Explosive rents in the Dutch private rental sector:
An explanation for regional differences in rent per square meter

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Abstract
This paper aims to analyze the main variables affecting the development in the housing rent per square meter of the Dutch private rental sector between 2010 and 2015. This subject is currently relevant since it may offer insight for future governmental policies by explaining increases and decreases in the affordability of private rentals. After the determination of likely explanatory variables, multiple statistical tools have been utilized in order to transform the data for the use of analytical testing. The main methods for inferring the significance of explanatory variables were a linear mixed model and a Pearson correlation test. These methods concluded that the variables (1) development years of return investment and (2) population growth per 100 inhabitants have a significant correlation and interaction with the variable development rent per m^2. Firstly, one might conclude that the construction of private rental dwellings remains behind compared to the increase of a population. Which could indicate that governments or individuals do not invest enough in private rental housing, or make the sector attractive enough. Secondly, the interaction between development rent per square meter and development years of return on investment could be interpreted as a solution for the growing shortage of private rentals. Governments might subsidize the construction of private rentals, decreasing the years of return on investment and increasing the amount of investments in private rental dwellings.

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1 Introduction

The aim of my bachelor thesis is to provide an explanation for regional differences in the development of rent per m² of private rentals in the Netherlands. The research will be structured as follows: first, in the background section I will provide a description about (i) emerging problems related to the increase of rental prices in the private housing market in the Netherlands, (ii) the characteristics of the Dutch housing market, and (iii) a recent established law and its implications for the (private) housing market. Second, in the theoretical section, I will discuss the affordability issue and present a conceptual framework, in order to better focus my analysis on the regional differences of the development of rents per m² in the Netherlands. Third, in the research problem and methodology section, I will present the main research problem and a detailed description about how the regional differences of the development of rent per m² will be analyzed. Fourth, in the subsequent section I will describe the main results and discuss the findings of this research.

2 Background

In recent years, alarming articles in several newspapers described explosive increases of the rents of private rental houses in the Netherlands and also an increase in search time that varied between different regions of the Netherlands (RTL Nieuws, 2017; Kieft, 2017; Telegraaf, 2017; NOS, 2017; Woonbond 2015; Pararius, 2016). According to these newspapers, a possible explanation for the regional differences in the increase in search time might be the housing needs of the middle-income earner class (as % of the total population). They stated that a considerable number of middle-income earners are lately in great(er) need for a private rental and that this demand is causing an increase in the prices of private rental houses. In other words, the middle-income earner class has a significant impact on the heights of rents of private rentals according to these news reporters.

Overall, the Dutch housing market is divided into three main segments: purchasing market, social rent and private rent. For each segment the government provides subsidies to support people with a low income. People may apply and qualify for a rent subsidy if their rent is not more than € 710,68 a month and if one earns less than € 22.100 a year (price level of 2016). It doesn't matter if one is renting a house in the social- or a private segment (Rijksoverheid, n.d.). This rent subsidy is a direct subsidy. Social housing is further supported through indirect subsidies: sale of public land at prices below market value and multiple guaranteed loan funds/banks (Priemus & Gruis, 2011). Housing corporations are responsible for the construction and exploitation of this social housin segment of the market. By law (Huisvestingswet, 2014), they need to allocate at least 80% of their houses to people who earn less than € 35.739 a year, 10% to households with an income between € 35.739 and € 39.874 a year and the remaining 10% might go to people with a higher income. Such ceilings of income prevent people with higher wages to rent cheap(er) houses which are intended for the lower income groups. Finally, the rent of a social house can never be higher than € 710,68 a month. A higher rent automatically qualifies such a house as being part of the private rental segment.

The system of income ceilings was introduced by the European Commission on the 1st of January 2011 (Asjes, 2012). Until this introduction, anyone could apply for a social house if the rent was less than a pre-defined amount of € 647,53 (in 2010) (Rijksoverheid Huurverhoging, n.d.). After 2011, a large number of people were earning too much to apply for a social house. CBS Kwart (2012) concluded that over 25% of the people that occupied a social house in 2011 earned more than the new introduced income ceiling. The income ceiling wasn't retroactive, but if these people would want to move house in the future, they would have to rent a house in the private sector or purchase a house. However, a large number of people does not have enough funds to purchase a house and they encounter several difficulties to obtain a mortgage. After the financial crisis of 2008, individuals are obligated to finance a considerable larger share of the house price by themselves and many firms are working with flexible- instead of fixed contracts (Vastgoedmarkt, 2016; ING, 2014). People who have a flexible- or temporary contract are according to McCarthy (2014) “more susceptible to credit constraints” (p.7). Arguably, these developments tend to cause the postponement of the purchase of a house and push those who earn too much to apply for social housing, but who are not able to obtain a mortgage, towards the private rental sector (Business Insider Nederland, 2016).

So the obvious conclusion seems to be that the private rental sector needs to accommodate a larger number of people than before the introduction of the income ceiling system. This would put pressure on this particular market segment, causing price increases. As one will read in section 3.1, these price increases differ among regions causing different developments of rents in the Dutch market of private rentals. This paper aims to provide in the research question: What explains the regional differences in the development of rent per m², in the Dutch market of private rentals, during the period 2010-2015? An explanation for the regional differences in the development of rent per m² could be of great importance, because it presents likely variables that effect the in- or decrease of the affordability of private rentals. These variables could be accounted for in future government policies.

3 Theoretical framework

3.1 Regional differences in the affordability of housing

Eskinasi et al. (2012) conducted a research about the projected effects of the income ceiling. As benchmark, they used the average search time in years for an individual to find a house. “The average search time is the ratio between the number of house seekers and the number of movers within a certain income group, measured on both the rent and the purchasing house segment” (p.12). Eskinasi et al. concluded that the search time of low-income earners is expected to decrease in the coming years, while the search time of middle- and high-income earners is expected to increase, as a result of the income ceiling. People earning an income between € 33.000 and € 38.000 per year will experience an increase of 52% in search time in the next 10 years. People earning an income between € 38.000 and € 43.000 per year will experience an increase of 34% in search time in the next 10 years, both due to the income ceiling. These increases represent the average for the whole of the Netherlands, but as Eskinasi et al. notes, housing markets are highly dependent on geographical regions. Therefore, the researchers concentrated onto the search time characteristics (in order to find suitable housing) of six Dutch regions (see Appendix A). One can see that the search time and the increase in search time displays great differences between the regions. Eskinasi et al. claims that these differences are mainly due to the extent to which the regional housing markets are stressed. As an example, they mention the relative long search time in Amsterdam, which has the tightest housing market of the Netherlands (Rooijers, 2016). Weinberg et al. (1981) defines a tight housing market as a housing market that endures low vacancy rates and as an environment where households “find it difficult to reproduce a good deal and difficult to improve a bad deal” (p.338). However, this argument does not give an explanation for the regional differences in the increase in search time. Rural regions are displaying the highest increases instead of the urbanized areas, while these housing markets should be less stressed than the urbanized ones.

3.2 Determinants in the development of house prices

Haab & Whitehead (n.d.) conclude that 'there are only 4 things that can change a price: Demand increases, Demand decreases, Supply increases or Supply decreases'. An increase of demand causes an increase of price, a decrease of demand causes a decrease of price, an increase of supply causes a decrease of price and a decrease of supply causes an increase of price. According to Moore & Skaburskis (2004), the price of a house is mainly constructed by demand. They state that shelter-cost-to-income ratios (the percentage of income one spends on housing) are affected by the development of the demand for housing brought about by increases in population- and decreases in household formation size. Furthermore, they conclude that "changes in the income distribution affect the type and price of housing that is built which determines the bid price of urban land. Increases in the wealthy populations can inflate land prices and raise the dwelling rent to a level that would make new construction economical, and be beyond the reach of the lower income groups" (p.396). Besides, when a region develops, a social value could also arise. High income households attracted by a high-status area are willing to pay a rent that lower income groups can't afford (Milligan, 2003). So far, the literature mentioned four determinants which could express a transition of demand and therefore a transition of price: an increase in population size, a decrease in household formation size, increases in the wealthy populations and a rise in social value of urban land. These are all transitions that represent an increase of demand. Decreases of demand could also express transitions of demand and for that reason a transition of price. Although the development of demand is definitely important for the bid price of urban land, Bunting et al. (2004) addresses that it could certainly be affected as well by an oversupply. Explanatory models should account for such a phenomenon.

3.3 Affordability measurements of housing

According to Chaplin & Freeman (1999) for describing affordability, the rent-to-income ratio is the most used international measure. The rent-to-income ratio is defined as the ratio of the actual rent costs over the actual income of people. A relatively high ratio signals that people need to pay a large part of their income in rent, it represents a current housing market whereby the supply- fails to meet the demand of rental housing. Presumably, higher rents might drive real estate developers to build more houses if they are earning excess returns on these houses. This would then depress rents over time. A particularly low value indicates a housing market which is presumably protected through rent control or is currently experiencing an oversupply of housing (Angel et al., 1993). Chaplin & Freeman (1999) warn that a "single rent-to-income ratio is not appropriate for all households, for housing and non-housing costs vary by household type. Furthermore, the ratio does not distinguish between households with very different income levels" (p.1950). As an example, they mention two households: one with a rent of €200/month and an income of €1.000/month, and the other with a rent of €2.000/month and an income of €10.000/month. Both would share the same 20 per cent ratio. Yip & Lau (2002) research the affordability of (social) rental houses through rent-to-income ratios. Their aim was to provide an optimal standardized affordability rate based on solid theoretical- and empirical evidence, rather than the usual guesswork governments apply. Yet, they conclude that such an optimal standardized affordability rate could not work due to the simplicity of the rent-to-income ratio, as Chaplin & Freeman (1999) warned. Nevertheless, Eskinasi et al. (2012) presents in their prognosis of the Dutch housing market a table with "acceptable rent quotas" (p.49). As discussed previously, such quotas are highly subjective.

Another common affordability measure of housing is the price per square meter, or specifically to rental housing: rent per square meter. Licciardi & Amirtahmasebi (2012) mention that "whatever data are used … it is important to convert the information into a common unit of comparison" (p.135). According to them, rent per square meter is a frequently used measure that represents a solid unit of comparison. However, the rent per square meter does not reflect the real cost people have to bear, it does not describe affordability on a personal level (the rent-to-income (partly) does).

Bogdon & Can (1997) conclude that there are two approaches in measuring phenomenon's like affordability: through longitudinal- or cross-sectional studies. In a longitudinal study, an individual measures over a period of time. In a cross-sectional study, one measures a specific point in time. Longitudinal research is overall more reliable than a cross-sectional study, but has as disadvantage that it needs a great number of cases of a single event/person over time. The research question and availability of data determines which approach is preferred (Atwork, 2015).

