The Dutch buy-to-let market

A quantitative study on the characteristics of the Dutch buy-to-let market and the relation between buy-to-let investments and regional house price development

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August 10 2018

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Master thesis submitted to Delft University of Technology

in partial fulfilment of the requirements for the degree of

MASTER OF SCIENCE

in **Complex Systems Engineering and Management**

Faculty of Technology, Policy and Management

by

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To be defended in public on August 28th 2018

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Preface

Before you lies the thesis “The Dutch buy-to-let market”. This thesis has been written within the Master’s program Complex Systems Engineering and Management (CoSEM). Since this is the final element of the master, I am glad that this thesis is a combination of the, to me, most interesting aspects of the master. I was able to combine the domain knowledge on the functioning of housing markets, the economic and financial knowledge obtained during the specialisation courses on investors’ behaviour and the forming of housing bubbles and the statistical knowledge on house price models. Furthermore, the systems engineering approach, which has a central place in the CoSEM master, could be used to integrate all this knowledge.

Before you start reading, I would like to thank several persons who supported me during the writing of this thesis. First, I would like to thank the Kadaster, and specifically the team “Project & Advies”, for providing me with the necessary data to conduct this research, their helpful feedback and the fun time I had during my internship. A special word of gratitude to Frank and Paul for their valuable suggestions and support. Next I would like to thank my graduation committee; Harry Boumeester, Marja Elsinga and Scott Cunningham, for providing me with constructive feedback. Last but not least, I would like to thank my family and friends for helping me with my thesis when necessary and for their more general support throughout my studies.

I hope you will enjoy reading this thesis.

Janneke Michielsen Delft, August 10th 2018

Summary

During the last decade, two developments on the Dutch housing market have received a lot of attention. One of these developments concerns the recovering house prices and specifically the strong price rises in cities. The other development is related to the growth of the private rental sector and particularly the buy-to-let market. This market consists of the private rental dwellings owned by reasonably small private landlords. These landlords predominantly buy owner-occupied dwellings to rent them out, hence the name buy-to-let. The growing buy-to-let market and the recent price rises have often been linked to each other. Some people claim that the buy-to-let landlords are driving up the house prices. Nevertheless, the relation between these two developments has not been properly studied yet for the Netherlands. Consequently, the objective of this study is to gain more insight in the Dutch buy-to-let market in general and specifically the relation between this market and the regional house price development. The main research question is as follows:

"What is the effect of buy-to-let investments on the Dutch regional house price development?"

Mostly quantitative research methods are applied to answer this research question since especially quantitative information on the Dutch buy-to-let market is missing. Data of the Kadaster on the Dutch housing stock and tenure and the Dutch private housing transactions is used in combination with data of the CBS, Statistics Netherlands. First, the separate developments are studied for the Netherlands in general and different municipalities. Subsequently, house price models are made for Groningen, Breda and Zoetermeer by using linear regression. The period under study is 2006-2017 and the focus is on the price development of apartments. The share of buy-to-let dwellings is high in Groningen, average in Breda and low in Zoetermeer. By making three models, it can be seen whether there is a relation between the size of the buy-to-let market and the drivers for the regional house price development. Moreover, the correlation between the share of buy-to-let transactions and the house price development in these three municipalities is determined, to gain more insight in the relation between buy-to-let investments and the house price development.

The research shows that the Dutch buy-to-let market is still quite small as the buy-to-let dwellings only comprise 5% of the total Dutch housing stock. These dwellings are owned by private landlords with a portfolio of maximum 50 dwellings. A basic distinction can be made between two types of buy-to-let landlords; the landlords with multiple dwellings in their possession which are mostly apartments located in urban areas and the landlords with only one or two dwellings in their possession which are mostly bigger dwellings located in the more rural areas. The first group is the biggest group in the Netherlands and is the focus of this study.

By comparing the house price development of different municipalities with a varying share of buy-to-let, it can be seen that the recent house price increases are on average stronger for the municipalities with a high share of buy-to-let dwellings. It is however possible that these stronger increases are caused by other factors than buy-to-let. When comparing the results of the three regional house price models no big differences in the drivers are found. The speculative behaviour of people and income-related variables can partially explain the house price development for the three municipalities. The real mortgage interest rate, which is normally an important variable in house price models, proved to be only a significant determinant for Groningen. However, the model fit only slightly improved when the real mortgage interest rate was included. For all three models, the explanatory power is roughly 50%. This is quite low for house price models. The low explanatory power is

presumably related to the short and specific period under study as the economic crisis is part of this period.

Last, the research shows that there is a negative correlation between the share of buy-to-let transactions and the house price development for Groningen, no correlation for Breda and a positive correlation for Zoetermeer. The buy-to-let landlords in Groningen were buying relatively more dwellings when the prices were still low, whilst the buy-to-let landlords in Zoetermeer were possibly more hesitant and started buying relatively more dwellings when the prices were on the rise again.

All in all, the results show that the determinants for the house price development are, despite the varying share of buy-to-let dwellings, in general the same for the three municipalities. Furthermore, a buy-to-let indicator could not explain some of the remaining unexplained variance. The correlations also indicate that buy-to-let investments do not necessarily drive up the prices, despite the positive correlation for Zoetermeer. Due to the small size of this market, it is unlikely that the recent price rises were caused by the growing buy-to-let market. Based on these results, it can be concluded that none of the results actually point at an inflationary effect of buy-to-let investments. However, because only three municipalities were studied, no general conclusions can be drawn and the possible inflationary effect of buy-to-let landlords cannot be completely excluded.

Although the results cannot be generalized, the results are interesting for municipalities. The results show that buy-to-let investments do not necessarily result in higher house prices. It is more likely that the recent prices rises are caused by the high demand for urban dwellings and the shortage of both owner-occupied and rental dwellings. Consequently, policy measures that restrict landlords from buying more dwellings will not necessarily lead to lower house prices as still the clear majority of dwellings is bought by households.

Since this is one of the first quantitative studies on the Dutch buy-to-let market and merely an explorative study, there are multiple interesting options for a follow-up study. One option would be to study the relation between buy-to-let investments and the recent house price development for more municipalities. A distinction could be made between municipalities with a bigger and more mature buy-to-let market and the municipalities with a smaller buy-to-let market. It would be interesting to investigate whether buy-to-let landlords behave differently in the more mature markets and whether the relation between buy-to-let investments and the house price development is different for these markets.

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1 Introduction

Ten years ago the global financial crisis started. This had a negative effect on most financial markets, including those of the Netherlands. The crisis resulted in declining bond yields, and declining stock and house prices. It took several years before these markets started recovering again. For a few years most financial markets, including the Dutch housing market, are recovering again. Possibly due to the financial crisis, interesting changes are now taking place on the Dutch housing market. For example, housing ownership structures are slowly changing and the share of private rental dwellings is on the rise again. In this thesis the focus will be on two developments regarding the Dutch housing market; the rising house prices and the growing private rental sector. More specifically the thesis focuses on the buy-to-let market .

In section 1.1, more insight will be gained into these two developments as well as the possible relation between them. Next, the main objective of this thesis and the corresponding research question will be discussed in section 1.2. The methodology for answering this research question is highlighted in paragraph 1.3. Section 1.4 revolves around the scientific and social relevance of this thesis. The last section sets out the structure for the rest of this thesis.

1.1 The Dutch housing market since the economic crisis

In this section, two developments related to the Dutch housing market will be discussed. In subsection 1.1.1, the development of the Dutch house prices since 2008 will be described. The growth of the Dutch private rental sector will be discussed in subsection 1.1.2. Subsection 1.1.3 revolves around the possible relation between these two developments.

1.1.1 Rising house prices…

In figure 1.1, the development of the Dutch price index for owner-occupied dwellings is shown. This index is compiled by CBS, Statistics Netherlands, and the Kadaster, Dutch Land Registry. It uses both transaction prices and appraisal values to arrive at an index which properly reflects the price changes of the Dutch owner-occupied housing stock (De Vries, De Haan, Van der Wal, & Mariën, 2009). The graph shows that the Dutch house prices started to decline at the end of 2008 and this descent continued until the second quarter of 2013. Since then, an upward trend is visible. These price rises have resulted in a new peak given the price index of May 2018 is now higher than the 2008 values.

Figure 1.1 Development Dutch house price index, 2013=100 (Kadaster, 2018)

Figure 1.1 shows the house price index for the Netherlands in general. Note that there are considerable differences in the house price levels and development between regions. For example, the four biggest cities in the Netherlands (Amsterdam, Rotterdam, The Hague and Utrecht) experienced stronger price increases than the Dutch average (Hekwolter of Hekhuis, Nijskens, & Heeringa, 2017). These stronger price increases are mainly caused by the increasing popularity of living in cities. Households are moving to the more urban areas because of the presence of educational facilities, jobs and other amenities such as restaurants and museums. This naturally results in higher prices (Garretsen & Marlet, 2017).

1.1.2 And a growing buy-to-let market

The majority of Dutch dwellings belong to the owner-occupied segment. The remaining dwellings are mostly owned by housing associations. Only a relatively small share is owned by private landlords. Whilst the share of private rental dwellings was only 7% in 2007, this share is slowly increasing and it currently amounts to roughly 10% of all Dutch dwellings (Capital Value, 2018). This upward trend is mainly caused by a growing demand for private rental dwellings. As a result, private investors are increasingly buying up dwellings in order to rent them out. These relatively small private landlords are therefore also known as buy-to-let landlords. They are predominantly responsible for the increase in the supply of private rental dwellings in the Netherlands (Aalbers, Bosma, Fernandez, & Hochstenbach, 2018).

The revival of the private rental sector and the growing buy-to-let market is not only happening in the Netherlands. This is a European and even global trend (Aalbers, Bosma, Fernandez, & Hochstenbach, 2018). The share of private rental dwellings has for example also grown between 2006 and 2014 in Australia, Belgium, Spain, United Kingdom and the United States. Moreover, in the majority of these countries, most private rental dwellings are owned by private landlords with only a few dwellings in their portfolio (Martin, Hulse, & Pawson, 2018).

1.1.3 Are these developments related?

In the last years, these buy-to-let landlords have received a lot of negative press coverage in the Netherlands. They are said to be hindering first-time buyers and causing higher house prices by increasingly buying up dwellings. In these articles, they are sometimes even accused of creating a new housing bubble (Couzy, 2018; Martens, 2018; Nieuwsuur, 2018; Van den Eerenbeemt, 2018). However, these articles are primarily based on opinions and feelings of first-time buyers and realtors instead of adequate research and/or facts. ING (2017) is one of the only parties who tried to study the effect of buy-to-let landlords on house prices. They focused on the rising house prices in Amsterdam and the possible determinants for these rises. One of their conclusions was that these buy-to-let landlords might indeed have an inflationary effect because of their extra demand for owner-occupied dwellings. Nevertheless, they also did not actually use inferential statistics to study the relation between buy-to-let and the house price development.

The relation between the buy-to-let market and house price development has been studied in more detail in the United Kingdom. Sprigings (2008) for example concluded that a growing buy-to-let market results in higher house prices. Other British researchers, estate agents and also landlords themselves agree that investments in the rental market contribute to higher house prices (Gibb & Nygaard, 2005; Girouard, Kennedy, Van Den Noord, & André, 2006; Hickman, Robinson, Casey, Green, & Powell, 2007).

1.2 Research objective and main research question

The main objective of this thesis is to gain more insight in one of the possible consequences of the growing Dutch buy-to-let market; the possible inflationary effect of buy-to-let investments. Although other possible consequences such as the competition with first-time buyers are also interesting to study, the focus is on these house price increases. This is because not much research has been done on this topic and because of the recent impressive house price increases. Hence, the main research question has been formulated as follows:

"What is the effect of buy-to-let investments on the Dutch regional house price development?"

1.3 Methodology

To study this possible relation between buy-to-let investments and the house price development, a quantitative dominant approach is proposed. This means that predominantly quantitative data and methods will be used to answer the main research question. Descriptive and inferential statistics will be applied to get an idea of the size and presence of the relation between the growing buy-to-let market and the recent house price increases.

Data of the Kadaster will serve as main input for these analyses. The Kadaster is the Dutch Land Registry and "collects and registers administrative and spatial data on property and the rights involved" (Kadaster, n.d.). Consequently, they have information on the Dutch housing tenure and private housing transactions. The first can be used to gain insight into the Dutch buy-to-let market while the latter can be used to study the Dutch house price development. Besides the use of the quantitative data, relevant literature will be studied to gain a greater understanding of the two separate aspects; the Dutch buy-to-let market and the Dutch house price development. Moreover, this literature will be used to reflect on the results of the quantitative research.

1.4 Relevance of the research

In this section the relevance of the research will be discussed. In subsection 1.4.1., the focus is on the scientific relevance of this study. In subsection 1.4.2, the societal relevance is evaluated.

1.4.1 Scientific relevance

Since the increase in the number of private rental dwellings and specifically buy-to-let dwellings is a relatively recent development in the Netherlands, little research has been done on this topic yet. A recent study by Aalbers, Bosma, Fernandez & Hochstenback (2018) provides some insight in the Dutch buy-to-let market, but focuses primarily on policy measures for dealing with the possible consequences of the growing buy-to-let market. It, however, does not provide a solid scientific basis for the mentioned consequences of the growing buy-to-let market. It does for example not prove that the buy-to-let market causes higher house prices. Hence, as indicated in paragraph 1.1.3, especially quantitative research on the possible relation between buy-to-let investments and the Dutch house price development is missing.

The Dutch house price development itself has been studied extensively in the past. Dutch house price models have for instance been made by De Vries (2010), Dröes & Van de Minne (2015), Francke, Vujic & Vos (2009) and Verbruggen, Kranendonk, Van Leuvensteijn & Toet (2005). Nevertheless, these house price models predominantly studied the period before the financial crisis

and/or did not comprise the possible role of buy-to-let. They focused on the role of the traditional buyers, households, and the factors that are important for them.

Last, the relation between the buy-to-let market and the house price development has been studied in more detail in other countries. For instance, Sprigings (2008) studied this relation for the United Kingdom (see chapter 2). However, since each housing market is unique in terms of regulation and other characteristics such as housing tenure, the consequences of a growing buy-to-let market will not necessarily be the same.

1.4.2 Societal relevance

As buy-to-let is currently getting more press coverage, it is increasingly a subject for debate in local governments. The municipality of Amsterdam for instance is investigating what the role of buy-to-let investors is in their city and whether policy measures need to be taken (Obbink, 2018). However, before policy measures should be implemented, it is important to know whether buy-to-let investments are indeed causing higher house prices and where this effect is occurring. It can for example be the case that this relation is only present in some municipalities.

Furthermore, since the housing market affects the broader economy and all Dutch households that own a dwelling, it is important to know which factors influence the house price development and whether buy-to-let is currently one of them. When the house price development is increasingly influenced by short-term variables, such as buy-to-let, it will become more difficult to predict the house price development. In addition, the housing market can become more vulnerable to economic shocks. This can lead to a sudden fall in housing prices (ING, 2017; Sprigings, 2008). Insight is therefore needed into the variables that drive the house price development.

1.5 Reading guide

This report is structured as follows. The next chapter, chapter 2, sets out the theoretical framework for this report by discussing the Dutch buy-to-let market and the drivers for the Dutch house price development. This chapter ends with a set of sub questions which are based on the identified knowledge gaps. In chapter 3, the quantitative methods and data for answering these sub questions are discussed. In chapters 4 and 5, several graphs and other descriptive statistics are presented to gain insight into the two separate aspects, the Dutch buy-to-let market and the Dutch house price development. Next, in chapter 6 and 7, the possible relation between these aspects and the house price models is discussed. Chapter 8 answers the sub questions and main research questions. Last, chapter 9, provides the main limitations of this study and the corresponding suggestions for further research. This last chapter also reflects on the societal relevance of the results.

2 Theoretical framework

In the Introduction the main research question has been formulated. Before the sub questions can be defined, more insight needs to be gained into the Dutch buy-to-let market and house price development. Hence the relevant academic literature has been studied. Especially literature on the Dutch and British private rental sector and the drivers for the house price development has been consulted. Using this literature review, specific knowledge gaps could be identified. These gaps form the basis for the sub questions. In addition, this literature study provides the necessary background information to understand the Dutch housing market and house price models in general.

The first section of this chapter serves as an introduction to the Dutch private rental sector. In section 2.2. the development of the Dutch private rental sector is described. Next, in section 2.3, the possible consequences of a bigger buy-to-let market on the house price development are discussed. To understand this possible impact, the fundamental and non-fundamental drivers for house price development are listed in section 2.4. In section 2.5, the motives of private investors are described. In section 2.6, the peculiarities of the Dutch housing system are discussed. Finally. in section 2.7, an overview of the knowledge gaps and the corresponding set of sub questions is provided.

2.1 An introduction to the Dutch housing market

The Dutch housing market, just as most housing markets, basically consists of the rental and the owner-occupied sector. Both sectors can be divided into different segments based on specific characteristics. For the rental sector, the height of the rent and the type of landlord are often used to break down this large sector (Jonker-Verkaart & Wassenberg, 2015). When the rent of a rental dwelling is below the deregulation limit, the rental dwelling is classified as a regulated rental dwelling. Rental dwellings with a rent above the deregulation limit are called deregulated rental dwellings. Currently, the deregulation limit is €710,68 per month (Rijksoverheid, n.d.-b). As the name already suggests, extra rules apply for the regulated rental dwellings. These rules are mainly related to the rent levels. The maximum rent for these dwellings is for instance based on the quality of the dwellings. Furthermore, the annual rent increases are limited (Rijksoverheid, n.d.-b). Besides looking at the rent levels, rental dwellings are often categorized by looking at the ownership of these dwellings. If a rental dwelling is owned by a housing association, it is called a social rental dwelling. When it is owned by a profit-oriented company, it is said to be a private rental dwelling (Jonker-Verkaart & Wassenberg, 2015). Since private rental dwellings are owned by a variety of landlords another distinction is often made between institutional investors such as pension funds and private investors (Jonker-Verkaart & Wassenberg, 2015).

Figure 2.1 shows an overview of the Dutch housing stock based on the type of ownership. It can be seen that the owner-occupied sector is currently the largest sector in the Netherlands. Regarding the rental sector, the majority of rental dwellings is owned by housing associations. According to Capital Value (2018), the majority, 83%, of the social and private rental dwellings belongs to the regulated segment. When comparing these figures with other European countries, it can be seen that the Netherlands has the largest share of social rental dwellings. This is primarily at the expense of the share of private rental dwellings. This share, 10%, is relatively low compared to other (western) European countries (Hekwolter of Hekhuis, Nijskens, & Heeringa, 2017; Whitehead, et al., 2016).

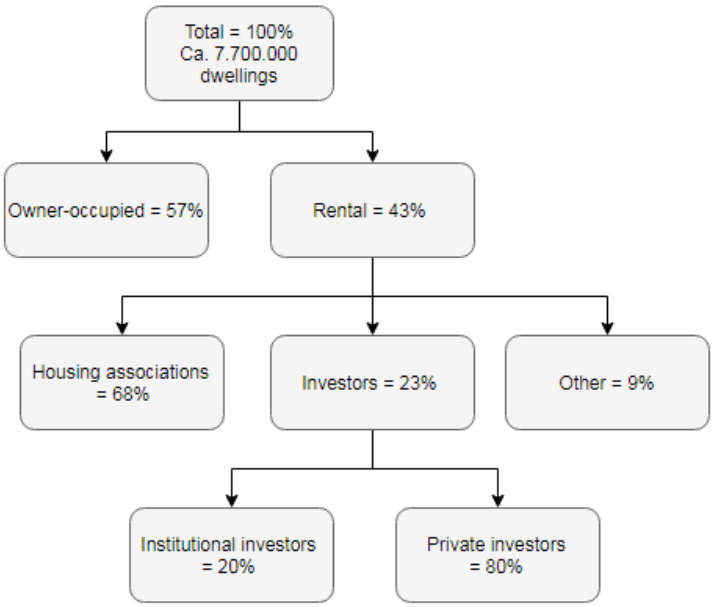

Figure 2.1 Overview of the Dutch housing stock (Source: own elaboration based on the data of Capital Value (2018))

2.2 The development of the Dutch private rental sector

In the previous section, the relatively small share of private rental dwellings (10%) has been mentioned. The share of private rental dwellings was, however, not always this low. In 1947, this share was for instance 60% (Van der Heijden, 2013). This entails that the share of private rental dwellings has decreased tremendously in the last decades. In this period, especially the number of rental dwellings owned by private persons declined (Van der Heijden, 2013). The main reason for this decrease is a change in government's policy after World War II. Since then the social rental sector has been stimulated in the form of, amongst others, lower land prices and cheap loans. The owner-occupied sector was stimulated by for example the mortgage tax relief system (Jonker-Verkaart & Wassenberg, 2015; Rouwendal, 2007; Whitehead, et al., 2016).

Despite this policy, the supply of private rental dwelling is starting to show an upwards trend again. The share of private rental dwellings has increased from 7% to 10% between 2009 and 2017 (Capital Value, 2018). This upwards trend is mainly caused by a growing demand for these dwellings. Population growth and new, more stringent, regulations regarding the allocation of social rental dwellings and mortgages can mainly explain this increasing demand (Elsinga & Lind, 2013; Hekwolter of Hekhuis, Nijskens, & Heeringa, 2017; Hoekstra, 2017; Van Middelkoop & Schilder, 2017). These factors will be discussed in more detail below.

One of the reasons for the increasing demand for private rental dwellings is a decision of the European Commission (EC) regarding the competition between private and social landlords. In 2009, the EC stated that this competition is not completely equal as housing associations receive state aid in the form of, for example, guarantees for loans and lower land prices (Elsinga & Lind, 2013). According to the EC, this state aid is not necessarily problematic but it should be used for social activities only. As a result of this decision, new regulations have come into force in the Netherlands. The main goal of these regulations is to ensure that housing associations will use the state aid for their target groups, such as low-income households, only. This means that housing associations need to split their activities between Services of General Economic Interest (SGEI) and non-SGEI. Furthermore, housing associations should focus on SGEI. Only under certain conditions they can carry out non-SGEI (Hoekstra, 2017). This has made it more challenging for housing associations to build and exploit

deregulated rental dwellings. Moreover, almost all their regulated rental dwellings should be allocated to their target group (Elsinga & Lind, 2013). This entails that it has become more difficult for households who do not belong to this target group to find a regulated rental dwelling. Since these regulations do not apply for private landlords, it can be expected that more households will start looking for private rental dwellings.

A few years later another regulation has been implemented which negatively affects both the social and private landlords. This policy measure is called the "Landlord Levy" and was introduced in 2013. Originally this levy needed to be paid by landlords who own more than 10 regulated rental dwellings, but this exemption has been expanded in 2018 to 50 regulated rental dwellings (Rijksoverheid, n.d.-a). The government advised landlords to increase their rents in order to be able to pay to this levy (Hoekstra, 2017). This levy, however, is not necessarily harmful for all landlords as most private landlords do not own more than 50 dwellings.

Although these new regulations make it less attractive for landlords to let (regulated) dwellings, it is expected that the demand for, and thereby also the supply of, rental dwellings will increase. The rise of flexible contracts and the more stringent regulations regarding the allocation of mortgages have made it more difficult for households to buy a dwelling (Hekwolter of Hekhuis, Nijskens, & Heeringa, 2017). In 2012 the law "Tijdelijke regeling hypothecair krediet" came into force which limits the maximum height of the mortgage. This maximum value depends on the household income (LTI) and the value of the dwelling (LTV). Each year the NIBUD, National Institute for Family Finance Information, adjusts the LTI criteria based on economic developments. The maximum LTV ratio will be reduced from 106% in 2012 to 100% in 2018 (NVB, 2014). This has made it more difficult for households to buy a dwelling as they can no longer use their mortgage to pay for the transaction costs.

All in all, the growing demand for (private) rental dwellings has made it more interesting for private investors to invest in rental dwellings, despite the introduction of the landlord levy (Hekwolter of Hekhuis, Nijskens, & Heeringa, 2017). This growing demand is probably also one of the main reasons for the recent increase in the share of private rental dwellings.

2.3 The possible consequences of a bigger buy-to-let market: the UK case

A bigger Dutch private rental sector might affect the wider Dutch housing market. To get an idea of the possible consequences of a bigger private rental segment, the British literature has been studied. The development of their private rental sector is broadly in line with the development of the Dutch private rental sector. Furthermore, the growth of the British private rental sector has been studied extensively.

As in the Netherlands, the British private rental sector declined drastically after World War II and this continued until the 1980s. The share of private rental dwellings dropped from 53% in 1950 to 8% in 1990 (Van der Heijden, 2013). From the 1990s on, the number of private rental dwellings, however, started to increase again. This was predominantly because of a change in government policy and changing economic conditions. This made it more attractive for investors to buy up dwellings to rent them out (Ronald & Kadi, 2017). These changes will be discussed in more detail below.

In the 1980s, when the share of British private rental dwellings was at its lowest point, the British government decided that investments in the private rental sector should be stimulated again. They still considered private rental dwellings as an important alternative to owner-occupied dwellings. Hence, they implemented new policy measures to deregulate this segment and to encourage investments (Van der Heijden, 2013). Moreover, a new type of investment mortgages, the buy-to-let mortgages, were introduced in 1996. These mortgages made it easier for private landlords to borrow

money (Kemp, 2015). Thereby, since the global financial crisis, the interest rates have been declining. This made it more profitable for private investors to borrow money and to invest this money in private rental dwellings. At the same time, the crisis made it more difficult for households to buy a dwelling. This increased the demand for rental dwellings (Whitehead, et al., 2016). All these developments contributed to an increase in the share of private rental dwellings. In 2014, the share of private rental dwellings amounted to 20% (Whitehead, et al., 2016). The number of private rental dwellings owned by reasonably small private landlords increased especially as they primarily profited from the introduction of the buy-to-let mortgages (Kemp, 2015).

Based on the above and the previous section, one could say that the development of the Dutch private rental sector broadly resembles the development of the British private rental sector. Nevertheless, it is of course questionable whether the growth of the Dutch private rental sector will continue and whether this growth will be as strong as in the United Kingdom. Because of this strong growth in the United Kingdom, several scholars have studied the possible consequences of a bigger British buy-to-let market. Since it might be possible that these effects will also occur in the Netherlands, their findings will be discussed below.

Sprigings (2008) is one of these scholars who studied the possible consequences of the growing private rental sector and the growing buy-to-let market specifically. He argues that the growing buy-to-let market resulted in a steep, possibly unsustainable, increase in house prices. In addition, the prices became more unpredictable. This predictability decreased because the house prices became less connected to fundamental drivers such as household incomes. Furthermore, it has become harder for first-time buyers to buy a dwelling due to the rising house prices and the declining home-ownership stock. In another article of Sprigings (2013), he again argues that other fundamental drivers need to be considered to understand the recent house price increases. Instead of solely considering drivers that are related to owner-occupiers, drivers that are relevant to landlords should also be taken into account.

Other researchers, estate agents, and also landlords themselves agree that investments in the rental market contribute to higher house prices (Gibb & Nygaard, 2005; Girouard, Kennedy, Van Den Noord, & André, 2006; Hickman, Robinson, Casey, Green, & Powell, 2007). While researchers acknowledge that buy-to-let investments have an influence on the house price, they, however, do not all agree on the size of the this effect and the importance of this market (NHPAU, 2008). According to them, the house price increases in the UK are still mainly caused by changes in the fundamental drivers.

Nevertheless, the research of NHPAU (2008) focused on the national house price indexes. It has, however, been shown that buy-to-let landlords are especially active in the south of the UK and particularly in London (Leyshon & French, 2009). Furthermore, private landlords tend to invest in relatively cheap apartments (Gibb & Nygaard, 2005). As a result, it is conceivable that these private landlords have a destabilizing effect on specific local housing markets, but detailed regional data was not available to study the house price development for specific segments. More research is therefore needed to understand their effect (Gibb & Nygaard, 2005; Girouard, Kennedy, Van Den Noord, & André, 2006; Lambert & Boddy, 2010).

Last, it is not necessarily the case that the consequences of buy-to-let landlords will be the same in the UK and the Netherlands. The British housing system and specifically the private rental sector is different from the Dutch system. Several contextual factors such as the regulatory framework are different for both countries (Whitehead, et al., 2016). Partly because of that, the role of buy-to-let mortgages is noticeably smaller in the Netherlands (Van Leeuwen & De Vries, 2016). On the other hand, the introduction of buy-to-let mortgages was important for the development of the British

private rental sector and still almost 50% of the British private rental dwellings is purchased using such a mortgage (Scanlon & Whitehead, 2016). Another difference is related to the regulation of rents. In the Netherlands, this regulation is strong and applies to both social and private landlords. Consequently, the gap between the average private and social rent is relatively low as most private rental dwellings belong to the regulated segment (Capital Value, 2018; Whitehead, et al., 2016). In the UK, the rents are market-based and this results in a big gap between the average private and social rent. The height of the rents influences the rental income of the private landlords and thereby the profitability of the investment. Another difference to consider is the selling behaviour in both countries. In the UK, apartments are usually sold separately whilst in the Netherlands, and also in other European countries, blocks of apartments are often sold together (Whitehead, et al., 2016). In the latter case, these apartments were never offered to households. It might therefore be expected that these transactions will have a smaller effect on the house price development.

2.4 House price development and fundamental drivers

In the previous section, the term "fundamental drivers" has been mentioned a few times without exactly defining this term. Since this is an important notion, more attention will be paid to this aspect here. Fundamental drivers or the underlying determinants are the factors that determine the house prices in the short-, medium- and/or long-term. As in most competitive markets, the price is the reflection of supply and demand. Hence these determinants either influence the demand for or the supply of dwellings (De Vries, 2010; Haffner & De Vries, 2009). The institutional setting of a country largely determines which factors influence the house price (Tsatsaronis & Zhu, 2004; Tu, De Haan, & Boelhouwer, 2017).

The Dutch housing market is strongly regulated. It is therefore not really a competitive market. Especially the housing supply is relatively inelastic as a result of restrictive spatial planning laws (Tu, De Haan, & Boelhouwer, 2017). This makes it difficult to quickly expand the housing stock. As a result, the Dutch housing market is often considered a stock market. This means that the price of newly built dwellings is primarily determined by the price of existing dwellings and not by supply variables such as construction costs (Haffner & De Vries, 2009). The Dutch housing market can therefore be characterized as a demand-oriented market. Most relevant drivers influence the demand for dwellings (Tu, De Haan, & Boelhouwer, 2017). An overview of these drivers for the Dutch house price will be provided below. Nonetheless, this list is not exhaustive and other factors can play a role. When making this selection, the most often mentioned drivers and the drivers linked to the Dutch housing market have been chosen. In figure 2.2, an overview of all these drivers and their expected effect on the house price is shown.

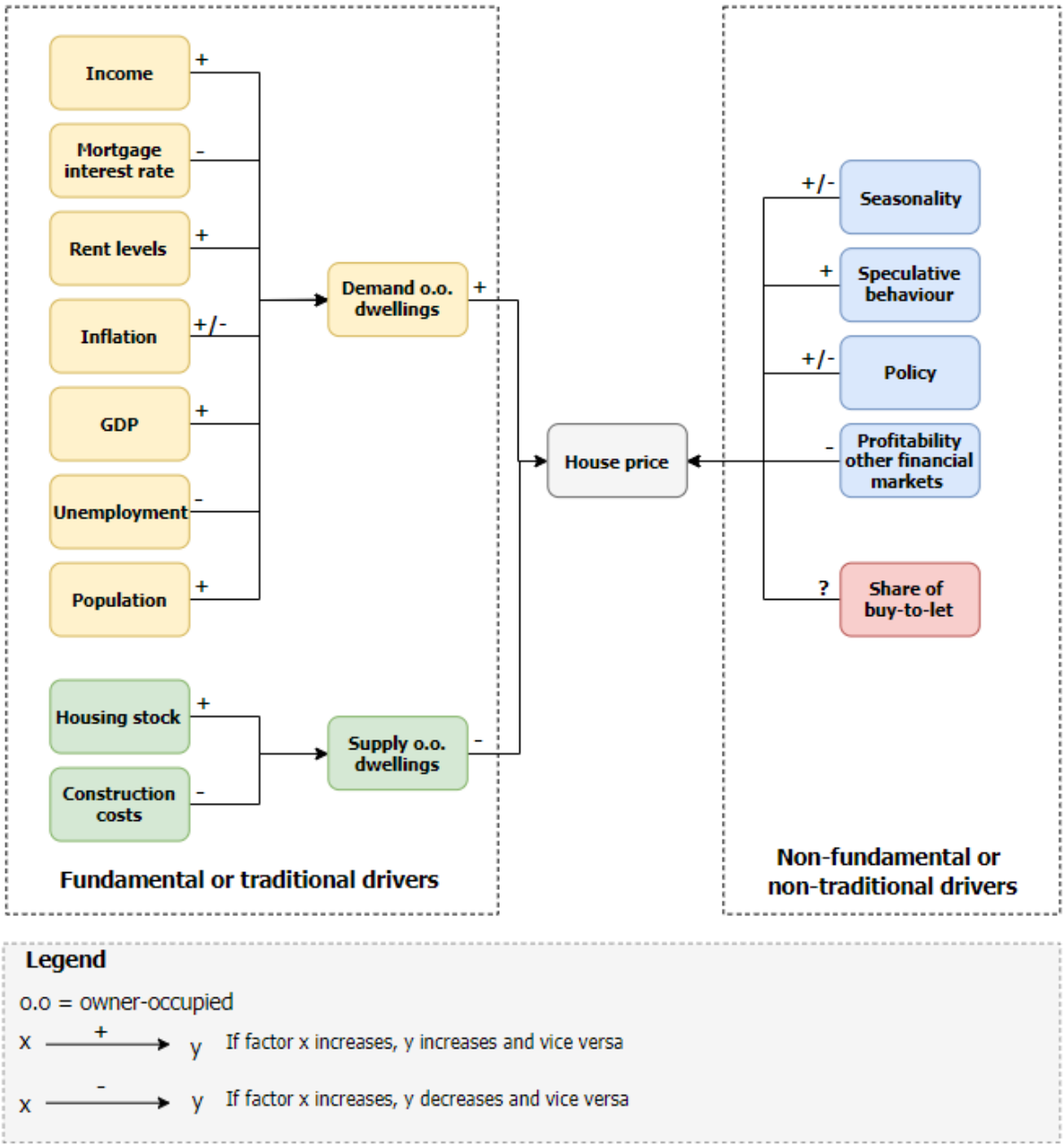

Figure 2.2 An overview of the drivers found in the literature and their effect on the house price development

Income or income growth is one of the most important drivers that influences the demand for dwellings (De Vries, 2010; Girouard, Kennedy, Van Den Noord, & André, 2006). In the case of income growth, households can get a higher mortgage which results in higher house prices. On the other hand, if there is a decline in income, it is more challenging for households to buy a dwelling. As a result, the demand will decrease and thereby also the house prices (Girouard, Kennedy, Van Den Noord, & André, 2006). The (house) price-to-income ratio is often used as an indicator for the affordability of dwellings. Another important driver, related to the affordability of dwellings, is the mortgage interest rate. When this rate increases, the interest payments increase and this has a negative effect on the house price (NHPAU, 2008). Sometimes researchers also compare these interest payments to income (De Vries, 2010; ING, 2017). It has been shown that this interest-to-income rate is a good indicator for the Dutch house price index in the long term, because it incorporates the household income, the interest rate and the Dutch mortgage tax relief system (Tu, De Haan, & Boelhouwer, 2017).

