HOUSE PRICES AND HOUSEHOLD MOBILITY IN THE NETHERLANDS: EMPIRICAL ANALYSES OF FINANCIAL CHARACTERISTICS OF THE HOUSEHOLD

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Woningprijzen en huishoudensmobiliteit in Nederland:
Empirische analyses van financiële huishoudenskenmerken
(met een samenvatting in het Nederlands)

Proefschrift

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Prof. dr. J. Plantenga

To Madeleine, Laura, and Elena for making our house into a home.

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Joep Steegmans
Bunnik, January 2017

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Chapter 1

Introduction

This dissertation on the housing market is as much about people as it is about houses. The point that is made throughout this study is that household behavior is an important factor in the owner-occupied market. Households do not only make the decision to buy or sell, they also play an active role in the determination of the price. The household behavior that is studied in this dissertation encompasses household mobility and house price determination. As we study both the decision to sell and the price at which a house is sold, the dissertation analyses the behavior of home-owners, buyers, and sellers.

Household characteristics can influence house prices as the owner-occupied housing market is not a perfect asset market. Characteristics related to the financial positions of households are the main focus of this dissertation as these seem to be the most important determinants of house prices. Financial characteristics can, for instance, influence the bargaining process between buyers and sellers or can make households unable or unwilling to sell. This dissertation tries to answer how the financial positions of households influence the determination of house prices and household mobility.

Financial characteristics of households include income, wealth, loan-to-value (LTV) ratio (i.e. housing equity), loan-to-income (LTI) ratio, and prospective losses.[1] These characteristics can influence household behavior in a variety of ways. Theories on bargaining and search explain, for instance, income and wealth effects on house prices. Equity constraints and nominal loss aversion also relate financial household characteristics to transaction

[1]Prospective losses occur when the house value is lower than the original purchase price. From a purely financial perspective the original purchase price should be irrelevant if a household is financially unconstrained.

prices. Besides, they relate them to household mobility. This dissertation will demonstrate that financial characteristics of households matter in explaining household behavior in the owner-occupied housing market.

1.1 Overview of the literature and research problem

In most housing market studies household characteristics are ignored as a determinant of house prices. Variation in prices is explained by variation in house characteristics, quality, location, neighborhood, etcetera. Hedonic pricing models, assigning implicit prices to these characteristics, are therefore a preferred method in many house price studies (see seminal paper of Rosen, 1974). According to traditional hedonic studies, household characteristics do not have a causal effect on prices; if household characteristics are correlated with house prices, it must be due to unobserved characteristics of the house. This dissertation will show that household characteristics capture more than unobserved house characteristics.

More recently scholars have started to stress the importance of financial household characteristics in explaining house prices (e.g. Anenberg, 2011; Genesove and Mayer, 1997, 2001; Harding et al., 2003). They examine income effects (Harding et al., 2003; Kestens et al., 2006), equity constraints (Anenberg, 2011; Genesove and Mayer, 1997, 2001), and nominal loss aversion (Anenberg, 2011; Genesove and Mayer, 2001). These studies demonstrate that income, housing equity, and prospective losses comprise different mechanisms that relate financial characteristics to household behavior.

The only mechanism that has been studied in more than a handful of isolated cases is the financial constraint of sellers. Households are financially constrained if they have insufficient housing equity to sell their house and obtain a mortgage for a new home. In markets with down-payment requirements, like the United States, equity constraints are synonym with down-payment constraints. Most influential in the study of equity constraints has been the theoretical down-payment model of Stein (1995), which describes how decreasing house prices can result in insufficient housing equity to make a down-payment on a new home. Home-owners facing financial constraints are said to be spatially locked-in (Chan, 2001). Obviously, equity constraints manifest itself in household mobility: equity constrained home-owners are expected to have a lower mobility than home-owners that are not financially constrained (Ferreira et al., 2010, 2012; Schulhofer-Wohl, 2012). However, effects of financial constraints are also visible in house prices: constrained sellers receive premiums above the market price that allow them to overcome spatial lock-in (Anenberg, 2011; Genesove and Mayer, 1997, 2001).

Most of the studies looking into equity constraints ignore other mechanisms that explain the lower household mobility and market premiums of households with low or negative equity (e.g. Ferreira et al., 2010, 2012; Genesove and Mayer, 1997; Schulhofer-Wohl, 2012). The reduction in household mobility or the market premium in the selling process is fully contributed to the inability to move due to equity constraints, although alternatively unwillingness to accept a lower price than the original purchase price could be the cause. Only few studies have tried to distinguish equity constraints from loss aversion, as the latter mechanism is generally called (Anenberg, 2011; Engelhardt, 2003; Genesove and Mayer, 2001).

The above-mentioned literature is United States-oriented, while this dissertation studies the housing market in the Netherlands. It is important to realize that the Dutch institutional setting differs from the American institutional setting. Most notable for the Netherlands are the absence of a formal down-payment requirement and the existence of recourse mortgages.[2] The first implies that Dutch households do not have to bring in their own money if they buy a house. As a matter of fact, Dutch homeowners are generally allowed to borrow more than the value of the house.[3] Equity constraints, therefore, are likely to be smaller in the Netherlands than in markets where a down-payment requirement does exist. The second institutional difference implies that 'strategic' defaults do not exist in the Netherlands; that is, if the mortgage is larger than the house value, households are not able to walk away from the negative housing equity. Thus, voluntary defaults do not exist in the Netherlands.

In regard to the above, two studies focusing on the Netherlands are worth mentioning.[4] The first is Dröes and Hassink (2014), which studies credit

[2]Home mortgage interest deduction is another important characterization of the Dutch owner-occupied housing market. However, this does not differentiate the institutional settings as American homeowners are also allowed to deduct home mortgage interest.

[3]A binding code of conduct for mortgage loans (GHF), setting a formal limit to the LTV, was introduced in August 2011. The initial LTV limit was set at 106 percent, decreasing to 100 percent in 2018.

[4]There are more studies on the Netherlands related to our topic, but these are not

constraints in the Dutch owner-occupied housing market. The starting point is the observation that a formal down-payment requirement does not exist in the Netherlands. Consequently, they convert the Genesove and Mayer (1997) model relating equity constraints to house prices – the theoretical basis of which is found in Stein (1995) – into a model that studies the effects of income constraints. They find that the self-reported home value of credit constrained homeowners, i.e. constrained in terms of income, is higher than that of unconstrained homeowners. However, the role of equity constraints – the topic of the original paper – is ignored.

The second study that should be mentioned in this respect is Struyven (2015) as he does the exact opposite: he works from the premise that – apart from the absence of strategic defaults – the institutional settings are essentially the same. As a consequence, he applies Stein's down-payment model to the Dutch housing market as if a down-payment requirement does exist. Compared to the US-oriented empirical studies he, admittedly, increases the critical LTV ratio from 80 to 90 percent, but the absence of a down-payment constraint is not given the attention it deserves. Struyven (2015) even claims explicitly that the results that he finds are consistent with Stein's down-payment model. Recognizing not only the similarities but also the differences between the housing market institutions would have allowed him to study implicit assumptions in the US-oriented studies. Besides, acknowledging the differences in institutions would have led him to investigate what else could lead to similarities with the US-oriented studies. It raises questions as to whether the down-payment constraint, or the balance sheet channel as he prefers to call it, is indeed the sole driver of the results.

Limited availability of reliable data has been an important reason why financial household characteristics, the focus of this dissertation, have received little attention in explaining house price determination and household mobility. Only few scholars have been able to obtain data of house transactions that were individually matched to house and household characteristics. The data that we have at our disposal combines house and household information and allows us to thoroughly study household behavior (see section 1.3).