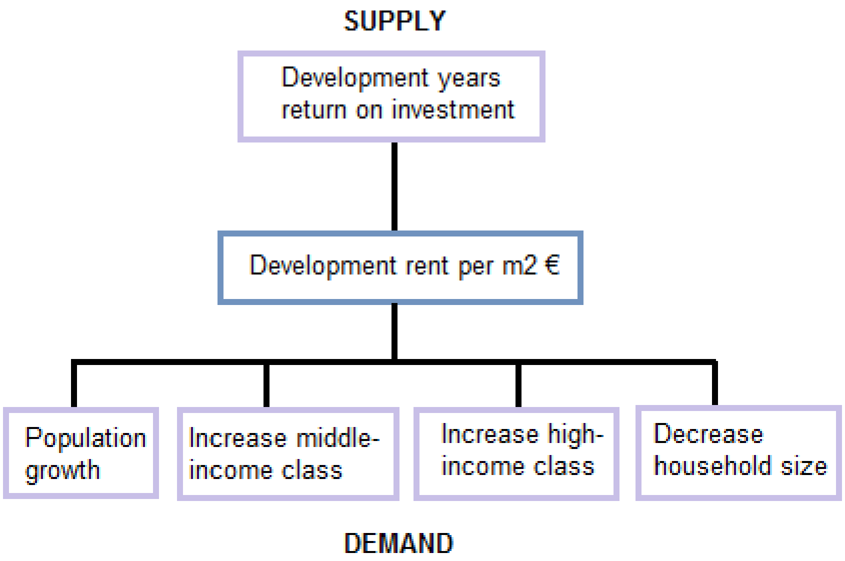
4 Conceptual model

4.1 Determinants in the development of rent per m²

Last section defined two common measurements in describing the affordability of (rental) housing: the rent-to-income ratio and the rent per square meter. As stated, the rent-to-income ratio measures the affordability of housing on a more personal level than the rent per square meter. Nonetheless, this paper will practice the rent per square meter measure, due to the availability of data. Thus, the aim of this paper is to provide an explanation for the regional differences in the development of rent per m² of private rentals. To achieve this goal, one needs to clarify which plausible factors may drive the development of rent per m² (independent variables).

Section 3.2 addresses four determinants which may express an increasing demand for private rentals and therefore plausible factors that may drive the development of rent per m²: an increase in population size, a decrease in household formation size, increases in the wealthy populations and a rise in social value of urban land. Besides, the importance of a supply determinant was underlined by Bunting et al. (2004). As mentioned in section 3.2, a transition of demand (or supply) could be disclosed through an in- or decrease of demand (or supply). Where achievable, this paper intents to include both transitions per determinant depending on the kind of data that is available. An in- or decrease of population size and a decrease in household formation size are two determinants obtained from the literature, which do not need an interpretation and will be used in this research. The determinants increases in wealthy populations and a rise in social value of urban land do need an interpretation before adaptable to this research. According to the literature, both determinants are linked to income classes. Since low income classes do not rent in the private rental segment and the literature mentions wealthy populations, this research will focus on the changes in income distribution of the middle- and high income earners classes. The exact definition of these determinants used in this research, will be discussed in section 4.3.2 and 4.3.3. At last, this research also includes a supply determinant as a plausible factor that may drive the development of rent per m². The years of return on investment is a determinant that reflects the attractiveness of investing in the private rental segment. The lower this determinant is, the less years it will cost for one to gain his investment back. More investments in the private rental segment leads to a greater supply and as Haab & Whitehead (n.d.) stated, this will be followed by a decrease of price (and vice versa). One will read more detailed about the dependent variable (section 4.2), the years of return on investment and the other independent determinants (section 4.3.x) in this chapter. A schematic view (conceptual model) of all these plausible forces is presented in figure 1.

Figure 1



4.2 Development of rent per m² (ratio)

The dependent variable in this research is the development of rent per m². Through Pararius Huurprijs (2016), a dataset is acquired that presents the average rent per m² of private rentals per region per year. Appendix B provides an overview of these rents. The development of rent per m² is expressed via the percentage difference between two consecutive years of the rents mentioned in Appendix B. The development of rent per m² per region per year is demonstrated in Appendix C.

4.3.1 Population growth (ratio)

The population growth per 100 inhabitants describes the difference between in-migration and out-migration plus the difference between deaths and births, all relative per 100 inhabitants (CBS Bevolkingsontwikkeling, 2017; Appendix D).

4.3.2 Middle-income earners (ordinal)

The CBS Inkomensverdeling (2016) dataset measured the distribution of the disposal income per earning household as percentage of the whole population. Households who have no income at all are not included in this dataset. Schilder & Conijn (2015) defines middle-income earners as households who had a disposal income between € 34.911 and € 52.800 a year (in 2015). Which translates the CBS Inkomensverdeling (2016) categories 6, 7 and 8 of the 10%-groups of the disposal income to be part of the middle-income earners class. Appendix G displays the middle-income earners class ratio per region and Appendix H the decrease (-1), status quo/no change (0) or increase (1) between years per region. A dummy of this variable will be generated presenting no increase (0) or an increase (1) of the middle-income earners class.

4.3.3 High-income earners (ordinal)

The CBS Inkomensverdeling (2016) dataset also provides in the high-income earners class ratio. The high-income earners class is defined as people earning a disposal income that is represented in the categories 9 and 10 of the CBS Inkomensverdeling dataset (see Appendix I). Appendix J demonstrates the decrease (-1), status quo/no change (0) or increase (1) of the high-income earners class between years per region. A dummy of this variable will be generated presenting no increase (0) or an increase (1) of the high-income earners class.

4.3.4 Household size (ordinal)

The average household size per region per year is described in Appendix E. The data is extracted of the CBS Kerncijfers (2017) dataset. Appendix F displays the decrease (-1), status quo/no change (0) or increase (1) of the average household size between years per region. A dummy of this variable will be generated presenting no decrease (0) or a decrease (1) of the household size.

4.3.5 Years of return on investment (ratio)

The years of return on investment are calculated through the Pararius Huurprijs (2016) and Huizenzoeker (2017) datasets. These datasets turned out to be more reliable than comparable datasets from the CBS. The Huizenzoeker dataset provides the average m² price of owner-occupied houses per region per year. Pararius Huurprijs supplies in the average rent per m² per region per year. When the average m² price of owner-occupied houses is divided through the average yearly rent per m², one gets the number of years as a proxy for a return on investment (see Appendix K). The percentage difference between two consecutive years expresses the development in the years of return on investment (see Appendix L).

5 Research problem and Methodology

5.1 Aim of the research

The research of Eskinasi et al. (2012) demonstrated that the Dutch rental market might be currently in transition due to the income ceiling. They concluded that the outcome of this transition differs per region, but they did not mention which factors are determinants to the outcome. This research aims to fill this gap by providing an explanation for the regional differences in the development of rent per m² in the Netherlands between 2010 and 2015. Due to the availability of data, the measure rent per m² is chosen over the rent-to-income ratio. As outlined in section 3.3, both measures are common to describe the affordability of rentals.

5.2 Research question and sub questions

Research question	What explains the regional differences in the development of rent per m², in the Dutch market of private rentals, during the period 2010-2015?
Sub-question 1	What are the regional differences in the development of rent per m²?
Sub-question 2	What are plausible factors that drive the development of rent per m²?
Sub-question 3	How do these factors contribute to the development of rent per m²?

5.3 Used methods

It should be clarified that there is a distinction between (general) regional differences in rent per m² and regional differences in the development of rent per m². This paper will research the regional differences in the development of rent per m². The paper practices a quantitative approach. The research uses datasets that are collected by the CBS. Furthermore, datasets of

Pararius Huurprijs (2016) and Huizenzoeker (2017) are adopted. With the practice of secondary data, no ethical considerations are involved.

Prior to providing an explanation for the regional differences in the development of rent per m², a descriptive analysis will be presented. As stated by Hulchanski (1995) and Dunn (1960), a descriptive analysis is a (visual) presentation of (a) dataset(s). Freeman & Julius (n.d.) conclude that "plotting data is an extremely useful first stage to any analysis, as this could show extreme observations (outliers) together with any interesting patterns" (p.5). They mention that the visual display of quantitative data is mainly about visualizing the distribution of a sample. Dot plots, histograms and boxplots are useful tools in order to acquire such a visualization. Subsequently, the research will conduct tests with sets of independent variables, that could provide an explanation for the regional differences in the development of rent per m². These tests are based on a cross-sectional study. As described in section 3.3, a longitudinal research is more reliable than a cross-sectional study. However, for this research, conducting a longitudinal research would be impossible due to the relatively small amount of cases.

5.4 Instruments of data collection and analyzation

The datasets that will be used in this research could be found in Appendices C, D, F, H, J and L. All the datasets have four till six years of measurement. These years will be split up in order to acquire more cases. The city of Amsterdam in Appendix C will be given as an example. After the years of Amsterdam are split up, six individual cases are obtained, namely: Amsterdam'10, Amsterdam'11, Amsterdam'12, Amsterdam'13, Amsterdam'14 and Amsterdam'15. When applied on all the datasets, 264 cases are available. This dataset is a panel dataset, it is measured in a time series and based on a cross-sectional study.

Prior to the assessment of factors driving the development of rent per m², a descriptive analysis is provided in section 6.2. Thereafter, the independent variables mentioned in section 4.3 are tested on their correlation, and where achievable on their interaction, with the dependent variable development of rent per m². Based on the best statistical model fit, two tests are carried out. The first test is based on a linear mixed model approach. As one reads in the results section, the relation between the dependent and the independent variables, population growth and years of return on investment, lead to a dependence of error. An independence of error is one of the six assumptions which have to be met in order to perform a linear regression. The phenomenon of dependence of error occurred because the dataset exists of subjects that are measured over multiple years (panel data). A linear mixed model is adjusted for the use of panel data. The ordinal variables are binary dummies and do not fit a linear mixed model, therefore these variables are only tested for correlation in a Pearson correlation matrix.

All the mentioned models test for correlation, and where achievable for interaction, between the dependent and independent variables of the same year. The dependent variable does not have a time lag of (for example) one year. In theory, this could be a weakness of the models. It is likely that the rent per square meter does not instantly react on the given determinants, there would be a time lag. However, the use of a linear mixed model approach does not allow a time lag for a dependent variable (Allison, 2015). As a result, to avoid different use of the datasets, this rule is generalized for the other statistical models.

The corresponding hypothesis is: there is no significant correlation between the dependent and independent variables. This hypothesis will be rejected when independent variables have a p value < 0,05.

6 Results

6.1 Pearson Correlation

Prior to the presentation of the descriptive analyses and the explanatory analyses, a Pearson correlation matrix is presented (see Table 1). With exception of the variable increase high-income earners class (InHigh), all the independent variables have a significant correlation with the dependent variable development rent per square m² (InvDevRent) at the 5% level. The independent variable population growth per 100 inhabitants has a positive correlation with the dependent variable. Meaning that an increase of the dependent variable goes along with an increase of population. All the other independent variables have a negative correlation with the dependent variable. Meaning that an increase of the dependent variable goes along with a decrease of the independent variables (and vice versa). A problem occurs when one examines the correlation of the independent variables decrease household size, increase middle-income earners class and increase high-middle income earners class, with the dependent variable. All the correlations are negative while these independent variables are binary. Meaning that the effect of the dependent variable is present when the effect of the independent variable is abscent (and vice versa). In other words, there is no correlation between these independent variables and the dependent variable, even when the Pearson correlation displays a significancy. Therefore, the independent variables decrease household size, increase middle-income earners and increase high-income earners will not be tested on any further causal correlations.