The above drivers, income and the mortgage interest rate, are related to the affordability of dwellings. Another often considered aspect is the competition between the owner-occupied and rental sector. The price-to-rent ratio is a driver that tries to reflect this competition. It is assumed that if the house prices increase faster than the rents, potential buyers will tend to rent instead of buy a dwelling. This will result in a lower demand for owner-occupied dwellings and thus lower prices (Girouard, Kennedy, Van Den Noord, & André, 2006; Hekwolter of Hekhuis, Nijskens, & Heeringa, 2017). Nevertheless, because of the regulated character of the Dutch rental sector, rents are often not included in Dutch house price models or not found to be an important driver (Verbruggen, Kranendonk, Van Leuvensteijn, & Toet, 2005). Another factor is the population growth. If the population is growing, the demand for dwellings will increase and thereby most likely also the house prices. This is especially the case if the supply is fixed in the short term (Dröes & Van De Minne, 2015).

An important macroeconomic variable is inflation. This variable is not always directly included in the models, but used to deflate all other price related variables. These price related variables are for instance the house price index, income growth and interest rates (Dröes & Van De Minne, 2015). However, it is possible that inflation still plays a role if all the prices are adjusted. Tu et al. (2017), for instance found a positive relation between inflation and real house prices in the long term. Different arguments can be used to explain this positive relation. One of these arguments is that households want to invest their savings in dwellings in the case of high inflation rates in order to hedge against the risk that further inflation might negatively affect their wealth in the future (Tsatsaronis & Zhu, 2004). Tu et al. (2017), however, thought that this positive relation could best be explained by the user-cost view. This implicates that a high inflation rate lowers the cost of owning a dwelling and thereby stimulates the demand for owner-occupied dwellings. Nevertheless, other studies have also found a negative relation between inflation and house prices. This was explained by the higher costs for mortgages in the beginning years (Tsatsaronis & Zhu, 2004).

Other macroeconomic variables that are sometimes included in house price models are the gross domestic product (GDP) and unemployment (Brounen & Huij, 2004; Timmermans, 2012; Van der Windt, 2015). If the economy is doing well and the gross domestic product is increasing and unemployment is falling, it is expected that the house prices will increase. These variables affect the household income and also the consumer confidence in the housing market.

Last, although the supply of dwellings is relatively fixed, the change in the housing stock and construction costs are sometimes included in the models. An increase in the housing stock is expected to have a negative effect on the house price and an increase in the construction costs is expected to have a positive effect on the house price (Dröes & Van De Minne, 2015; NHPAU, 2008).

The above mentioned factors are often considered fundamental drivers as these drivers determine the house price in the long term (De Vries, 2010; Tu, De Haan, & Boelhouwer, 2017). However, in most models also “softer” factors are included. These softer factors can sometimes better explain the changes in the short term. Two examples of these factors are seasonality and speculation. It has for instance been shown that most houses are being sold in the second quarter which results in higher house prices (NHPAU, 2008). This can partly be explained by the preference of especially parents to buy a dwelling in the summer holiday (Hale, 2012).

Regarding the speculative effects, households and investors will want to buy quickly in the case of price increases in the hope that they can profit from future price increases. This results in extra price increases. These might convince other people to buy a (new) dwelling as well (De Vries, 2010). These expectations are, however, not always valid and often based on the gut feeling of people (Shiller,

2007). Since these speculative effects can have a large effect on the house price development in the short term, a variable is often created to include this effect. This is mostly done by including the house price development of the previous period (De Vries, 2010).

Last, changes in policy should sometimes be considered. These can, depending on the contents, have a significant effect on the house price development in the short, medium and sometimes even long term. Timmermans (2012) for instance found that the lowering of the LTV ratio will likely have a negative effect on the house prices in the short-term, but it is expected that the house prices will slowly recover in the long term.

In the case of strong price increases, people sometimes start talking about the development of a housing bubble. Nonetheless, it is important to make a distinction between a sharp price increase and a bubble, since the consequences can be quite different. The main difference between a bubble and an ordinary price increase is that the former cannot be explained by changes in the fundamentals (Haffner & De Vries, 2009). Thus when a bubble is being created, the house price increase is not caused by for example income growth, but by the speculative behaviour of people. Such a bubble can suddenly burst and this may result in falling house prices (Shiller, 2007). These declines might end when the house price development is again in line with the changes in the fundamentals, but the prices might also continue to decline. This overshooting is again caused by the speculative behaviour of people. If people are pessimistic about the future house prices, the demand will fall and this will result in decreasing prices (Haffner & De Vries, 2009). Whether a market is susceptible to the development of bubbles depends on the elasticity of supply. When the supply is relatively inelastic, the role of fundamentals is shown to be less strong (Haffner & De Vries, 2009). Since this is the case for the Netherlands, both speculative behaviour and fundamental drivers should be considered when explaining the house price development.

Furthermore, before a house price increase can be characterized as a housing bubble, the changing role of fundamentals should be considered. Dröes and Van De Minne (2015) have shown that the importance of certain determinants can change over time and that new determinants can start playing a role. By studying the determinants for the house price development in Amsterdam from 1825 onwards, they for instance found that supply variables such as the housing supply and construction costs were important in the 19th century. Yet from the 1970s onwards, these variables were no longer the most factors and the demand variables such as income and interest rates became dominant. Thereby, they have shown that the Dutch housing market was not always a demand-oriented market, but that it slowly changed from a supply-oriented towards a demand-oriented market.

In the future, these fundamentals and their relative influence are likely to keep changing. As mentioned in section 2.3, Sprigings (2013) indicated that some fundamentals, such as household income, have already become less important in the UK. This is caused by the decreasing influence of first-time buyers and the increasing influence of private landlords. For private landlords, other variables determine how much they can or want to offer for a dwelling. Recently the ING (2017) studied the drivers for the house price dynamics in Amsterdam. They also included some new variables, such as the influence of AirBnB and private investors, to check whether these variables are indeed gaining importance. They concluded that long-term fundamentals such as income growth and the mortgage interest rate are pointing towards more moderate price rises. Especially the speculative behaviour of people and the role of investors are currently driving up the prices. This shows that the speculative behaviour of people is a variable that should be considered. It also indicates that it might be relevant to include new variables. Furthermore, the observation that the house price in Amsterdam is being

increasingly determined by short-term variables, might be a worrying observation as this makes the market more sensitive to shocks. People are currently expecting that the prices will continue to increase and due to their expectations, the prices continue to increase. Nevertheless, the past has shown that these expectations can quickly change (Hekwolter of Hekhuis, Nijskens, & Heeringa, 2017; ING, 2017). This can result in significant price drops as explained above. The increasing sensitivity to shocks can also be a consequence of the rise of private investors. Since private investors want to buy a dwelling in Amsterdam to profit from the rising prices and the high demand for rental dwellings, they likely contribute to the higher prices. Despite the high prices, the yields are still high in comparison to other investment markets. When other markets, however, become more profitable, it is possible that some investors will leave the housing market (ING, 2017). This shows the possible dangerous role of investors. They can have a destabilizing effect on the housing market by increasing the demand in economic good times and decreasing the demand in economic bad times (Kemp, 2015; Scanlon & Whitehead, 2016).

2.5 The motives of private investors

The previous section ended with the possible influence of private investors on the housing market and their potential strategy. This strategy entailed that the investment decisions of private landlords depend on the relative height of the residential property yield. In other words, if other investments are more profitable, private investors will possibly move their money from the housing market to these markets. Whether investors will actually do this depends on their motives for investing in residential property. These motives will therefore be discussed below. Since little research is done on the motives of Dutch landlords, the motives are primarily based on British research and thus related to the behaviour of British landlords.

The motives of British private landlords have most recently been studied by Scanlon and Whitehead (2016). They found that the majority of landlords, more than 90%, regarded their rental activities as a part-time job. Landlords mainly saw this as a profitable investment because of the (expected) capital growth and rental income, and/or a contribution to their pension. A smaller group invested in residential property just for the rental income or just for capital growth. Some persons became a landlord to house family or because they were unwillingly unable to sell their dwelling(s).

Most of these motives have also been mentioned in other studies and a classification of different types of investors has sometimes been made. Rhodes and Bevan (2003) made the basic distinction between small-scale part-time and large-scale fulltime landlords. They found that the majority of part-time landlords were active in this market to build up a pension. However, they were also interested in the residential property market, because this market performed better than the stock market in terms of yield and risk. The fulltime landlords, on the other hand, were predominantly interested in the rental income and regarded the capital growth as a nice side effect that could be used to acquire new property. Lambert and Boddy (2010) added another group of landlords to this distinction: the speculative investors. These are counting on capital growth and are not interested in the rental income. These landlords are actually not really landlords but just investors as they are not letting out their dwellings (Hickman, Robinson, Casey, Green, & Powell, 2007).

This last category is, however, in the minority as less than 5% of the British landlords belongs to this group (Scanlon & Whitehead, 2016). The majority of the private landlords is in it for the medium to long term. They are investing in this market because the future profits of alternative investments are expected to be lower and they regard it as a good way to build up their pension (Gibb & Nygaard, 2005). The relative attractiveness of the residential property market in the UK can primarily be

explained by the poor performance of other markets (Kemp, 2015). Since 2000 the returns on the stock market, bank deposits and pension savings have been relatively low. The poor performance of other investments is potentially also one of the main reasons why private investors are investing in the Dutch residential property market. Jonker-Verkaart and Wassenberg (2015) indeed mention that the yield compared to the risk is relatively attractive. Consequently, investing in this market is regarded as a good hedge against inflation.

2.6 The differences within the Netherlands

In the previous section, the motives for investing in the residential property market have been discussed. Nevertheless, when this market appears to be attractive, investors will not just randomly buy a dwelling. They will have a certain preference for a region and/or segment. British private landlords are for instance especially active in the south of the UK and particularly in London (Leyshon & French, 2009). In addition, they primarily own rental dwellings in the region where they live and/or adjacent regions. They also tend to invest in relatively cheap apartments or terraced houses (Gibb & Nygaard, 2005; Scanlon & Whitehead, 2016). These preferences are also found in a comparative study of Whitehead et al. (2016). They compared the private rental sector of Denmark, England, Germany and the Netherlands. In all these countries the share of private rental dwellings is the highest in large cities, such as Amsterdam, and the majority of these dwellings is an apartment. It is expected that the influence of private investors on the house price dynamics will be lower in regions in which private investors are less active.

The fact that private investors are more interested in certain regions might also be related to the regional character of the Dutch housing market (Van Middelkoop & Schilder, 2017). The recent price increases are for instance stronger in the four big cities (Amsterdam, The Hague, Rotterdam & Utrecht) and other relatively large cities, such as Groningen and Eindhoven (Hekwolter of Hekhuis, Nijskens, & Heeringa, 2017). These higher house prices are a result of the increasing attractiveness of living in cities and this is fuelling the demand. The cities that are especially popular have a high availability of jobs and amenities, such as a university and a wide variety of restaurants and museums (Garretsen & Marlet, 2017). These cities are also popular by immigrants and in particular highly educated immigrants (Hekwolter of Hekhuis, Nijskens, & Heeringa, 2017). As a result, the house prices are increasing at a higher rate in cities. Consequently, other households, especially families, are leaving these cities and are moving to neighbouring areas. The high house prices in comparison to the size of the dwellings is one of the main reasons for leaving the city for these households. The above developments have resulted in the fact that the house price increases are the strongest in cities, next the surrounding areas and the house price increases are the weakest in the shrinkage areas or “krimpgebieden” (Hekwolter of Hekhuis, Nijskens, & Heeringa, 2017).

2.7 Conclusion: the knowledge gaps and set of sub questions

In this chapter, the Dutch and British private rental sector have been discussed. It has been shown that the development of the Dutch private rental sector is, to a certain extent, in line with the British private rental sector. Based on this comparison, it might be the case that a bigger private rental market has some effects on the wider housing market. One of these possible consequences is related to the house price development. A growing private rental market might result in extra house price increases. This means that other drivers besides the fundamental drivers might be gaining importance. It is important to know which factors have caused the recent house price increases as some factors might have a destabilizing effect on the housing market. When studying these consequences, it is essential to

consider the regional character of the housing market and the preferences of private landlords. These consequences have not been properly studied yet in the Netherlands. Therefore more research is needed to study the relation between the presence of private investors and the house price development.

In this research, the focus will specifically be on small non-institutional private landlords, the buy-to-let landlords. These landlords are especially buying up owner-occupied dwellings to let them out. This focus has been chosen because the motives of these landlords are different from the fulltime private landlords (see Section 2.5). Because of these different motives, the effect of these relatively small landlords on the house price will probably be different. Furthermore, the share of these buy-to-let landlords is higher than the share of the institutional landlords in both the Netherlands and the UK. This makes it more interesting to focus on this group.

Based on the literature study and the identified knowledge gaps, it is possible to formulate the set of sub questions. These are based on the main research question as formulated in the previous chapter: *"What is the effect of buy-to-let investments on the Dutch regional house price development?"*

This has resulted in the following sub questions:

1. *What are the characteristics of the Dutch buy-to-let market?*

   First more insight needs to be gained in the size of this market and the specific interests of the buy-to-let landlords. In which regions are they for instance particularly active and what type of dwellings do they mainly own. This makes it possible to define buy-to-let landlords; when is a private landlord a buy-to-let landlord?
2. *What does the house price development look like for the Netherlands in general and is the house price development different for municipalities with a relatively high share of buy-to-let dwellings?*

   Before studying the drivers for the house price development, the house price development for the last years will be shown and described. Furthermore, based on sub question 1, three different municipalities will be chosen. The share of buy-to-let dwellings will be different in each municipality and the house price development for these specific municipalities will also be included.
3. *Which fundamental or traditional drivers can explain the house price development on a regional level and do these drivers vary between regions?*

   A house price model will be made for the three different regions. This makes it possible to test which factors can explain the changes in the house price development. By comparing the results of these different models, it can be seen whether these drivers are different for the three municipalities.
4. *Which drivers related to speculation and policy, such as the presence of buy-to-let, can explain the house price development on a regional level and do these drivers vary between regions?*

   Besides including the fundamental drivers in the regional house price models, other drivers such as the speculative behaviour of people and the presence of buy-to-let will be included. By doing this, it can be checked whether these drivers also played a role in the house price development for the different municipalities. Furthermore, the specific relation between buy-to-let and the house price development will be studied.

3 Methodology

The previous chapter ended with the set of sub questions. In this chapter, the methods and data sources that will be used to answer these sub questions will be discussed. As indicated in the Introduction, a quantitative approach has been chosen and mainly statistical methods will be applied. Statistical methods can be divided into descriptive statistics and inferential statistics (Mann & Lacke, 2010). Descriptive statistics are used to answer the first two sub questions and inferential statistics are predominantly used to answer the other two sub questions. This distinction has been used to structure this chapter. In section 3.1, the methods and data sources for the first two sub questions will be discussed. In section 3.2, the methods and data sources for the other two sub questions will be reviewed.

3.1 Method and data sources for the first two sub questions

In this section, the methodology for the first two sub questions will be discussed. These sub questions are defined as follows:

1. *What are the characteristics of the Dutch buy-to-let market?*
2. *What does the house price development look like for the Netherlands in general and is the house price development different for municipalities with a relatively high share of buy-to-let dwellings?*

For these sub questions, descriptive statistics will be used to show and summarize the data. Since the use of descriptive statistics is relatively straightforward and does not involve the testing of statistical hypotheses, these methods will not be discussed in detail. Nevertheless, attention will be paid to the data that is needed to conduct these analyses.

For the first sub question, primarily data of the Kadaster will be used. The Kadaster is the Dutch Land Registry and "collects and registers administrative and spatial data on property and the rights involved" (Kadaster, n.d.). Since they collect and register all this data, different datasets can be created. One of these datasets is a dataset with the Dutch housing stock. This dataset is based on the "Basisregistratie Adressen en Gebouwen" (BAG) and contains information on all the registered dwellings in the Netherlands. Per dwelling, information such as the floor area, location and type of owner is available. More information on this dataset, including a list of attributes, can be found in appendix A. This dataset will also be connected to data from the CBS, Statistics Netherlands. This makes it possible to attach neighbourhood information to the dwellings. Because the Kadaster dataset contains information on all the 7,7 million dwellings in the Netherlands, Excel cannot be used to directly analyse this data. Hence first Access will be used to categorize and edit the data after which Excel can be used to visualise the results.

The data of the Kadaster will also be used to answer sub question 2. Since the Kadaster records the transfers of ownership, it has information on the transactions of dwellings and other objects. This information can be used to study the Dutch house price development as information on the transaction price, transaction date and dwelling is available. More information on this dataset and the attributes can be found in appendix A. Because the transaction prices are in nominal terms, the Consumer Price Index of the CBS will be used to deflate these transaction prices to study the house price development in real terms. Besides studying the national house price development, the regional house price development will be studied. The results of sub question 1 will be used to select specific municipalities. Each municipality will have a different share of buy-to-let dwellings. This makes it

possible to see whether the house price development is different for municipalities with a low, medium or high share of buy-to-let dwellings.

3.2 Method and data sources for the last two sub questions

In this paragraph, the methodology for the last two sub questions will be discussed. These sub questions are defined as follows:

3. *Which fundamental or traditional drivers can explain the house price development on a regional level and do these drivers vary between regions?*
4. *Which drivers related to speculation and policy, such as the presence of buy-to-let, can explain the house price development on a regional level and do these drivers vary between regions?*

Several house price models will be made to answer these two sub questions. These models will be made by using linear regression. This approach makes it possible to model the relationship between the house price development and the different drivers. For the last sub question, also the correlation between buy-to-let investments and the house price development will be checked. Since this is a relatively straightforward technique, this method will not be discussed in this section. First, the data for the linear regression will be discussed in subsection 3.2.1. Some of this data will be used to check the correlation between buy-to-let and house price development. Next, in subsection 3.2.2, the linear regression and house price models will be discussed in more detail.

3.2.1 Data

Dependent variable: house price

Based on the results of sub question 1, three municipalities will be chosen. Each municipality has a different share of buy-to-let dwellings. The house price development of these municipalities will be studied in more detail for these two sub questions. The house price development for the period 2006Q1 to 2017Q4 will be analysed. This period is chosen because the buy-to-let market has been increasing in the past few years. Furthermore, since 2006 more information is available on the Dutch housing transactions. The house price development will be studied on a quarterly basis to make sure that enough observations are available to use linear regression.

The house price development for the three municipalities will be obtained from the same dataset as the dataset used for sub question 2. Nevertheless, several steps will need to be taken to get a good house price index for each municipality. First, the nominal transaction prices will be changed into real transaction prices. The CBS figures on the consumer price index (2015=100) will be used to deflate the individual transaction prices. Since the specific transaction date is known, the monthly consumer price index can be used. Moreover, steps need to be taken to make sure that the average transaction prices for each period reflect the actual house price development. The quality of the dwellings sold is different for each period. This can result in a biased house price index (Bailey, Muth, & Nourse, 1963). To prevent a biased house price index, the house price development for a specific group of dwellings will be studied. Both attributes of the dwelling and the neighbourhood will be used to select similar dwellings. It is expected that these measures result in smaller quality differences between periods. This will result in a better house price index. The house price development is not only affected by the quality of the dwellings sold, but it is also seasonally affected (NHPAU, 2008; Van der Windt, 2015). It has been decided to smooth out both fluctuations by using the moving average. By using the moving average of four quarters, the seasonal effect will be reduced and peaks that might still be caused by quality differences will be smoothed out. The house price for a specific quarter will

be determined by taking the average of the average house price in the previous quarter, the actual quarter and next two quarters. Each period is given equal weight.

Independent variables: the drivers

Based on the literature study in chapter 2 (see figure 2.2), different fundamental and non-fundamental drivers have been selected. These will be tested in the house price models. The following drivers have been chosen: inflation, mortgage interest rate, unemployment, income, population, housing stock, speculative behaviour, policy, profitability other financial markets and the share of buy-to-let.

This entails that the rent levels, construction costs and GDP are not included in the model. The rent levels have not been included because no reliable data on the rent levels for the three municipalities could be found. Furthermore, the rent levels are mostly not included in Dutch house price models because of the regulated character of the Dutch rental sector (Verbruggen, Kranendonk, Van Leuvensteijn, & Toet, 2005) When Verbruggen et al. (2005) included this variable in their model it did not have the theoretically correct sign. They therefore excluded this variable from their model. Regarding the construction costs, this variable is not included because the study of Dröes and Van de Minne (2015) indicated that construction costs are no longer an important variable in house price models. This is also the reason that Verbruggen et al. (2005) did not include this variable in their model. Last, the gross domestic product or gross regional product is not included because the CBS only provides data on this variable on the COROP level and on an annual basis. Furthermore, it does not provide the value of the gross regional product but only the changes in volume. When studying these numbers, it became clear that these numbers fluctuated considerably between years. This makes it difficult to interpolate this data. Another reason for not using this data is that the COROP regions are relatively large. Hence, it is expected that these numbers do not correctly reflect the economic conditions in the specific municipalities. Last, the gross domestic/regional product is often not included in house price models because it makes more sense to incorporate the household income or another income measure to reflect the economic conditions for buying a house (Van der Windt, 2015; Verbruggen, Kranendonk, Van Leuvensteijn, & Toet, 2005).

Next, the variables that will be tested in the model will be shortly discussed. An overview of these variables is provided in table 3.1.

Table 3.1 The variables that will be tested in the model

Variable	Description
HP_t	Ln average nominal house price – ln CPI
P_t	Inflation
I_t	Nominal mortgage interest rate - inflation
Y_t	Ln nominal disposable household income – ln CPI
U_t	Ln unemployment rate
HH_t	Ln number of households
$LTV1_t$	Dummy variable for max. LTV ratio (2006-2011 = 0, 2012 = 1, 2013 = 0,75, 2014 = 0,50, 2015 = 0,25, 2016-2017 = 0)
$LTV2_t$	Dummy variable for max. LTV ratio (2006-2011 = 0, 2012-2017 =1)
S_t	Ln housing stock
B_t	Nominal interest rate Dutch 10 year government bonds - inflation
BTL_t	Increase in BTL dwellings divided by the number of transactions

One of the most important variables is inflation. This variable will be included in the model by using the Consumer Price Index of the CBS. The year-on-year changes of this index are used to calculate the inflation. The Consumer Price Index is used to deflate all the price related nominal variables and the inflation is used to deflate the interest rates. The CBS provides this index on a monthly basis. To get the quarterly figures, the average is taken of the three monthly figures. The mortgage interest rate is obtained from the DNB, the Dutch Central Bank, and is available on a quarterly basis. The mortgage interest rate for new contracts with a 5 to 10 year fixed mortgage will be used. This type of mortgage has been chosen, because these mortgages have been issued the most in the period 2006-2017 (DNB, n.d.).

Information on the unemployment rate is obtained from the CBS. They provide this data on the municipal level and on an annual basis. To get quarterly data, the unemployment rates are interpolated. The population growth is also provided by the CBS on an annual frequency for the three municipalities. It has been chosen to include the development of the number of households instead of the number of individuals, because this demographic variable is most relevant for the house price development. These figures are interpolated to get quarterly data. To incorporate the income development in the model, CBS data on the average disposable household incomes has been used. The CBS provides this information for the period 2005-2014 on a yearly basis on the municipal level. These numbers have been extrapolated by using the national income growth percentages. Next, the yearly numbers are interpolated to get the quarterly figures. Last, the CBS data is used to get the development of the housing stock. For 2006-2011, these figures are provided on an annual basis. From 2012 on, these figures are available on a quarterly basis. The figures for 2006-2011 are therefore interpolated and added to the quarterly figures from 2012 on.

To incorporate the speculative behaviour in the model, no external data needs to be used. The house price development of the previous quarter will be used to include this type of behaviour in the model. Several steps need to be taken to include the possible influence of policy measures. During the period under study, the law “Tijdelijke regeling hypothecair krediet” came into force which limits the maximum height of mortgages. The maximum LTV-ratio has been reduced from 106% in 2012 to 101% in 2017 (NVB, 2014). This might have impacted the house price development. Therefore two different dummy variable will be created to test the influence of this measure. Regarding the first dummy variable, the variable is 0 for the period 2006-2011, 1 for 2012, after which the value diminished with 0,25 every year till it reaches zero in 2016. This entails that it is expected that the impact of this measure has decreased over time. For the other dummy variable, the variable is 0 for the period 2006-2011 and 1 for the period 2012-2017. For this dummy variable, it is assumed that the impact of the measure has remained constant.

Regarding the profitability of other financial markets, it has been decided to include the interest rate for Dutch 10 year government bonds. Based on section 2.6, it can be concluded that most landlords are in it for the medium to long term. They have switched to the residential property market because of the attractive yield/risk combination. Since the interest rate on the 10 year government bonds partially reflects the yield on other relatively low risk markets, this rate will be included to model the profitability on comparative markets. These interest rates are obtained from the DNB and are available on a monthly basis. The average of three months has been taken to get the quarterly numbers. Another variable that more directly reflects the presence of buy-to-let landlords, is the increase in the number of the buy-to-let dwellings in the municipalities. This variable is obtained from a new dataset of the Kadaster and is available on a quarterly basis. To get the relative growth, the

increase in the number of buy-to-let dwellings is divided by the number of private transactions for the specific period.

All the variables, except the percentages, are denoted in natural logarithms (ln). This is done because (small) changes in the natural logarithm of a variable can be interpreted as percentage changes. This makes it easier to work with the data and interpret the results. Consequently most researchers make use of the natural log transformation when making a house price model (NHPAU, 2008; Tu, De Haan, & Boelhouwer, 2017; Verbruggen, Kranendonk, Van Leuvensteijn, & Toet, 2005) .

3.2.2 House price models and linear regression

The goal of this master thesis is to gain insight into the drivers for the house price development. This entails that the relation between independent variables and one dependent variable needs to be studied. A regression analysis is the most appropriate method to study these relations. Most researchers who study the house price development do not use a simple regression model, but use a two-step approach (Francke, Vujic, & Vos, 2009; Verbruggen, Kranendonk, Van Leuvensteijn, & Toet, 2005). They use an error-correction model in which they first make a long-term model and next a short-term model. This approach is often preferred for house price models, because of the stock character of the Dutch housing market. It is assumed that in the long-term, the house price fluctuates around an equilibrium, while in the short-run the house price development deviates from this equilibrium due to the peculiarities of the housing market (Francke, Vujic, & Vos, 2009).

For the long-term model, an OLS regression model is made in which the real house price is the dependent variable and the fundamental drivers, such as the real household income and real mortgage interest rate, are the dependent variables. This relation is shown in equation 1:

$$(1) \quad HP_t = \beta_0 + \beta_k x_{k,t}$$

In this equation, HP_t is the real house price, the β's are the parameters and the x's represent the fundamental drivers. Although this model is called a long-term model, it will, in this case, actually be more a medium-term model. The period 2006-2017 is relatively short when you consider the average lifespan of a dwelling (Verbruggen, Kranendonk, Van Leuvensteijn, & Toet, 2005).

Based on the above equation, a short-term model can be estimated by using an OLS regression analysis. In the short-term model, the changes in the real house price are the dependent variable and all the fundamental and non-fundamental variables will be tested as independent variables. Furthermore, the deviation from the long-term equilibrium, also called the error correction term, is included. This relationship is shown in equation 2:

$$(2) \quad \Delta HP_t = \beta_0 + \beta_1 \Delta HP_{t-1} + \beta_2 (HP_{t-1} - HP^*_{t-1}) + \beta_k \Delta x_{k,t}$$

In this equation, ΔHP_t is the change in the real house price, the β's are the parameters, the Δx's represent the changes in the fundamental and non-fundamental drivers, ΔHP_{t-1} is the variable for the speculative behaviour and ($HP_{t-1} - HP^*_{t-1}$) is the error correction term. Francke et al. (2009) also call ΔHP_{t-1} the bubble builder and ($HP_{t-1} - HP^*_{t-1}$) the bubble burster. The first variable can create a model in which the prices keep on increasing or declining. The latter variable makes sure that the prices will return to the equilibrium.

To compute a good error-correction model, several conditions have to be met (Francke, Vujic, & Vos, 2009; Timmermans, 2012; Van der Windt, 2015). First, HP_t and the x's should be integrated of order 1. This entails that the development of these variables can be non-stationary but that the development of the first difference (ΔHP_t and Δx's) should be stationary. Furthermore, the development of ($HP_{t-1} - HP^*_{t-1}$) also has to be stationary because this implies that there is a co-integrating relation between the fundamental drivers and the house price development. If the error-correction term is non-stationary, the output cannot be normally interpreted. The Augmented Dickey Fuller test will be used to test whether the variables have a unit root (non-stationary). The same test needs to be conducted for the short-term model. The residuals of the short-term model need to be stationary in order to conclude that there exists a co-integrating relation between the drivers and the house price development.

Multicollinearity also needs to be avoided (De Vocht, 2010). Multicollinearity entails that several independent variables are highly correlated with each other. As a result, these variables measure roughly the same and only one of these variables should be included in the model. When the absolute value of correlation coefficient for two variables is higher than 0,9, one of the two variables should be excluded.

Last, for a multiple regression model in general, the residuals should be carefully studied (De Vocht, 2010). They should for example be tested for autocorrelation or serial correlation as the presence of autocorrelation can result in an underestimation of the standard errors. The Durbin Watson test can be used to check for autocorrelation. The Durbin Watson lies between 0 and 4 and a value of 2 indicates that there is no autocorrelation. Furthermore, the residuals should be normally distributed and homoscedastic. The latter means that the variance is homogeneous or constant.

If the conditions regarding the co-integration are not met than only a short-term regression model can be estimated. This entails that the equation changes and that the error-correction term is not included. This is shown in equation 3:

$$(3) \quad \Delta HP_t = \beta_0 + \beta_1 \Delta HP_{t-1} + \beta_k \Delta x_{k,t}$$

In this equation, ΔHP_t is the change in the real house price, the β's are the parameters, the Δx's represent the changes in the fundamental and non-fundamental drivers and ΔHP_{t-1} is the variable for the speculative behaviour. For this short-term model, multicollinearity should still be avoided and the residuals should be checked for autocorrelation and homoscedasticity.

4 The Dutch buy-to-let market

In this chapter, the Dutch private rental sector and specifically the Dutch buy-to-let market will be studied in more detail. The dataset of the Kadaster with the Dutch housing stock is used gain the necessary information. In appendix B, the different steps for getting the descriptive statistics are described. Based on the descriptive statistics in this chapter, it becomes possible to determine the focus for the rest of this thesis.

In the first section, the distribution of the Dutch housing stock with respect to the type of owner will be shown. Next, in section 4.2, the focus will be on the private landlords and the size of their portfolios. In section 4.3, the buy-to-let market will be studied in more detail. It will be shown what type of dwellings belong to this segment and where these dwellings are mostly located. Based on these findings, a specific group of buy-to-let landlords and dwellings will be chosen. In the last section, the three municipalities that will be studied in more detail in the coming chapters will be chosen and discussed.

4.1 The Dutch housing stock with respect to type of owner

Before zooming in on the Dutch buy-to-let market, the entire Dutch housing stock has been studied. In figure 4.1, a division of the Dutch housing stock has been made based on the type of owner. As can be seen from this figure, the majority of the dwellings belongs to the owner-occupied segment. The housing associations hold the second largest share Their share is close to 30%. The remaining groups only have a small market share.

These numbers are broadly in line with the numbers presented in chapter 2. These figures were derived from Capital Value (2018). The major difference is the share and number of dwellings owned by private investors. According to Capital Value (2018), 8% of the Dutch housing stock is owned by private investors, whilst this share is only 6% according to the data of the Kadaster. This is a difference of approximately 125.000 dwellings. This difference can be caused by the relatively high share of unidentified dwellings in the dataset of the Kadaster. Capital Value (2018) has a smaller number of other/unknown dwellings. It might be the case that some of the dwellings that are now classified as other/unknown, are owned by private investors.