One can only conclude that household characteristics, particularly characteristics related to the financial positions of households, have been given

relevant for the argument made here. For instance, Eichholtz and Lindenthal (2013) study loss aversion in Amsterdam. However, they do not take negative equity into account. Therefore, differences in institutional settings do not play a role in their study.

little consideration even though they seem to affect house prices and household mobility in various important ways. This dissertation, therefore, tries to answer the question how financial characteristics of households affect the determination of house prices and household mobility in the owner-occupied housing market. The dissertation will focus on three research questions: (i) What is the effect of the relative financial positions of sellers and buyers on house prices? (ii) How do negative equity and loss aversion affect household mobility? (iii) What is the effect of negative equity and loss aversion on house prices?

1.2 Objectives and contribution

The recent housing market crisis in the Netherlands, house prices decreased with over 20 percent between August 2008 and June 2013 (CBS StatLine, 2016), has renewed interest in topics related to house prices and housing wealth. Decreases in housing wealth have affected the balance sheets of households and those of banks and financial institutions, that is, the financial system at large. Consequently, the housing market crisis has been debated widely by both scholars and policymakers. For that reason, it is surprising how little is actually known of how financial characteristics of buyers and sellers influence transaction prices and household mobility.

The main goal of this dissertation is to show the role that financial characteristics of the household play in explaining household behavior in the owner-occupied housing market. This is done by identifying various mechanisms that relate to house price determination and household mobility. We aim to present evidence that the owner-occupied housing market is not the perfect asset market that scholars generally assume and that house prices are not as clearly defined as often claimed. Therefore, the objective of this dissertation is to explain heterogeneity in house prices by including financial household characteristics.

We contribute to the literature in a variety of ways. First, by incorporating the role of household wealth. Note that household wealth incorporates more than only (net) housing equity. Thus far, household wealth has received almost no attention as data was unavailable. The dissertation focuses on the effects of the amount of household wealth on bargaining outcomes and we include housing and non-housing wealth in relation to financial constraints when we study household mobility.

Second, we contribute to the literature by distinguishing not wanting to move from not being able to move. Surprisingly, this fundamental difference is rarely recognized by scholars. We argue that one needs to differentiate between financial and psychological constraints. Concretely, we will identify both equity constraints and loss aversion. Therefore, this study is closely related to Genesove and Mayer (2001), Engelhardt (2003), and Anenberg (2011).

Third, we contribute to the literature by studying the mechanisms that influence household behavior in a different institutional setting. As noted before, the Dutch institutional setting differs from the American setting. Thus, both differences and similarities in findings allow us to critically evaluate the validity of the US-oriented studies.

1.3 Microdata and methodology

Thus far, the absence of adequate data hindered research on the effects of financial household characteristics on household behavior. The extensive administrative data that we have at our disposal allow us to empirically analyze their role; that is, the data allow us to distinguish between mechanisms and to test for relationships.

The administrative microdata of Statistics Netherlands (CBS), covering the period 2006-2011, are among the most comprehensive in the world.[5] The main advantages of these data are their accuracy, sample size, longitudinal nature, and the fact that data sets can be matched at the individual level. Microdata are available for virtually all houses and households in the Netherlands. The data include information from cadaster records, the housing stock register, the population register, the job register, and the tax authorities. An extensive set of house characteristics is obtained from the Dutch Association of Realtors (NVM). These data are matched at the individual level to the administrative CBS data when we need to include house characteristics. The NVM records cover about 70 percent of the house transactions during 2006-2011.[6]

[5]In chapter 2 we have limited ourselves to the period 2006-2010 due to practical reasons. Still, we will demonstrate that the results are independent of the years that we use in our analysis.

[6]For details, see chapters 2 and 4.

From an empirical perspective it is important that the data include periods of both increasing and decreasing prices. Most notably, the decrease in house prices allows us to differentiate financial constraints from psychological constraints; that is, both equity constraints and loss aversion can be identified. If the data would not have covered a longer period of decreasing house prices identifying these mechanisms would not have been possible.

The microdata at our disposal allow for thorough empirical analyses. The data allow us to estimate the effect of the relative financial positions of buyers and sellers on house prices, the effect of negative equity and loss aversion on household mobility, and the effect of negative equity and loss aversion on house prices. The data allow us to look into heterogeneity issues that might influence the results of the empirical analyses. In chapter 2 special attention is given to unobserved house characteristics. The extensive house, buyer, and seller characteristics allow us to follow the empirical strategy of Harding et al. (2003), which makes it possible to distinguish bargaining effects from unobserved house characteristics. In chapter 3, the chapter on household mobility, we investigate unobserved heterogeneity due to unobserved duration starts for housing durations that started before the year 1995. We compare various empirical approaches and, importantly, add a new one. In chapter 4 unobserved house characteristics are again the main focus; we compare models that make use of different house values, which incorporate unobserved house characteristics to different degrees.

1.4 Financial position and house prices

Chapter 2 focuses on the effects of the financial positions of buyers and sellers on house prices, distinguishing between income and wealth effects. The hedonic bargaining literature hypothesizes that household characteristics affect transaction prices through bargaining power (Harding et al., 2003). Households with a relatively good financial position, higher income or more wealth, do worse in the bargaining process as the better financial position translates into higher search and/or bargaining costs. Households that are financially well-off spend less time and effort in bargaining and search (Song, 1995, 1998; Wilhelmsson, 2008).[7] Consequently, buyers with a good financial

[7] Note that 'alternative' explanations – such as differences in motivation to buy (or sell) and diminishing marginal utility of income and wealth – can all be translated into costly search and bargaining.

position will pay more, while sellers with a good financial position receive less. Evidence that higher buyer income leads to higher transaction prices is presented by Song (1998) and Kestens et al. (2006). Harding et al. (2003) contribute to the literature by also including seller income. They present clear evidence that buyers with relatively high incomes pay more for a given house, while sellers with relatively high incomes receive less.[8]

Like Harding et al. (2003) chapter 2 studies the effects of buyer and seller characteristics on house prices in a hedonic framework. In order to include both buyer and seller characteristics the chapter looks into the price effects of the relative income and wealth positions. While an extensive set of household characteristics is used, the focus is on the financial characteristics. To our knowledge this study is the first to actually include both household income and household wealth. Harding et al. (2003) – while talking about wealth – only include income in their models. The data at our disposal allow us to clearly distinguish between income and wealth effects. However, it is empirically not possible to determine the exact mechanism that relates financial position to house prices; that is, the bargaining process cannot be distinguished from the search process.

1.5 Equity constraints, loss aversion, and household mobility

Chapter 3 focuses on decreasing house prices and how these decreases can create constraints on household mobility. First, price decreases can create equity constraints. Housing wealth evaporates when house prices start decreasing, leading to low or even negative housing equity. The decline in wealth makes obtaining a mortgage for a new home more difficult. Decreasing house prices, thus, lead to lower household mobility. Second, price decreases can result in the house value becoming lower than the original purchase price, that is, a paper loss. Prospect theory (Kahneman and Tversky, 1979) suggests that

[8]Note that all of these are micro approaches where price effects are defined relative to the market value. Macro approaches relating (national) income levels to house prices (e.g. McQuinn and O'Reilly, 2008) have little in common with the approach that is chosen in this chapter. Macro studies try to explain market price developments not deviations from market values.

households are averse to these nominal losses.[9] Nominal losses, therefore, also have a negative effect on household mobility.