Table 1 – Pearson Correlation

		InvDevRent	DevReInv	PopGrowth	DecHouse	InMid	InHigh
InvDevRent	Pear	1	-,843**	,170**	-,145*	-,197*	-,079
	Sig. 2		,000	,007	,021	,010	,308
	N	253	253	253	252	168	168
DevReInv	Pear	-,843**	1	-,050	,087	,170*	,111
	Sig. 2	,000		,423	,165	,027	,152
	N	253	254	254	253	169	169
PopGrowth	Pear	,170**	-,050	1	-,103	-,322**	,088
	Sig. 2	,007	,423		,101	,000	,257
	N	253	254	254	253	169	169
DecHouse	Pear	-,145*	,087	-,103	1	,059	,007
	Sig. 2	,021	,165	,101		,446	,931
	N	252	253	253	253	169	169
InMid	Pear	-,197*	,170*	-,322**	,059	1	-,117
	Sig. 2	,010	,027	,000	,446		,129
	N	168	169	169	169	169	169
InHigh	Pear	-,079	,111	,088	,007	-,117	1
	Sig. 2	,308	,152	,257	,931	,129	
	N	168	169	169	169	169	169

** Significant at the 0,01 level (2-tailed).

* Significant at the 0,05 level (2-tailed).

6.2 Descriptive analyses

This section starts with the presentation of the descriptive analysis of the dependent variable development rent per m² (DevRentM2) as shown in Appendix C. Hereafter, descriptive analyses for the independent variables will follow.

Figure 2 consists of a boxplot visualizing the variation of the cases, whereby the y-axis represents the percentages of in-/decrease of rent per m². Extreme values (cases) might disturb the output of the analyses. Therefore, all the cases marked as extreme values, are filtered out of the dataset. Figure 3 presents a histogram with the frequencies of DevRentM2 values. Table 2 demonstrates the number of cases, the mean, the median and the percentiles.

Figure 2

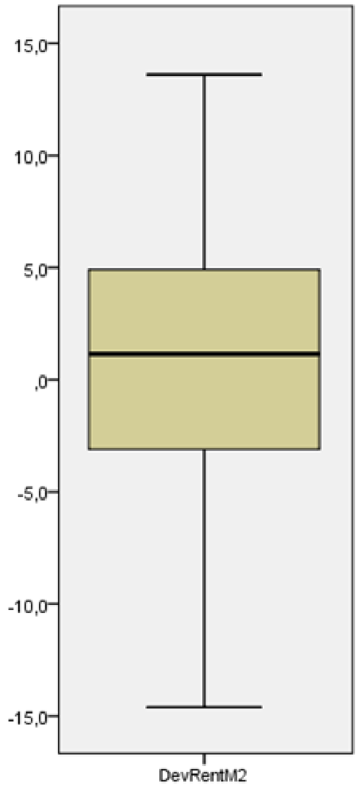


Figure 3

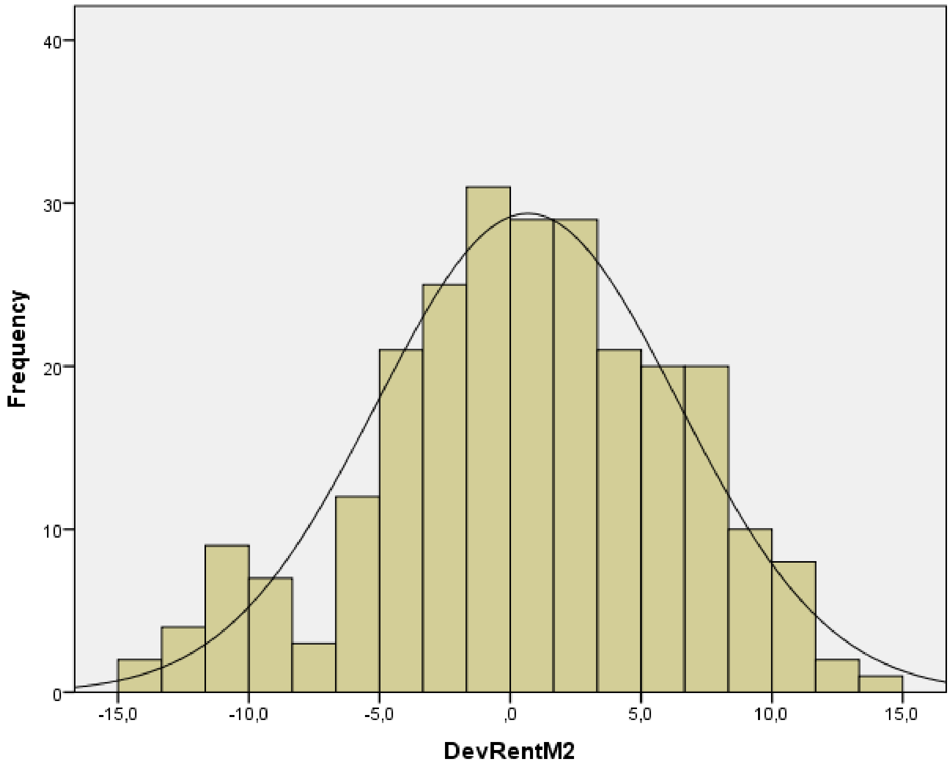


Table 2 – Frequencies

N	Valid	254
	Missing	0
Mean		,671
Median		1,150
Std. Deviat		5,7496
Percentiles	25	-3,100
	50	1,150
	75	4,900

6.2.1 Development years of return on investment

Figure 4 demonstrates the spread of the DevReturnInvest values, whereby the y-axis represents the percentages of in-/decrease of years of return on investment. The boxplot points out that there are no extreme values for this variable. Figure 5 is a scatter plot between DevReturnInvest (x-axis) and DevRentM2 (y-axis). The scatter plot implies that there is a negative correlation between DevReturnInvest and DevRentM2. In different words, when there is a great increase of rent per m², there is a great decrease of years of return on investment. Not very remarkably, higher rents do increase the profitability of rental units.

Figure 4

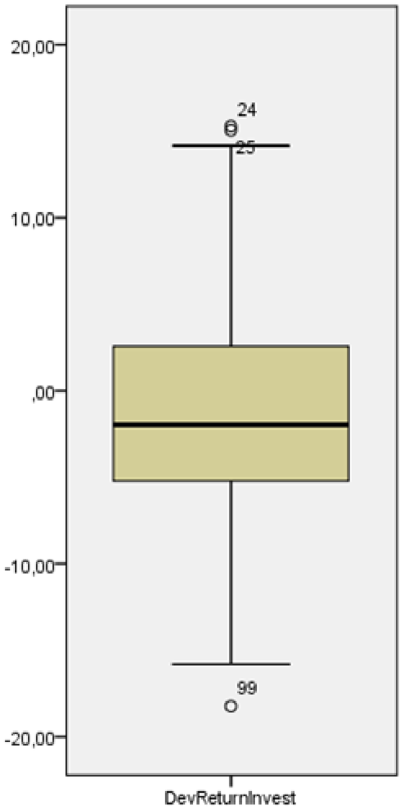
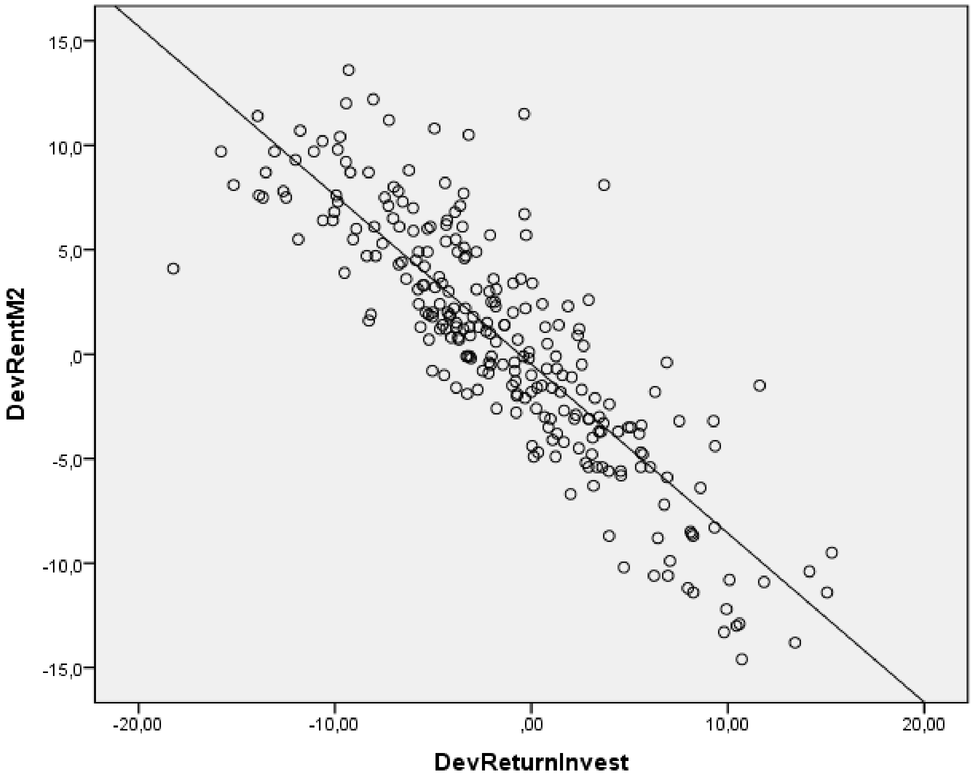


Figure 5



6.2.2 Population growth per 100 inhabitants

The population growth per 100 inhabitants (PopGrowth100) is introduced in Appendix D. Figure 6 demonstrates a boxplot and Figure 7 presents a scatter plot, which shows a small positive correlation between PopGrowth100 (y-axis) and DevRentM2 (x-axis). Implying that an increase of rent per m² goes along with an increase of population.