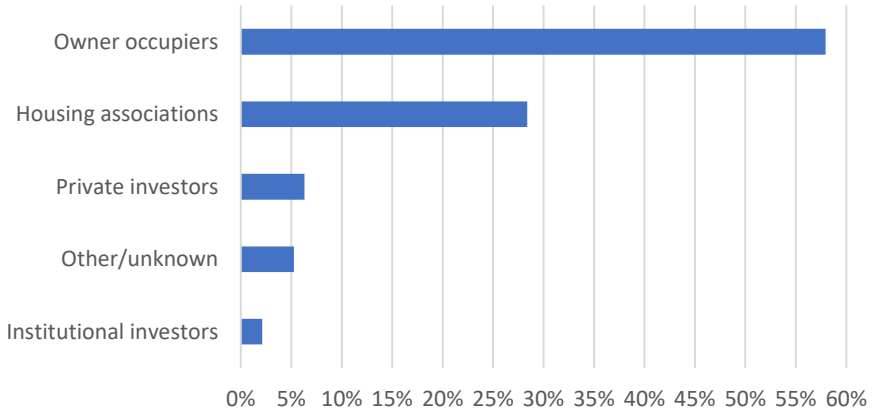

Figure 4.1 Division of the Dutch housing stock with respect to type of owner (Source: own elaboration with data from the Kadaster)

4.2 The portfolio size of private landlords

To gain a better understanding of the Dutch private rental sector, the portfolios of these landlords have been studied. These results are shown in figure 4.2. This figure shows that most private landlords have only a few dwellings in their possession. The majority of the private rental dwellings, however, is owned by the bigger investors. This division is similar to the division in the United Kingdom. Nevertheless, in the UK, an even larger share of the private landlords owns only one rental dwelling. As a result, the majority of the private rental dwellings is owned by landlords who have less than five dwellings in their portfolio (Scanlon & Whitehead, 2016).

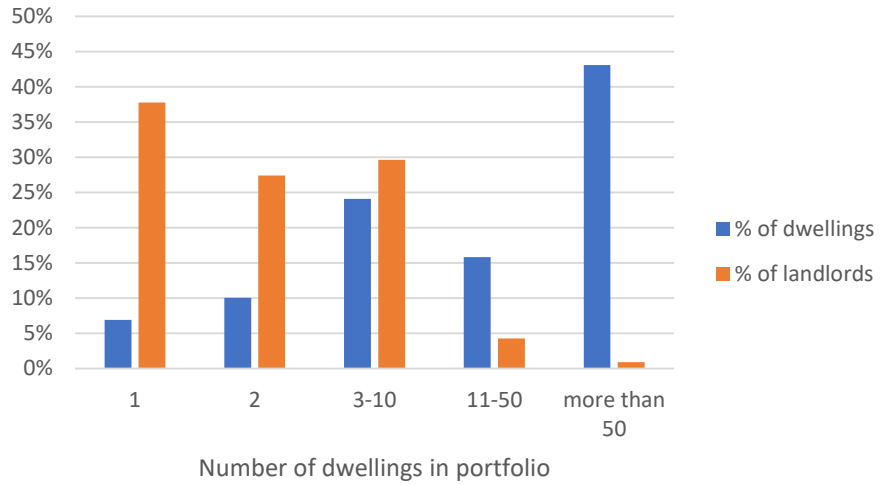

Figure 4.2 Distribution of portfolio size (Source: own elaboration with data from the Kadaster)

Based on this figure and literature, it has been decided to focus on the private landlords with a portfolio of maximum 50 dwellings. The maximum portfolio size has been set on 50, because the focus of this study is on the buy-to-let landlords. These are relatively small landlords that mostly buy dwellings to rent them out instead of building new rental dwellings. It is expected that most landlords with a portfolio of maximum 50 dwellings belong to this group. Furthermore, this maximum portfolio size is used by other parties such as DNB, the Dutch Central Bank, and Kadaster when they discuss the buy-to-let market (Aalbers, Bosma, Fernandez, & Hochstenbach, 2018). This implicates that 99% of the landlords is selected (117855 landlords) and 57% of the private rental dwellings (369184 dwellings). These buy-to-let dwellings make up 5% of the total Dutch housing stock.

Buy-to-let landlords can either be private persons or private companies. Most Dutch buy-to-let landlords are private persons. Only 12% of the buy-to-let landlords have a private company as ownership structure. In figure 4.3, the distribution of the portfolio size for private persons and companies is shown. As might be expected, the majority of the private persons possesses only one or two rental dwellings, whilst the majority of the private companies owns three or more rental dwellings. Only a small share of the private persons and companies own 10 dwellings or more. This might be related to the presence of landlord levy. Before the first of January 2018, landlords that owned less than 10 regulated rental dwellings were exempted from this levy. Since 2018, this exemption has been expanded to 50 dwellings (Rijksoverheid, n.d.-b). Based on the data of the Kadaster, it can, however, not be seen whether these dwellings belong to the regulated or non-regulated segment.

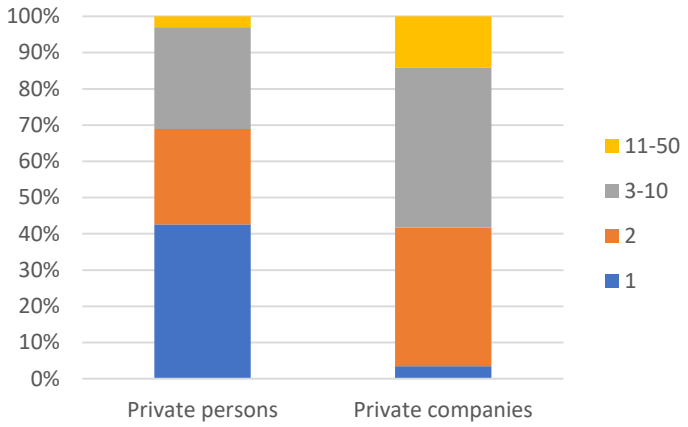

Figure 4.3 Distribution portfolio size private landlords with a portfolio of maximum 50 dwellings (Source: own elaboration with data from the Kadaster)

4.3 The preferences of buy-to-let landlords

In this section, the dwellings of buy-to-let landlords will be discussed and compared to the dwellings of other owners. In the first four subsections, the type, size, value and location of these dwellings will be studied respectively. These insights will be used to sharpen the definition of the buy-to-let landlord and to determine the focus for the remainder of the thesis. This will be done in subsection 4.3.5.

4.3.1 Dwelling types

First the dwelling types have been studied. In figure 4.4, the division of buy-to-let dwellings is shown. To get a better understanding of this division, the division for all dwellings and specifically the rental and owner-occupied dwellings has been included. Based on this figure, several interesting conclusions can be drawn. First, as might be expected, the share of apartments is high for buy-to-let dwellings. This is the case for rental dwellings in general. Nevertheless, compared to all rental dwellings, the share of (end-) terraced dwellings is smaller and the share of detached dwellings is higher.

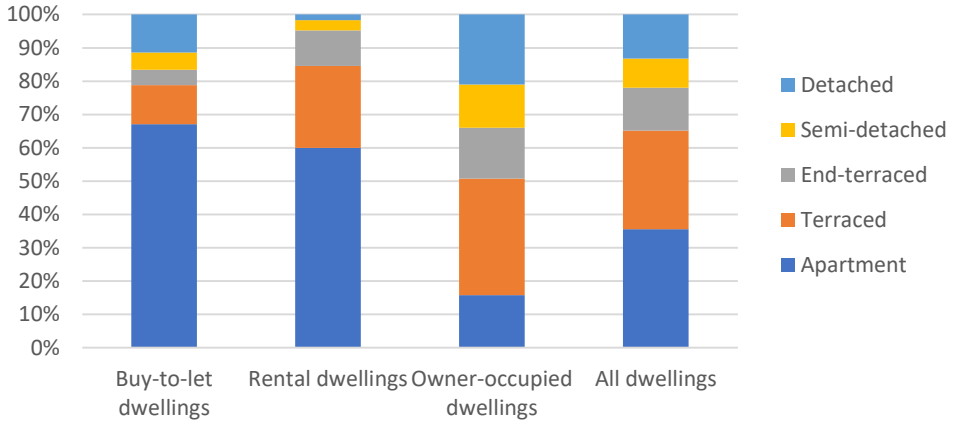

Figure 4.4 Distribution of dwelling types (Source: own elaboration with data from the Kadaster)

Because of particularly the reasonably high share of detached dwellings, it is interesting to study whether this division is different for specific buy-to-let portfolios. Hence in figure 4.5, the distribution of dwelling types is shown for dwellings that are part of different portfolio sizes. This figure shows that dwellings that are part of a small portfolio are mostly an apartment or a detached dwelling. The share of apartments increases as the portfolio size increases, whilst the share of detached dwellings decreases.

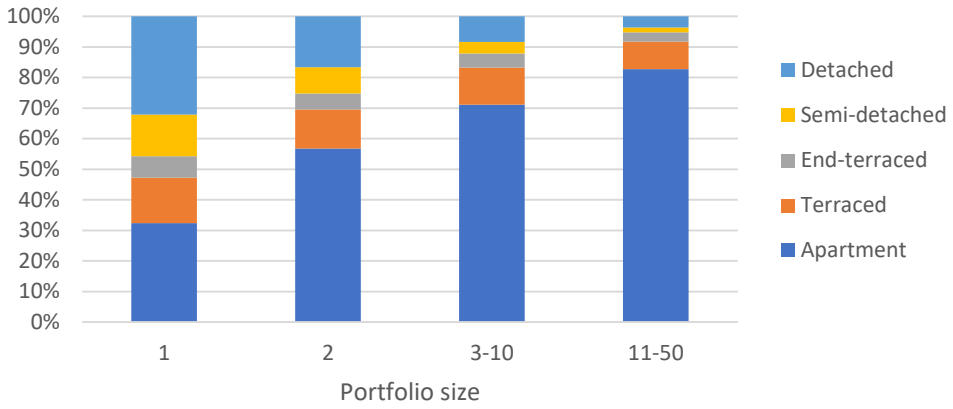

Figure 4.5 Distribution of dwelling types for different buy-to-let portfolio sizes (Source: own elaboration with data from the Kadaster)

4.3.2 Floor space

Besides studying the dwelling types, the data of the Kadaster can be used to study the average floor area of buy-to-let dwellings. In figure 4.6, a distribution of buy-to-let dwellings based on their floor area is shown. A distribution for other types of dwellings has also been included. It can be concluded that like most rental dwellings, most buy-to-let dwellings have a relatively small floor space. However, the share of dwellings with an area of more than 125 square metres is surprisingly large. This share is more than twice as high than that share for all rental dwellings. This relatively high share is presumably related to the relatively high share of detached dwellings.

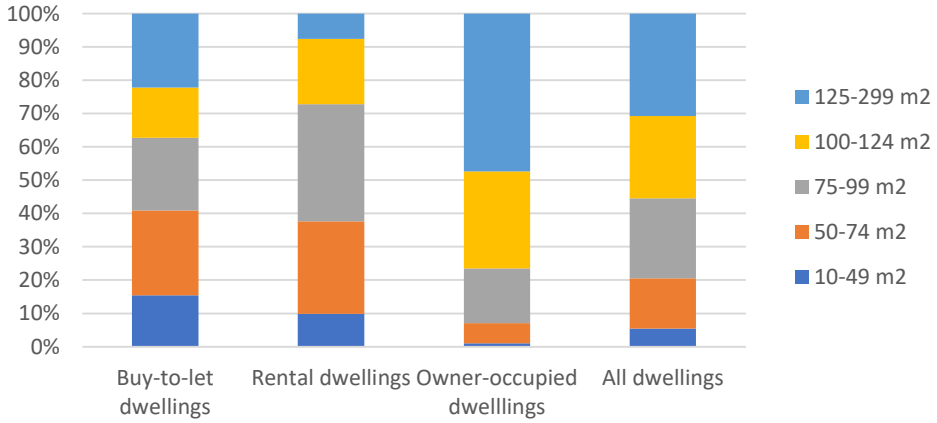

Figure 4.6 Division of dwelling size to different type of dwellings (Source: own elaboration with data from the Kadaster)

To see whether this distribution is related to the portfolio size of buy-to-let landlords, another graph has been created. Based on this graph, figure 4.7, it can be concluded that a similar trend for the size of dwellings as for the dwelling types can be observed. Dwellings that are part of a small portfolio are in general larger than dwellings that are part of a bigger portfolio. This makes sense as most dwellings that are part of a bigger portfolio are an apartment.

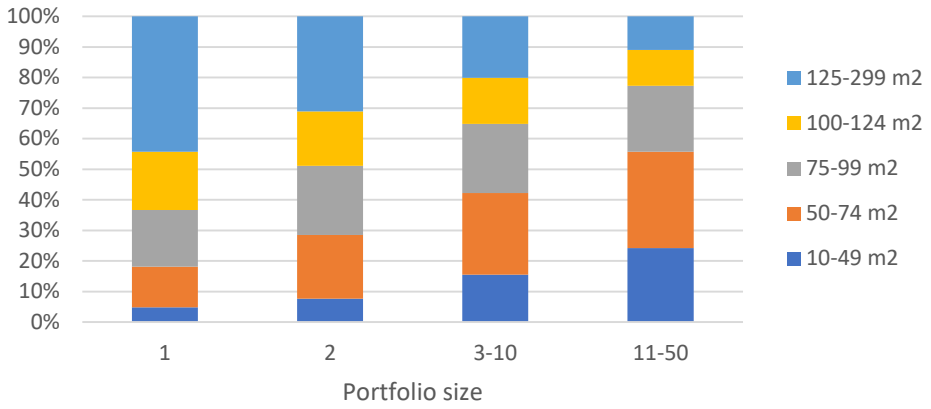

Figure 4.7 Distribution of dwelling size for different buy-to-let portfolio sizes (Source: own elaboration with data from the Kadaster)

4.3.3 The value of buy-to-let dwellings

When combining the dataset with the Dutch housing stock and the dataset with all Dutch private housing transactions, the value of buy-to-let dwellings and other dwellings can be estimated. In figure 4.8, the distribution of these values is shown for different types of dwellings. It can be seen that buy-to-let dwellings and rental dwellings in general are relatively cheap compared to all Dutch dwellings. However, the share of expensive dwellings is quite high compared to the rental dwellings. This share is almost equal to the Dutch share. These prices probably belong to the relatively large detached buy-to-let dwellings.

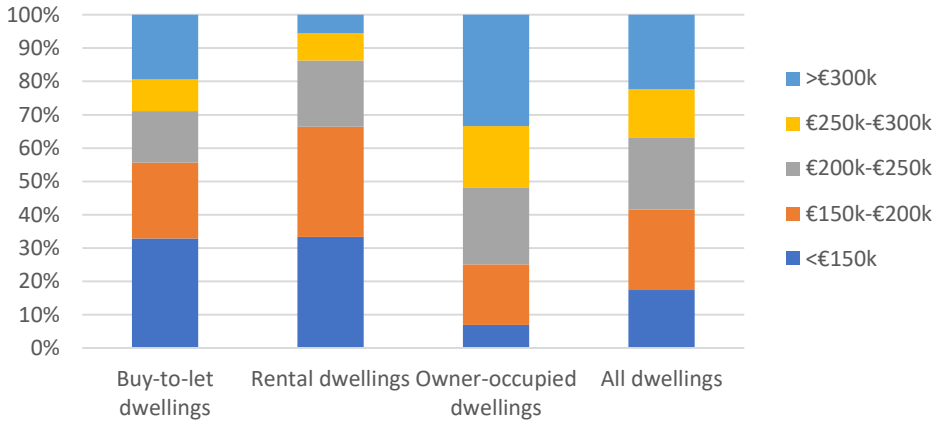

Figure 4.8 Division of the value of dwellings to different type of dwellings (Source: own elaboration with data from the Kadaster)

To check whether these more expensive dwellings are primarily owned by the smaller landlords, the portfolio size of buy-to-let landlords in relation to the value of the dwellings has been studied. The results are shown in figure 4.9. This graphs looks similar to graphs 4.5 and 4.7. Based on these graphs, it can be concluded that the smaller landlords with only one or two rental dwellings are more likely to own the bigger more expensive detached dwellings. On the other hand, the larger buy-to-let landlords mostly own the relatively cheap and small apartments.

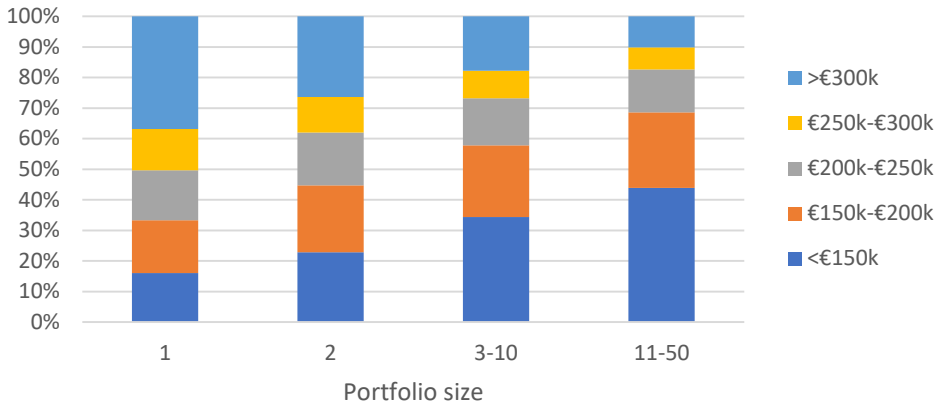

Figure 4.9 Distribution of the value of dwellings for different buy-to-let portfolio sizes (Source: own elaboration with data from the Kadaster)

4.3.4 The location of buy-to-let dwellings

Not only the attributes of buy-to-let dwellings can be studied, but also the location of these dwellings. The location has been studied by looking at the different municipalties and the environment in which buy-to-let dwellings are located. First, it has been studied whether buy-to-let dwellings are mainly located in urban or rural areas. These results are displayed in figure 4.10. As expected, most buy-to-let dwellings are located in areas with a (very) high dwelling density. Nevertheless, the share of buy-to-let dwellings in areas with a very low density is relatively high in comparison with all Dutch dwellings.

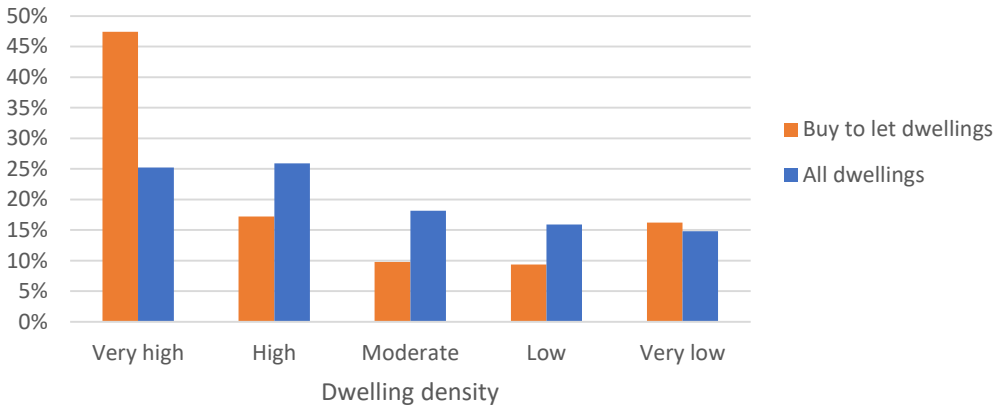

Figure 4.10 The spatial distribution of buy-to-let dwellings compared to all Dutch dwellings (Source: own elaboration with data from the Kadaster)

Since previous figures indicated that the distribution in general varied with the size of the portfolio, this was also checked for the dwelling density. The results are shown in figure 4.11. As for the previous figures, a gradual change can be identified. The bigger the size of the portfolio the dwelling belongs to, the higher the dwelling density. The differences between the portfolio sizes are for this figure reasonably large. The majority of dwellings that are part of a portfolio of solely one dwelling are situated in a more rural environment whilst the majority of the dwellings that are part of a bigger portfolio are situated in a more urban environment.

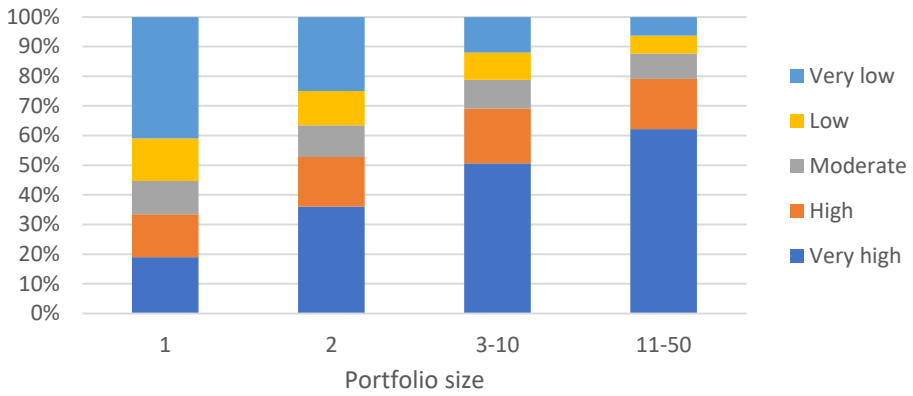

Figure 4.11 The spatial distribution of buy-to-let dwellings for varying portfolio sizes (Source: own elaboration with data from the Kadaster)

To see in which urban or rural areas the buy-to-let segment is relatively big, the buy-to-let market at the municipal level has been studied. In figure 4.12, the share of buy-to-let dwellings for all municipalities is shown. It can be seen that the share of buy-to-let dwelling is the highest in relatively small municipalities such as Schiermonnikoog (15%), Vaals (15%) and Vlieland (14%). Regarding the relatively large municipalities (more than 30.000 dwellings), the share of buy-to-let is the highest in Maastricht (11%), Groningen (10%), The Hague (10%) and Amsterdam (10%). Furthermore, the map shows that the share of buy-to-let dwellings is in general higher in coastal and border regions. This is relatively surprising as it was expected that the share of buy-to-let would be especially high for the bigger cities and the Randstad in general. Nevertheless, the share of buy-to-let is still relatively high for Amsterdam, Rotterdam, The Hague and Utrecht.

When the varying portfolio sizes are studied, it can be seen that the share of buy-to-let dwellings that are part of a small portfolio (one or two dwellings in the portfolio) are the highest in small municipalities such as Tubbergen, Schiermonnikoog and Ameland. When looking at the share of buy-to-let dwellings that are part of larger portfolio (3-10 and 11-50 dwellings), it can be seen that this share is in general higher in the larger municipalities such as Amsterdam, The Hague and Maastricht.

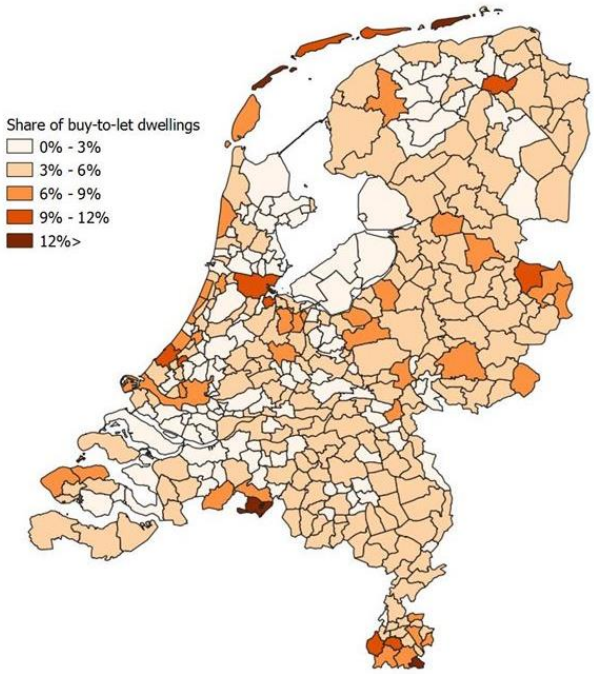

Figure 4.12 The percentage of buy-to-let dwellings by municipality (Source: own elaboration with data from the Kadaster)

4.3.5 What is buy-to-let?

Based on the above figures, no uniform picture of the buy-to-let market arises. Whilst most buy-to-let dwellings are relatively small and cheap apartments located in an urban environment and/or large municipalities, a noticeable share of these dwellings are relatively expensive and large detached dwellings in a more rural environment and/or small municipalities. The first group of buy-to-let dwellings is the most often mentioned classification found in the literature. The second group of buy-to-let dwellings is not an expected or known classification of buy-to-let dwellings.

These second group of dwellings are mostly located in touristic areas. Based on the other dwelling characteristics, some of these dwellings are possibly holiday homes. The intended use of a building is registered in the BAG and this intended use is used to select the buildings with a residential function (see Appendix A). This intended use is initially based on structural characteristics of the building and the Dutch building code. This means that the actual and/or the designated use can be different from the intended use as indicated in the BAG (Rietdijk, 2009). Municipalities can add another intended use to the object, but it is expected that this will not always be done. As a result, some of the dwellings in the used dataset should maybe not have been included because they are not used as a dwelling but as a holiday home. Furthermore, it looks like these dwellings or holiday homes are in general owned by the smaller private landlords. Especially the private landlords with only one rental dwelling in their possession, tend to own the bigger dwellings in the more rural areas. As the size of the portfolio increases, it becomes more likely that the rental dwelling is a relatively small apartment in an urban area.

All in all, still the majority, relatively and absolutely, of the identified buy-to-let dwellings are small apartments in the bigger cities. It has been decided to focus in this thesis on these buy-to-let dwellings and the landlords that own these dwellings. This choice has been made because it is expected that the buy-to-let landlords that possess the holiday homes have a different interest than the buy-to-let landlords that own the smaller dwellings in the cities. These smaller private rental dwellings are mostly owned by the semi-professional landlords with multiple dwellings in their possession. It has been decided to focus on these dwellings and landlords for three reasons. First, these dwellings are chosen because the majority of buy-to-let dwellings are the relatively small apartments or terraced houses in urban areas. Moreover, these dwellings are predominantly mentioned in the literature when discussing the buy-to-let market (Whitehead, et al., 2016). Consequently, it is interesting to investigate this type of dwellings in more detail in order to add to the existing body of knowledge. Last, because the increasing attractiveness of living in cities is already causing higher house prices, it is valuable to study the combination of this increasing popularity and the increasing share of buy-to-let. Therefore, in the remainder of this thesis, the focus will be on the buy-to-let dwellings in urban areas. These dwellings are predominantly relatively small and cheap apartments owned by landlords with multiple dwellings in their possession.

4.4 The buy-to-let market in three different municipalities

The purpose of this chapter is not only to gain more insight in the Dutch buy-to-let market, but also to choose three municipalities that will be further studied in this thesis. As mentioned in chapter 3, the house price development for three municipalities with a different share of buy-to-let dwellings will be studied in order to see whether this house price development is related to the share of buy-to-let.

Based on the analyses for subsection 4.3.4, three municipalities can be chosen. It has been decided to further study the buy-to-let market in Groningen, Breda and Zoetermeer. These municipalities have been chosen for several reasons. First, they are all urban areas or cities and this is

in line with the choices made in the previous paragraph. Furthermore, Groningen is one of the cities with a very high share of buy-to-let dwellings, whilst the share of buy-to-let dwellings in Breda is approximately equal to the Dutch average. The number and share of buy-to-let dwellings in Zoetermeer is particularly low and is ranked at the bottom of the list. This entails that the share of buy-to-let is different for each city. This makes it possible to see whether the share of buy-to-let affects the house price development. Moreover, the number of transactions per quarter were checked to make sure that enough transactions were available for each period to calculate the average transaction price. Last, when choosing the three municipalities, it has deliberately been decided to not select Amsterdam or municipalities near this city. This has been done because the price development in Amsterdam has already received a lot of attention. The ING (2017) and Dröes, Houben & Van Lamoen (2017) for instance studied the house price development for Amsterdam. Moreover, Amsterdam experienced some very sharp price increases because of the increasing popularity of the capital and Dröes et al. (2017) already showed that these were not always related to changes in the fundamentals.

Regarding the three selected municipalities, the varying share of buy-to-let might be related to the number of students in these cities. Groningen has around 35.000 students, Breda 11.000 students and Zoetermeer 4.000 students. Students mainly live in a rental dwelling during their studies and when they are finished studying they often continue to live in a rental dwelling for several years. During these years, they can save money to buy a dwelling. Hence, students can raise the demand for rental dwellings. This can result in a higher supply of rental and buy-to-let dwellings.

Before studying the house price development in these three municipalities, it is good to get more insight in these municipalities. The data of the CBS and Kadaster have been used to make table 4.1 and figures 4.13-4.16. Table 4.1 shows the varying share of buy-to-let dwellings and number of students.

Table 4.1 Figures on the population and housing stock for Groningen, Breda and Zoetermeer (Source: CBS & Kadaster)

	Groningen	**Breda**	**Zoetermeer**
Number of dwellings	101000	83000	56000
Share buy-to-let dwellings	10%	5%	1%
Number of students	35000	11000	4000
Number of citizens	203000	184000	125000

The share of buy-to-let dwellings was not always the same for these cities and a new dataset of the Kadaster, which is still in process, has been used to study the development of buy-to-let in these three municipalities. In figure 4.13, the development of the number of buy-to-let dwellings is shown. It can be seen that the number of buy-to-let dwellings is relatively constant in Zoetermeer and that the number of buy-to-let dwellings increased over time in Groningen and Breda. From 2013 on, the number of buy-to-let dwellings increased at a slightly higher rate in both Groningen and Breda.

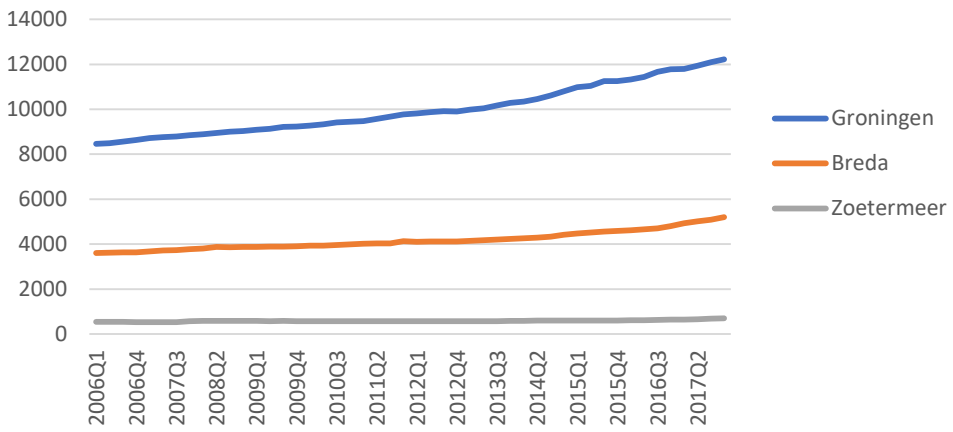

Figure 4.13 The development of the number of buy-to-let dwellings in Groningen, Breda and Zoetermeer (Source: Kadaster)

Besides studying the development of buy-to-let dwellings for these three cities, it is interesting to see what type of buy-to-let landlords are particularly active in these cities. Figure 4.14 shows that the majority of the buy-to-let dwellings in these municipalities are owned by landlords with three or more dwellings in their possession. This shows that the bigger buy-to-let landlords are indeed particularly active in urban areas as indicated in the previous subsection. Moreover, the share of semi-professional landlords is especially high for Zoetermeer, whilst the distribution for Breda and Groningen is roughly the same.

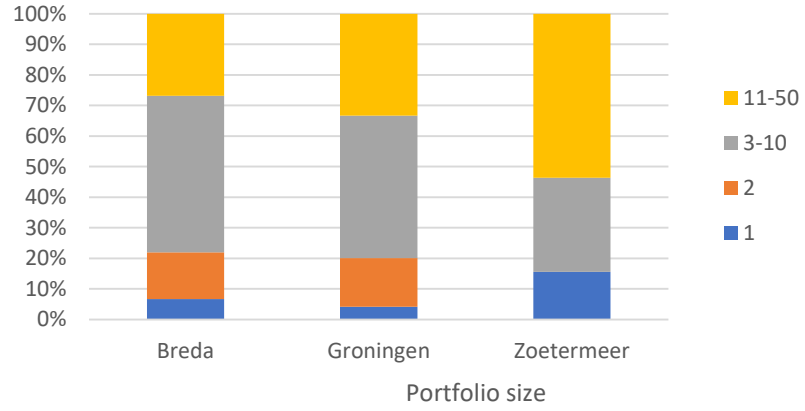

Figure 4.14 Distribution portfolio size buy-to-let dwellings per municipality (Source: own elaboration with data from the Kadaster)

Last, the buy-to-let dwellings in these cities have been studied in more detail by looking at the type of dwelling and the floor surface of these dwellings. These divisions are shown in figure 4.15 and 4.16. As expected, most buy-to-let dwellings are an apartment. Next come the terraced houses with a share of around 10% for the three cities. The other three types of dwellings only account for a small proportion of the total number of buy-to-let dwellings. Regarding the floor surface of the buy-to-let dwellings, it can be seen that most buy-to-let dwellings are relatively small. The majority of the buy-to-let dwellings in these cities have a floor surface of less than 100 square meter. The buy-to-let dwellings in Zoetermeer are in general even smaller as the share of dwellings with a floor surface of 50-74 square meter is almost twice the share for Groningen and Breda.