In household mobility studies the first mentioned mechanism, i.e. equity constraints, has received the almost exclusive attention. Ferreira et al. (2010, 2012) and Schulhofer-Wohl (2012) are among the many scholars that have simply ignored loss aversion. That is, any reduction in household mobility is fully contributed to an inability to move, while unwillingness to move could also be an explanation. Engelhardt (2003) is the only scholar that explicitly distinguishes the financial constraint from the psychological constraint when studying household mobility. Interestingly, he concludes that there is little evidence that decreasing house prices reduce household mobility through equity constraints. Loss aversion, on the contrary, does significantly reduce household mobility.

Like Engelhardt (2003) this chapter distinguishes equity constraints from loss aversion. This study contributes to the literature by presenting clear evidence that loss aversion cannot be discarded. Besides, our analysis includes non-housing wealth in the analysis as additional sources of wealth explain why negative housing equity does not necessarily lead to financial lock-in.

1.6 Equity constraints, loss aversion, and transaction prices

Chapter 4 investigates the effects of loss aversion and equity constraints on house prices. The chapter builds on the preceding chapter. If equity constraints and loss aversion affect household mobility these mechanisms are also expected to affect transaction prices. Households that are unable or unwilling to sell at market value could be able or willing to sell if they receive a market premium, that is, a price that is higher than the market value of the house.

This chapter is closely related to Anenberg (2011) and Genesove and Mayer (2001) who have empirically tested the effects of loss aversion and equity constraints on house prices. The empirical approach, however, is different. Still, the most important difference between this study and Anenberg (2011) and Genesove and Mayer (2001) is the difference in institutional set-

[9] It should be noted that in most housing market applications the gain domain is not defined (e.g. Genesove and Mayer, 2001; Anenberg, 2011).

ting. In the Netherlands, down-payment constraints or strategic defaults do not exist. Our study, thereby, investigates whether the value of the mortgage might also function as a reference point, that is, whether negative equity could potentially be more than only a financial constraint.

1.7 Assumptions, limitations, and scope

As the above sections have shown, the chapters rely on different assumptions. There are several arguments to justify these differences. The first is the standard simplicity argument: assumptions are necessary to capture complexity in an economic model (e.g. Gilboa et al., 2014). The chapters have different topics, focus on different issues, thereby implicitly justifying different assumptions. The second argument is a comparability argument: for all individual topics we want to be able to compare, at least to some extent, the results of our studies with those of prior studies.

The most notable difference in assumptions is found in chapters 2 and 4. In chapter 2 both buyer and seller characteristics are assumed to be determinants of house prices, whereas in chapter 4 buyer characteristics are assumed irrelevant. In chapter 2 allowing for both seller and buyer characteristics comes at a cost: we have to assume symmetric behavior of buyers and sellers. Still, in a bargaining framework it makes most sense to include both buyer and seller behavior. In chapter 4 we ignore buyer characteristics. The main reason to do this is the existing literature; house price studies focusing on constraints have ignored buyer effects. Besides, symmetry assumptions make less sense when focusing on constraints related to housing equity and prospective losses. Hence, the decision to include only seller characteristics makes more sense in the setting of chapter 4 than it does in chapter 2.

The differences in assumptions imply that the chapters of this dissertation, while closely related in topics, investigate separate reduced form models. It is beyond the scope of this dissertation to present a single model or theory that incorporates all of the studied mechanisms. However, will look into the complementarity of the different mechanisms in the concluding chapter. A thorough discussion of the assumptions, the relationship between the theories, and the extent to which the various mechanisms are consistent with each other will be presented in chapter 5.

Chapter 2

Financial position and house prices

2.1 Introduction[1]

Hedonic models explain prices of heterogeneous goods in terms of differences in characteristics of the good (Rosen, 1974). Therefore, hedonic models are a preferred method in the analysis of house prices (Malpezzi, 2003; Sheppard, 1999). However, after correcting for differences in house characteristics, location, market circumstances, etc. there remains notable heterogeneity in house prices (Harding et al., 2003; Kestens et al., 2006). Both bargaining and search have been suggested as explanations for this heterogeneity. The hedonic bargaining literature suggest that, because house values are not easily determined, bargaining incentives arise within every house transaction (Harding et al., 2003). Investing more effort and time in the bargaining process leads to a better bargaining outcome, ceteris paribus. Search models have the same implications: differences in search costs lead to different search strategies and, therefore, differences in transaction outcomes (Glower et al., 1998; Wheaton, 1990).

As household characteristics are related to search and bargaining, it seems likely that buyer and seller characteristics explain part of the observed price heterogeneity in the housing market. In particular the financial position of a

[1] A revised version of the chapter is published as: Steegmans, J., Hassink, W., 2017. Financial position and house price determination: An empirical study of income and wealth effects. Journal of Housing Economics 36, 8–24.

household is likely to affect search and bargaining (Elder et al., 1999; Harding et al., 2003). We will, therefore, focus on the role of household income and wealth in the determination of house prices. It is an empirical issue whether the financial positions of buyers and sellers indeed have an effect on house prices. After correcting for house characteristics, does the financial position of buyers and sellers indeed have an impact on house prices? Are financially well-off and less well-off households located at different sides of the price distribution? That is, can the financial position of buyers and sellers explain part of the heterogeneity in house prices?

The role of buyer and seller characteristics has received relatively little attention in the housing literature as it has been hard to obtain data on both buyers and sellers. Consequently, most empirical studies have limited themselves to either sellers or buyers, while even these studies had to rely on very limited data sets (Kestens et al., 2006; Song, 1995, 1998). To the best of our knowledge, no studies on the role of personal characteristics have included both income and wealth, as data were not available. Therefore, this study is the first to make a distinction between income and wealth effects in a hedonic bargaining framework. We will investigate the relative magnitude and the shape of the relation. Due to both the size of the data set and the extensive seller and buyer characteristics the data are particularly well-suited to study the role of financial positions in house price determination.

Understanding how relative financial positions affect house prices will explain buyer and seller behavior in the housing market. The insights in the relationship between financial positions and house prices thus help to unravel the mechanisms in house price determination. This study contributes to the literature on the role of household characteristics in house price determination, in particular to theory related to bargaining and search.

The remainder of this chapter is organized as follows. Section 2.2 presents the theoretical framework. Section 2.3 discusses the data set and variables. Section 2.4 describes the empirical model. Section 2.5 reports the estimates. Section 2.6 considers the robustness of the results and section 2.7 summarizes and concludes.

2.2 Theoretical framework

Within housing market research two strands of literature exist that explain how (buyer and seller) income and wealth can influence house prices. The first involves search, the second involves bargaining. Nevertheless, these strands of literature are overlapping and not mutually exclusive.

2.2.1 Search and matching models

Search models explain how similar goods can be sold at different prices due to imperfect information. Continued search leads to a more favorable price, but it comes at the cost of additional search costs. Selling price and selling time are thus determined jointly (Glower et al., 1998). Depending on the search cost there is an optimal search strategy. Most of the housing market search models focus on seller search without paying attention to buyers, i.e. these studies focus on selling time or time-on-the-market only (e.g. Genesove and Mayer, 1997, 2001; Springer, 1996). Sellers will simply accept the first (buyer) offer above their reservation price.