Figure 6

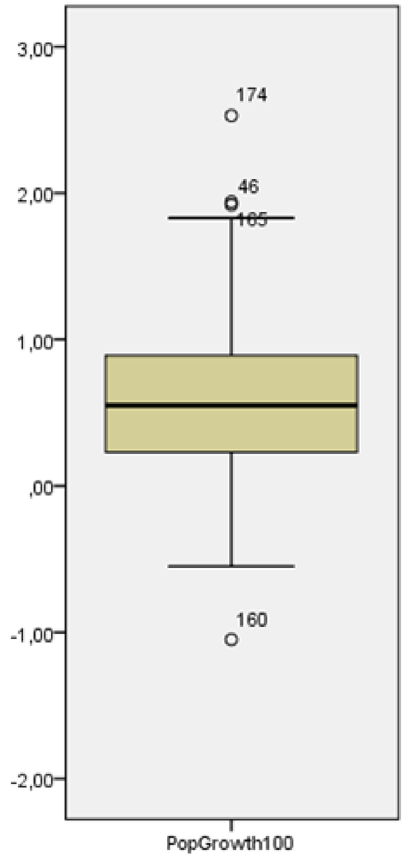
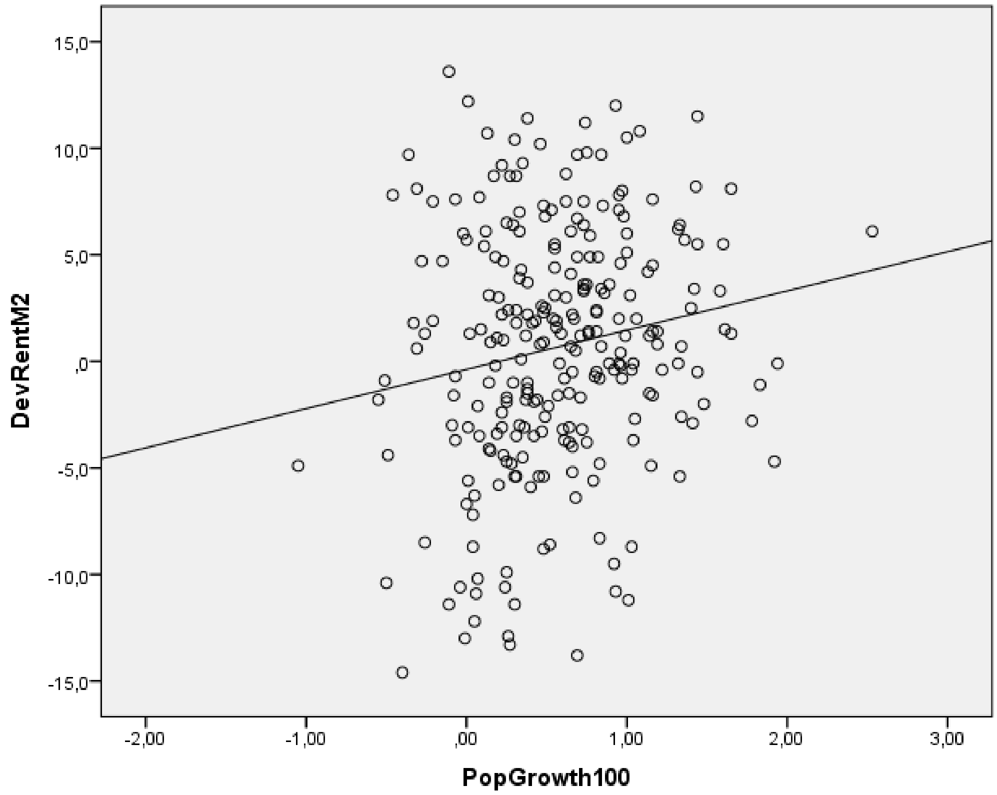


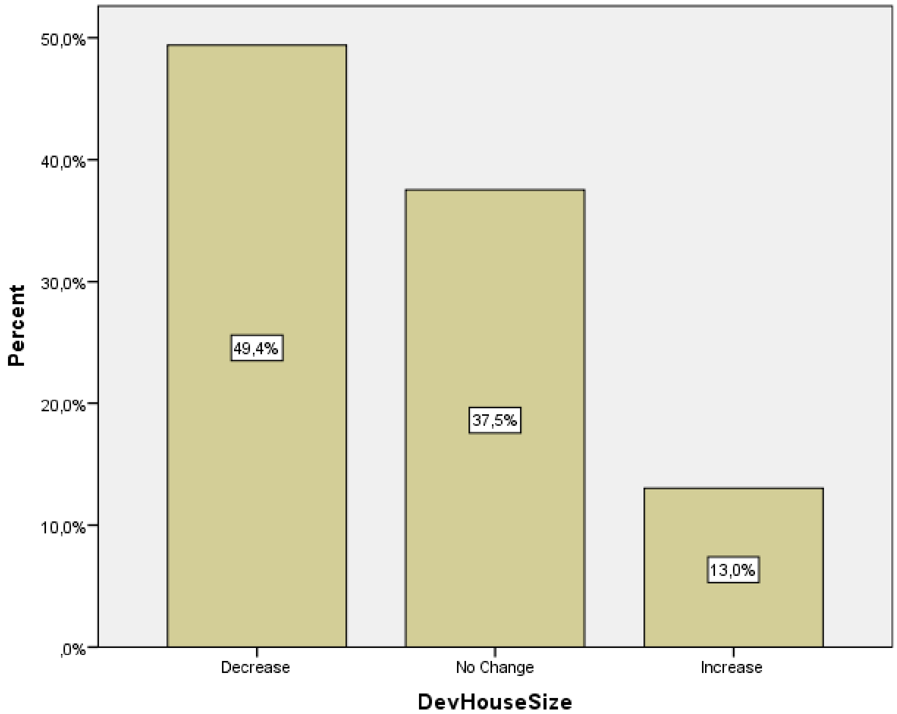
Figure 7



6.2.3 Development Household size

The development household size is a ordinal variable including three categories (decrease, no change and increase). The distribution of the cases is visualized in Figure 8. As one can notice, a decrease of the household size is most common (in 49,4% of the cases).

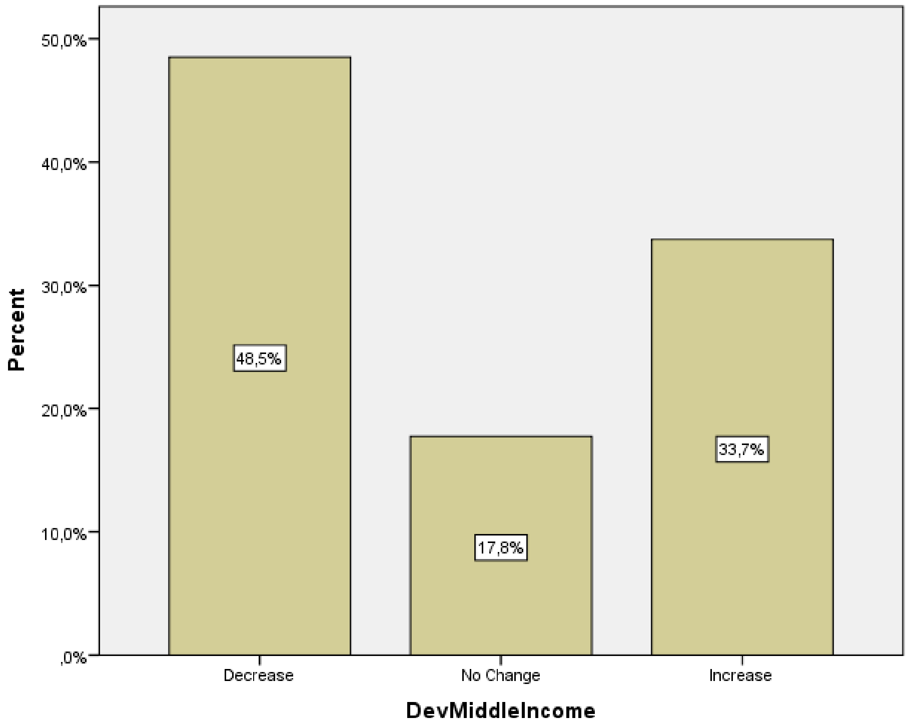
Figure 8



6.2.4 Development Middle-income earners class

The distribution of the ordinal variable development middle-income earners class is visualized in Figure 9. It applies the same three categories as the development household size, namely: decrease, no change and increase. Due to the availability of data, the variable development middle-income earners class handles 33% less cases than the dependent variable (the years 2014 and 2015 are not measured). A decrease of the middle-income earners class occurred in 48,5% of the cases.

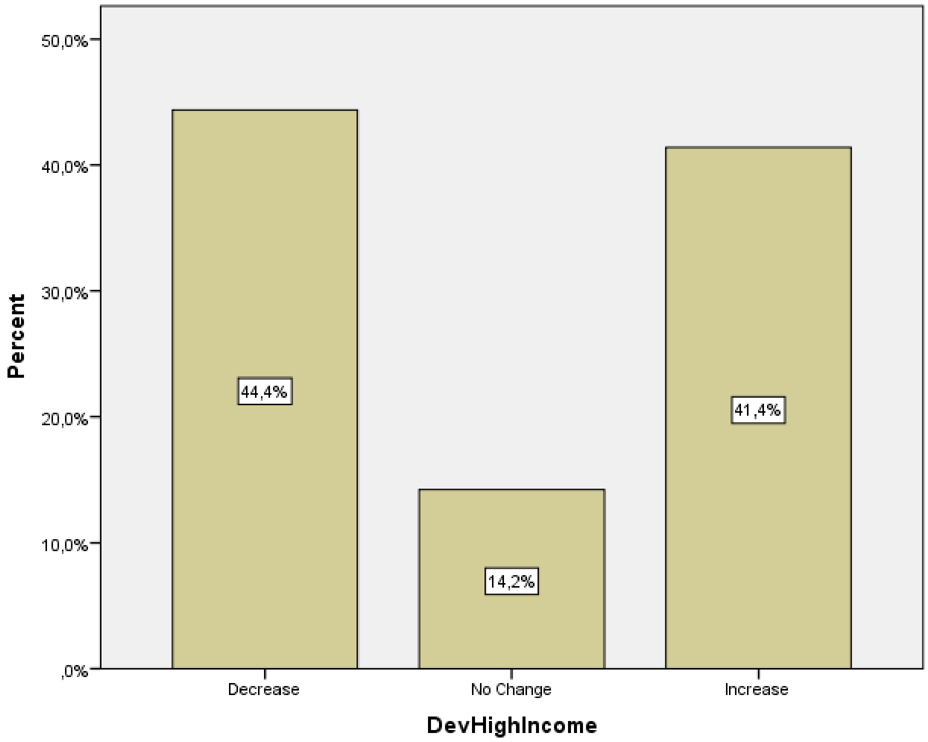
Figure 9



6.2.5 Development High-income earners class

The ordinal variable development high-income earners class has the same characteristics as the variable development middle-income earners class. Therefore, it has 33% less cases than the dependent variable. In most of the cases, a decrease (44,3%)-closely followed by an increase (41,4%)-of the high-income earners class occurred.

Figure 10



6.3 Linear mixed model

In order to research factors that contribute to the establishment of the development of rent per m², an appropriate statistical model has to be selected and prepared. Due to the use of panel data, a linear mixed model is the best fit for testing a interaction between a dependent- and a set of independent variable(s). A linear mixed model relies on the next six assumptions:

Assumption 1: Variables have to be measured at the continuous level.
Assumption 2: There has to be a linear relationship between the variables.
Assumption 3: There are no significant outliers.
Assumption 4: There is a normal distribution of the residuals of error.
Assumption 5: Data has to be homoscedastic.
Assumption 6: There is a dependence of observations.