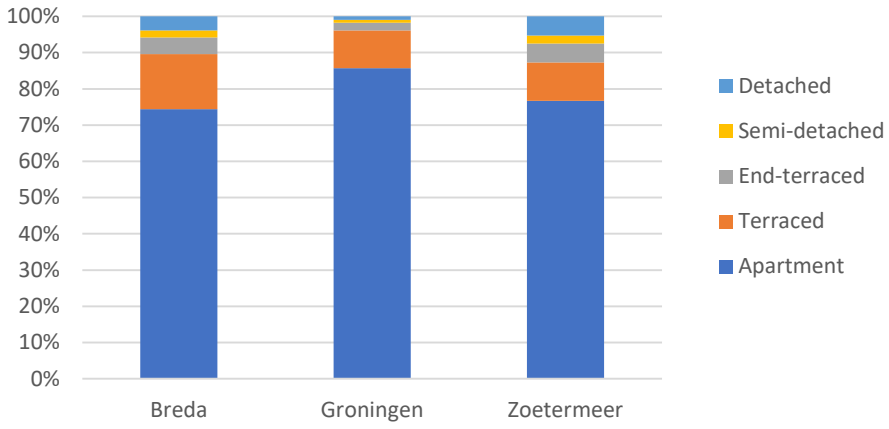

Figure 4.15 Distribution of dwelling types per municipality (Source: own elaboration with data from the Kadaster)

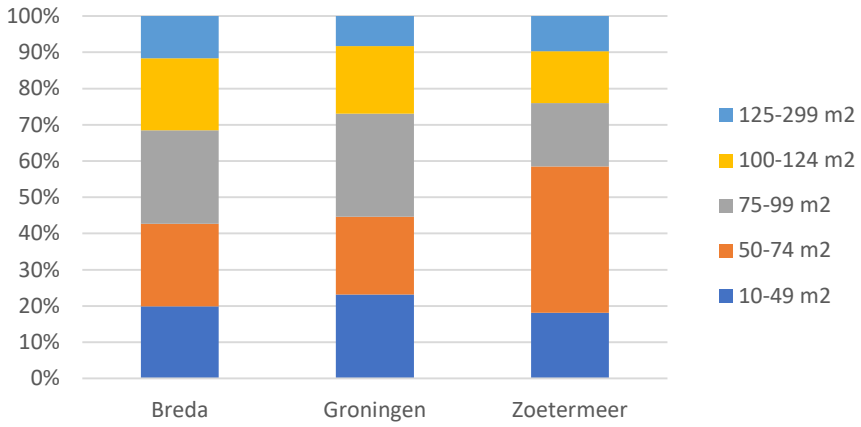

Figure 4.16 Distribution of dwelling size per municipality (Source: own elaboration with data from the Kadaster)

5 Examining the Dutch (regional) house price development

In the previous chapter, the characteristics of the Dutch buy-to-let market have been studied. In this chapter, the focus will be on the Dutch house price development. In the first section, section 5.1, the house price development for the Netherland in general will be studied. In section 5.2, the house price development for different dwelling types will be discussed. Next, in section 5.3, the regional house price development for different municipalities, including Groningen, Breda and Zoetermeer, will be examined. Last, in section 5.4, several conclusions will be drawn based on the findings in the previous sections. As for the previous chapter, data of the Kadaster and CBS has been used to study the house price development. In appendix A and B, more information on the data and the making of the figures can be found.

5.1 The Dutch house price development

First, the Dutch house price development for the period 1993-2017has been studied. This development is shown in figure 5.1. It can be seen that the Dutch house prices have doubled in both real and nominal terms during this period. This increase was, however, not completely linear and different periods can be observed.

Between 1993 and 2000, the Dutch house prices increased at a relatively high rate. The prices could increase at such a high rate, because of rising household incomes and decreasing interest rates. Furthermore, some changes occurred regarding the requirements for mortgages. Households could for instance get a higher mortgage due to new regulations. It became possible to include a second income and interest-only mortgages came into use (Haffner & De Vries, 2009).

From 2000 on, the Dutch house prices increased at a more moderate rate. Nevertheless, the price increases were still higher than the inflation. According to Haffner & De Vries (2009), these price increases were supported by growing household incomes and moderate increases in the housing stock. After these steady price increases, the Dutch housing market reached a peak level in 2008.

After these steady house price increases, the house prices declined considerably between 2008 and 2013. These declines are related to the global financial crisis of 2008. In most European countries, the house prices started to decline in 2008 and the period of declining prices was relatively long in the Netherlands (Tu, De Haan, & Boelhouwer, 2017).

At the end of 2013, the house prices were at its lowest. Since this point, the Dutch house price have started to increase again. Figure 5.1 shows that the nominal house prices are already higher than the nominal peak level in 2008. This is not the case for the real house prices. The average real house price of 2017 is just below the average real house price of 2008. The recent house price increases are likely the result of the recovering economy and the low interest rates on mortgages (Hekwolter of Hekhuis, Nijskens, & Heeringa, 2017).

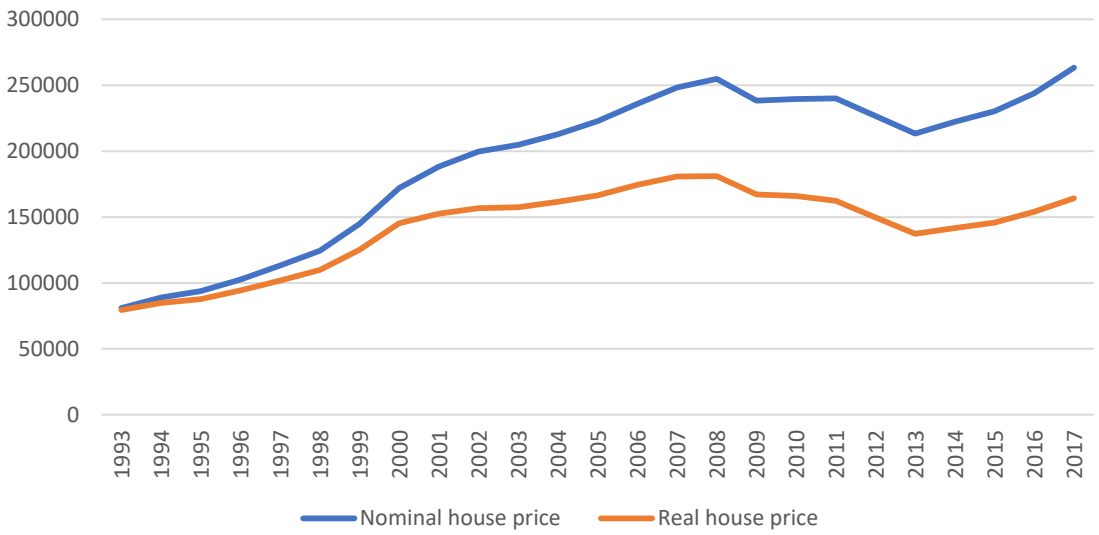

Figure 5.1 Average Dutch house price development in € (Source: own elaboration with data from the Kadaster)

The house price development is sometimes also studied by looking at the prices per square meter. In figure 5.2, both the Dutch house price development in euros and in euros per square meter are shown. Since good data on the size of the dwellings is only available since 2006, the development of these indicators is depicted for the period 2006-2017 instead of 1993-2017. By studying this figure, it can be seen that both variables largely follow the same trend. Still, the decline between 2011 and 2013 looks stronger for the square meter price than for the average house price.

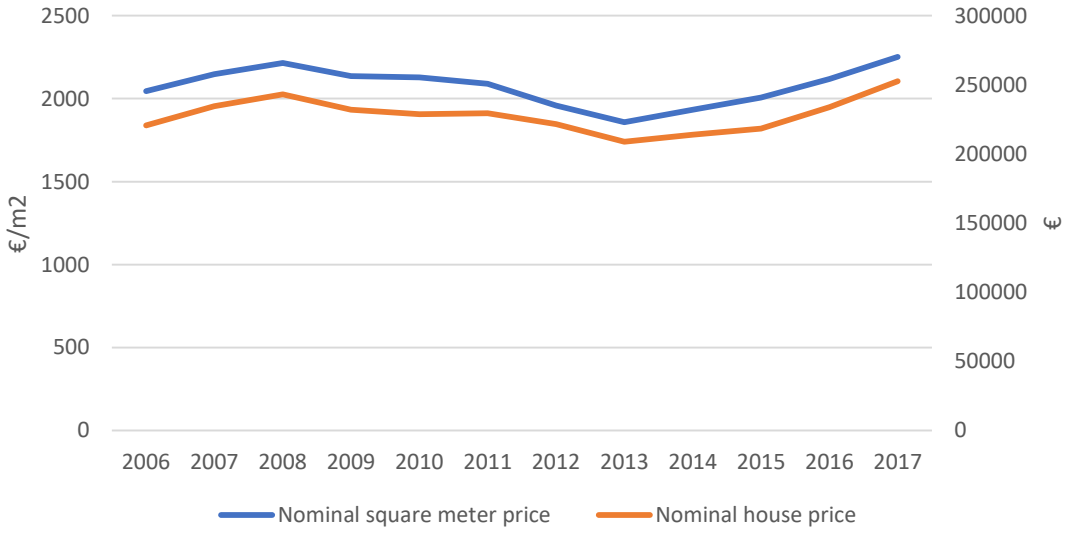

Figure 5.2 Average Dutch house price development in € and in € per m2 (Source: own elaboration with data from the Kadaster)

5.2 The house price development for varying dwelling types

In figure 5.1, the general house price development is shown. This means that no distinction was made between the different dwelling types. It is interesting to study whether the house price development is the same for all dwelling types. In figure 5.3 and 5.4 the average nominal house price development and the development of the average nominal house price index are shown. Figure 5.3 shows that detached dwellings are on average the most expensive dwellings and apartments the cheapest. This is not really surprising.

The development of the nominal house price index is therefore more interesting. Up to 2008, the nominal house price index increased the most for (semi-)detached dwellings and apartments. However, after 2008, the nominal house price index declined the most for semi-detached and especially detached dwellings. On the other hand, this index declined less for the other types of dwellings. Since 2013, the price index for all dwelling types have started to increase again. Last, it is interesting to see the difference between the nominal house price index for apartments in 2017 and nominal house price index for the other dwelling types in 2017. The nominal house price index for apartments is noticeably higher. This entails that the price for apartments increased relatively the most since 1993. The relative price increases for the other dwelling types were roughly the same in this period.

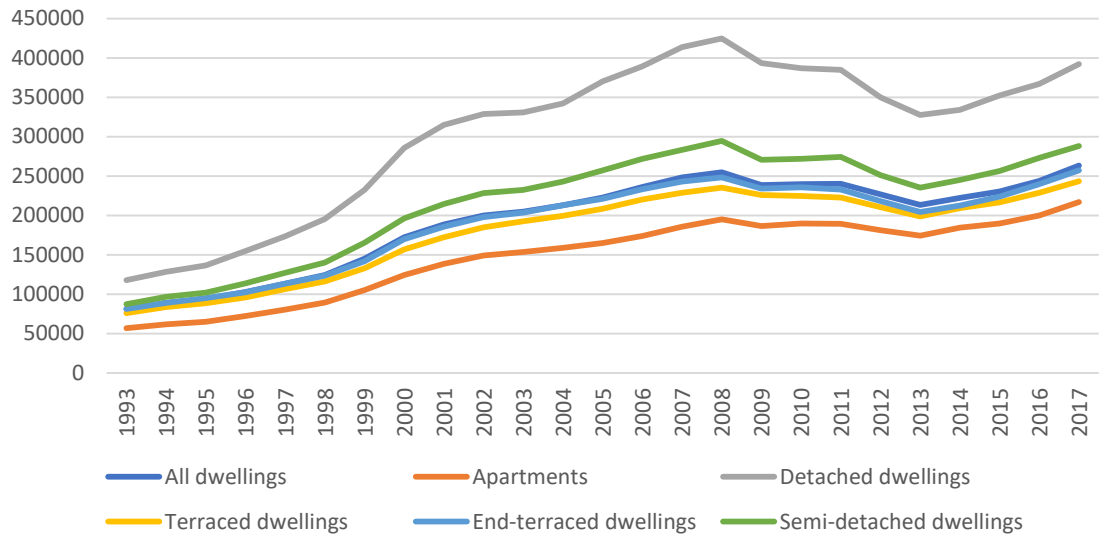

Figure 5.3 Average nominal house price development for varying dwelling types (Source: own elaboration with data from the Kadaster)

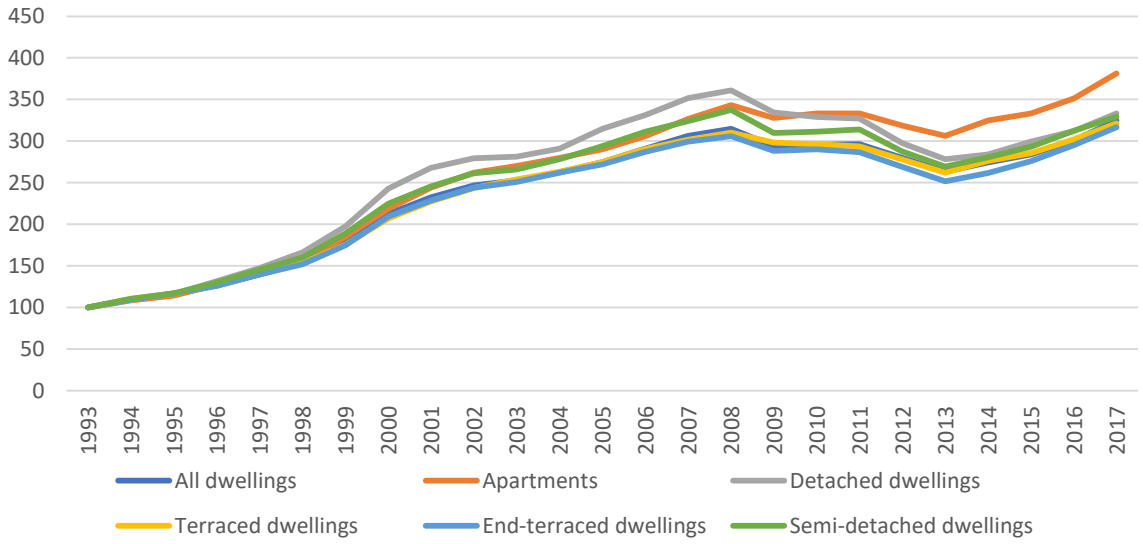

Figure 5.4 Nominal house price index for varying dwelling types (1993=100, source: own elaboration with data from the Kadaster)

5.3 The house price development for different municipalities

After studying the Dutch house price development, the house price development for specific municipalities, including Groningen, Breda and Zoetermeer, has been examined. The other municipalities were selected based on their number of inhabitants and the share of buy-to-let dwellings.

First, the municipalities that had more than 100.000 inhabitants on the 1st of January 2017 were selected by using CBS data (2017). It has been decided to focus on the bigger municipalities or cities, because the share of buy-to-let is usually higher in these areas as shown in chapter 4. Furthermore, because of the increasing attractiveness of living in cities, it is wise to only compare these bigger municipalities with each other. Next, the information on the share of buy-to-let dwellings has been used to select twelve municipalities from this list. First, the four municipalities with the highest share and lowest share have been chosen. Next, four municipalities were selected that had a share close to the general Dutch share of 4,8%. These twelve municipalities and the three previously selected municipalities are shown in table 5.1. This table also shows the share of buy-to-let dwellings and the corresponding category.

Table 5.1 The selected municipalities and their share of buy-to-let dwellings

Municipality	**Share buy-to-let dwellings**	**Category (high, medium, low)**
Maastricht	10,9%	High
Groningen	10,2%	High
The Hague	10,0%	High
Amsterdam	9,6%	High
Leiden	8,3%	High
Tilburg	5,5%	Medium
Breda	5,4%	Medium
Zwolle	5,1%	Medium
Den Bosch	4,8%	Medium
Ede	4,6%	Medium
Zaanstad	2,7%	Low
Haarlemmermeer	2,5%	Low
Alphen aan den Rijn	2,1%	Low
Almere	1,1%	Low
Zoetermeer	1,0%	Low

Subsequently, the house price development for these municipalities has been determined by using the Kadaster dataset with the Dutch private housing transactions (see appendix A). To limit the quality differences between periods, only the transaction prices of average-sized apartments in urban areas have been included. This means that apartments with a floor space between 50 and 100 squared meter located in a neighbourhood with a high or very high dwelling density have been selected. Next, the moving average of four quarters has been taken to reduce the seasonal effects and to smooth out the peaks that are possibly caused by quality differences. The transaction prices have not been deflated by the Consumer Price Index. This is not deemed necessary because this is a national index and the goal is to compare the relative house price increases between municipalities. The development of the average nominal house prices for the fifteen municipalities are shown in figures 5.5-5.7. In each figure, the house price development for one group of municipalities is depicted.

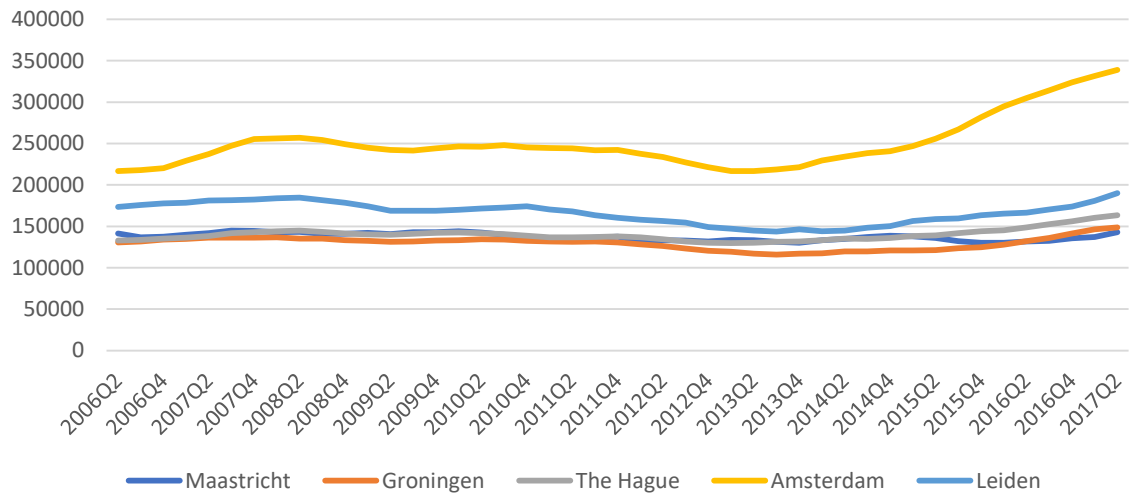

Figure 5.5 Average nominal house price development for municipalities with a relatively high share of buy-to-let (Source: own elaboration with data from the Kadaster)

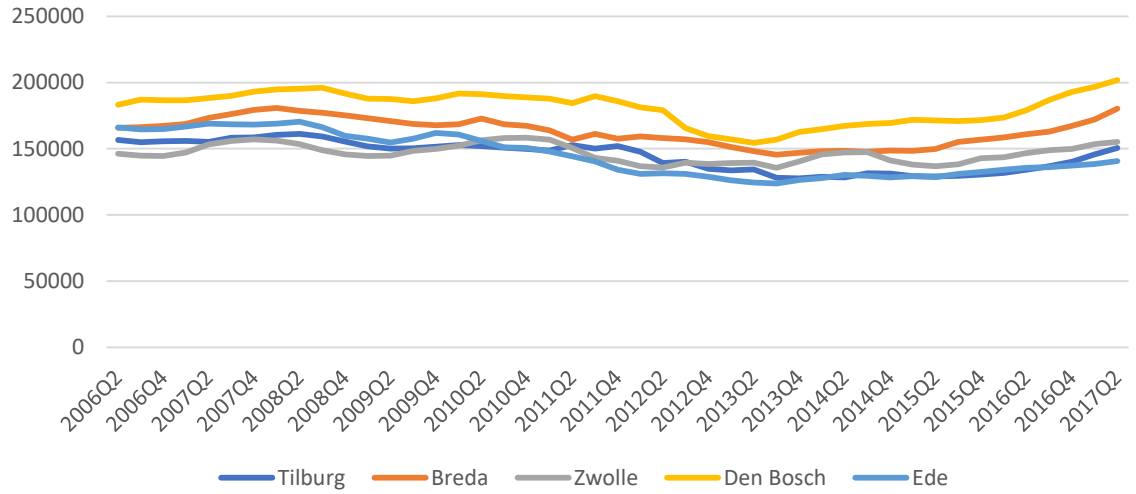

Figure 5.6 Average nominal house price development for municipalities with an average share of buy-to-let (Source: own elaboration with data from the Kadaster)

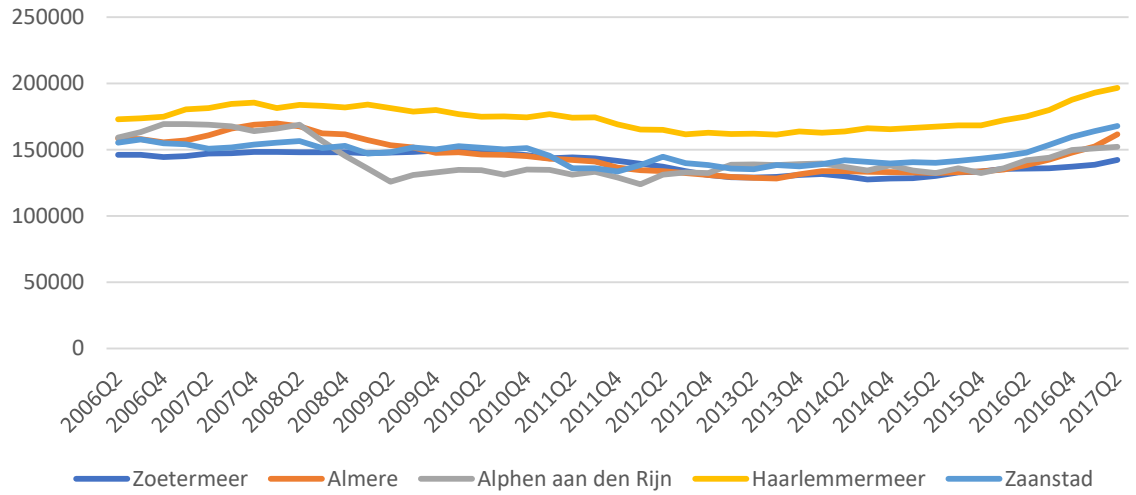

Figure 5.7 Average nominal house price development for municipalities with a relatively low share of buy-to-let (Source: own elaboration with data from the Kadaster)

By comparing the three graphs with each other, several conclusions can be drawn. First, it can be concluded that the house prices in Amsterdam are by far the highest and unique compared to the other transaction prices. When Amsterdam is not included in the comparison, it can been seen that the house price levels for the three types of municipalities are rather similar. The house prices are not necessarily higher for the same type of apartments in municipalities with a high share of buy-to-let. On the contrary, the prices for apartments look to be lower for the municipalities with a high share of buy-to-let. Furthermore, the house price development for the municipalities with a low share of buy-to-let looks more volatile due to the lower number of transactions per period. This results in bigger differences between periods. Last, when comparing the nominal house price development of apartments in Groningen, Breda and Zoetermeer, it can be seen that the house prices for apartments are in general higher in Breda. Groningen comes second and Zoetermeer has the lowest prices.

To gain a better insight into the relative house price development, a nominal house price index has been constructed. For this index, the first quarter of 2015 has been chosen as the base value. This makes it easier to compare the recent house price increases with which the rise of the buy-to-let market is often associated. The development of this index for the fifteen municipalities is shown in figures 5.8-5.10.

By studying these figures, different insights can be gained regarding the house price development. First, it can be concluded that most municipalities have experienced relatively strong price rises in the last two years. These price rises were in general a bit stronger for the municipalities with a higher share of buy-to-let, but the differences are small. Moreover, it can be seen that Amsterdam is a unique case again. It has experienced the strongest price increases and no municipality comes near these price rises. It is also interesting to note that Maastricht, the municipality with the highest share of buy-to-let dwellings, has the lowest price rises. This might be related to the moderate price increases in general for the province of Limburg (Kadaster, 2018). Another interesting observation is the relative strong recent house price rises in Zaanstad, Haarlemmermeer and Almere. These municipalities are close to Amsterdam. They might have profited from the increasing popularity of living in Amsterdam and the dramatic house price increases in this municipality. Different articles indicate that people from Amsterdam are increasingly buying dwellings outside of Amsterdam. Municipalities that are increasingly popular by these households are amongst others Zaanstad, Haarlemmermeer and Almere. They might, for example, move to these municipalities because of the better affordability (De Vries & Van der Harst, 2018; Van Ammelrooy & Van den Eerenbeemt, 2017).

Besides studying the recent price rises, the recent price index has been compared to the pre-crisis index. On the whole, when Maastricht is not included, the current nominal house price index is higher than the pre-crisis value for the municipalities with a higher share of buy-to-let. This is in general not the case for the municipalities with a low share of buy-to-let dwellings. Only the house prices of Haarlemmermeer and Zaanstad have reached their pre-crisis levels. This could be related to the popularity of Amsterdam as indicated above.

Last, the development of the house price index for the three selected municipalities, Groningen, Breda and Zoetermeer, have been compared. It can be seen that the recent price increases are similar for Groningen and Breda. These price rises are stronger than the price rises in Zoetermeer. However, Groningen is the only municipality for which the current prices are clearly higher than the pre-crisis prices. The current prices in Breda are roughly equal to the pre-crisis levels. The current prices in Zoetermeer are still below the pre-crisis prices.

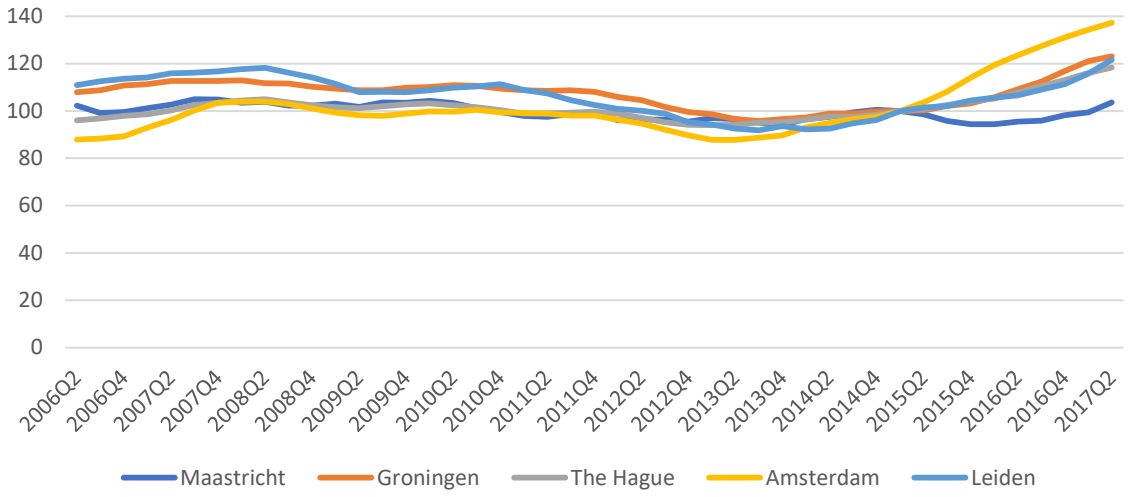

Figure 5.8 Nominal house price index for municipalities with a relatively high share of buy-to-let (2015Q1=100, source: own elaboration with data from the Kadaster)

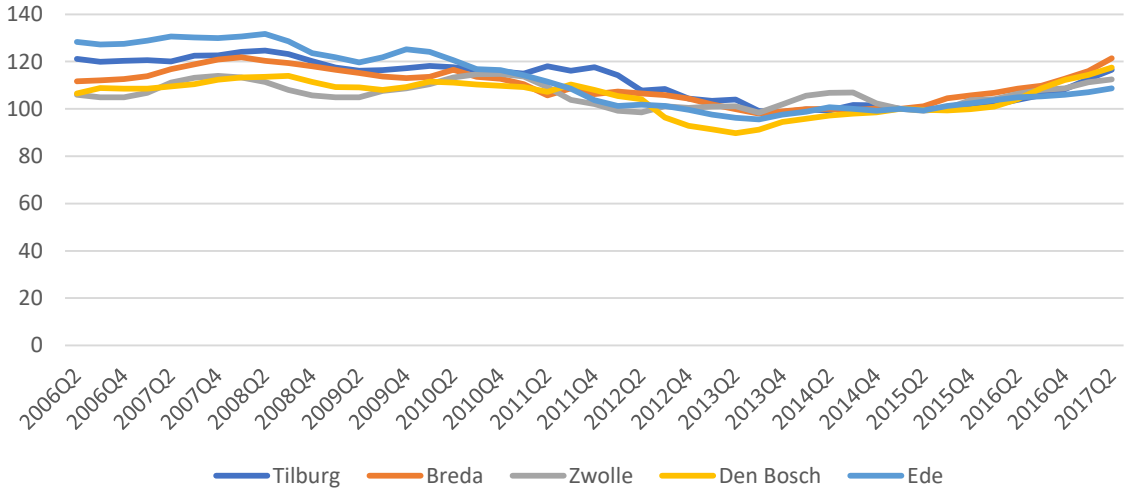

Figure 5.9 Nominal house price index for municipalities with an average share of buy-to-let (2015Q1=100, source: own elaboration with data from the Kadaster)

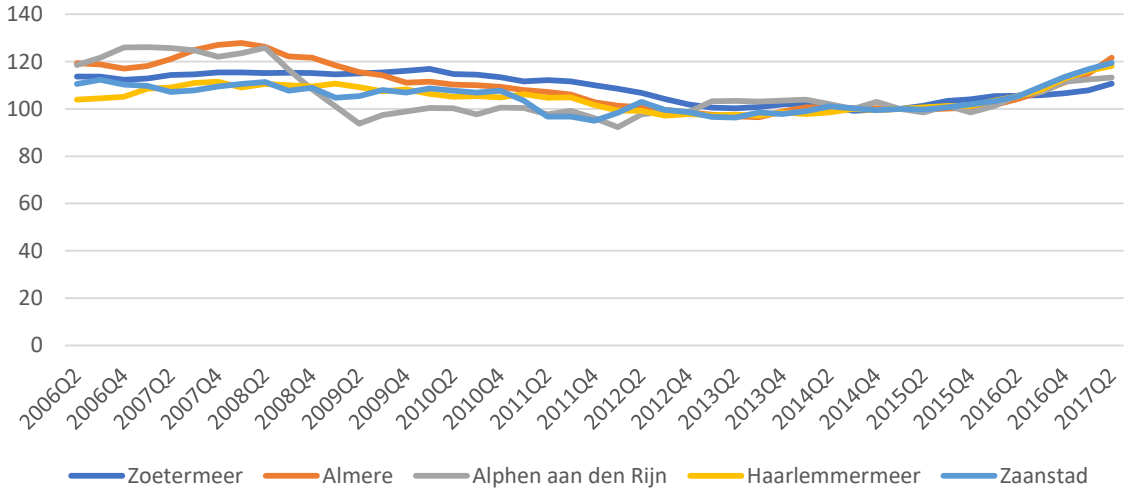

Figure 5.10 Nominal house price index for municipalities with a relatively low share of buy-to-let (2015Q1=100, source: own elaboration with data from the Kadaster)

5.4 Conclusion

In this chapter, the house price development for the Netherlands in general and specific segments has been shown and discussed. Although the general trend was the same for all figures (increase up to 2008, decrease till 2013 and then an increase again), the strength of these developments differed between segments. The prices of apartments have for instance withstood the economic crisis relatively well. Regarding the house price development for the different municipalities, no uniform picture arises when studying these figures. It seems as the recent house price increases are generally a bit stronger for the municipalities with a high share of buy-to-let. This effect looks even stronger when the development since the economic crisis is being studied. Nevertheless, it is not the case that the recent price increases for these municipalities are all stronger than the prices rises for the other municipalities. The figures show that each municipality has experienced a unique house price development. This is not surprising as many factors influence the house price development. Consequently, also other regional factors need to be studied in combination with the regional house price development in order to actually say something about the possible inflationary effect of buy-to-let investments. Hence, in the forthcoming chapters, more attention will be paid to the house price development in Groningen, Breda and Zoetermeer and the underlying determinants.

6 The variables for the regional house price models

Before the regional house price models for Groningen, Breda and Zoetermeer can be made, the required variables need to be constructed. Some of these variables will also be used to test the correlation between the house price development and buy-to-let investments. Moreover, the validity of these variables needs to be tested. Therefore, in this chapter, these steps will be discussed. These steps are based on the methodology as described in chapter 3. In the first section, the dependent variables, the house prices, will be discussed. In section 6.2, the independent variables, the drivers, will be reviewed.

6.1 The dependent variables: the house prices for Groningen, Breda and Zoetermeer

In this section, the dependent variables for the regional house price models will be discussed. In subsection 6.1.1, it will be explained how these variables have been constructed. Next, in subsection 6.1.2, the validity of these variables will be discussed.

6.1.1 Constructing the dependent variables

In the previous chapter, the house price development for Groningen, Breda and Zoetermeer has already been shown. Several steps were taken to get a good idea of the house price development in these municipalities. Only the transaction prices for average-sized apartments in urban areas were for instance used to limit the quality differences between periods. These are also the type of dwellings in which buy-to-let landlords are specifically interested. Furthermore, the moving average of four quarters was taken to reduce the seasonal effects and to smooth out the peaks that are possibly caused by quality differences. These steps were also taken when constructing the dependent variables for the house price models. Since it is even more important for the house price models to limit the quality differences between periods, additional steps have been taken when constructing the dependent variables. These steps are not necessary when comparing the house price development of different municipalities. The different steps for constructing the dependent variables will be discussed below.

First, all transactions of apartments with a floor space between 50 and 100 squared meter located in a neighbourhood with a high or very high dwelling density have been selected. Next, the price levels for specific neighbourhoods have been studied to see which neighbourhoods are comparable. This means that for Groningen five neighbourhoods have been chosen. These are “Centrum”, “Oud-Zuid”, “Oud-West”, “Oud-Noord” and “Oosterparkwijk”. All these neighbourhoods have a very high dwelling density and are situated in the centre of Groningen. These neighbourhoods are shown in figure 6.1 and are depicted in orange.