The role of buyers, however, should not be neglected as a transaction involves both seller and buyer search. Price determination in the housing market is a strategic interaction between buyers and sellers (Merlo and Ortalo-Magne, 2004). In search models where both seller and buyer valuations matter, a match occurs if the valuation of the buyer is higher than the valuation of the seller. Matching is the first stage, whereas bargaining over the surplus is the second stage (Wheaton, 1990; Yavaş, 1992). Nevertheless, these theoretical contributions do generally refer to the special case where bargaining power of buyers and sellers is equal. "Since both parties are otherwise identical individuals, it seems reasonable to assume that each has equal bargaining power and that they will split the gains from the transaction" (Wheaton, 1990, p. 1280). Arnold (1999) notes that an equal split is very unlikely as a bargaining outcome depends on buyer and seller discount rates, outside opportunities and the value of the continued search (Arnold, 1999, p. 455).[2]

Buyers and sellers who engage in a transaction are not identical individuals. Sellers and buyers are heterogeneous and have different search costs. They differ, for instance, in their impatience or urgency to make a transaction. More motivated sellers have higher holding costs (search costs) and lower reservation prices. They put less effort in the searching process and

[2]Note that in theoretic search models a very narrow definition of bargaining is applied that clearly distinguishes bargaining from search. In the first stage the reservation prices determine whether a transaction can occur (the matching stage) and relatively to these reservation prices one defines bargaining power (the bargaining stage).

sell their houses more quickly at a lower price (Springer, 1996). Impatient buyers, on the other hand, will pay more (Quan and Quigley, 1991).

Search costs are likely to be related to household income and household wealth. Financially unrestrained households are likely to be less patient and more motivated to buy or sell. In other words, households with high incomes and/or wealth have higher search costs. The existence of heterogeneous search costs implies that financially well-off buyers will pay more for a given house, while financially well-off sellers will receive less for a given home. This holds even in matching models in which bargaining power between buyer and seller is assumed to be equal.

It is possible that differences in search costs also lead to differences in the employment of a realtor. Jud (1983), for instance, argues that higher income buyers and sellers – due to higher search costs – are more likely to employ a broker. Based on a sample of house transactions in North Carolina from 1980 he indeed concludes that "higher income buyers were somewhat more likely to consult a broker than others" (Jud, 1983, p. 80). Reasoning along the same lines, Elder et al. (1999) also present evidence that higher income buyers are more likely to use a broker. The use of a real estate agent could mitigate the negative effect of a better financial position on transaction outcome. Nevertheless, as employing a broker does not fully offset differences in search costs, effects of financial position on transaction outcomes would remain.[3]

2.2.2 Hedonic bargaining literature

The hedonic bargaining literature explains that prices of heterogeneous goods do not only depend on the characteristics of the good.[4] With pure competition prices are well defined and different people will pay the same price for a given good. However, the more heterogeneous goods are, the thinner markets will become; prices will be less defined and bargaining incentives arise (Harding et al., 2003; Ihlanfeldt and Mayock, 2009; Pennington-Cross,

[3]See section 2.3 for some notes on brokerage in the Netherlands. We will argue that the data used limits heterogeneity due to differences in broker employment. Besides, from an international perspective, the role of brokers seems to be relatively small in the Netherlands.

[4]We prefer the use of the term hedonic bargaining literature over bargaining literature in order to make a clear distinction with the theoretic bargaining literature that is used in relation to game theory.

2004). Bargaining, therefore, can explain why different people pay a different price for a similar house. The housing market is a clear example of a market where bargaining incentives are large. After all, at the margin every house is unique as houses differ in location, characteristics, and quality (Harding et al., 2003). Bargaining power, therefore, affects transaction prices.

The price of a house does not only depend on the house characteristics, but also on the characteristics of the buyer and seller. Empirical studies have found that income has a negative effect on bargaining power. In other words, buyer income increases transaction price, whereas seller income decreases it (Harding et al., 2003; Kestens et al., 2006; Song, 1995, 1998). The explanation is sought for, *a posteriori*, in a framework in which bargaining is costly. Bargaining costs, like search costs, are likely to increase with income and wealth, thereby leading to a negative effect on relative bargaining power.[5] Harding et al. (2003) suggest that diminishing marginal utility is the likely explanation for a negative effect of financial position on bargaining power: "wealthy individuals demand higher-valued homes but prefer not to expend the time and energy needed to bargain aggressively, and so do worse" (Harding et al., 2003, p. 185).[6] Song (1995, 1998) and Wilhelmsson (2008) refer to search costs to explain negative effects of income on bargaining.

All in all, both search models and bargaining models explain how income and wealth of buyers and sellers influence house prices. As long as search and/or bargaining costs increase with income and or wealth, both search models and bargaining models imply that a better financial position leads to less search and/or less aggressive bargaining. A better financial position, thus, leads to lower prices for sellers and higher prices for buyers. In this analysis we will not empirically distinguish between search and bargaining.

[5]In the hedonic bargaining literature a broader definition of bargaining is used than in theoretic search models (or matching models). This broader definition does not distinguish between search and bargaining costs. Bargaining power is not defined relative to the reservation prices of the buyer and seller, but relative to the expected market price.

[6]Harding et al. (2003) estimate bargaining effects by making use of income, not wealth. Nevertheless, they draw conclusions on wealth, not income. They argue that wealth is "strongly and positively correlated" with income and other observables (Harding et al., 2003, p. 185).

2.3 Data

2.3.1 Data set

The Statistics Netherlands (CBS) data set that is used for the analysis in this chapter was obtained by combining transactions of existing homes with buyer and seller household characteristics for the period 2006-2010. In the Netherlands transactions of houses are registered by the Cadastre, Land Registry and Mapping Agency. The Cadastre records provide transaction price, transaction month, location, and house type for existing homes. These data have been extended with an extensive set of house characteristics from the Dutch Association of Realtors (NVM), which covers about seventy percent of the market.[7] The house transactions, including house characteristics, have been matched at the individual level to the characteristics of both buyers and sellers. The period under investigation includes both the upturn and the downturn in the Dutch housing market, as prices peaked around August 2008.

The personal characteristics are identified through the household's reference person. The main characteristics are found in the Population Register (GBA). It includes information on birth date, gender, marital status, the number of children, and the number of adults in the household. These characteristics have been further extended with the household's financial data as known by the tax authorities, which include both household income and household wealth. Besides, it provides information on whether a household has significant self-employment income. Again by making use of the household's reference person, additional labor market characteristics have been matched to individuals that are in (salaried) employment. The job characteristics contain information on contract type, that is, full-time/part-time, permanent/temporary, or flexible/fixed.

The house characteristics consist of the lot size (square meters), floor size (square meters), number of rooms, construction period, type of parking lot, garden orientation, insulation, type of heating, type of road the house is located on, the ground lease status, and the interior and the exterior quality. The quality is determined by the broker with a number between 1 and 10. Conditioning on the house characteristics of the Dutch Association of Re-

[7]While the NVM realtors have a somewhat larger market share in the core of the Netherlands than in the periphery, there is no indication of any selection effects.

altors implies that all of the sellers in our data set made use of a seller's agent.[8] This obviously limits variation due to brokerage. Still, there remains unobserved brokerage heterogeneity as buyers might or might not employ a realtor.[9]

The data set thus consists of combined data on house transactions and buyer and seller characteristics that are matched at the individual level. The data set consist of existing family homes (row houses, corner houses, semi-detached houses, and detached houses) that have been sold between 2006 and 2010. Observations of non-private transactions and non-unique addresses have been removed. The remaining Statistics Netherlands data set that is used for the estimations in this chapter contains 144,604 observations. Due to both the size and the extensive seller and buyer characteristics the data set is particularly well-suited to study 'bargaining power' in the owner-occupied housing market.

Although the data set is very detailed a limitation does exist: household wealth is not observed entirely. The most important wealth component that is missing is the asset side in endowment mortgages (in Dutch *beleggingshypotheek* and *spaarhypotheek*) as these are not known by the tax authorities. Household wealth excluding mortgage and house value can serve as an alternative wealth variable as it does not have this drawback. We will use this alternative wealth measure in the robustness checks. Apart from that, not all debts from low-income households are observed (mainly short-term debts) nor are assets from current accounts (Statistics Netherlands, 2012, p. 10). The latter entail only minor deviations in wealth.