The linear mixed model tests for interaction between the dependent variable development rent per m² and the independent variables development years of return on investment and population growth per 100 inhabitants. Besides, the linear mixed model will also test for interaction between the independent variables themselves. Therefore, a test of multicollinearity will be implemented through a variance inflation factor test (VIF). In a situation of multicollinearity, the coefficient estimates of the linear mixed model may change unevenly in response to small changes in the model or the data. The results of the VIF are shown in table 2.

Table 3 – Variance inflation factor

Dependent variable: DevReturnInvest	Tolerance	VIF
PopGrowth100	1,000	1,000

Dependent variable: PopGrowth100	Tolerance	VIF
DevReturnInvest	1,000	1,000

The rule of the variance inflation factor is: there is possibly multicollinearity when the VIF has a value of 3 or higher, probably multicollinearity when it is more than 5 and definitely multicollinearity when the VIF is more than 10. The independent variables are tested on multicollinearity and they all score below 3, implying that there is no multicollinearity.

Section 7.3 mentioned six assumptions which must be met prior to the execution of a linear regression. The first assumption is met, all the variables are measured on the continuous level. The second assumption suggests that there has to be a linear relationship between the variables. The variables development years of return on investment and population growth per 100 inhabitants do have a linear relationship as shown in section 6.2.1 and 6.2.2. Assumption 3 states that there should be no significant outliers. Prior to the descriptive analysis, multiple outliers were discarded from the dataset. So far, more outliers were not identified. Assumption 4 concludes that there is a normal distribution of the residuals of error. To test this assumption, a Shapiro-Wilk test of normality is implemented. The result of this test are presented in table 4.

Table 4 – Shapiro-Wilk

	Statistic	Df	Sig.
DevRentM2	,995	254	,513
DevReturnInvest	,991	254	,129
PopGrowth100	,988	254	,027

According to the Shapiro-Wilk test, when a variable is significant (5% level) it has a non-normal distribution. The dependent variable Development rent per m^2 is significant and is therefore not normal distributed. To get to a normal distribution, a transformation of the variable development rent per m^2 is needed, namely: a reciprocal (inverse) transformation. The calculation of the new values resulted in a normal distribution (see table 5).

Table 5 – Shapiro-Wilk

	Statistic	Df	Sig.
InvDevRent	,999	253	1,000

Assumption 5: Data has to be homoscedastic. To test the homoscedasticity, a Breusch-Pagan and Koenker test is enforced (table 6).

Table 6 – Breusch-Pagan & Koenker

	LM	Sig.
BP	10,093	,006
Koenker	4,805	,090

According to Breusch-Pagan and Koenker, data is heteroscedastic when their tests are significant (5% level). The Koenker test is insignificant, suggesting a homoscedastic dataset. Nonetheless, the Breusch-Pagan test is significant at a level of ,006, implying a heteroscedastic dataset. The Breusch-Pagan test is seen as more powerful than the Koenker test, therefore, heteroscedasticity of the data needs to be assumed. However, the presence of heteroscedasticity is not an issue when using a linear mixed model. When preparing the data prior to the execution of a linear mixed model, diagonal needs to be checked in the repeated covariance type box.

The last assumption, there is a dependence of observations, will be examined by the Durbin-Watson test (table 7). The linear mixed model is designed to handle a dependence of observations. If there is not a dependence of observations, another statistical model that has the assumption of independence of observations might be used.

Table 7 – Durbin-Watson

	Durbin-Watson
Model 1	1,023

No clear margins are set for the interpretation of the Durbin-Watson ratio. Most scientists state that a ratio between 1,5 and 2,5 equals an independence of observations. For this model, a Durbin-Watson ratio of 1,023 is given, implying a dependence of observations. Therefore, the last assumption, a dependence of observations is met.

The results of the linear mixed model are presented in table 8. The model for fixed effects, as wel as random effects is set as follow: DevReturnInvest, PopGrowth100 and DevReturnInvest * PopGrowth100. Scaled identity is checked in the covariance type of the random effects box. One can interpret the outcome of a linear mixed model similar to a linear regression. Both independent variables, development years of return on investement and population growth per 100 inhabitants, have a significant interaction with the dependent variable development rent per square m². There is not a significant development years of return on investement by population growth per 100 inhabitants interaction.

Table 8 – Linear mixed model

Parameter	Estimate	Std. Error	Df	T	Sig.	Lower Bound	Upper bound
Intercept	-1,925589	,214624	130,437	-8,972	,000	-2,350185	-1,500994
DevReturnInvest	-,828285	,035921	56,095	-23,058	,000	-,900241	-,756329
PopGrowth100	1,041630	,285452	153,939	3,649	,000	,477721	1,605539
DevReturnInvest * PopGrowth100	,066972	,056480	63,921	1,186	,240	-,045862	,179807

7 Discussion

This paper aims to provide an explanation regarding the research question: What explains the regional differences in the development of rent per m², in the Dutch market of private rentals, during the period 2010-2015? Following the outcome of the linear mixed model (table 8), this section presents the interpretation of the model.

The linear mixed model proofed that there is a significant interaction between the dependent variable development rent per square m² and the independent variables development years of return on investment and population growth per 100 inhabitants. Meaning that the null hypothesis, there is no significant correlation between the dependent and independent variables, is rejected for these variables. The Pearson correlation matrix demonstrated a positive correlation between the population growth per 100 inhabitants and the dependent variable. Meaning that an increase of the rent per square m² goes along with an increase of population. One might conclude that the construction of private rental dwellings remains behind compared to the increase of a population. Which could indicate that governments or individuals do not invest enough in private rental housing, or make the sector attractive enough. Furthermore, the Pearson correlation matrix demonstrated a negative correlation between the development years of return on investment and the dependent variable. Meaning that an increase of rent per square m² goes along with a decrease of years of return on investment (and vice versa). It is very plausible that a decrease of years of retun on investment will lead to more investments and thus to more private rental dwellings. What in the long term might lead to a decrease of rent per square m². In addition, this interaction could also be interpreted as a solution for the growing shortage of private rentals. Governments might subsidize the construction of private rentals, decreasing the years of return on investment and increasing the amount of investments in private rental dwellings.

The research conducted in this paper was restricted by the limited amount of data at public disposal. Therefore, future research could be directed at exploring the magnitude of variables such as development years of return on investment and population growth on the private rental market by the use of other-broader-datasets. Moreover, this research failed to establish a correlation or interaction between decrease householdsize, increase middle-income earners class and increase high-income earners class, and the development of rent per square m². The literature as well as newspapers suggested that these determinants could have a proportional effect on the height of rents of private rental dwellings. Future research could investigate the magnitude of these variables on the private rental market.

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9 Appendices

Appendix A: Prognosis PBL 2012-2022

		Search time years	Difference income ceiling	Search time years	Difference income ceiling
Income classes (x € 1.000)	With or without income ceiling	Netherlands overall		Amsterdam region	
Low (<33)	With	2,2	-19%	5,3	-14%
	Without	2,7		6,2	
Low medium (34-38)	With	3,2	52%	6,8	27%
	Without	2,1		5,3	
Medium (38-43)	With	2,7	34%	5,9	22%
	Without	2,0		4,8	
High medium (43-62)	With	2,1	18%	4,4	17%
	Without	1,8		3,8	
High (>62)	With	1,4	5%	2,2	5%
	Without	1,4		2,1	
Average	**With**		**18%**		**11,4%**
Income classes (x € 1.000)	With or without income ceiling	Arnhem Nijmegen region		Eindhoven region	
Low (<33)	With	3,1	-19%	2,8	-19%
	Without			3,5	
Low medium (34-38)	With	3,3	27%	2,9	21%
	Without	2,6		2,4	
Medium (38-43)	With	3,3	28%	3,4	26%
	Without	2,3		2,7	

High medium (43-62)	With	3,5	32%	3,4	26%
	Without	2,6		2,7	
High (>62)	With	1,9	11%	1,5	6%
	Without	1,7		1,4	
Average	**With**		**15,8%**		**12%**
Income classes (x € 1.000)	With or without income ceiling	Rijnmond region		Province of Friesland	
Low (<33)	With	2,3	-24%	2,7	-20%
	Without	3,0		3,4	
Low medium (34-38)	With	3,4	41%	3,6	41%
	Without	2,4		2,5	
Medium (38-43)	With	3,3	43%	2,9	30%
	Without	2,3		2,2	
High medium (43-62)	With	3,0	38%	3,9	46%
	Without	2,1		2,7	
High (>62)	With	1,6	6%	1,6	9%
	Without	1,5		1,5	
Average	**With**		**20,8%**		**21,2%**

Income classes (x € 1.000)	With or without income ceiling	Zeeuws-Vlaanderen region	
Low (<33)	With	1,5	-19%
	Without	1,8	
Low medium (34-38)	With	1,5	16%
	Without	1,3	
Medium (38-43)	With	1,5	16%
	Without	1,3	
High medium (43-62)	With	1,6	19%
	Without	1,4	
High (>62)	With	1,3	8%
	Without	1,2	
Average	**With**		**8%**