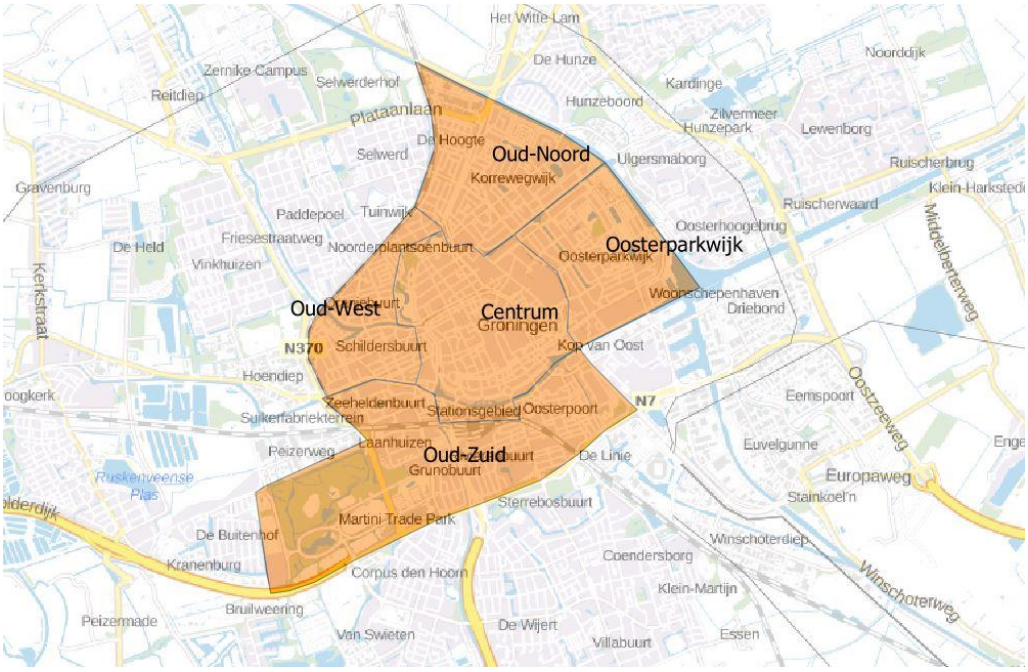

Figure 6.1 The selected neighbourhoods in Groningen (Source: own elaboration with data from PDOK)

Also five comparable urban neighbourhoods have been selected for Breda. These are “Centrum”, “Oost”, “Zuid-Oost”, “Zuid” and “West”. These selected neighbourhoods are shown in figure 6.2 and depicted in orange. This figure shows that the neighbourhoods in Breda are bigger than in Groningen. It is important to note that not all transactions of apartments in the neighbourhood “West” have been selected. Some of the areas within this neighbourhood do not have a very high or high dwelling density.

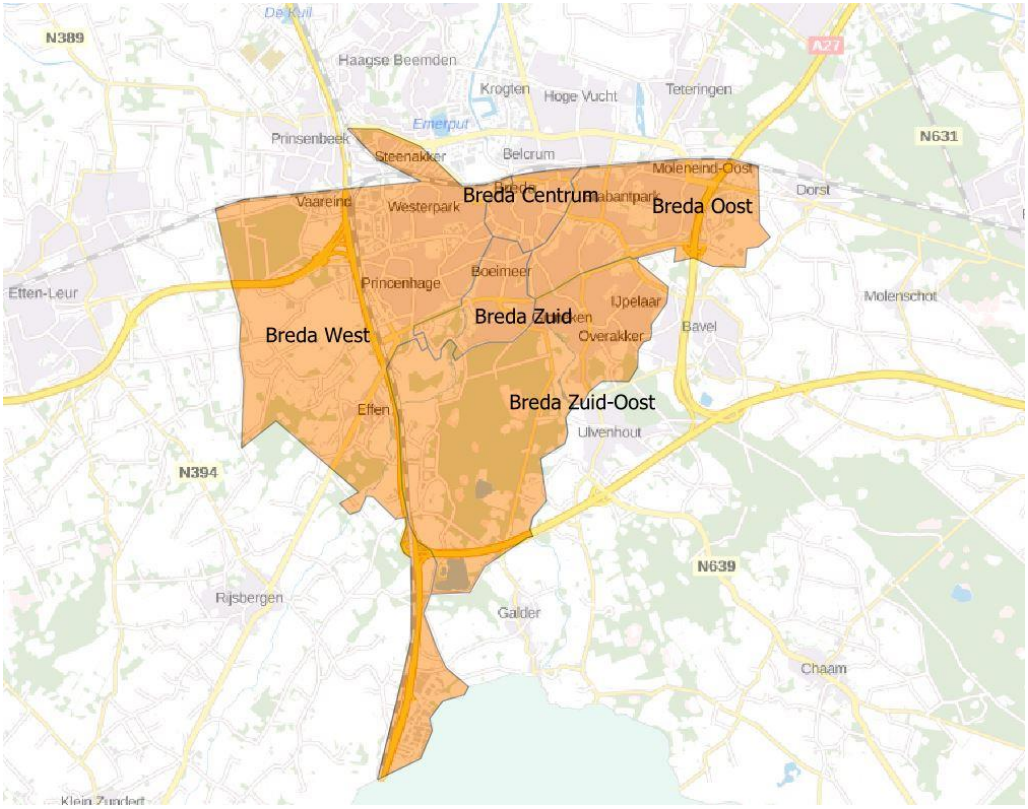

Figure 6.2 The selected neighbourhoods in Breda (Source: own elaboration with data from PDOK)

Last, four neighbourhoods have been selected for Zoetermeer. These are “Centrum”, “Meerzicht”, “Buytenwegh de Leyens” and “Seghwaert”. These neighbourhoods are depicted in orange in figure 6.3. Because the house prices were significantly higher in the areas with a high dwelling density compared to a very high dwelling density, only the areas with a very high dwelling density have been included. This entails that some of the apartments in “Buytenwegh de Leyens” are not included.

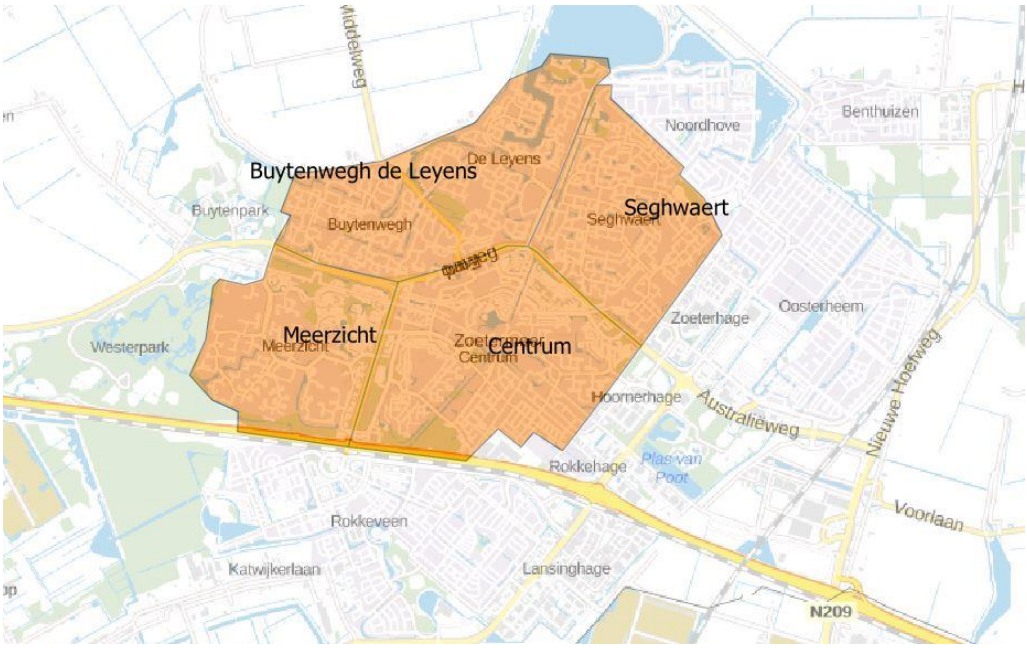

Figure 6.3 The selected neighbourhoods in Zoetermeer (Source: own elaboration with data from PDOK)

Next, the nominal transaction prices are deflated by using the consumer price index of the CBS. This step also makes it possible to remove potential outliers. This is done by first looking at the average real price for these dwellings in each municipality. Subsequently, all transactions that are more than twice as small or large are excluded. This means that for Groningen 38 of the 4896 transactions are excluded, for Breda 109 of the 3706 and for Zoetermeer 28 of the 4171. Last, the moving average of four quarters has been taken to reduce the seasonal effects and to smooth out the peaks that are possibly caused by quality differences. All these measures ensure that a more reliable price index is constructed for the three municipalities.

The results of all these steps are shown in figure 6.4. In this figure, the house price development for the apartments in the three municipalities is shown. It can be seen that basically the same type of apartments are generally more expensive in Breda. Furthermore, the house price development looks relatively the same for the three municipalities for the period 2006-2015. After this period, the house price increases are stronger in Groningen, weaker in Zoetermeer and moderate in Breda.

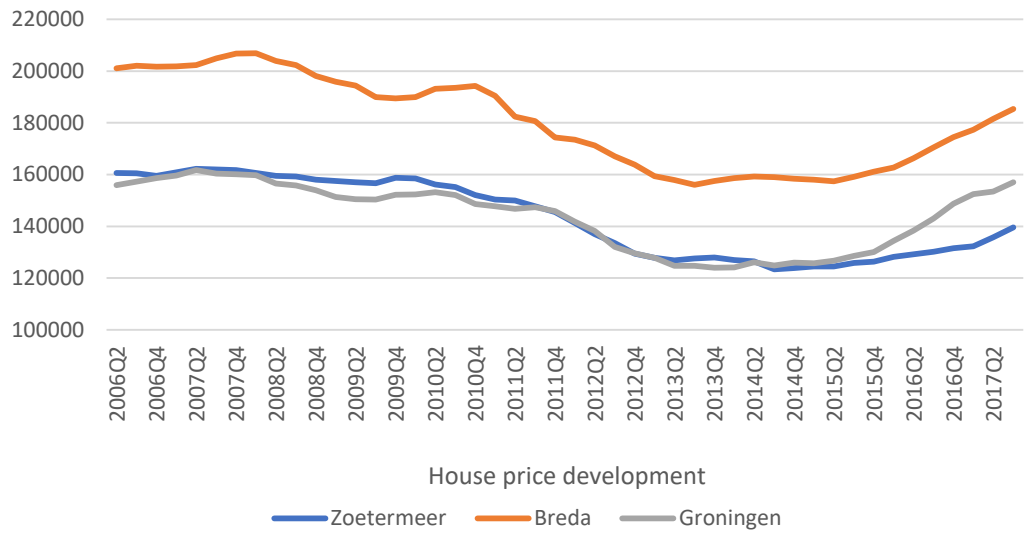

Figure 6.4 The average house price development in € for the selected dwellings in Zoetermeer, Groningen and Breda (Source: own elaboration with Kadaster data)

6.1.2 Testing the validity of the dependent variables

One of the conditions for an error-correction model is that the dependent variables should be integrated of order 1. This entails that the development of the dependent variables can be non-stationary but that the development of the first difference of the dependent variables should be stationary. To test this condition, the Augmented Dickey Fuller test has been used. The null hypothesis of this test is that there is a unit root. The alternative hypothesis is that the time series is stationary. The results of this test can be found in appendix C. Based on these results, it can be concluded that the time series of the house prices are non-stationary as the null hypothesis cannot be rejected. Next, the Augmented Dickey Fuller test was used to study the time series for the first difference of the house prices. The results of the these tests show that it is not completely certain for all dependent variables that the null hypothesis can be rejected. The p-values are 0,20 for Zoetermeer, 0,10 for Groningen and 0,07 for Breda. This means that none of the p-values is lower than 0,05. Figure 6.4 shows that it is not surprising that none of the p-values is below 0,05 as a certain trend can be observed for this period. First, the house prices are mainly decreasing, after which the house prices are increasing. This indicates that the time series is non-stationary.

6.2 The independent variables: the drivers for the house price development

The information on the independent variables have predominantly been obtained from external sources such as CBS and DNB. For some drivers, extra steps such as interpolation needed to be taken. These steps are explained in chapter 3. The results of these steps are shown in appendix D.

Just as the dependent variables, the independent variables should be integrated of order 1. The Augmented Dickey Fuller test has also been used to test the independent variables. The results are shown in appendix C. Based on these results, it can be concluded that not all independent variables are integrated of order 1. Most economic variables, such as the inflation, mortgage interest rate and household income, are integrated of order 1. Nevertheless, other variables, such as the unemployment rate and the number of households, are not integrated of order 1.

The correlation between the independent variables has also been studied to avoid multicollinearity. A correlation table has been made for the first difference of the independent variables for all three municipalities. These tables can be found in appendix E. These tables show that

the correlation coefficient is higher than 0,9 for the relation between the first difference of three variables. These are the inflation rate, the real mortgage interest rate and the real interest rate on Dutch government bonds. These values are the same for the three municipalities. This entails that these variables cannot be included in the same model. Because the real mortgage interest rate is expected to be one of the main drivers for the house price development, it has been decided to exclude the other two variables when this variable is included in a model.

6.3 Conclusion

In this chapter, the dependent and independent variables for the house price models have been constructed and the validity of these variables has been tested. Two of these variables, the house price development and the share of buy-to-let investments, will also be used to study their correlation. Since the dependent and independent variables are not all integrated of order 1, it has been decided to only make a short term model without an error-correction term. When considering the relatively short period, it also makes sense to only make a short term model instead of a short and long term model. Last, to avoid multicollinearity, the inflation and real interest rate on Dutch government bonds will not be used in the house price models when the real mortgage interest rate is included.

7 The house price models for Groningen, Breda and Zoetermeer

To identify the determinants for the development of the house prices in Groningen, Breda and Zoetermeer and to check whether buy-to-let actually results in higher house prices, three regional house prices models have been made. In addition, the correlation between the house price development and buy-to-let has been analysed. The house price models have been made for the period 2016 Q3 – 2017 Q3 and specifically the price development of urban apartments has been studied.

When making the house price models, first the real household income and the real mortgage interest rate were tested. These variables are mostly included in Dutch house price models and are said to be an important forecaster for the development of the house prices. Next, another variable was included which is the speculative behaviour of people. These speculative effects often play a large role in the short term (De Vries, 2010). These effects were included by using the house price development of the previous period. Subsequently, all other fundamental and non-fundamental variables, including the share of buy-to-let transactions, were tested in combination with one of these variables. For all variables, also the one-period-lagged values were tested as it might take some time for some variables to have an effect on the house price development. These variables were only included in the model when the p-value was below 0,10 and when the sign was theoretically correct.

In the first section, section 7.1, the three regional house price models will be discussed and compared with each other. Subsequently, in section 7.2, the specific relation between buy-to-let investments and the house price development is studied for the three municipalities. Last, in section 7.3, several conclusions will be drawn based on the findings in the previous sections.

7.1 The three short term regional house price models

In this section the different short term house price models for Groningen, Breda and Zoetermeer will be discussed. These are discussed in subsections 7.1.1-7.1.3 respectively. The validity of these models is considered in subsection 7.1.4. Last, in subsection 7.1.5, the three models will be compared with each other.

7.1.1 Short term house price model Groningen

Different combinations of variables were tested to get to a good short term house price model for Groningen. In the end, only two short-term models were made and these are shown in table 7.1. In this table, the unstandardized coefficients and the p-values for each variable, and several model statistics are shown.

As mentioned earlier, in the first model only two variables are included. These are the development of the real household income and the real mortgage interest rate. Both variables are statistically significant and have the correct sign. If the real household income increases, the house prices also increase and vice versa. The sign for the real mortgage interest rate is negative which entails that a higher real mortgage interest rate results in lower house prices and vice versa. Although both variables are statistically significant, the explanatory power of this model is relatively low. Only 28% of the variance can be explained. In addition to the low explanatory power, the Durbin Watson for this model is reasonably low and not close to two. This indicates positive autocorrelation.

In model 2, the house price development of the previous period is added. The inclusion of this variable increased the explanatory power of the model to 56%. This is an improvement of 28%. Furthermore, the Durbin Watson is closer to two and the standard error of the estimate is lower. The

signs for the three variables are in line with the literature. The signs for the real household income and the real mortgage interest rate are the same and the sign is positive for the house price development of the previous period. This means that if the house prices are increasing, they will likely keep on increasing and vice versa. This is a result of the speculative behaviour of people. Because of the inclusion of this variable, the p-values for the other two variables slightly increased. Since the p-values are still close to 0,05, it has been decided to keep both variables in the model.

Other demand- and supply-side factors were also tested in combination with (one of) these variables, but they were not significant and/or they had the wrong sign. Since model 2 performs considerably better than model 1, model 2 has been chosen as the final model for Groningen.

Table 7.1 Results short term house price models Groningen, P-values in parentheses

Dependent var. =ΔHP$_{Gron}$	**Model**	
Independent variables	1	2
ΔIncome	1,194 (0,001)	0,527 (0,070)
ΔI$_{real}$	-1,084 (0,027)	-0,801 (0,040)
ΔHP$_{Gron,t-1}$		0,610 (0,000)
Model statistics		
Number of observations	44	44
R-squared	0,279	0,561
Adjusted R-squared	0,244	0,528
Std. Error of the Estimate	0,015	0,012
Durbin-Watson	0,977	2,145

7.1.2 Short term house price model Breda

Just as for Groningen, different house price models were made for Breda. The results of these models are shown in table 7.2. In model 1, the development of the real household income and the real mortgage interest rate are included. The signs for both variables are in line with the literature, but the development of the real mortgage interest rate is not statistically significant. Furthermore, the R-squared for model 1 is only 16%. The Durbin Watson for this model is also not good and indicates positive autocorrelation.

In the next model, the speculative behaviour of people is included by using the house price development of the previous period. This results in a higher R-squared and the Durbin Watson is closer to. Although the R-squared is 31% higher, the p-values of the real household income and the real mortgage interest rate are not lower than 0,05 or 0,10. The signs for the three variables are nevertheless as expected.

Because the p-value of the real mortgage interest rate is especially high, it has been decided to remove this variable. The high p-value indicates that the mortgage interest rate is not a good determinant for the house price development for this period. The removal of this variable resulted in model 3. The model statistics are roughly the same for model 2 and 3. This is good as this indicates that despite the removal of one variable, the model still performs equally good. This is also why the difference in the adjusted R-squared is smaller than the difference in the normal R-squared. The adjusted R-squared considers the number of variables and penalizes models with a lot of variables. The relationship between the real household income and the house price development is, however, still not statistically significant.

Therefore it has been tested whether another income-related measure performs better than the real household income in combination with the house price development of the previous period. This new variable is the development of the unemployment rate. This variable has also been used in other short-term house price models and is sometimes used to replace the development of the household income (Brounen & Huij, 2004; Van der Windt, 2015). The results of model 4 are also shown in table 7.2. It can be seen that this model performs slightly better than model 3. The R-squared is 3% higher and the Durbin Watson is closer to 2. Moreover, the p-value of the unemployment rate is close to 0,05 and below 0,10. The sign is also as expected. If the unemployment rate increases, the house prices decrease and vice versa.

The inclusion of other variables did not result in better performing models. By comparing the characteristics of the four models, a decision could be made for the final model. Since the goodness of fit of model 1 is considerably lower, it has been decided to exclude this model. Next model 2 was excluded because the p-value of the real mortgage interest rate is relatively high and not significant. This means that this variable is not a good predictor. In model 3 and model 4, both an income-related measure is used in combination with the speculative behaviour of people. Both models are in line with the literature as both variables are often included in short-term house price models (see chapter 2). Because the model statistics of model 4 are slightly better than those of model 3 and because the p-value of the unemployment is close to significant, model 4 has been chosen.

Table 7.2 Results short term house price models Breda, P-values in parentheses

Dependent var. =ΔHP$_{Breda}$	**Model**			
Independent variables	1	2	3	4
ΔIncome	0,784 (0,009)	0,395 (0,115)	0,306 (0,196)	
ΔI$_{real}$	-0,735 (0,117)	-0,422 (0,268)		
ΔHP$_{Breda,t-1}$		0,602 (0,000)	0,626 (0,000)	0,398 (0,034)
ΔU				-0,121 (0,057)
Model statistics				
Number of observations	44	44	44	44
R-squared	0,166	0,473	0,457	0,482
Adjusted R-squared	0,125	0,434	0,430	0,457
Std. Error of the Estimate	0,015	0,012	0,012	0,012
Durbin-Watson	0,941	2,367	2,446	2,236

7.1.3 Short term house price model Zoetermeer

In the same way as for Groningen and Breda, different house price models were made for Zoetermeer. The results of these models are shown in table 7.3. When studying the results of model 1, it can be seen that the signs for the two variables are in line with the literature. Nevertheless, the p-value of the real mortgage interest rate is rather high and the goodness of fit of this model is relatively low.

In model 2, the house price development of the previous period is included. This model has a higher explanatory power. The difference in R-squared is 31%. The standard error of the estimate is also smaller and the Durbin Watson is closer to 2. Despite the better model statistics, the variables are not all significant. The p-value of the real mortgage interest rate is not close to 0,05 or 0,10. The signs for the three variables are nevertheless as expected and theoretically correct.

Since the relationship between the development of the real mortgage interest rate and the development of the real house prices is not statistically significant, the development of the real mortgage interest rate was removed in the next model, model 3. The goodness of fit is roughly the same for model 2 and 3. The decrease in R-squared is just 1% and the decrease in the adjusted R-squared is negligible. The signs for both variables are theoretically correct and the p-values are below or close to 0,05.

Because the unemployment rate proved to be a good indicator for the house price development in Breda, this variable was also tested for Zoetermeer. The real household income was replaced by this variable. This resulted in model 5. The explanatory power of this model is slightly higher than the explanatory power of model 4. The R-squared is 6% higher. Moreover, the Durbin Watson is closer to two and the standard error of the estimate is lower. Regarding the two variables, the signs of these variables are as expected and the p-values are lower than 0,05. This entails that the relationship between these variables and the house price development is statistically significant.

The inclusion of other fundamental and non-fundamental variables did not result in new models. Since the results of model 3 and model 4 are similar, it has been decided to consider both models in the subsequent sections. The models with the real mortgage interest rate are not selected because the relationship with the house price development is not (close to) statistically significant. The real mortgage interest rate is therefore not a good predictor for the house price development in Zoetermeer for this period.

Table 7.3 Results short term house price models Zoetermeer, P-values in parentheses

Dependent var. =ΔHP$_{Zoet}$	**Model**			
Independent variables	1	2	3	4
ΔIncome	0,847 (0,002)	0,455 (0,038)	0,401 (0,057)	
ΔI_{real}	-0,281 (0,455)	-0,296 (0,320)		
$\Delta HP_{Zoet,t-1}$		0,641 (0,000)	0,640 (0,000)	0,477 (0,001)
ΔU				-0,138 (0,003)
Model statistics				
Number of observations	44	44	44	44
R-squared	0,219	0,526	0,514	0,572
Adjusted R-squared	0,181	0,491	0,490	0,551
Std. Error of the Estimate	0,012	0,010	0,010	0,009
Durbin-Watson	,869	2,195	2,232	2,114

7.1.4 Validity regional house price models

To check the validity of the three regional house price models, the residuals for each model have been studied. Three aspects have been studied which are serial correlation, normality and homoscedasticity.

The Durbin Watson test has been used to test for serial correlation. Serial correlation can result in an underestimation of the standard error and thereby an overestimation of the importance and significance of the independent variables. Since the values for the Durbin Watson statistic are all close to 2 for the selected models, it can be concluded that the residuals are not serially correlated.

To see whether the residuals are normally distributed and homoscedastic, different plots have been made by using the standardized residuals. Histograms and normal probability plots were used to examine whether the residuals are normally distributed. Scatterplot with the standardized residuals and the standardized predicted values were used to inspect homoscedasticity. These plots can be

found in appendix F. Based on these plots, it can be concluded that the residuals of the three selected models seem to follow a normal distribution. This is especially the case for the residuals of house price model 5 (with the unemployment rate) for Zoetermeer and less likely for the residuals of the house price models for Groningen, Breda and house price model 4 (with the real household income) for Zoetermeer.

Last, regarding the homoscedasticity or constant variation of the residuals, it looks as the residuals are relatively equally distributed for the house price models for Groningen and Zoetermeer. The scatterplot for Breda looks less equal and this indicates that the variance is not constant. Consequently, the predictive ability of the model is less constant which entails that the standard errors might be biased.

7.1.5 Comparing the results of the three regional house price models

In the previous paragraphs, the different house price models for Groningen, Breda and Zoetermeer have been discussed. For Groningen and Breda one model has been chosen and for Zoetermeer two models have been selected. The house price development of the previous period is included in all four models. This is in line with the literature as speculative behaviour of people is often an important variable for short term models. The main differences between the models are related to the role of the fundamental drivers. Consequently, these will be discussed in more detail and some possible explanations for these differences will be given.

Regarding the real household income, this variable is a significant predictor for the house price development in Groningen and Zoetermeer in combination with the speculative behaviour, but not for Breda. By studying the graphs of the house price development and the real household income for the three municipalities, it can be seen that Breda experienced a slight increase in house prices in 2010. This is not the case for Groningen and Zoetermeer. In the period 2008-2013, the real household income, however, decreased in all three municipalities. This might be one of the reasons why the real household income is not a significant predictor for Breda.

The development of the unemployment rate is a significant predictor for Breda and Zoetermeer, but not for Groningen. This is probably because the unemployment rate for all municipalities starts increasing from 2008 on, but starts decreasing again in 2014 in Breda and Zoetermeer. This happens later in Groningen as the unemployment starts decreasing late 2015. Since the house prices start to increase again in 2014, the unemployment rate is not a good indicator for Groningen, but it is for Breda and Zoetermeer.

Regarding the importance of the real mortgage interest rate for the house price development, the development of this variable is the same for the three municipalities, but it is only a significant determinant for the house price development in Groningen. This is maybe because the recent house price increases are reasonably strong for Groningen and weaker for Breda and Zoetermeer. It is therefore possible that the recent declines in the real mortgage interest rate are linked to the strong house price rises in Groningen. Since the increases in the real household income were more moderate in Groningen, this variable cannot completely explain the recent rises. The mortgage interest rate is therefore a better indicator for this period.

All in all, for all three municipalities the price development of the previous period is an important determinant and the strength of the regression coefficient is roughly the same. Income-related indicators can explain part of the remaining unexplained variance in the three municipalities. Only the real mortgage interest rate is not a good indicator for this period for all municipalities. This is not completely surprising as the interest rates were kept low during the crisis to stimulate new

investments, but the house prices first continued to decline. The fact that the economic crisis is part of the short period under study, is presumably also one of the reasons for the low explanatory power of the models.

The R-squared for all three models is around 50%. This means that around 50% of the variance can be explained by the chosen indicators. This is not high as there are several Dutch house price models with an R-squared of more than 80%. As indicated above, most buyers did not act rationally during the crisis. This makes it difficult to explain the price declines during this period. The R-squared is the lowest for the final house price model for Breda and the model validity was also lower for this municipality. This indicates that it is especially difficult to explain the house price development of apartments in Breda.

Last, the main purpose of making the house price models was to check whether the size of the buy-to-let market influences the house price development. Since the results of the models are in general the same and since the buy-to-let variable could not improve the explanatory power of the models, it might be the case that the size of the buy-to-let market does not directly affect the house price development. Nevertheless, because of the low explanatory power of the models and because the role of buy-to-let might only be important for the last few years, it cannot be completely ruled out that there is no relation between buy-to-let and house price development. Hence the correlation between these two developments for the last years will be determined and discussed in the next section.

7.2 The relation between buy-to-let and the recent house price increases

To gain more insight into the possible relation between buy-to-let investments and the house price development, the correlation between these two variables has been checked. Since most people link the recent house price increases to the rise of buy-to-let, it has been decided to focus on the recent development of buy-to-let and the house price development for the three municipalities. First both developments for the three municipalities will be discussed in subsection 7.2.1. In subsection 7.2.2, the actual correlation between the two variables will be tested.

7.2.1 The recent development of buy-to-let investments and house prices

To get an idea of the two developments for the municipalities Groningen, Breda and Zoetermeer, two graphs have been constructed for the period 2014-2017. This is the period in which most house prices started to increase again. The relative change of the house prices is shown in figure 7.1. The share of buy-to-let transactions with respect to the total number of private transactions is shown in figure 7.2. This is not the actual share of buy-to-let transactions as the difference in the buy-to-let stock is divided by the number of private transactions. This means that the transaction is for example not included when one buy-to-let dwelling is sold to another buy-to-let landlord. Furthermore, some buy-to-let transactions are not private transactions. However, since most buy-to-let landlords are private individuals, this share is a relatively good indicator for the share of buy-to-let transactions.

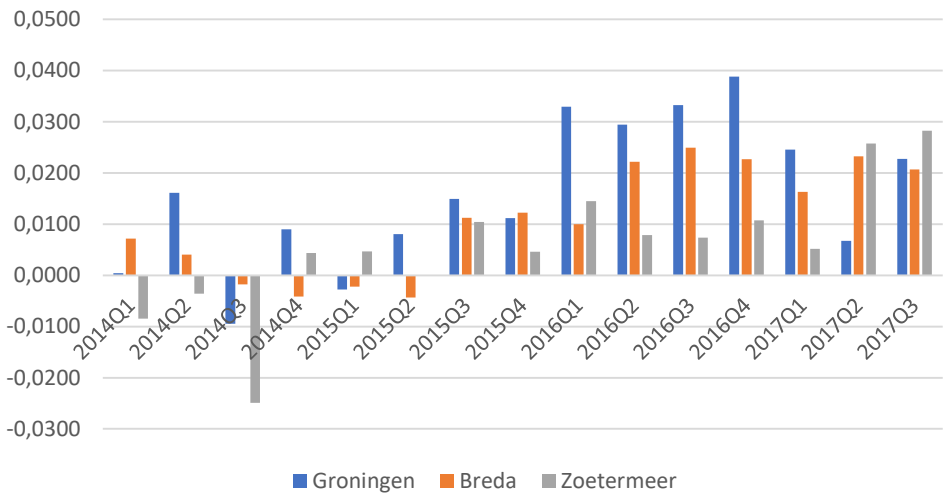

Figure 7.1 The changes (QoQ) in the average prices for apartments in Groningen, Breda and Zoetermeer (Source: own elaboration with data from the Kadaster)

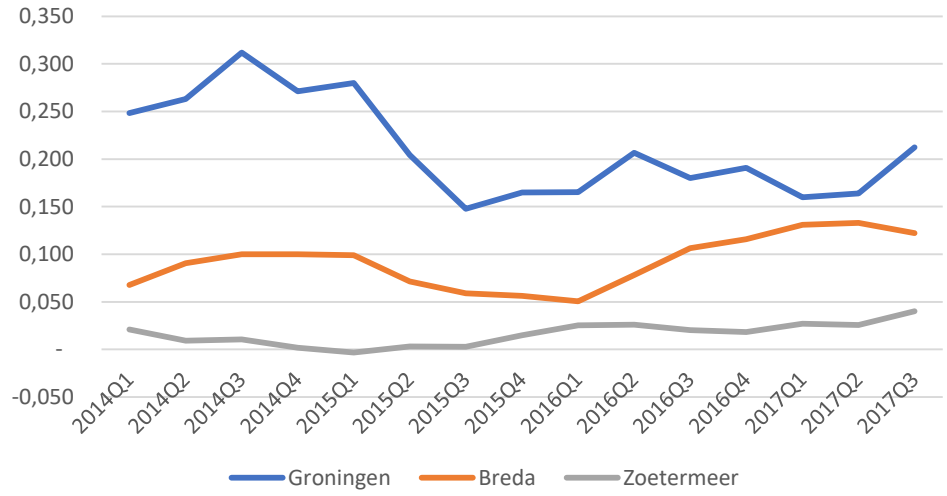

Figure 7.2 The development of the share of buy-to-let transactions for Groningen, Breda and Zoetermeer (Source: own elaboration with data from the Kadaster)

Figure 7.1 shows that the average prices of apartments in the three municipalities only experienced continuous increases since the second half of 2015. Before that moment, the prices between periods also declined several times. Groningen experienced the strongest price rises of the three municipalities and these took place in 2016. The price increases are relatively steady for Breda since the second quarter of 2016. The prices increases for Zoetermeer are especially strong in the second and third quarter of 2017.

Figure 7.2 shows that the share of buy-to-let transactions is, just as the share of buy-to-let dwellings, the highest for Groningen. Zoetermeer has the lowest share of buy-to-let transactions. In addition, the figure shows that the share of buy-to-let transactions was not constant for the three municipalities. This share has for example decreased for Groningen and increased for Breda and Zoetermeer. The difference in the share of buy-to-let transactions between Groningen and Breda has become smaller.

Besides separately studying the figures, it is interesting to compare both figures. Regarding the figures for Groningen, it seems as two separate periods can be identified. In the first period, 2014Q1-2015Q1, the share of buy-to-let transactions was relatively high while the house prices remained

roughly the same. In the second period, 2015Q2-2017Q3, the share of buy-to-let transactions is significantly lower but the prices for apartments in Groningen were strongly increasing. Hence it looks like there might be a negative relation between the share of buy-to-let transactions and the house price development in Groningen for the entire period. When focusing on the second period, it however seems as there might be a positive relation between the two variables. It looks as the changes in the share of buy-to-let transactions have a small delayed effect on the house price development. It is more difficult to identify a pattern for Breda. This is especially the case for 2014 and 2015. In these two years, the share of buy-to-let transactions was first increasing and then decreasing while the house prices did not change much in this period. In the last two years, the share of buy-to-let transactions started to increase just as the average house prices. This indicates that there might be a positive relation between the development of the share of buy-to-let transactions and the development of the house prices for this period. Last, the relation between the share of buy-to-let transactions and the house price development looks positive for Zoetermeer. In the first two years the share of buy-to-let transactions was relatively low and the house prices did not increase much. In the last two years the share of buy-to-let was relatively higher and the house price increases were also stronger. Nevertheless, the share of buy-to-let transactions remained very low for Zoetermeer.

