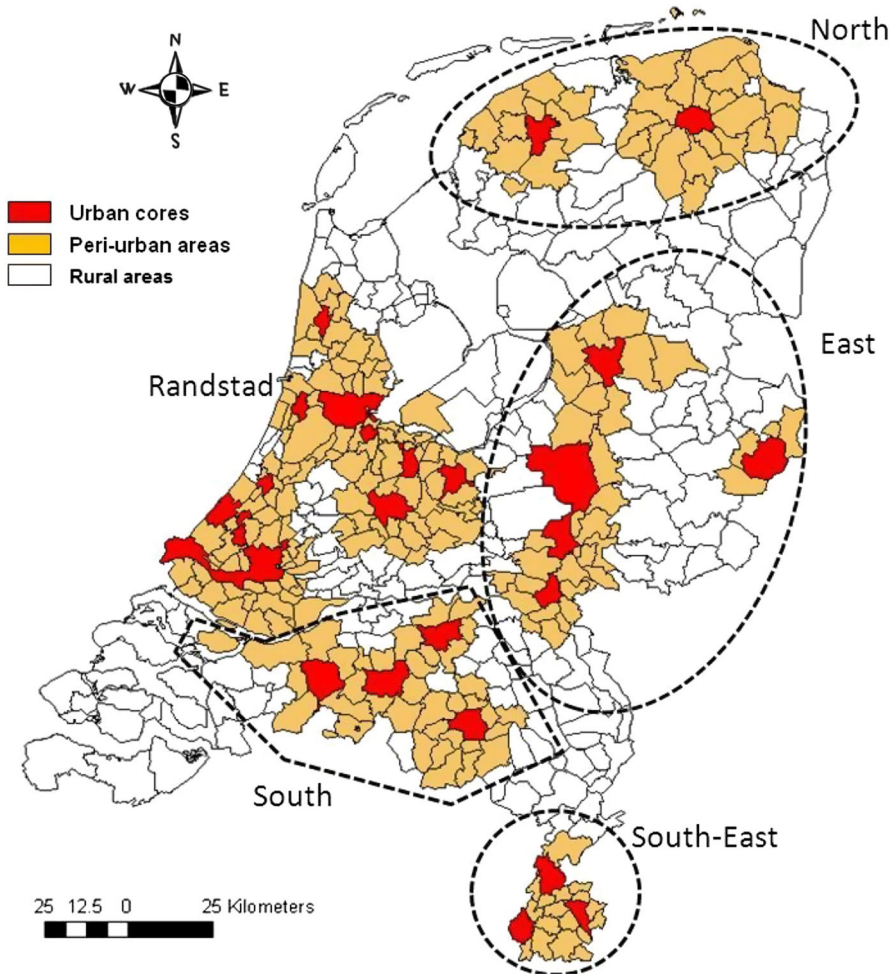
Fig. 2 Urban systems composed of urban cores and peri-urban areas, grouped by geographical zones. Rural municipalities are not considered part of the urban system. The divisions are according to municipal boundaries (n = 443)

ological, economic or policy perspective (Pahl 1966; Deavers 1992). This debate has given rise to a third, intermediate category of peri-urban areas (e.g. Allen 2003). We define these areas as having an urban appearance, but being functionally subordinate to main cities. In our analysis we build on the urban-core / peri-urban categorisation proposed by Hornis and Ritsema van Eck (2007, 2008). In their approach, functional relationships in an urban system are revealed by flows of people, goods and information between places. Using human mobility patterns, the 24 cities which have the largest daily inflow of people are categorized as urban cores. The peri-urban areas are the municipalities with a large (above average) daily out-flow to these urban cores (Hornis and Ritsema van Eck 2008). Other municipalities, with lower or more dispersed out-flows are not considered part of the urban system (Hornis and Ritsema van Eck 2007) and therefore are referred here as rural areas.