2.3.2 Descriptive statistics

As figure 2.1 shows the market conditions in the Dutch housing market have clearly changed between 2006 and 2010. Since the peak in August 2008 the mean house price has shown a significant decrease. The period of rising prices

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[8] In the Netherlands seller's agents advice on the list price, arrange property showings, help in the negotiation process, and draw up the contract of sale (Overvest and Van der Poel, 2013). From an international perspective, the Dutch commission rates for seller's agents are very low: seller's agents receive only between 1.5 and 2 percent of the transaction price (Delcoure and Miller, 2002).

[9] Making use of survey data of the period 2008-2011 Van der Zeijden et al. (2011) observe that almost 56 percent of Dutch buyers employed a broker. Buyer's agents generally have a smaller role in the transaction process than seller's agents. Consequently, their services cost less than those of seller's agents.

Figure 2.1: Average house prices (2006-2010)

turned into a period of decreasing prices; in our terminology, the housing boom turned into a housing bust. These terms are simply used to refer to the periods of ascending and descending house prices. During the housing market bust the number of transactions has dropped significantly too (see figure 2.2), it has to be noted though that transaction numbers had started dropping well before the prices peaked. Note that the development in average house price is very similar for all types of family homes. The same holds for the number of transactions.

Descriptive statistics of buyer and seller characteristics can be found in table 2.1; the differences between them are shown in table 2.7 in appendix 2.A. We observe that on average buyers are younger (8.8 years), less often married (19.0 percentage points), and less often divorced (1.5 percentage points).[10] Besides, buyers have lower mortgages than sellers (126.0 thousand euros). This holds for all years between 2006-2010. These statistics demonstrate the existence of a housing career. We observe the same for income,

[10]Divorces are defined as a change from a married status to an unmarried status, compared to the year before.

Figure 2.2: Housing market transactions (2006-2010)

as income is on average lower for the buyer household (almost 9.1 thousand euros). Buyers have higher wealth (almost 20.5 thousand euros), even though this is mainly due to the bust years 2009-2010. Note, however, that buyer and seller wealth fluctuate strongly throughout the years. The labor market developments are a little less clear cut even though sellers are more often sell-employed and have a fixed contract more often than buyers. These results also hold for the entire period. The summary statistics of the NVM house characteristics can be found in table 2.8 in appendix 2.A.

Tables 2.2 and 2.3 show the main percentiles of buyer and seller income and wealth. Noticeable is the large variation in wealth; particularly seller wealth exhibits a wide distribution, both during the boom and the bust. Table 2.2 illustrates that overall the median buyer and seller income rose from 2006 to 2010; the median income of households selling a detached house is the main exception. Table 2.3 shows that median seller wealth increased until 2008 and decreased after that, while median buyer wealth peaked in 2007 or 2008, depending on the house type.

For analysis purposes income, wealth, age, and employment status have

Table 2.1: Buyer and seller characteristics

	2006		2007		2008		2009		2010	
	Buyer	Seller	Buyer	Seller	Buyer	Seller	Buyer	Seller	Buyer	Seller
Household characteristics:										
Gross income (in euros)	67314	75442	71585	79772	72617	81550	71655	82551	73779	82995
	(42359)	(51589)	(48863)	(58200)	(46020)	(56994)	(42243)	(56433)	(45809)	(56106)
Wealth (in euros)	147461	136487	171185	169360	168170	172119	180486	131028	180752	136586
	(685345)	(649479)	(620134)	(720699)	(646429)	(515319)	(1375832)	(406041)	(1071533)	(479830)
Wealth excl. housing (in euros)	79933	84760	93966	113261	87322	112586	104435	105056	115788	102166
	(456898)	(515558)	(468693)	(577513)	(593735)	(429303)	(1361322)	(340165)	(1050934)	(440454)
Mortgage (in euros)*	96190	202827	101650	217703	106685	223586	91161	250254	94740	226181
	(443239)	(400255)	(372188)	(438973)	(175619)	(268088)	(124152)	(229086)	(129830)	(203502)
Multiple adults (1 = yes)	0.823	0.816	0.826	0.813	0.826	0.811	0.812	0.783	0.799	0.755
	(0.382)	(0.387)	(0.379)	(0.390)	(0.379)	(0.392)	(0.391)	(0.413)	(0.401)	(0.430)
Children (1 = yes)	0.440	0.538	0.433	0.532	0.420	0.530	0.374	0.531	0.400	0.502
	(0.496)	(0.499)	(0.495)	(0.499)	(0.494)	(0.499)	(0.484)	(0.499)	(0.490)	(0.500)
Married (1 = yes)	0.455	0.644	0.449	0.636	0.425	0.625	0.385	0.589	0.395	0.566
	(0.498)	(0.479)	(0.497)	(0.481)	(0.494)	(0.484)	(0.487)	(0.492)	(0.489)	(0.496)
Divorced (1 = yes)	0.019	0.033	0.018	0.034	0.018	0.035	0.017	0.031	0.015	0.033
	(0.135)	(0.179)	(0.133)	(0.182)	(0.134)	(0.183)	(0.129)	(0.173)	(0.122)	(0.177)
Self-employed (1 = yes)	0.110	0.131	0.114	0.138	0.117	0.144	0.104	0.142	0.095	0.138
	(0.312)	(0.337)	(0.318)	(0.345)	(0.322)	(0.352)	(0.306)	(0.349)	(0.293)	(0.345)
Characteristics household head:										
Age (in years)	37.7	45.4	37.9	46.0	37.3	46.0	36.1	45.7	36.7	46.5
	(10.6)	(12.7)	(10.8)	(12.9)	(10.8)	(12.9)	(10.6)	(13.0)	(10.7)	(13.4)
Male (1 = yes)	0.899	0.905	0.903	0.905	0.901	0.903	0.892	0.888	0.884	0.885
	(0.301)	(0.293)	(0.296)	(0.293)	(0.298)	(0.296)	(0.310)	(0.316)	(0.320)	(0.319)
Fixed contract (1 = yes)	0.979	0.986	0.976	0.986	0.975	0.984	0.977	0.981	0.978	0.982
	(0.143)	(0.116)	(0.154)	(0.119)	(0.157)	(0.124)	(0.149)	(0.137)	(0.147)	(0.134)
Permanent contract (1 = yes)	0.826	0.836	0.800	0.814	0.812	0.825	0.856	0.852	0.870	0.864
	(0.379)	(0.371)	(0.400)	(0.389)	(0.390)	(0.380)	(0.352)	(0.355)	(0.336)	(0.343)
Full-time contract (1 = yes)	0.913	0.917	0.920	0.923	0.925	0.920	0.925	0.915	0.917	0.912
	(0.281)	(0.276)	(0.271)	(0.267)	(0.263)	(0.271)	(0.264)	(0.278)	(0.276)	(0.283)
House:										
House price (in euros)	261510	261510	275501	275501	279758	279758	265808	265808	267545	267545
	(123568)	(123568)	(137310)	(137310)	(138900)	(138900)	(128143)	(128143)	(128521)	(128521)
Observations	40,509	40,509	37,913	37,913	31,095	31,095	19,845	19,845	15,242	15,242

Notes: Standard deviations are shown under the means. Contract types are conditional on having a job.
* Mortgages are observed prior to the transaction; that is, the seller mortgage corresponds to the house that is sold while the buyer mortgage corresponds to the house where the household lived previously (without an owner-occupied house the mortgage would thus be equal to zero).