7.2.2 Correlation between buy-to-let investments and house price development

To test whether the abovementioned assumptions regarding the relationship between the share of buy-to-let transactions and the house price development are correct, the correlation between these two variables has been determined. Also the correlation between the relative changes in the share of buy-to-let transactions and the house price development has been tested. The results of these tests are shown in table 7.4. When conducting these tests, also the one-period lagged values of the buy-to-let variables were included as it might take some time for some variables to have an effect on the house price development. This did however not result in different results. These results are therefore not included in table 7.4. Before discussing the results, it is important to note that the period under study is reasonably short. The number of observations is only 15. This makes it more difficult to get significant results and to reject the null hypothesis. The null hypothesis is that there is no correlation between the two variables. This is also one of the reasons for not separately studying the correlation between buy-to-let and the house price development in Groningen for the two different periods. This would result in an even lower number of observations.

Table 7.4 Correlation between buy-to-let and house price development for Groningen, Breda and Zoetermeer

		$ShareBTL_{municipality}$	$\Delta ShareBTL_{municipality}$
$\Delta HP_{Groningen}$	Pearson Correlation	-0,613	0,002
	Sig. (2-tailed)	0,015	0,995
	N	15	15
ΔHP_{Breda}	Pearson Correlation	0,349	0,408
	Sig. (2-tailed)	0,202	0,131
	N	15	15
$\Delta HP_{Zoetermeer}$	Pearson Correlation	0,493	0,098
	Sig. (2-tailed)	0,062	0,729
	N	15	15

The results in table 7.4 mostly confirm the previously mentioned expectations and the specific results for each municipality will be discussed in more detail below. For Groningen, the share of buy-to-let correlates with the house price development. This is a negative relation. Nevertheless, the changes in the share of buy-to-let transactions do not correlate with the changes in the house prices. Since correlation does not imply causation, it cannot be said that a high share of buy-to-let transactions leads to lower prices and vice versa. For Groningen, it could be the case that several buy-to-let landlords wanted to profit from the relatively low prices for apartments in 2014, which resulted in a higher share of buy-to-let transactions. When the prices started to increase again, it maybe became less attractive for buy-to-let landlords to buy dwellings, This could explain the drop in the share of buy-to-let transactions halfway 2015.

Regarding Breda, no significant relation was found between the development of buy-to-let and the house price development. This is possibly because the share of buy-to-let transactions first increased slightly when the prices were declining, then decreased when the prices were increasing and then increased again when the prices were also increasing. Maybe because the buy-to-let market is less mature in Breda, the landlords were not convinced that the prices would continue to increase in 2015 and therefore decided to buy less dwellings. When they noticed the rising prices, they may have decided to start buying more dwellings again.

Last for Zoetermeer, a positive, very close to significant, correlation between the share of buy-to-let transactions and the house price development has been found. However, no correlation between the changes in the share of buy-to-let transactions and the house price development has been found. Although the results cannot be used to conclude whether there is a cause-and-effect relationship between the share of buy-to-let transactions and the house price development in Zoetermeer, it is questionable whether the low share of buy-to-let transactions can actually affect the house price development. It is more logical that the recovering housing market made it more attractive for buy-to-let landlords to buy dwellings in Zoetermeer. The actual direction of the relationship between the two variables, however, cannot be specified.

7.3 Conclusion

In this chapter, the price development of apartments in Groningen, Breda and Zoetermeer has been studied. Different short term house price models have been constructed to investigate which factors can explain the house price development in these municipalities. This makes it possible to see whether the drivers are different for the three municipalities. These potential differences could be related to the size of the buy-to-let market. Besides constructing several house price models, the direct relation between the house price development and the share of buy-to-let transactions has been studied. Based on these analyses, several conclusions can be drawn.

First it can be concluded that the house price models for Groningen, Breda and Zoetermeer look relatively the same. This is interesting as the size of the buy-to-let market is considerably different for the three municipalities. A combination of an income-related variable, the household income or unemployment rate, and the price development of the previous period can partly explain the price development in the three municipalities. The real mortgage interest rate, normally an important determinant in house price models, is only a significant determinant for the house price model of Groningen. Nevertheless, this variable cannot explain much of the variance. The fact that the economic crisis is part of the short period under study is probably one of the reasons for the poor performance of this variable. This is potentially also one of the reasons for the low explanatory power of the different

house price models. The models can explain around 50% of the variance while most Dutch house price models can explain a large majority of the variance.

Moreover, the different house price models do not indicate that the size of the buy-to-let market affects the house price development. To check whether there is actually no relation between the buy-to-let market and the house price development, the relation between these two variables has been studied in more detail. The period after the economic crisis has been studied to reduce the possible consequences of this event. These analyses show that the share of buy-to-let transactions was especially high in Groningen in the period after the economic crisis. The share of buy-to-let transactions reduced when the prices started to increase. This is the other way around for Zoetermeer. Consequently, a negative relation between the share of buy-to-let transactions and the price development can be identified for Groningen and a positive relation for Zoetermeer. It is possible that the buy-to-let landlords in Groningen wanted to profit from the relatively low house prices after the crisis. This may have resulted in the higher buy-to-let share after the crisis and the lower share in the last two years. By studying the development of both variables for the municipalities, it could however also be seen that there might be a small positive relationship between the development of the share of buy-to-let transactions and the house price development in Groningen and Breda in the last three years. Nonetheless, no significant correlation was found for the entire four years.

Based on the abovementioned results, a more general conclusion can be drawn. This is that none of the analyses actually indicate that a growing or large buy-to-let market results in higher house prices. Although a positive relation was found for Zoetermeer, the size of their buy-to-let market is too small to significantly influence the price development in this municipality. Furthermore, the recent price rises were the strongest for Groningen, but the share of buy-to-let transactions did not increase much in this period in Groningen. This is an interesting conclusion as specifically the price development of urban apartments has been studied. These dwellings are particularly popular amongst buy-to-let landlords. The potential effect of buy-to-let landlords on the general house price development will therefore be even smaller. It is thus, in my opinion, unlikely that the recent price increases in the municipalities under study are caused by the buy-to-let landlords. The strong price rises are probably predominantly caused by the increasing popularity of living in cities. This increases the demand for owner-occupied and rental dwellings by households. This higher demand for rental dwellings makes it more attractive for landlords to buy owner-occupied dwellings and to rent these to interested households. As a result, the share of buy-to-let dwellings increases. This naturally also results in an extra demand for owner-occupied dwellings and puts, to a certain extent, further pressure on the house prices in these cities. This extra demand for owner-occupied dwellings is, however, significantly smaller than the demand by households.

8 Conclusion

This chapter concludes this study by answering the four sub questions and the main research question. First, the sub questions will be answered. Based on these insights, the main research question will be answered.

The sub questions are answered as follows:

1. *What are the characteristics of the Dutch buy-to-let market?*

The buy-to-let market is a part of the private rental sector. For this thesis, based on the literature and data, the private landlords with a maximum of 50 dwellings in their portfolio were considered as buy-to-let landlords. Their dwellings comprise 5% of the total Dutch housing stock. The study shows that almost all Dutch private landlords are buy-to-let landlords, but that they together only possess a slight majority of the private rental dwellings.

By studying the portfolios of these buy-to-let landlords, it became clear that a rough distinction can be made between two types of buy-to-let landlords; the landlords with multiple dwellings in their possession which are mostly located in urban areas and the landlords with only one or two dwellings in their possession which are mostly located in the more rural areas. The first group is the biggest group in the Netherlands. They predominantly own relatively small and cheap apartments in cities. These are mainly the semi-professional landlords that are investing in residential property for financial reasons. The latter group especially owns the bigger and more expensive buy-to-let dwellings in the holiday regions. Since these two groups of buy-to-let landlords have different motives, it was decided to focus on the buy-to-let landlords that are especially active in cities.

2. *What does the house price development look like for the Netherlands in general and is the house price development different for municipalities with a relatively high share of buy-to-let dwellings?*

The information on the transaction prices of dwellings has been used to study the Dutch house price development. The Dutch house prices experienced a continuous growth until the start of the economic crisis. In the period 2008-2013 the house prices seriously declined after which they started to increase again. The average nominal prices are currently higher than the pre-crisis levels, but the real prices do not reach the pre-crisis levels yet.

Besides studying the average Dutch house price development, the price development of apartments in specific municipalities has been examined. Although the general trend is the same for all studied municipalities in the period 2006-2017, there are considerable differences in the strength of the increases and declines. Two specific aspects should be highlighted. First, it seems as if the recent house price increases are on average stronger for the municipalities with a high share of buy-to-let dwellings. When comparing the pre-crisis levels with the current levels, it can be seen that the present levels are in general higher than the pre-crisis levels for these municipalities. This is less frequently the case for municipalities with an average or low share of buy-to-let dwellings. Nevertheless, it is not certain that these higher house prices are caused by the higher share of buy-to-let dwellings. It can for instance be the case that a confounding variable is present which influences both the house prices and the share of buy-to-let dwellings. Such a factor could be the increasing popularity of living in cities. Second, it could be seen that the recent house price increases are unique for Amsterdam. In addition, it looks like these dramatic price increases have affected the house price development in the neighbouring municipalities. This could explain the relatively strong price rises in these municipalities despite the relatively small size of their buy-to-let market.

3. *Which fundamental or traditional drivers can explain the house price development on a regional level and do these drivers vary between regions?*

To gain more insight in the possible drivers for the regional price development of apartments, house price models have been made for three municipalities with a varying share of buy-to-let dwellings for the period 2006-2017. These are Groningen, Breda and Zoetermeer. The share of buy-to-let dwellings is high in Groningen, average in Breda and low in Zoetermeer. Different fundamental drivers were tested in the regional house price models to verify whether they could explain the regional house price development. The tested fundamental drivers were based on the literature and the following drivers were included: real household income, inflation, nominal and real mortgage interest rate, unemployment rate, number of households and the housing stock.

An income-related variable could improve the model fit of all three regional house price models. For Groningen, the changes in the real household income proved to be a good indicator, whilst for Breda the changes in the unemployment rate could remove some of the unexplained variance. For Zoetermeer both variables were a good indicator. The real mortgage interest rate, normally an important variable in house price models, proved to be a significant determinant for Groningen only. However, the model fit just slightly improved when the real mortgage interest rate was included. The poor performance of this variable is possibly related to the developments during the economic crisis. The mortgage interest rates were kept low in this period, but the house prices continued to decline.

In general, it can be concluded that the explanatory power of the fundamental drivers is low for all three the models. This is presumably related to the short and specific period under study as the economic crisis is part of this period. Most buyers did not act rationally in this period and therefore the house price development was not in line with the development of the fundamental drivers.

4. *Which drivers related to speculation and policy, such as the presence of buy-to-let, can explain the house price development on a regional level and do these drivers vary between regions?*

Besides testing the role of fundamental drivers, other drivers related to speculation and policy were included in the models. These were the following: the price development of the previous period to test the role of speculative behaviour, two dummy variables for the new regulations on the maximum LTV ratio, the nominal and real interest rate for Dutch 10 year government bonds and the share of buy-to-let transactions.

Only one of these drivers could improve the model fit. The price development of the previous period proved to be an important indicator in all three models. This entails that people expect that the prices will keep on increasing when they are increasing and vice versa. This speculative behaviour is often a key driver in short-term house price models and this behaviour can be dangerous. When the house prices rely too much on expectations instead of the development of fundamentals, housing bubbles can arise. However, because the role of fundamental drivers is probably limited due to crisis, it cannot be concluded whether a new housing bubble is forming.

Including the share of buy-to-let transactions could not improve the model fit in any of the models. Since the relation between buy-to-let and house price development could have been formed in the last few years, the correlation between buy-to-let and house price development has also been studied for the shorter period 2014-2017. This showed that there is a negative correlation between the share of buy-to-let transactions and the house price development for Groningen, no correlation for Breda and a positive correlation for Zoetermeer. These results could be related to the matureness of the buy-to-let markets. It seems as the buy-to-let landlords in Groningen were eager to profit from the low house prices after the crisis. These landlords were relatively less active when the prices started

to increase again. On the other hand, the buy-to-let landlords in Zoetermeer seemed more hesitant and started buying more dwellings when the prices were on the rise again. Based on this finding, it is expected that different landlords are active in each municipality. In the portfolio sizes of the landlords, however, no clear differences could be identified. In all three municipalities the clear majority of buy-to-let dwellings are owned by landlords with 3-50 dwellings in their portfolio. Nevertheless, the buy-to-let market of Groningen is considerably larger than the buy-to-let markets of Breda and Zoetermeer. The buy-to-let market of Groningen has also grown more in the last ten years. This indicates that buy-to-let landlords have already been active in Groningen for a long time. This could explain their different behaviour.

Based on the above answers to the sub questions, the main research question can be answered. The main research question is formulated as follows:

"What is the effect of buy-to-let investments on the Dutch regional house price development?"
Based on the results of the analyses, it is difficult to draw firm conclusions regarding the relation between buy-to-let investments and regional house price development. Nevertheless, they did provide three valuable insights into this possible relation. These insights indicate that there is no clear reason to assume that a growing or large buy-to-let market results in higher house prices.

First, the average prices of apartments have increased relatively the most in municipalities with a high share of buy-to-let dwellings since the start of the economic crisis. It is however possible that these strong increases are caused by other factors than buy-to-let. The increasing popularity of living in these cities, for example, can have caused a higher demand for dwellings. This could explain the higher house prices and the higher share of buy-to-let dwellings. Since different factors influence the house price development, three regional house price models were made. These led to the second key insight. This is that the house price models for the three municipalities with a different share of buy-to-let look roughly the same. The speculative behaviour of people and income-related variables can partially explain the house price development. Moreover, the model fit was relatively low for all three models due to the turbulent period under study. The main difference was that the development of the real mortgage interest rate was a significant driver for the municipality with the highest share of buy-to-let dwellings and not for the others. This entails that the house price model for the municipality with one of the biggest buy-to-let markets most closely resembles a standard house price model. Nevertheless, it must be said that the model fit only slightly improves when the mortgage interest rate is included. The last insight is based on the correlation between the share of buy-to-let transactions and the house price development. This showed that share of buy-to-let transactions negatively correlates with the house price development for the municipality with the more mature buy-to-let market and positively correlates for the municipality with the small buy-to-let market. Due to the small size of this market, it is unlikely that the recent price rises were caused by the growing buy-to-let market. These results might indicate that buy-to-let landlords in a bigger buy-to-let market act more like genuine investors, who buy more when the prices are low.

All in all, based on the analyses for the three municipalities, it can be concluded that none of the results actually point at an inflationary effect of buy-to-let investments. This is interesting because specifically the price development of urban apartments has been studied. Since these dwellings are mostly bought by buy-to-let landlords, it was expected that if buy-to-let investments result in higher house prices, this effect would have been found for these type of dwellings. The general effect, if any, of buy-to-let investments on the regional house price development will therefore be even smaller.

Although the analyses have provided several interesting insights, the actual relation between buy-to-let investments and house price development is not entirely clear yet and more attention needs to be paid to the potential reasons for the relatively stronger price increases in the municipalities with a bigger buy-to-let market.

9 Discussion

In this chapter, the research methods and results will be discussed in more detail. Since this is one of the first quantitative studies on the Dutch buy-to-let market and the relation between buy-to-let and the house price development, different limitations regarding the data and research methods were encountered during the process. The most important limitations will be discussed in section 9.1. In section 9.2, based on these limitations, recommendations for further research will be given. In the last section, section 9.3, the focus is on the results of this study. Although the previous chapter showed that it is difficult to draw firm conclusions regarding the relation between buy-to-let and the house price development, the results of the analyses are interesting for policy makers and other parties involved in the housing market. The societal relevance of the results will therefore be discussed in the last section.

9.1 Main limitations data and research methods

In this paragraph, the main limitations regarding this research in general, the research methods and data are highlighted. First, regarding the research results, these cannot be generalised unreservedly due to the explorative character of this study. The relation between buy-to-let investments and the house price development has only been studied for three municipalities. Consequently, it cannot be said that the results will be the same for other municipalities. Each municipality is different in terms of location and the socio-economic and demographic characteristics. These characteristics affect the house price development. This also became clear when studying the house price development of fifteen different municipalities. This development was different for each municipality and a range of arguments can be provided to explain these differences. It is, however, difficult to correct for all of them. This makes it hard to compare municipalities and to generalize results.

When reflecting on the research method and specifically the use of linear regression and house price models, other limitations come to light. First, the results indicate that the relation between buy-to-let investments and house price development is potentially different from the relation between most other variables and the house price development. As a result, the use of linear regression and house price models might not be the best to study this relation. It is, based on the correlation results, expected that the relation between buy-to-let and the house prices is two-way. This is not necessarily the case for the other variables or this will be more indirect. If the house prices, for instance, increase, the income levels will not immediately change, but this will affect the investment decisions of buy-to-let landlords. Furthermore, because only a relatively short period was selected, mainly due to data limitations, it was difficult to construct good house price models. This was even more challenging because the economic crisis was part of this short period. If the house price development for a longer period could have been studied, maybe an error-correction model could have been constructed and more insight could be gained into the fundamental drivers for the house price development for the three municipalities.

Last, although a lot of data was available to study the Dutch buy-to-let market and the relation between buy-to-let investments and regional house price development, even more or better data is required to properly study these aspects. For example, when studying the price development of apartments, it became clear that the number of transactions for the municipalities with a low share of buy-to-let was relatively low. This made it more difficult to get a good idea of the price development. Furthermore, several steps needed to be taken to get the data on the independent variables ready for the house price models. Information on these variables was often not available on a quarterly basis

and this made it necessary to interpolate the data. This means that it was assumed that the development was constant during the year. Good data on the height of rents was also not available. Since this is normally not an important driver in Dutch house price models, it would have been interesting to have this data as the rents are a key variable for landlords. The average rent levels can influence their investment decisions and landlords can directly influence these rent levels.

9.2 Recommendations for further research

Based on the previously discussed limitations, several recommendations for further scientific research can be provided. Since this is mainly an explorative study, there are multiple interesting options for a follow-up study. One option would be to zoom in even more on the three municipalities. Qualitative methods could be used to gain more insight in the possible reasons for the higher house prices and the development of the buy-to-let market. It would specifically be interesting to better understand the negative correlation between the share of buy-to-let transactions and the house price development in Groningen. Interviews could for example be held with buy-to-let landlords in Groningen to understand why they bought relatively more dwellings at the end of 2014/start 2015. These qualitative methods would make it possible to better grasp the local dynamics and these could be used to explain the quantitative results.

Another interesting option would be a more quantitative study in which more municipalities are being studied. The focus should still be on the bigger municipalities and cities but a division could be made between the municipalities with a bigger and more mature buy-to-let market and the municipalities with a smaller buy-to-let market. It would be interesting to investigate whether buy-to-let landlords behave differently in the more mature markets and for instance buy dwellings when the prices are low and sell dwellings when the prices are high. By focusing on the purchases and sales of buy-to-let dwellings and the house price development, more insight can be gained into the behaviour of these landlords. In that case, there is also no need for constructing more house price models which involves collecting and processing suboptimal data.

For both studies, it would be good if also other house prices indexes could be used to study the house price development. A regional SPAR (Sale Price Appraisal Ratio) index could for instance be constructed and maybe even a specific index for apartments. For constructing such an index, information on the appraisal values of the dwellings is needed. The transaction prices of dwellings are compared to their appraisal values to see whether the prices are increasing or decreasing and at what rate. The use of appraisal values makes it possible to better correct for the quality differences of the dwellings sold between periods. Hence, the development of this index would better reflect the actual market conditions. Another possibility would be to construct two different indexes. Both indexes could be constructed by using the SPAR method. One index should reflect the house price development of dwellings bought by owner-occupiers. The other index should reflect the house price development of dwellings bought by private landlords. These indexes could be compared with each other. It would be interesting to see whether the development of both indexes is the same. This could also say something about the relation between buy-to-let investments and the house price development.

Last, as the growing buy-to-let market is a relatively recent development, it would be interesting to conduct a comparable study in ten years' time. New regional house price models could be made for the three municipalities. This would make it possible to see whether the same drivers are still important. Furthermore, if there will be no new crisis, it might be possible to construct house price models with a greater explanatory power. The specific relation between buy-to-let investments and the house price development could also be better studied as more data will be available by that time.

9.3 The societal relevance of the results

The possible societal relevance of this study has been discussed in the Introduction. In this chapter, two specific aspects regarding the societal relevance were mentioned and these will be reflected on in this section. One of these aspects is the importance of knowing the drivers for the house price development. When these drivers are known, it becomes possible to predict the house price development. It is also relevant to know whether the house price development is mainly influenced by fundamental or non-fundamental drivers, because the housing market becomes more vulnerable if non-fundamental drivers are gaining importance. Based on the regional house price models, several conclusions can be drawn regarding this aspect. The regional house price models for instance show that it is difficult to explain the house price development for the period 2006-2017. Only half of the variance can be explained while many factors were tested. The factors that were included in the final models were income-related variables, the mortgage interest rate and the price development of the previous period. Thus a combination of fundamental and non-fundamental variables. The low explanatory power of the models indicates that the house price development was not in line with the development of most drivers during this period. This does, however, not mean that the recent house price rises are not related to the development of the fundamental drivers. The low explanatory power is more likely related to the house price development during the economic crisis. The recent price rises can for instance be explained by the increasing household income and the low mortgage interest rate. Therefore, it is not expected that the house prices will suddenly decline.

The second aspect, which was the main focus of this study, is regarding the relation between buy-to-let investments and regional house price development and the potential need for policy measures. Based on the analyses for the three municipalities, it can be concluded that buy-to-let investments do not significantly result in higher house prices. The migration to cities is, in my opinion, one of the main reasons for the stronger price rises in cities. The higher demand for urban dwellings in combination with the shortage of both owner-occupied and rental dwellings results in higher house prices. As a result, policy measures that restrict landlords from buying more dwellings will not necessarily lead to lower house prices because still the clear majority of the dwellings is bought by households. On the other hand, these policy measures would help first-time buyers as it reduces the competition between first-time buyers and private landlords. Since the smaller private landlords mostly buy owner-occupied dwellings instead of building new rental dwellings, the competition between these two groups is quite strong. This measure might be beneficial for first-time buyers, but it could negatively affect the households that want to live in a rental dwelling. These households are maybe unable to finance an owner-occupied dwelling. Consequently, municipalities should in my opinion mostly focus on expanding their housing stock. This could have a dampening effect on the house prices over time. As this might take some time, it is important that the municipalities carefully monitor the quality of the private rental stock and interfere when necessary. Some landlords might want to profit from the shortage and the high demand by increasing the rents and/or lowering the maintenance costs.

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Appendices

A Datasets Kadaster

For this thesis, different datasets of the Kadaster have been used. For chapter 4, especially the dataset with the Dutch housing stock has been used. For chapter 5 and the regression analysis, the dataset with the housing transactions has been used. Since most results are based on these two datasets, it will shortly be explained how these datasets are being compiled and which choices have been made. In section A.1, the dataset with the Dutch housing stock will be discussed. Next in section A.2, the dataset with the housing transactions will be reviewed.

A.1 Dataset with the Dutch housing stock

This dataset is based on the "Basisregistratie Adressen en Gebouwen" (BAG). The municipalities are responsible for updating this registry and the Kadaster manages all the data. Not all the information of the BAG is included in this database. Only the objects that are in use and that have a residential function have been selected. Some of the properties of these objects are also copied to the database. These are the floor area, the year of construction, the x- and y coordinates, municipality and the pht (postal code, house number and suffix).

Next, these objects are being linked to the basic registry of the Kadaster (BRK). This registry contains amongst others information on the ownership rights. This makes it possible to link information on the owner to the objects. Since often multiple property rights are associated with one property, the Kadaster uses a specific method to select the "most important" owner. This information is needed to determine the type of owner.

For this specific database, the Kadaster makes a distinction between seven types of owners; owner-occupier, second dwelling, housing association, institutional investor, small private landlord, other and unknown. The owner is an owner-occupier when he/she is a natural person and owns only one dwelling. When a natural person owns two dwellings and does not live in that dwelling, the dwelling is classified as a "second home". To see whether the dwelling is owned by a housing association, a list with all the Dutch housing associations is being used. These subjects numbers are being compared with the subject number of the owner and when there is a match, the type of owner is said to be a housing association. Two methods are used to classify an owner as a large private landlord or institutional investor. If a private company owns more than 500 dwellings, it is said to be a large private landlord. Furthermore, the name of the owner is being checked. If for example "pension" or "Achmea" is part of the name, the owner is also regarded an institutional investor. It is often the case that these pension funds are the legal owner, but that institutional investors are the beneficial owner. These investors manage the money of different funds and use this money for instance to invest in residential property. If a private company owns more than one dwelling and is not an institutional investor or "other", it is classified as a small private landlord. Also private persons with more than two dwellings in their possession are considered a small private landlord. When a dwelling is owned by government institutions, ecclesiastical parties or other associations (which are not a housing association or private landlord), it falls in the category "other". Last, it can be the case that the link between the BAG and the BRK was not successful. In such cases, the type of owner is unknown.

The final dataset contains the following properties (the properties related to the owner are all based on the most important owner of the property):

- Information on the object:
    - Identity number object
    - Identity number building
    - Floor area object
    - Floor area building
    - Municipality
    - X and y coordinates
    - Year of construction
    - Pht (postal code, house number & suffix)
    - Type of dwelling (apartment, terraced, end-terraced, semi-detached, detached and other)
    - Object number
    - Energy label and index
    - Neighbourhood code
    - Number of private persons with property rights
    - Last purchase date (year)
- Information on the most important owner:
    - Identity and KVS number owner
    - Name private company
    - Type of private company (e.g. private/public liability company or association)
    - Gender private person
    - Date of birth private person
    - Number of dwellings in possession
    - Type of owner (owner-occupier, second dwelling, housing association, small/large private landlord, other & unknown)
    - Nature of property
- Method of linkage BAG and BRK (administrative, geometric or both)

A.2 Dataset with the Dutch housing transactions

The Kadaster also records the transfers of ownership. As a result, it has information on the type of transaction, the traded objects and the parties involved. This information is stored in one large database and this database contains all the transactions since 1993 and is updated on a monthly basis. Based on this database, specific datasets can be produced. One of these datasets contains the housing transactions by private individuals only. As such, it can be used to calculate the average house price of private dwellings. To make sure that this gives a correct image, only transactions with a reliable transaction price are included. The Kadaster uses different checks to determine this. Furthermore, solely transactions with a transaction price between €10.000 and €5.000.000 are included.

This dataset contains the following information:

- Information on the transaction:
    - Transaction date
    - Transaction price
    - Identity number

- Information on the object:
    - Floor area
    - Type of dwelling (apartment, terraced, end-terraced, semi-detached, detached and other)
    - Pht (postal code, house number & suffix)
    - X and y coordinates
    - Municipality code
- Information on the buyer(s):
    - Number of buyers
    - Gender of buyer
    - Age
    - Address
- Information on the seller(s):
    - Private person/company

B The steps undertaken for the descriptive statistics

In appendix 1, the two datasets have been discussed. When creating the descriptive statistics sometimes extra steps needed to be taken to get the right results. These steps will be briefly explained in this appendix. First, in section B.1, the steps related to the descriptive statistics shown in chapter 4 will be discussed. In section B.2, the descriptive statistics for chapter 5 will be treated.

B.1 The descriptive statistics in chapter 4

B.1.1 Division of the Dutch housing stock with respect to type of owner

For this figure, the attribute "type of owner" has been used. Furthermore, for dwellings with the classification second dwelling, it has been checked whether these dwellings have been in possession for more than 6 months. If this is the case, it has been assumed that this dwelling is being rented out and these dwellings were added to the other private rental dwellings. If this was not the case, these dwelling were added to the other/unknown class. This was done to correct for the possibility that some people have two dwellings in their possession when they are moving houses.

B.1.2 Distribution of portfolio size

A new variable was created which was based on the number of rental dwellings owned by the landlords. This also entails that the dwellings in which the private landlords live themselves were excluded to make sure that only the rental dwellings are included. To get the number of landlords, the dwellings with the same subject number (identity number for owner) were grouped together.

B.1.3 The preferences of buy-to-let landlords

First the dwellings types have been studied. The dwellings for which the dwelling type was unknown have been excluded. This was done because this share was less than 1% of the total number of dwellings. Regarding the floor area of the dwellings, dwellings with a floor area of less than 10m2 and dwellings with a floor area equal to or greater than 300m2 have been excluded. This means that roughly 4% of the buy-to-let dwellings were excluded for this analysis. These were predominantly dwellings with a relatively large floor area. These dwellings were excluded because sometimes mistakes are made when entering the attributes in the registry and because error codes such as 99999 can distort the results.

Since the dataset with the Dutch housing transactions and the dataset with the Dutch housing stock cannot easily be connected, several steps needed to be taken to get an estimation of the value of the dwellings. First, the dataset with the housing transactions was used to calculate the average square meter price for different groups of dwellings. Several variables were used to get these groups. These were the province, dwelling type and dwelling density. Next, these average square meter prices were connected to the database with the Dutch housing stock. By multiplying these prices with the floor surface of each dwelling, the value of the dwelling could be estimated. Since this method is dependent on the quality of the average square meter price for each group, this method can result in very low or high prices. Therefore, dwellings with a price below €10.000 or higher than €1.000.000 have been excluded. This entails that about 5% of the dwellings were excluded. Although the values will not be completely accurate, they give a good representation of the value of buy-to-let dwellings in general compared to other dwellings.

Last, to study the location of buy-to-let dwellings, the dataset of the Kadaster has been connected to data from the CBS. This has been done by using the neighbourhood code. CBS has information on the dwelling density on the neighbourhood level and their classification (very high, high, moderate, low and very low) has been used (CBS, 2018). This attribute is based on the number of dwellings per squared kilometre and the classification is shown in table B.1.

Table B.1 Classification dwelling density

Dwelling density class	Number of dwellings per km2
1 - Very high	>=2500
2 - High	1500 - 2499
3 - Moderate	1000 - 1499
4 - Low	500 - 999
5 - Very low	<500

B.2 The descriptive statistics in chapter 5

B.2.1 The Dutch house price development in real terms

The CBS figures on the consumer price index have been used to deflate the transaction prices. All individual transaction prices have first been deflated before the average house price was calculated for each year. Since the specific transaction date is known, the monthly consumer price index could be used. Last, the consumer price index was set on 100 for the first of January 1993.

B.2.2 The average price per square meter

To get the average price per square meter, the transaction price for each dwelling has been divided by the floor surface. As the floor surface is not always included or sometimes incorrect, dwellings with a floor surface below 20 square meter or higher than 500 square meter were excluded.