Table 1 Population and residential stock (number of housing units) in The Netherlands, 2000 and 2010

	Urban cores	Peri-urban	Rural areas	Total (national)
Number of municipalities[a]	24	227	192	443
Residential stock in 2010[b]	2,383,980	2,683,271	2,215,232	7,282,483
Residential stock share in 2010 (%)	32.74	36.85	30.42	100
Residential stock growth in period 2000–2010 (%)	8.23	10.06	8.74	9.05
Average residential density in 2010 (housing units/ha)	32	12	8	13
Population in 2010[c]	4,896,785	6,299,685	5,300,585	16,497,055
Population share in 2010 (%)	29.68	38.19	32.13	100
Population growth in period 2000–2010 (%)	5.49	4.63	3.3	4.45

[a] The number of municipalities is decreasing continuously, this number refers to 2011
[b] Source: PBL Netherlands Environmental Assessment Agency
[c] Source CBS 2013a. Slight differences with other sources (CBS 2013b) may occur due to different data definition issues

The urban systems, composed by urban cores and peri-urban related municipalities, were then grouped by geographical proximity. The urban system located in the central-west and most populated area of the country, which includes the main cities, is referred as the Randstad. Other urban systems are denominated according to their geographical location (Fig. 2).

Table 1 summarizes the main figures related to housing units and population distribution according to urban categories in the analysed period. During the study period, population grew by 4.5 % while residential stock grew by 9 %. This mismatch is caused by the continuously declining size of households (Bijl et al. 2011). Higher growth rates for household numbers than for population totals are found in many European cities (Haase et al. 2013). Also remarkable is the fact that the residential stock growth is higher in peri-urban areas than in urban cores, a topic that will be discussed in the next section.

4 Regional differences in urban and peri-urban development

The regional analysis of the residential development in the period 2000–2010 shows differences between regions and different functional categories. Table 2 shows the extreme unevenness in the distribution of the location of new housing units. 61 % of the new housing units in urban systems (including urban cores and peri-urban areas) built in the period 2000–2010 was located in the Randstad.

Figure 3 shows the housing unit development dynamics together with the population growth rates, for the whole country and for the selected regions. Both growth rates are displayed per 2 years periods.

The residential stock growth for the whole period 2000–2010 ranges between 7 and 12 %, with the exception of the South-East region with a lower growth (around 5 %).

Table 2 Regional dynamics for urban areas in housing stock and population between 2000 and 2010

	Absolute increase in residential stock by 2010	Relative increase in residential stock by 2010 (%)	Absolute change in population by 2010	Relative change in population by 2010 (%)
North	30,944	8.41	34,915	4.26
East	57,006	8.87	67,040	4.32
Randstad	261,573	9.67	388,260	6.37
South	62,312	9.80	70,975	4.64
South-East	14,661	5.08	−27,605	−4.14

At the national level, peri-urban areas developed faster than urban cores. However, the disaggregation of the data into regions shows that this national trend is a result of the dominance of developments in the Randstad. The internal distribution of new housing units between urban cores and peri-urban areas in the Randstad is quantitatively and qualitatively different from other areas. It is characterized by a much stronger peri-urban housing development (around two thirds of the new housing units in this group of urban systems), than its core urban areas. Other regions show much lower rates of residential building activity, in decreasing order, the South, East, North, and the South-East area. In all these areas, growth rates in urban cores and peri-urban areas in observed.

The population grew in all the regions, except for the South-East. In this region, at the local, neighbourhood level, houses have become vacant, however, and incidental demolition of housing units followed as was observed in a limited number of specific places. In the North, East and South regions, the urban population grew faster than the peri-urban. Conversely, and in line with the residential growth trends, the Randstad is the only region where the peri-urban population is growing faster than the population in the urban cores.

5 Possible drivers behind regional residential stock dynamics

To get an understanding of possible drivers behind regional changes in housing stock we take a closer look at the importance of regional economic performance, the validity of the proportionate growth hypothesis formulated by Gibrat and the impact of spatial planning policies.