Table 2.2: Distribution of gross household income

	Buyer income (in euros)					Seller income (in euros)				
	2006	2007	2008	2009	2010	2006	2007	2008	2009	2010
Row houses										
p10	31826	33162	34526	34663	34892	32751	33525	34516	34224	32707
p25	43198	44605	46668	46712	47239	47585	49174	51680	51923	51450
p50	57282	59029	61798	61633	62368.5	66958	69656	72829.5	74865	75442
p75	74587	77132	80598	79775	81425	91899	95639	99432	102928	104704
p90	96367	100270	103629	102395	105369	123180	129063	132542	136246	141407
Obs.	22374	20191	17086	11322	8418	22374	20191	17086	11322	8418
Corner houses										
p10	33075	34080	35220	35218	36106	29907	30651	32713	31501	31314
p25	45104.5	47061	48431	49327.5	49729	46138.5	47290	49567	48821.5	48726
p50	59766.5	62269	64024	65509	65770	66581.5	69770.5	71496.5	73543.5	74808
p75	77683.5	81858	84339	84066.5	85936	91864	97365.5	99281	101585.5	104027
p90	104041	107144	109810	109052	115423	126822	133128	133260	137642	140227
Obs.	7268	7276	5974	3884	2981	7268	7276	5974	3884	2981
Semi-detached houses										
p10	33891	34649	36899	36180.5	37660	27095	27050	28334	28031.5	27653
p25	46754	48475	50797	51556.5	51575	43855	44804	46454	45949	44682
p50	63130.5	66060	67605	68988.5	68561	65434.5	67338	70692	71232.5	71113
p75	84093	89318	91275	91540.5	93179	92188	96703	99445	104206.5	102380
p90	115080	124799	125707	125142	125403	127679	135074	137673	143365	144611
Obs.	6122	5653	4551	2780	2333	6122	5653	4551	2780	2333
Detached houses										
p10	34322	37234	38629	37511	38194.5	22803	23954	23580	24121	22594.5
p25	51387	54430	56202.5	55797	58440	38433	40024	40435	37906	37456
p50	75076	79740	81138	82306	85698	62417	64704	65476.5	63068	61528.5
p75	107804	115677	116848	116381	123102	97288	102331	101960.5	102405	97830
p90	152372	172739	164084	163048	176534.5	146637	155439	152703	151604	148609
Obs.	4745	4793	3484	1859	1510	4745	4793	3484	1859	1510

Note: p10, p25, p50, p75, and p90 are the respective percentiles.

Table 2.3: Distribution of household wealth

	Buyer wealth (in euros)					Seller wealth (in euros)				
	2006	2007	2008	2009	2010	2006	2007	2008	2009	2010
Row houses										
p10	0	565	561	621	20	-87544	-35281	-35375	-145695	-94867
p25	5400	6427	6385	6001	5624	6998	20452	20339	-1483	-3907
p50	35180.5	41415	38115.5	37535	29849.5	69688.5	85308	86400	64608.5	57301
p75	141813	159315	159744	177387	148620	154584	180065	188312	171997	156733
p90	291101	327171	331333	360204	330659	263210	299844	311887	302941	283259
Obs.	22374	20191	17086	11322	8418	22374	20191	17086	11322	8418
Corner houses										
p10	559	754	827	1060	603	-75492	-38900	-34142	-147184	-99827
p25	7803	9437	9753	8724.5	7642	14249	25389.5	24792	2967	-2911
p50	55114.5	59780.5	59188	55585.5	46371	86546	103314	104964	77540.5	68357
p75	172708.5	181994.5	184926	210209	187340	182782.5	212332	213704	199581.5	189389
p90	347484	371026	396667	410284	398076	307786	353782	360803	338562	344919
Obs.	7268	7276	5974	3884	2981	7268	7276	5974	3884	2981
Semi-detached houses										
p10	1075	1604	1750	1749	107	-66375	-15609	-18581	-112842	-66931
p25	17789	20959	20247	15810.5	13791	23551	44475	47271	14831	17421
p50	85567.5	96688	99070	95609.5	79307	115311.5	138961	149564	114821.5	106843
p75	209371	230802	248101	259461	226208	225398	267732	272400	260529	231490
p90	395476	447951	464302	503100.5	454103	373911	445098	447255	436429	406035
Obs.	6122	5653	4551	2780	2333	6122	5653	4551	2780	2333
Detached houses										
p10	4714	8096	7896	7010	3310.5	-47961	-7540	1876	-42598	-40390.5
p25	54551	71071	66660.5	55787	40500	60937	91527	103443	69211	60847
p50	167712	199790	188498.5	197894	156892.5	207536	245656	255023	222609	211141.5
p75	339496	384907	374474.5	413270	388184	375081	418264	438594	412124	388938
p90	623926	738353	675243	790070	799466.5	615581	701845	708165	658048	720129.5
Obs.	4745	4793	3484	1859	1510	4745	4793	3484	1859	1510

Note: p10, p25, p50, p75, and p90 are the respective percentiles.

been used to create categories. Gross household income has been split up into 10 nominal categories. The reference category is the group with an annual gross household income between 0 and 20,000 euros. Wealth has been used to create 7 nominal wealth categories. The reference category is household wealth smaller than 0 euro, which is a relatively heterogeneous group as it seems to over-represent households that make full use of their fiscal opportunities to limit taxable wealth. Age has been used to generate 9 age classes (reference category: younger than 25 years). Finally, labor market status has been used to generate 8 employment groups (reference category: workers with a flexible, part-time, and temporary contract).

2.4 Empirical model

Hedonic pricing models have been used extensively to study the housing market (see Malpezzi (2003) and Sheppard (1999) for reviews). Hedonic models focus on the attributes of an object and the corresponding attributes' implicit marginal prices. An object is considered a bundle of attributes; the object's price is given by the sum of the attributes' implicit prices. Pure competition leads to a market equilibrium in which the marginal prices are known by all agents (Rosen, 1974). As the so-called shadow prices are known by both buyers and sellers bargaining does not influence prices.

$$log(P_i) = \alpha Z_i \tag{2.1}$$

where P_i is the price of house i, α is the vector of shadow prices, and Z_i is the vector of house characteristics.

In thick markets competition is large and prices are well-defined. However, in thin markets prices are less defined and bargaining incentives arise. Therefore, we extend the traditional hedonic model with a bargaining component that captures bargaining relative to the expected market price.

$$log(P_i) = \alpha Z_i + B_i \tag{2.2}$$

where B_i indicates bargaining between the seller and buyer of house i. Following Harding et al. (2003) we assume that bargaining power, or search for that matter, is a function of personal characteristics.

$$B_i = \beta^{buy} X_i^{buy} + \beta^{sell} X_i^{sell} + \epsilon_b \tag{2.3}$$

where B_i is bargaining, β is a vector of bargaining coefficients, X_i^{buy} and X_i^{sell} are the vectors of personal characteristics of buyers and sellers respectively, and ϵ_b is a random error term. Substituting equation (2.3) into equation (2.2) results in an extended hedonic model, which expresses the house price in terms of the house characteristics and buyer and seller characteristics (Harding et al., 2003).

$$log(P_i) = \alpha Z_i + \beta^{buy} X_i^{buy} + \beta^{sell} X_i^{sell} + \epsilon_b \tag{2.4}$$

where P_i is the house price, α is the vector of shadow prices, Z_i is the vector of house characteristics, β is the vector of bargaining coefficients, X_i is a vector of personal characteristics, and ϵ_b is a random error term.

The bargaining power, relative to the market, is thus determined by the personal characteristics of buyers and sellers. While the market conditions and house characteristics determine an expected market price, the buyer and seller traits may result in a bargaining outcome that is either higher or lower. Income and wealth are important buyer and seller characteristics that affect the transaction price in the market for existing homes (Harding et al., 2003).