Source: PBL Netherlands

Appendix B: Rent per m²

	Q1 2010	Q1 2011	Q1 2012	Q1 2013	Q1 2014	Q1 2015	Q1 2016
Alkmaar	9,89	10,65	10,17	9,98	11,12	10,50	10,60
Almere	8,63	8,19	8,18	8,34	8,49	8,22	8,94
Alphen Rijn	9,95	10,25	9,27	8,96	9,53	9,38	10,05
Amersfoort	9,40	9,53	9,93	10,13	9,67	9,42	10,47
Amstelveen	15,07	15,93	15,22	15,16	15,70	16,65	17,99
Amsterdam	16,32	16,57	17,59	18,93	18,83	20,04	22,34
Apeldoorn	9,15	8,68	8,46	8,10	7,77	8,49	8,60
Arnhem	9,76	9,46	9,59	9,42	9,37	9,30	9,77
Assen	7,41	10,14	8,15	7,21	7,64	9,66	8,10
Baarn	11,07	11,79	10,58	11,44	11,54	11,79	12,10
Best	11,74	11,25	9,82	10,56	10,18	9,84	9,09
Breda	10,65	11,69	10,75	10,88	10,79	11,60	11,74
Bussum	11,22	12,57	12,82	12,32	11,55	12,29	13,11
Capelle Ijssel	11,49	11,65	9,88	10,34	10,44	9,91	11,12
Delft	12,89	13,48	12,12	12,35	12,40	13,24	14,00
Den Bosch	11,24	11,62	11,00	11,45	11,28	12,45	12,74
Den Haag	13,13	13,22	12,85	13,01	12,91	13,49	14,30
Deventer	8,91	8,70	9,36	9,09	9,21	8,93	8,67
Dordrecht	11,76	11,22	10,32	10,51	10,62	11,14	10,97
Eindhoven	11,96	11,53	12,04	12,27	12,09	12,08	12,67
Geldrop	9,20	9,05	9,35	8,93	9,75	8,79	8,20
Gouda	9,63	10,94	9,69	10,45	9,83	10,29	10,92
Groningen	11,12	11,73	11,88	11,97	11,74	12,10	13,15
Haarlem	12,89	13,33	13,51	13,61	13,27	14,33	15,35
Heemstede	14,01	12,79	13,03	12,90	12,88	12,65	14,01
Helmond	9,01	8,09	8,79	8,64	8,85	8,15	8,98
Hilversum	11,92	12,22	12,31	12,51	11,50	12,34	12,94
Huizen	11,27	10,21	11,20	11,27	9,20	10,00	10,31
Leeuwarden	9,14	9,35	9,16	8,71	8,60	9,12	8,82
Leiden	13,56	13,63	13,79	13,78	13,94	14,92	15,65
Lelystad	7,32	8,96	7,91	8,15	7,73	7,50	8,01
Maastricht	11,73	11,72	11,54	11,19	11,80	11,72	12,35
Middelburg	8,22	10,14	9,96	9,87	8,98	10,74	11,07
Nijmegen	9,85	10,43	10,42	10,79	10,29	10,64	10,90
Oegstgeest	12,04	11,60	11,77	12,42	11,84	11,72	11,67
Roermond	9,73	8,55	8,52	7,69	7,55	8,36	7,92
Rotterdam	12,29	12,20	12,18	11,82	12,28	12,67	13,66
Schiedam	10,77	10,18	11,17	10,10	10,28	10,82	10,45
Tilburg	9,54	8,97	9,52	9,60	10,53	10,13	9,77
Utrecht	13,87	14,21	14,68	14,28	14,26	14,11	15,26
Veldhoven	9,84	9,79	10,00	10,73	10,62	10,76	10,77
Wassenaar	14,47	12,90	11,89	15,52	14,09	14,40	13,95
Zeist	11,08	11,48	11,71	11,11	11,63	11,20	12,38
Zoetermeer	7,97	8,16	8,51	9,15	9,01	9,34	9,15

Appendix C: Development rent per m² in percentages

	% 2010	% 2011	% 2012	% 2013	% 2014	% 2015
Alkmaar	7,7	-4,5	-1,9	11,4	-5,9	0,9
Almere	-5,4	-0,1	2,0	1,8	-3,3	8,8
Alphen Rijn	3,0	-10,6	-3,5	6,4	-1,6	7,1
Amersfoort	1,4	4,2	2,0	-4,8	-2,7	11,2
Amstelveen	5,7	-4,7	-0,4	3,6	6,1	8,1
Amsterdam	1,5	6,2	7,6	-0,5	6,4	11,5
Apeldoorn	-5,4	-2,6	-4,4	-4,2	9,3	1,3
Arnhem	-3,2	1,4	-1,8	-0,5	-0,8	5,1
Assen	36,8	-24,4	-13,0	6,0	26,4	-19,3
Baarn	6,5	-11,4	8,1	0,9	2,2	2,6
Best	-4,4	-14,6	7,5	-3,7	-3,5	-8,3
Breda	9,8	-8,7	1,2	-0,8	7,5	1,2
Bussum	12,0	2,0	-4,1	-6,7	6,4	6,7
Capelle Ijssel	1,4	-17,9	4,7	1,0	-5,4	12,2
Delft	4,6	-11,2	1,9	0,4	6,8	5,7
Den Bosch	3,4	-5,6	4,1	-1,5	10,4	2,3
Den Haag	0,7	-2,9	1,3	-0,8	4,5	6,0
Deventer	-2,4	7,6	-3,0	1,3	-3,1	-3,0
Dordrecht	-4,8	-8,7	1,8	1,1	4,9	-1,6
Eindhoven	-3,7	4,4	1,9	-1,5	-0,1	4,9
Geldrop	-1,7	3,3	-4,7	9,2	-10,9	-7,2
Gouda	13,6	-12,9	7,8	-6,3	4,7	6,1
Groningen	5,5	1,3	0,8	-2,0	3,1	8,7
Haarlem	3,4	1,4	0,7	-2,6	8,0	7,1
Heemstede	-9,5	1,9	-1,0	-0,2	-1,8	10,8
Helmond	-11,4	8,7	-1,7	2,4	-8,6	10,2
Hilversum	2,5	0,7	1,6	-8,8	7,3	4,9
Huizen	-10,4	9,7	0,6	-22,5	8,7	3,1
Leeuwarden	2,3	-2,1	-5,2	-1,3	6,1	-3,4
Leiden	0,5	1,2	-0,1	1,2	7,0	4,9
Lelystad	22,4	-13,3	3,0	-5,4	-3,1	6,8
Maastricht	-0,1	-1,6	-3,1	5,5	-0,7	5,4
Middelburg	23,4	-1,8	-0,9	-9,9	19,6	3,1
Nijmegen	5,9	-0,1	3,6	-4,9	3,4	2,4
Oegstgeest	-3,8	1,5	5,5	-4,9	-1,0	-0,4
Roermond	-13,8	-0,4	-10,8	-1,9	10,7	-5,6
Rotterdam	-0,7	-0,2	-3,1	3,9	3,2	7,8
Schiedam	-5,8	9,7	-10,6	1,8	5,3	-3,5
Tilburg	-6,4	6,1	0,8	9,7	-4,0	-3,7
Utrecht	2,5	3,3	-2,8	-0,1	-1,1	8,2
Veldhoven	-0,5	2,2	7,3	-1,0	1,3	0,1
Wassenaar	-12,2	-8,5	30,5	-10,2	2,2	-3,2
Zeist	3,6	2,0	-5,4	4,7	-3,8	10,5
Zoetermeer	2,4	4,3	7,5	-1,5	3,7	-2,1

Appendix D: Population growth per 100 inhabitants

	2010	2011	2012	2013	2014	2015
Alkmaar	0,08	0,35	0,25	0,38	0,40	0,48
Almere	1,33	1,32	1,06	0,41	0,47	0,62
Alphen Rijn	0,20	0,24	0,08	0,29	0,57	0,53
Amersfoort	1,19	1,13	0,95	0,83	1,05	0,74
Amstelveen	1,36	1,92	1,22	0,75	2,53	1,65
Amsterdam	1,61	1,32	1,16	1,44	1,33	1,44
Apeldoorn	0,30	0,49	0,23	0,15	0,35	0,59
Arnhem	0,72	0,81	0,37	0,66	0,97	1,00
Assen	0,48	0,05	-0,01	-0,02	-0,04	-0,15
Baarn	0,25	-0,11	-0,31	0,15	0,38	0,47
Best	-0,49	-0,40	-0,21	-0,07	0,42	0,83
Breda	0,75	1,03	0,99	0,83	0,73	0,37
Bussum	0,93	0,54	0,14	0,00	0,73	0,69
Capelle Ijssel	1,16	0,03	-0,15	0,23	0,45	0,01
Delft	0,96	1,01	0,43	0,96	0,98	0,00
Den Bosch	0,84	0,79	0,65	0,64	0,30	0,48
Den Haag	1,34	1,41	0,76	0,61	1,16	1,00
Deventer	0,22	-0,07	-0,09	-0,26	0,22	0,33
Dordrecht	0,28	0,04	-0,33	0,19	0,18	-0,08
Eindhoven	1,04	0,55	0,56	1,14	1,04	0,69
Geldrop	0,71	0,73	0,25	0,22	0,06	0,04
Gouda	-0,11	0,26	-0,46	0,05	0,23	0,12
Groningen	1,44	1,65	1,19	1,48	1,02	0,31
Haarlem	0,73	0,76	0,84	1,34	0,97	0,95
Heemstede	0,92	-0,21	0,29	0,18	0,44	1,08
Helmond	0,30	0,27	0,25	0,26	0,52	0,46
Hilversum	0,49	0,65	0,56	0,48	0,85	0,77
Huizen	-0,50	-0,36	-0,31	-0,48	0,17	0,14
Leeuwarden	0,81	0,51	0,66	0,38	0,33	0,19
Leiden	0,68	0,71	0,89	1,14	0,33	0,82
Lelystad	0,65	0,27	0,62	0,48	0,36	0,49
Maastricht	0,95	1,16	0,64	0,55	-0,07	0,11
Middelburg	0,07	-0,55	-0,51	0,25	-0,06	0,55
Nijmegen	0,77	0,58	0,73	1,15	1,42	0,81
Oegstgeest	0,75	0,09	1,60	-1,05	0,38	0,92
Roermond	0,69	1,03	0,93	0,42	0,13	0,01
Rotterdam	0,80	0,96	0,01	0,33	0,86	0,95
Schiedam	0,20	0,69	-0,04	0,31	0,55	0,31
Tilburg	0,68	0,65	0,46	0,84	0,66	0,61
Utrecht	1,40	1,58	1,78	1,94	1,83	1,43
Veldhoven	0,81	0,66	0,48	0,14	0,02	0,34
Wassenaar	0,05	-0,26	-0,41	0,07	0,22	0,60
Zeist	0,89	0,67	0,31	-0,28	0,64	1,00
Zoetermeer	0,31	0,34	0,62	0,38	0,38	0,07