5.1 Regional economic performance

As argued by Glaeser et al. (2006), the growth (or decline) of a region's economy has a close relation with man-made physical structures existing there. Therefore, residential development is expected to be related to the regional economic performance. This relation is apparent from casual inspection since residential stock, population and number of jobs, are generally strongly correlated over cities and regions (Vermeulen and van Ommeren 2006). We use GDP and employment in order to assess the economic performance of the regions defined in our analysis.
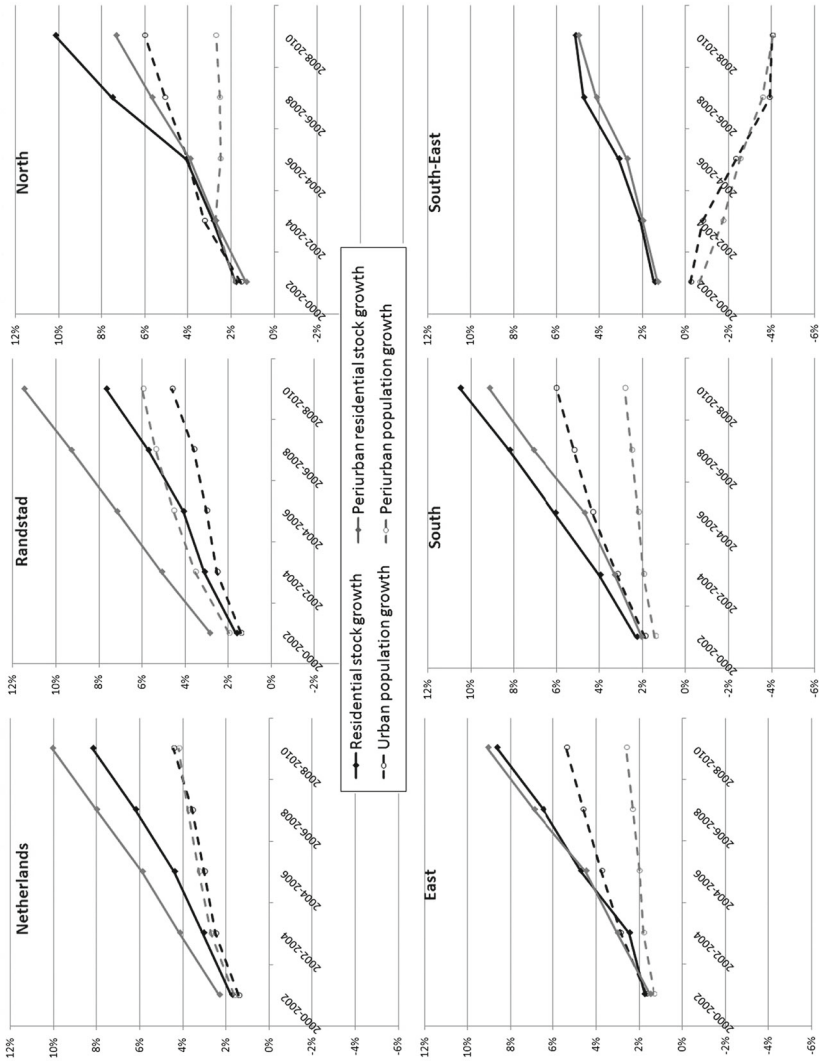
Fig. 3 Residential and population development (growth rate, %) at national level and by urban region and urban category

Table 3 Economic performance 2000–2010 (GDP in millions of € and employment n full time equivalent—FTE—jobs) for selected urban regions compared to the national total

	GDP 2000 (Million €)	GDP growth 2000–2010 (Million €)	GDP growth 2000–2010 (%)	Employment 2000 (1,000 FTE)	Employment growth 2000–2010 (1,000 FTE)	Employment growth 2000–2010 (%)
National total	417,960	168,829	40	6,534	185	3
North	27,658	15,257	55	395	−4	−1
East	62,511	24,969	40	1,105	32	3
Randstad	192,589	77,378	40	2,994	25	1
South	62,960	24,369	39	1,004	26	3
South-East	15,199	4,027	26	235	−12	−5

Since economic data is mainly collected and processed at the NUTS-3 level, the performance of each urban system is calculated aggregating the figures of the NUTS-3 regions in which the relevant municipalities are located. Table 3, based on Statistics Netherlands (CBS 2013b), summarizes the regional economic performance during the period 2000–2010.

The economic variables summarized above sketch the context for the observed regional residential dynamics.

Regional GDP expresses the output value of each regional economy at current prices, and it is used here as an approximation of regional economic performance. By far, the highest regional GDP is produced in the Randstad, followed by the East and South regions, both with a GDP of approximately one third of the Randstad, and then by the North and finally the South-East region, with the lowest one. GDP grew during the decade 2000–2010 by around 40 % in three of the five analysed regions, in line with the national GDP growth. The exceptions were the South-East region, in which the GDP growth was substantially lower, and the North area (the highest growth rate) mainly due to the natural gas resources located and exploited in the area.