Different methodologies exist within the study of buyer and seller bargaining power to estimate the effect of personal characteristics. The first approach is based on the assumption that unobserved house characteristics are uncorrelated with the seller and buyer characteristics (Cotteleer et al., 2008; Kestens et al., 2006; Song, 1998). Under the assumption that unobserved house characteristics are uncorrelated with seller and buyer characteristics bargaining effects can simply be estimated from equation (2.4).

However, a correlation between unobserved house characteristics and personal characteristics would lead to biased estimates for bargaining. Kestens et al. (2006), for instance, recognize that the omission of luxury house attributes from their model leads to biased estimates for the effect of buyer income on house price if unobserved luxury attributes are correlated with household income.

Harding et al. (2003) start from the premise that buyer and seller characteristics are correlated with unobserved house characteristics. Due to the correlation between unobserved house characteristics and seller and buyer characteristics part of the effects of the unobserved house attributes will be picked up by the seller and buyer traits, resulting in biased estimates for the bargaining effects if equation (2.4) is estimated. It is, therefore, important to divide house characteristics in observed and unobserved house characteristics, Z_1 and Z_2 respectively, and to formalize the relationship between unobserved house attributes and the seller and buyer characteristics. Note that, for simplicity, the subscripts i have been dropped.

$$\alpha Z = \alpha_1 Z_1 + \alpha_2 Z_2 \tag{2.5}$$

$$\alpha_2 Z_2 = \delta^{sell} X^{sell} + \delta^{buy} X^{buy} + \epsilon_d \tag{2.6}$$

where α_1 and α_2 are shadow prices of observed and unobserved house attributes, Z_1 and Z_2 are observed and unobserved house characteristics, δ is a vector of coefficients, X is a vector of personal characteristics, and ϵ_d is a random error term. Substituting equation (2.5) and (2.6) into equation (2.4) results in the following equation:

$$log(P) = \alpha_1 Z_1 + (\beta^{sell} + \delta^{sell}) X^{sell} + (\beta^{buy} + \delta^{buy}) X^{buy} + \epsilon \tag{2.7}$$

where ϵ is a composite random error term ($\epsilon_b + \epsilon_d$).

It follows directly from equation (2.7) that without further assumptions the bargaining effects cannot be distinguished from the unobserved attributes effects. In order to make identification of the bargaining effect possible Harding et al. (2003) impose restrictions on the unobserved parameters. More particularly, they "assume that identical buyers and sellers have both similar tastes for housing and similar bargaining power" (Harding et al., 2003, pp. 181–182). In other words, they assume symmetric bargaining power and symmetric demand:

$$\beta^{sell} = -\beta^{buy} \tag{2.8a}$$

$$\delta^{sell} = \delta^{buy} \tag{2.8b}$$

The first restriction implies that if buyers and sellers have identical characteristics they will also have identical bargaining power; neither party will have an advantage. The second restriction implies that buyers and sellers with identical characteristics attach the same value to a house. This assumption, consequently, excludes endowment effects, that is, sellers attaching higher values to dwellings simply because they possess them (see Hoffman and Spitzer, 1993; Kahneman et al., 1990). Applying symmetric bargaining power and symmetric demand to equation (2.7) results in the following equation:

$$log(P) = \alpha_1 Z_1 + \beta(X^{sell} - X^{buy}) + \delta(X^{sell} + X^{buy}) + \epsilon \tag{2.9}$$

The resulting model includes a vector of sums of the seller and buyer attributes and a vector of differences of the seller and buyer attributes. Under the above-mentioned assumptions, the vector of sums identifies the effect of the unobserved house characteristics, called demand effects by Harding et al. (2003) and property class effects by Colwell and Munneke (2006), while the vector of differences identifies the bargaining effect.

Even though we observe an extensive set of house characteristics, it is likely that unobserved house characteristics are correlated with the characteristics of buyers and sellers. We will, therefore, estimate a model including the vector of sums and the vector of differences of seller and buyer characteristics. To allow for a direct effect of market conditions and to allow for local markets a set of time and municipality dummies is added. In order to allow for different bargaining effects throughout different market conditions the model will be estimated separately for all years. Thus, per year the following model is to be estimated:

$$\begin{aligned} log(P_{ity}) = \alpha_1 Z_{1ity} + \beta(X_{iy}^{sell} - X_{iy}^{buy}) + \delta(X_{iy}^{sell} + X_{iy}^{buy}) \\ + \sum_{t=2}^{12} \tau_t month_t + \sum_{m=2}^{431} \mu_m munip_m + \epsilon_{it} \end{aligned} \tag{2.10}$$

$$\text{with } i = 1, ..., N; t = 1, .., 12; y = 2006, ..., 2010; m = 1, ..., 431$$

where subscripts i, t, y, and m indicate the house, month, year, and municipality respectively. α_1 is the effect of observed house characteristics (shadow price of observed characteristics), β is the bargaining effect, δ is the effect of unobserved house characteristics, τ is a time (month) effect, μ is a (fixed) municipality effect, and ϵ_{it} is a random error term.

Note, once more, that the bargaining effects in equation (2.10) are measured relative to the expected market price. Thus, if there is a relative bargaining advantage for sellers in a certain period due to changing demand and supply this will not lead to a change in the bargaining coefficient but a change in the time dummies and/or shadow prices.

2.5 Estimates

The estimation results can be found in table 2.4. The table presents the coefficients of the difference between the seller and buyer characteristics. The coefficients of the observed house characteristics and the sum of the seller and buyer characteristics can be found in table 2.9 in appendix 2.A.

The coefficients of the summed variables behave as expected. House prices rise with summed income and summed wealth. Thus, on average, sellers and buyers that earn more (or have more wealth) live in more expensive homes. House prices also rise with multiple adults and/or children, that is, bigger households live in more expensive homes. The main result regarding employment is that self-employed people live in more expensive homes.

As the convention to subtract buyer characteristics from seller characteristics is followed negative coefficients for the differenced variables represent negative bargaining effects (e.g. Harding et al., 2003, p. 185). The results thus indicate that households with high relative incomes, compared to the other party, have less bargaining power than households with relatively less income. As a causal interpretation of the coefficients is not possible we will, like Harding et al. (2003) and Colwell and Munneke (2006), refrain from interpreting the coefficients as such.

One can still get an impression of the magnitude of the effects by looking at an example. For instance, a seller with an annual income larger than 100,000 euros who engages in a transaction with a buyer from a different income group (let's say between 40,000 and 50,000 euros) will receive between 5.4 and 7.2 percent less, depending on the year, than a seller with an income between 0 and 20,000 euros who engages in a transaction for an identical house with a buyer with the exact same characteristics.[11] Even though the coefficients cannot be interpreted as a causal effect, the results show that the larger the seller income is compared to the buyer income the less the seller will receive for a given house. F-tests show that the income dummies are jointly significant in all regressions.

The estimated coefficients for differenced wealth show, similarly, that bargaining power decreases with relative wealth. The larger the difference in relative wealth, the worse the households do. However, the effect of wealth is not monotonically decreasing; the effect seems largest for wealth between 100,000 and 200,000 euros. For wealth above 200,000 euros, the highest wealth category, the negative effect is slightly less negative. Still, the results

[11] Realize that we have taken differences of dummy variables. Therefore, the differenced variable can have three values: -1, 0, and 1. For this example we have chosen the easiest possibility: we focus on the differenced variable having value one because the seller is in this particular income group, $Y > 100$, and the buyer is not. Thus, for income group $Y > 100$: $\Delta X = 1$ because $X^{seller} = 1$ and $X^{buyer} = 0$. This is compared to the (excluded) reference category, that is, the seller is in the income group $0 < Y < 20$ and the buyer is not.