Appendix E: Household size

	2010	2011	2012	2013	2014	2015	2016
Alkmaar	2,09	2,09	2,08	2,08	2,08	2,11	2,10
Almere	2,44	2,43	2,41	2,40	2,39	2,38	2,38
Alphen Rijn	2,30	2,31	2,30	2,29	2,33	2,31	2,31
Amersfoort	2,29	2,29	2,28	2,28	2,28	2,28	2,27
Amstelveen	2,04	2,04	2,04	2,04	2,05	2,05	2,06
Amsterdam	1,81	1,81	1,81	1,81	1,82	1,81	1,81
Apeldoorn	2,26	2,27	2,26	2,24	2,23	2,22	2,21
Arnhem	1,96	1,96	1,96	1,96	1,97	1,96	1,96
Assen	2,23	2,23	2,21	2,20	2,20	2,18	2,17
Baarn	2,18	2,14	2,13	2,14	2,15	2,14	2,14
Best	2,48	2,47	2,46	2,44	2,41	2,40	2,39
Breda	2,09	2,09	2,08	2,07	2,07	2,06	2,06
Bussum	2,15	2,15	2,15	2,15	2,15	2,15	
Capelle Ijssel	2,20	2,19	2,18	2,17	2,17	2,16	2,15
Delft	1,82	1,80	1,78	1,77	1,76	1,75	1,76
Den Bosch	2,12	2,12	2,12	2,11	2,11	2,13	2,12
Den Haag	1,98	1,99	1,99	1,99	2,01	2,00	2,00
Deventer	2,17	2,17	2,17	2,18	2,19	2,18	2,17
Dordrecht	2,15	2,15	2,15	2,15	2,15	2,15	2,14
Eindhoven	1,97	1,96	1,95	1,95	1,95	1,94	1,94
Geldrop	2,30	2,28	2,26	2,26	2,26	2,26	2,24
Gouda	2,26	2,26	2,25	2,25	2,23	2,22	2,21
Groningen	1,68	1,67	1,66	1,65	1,65	1,64	1,64
Haarlem	2,01	2,02	2,02	2,03	2,03	2,04	2,04
Heemstede	2,24	2,22	2,22	2,22	2,21	2,20	2,20
Helmond	2,30	2,31	2,31	2,30	2,28	2,28	2,27
Hilversum	2,08	2,07	2,07	2,07	2,07	2,07	2,08
Huizen	2,31	2,30	2,28	2,27	2,27	2,26	2,25
Leeuwarden	1,92	1,91	1,90	1,89	1,93	1,92	1,92
Leiden	1,88	1,87	1,86	1,84	1,84	1,82	1,82
Lelystad	2,30	2,30	2,29	2,28	2,29	2,28	2,28
Maastricht	1,87	1,84	1,81	1,79	1,78	1,77	1,76
Middelburg	2,14	2,13	2,12	2,12	2,11	2,11	2,10
Nijmegen	1,84	1,83	1,83	1,82	1,82	1,81	1,80
Oegstgeest	2,27	2,25	2,23	2,21	2,22	2,23	2,24
Roermond	2,13	2,12	2,11	2,10	2,09	2,08	2,07
Rotterdam	1,95	1,95	1,95	1,95	1,96	1,95	1,95
Schiedam	2,11	2,10	2,10	2,10	2,10	2,10	2,09
Tilburg	2,05	2,04	2,03	2,03	2,02	2,00	2,00
Utrecht	1,89	1,89	1,90	1,91	1,91	1,91	1,92
Veldhoven	2,33	2,32	2,29	2,28	2,28	2,26	2,26
Wassenaar	2,24	2,23	2,24	2,23	2,22	2,22	2,23
Zeist	2,12	2,12	2,12	2,12	2,12	2,11	2,13
Zoetermeer	2,29	2,29	2,28	2,27	2,26	2,25	2,24

Appendix F: Household size balanced ternary
(-1 = decrease, 0 = status quo, 1 = increase)

	2010	2011	2012	2013	2014	2015
Alkmaar	0	-1	0	0	1	-1
Almere	-1	-1	-1	-1	-1	0
Alphen Rijn	1	-1	-1	1	-1	0
Amersfoort	0	-1	0	0	0	-1
Amstelveen	0	0	0	1	0	1
Amsterdam	0	0	0	1	-1	0
Apeldoorn	1	-1	-1	-1	-1	-1
Arnhem	0	0	0	1	-1	0
Assen	0	-1	-1	0	-1	-1
Baarn	-1	-1	1	1	-1	0
Best	-1	-1	-1	-1	-1	-1
Breda	0	-1	-1	0	-1	0
Bussum	0	0	0	0	0	
Capelle Ijssel	-1	-1	-1	0	-1	-1
Delft	-1	-1	-1	-1	-1	1
Den Bosch	0	0	-1	0	1	-1
Den Haag	1	0	0	1	-1	0
Deventer	0	0	1	1	-1	-1
Dordrecht	0	0	0	0	0	-1
Eindhoven	-1	-1	0	0	-1	0
Geldrop	-1	-1	0	0	0	-1
Gouda	0	-1	0	-1	-1	-1
Groningen	-1	-1	-1	0	-1	0
Haarlem	1	0	1	0	1	0
Heemstede	-1	0	0	-1	-1	0
Helmond	1	0	-1	-1	0	-1
Hilversum	-1	0	0	0	0	1
Huizen	-1	-1	-1	0	-1	-1
Leeuwarden	-1	-1	-1	1	-1	0
Leiden	-1	-1	-1	0	-1	0
Lelystad	0	-1	-1	1	-1	0
Maastricht	-1	-1	-1	-1	-1	-1
Middelburg	-1	-1	0	-1	0	-1
Nijmegen	-1	0	-1	0	-1	-1
Oegstgeest	-1	-1	-1	1	1	1
Roermond	-1	-1	-1	-1	-1	-1
Rotterdam	0	0	0	1	-1	0
Schiedam	-1	0	0	0	0	-1
Tilburg	-1	-1	0	-1	-1	0
Utrecht	0	1	1	0	0	1
Veldhoven	-1	-1	-1	0	-1	0
Wassenaar	-1	1	-1	-1	0	1
Zeist	0	0	0	0	-1	1
Zoetermeer	0	-1	-1	-1	-1	-1

Appendix G: Middle-income earners class ratio

	2010	2011	2012	2013	2014
Alkmaar	32,8	32,9	33,0	33,3	33,4
Almere	32,8	32,6	32,2	32,2	32,2
Alphen Rijn	33,5	33,8	33,8	34,1	34,1
Amersfoort	32,2	32,3	32,0	32,0	32,1
Amstelveen	28,8	28,8	28,6	28,8	28,4
Amsterdam	23,2	23,0	23,0	22,9	22,9
Apeldoorn	31,7	31,8	31,9	32,0	31,9
Arnhem	26,5	26,4	26,2	26,1	25,9
Assen	31,0	31,3	31,3	31,4	32,0
Baarn	29,1	29,0	29,2	29,7	29,4
Best	34,1	34,1	34,6	34,9	34,5
Breda	28,9	28,9	28,6	28,7	28,5
Bussum	26,6	26,6	26,4	26,8	26,6
Capelle Ijssel	31,0	31,0	30,8	30,7	30,6
Delft	24,4	24,2	23,9	23,8	23,4
Den Bosch	30,4	30,1	30,2	30,0	30,3
Den Haag	25,3	25,2	24,8	24,7	24,7
Deventer	30,1	30,5	30,4	30,6	30,4
Dordrecht	29,5	29,7	29,8	29,9	29,8
Eindhoven	27,9	28,0	27,7	27,7	27,6
Geldrop	33,4	33,1	32,9	33,0	33,8
Gouda	30,8	30,7	30,8	30,4	30,8
Groningen	20,7	20,7	20,5	20,5	20,5
Haarlem	30,4	30,3	30,2	30,2	30,2
Heemstede	26,0	26,2	26,5	26,4	26,4
Helmond	30,2	30,3	30,2	30,3	30,4
Hilversum	29,0	29,0	29,2	29,4	29,3
Huizen	31,0	31,2	31,2	31,3	31,4
Leeuwarden	25,6	25,7	25,4	26,2	26,2
Leiden	24,8	24,6	24,1	24,2	24,2
Lelystad	30,2	30,2	29,9	30,0	30,1
Maastricht	24,3	23,9	24,3	24,1	23,9
Middelburg	31,7	30,9	31,5	31,6	31,3
Nijmegen	24,2	23,9	23,6	23,3	23,1
Oegstgeest	27,6	28,0	27,8	28,1	29,1
Roermond	29,3	29,2	29,3	29,1	29,3
Rotterdam	24,6	24,6	24,2	24,0	23,9
Schiedam	28,5	28,5	28,3	27,9	27,9
Tilburg	27,6	27,3	27,1	26,7	26,7
Utrecht	24,8	24,8	24,7	24,5	24,4
Veldhoven	34,3	34,0	33,9	33,6	33,5
Wassenaar	24,4	24,7	24,7	24,8	24,5
Zeist	27,5	27,4	27,1	27,0	27,1
Zoetermeer	33,7	33,5	33,6	33,4	33,3

Appendix H: Middle-income earners class ratio balanced ternary (-1 = decrease, 0 = status quo, 1 = increase)

	2010	2011	2012	2013
Alkmaar	1	1	1	1
Almere	-1	-1	0	0
Alphen Rijn	1	0	1	0
Amersfoort	1	-1	0	1
Amstelveen	0	-1	1	-1
Amsterdam	-1	0	-1	0
Apeldoorn	1	1	1	-1
Arnhem	-1	-1	-1	-1
Assen	1	0	1	1
Baarn	-1	1	1	-1
Best	0	1	1	-1
Breda	0	-1	1	-1
Bussum	0	-1	1	-1
Capelle Ijssel	0	-1	-1	-1
Delft	-1	-1	-1	-1
Den Bosch	-1	1	-1	1
Den Haag	-1	-1	-1	0
Deventer	1	-1	1	-1
Dordrecht	1	1	1	-1
Eindhoven	1	-1	0	-1
Geldrop	-1	-1	1	1
Gouda	-1	1	-1	1
Groningen	0	-1	0	0
Haarlem	-1	-1	0	0
Heemstede	1	1	-1	0
Helmond	1	-1	1	1
Hilversum	0	1	1	-1
Huizen	1	0	1	1
Leeuwarden	1	-1	1	0
Leiden	-1	-1	1	0
Lelystad	0	-1	1	1
Maastricht	-1	1	-1	-1
Middelburg	-1	1	1	-1
Nijmegen	-1	-1	-1	-1
Oegstgeest	1	-1	1	1
Roermond	-1	1	-1	1
Rotterdam	0	-1	-1	-1
Schiedam	0	-1	-1	0
Tilburg	-1	-1	-1	0
Utrecht	0	-1	-1	-1
Veldhoven	-1	-1	-1	-1
Wassenaar	1	0	1	-1
Zeist	-1	-1	-1	1
Zoetermeer	-1	1	-1	-1

Appendix I: High-income earners class ratio

	2010	2011	2012	2013	2014
Alkmaar	18,0	18,2	18,0	18,1	19,0
Almere	20,4	20,2	19,9	20,2	20,2
Alphen Rijn	24,6	24,3	24,2	24,2	23,9
Amersfoort	24,2	24,0	24,1	24,2	24,6
Amstelveen	31,0	30,7	30,8	30,5	29,9
Amsterdam	19,8	19,9	20,1	20,5	20,6
Apeldoorn	19,9	19,8	19,7	19,5	19,5
Arnhem	15,7	15,6	15,6	15,6	15,5
Assen	15,4	15,2	15,3	15,6	15,4
Baarn	25,8	26,0	26,4	25,9	26,5
Best	25,5	26,0	25,9	25,7	26,0
Breda	21,7	21,6	21,8	25,7	22,0
Bussum	31,6	31,3	31,6	31,3	31,6
Capelle Ijssel	22,9	22,7	22,5	21,9	21,6
Delft	18,1	17,8	17,5	17,4	17,0
Den Bosch	22,2	22,5	22,5	22,6	22,7
Den Haag	19,4	19,1	19,1	19,0	19,0
Deventer	16,8	16,7	17,1	17,5	17,2
Dordrecht	18,1	18,1	18,2	18,1	17,9
Eindhoven	17,7	17,8	18,0	18,3	18,1
Geldrop	21,3	21,5	21,9	21,9	21,5
Gouda	21,9	21,6	21,4	21,2	21,1
Groningen	12,1	12,0	12,0	12,1	12,2
Haarlem	21,8	21,9	22,3	22,7	22,8
Heemstede	40,0	39,4	40,3	40,1	40,2
Helmond	16,1	16,4	16,2	16,1	16,0
Hilversum	24,1	23,8	23,8	23,6	23,8
Huizen	27,5	27,6	27,5	26,8	26,6
Leeuwarden	12,0	11,9	11,9	12,7	12,7
Leiden	20,7	20,4	20,4	20,5	20,6
Lelystad	17,1	17,1	16,7	16,7	16,5
Maastricht	15,0	15,2	14,9	14,9	15,2
Middelburg	18,1	18,2	18,3	18,1	18,4
Nijmegen	15,4	15,3	15,3	15,4	15,4
Oegstgeest	38,9	38,0	38,6	38,8	39,1
Roermond	15,7	16,0	16,0	16,2	16,1
Rotterdam	15,2	15,1	15,4	15,6	15,5
Schiedam	16,4	16,3	16,3	16,3	16,2
Tilburg	14,9	15,0	14,9	14,8	14,8
Utrecht	21,0	21,1	21,4	21,9	21,9
Veldhoven	23,7	24,2	24,4	24,5	24,7
Wassenaar	39,9	39,1	39,5	38,4	39,0
Zeist	27,6	27,0	27,2	27,0	26,5
Zoetermeer	25,2	24,9	24,4	24,2	23,8