However, the employment evolution during the same period is much more diverse. The regional employment, measured using the number of full-time (FTE) jobs, in 2000, has a strong resemblance with the regional GDP. The absolute change in full-time jobs during 2000–2010, reveals a net loss of employment in the North and South-East regions. In the North, this occurs regardless of the high GDP growth rate observed previously suggesting that the economic activities performed (amongst others the extraction of natural gas) involve relatively little labour. In the South-East region, around 12,000 jobs were lost in the analysed decade, which accounts for more than 5 % of the jobs that were available in the region in 2000. In the Randstad, East and South regions, employment grew steadily during 2000–2010.

GDP and employment figures for 2000 in NUTS-3 regions are highly correlated (Pearson correlation = 0.995, p<0.001). Therefore, in order to assess their correlation with the residential stock development, only one of them is used. We choose the GDP in 2000 as the independent variable, with the residential stock growth as the dependent

Table 4 Housing units' absolute growth predicted by regional GDP in 2000

	NUTS-3 regions containing urban systems
N	28
R square	0.913
Constant	1,760 (1,227)
GDP in 2000	1.265*** (0.075)

*** Significant at 0.01

one. Only the 28 out of 40 existing NUTS-3 regions that contain urban systems were selected for the analysis. The regression result is included in Table 4.

High GDP is closely correlated with substantial residential stock increase. The explanatory power is remarkably high, as expected, and a similar result is obtained if the absolute employment in 2000 is used. In any case, this type of analysis is not able to shed light on the differences between urban cores and peri-urban regions.

5.2 Testing the hypothesis of proportionate growth

The residential stock and the population in the Netherlands had a certain distribution in 2000 among regions, urban cores, peri-urban and rural areas. If we assume a constant growth rate for housing development as described in Gibrat's law, we expect to find the same stock distribution in 2010. This implies that the share of the total number of houses added to the regions should also be in line with their initial shares in total housing stock in 2000. This hypothesis is easily rejected, as shown in Table 5 below. The table compares the residential stock share in 2000 with the share of new housing units added in the period 2000–2010 in the same area. The fourth column (highlighted) is the difference between both figures and the table is sorted from smallest to largest according to it. The three last columns display the same calculations related to population shares and growth.

The rural area residential stock grew less than its share in 2000 suggest (−1 %) and population growth in these areas was even lower (less than −8 %). The figures for the South-East region are very similar: low rates of housing unit development and a declining population. The North region has a different development pattern in urban cores or peri-urban areas. The peri-urban area developed slightly below its share of housing units and population in 2000. However, urban cores developed above their share in 2000 in both parameters. Residential stock in the regions located near the central part of the country (south and east) developed in line with their share in 2000 (with a variance of less than ±1 %). The population share in the same areas, however, shows a greater variance, with the urban cores gaining weight compared with their peri-urban ones.

In the Randstad, in line with the previous findings, the story is different. First, its urban cores and peri-urban areas appear in the opposite extremes of Table 5. There was a decline in the Randstad's share in the total residential stock between 2000 and 2010 (around −3 %). This might hint at a form of saturation that slows down the

Table 5 Housing units and population distribution in 2000 and growth rate during 2000-2010

	Difference between residential stock in 2000 and share of housing units added in 2000–2010 (%)	Residential stock share (%) in 2000	Share (%) of housing units added during 2000–2010	Difference between population share in 2000 and share of population growth in 2000–2010	Population share (%) in 2000	Share (%) of absolute population growth during 2000–2010
Randstad, urban cores	−2.81	19.53	16.71	5.29	17.00	22.28
Rural areas	−1.05	30.51	29.46	−8.37	32.49	24.11
South-East peri-urban	−0.99	2.17	1.18	−4.38	2.23	−2.16
South-East, urban cores	−0.91	2.15	1.24	−3.76	1.99	−1.77
North, peri-urban	−0.63	3.44	2.81	−1.45	3.54	2.08
East, urban cores	−0.23	4.64	4.41	1.65	4.41	6.07
East, peri-urban	0.03	4.99	5.02	−1.94	5.41	3.47
South, peri-urban	0.07	4.93	4.99	−2.06	5.34	3.29
North, urban cores	0.24	2.07	2.31	1.23	1.65	2.88
South, urban cores	0.72	4.60	5.31	2.47	4.34	6.81
Randstad, peri-urban	5.56	20.99	26.55	11.33	21.61	32.94

Table 6 Descriptive statistics of variables used in the planning policies analysis

	N	Min (%)	Max (%)	Average (%)	SD (%)
Residential growth rate	443	−9.53	61.05	8.93	6.88
Share of protected land	443	0	96.19	26.72	18.48
Share of land planned for residential development	443	0	15.64	0.62	2.11

urban growth process in the cores of the main cities. Compared to that, the peri-urban areas of the Randstad gained relevance, holding above 5 % more housing units than its share in 2000. However, despite these sharp differences, when looking at population dynamics, all the Randstad (urban cores and peri-urban areas alike) is gaining an increasing share (more than 5 % the cities and more than 11 % their subordinate areas). The figures calculated in Table 5 suggest that during 2000–2010 there was a strong growing demand for dwelling in the Randstad as a whole.