C The results of the Augmented Dickey Fuller tests

Table C.1 Results ADF test for P_t

Augmented Dickey-Fuller test for P_t				**Number of obs =**	**44**
		---------- Interpolated Dickey-Fuller ---------			
	Test Statistic	1% Critical Value		5% Critical Value	10% Critical Value
Z(t)	-2.048	-3.621		-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.2659					

Table C.2 Results ADF test for ΔP_t

Augmented Dickey-Fuller test for ΔP_t				**Number of obs =**	**44**
		---------- Interpolated Dickey-Fuller ---------			
	Test Statistic	1% Critical Value		5% Critical Value	10% Critical Value
Z(t)	-6.609	-3.621		-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.000					

Table C.3 Results ADF test for I_t

Augmented Dickey-Fuller test for I_t				**Number of obs =**	**44**
		---------- Interpolated Dickey-Fuller ---------			
	Test Statistic	1% Critical Value		5% Critical Value	10% Critical Value
Z(t)	-1.540	-3.621		-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.5135					

Table C.4 Results ADF test for ΔI_t

Augmented Dickey-Fuller test for ΔI_t				**Number of obs =**	**44**
		---------- Interpolated Dickey-Fuller ---------			
	Test Statistic	1% Critical Value		5% Critical Value	10% Critical Value
Z(t)	-6.915	-3.621		-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.000					

Table C.5 Results ADF test for B_t

Augmented Dickey-Fuller test for B_t				**Number of obs =**	**44**
		---------- Interpolated Dickey-Fuller ---------			
	Test Statistic	1% Critical Value		5% Critical Value	10% Critical Value
Z(t)	-1.377	-3.621		-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.5932					

Table C.6 Results ADF test for ΔB_t

Augmented Dickey-Fuller test for ΔB_t		**Number of obs =**		**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-6.437	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.000				

Table C.7 Results ADF test for $LTV1_t$

Augmented Dickey-Fuller test for $LTV1_t$		**Number of obs =**		**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-1.000	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.7533				

Table C.8 Results ADF test for $LTV2_t$

Augmented Dickey-Fuller test for $LTV2_t$		**Number of obs =**		**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-1.634	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.4653				

Table C.9 Results ADF test for $HP_{t,\ Groningen}$

Augmented Dickey-Fuller test for $HP_{t,Groningen}$		**Number of obs =**		**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-0.647	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.8599				

Table C.10 Results ADF test for $\Delta HP_{t,\ Groningen}$

Augmented Dickey-Fuller test for $\Delta HP_{t,Groningen}$		**Number of obs =**		**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-2.558	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.1020				

Table C.11 Results ADF test for $HP_{t,\ Breda}$

Augmented Dickey-Fuller test for $HP_{t,Breda}$		**Number of obs =**		**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-1.201	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.6732				

Table C.12 Results ADF test for $\Delta HP_{t,Breda}$

Augmented Dickey-Fuller test for $\Delta HP_{t,Breda}$			**Number of obs =**	**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-2.755	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.0650				

Table C.13 Results ADF test for $HP_{t,\ Zoetermeer}$

Augmented Dickey-Fuller test for $HP_{t,Zoetermeer}$			**Number of obs =**	**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-1.237	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.6576				

Table C.14 Results ADF test for $\Delta HP_{t,\ Zoetermeer}$

Augmented Dickey-Fuller test for $\Delta HP_{t,Zoetermeer}$			**Number of obs =**	**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-2.218	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.1998				

Table C.15 Results ADF test for $Y_{t,\ Groningen}$

Augmented Dickey-Fuller test for $Y_{t,Groningen}$			**Number of obs =**	**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-0.696	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.8479				

Table C.16 Results ADF test for $\Delta Y_{t,\ Groningen}$

Augmented Dickey-Fuller test for $\Delta Y_{t,Groningen}$			**Number of obs =**	**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-4.611	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.0001				

Table C.17 Results ADF test for $Y_{t,\ Breda}$

Augmented Dickey-Fuller test for $Y_{t,Breda}$			**Number of obs =**	**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-0.642	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.8613				

Table C.18 Results ADF test for $\Delta Y_{t,\ Breda}$

Augmented Dickey-Fuller test for $\Delta Y_{t,Breda}$		**Number of obs =**		**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-4.280	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.0005				

Table C.19 Results ADF test for $Y_{t,\ Zoetermeer}$

Augmented Dickey-Fuller test for $Y_{t,Zoetermeer}$		**Number of obs =**		**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-0.775	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.8263				

Table C.20 Results ADF test for $\Delta Y_{t,\ Zoetermeer}$

Augmented Dickey-Fuller test for $\Delta Y_{t,Zoetermeer}$		**Number of obs =**		**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-4.482	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.0002				

Table C.21 Results ADF test for $U_{t,\ Groningen}$

Augmented Dickey-Fuller test for $U_{t,Groningen}$		**Number of obs =**		**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-0.623	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.8657				

Table C.22 Results ADF test for $\Delta U_{t,\ Groningen}$

Augmented Dickey-Fuller test for $\Delta U_{t,Groningen}$		**Number of obs =**		**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-1.961	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.3038				

Table C.23 Results ADF test for $U_{t,\ Breda}$

Augmented Dickey-Fuller test for $U_{t,Breda}$		**Number of obs =**		**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-0.234	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.9344				

Table C.24 Results ADF test for $\Delta U_{t,\ Breda}$

Augmented Dickey-Fuller test for $\Delta U_{t,Breda}$			**Number of obs =**	**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-1.618	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.4735				

Table C.25 Results ADF test for $U_{t,\ Zoetermeer}$

Augmented Dickey-Fuller test for $U_{t,Zoetermeer}$			**Number of obs =**	**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-0.651	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.8590				

Table C.26 Results ADF test for $\Delta U_{t,\ Zoetermeer}$

Augmented Dickey-Fuller test for $\Delta U_{t,Zoetermeer}$			**Number of obs =**	**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-1.411	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.5772				

Table C.27 Results ADF test for $HH_{t,\ Groningen}$

Augmented Dickey-Fuller test for $HH_{t,Groningen}$			**Number of obs =**	**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-1.587	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.4900				

Table C.28 Results ADF test for $\Delta HH_{t,\ Groningen}$

Augmented Dickey-Fuller test for $\Delta HH_{t,Groningen}$			**Number of obs =**	**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-1.673	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.4451				

Table C.29 Results ADF test for $HH_{t,\ Breda}$

Augmented Dickey-Fuller test for $HH_{t,Breda}$			**Number of obs =**	**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-2.289	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.1754				

Table C.30 Results ADF test for $\Delta HH_{t,\ Breda}$

Augmented Dickey-Fuller test for $\Delta HH_{t,Breda}$		**Number of obs =**		**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-1.906	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.3291				

Table C.31 Results ADF test for $HH_{t,\ Zoetermeer}$

Augmented Dickey-Fuller test for $HH_{t,Zoetermeer}$		**Number of obs =**		**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-8.431	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.000				

Table C.32 Results ADF test for $\Delta HH_{t,\ Zoetermeer}$

Augmented Dickey-Fuller test for $\Delta HH_{t,Zoetermeer}$		**Number of obs =**		**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-1.716	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.4227				

Table C.33 Results ADF test for $S_{t,\ Groningen}$

Augmented Dickey-Fuller test for $S_{t,Groningen}$		**Number of obs =**		**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-0.359	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.9167				

Table C.34 Results ADF test for $\Delta S_{t,\ Groningen}$

Augmented Dickey-Fuller test for $\Delta S_{t,Groningen}$		**Number of obs =**		**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-2.705	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.0732				

Table C.35 Results ADF test for $S_{t,\ Breda}$

Augmented Dickey-Fuller test for $S_{t,Breda}$		**Number of obs =**		**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-0.478	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.9842				

Table C.36 Results ADF test for $\Delta S_{t,\ Breda}$

Augmented Dickey-Fuller test for $\Delta S_{t,Breda}$		**Number of obs =**		**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-4.512	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.0002				

Table C.37 Results ADF test for $S_{t,\ Zoetermeer}$

Augmented Dickey-Fuller test for $S_{t,Zoetermeer}$		**Number of obs =**		**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-2.490	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.1180				

Table C.38 Results ADF test for $\Delta S_{t,\ Zoetermeer}$

Augmented Dickey-Fuller test for $\Delta S_{t,Zoetermeer}$		**Number of obs =**		**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-4.011	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.0014				

Table C.39 Results ADF test for $BTL_{t,\ Groningen}$

Augmented Dickey-Fuller test for $BTL_{t,Groningen}$		**Number of obs =**		**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-1.706	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.4279				

Table C.40 Results ADF test for $\Delta BTL_{t,\ Groningen}$

Augmented Dickey-Fuller test for $BTL_{t,Groningen}$		**Number of obs =**		**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-5.944	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.0000				

Table C.41 Results ADF test for $BTL_{t,\ Breda}$

Augmented Dickey-Fuller test for $BTL_{t,Breda}$		**Number of obs =**		**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-1.756	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.4026				

Table C.42 Results ADF test for $\Delta BTL_{t,\ Breda}$

Augmented Dickey-Fuller test for $BTL_{t,Groningen}$			**Number of obs =**	**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-7.937	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.0000				

Table C.43 Results ADF test for $BTL_{t,\ Zoetermeer}$

Augmented Dickey-Fuller test for $BTL_{t,Breda}$			**Number of obs =**	**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-2.026	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.2752				

Table C.44 Results ADF test for $\Delta BTL_{t,\ Zoetermeer}$

Augmented Dickey-Fuller test for $BTL_{t,Breda}$			**Number of obs =**	**44**
		---------- Interpolated Dickey-Fuller ---------		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-5.955	-3.621	-2.947	-2.607
MacKinnon approximate p-value for Z(t) = 0.0000				

D Graphs dependent and independent variables

In this appendix, the graphs for all the dependent and independent variables are shown. In section D.1, the development of the inflation, real mortgage interest rate and the real interest rate for the Dutch government bonds are shown. In sections D.2-D.4 the graphs for Groningen, Breda and Zoetermeer respectively are shown.

D.1 Graphs for the Netherlands in general

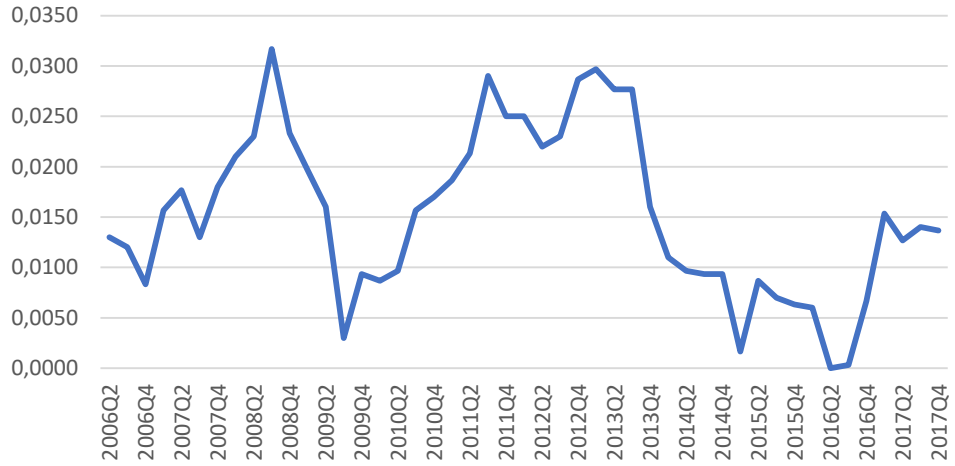


Figure D.1 Inflation

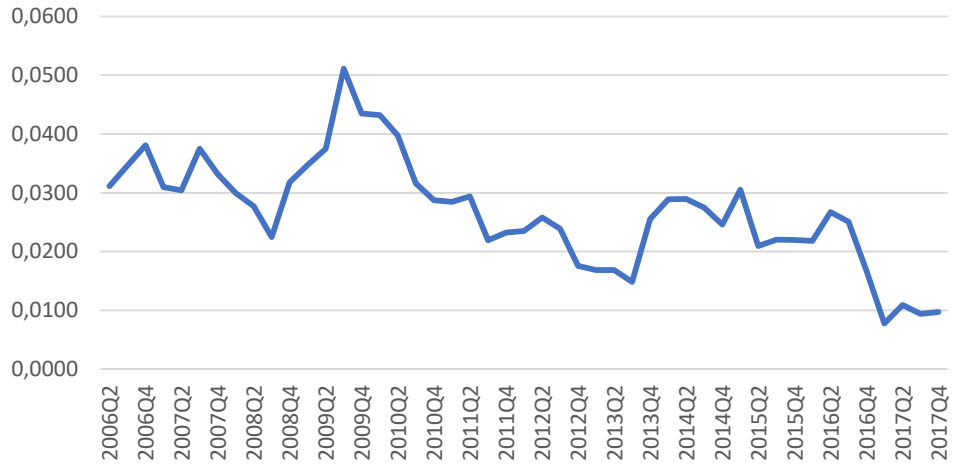


Figure D.2 Real mortgage interest rate

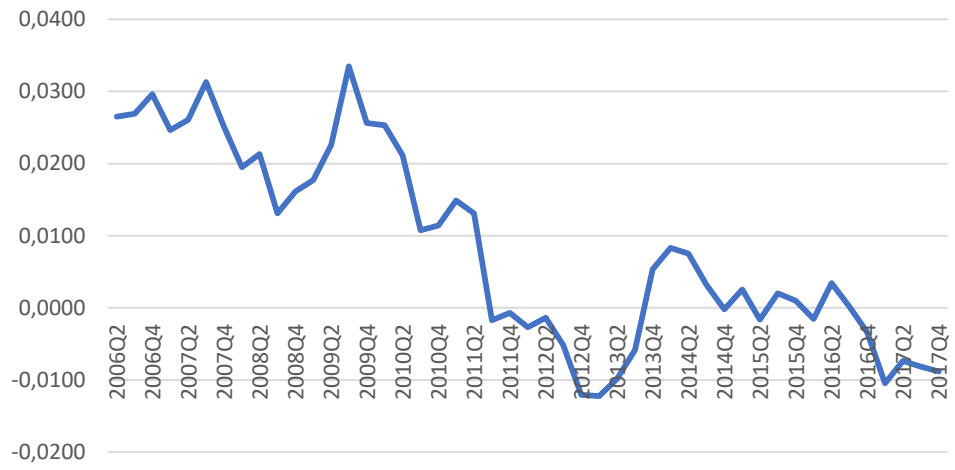


Figure D.3 Real interest rate Dutch government bonds

D.2 Graphs Groningen

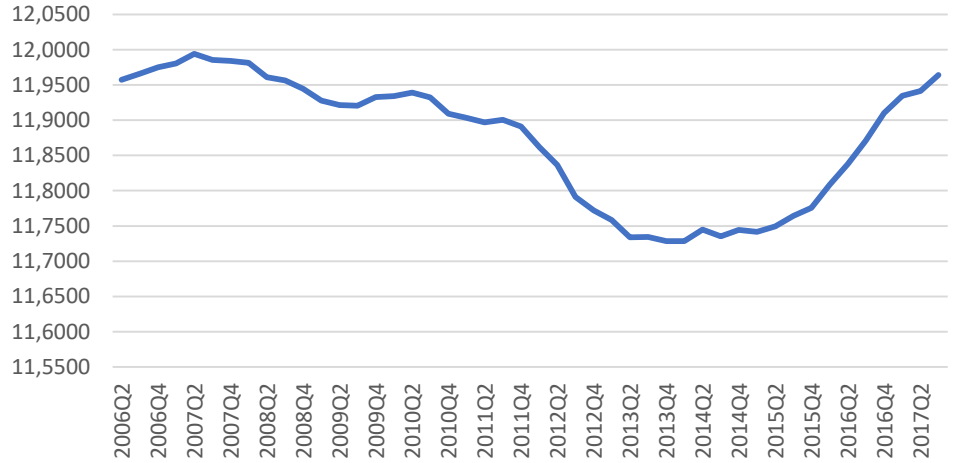


Figure D.4 Ln house price development for Groningen

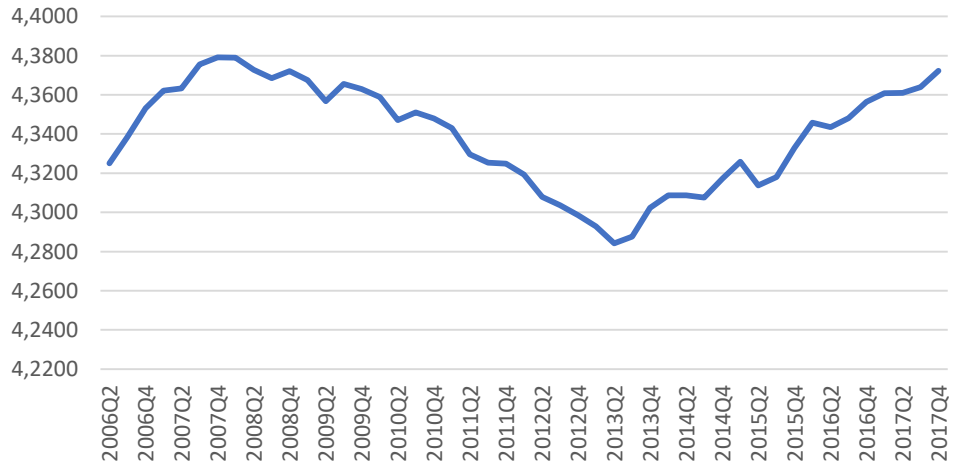


Figure D.5 Ln real household income for Groningen

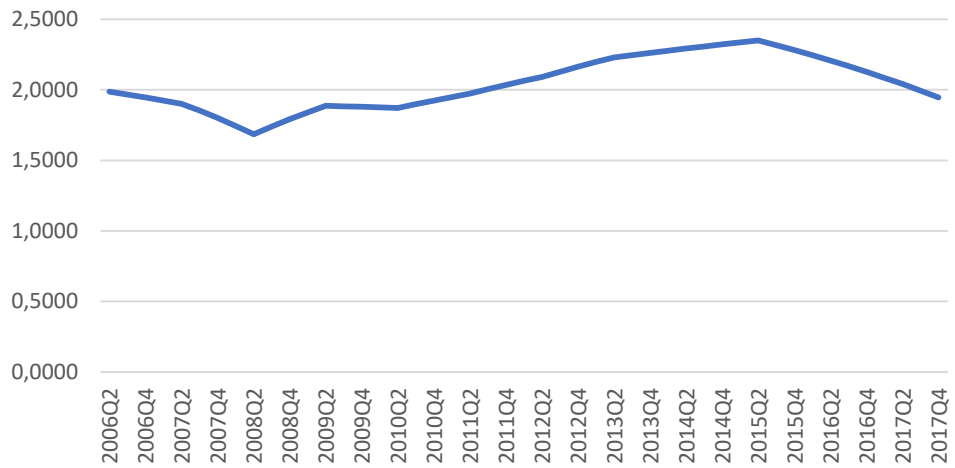


Figure D.6 Ln unemployment rate for Groningen

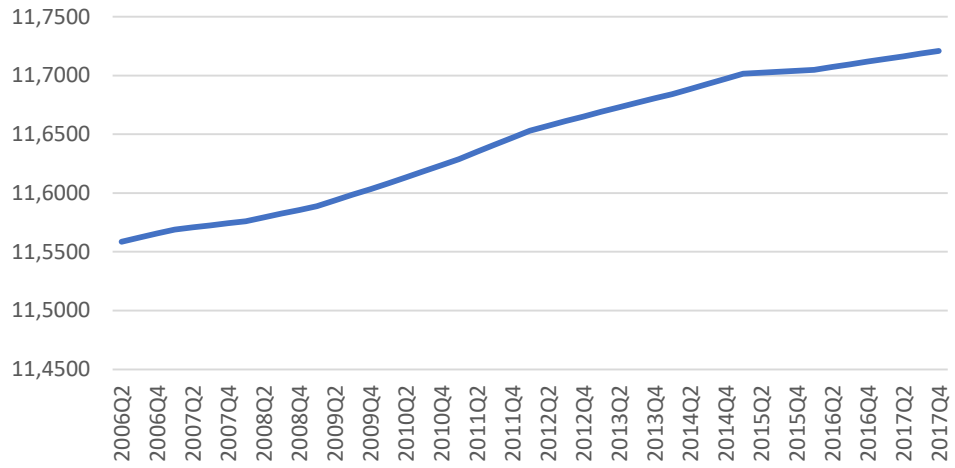


Figure D.7 Ln number of households for Groningen

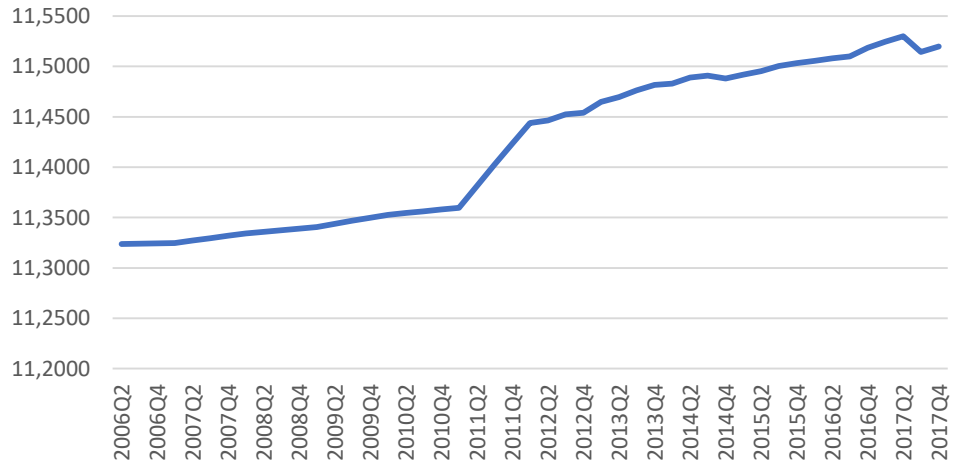


Figure D.8 Ln housing stock for Groningen

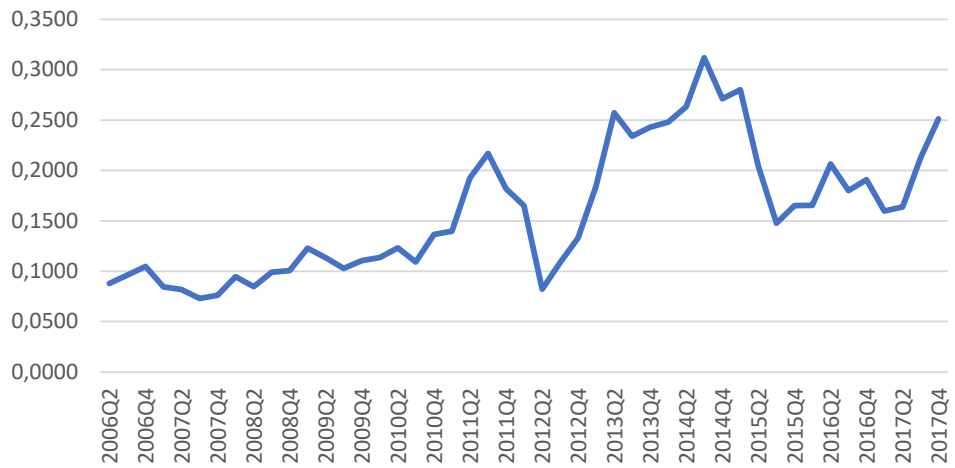


Figure D.9 Share buy-to-let in transactions for Groningen

D.3 Graphs Breda

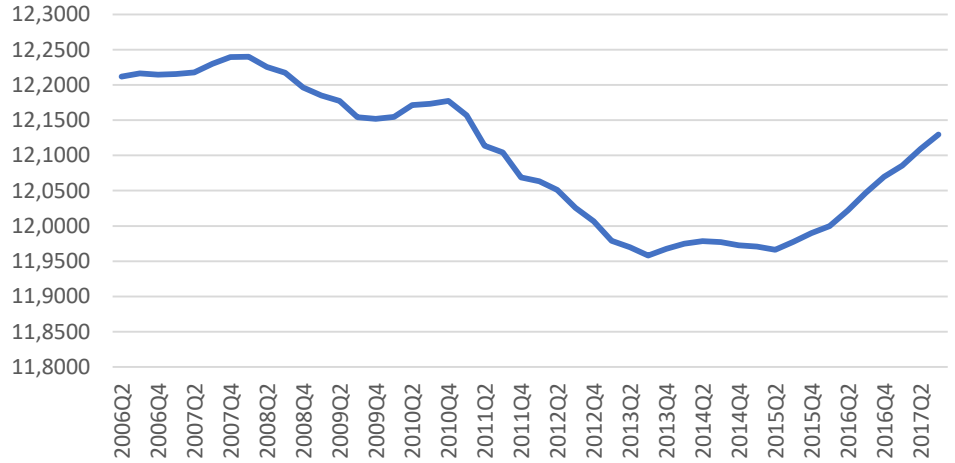


Figure D.10 Ln house price development for Breda

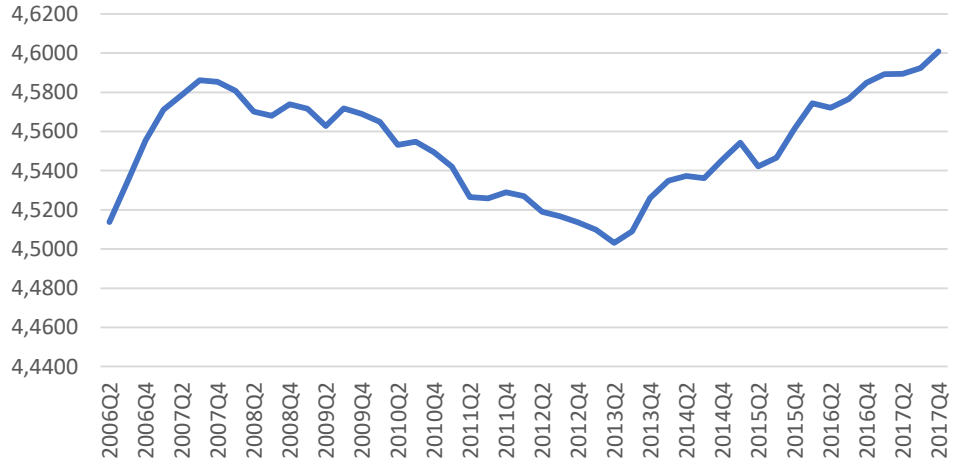


Figure D.11 Ln real household income for Breda

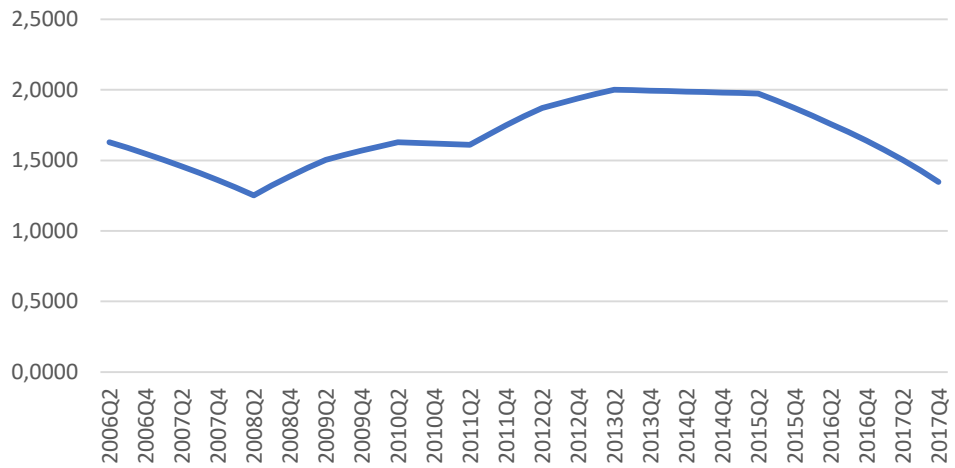


Figure D.12 Ln unemployment rate for Breda

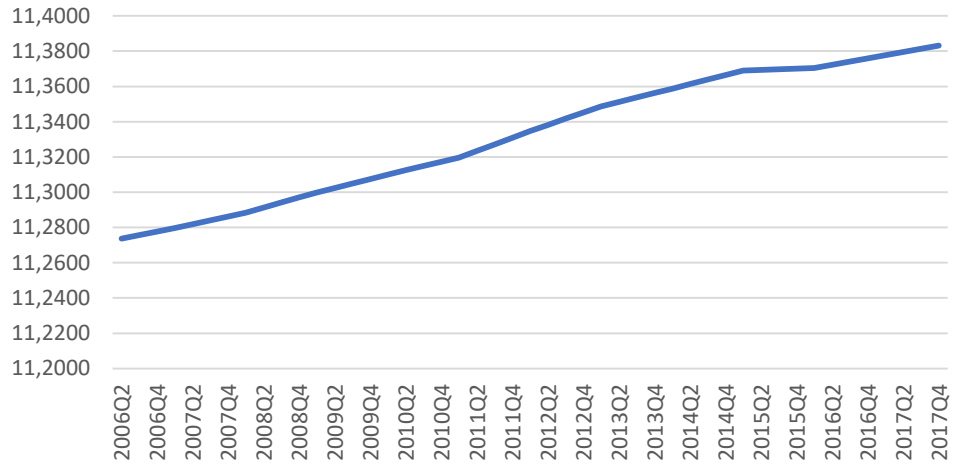


Figure D.13 Ln number of households for Breda

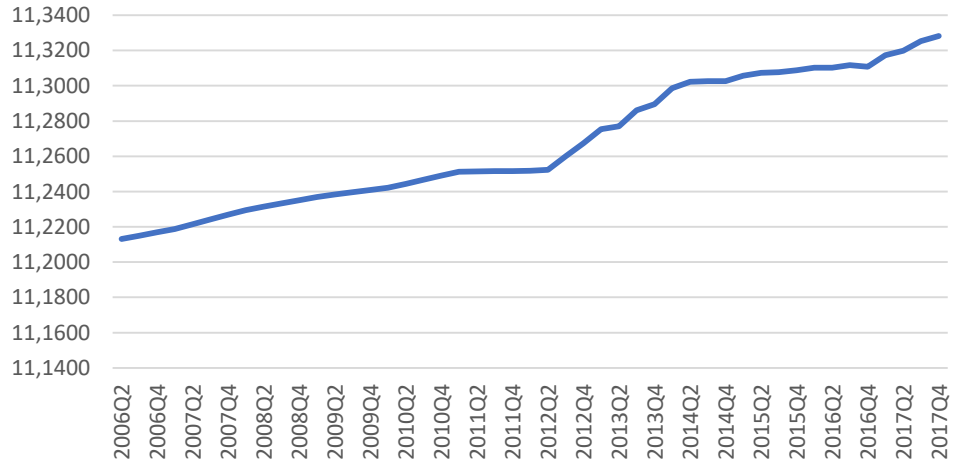


Figure D.14 Ln housing stock for Breda

Figure D.15 Share buy-to-let in transactions for Breda

D.4 Graphs Zoetermeer

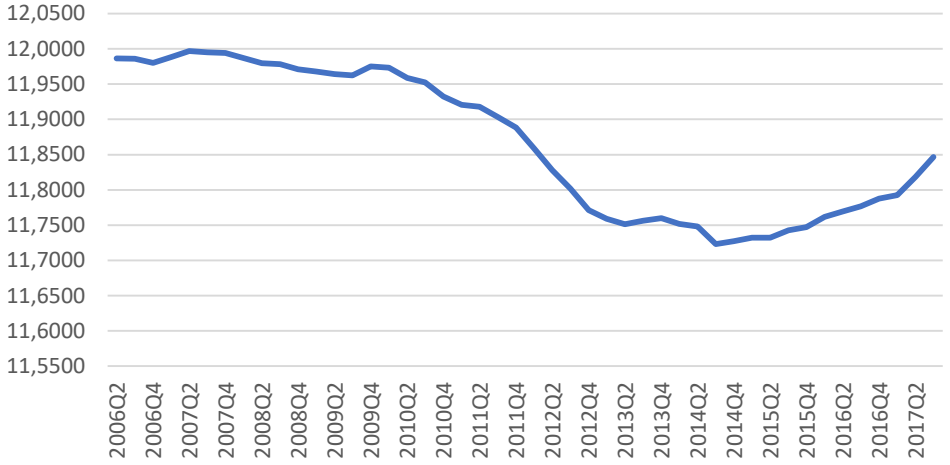


Figure D.16 Ln house price development for Zoetermeer

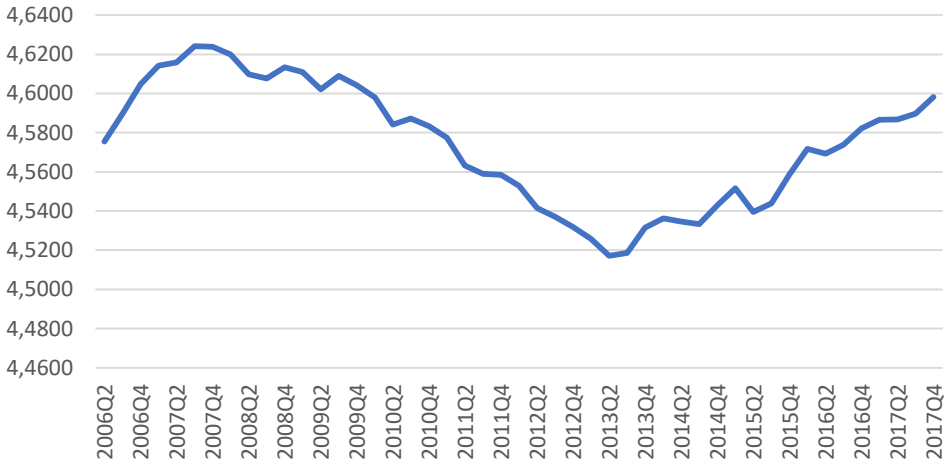


Figure D.17 Ln real household income for Zoetermeer

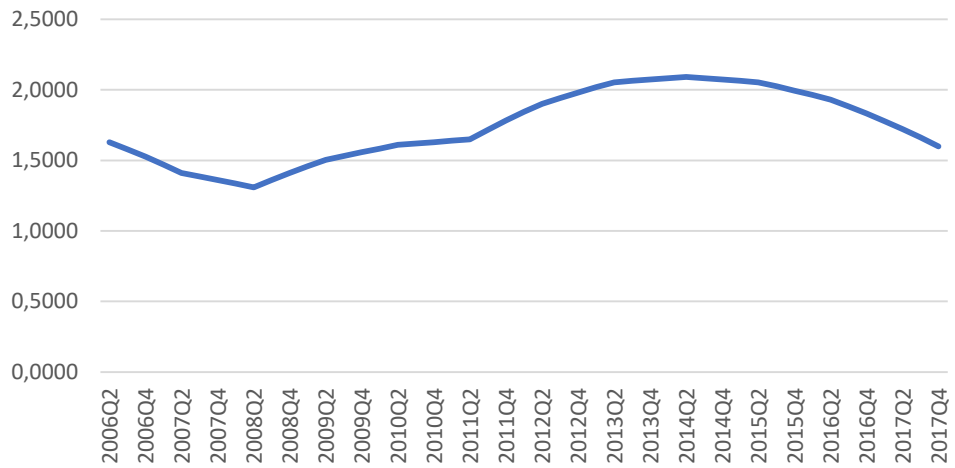


Figure D.18 Ln unemployment rate for Zoetermeer

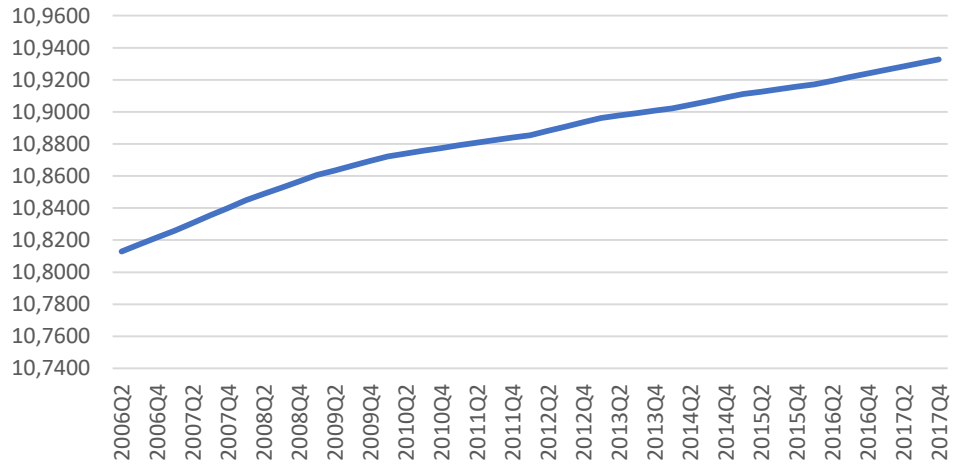


Figure D.19 Ln number of households for Zoetermeer

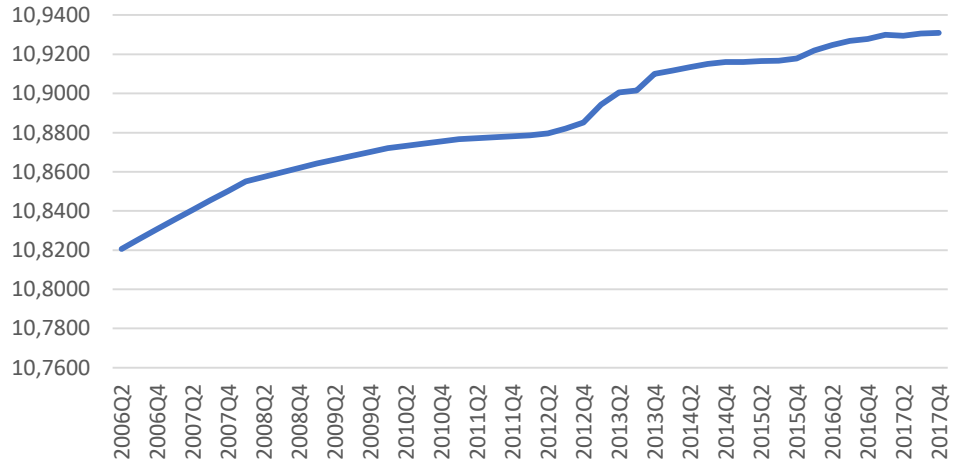
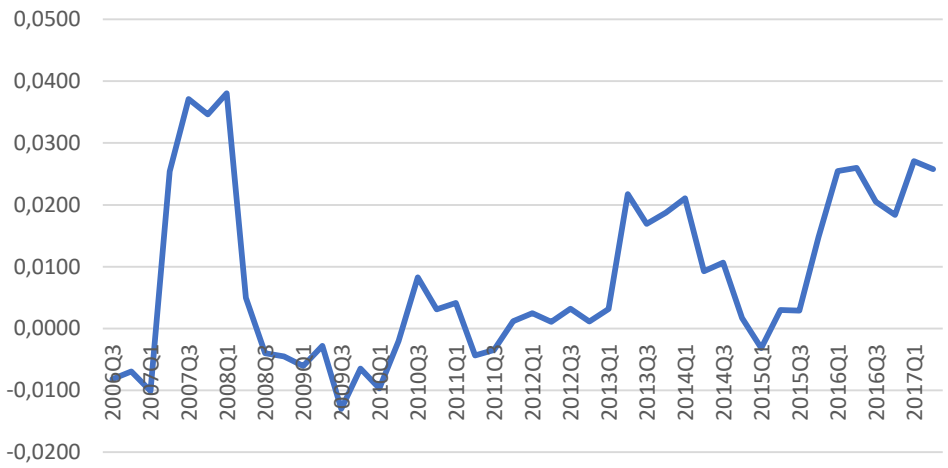