Appendix J: High-income earners class ratio balanced ternary (-1 = decrease, 0 = status quo, 1 = increase)

	2010	2011	2012	2013
Alkmaar	1	-1	1	1
Almere	-1	-1	1	0
Alphen Rijn	-1	-1	0	-1
Amersfoort	-1	1	1	1
Amstelveen	-1	1	-1	-1
Amsterdam	1	1	1	1
Apeldoorn	-1	-1	-1	0
Arnhem	-1	0	0	-1
Assen	-1	1	1	-1
Baarn	1	1	-1	1
Best	1	-1	-1	1
Breda	-1	1	1	-1
Bussum	-1	1	-1	1
Capelle Ijssel	-1	-1	-1	-1
Delft	-1	-1	-1	-1
Den Bosch	1	0	1	1
Den Haag	-1	0	-1	0
Deventer	-1	1	1	-1
Dordrecht	0	1	-1	-1
Eindhoven	1	1	1	-1
Geldrop	1	1	0	-1
Gouda	-1	-1	-1	-1
Groningen	-1	0	1	1
Haarlem	1	1	1	1
Heemstede	-1	1	-1	1
Helmond	1	-1	-1	-1
Hilversum	-1	0	-1	1
Huizen	1	-1	-1	-1
Leeuwarden	-1	0	1	0
Leiden	-1	0	1	1
Lelystad	0	-1	0	-1
Maastricht	1	-1	0	1
Middelburg	1	1	-1	1
Nijmegen	-1	0	1	0
Oegstgeest	-1	1	1	1
Roermond	1	0	1	-1
Rotterdam	-1	1	1	-1
Schiedam	-1	0	0	-1
Tilburg	1	-1	-1	0
Utrecht	1	1	1	0
Veldhoven	1	1	1	1
Wassenaar	-1	1	-1	1
Zeist	-1	1	-1	-1
Zoetermeer	-1	-1	-1	-1

Appendix K: Years of return on investment

	Q1 2010	Q1 2011	Q1 2012	Q1 2013	Q1 2014	Q1 2015	Q1 2016
Alkmaar	19,78	19,12	19,58	18,96	16,64	17,79	18,21
Almere	19,19	20,35	20,27	19,44	18,88	19,57	18,42
Alphen Rijn	20,97	20,53	21,81	22,00	19,98	20,19	18,82
Amersfoort	22,37	22,68	21,51	20,48	21,11	21,46	20,01
Amstelveen	17,02	16,67	17,60	17,45	17,12	16,54	17,15
Amsterdam	17,96	17,30	16,58	14,56	14,35	13,76	13,71
Apeldoorn	22,81	24,08	23,66	23,67	24,06	21,48	21,63
Arnhem	17,83	19,17	18,34	18,34	17,97	17,82	17,23
Assen	20,69	15,25	18,59	20,53	18,85	14,76	17,93
Baarn	25,99	24,28	26,28	22,82	22,13	21,29	21,91
Best	18,08	19,77	21,89	19,26	19,92	20,93	22,88
Breda	20,16	18,35	19,86	19,03	18,57	17,28	17,70
Bussum	23,56	21,53	21,33	21,56	21,99	19,88	19,81
Capelle Ijssel	15,63	15,42	17,97	16,58	16,24	16,78	15,53
Delft	16,37	15,83	17,09	15,80	16,22	14,74	14,70
Den Bosch	18,48	18,49	19,33	16,35	18,25	16,63	16,94
Den Haag	14,71	14,61	14,94	14,39	13,70	12,94	12,29
Deventer	20,64	21,46	19,52	19,65	18,60	18,78	19,43
Dordrecht	14,81	15,65	16,27	15,49	15,14	14,38	14,42
Eindhoven	16,37	16,95	15,90	15,11	15,19	15,38	14,96
Geldrop	21,50	22,05	20,91	20,98	19,17	21,44	22,89
Gouda	18,69	17,10	18,91	16,79	17,32	16,76	15,94
Groningen	15,12	14,56	14,18	13,67	13,57	13,20	12,19
Haarlem	19,02	18,19	17,94	17,05	17,09	15,97	15,41
Heemstede	21,19	24,43	23,46	22,46	21,79	23,16	22,07
Helmond	20,73	23,85	21,01	20,45	19,34	20,92	18,91
Hilversum	20,62	20,21	19,49	18,00	19,16	17,98	17,33
Huizen	23,37	26,68	23,04	22,63	27,59	25,26	23,88
Leeuwarden	16,24	15,95	15,90	16,34	16,21	15,19	16,04
Leiden	16,02	16,15	15,61	15,30	14,62	13,79	13,04
Lelystad	20,67	17,12	18,80	18,04	18,69	19,24	18,52
Maastricht	17,07	16,55	15,94	16,40	14,66	14,85	14,23
Middelburg	20,81	17,58	17,84	17,46	18,69	15,91	15,63
Nijmegen	20,30	19,15	18,55	17,44	17,46	17,30	16,53
Oegstgeest	21,46	21,74	21,26	19,49	19,73	20,04	21,42
Roermond	17,07	19,36	18,95	20,86	20,71	18,53	19,26
Rotterdam	14,10	14,21	14,19	14,50	13,24	12,62	11,82
Schiedam	14,68	15,35	13,82	14,78	14,19	13,19	13,84
Tilburg	19,51	21,19	19,62	18,85	16,67	17,19	17,95
Utrecht	16,92	16,61	15,74	15,62	15,12	15,43	14,78
Veldhoven	20,99	21,53	20,83	18,96	18,96	18,38	18,36
Wassenaar	25,39	27,91	30,17	22,31	23,36	23,29	25,45
Zeist	24,09	23,96	22,74	23,40	21,68	22,87	22,16
Zoetermeer	23,43	23,56	22,07	19,62	19,43	18,56	19,16

Appendix L: Development years of return on investment in percentages

	% 2010	% 2011	% 2012	% 2013	% 2014	% 2015
Alkmaar	-3,45	2,41	-3,27	-13,94	6,91	2,36
Almere	6,05	-0,40	-4,27	-2,97	3,66	-6,24
Alphen Rijn	-2,14	6,24	0,87	-10,11	1,05	-7,28
Amersfoort	1,39	-5,44	-5,03	3,08	1,66	-7,25
Amstelveen	-2,10	5,58	-0,86	-1,93	-3,51	3,69
Amsterdam	-3,82	-4,34	-13,87	-1,46	-4,29	-0,37
Apeldoorn	5,57	-1,78	0,04	1,65	-12,01	0,70
Arnhem	7,52	-4,53	0,00	-2,06	-0,84	-3,42
Assen	-35,67	21,90	10,44	-8,91	-27,71	21,48
Baarn	-7,04	8,24	-15,16	-3,12	-3,95	2,91
Best	9,35	10,72	-13,66	3,43	5,07	9,32
Breda	-9,86	8,23	-4,36	-2,48	-7,47	2,43
Bussum	-9,43	-0,94	1,08	1,99	-10,61	-0,35
Capelle Ijssel	-1,36	16,54	-8,38	-2,09	3,33	-8,05
Delft	-3,41	7,96	-8,17	2,66	-10,04	-0,27
Den Bosch	0,05	4,54	-18,23	11,62	-9,74	1,86
Den Haag	-0,69	2,26	-3,82	-5,04	-5,87	-5,29
Deventer	3,97	-9,94	0,67	-5,65	0,97	3,46
Dordrecht	5,67	3,96	-5,04	-2,31	-5,29	0,28
Eindhoven	3,54	-6,60	-5,23	0,53	1,25	-2,81
Geldrop	2,56	-5,45	0,34	-9,44	11,84	6,76
Gouda	-9,30	10,59	-12,63	3,16	-3,34	-5,14
Groningen	-3,85	-2,68	-3,73	-0,74	-2,80	-8,29
Haarlem	-4,56	-1,39	-5,22	0,24	-7,01	-3,63
Heemstede	15,29	-4,14	-4,45	-3,08	6,29	-4,94
Helmond	15,05	-13,52	-2,74	-5,74	8,17	-10,63
Hilversum	-2,03	-3,69	-8,28	6,44	-6,56	-3,75
Huizen	14,16	-15,80	-1,81	21,92	-9,22	-5,78
Leeuwarden	-1,82	-0,32	2,77	-0,80	-6,72	5,60
Leiden	0,81	-3,46	-2,03	-4,65	-6,02	-5,75
Lelystad	-20,74	9,81	-4,21	3,60	2,94	-3,89
Maastricht	-3,14	-3,83	2,89	-11,87	1,30	-4,36
Middelburg	-18,37	1,48	-2,18	7,05	-17,47	-1,79
Nijmegen	-6,01	-3,24	-6,37	0,12	-0,93	-4,66
Oegstgeest	1,31	-2,26	-9,08	1,23	1,57	6,89
Roermond	13,42	-2,16	10,08	-0,72	-11,77	3,94
Rotterdam	0,78	-0,14	2,19	-9,52	-4,91	-6,77
Schiedam	4,56	-11,07	6,95	-4,16	-7,58	4,93
Tilburg	8,61	-8,00	-4,09	-13,08	3,12	4,42
Utrecht	-1,87	-5,53	-0,77	-3,31	2,05	-4,40
Veldhoven	2,57	-3,36	-9,86	0,00	-3,16	-0,12
Wassenaar	9,93	8,10	-35,23	4,71	-0,30	9,27
Zeist	-0,54	-5,37	2,90	-7,93	5,49	-3,20
Zoetermeer	0,56	-6,75	-12,49	-0,98	-4,69	3,23