5.3 The importance of planning policies

Residential dynamics are steered by spatially explicit policies that restrict urban development in some locations and promote it in others. To some extent this might explain why the different regions did not show proportionate growth as was expected. To get an idea about the importance of these policies for different hierarchical levels of urban areas and for different regions we perform a straightforward regression analysis. Residential growth rate was taken as the independent variable to be explained by the share of protected land, and the share of land planned for large scale residential development. The regions used for the analysis are the Dutch municipalities, grouped according to their geographical region and urban hierarchy level. Table 6 describes the basic statistics of the variables included in this analysis and makes clear that municipalities differ considerably, especially in the share of protected land.

The statistical analysis indicates that land restrictions may adversely affect residential stock development, but this potential impact is only significant in the East region (Table 7, row 5). This region is characterised by large natural protected areas. Urban extension plans are effective and relevant in general, but especially in the Randstad, allowing ordered urban development where it is most needed. Considering all the municipalities together, both variables explains around 22 % of the variation in the municipal residential stock growth. Excluding the rural areas (in which both planning variables are irrelevant, as seen in row 3), the explanatory power increases to 29 %, associating each additional percent of planned land with almost an additional residential stock growth of 1.7 % (row 2). Taking regions separately, only in the Randstad and the South regions the percentage of land devoted to housing developments is significant and positive. The explanatory power in the South region is around 24 % (row 9). In the case of the Randstad as a whole, the R-square is higher (32%) and associated with a residential growth increase of 1.7 % (row 6). However, disaggregating the Randstad

Table 7 Results of the statistical analysis explaining housing unit growth rate (%) from the presence of planning policies

	N	R square	% of restricted land	% of planned land for urban extension	Constant
All municipalities	443	0.223	−0.017	1.507***	8.439***
All urban or peri-urban municipalities	251	0.291	−0.018	1.672***	8.017***
Rural areas	192	0.006	−0.003	0.321	8.754***
North region (urban cores & peri-urban)	32	0.077	0.064	0.830	5.631***
East region (urban cores & peri-urban)	41	0.102	−0.058**	0.113	11.04***
Randstad region (urban cores & peri-urban)	120	0.316	−0.038	1.714***	9.104***
Randstad region (urban cores only)	10	0.788	0.05	0.831***	4.099***
Randstad region (peri-urban only)	110	0.377	−0.049	2.123***	9.615***
South region (urban cores & peri-urban)	38	0.239	−0.024	0.994***	8.771***
South-East region (urban cores & peri-urban)	21	0.003	−0.003	0.107	5.177***

*** Significant at 0.01; ** Significant at 0.05

in urban cores and peri-urban components, the result is different (rows 7 and 8): For the urban cores municipalities, the parameters explain 79 % of the variance, and are associated with a growth increase of 0.8 %. For the peri-urban, their explanatory power is lower (38 %) but they are associated with a higher growth (2.12 % for each additional land planned percent). These results suggest that urban extension plans could have helped diverting urbanisation pressure in the Randstad from the urban cores to the peri-urban areas.

6 Conclusions

In the Netherlands, population and residential stock were growing steadily between 2000 and 2010, with population growing less than residential stock. The disaggregation of urban development into regions and functional units related to urban hierarchy shows that the residential stock and population growth rates were diverse and uneven, adding nuance to the generally accepted Gibrat's law of proportionate grow. We linked the observed regional variation in housing growth rate to well-known drivers of residential development indicating their importance for region-specific development.