Figure D.20 Ln housing stock for Zoetermeer



Figuur D.21 Share buy-to-let in transactions for Zoetermeer

E The correlation between independent variables

Table E.1 Correlation matrix for Groningen

		ΔHP_T1_Gron	ΔY	ΔP	ΔInom	ΔIreal	ΔU	ΔHH	ΔS	LTV1	LTV2	ΔBnom	ΔBreal	BTL
ΔHP_T1_Gron	Pearson Correlation	1	,446	-,030	-,112	-,003	-,665	-,393	-,058	,129	-,538	-,039	,008	,152
	Sig. (2-tailed)		,002	,849	,467	,985	,000	,008	,710	,404	,000	,803	,959	,324
	N	44	44	44	44	44	44	44	44	44	44	44	44	44
ΔY	Pearson Correlation	,446	1	-,294	,037	,297	-,448	-,383	-,285	,109	-,173	-,126	,222	,050
	Sig. (2-tailed)	,002		,050	,812	,047	,002	,009	,058	,477	,255	,408	,143	,743
	N	44	45	45	45	45	45	45	45	45	45	45	45	45
ΔP	Pearson Correlation	-,030	-,294	1	,067	-,956	-,095	-,063	,072	-,103	-,131	,233	-,860	-,167
	Sig. (2-tailed)	,849	,050		,664	,000	,536	,681	,638	,503	,391	,124	,000	,271
	N	44	45	45	45	45	45	45	45	45	45	45	45	45
ΔInom	Pearson Correlation	-,112	,037	,067	1	,230	-,085	-,072	,099	-,419	-,263	,219	,049	-,471
	Sig. (2-tailed)	,467	,812	,664		,128	,578	,638	,520	,004	,081	,148	,749	,001
	N	44	45	45	45	45	45	45	45	45	45	45	45	45
ΔIreal	Pearson Correlation	-,003	,297	-,956	,230	1	,067	,040	-,041	-,024	,050	-,162	,853	,024
	Sig. (2-tailed)	,985	,047	,000	,128		,660	,793	,788	,878	,744	,286	,000	,874
	N	44	45	45	45	45	45	45	45	45	45	45	45	45
ΔU	Pearson Correlation	-,665	-,448	-,095	-,085	,067	1	,639	,305	-,058	,428	-,240	-,031	,191
	Sig. (2-tailed)	,000	,002	,536	,578	,660		,000	,041	,706	,003	,113	,838	,208
	N	44	45	45	45	45	45	45	45	45	45	45	45	45
ΔHH	Pearson Correlation	-,393	-,383	-,063	-,072	,040	,639	1	,445	-,312	,177	-,272	-,081	,136
	Sig. (2-tailed)	,008	,009	,681	,638	,793	,000		,002	,037	,245	,070	,597	,372
	N	44	45	45	45	45	45	45	45	45	45	45	45	45
ΔS	Pearson Correlation	-,058	-,285	,072	,099	-,041	,305	,445	1	-,047	,163	-,134	-,140	,152
	Sig. (2-tailed)	,710	,058	,638	,520	,788	,041	,002		,759	,286	,381	,360	,319
	N	44	45	45	45	45	45	45	45	45	45	45	45	45
LTV1	Pearson Correlation	,129	,109	-,103	-,419	-,024	-,058	-,312	-,047	1	,635	-,020	,091	,653
	Sig. (2-tailed)	,404	,477	,503	,004	,878	,706	,037	,759		,000	,894	,553	,000
	N	44	45	45	45	45	45	45	45	45	45	45	45	45
LTV2	Pearson Correlation	-,538	-,173	-,131	-,263	,050	,428	,177	,163	,635	1	-,079	,088	,347
	Sig. (2-tailed)	,000	,255	,391	,081	,744	,003	,245	,286	,000		,605	,564	,020
	N	44	45	45	45	45	45	45	45	45	45	45	45	45
ΔBnom	Pearson Correlation	-,039	-,126	,233	,219	-,162	-,240	-,272	-,134	-,020	-,079	1	,296	-,203
	Sig. (2-tailed)	,803	,408	,124	,148	,286	,113	,070	,381	,894	,605		,048	,182
	N	44	45	45	45	45	45	45	45	45	45	45	45	45
ΔBreal	Pearson Correlation	,008	,222	-,860	,049	,853	-,031	-,081	-,140	,091	,088	,296	1	,059
	Sig. (2-tailed)	,959	,143	,000	,749	,000	,838	,597	,360	,553	,564	,048		,698
	N	44	45	45	45	45	45	45	45	45	45	45	45	45
BTL	Pearson Correlation	,152	,050	-,167	-,471	,024	,191	,136	,152	,653	,347	-,203	,059	1
	Sig. (2-tailed)	,324	,743	,271	,001	,874	,208	,372	,319	,000	,020	,182	,698	
	N	44	45	45	45	45	45	45	45	45	45	45	45	45

Table E.2 Correlation matrix for Breda

		ΔHP_T1_Breda	ΔY	ΔP	ΔInom	ΔIreal	ΔU	ΔHH	ΔS	LTV1	LTV2	ΔBnom	ΔBreal	BTL
ΔHP_T1_Breda	Pearson Correlation	1	,293	,031	-,159	-,075	-,774	-,604	,047	,171	-,410	,162	,055	,456
	Sig. (2-tailed)		,054	,844	,302	,628	,000	,000	,762	,267	,006	,293	,723	,002
	N	44	44	44	44	44	44	44	44	44	44	44	44	44
ΔY	Pearson Correlation	,293	1	-,301	,043	,306	-,364	-,347	,066	,120	-,074	-,137	,224	,090
	Sig. (2-tailed)	,054		,044	,781	,041	,014	,019	,668	,433	,630	,370	,139	,557
	N	44	45	45	45	45	45	45	45	45	45	45	45	45
ΔP	Pearson Correlation	,031	-,301	1	,067	-,956	-,116	-,039	,035	-,103	-,131	,233	-,860	,113
	Sig. (2-tailed)	,844	,044		,664	,000	,448	,801	,818	,503	,391	,124	,000	,461
	N	44	45	45	45	45	45	45	45	45	45	45	45	45
ΔInom	Pearson Correlation	-,159	,043	,067	1	,230	-,064	,148	-,044	-,419	-,263	,219	,049	-,212
	Sig. (2-tailed)	,302	,781	,664		,128	,675	,332	,776	,004	,081	,148	,749	,162
	N	44	45	45	45	45	45	45	45	45	45	45	45	45
ΔIreal	Pearson Correlation	-,075	,306	-,956	,230	1	,094	,081	-,047	-,024	,050	-,162	,853	-,172
	Sig. (2-tailed)	,628	,041	,000	,128		,539	,595	,758	,878	,744	,286	,000	,257
	N	44	45	45	45	45	45	45	45	45	45	45	45	45
ΔU	Pearson Correlation	-,774	-,364	-,116	-,064	,094	1	,674	-,041	-,214	,347	-,366	-,078	-,537
	Sig. (2-tailed)	,000	,014	,448	,675	,539		,000	,788	,158	,020	,013	,612	,000
	N	44	45	45	45	45	45	45	45	45	45	45	45	45
ΔHH	Pearson Correlation	-,604	-,347	-,039	,148	,081	,674	1	,132	-,246	,345	-,262	-,100	-,233
	Sig. (2-tailed)	,000	,019	,801	,332	,595	,000		,388	,103	,020	,082	,512	,124
	N	44	45	45	45	45	45	45	45	45	45	45	45	45
ΔS	Pearson Correlation	,047	,066	,035	-,044	-,047	-,041	,132	1	,295	,411	,164	,051	,072
	Sig. (2-tailed)	,762	,668	,818	,776	,758	,788	,388		,049	,005	,283	,741	,639
	N	44	45	45	45	45	45	45	45	45	45	45	45	45
LTV1	Pearson Correlation	,171	,120	-,103	-,419	-,024	-,214	-,246	,295	1	,635	-,020	,091	,526
	Sig. (2-tailed)	,267	,433	,503	,004	,878	,158	,103	,049		,000	,894	,553	,000
	N	44	45	45	45	45	45	45	45	45	45	45	45	45
LTV2	Pearson Correlation	-,410	-,074	-,131	-,263	,050	,347	,345	,411	,635	1	-,079	,088	-,065
	Sig. (2-tailed)	,006	,630	,391	,081	,744	,020	,020	,005	,000		,605	,564	,673
	N	44	45	45	45	45	45	45	45	45	45	45	45	45
ΔBnom	Pearson Correlation	,162	-,137	,233	,219	-,162	-,366	-,262	,164	-,020	-,079	1	,296	,073
	Sig. (2-tailed)	,293	,370	,124	,148	,286	,013	,082	,283	,894	,605		,048	,635
	N	44	45	45	45	45	45	45	45	45	45	45	45	45
ΔBreal	Pearson Correlation	,055	,224	-,860	,049	,853	-,078	-,100	,051	,091	,088	,296	1	-,073
	Sig. (2-tailed)	,723	,139	,000	,749	,000	,612	,512	,741	,553	,564	,048		,634
	N	44	45	45	45	45	45	45	45	45	45	45	45	45
BTL	Pearson Correlation	,456	,090	,113	-,212	-,172	-,537	-,233	,072	,526	-,065	,073	-,073	1
	Sig. (2-tailed)	,002	,557	,461	,162	,257	,000	,124	,639	,000	,673	,635	,634	
	N	44	45	45	45	45	45	45	45	45	45	45	45	45

Table E.3 Correlation matrix for Zoetermeer

		ΔHP_T1_Zoet	ΔY	ΔP	Δlnom	Δlreal	ΔU	ΔHH	ΔS	LTV1	LTV2	ΔBnom	ΔBreal	BTL
ΔHP_T1_Zoet	Pearson Correlation	1	,378	-,108	,029	,114	-,598	,050	-,071	,329	-,074	,077	,145	,453
	Sig. (2-tailed)		,011	,486	,852	,461	,000	,749	,648	,029	,633	,619	,349	,002
	N	44	44	44	44	44	44	44	44	44	44	44	44	44
ΔY	Pearson Correlation	,378	1	-,291	,045	,297	-,515	,143	,226	,298	,156	-,143	,211	,166
	Sig. (2-tailed)	,011		,053	,770	,048	,000	,350	,135	,047	,305	,349	,165	,275
	N	44	45	45	45	45	45	45	45	45	45	45	45	45
ΔP	Pearson Correlation	-,108	-,291	1	,067	-,956	-,123	,054	-,117	-,136	-,251	,233	-,860	,045
	Sig. (2-tailed)	,486	,053		,664	,000	,422	,722	,445	,371	,096	,124	,000	,769
	N	44	45	45	45	45	45	45	45	45	45	45	45	45
Δlnom	Pearson Correlation	,029	,045	,067	1	,230	-,086	,507	,236	-,419	-,422	,219	,049	-,026
	Sig. (2-tailed)	,852	,770	,664		,128	,575	,000	,119	,004	,004	,148	,749	,868
	N	44	45	45	45	45	45	45	45	45	45	45	45	45
Δlreal	Pearson Correlation	,114	,297	-,956	,230	1	,094	,097	,183	,009	,120	-,162	,853	-,051
	Sig. (2-tailed)	,461	,048	,000	,128		,537	,528	,228	,951	,432	,286	,000	,737
	N	44	45	45	45	45	45	45	45	45	45	45	45	45
ΔU	Pearson Correlation	-,598	-,515	-,123	-,086	,094	1	-,226	-,127	-,384	,008	-,356	-,066	-,506
	Sig. (2-tailed)	,000	,000	,422	,575	,537		,135	,406	,009	,958	,017	,669	,000
	N	44	45	45	45	45	45	45	45	45	45	45	45	45
ΔHH	Pearson Correlation	,050	,143	,054	,507	,097	-,226	1	,442	-,530	-,442	,092	-,007	,007
	Sig. (2-tailed)	,749	,350	,722	,000	,528	,135		,002	,000	,002	,550	,966	,963
	N	44	45	45	45	45	45	45	45	45	45	45	45	45
ΔS	Pearson Correlation	-,071	,226	-,117	,236	,183	-,127	,442	1	-,027	,250	,127	,182	,204
	Sig. (2-tailed)	,648	,135	,445	,119	,228	,406	,002		,862	,097	,406	,233	,178
	N	44	45	45	45	45	45	45	45	45	45	45	45	45
LTV1	Pearson Correlation	,329	,298	-,136	-,419	,009	-,384	-,530	-,027	1	,759	,059	,166	,442
	Sig. (2-tailed)	,029	,047	,371	,004	,951	,009	,000	,862		,000	,702	,277	,002
	N	44	45	45	45	45	45	45	45	45	45	45	45	45
LTV2	Pearson Correlation	-,074	,156	-,251	-,422	,120	,008	-,442	,250	,759	1	,027	,262	,172
	Sig. (2-tailed)	,633	,305	,096	,004	,432	,958	,002	,097	,000		,860	,082	,259
	N	44	45	45	45	45	45	45	45	45	45	45	45	45
ΔBnom	Pearson Correlation	,077	-,143	,233	,219	-,162	-,356	,092	,127	,059	,027	1	,296	,154
	Sig. (2-tailed)	,619	,349	,124	,148	,286	,017	,550	,406	,702	,860		,048	,311
	N	44	45	45	45	45	45	45	45	45	45	45	45	45
ΔBreal	Pearson Correlation	,145	,211	-,860	,049	,853	-,066	-,007	,182	,166	,262	,296	1	,036
	Sig. (2-tailed)	,349	,165	,000	,749	,000	,669	,966	,233	,277	,082	,048		,815
	N	44	45	45	45	45	45	45	45	45	45	45	45	45
BTL	Pearson Correlation	,453	,166	,045	-,026	-,051	-,506	,007	,204	,442	,172	,154	,036	1
	Sig. (2-tailed)	,002	,275	,769	,868	,737	,000	,963	,178	,002	,259	,311	,815	
	N	44	45	45	45	45	45	45	45	45	45	45	45	45

F Plots residuals

In this appendix different plots of the residuals of the several house price models are shown. In section F.1, histograms and normal probability plats of the standardized residuals are shown. These can be used to see whether the residuals follow a normal distribution. In section F.2, scatterplots are shown of the standardized residuals and the predicted values.

F.1 Plots normal distribution

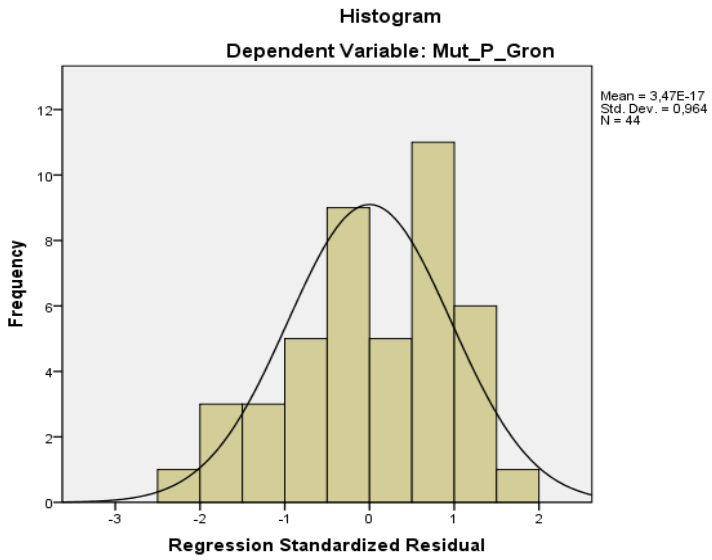


Figure F.1 Histogram standardized residuals house price model Groningen

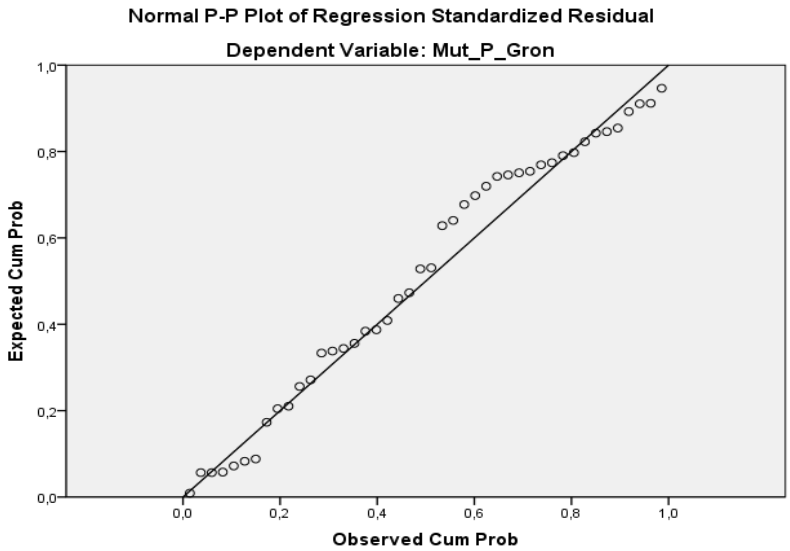


Figure F.2 Normal probability plot standardized residuals house price model Groningen

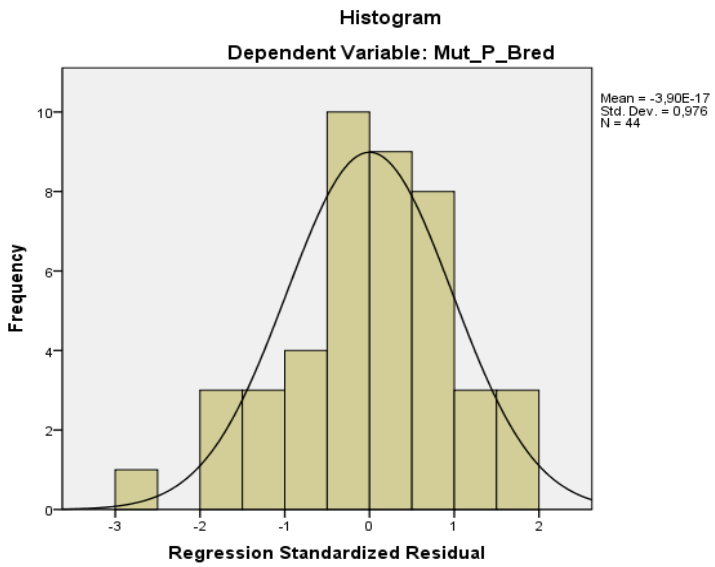


Figure F.3 Histogram standardized residuals house price model Breda

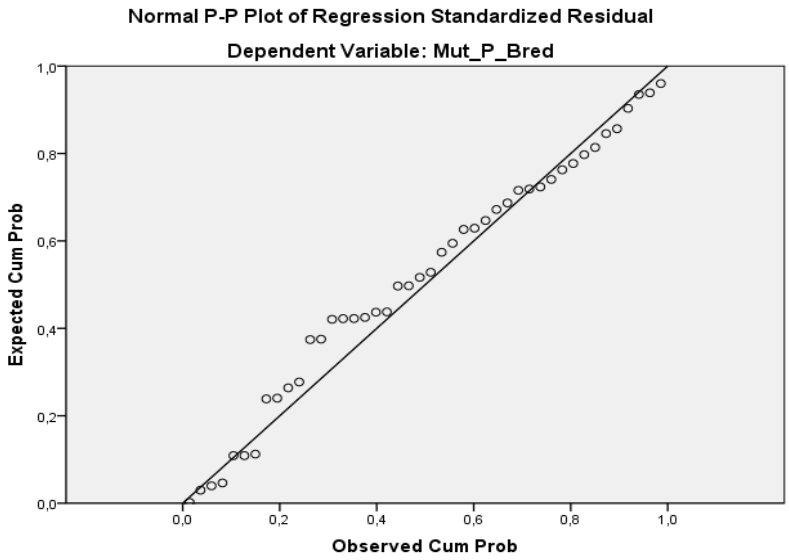


Figure F.4 Normal probability plot standardized residuals house price model Breda

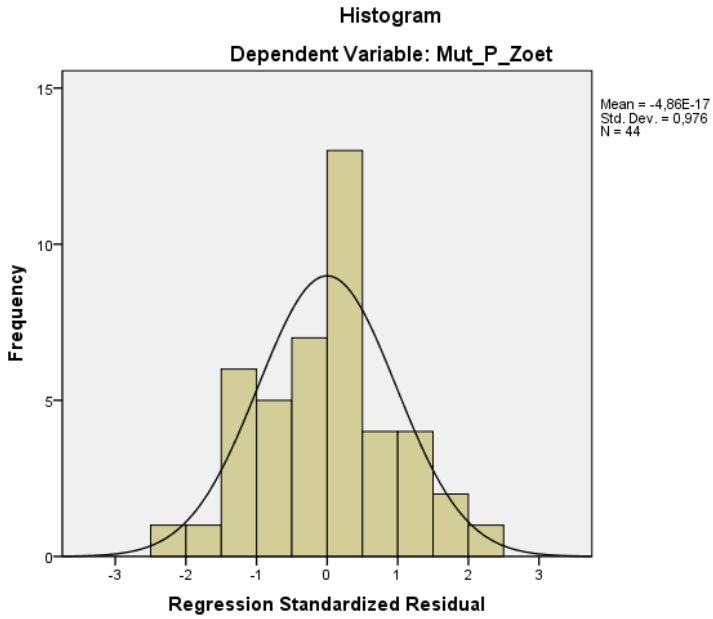


Figure F.5 Histogram standardized residuals house price model Zoetermeer with real household income

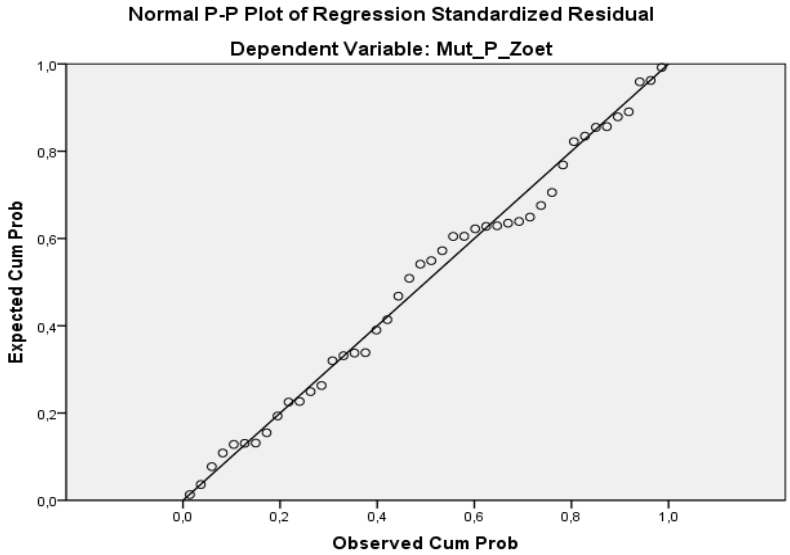


Figure F.6 Normal probability plot standardized residuals house price model Zoetermeer with real household income

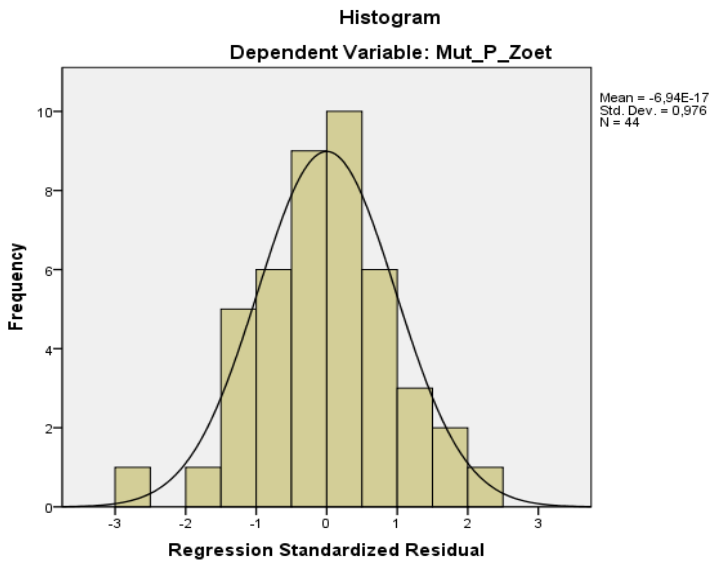


Figure F.7 Histogram standardized residuals house price model Zoetermeer with unemployment rate

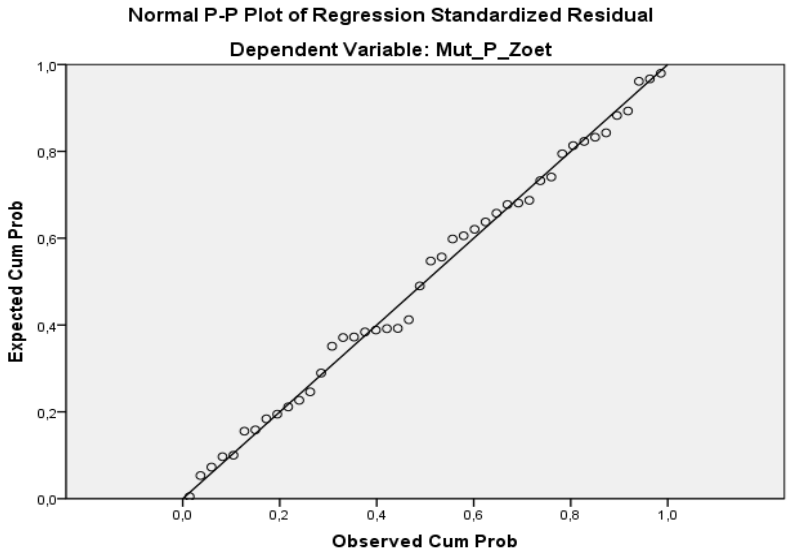


Figure F.6 Normal probability plot standardized residuals house price model Zoetermeer with unemployment rate

F.2 Plots homoscedasticity

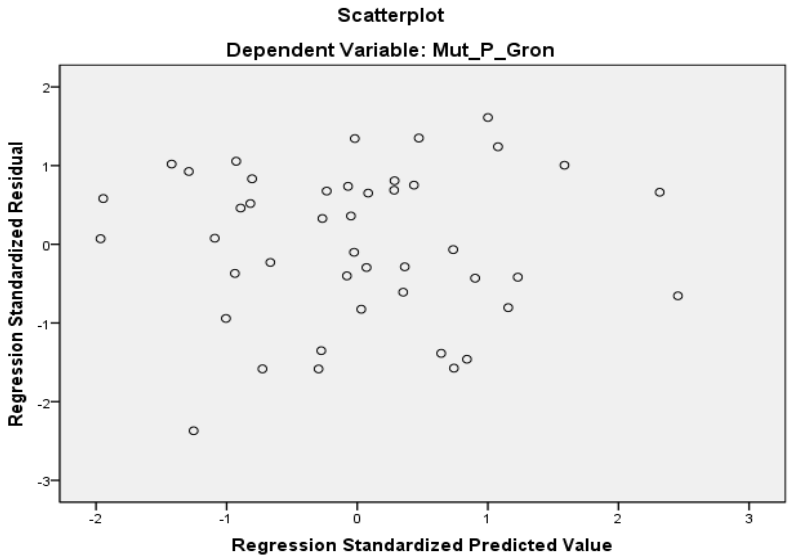


Figure F.7 Scatterplot standardized residuals and predicted values house price model Groningen

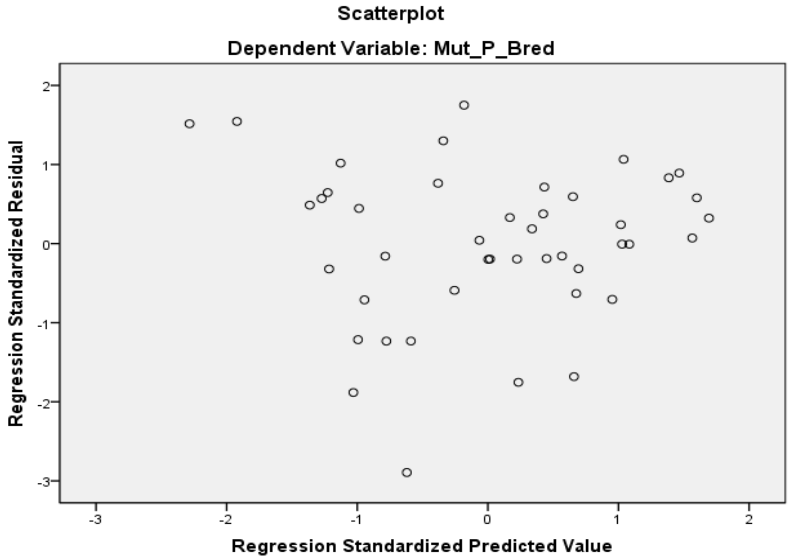


Figure F.8 Scatterplot standardized residuals and predicted values house price model Breda

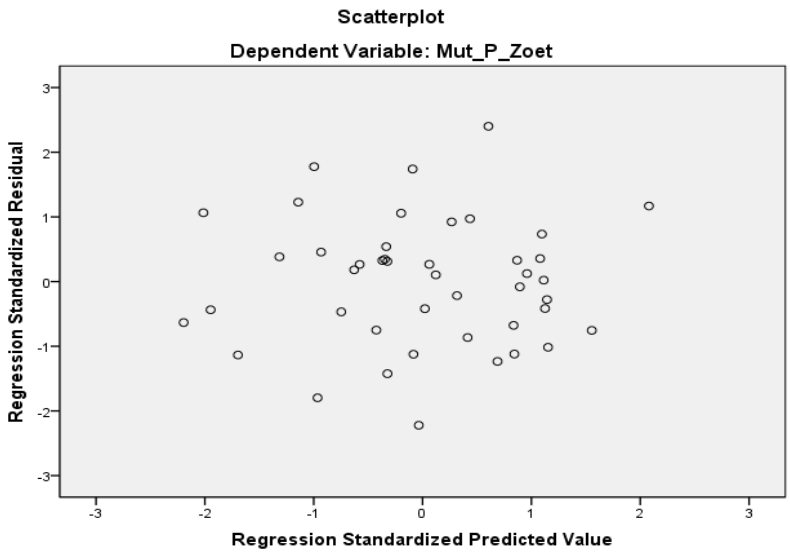


Figure F.9 Scatterplot standardized residuals and predicted values house price model Zoetermeer with real household income

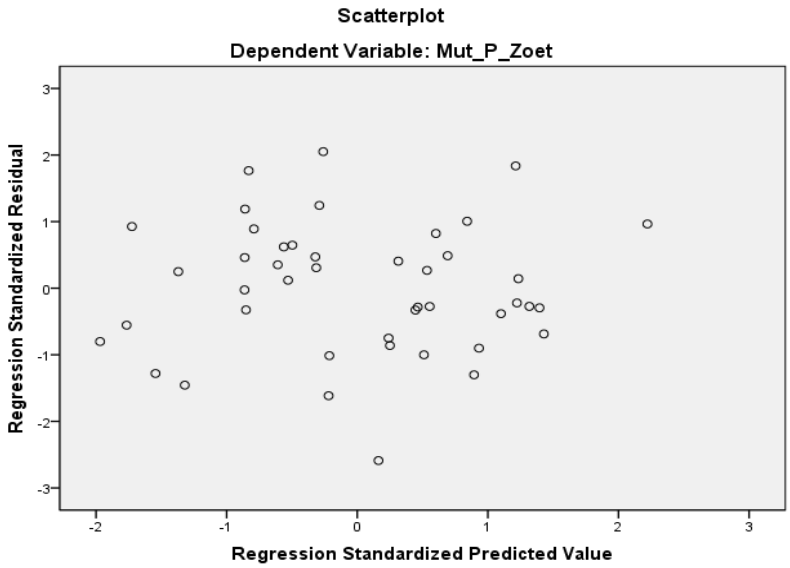


Figure F.10 Scatterplot standardized residuals and predicted values house price model Zoetermeer with unemployment rate