Links between population, residential stock, economic activity and housing supply policies at local and regional levels are likely to be strong. These strong ties are evident from the high correlations explored in previous sections. However, these interdependences are not enough to establish causation, since the interplay between some of these variables is complex and even bidirectional (Vermeulen and van Ommeren 2006). This study was designed to test significant correlations between residential stock dynamics and possible driving forces, suggesting the mechanisms behind them. Further research is required to study these mechanisms in more detail. For example, longer time series are needed in order to discern between short and long run effects of economic development on housing stock in a certain region. In addition, causal effects between both variables could be explored, as the possible role of housing stock as a driver for economic development, or its impact on regional economic activity if housing supply is not adjusted to the local demand.

We found statistically significant correlations between regional economic activity and residential development. Relatively low GDP growth and loss of jobs are associated with low residential growth rate and population decline in the South-East region. In this area, the formation of new, smaller households is likely to have compensated for the population decline and may have, in fact, have resulted in the observed small increase in housing units. This decreasing household size has been documented for the Netherlands (De Jong 2009; Bijl et al. 2011) and other regions in Europe (Haase et al. 2013). It is not sure, however, that this process fully explains the observed increase in housing units. An increase in, for example, vacancy rates or vacation houses could also party explain the observed trends, but data on these aspects is lacking in our case study. In the North, urban cores developed faster than peri-urban areas. The East and South regions are characterized by a moderate employment and GDP growth. In both regions, their peri-urban areas developed slightly faster than their urban cores. In addition, the East is the only one in which restrictive urban policies are significant. In the Randstad, the central part of the Netherlands, regional GDP is by far the highest in the country. Working opportunities are widespread as the region has the largest share of jobs in the country, and new jobs have been being created during the analysed period. It is not surprising to find that people are increasingly being attracted by this region. However, since the Randstad is the most densely urbanized part of the country, allocating space for new housing units is not an easy task, certainly not in the main cities. We find that during 2000–2010 there was a strong growing demand for dwelling in the Randstad as a whole. Only part of this demand was realized within the urban cores of the region. The remainder spilled over the peri-urban areas around them. In this context of high regional demand and relatively restricted available space, planning policies become increasingly relevant. This is the reason why the presence of assigned areas for large scaling housing development matters, both in Randstad urban cores and peri-urban areas.

Gibrat's law, applied to cities and urban systems, states that all urban areas grow at more or less the same relative rate. This law is examined extensively in literature, with some authors claiming that it holds universally (Berry and Okulicz-Kozaryn 2012; Giesen and Suedekum 2009) and others reporting significant deviations (Masucci et al. 2013; Rozenfeld et al. 2008). Our results for the urban regions in the Netherlands indicate that Gibrat's law does not fully hold for the development of Dutch

urban systems during the period 2000–2010. We find that actual growth rates are dependent on specific regional conditions that influence the demand for housing and the opportunities for residential development. Moreover, we found that some urban cores behave differently from peri-urban areas. And this behaviour is different again within different regions. Recent empirical studies suggest that complete city distributions (without size restrictions) and a timespan of around a century are required in order to validate Gibrat's law (González-Val et al. 2014). So while the law may be appropriate to characterise the average development in large samples, where good performes may compensate poor ones, it has less relevance for more specific cases. It would be interesting to study if the higher residential growth rates in the economic core in the Netherlands find a parallel in other regions and Europe and beyond and thus signify a growing importance of economic drivers in steering residential development away from the more evenly distributed growth observed in the past and described in Gibrat's law. In addition, there is growing evidence about recent reinforcement of central cities after decades of more gradual and dispersed development (Haase et al. 2010; Delmelle et al. 2014). The impact of reurbanization processes in inner-city areas on Gibrat's law validation is an another possible direction for further research.

Planning policies appear to matter for explaining regional dynamics in residential development. Especially the availability of large-scale urban extension plans helped accommodate the growth in residential housing units. These plans have been instrumental in diverting residential growth from the urban cores in the Randstad to its peri-urban areas. The presence of spatial restrictions may have limited the local amount of growth in the different regions we analyses, but this impact was not significant.

The residential trends described in this paper suggest a strong tendency towards uneven development among regions, and within regions, among urban cores and their subordinate peri-urban areas. Assuming a moderate economic growth in the medium term, the suggested residential stock development trends may be continued. In that case, both national and regional dwelling policies should be prepared to deal with increasing spatial inequality. This means that the expected raising housing demand in the Randstad will need to be accommodated mainly in its peri-urban areas, and plans for urban development in these areas will be increasingly relevant. At the same time, dedicated urban restructuring policies are needed in more peripheral regions, addressing low or declining population growth rates, in both urban cores and peri-urban areas.

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