Table 2.4: Regression results with total wealth

	2006		2007		2008		2009		2010	
ΔY 20-30	0.007	(0.004)	-0.002	(0.004)	0.002	(0.005)	0.008	(0.006)	0.001	(0.010)
ΔY 30-40	0.009*	(0.004)	0.003	(0.004)	0.005	(0.005)	0.011	(0.006)	0.001	(0.010)
ΔY 40-50	0.002	(0.004)	-0.001	(0.004)	0.001	(0.005)	0.004	(0.006)	-0.003	(0.009)
ΔY 50-60	-0.006	(0.004)	-0.010*	(0.004)	-0.003	(0.005)	-0.008	(0.006)	-0.011	(0.009)
ΔY 60-70	-0.012**	(0.004)	-0.019***	(0.004)	-0.013*	(0.005)	-0.014*	(0.006)	-0.020*	(0.010)
ΔY 70-80	-0.019***	(0.004)	-0.026***	(0.004)	-0.018***	(0.005)	-0.020***	(0.006)	-0.027**	(0.009)
ΔY 80-90	-0.026***	(0.004)	-0.037***	(0.005)	-0.027***	(0.005)	-0.029***	(0.006)	-0.045***	(0.009)
ΔY 90-100	-0.033***	(0.004)	-0.040***	(0.005)	-0.037***	(0.006)	-0.037***	(0.007)	-0.047***	(0.009)
ΔY >100	-0.054***	(0.004)	-0.063***	(0.005)	-0.059***	(0.005)	-0.057***	(0.006)	-0.072***	(0.010)
ΔW 0-10	0.001	(0.002)	0.004	(0.002)	0.003	(0.003)	0.003	(0.004)	0.010**	(0.003)
ΔW 10-25	-0.006*	(0.002)	-0.005*	(0.002)	-0.005	(0.003)	-0.008*	(0.003)	-0.003	(0.003)
ΔW 25-50	-0.009***	(0.002)	-0.014***	(0.002)	-0.010***	(0.002)	-0.008*	(0.003)	-0.004	(0.004)
ΔW 50-100	-0.015***	(0.002)	-0.018***	(0.002)	-0.015***	(0.003)	-0.017***	(0.004)	-0.007*	(0.003)
ΔW 100-200	-0.018***	(0.002)	-0.020***	(0.002)	-0.019***	(0.002)	-0.016***	(0.003)	-0.012***	(0.003)
ΔW >200	-0.011***	(0.002)	-0.017***	(0.002)	-0.015***	(0.003)	-0.014***	(0.003)	-0.011***	(0.003)
Δage 25-30	0.004	(0.007)	-0.004	(0.007)	-0.003	(0.008)	-0.012	(0.007)	0.007	(0.014)
Δage 30-35	-0.001	(0.007)	-0.009	(0.007)	-0.004	(0.008)	-0.020**	(0.007)	0.008	(0.014)
Δage 35-40	-0.002	(0.007)	-0.011	(0.007)	-0.010	(0.008)	-0.024**	(0.007)	0.002	(0.014)
Δage 40-45	0.001	(0.007)	-0.011	(0.007)	-0.010	(0.009)	-0.021**	(0.007)	0.001	(0.014)
Δage 45-50	0.001	(0.008)	-0.011	(0.007)	-0.007	(0.009)	-0.021**	(0.008)	0.001	(0.014)
Δage 50-55	-0.002	(0.008)	-0.009	(0.007)	-0.004	(0.009)	-0.022**	(0.008)	0.000	(0.014)
Δage 55-60	-0.005	(0.008)	-0.010	(0.008)	-0.010	(0.009)	-0.025***	(0.007)	0.003	(0.015)
Δage 60-65	-0.008	(0.008)	-0.018*	(0.008)	-0.019*	(0.009)	-0.030**	(0.010)	0.006	(0.015)
Δage >65	-0.021*	(0.008)	-0.034***	(0.008)	-0.035***	(0.009)	-0.059***	(0.009)	-0.016	(0.016)
Δmale	0.005	(0.002)	0.004	(0.002)	0.001	(0.003)	-0.002	(0.003)	0.007	(0.004)
Δadults	-0.003	(0.002)	-0.003	(0.002)	0.000	(0.002)	0.003	(0.003)	-0.001	(0.003)
Δmarried	-0.006***	(0.002)	-0.006***	(0.002)	-0.007***	(0.002)	-0.003	(0.002)	-0.006***	(0.002)
Δdivorced	0.027***	(0.004)	0.028***	(0.004)	0.024***	(0.005)	0.022***	(0.007)	0.026**	(0.009)
Δchildren	-0.005***	(0.002)	-0.004**	(0.001)	-0.005**	(0.002)	-0.007**	(0.002)	-0.005*	(0.002)
Δfixfulperm	0.003	(0.006)	0.004	(0.007)	-0.013	(0.007)	0.002	(0.010)	0.017	(0.010)
Δflexfulperm	0.024*	(0.010)	0.016	(0.011)	-0.014	(0.011)	-0.015	(0.012)	0.015	(0.017)
Δfixparperm	0.008	(0.007)	0.003	(0.007)	-0.013	(0.008)	0.007	(0.011)	0.025*	(0.011)
Δflexparperm	-0.006	(0.013)	0.019	(0.019)	-0.021	(0.019)	0.032	(0.021)	0.037	(0.025)
Δfixfultemp	0.007	(0.006)	0.007	(0.007)	-0.006	(0.008)	0.003	(0.010)	0.013	(0.011)
Δflexfultemp	0.003	(0.011)	0.015	(0.011)	-0.013	(0.012)	0.019	(0.022)	0.022	(0.017)
Δfixpartemp	0.008	(0.008)	0.007	(0.008)	-0.001	(0.009)	-0.004	(0.012)	0.018	(0.012)
Δselfwithjob	0.002	(0.006)	0.002	(0.007)	-0.012	(0.008)	0.003	(0.011)	0.009	(0.011)
Δselfwithoutjob	0.006	(0.006)	0.006	(0.007)	-0.010	(0.008)	-0.006	(0.010)	0.008	(0.010)
Δjobother	-0.002	(0.006)	0.002	(0.007)	-0.017*	(0.008)	-0.005	(0.010)	-0.000	(0.011)
House characteristics	yes		yes		yes		yes		yes	
Municipality dummies	yes		yes		yes		yes		yes	
Month dummies	yes		yes		yes		yes		yes	
Vector of sums	yes		yes		yes		yes		yes	
Constant	10.942***	(0.059)	11.052***	(0.080)	10.851***	(0.053)	11.234***	(0.110)	10.945***	(0.045)
N	40,509		37,913		31,095		19,845		15,242	
Adj. R-sq	0.852		0.858		0.857		0.844		0.852	

Notes: Dependent variable: log(house price). Robust standard errors clustered by municipality in parentheses. Income (Y) and wealth (W) are measured in thousands of euros. Summed variables and house characteristics can be found in table 2.9 in appendix 2.A. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

show that higher relative wealth decreases bargaining power. The wealth dummies are jointly significant for all years.[12]

The bargaining coefficients of income and wealth show that these effects hold for all years. There is little evidence that bargaining effects differ between the boom years (2006-2007) and the busts years (2009-2010). All in all, there is clear evidence of negative effects of relative income and wealth on bargaining power in different market conditions. Nevertheless, the wealth effect subsides for the highest wealth category.

2.6 Robustness

2.6.1 Wealth

In order to test for robustness of the results we will estimate a second specification. As noted before, wealth is possibly not observed entirely. Most notably, particular mortgage types may have unobserved components. Results are likely to be biased if the unobserved wealth components are correlated with house or household characteristics. A second issue that needs to be addressed is the possible endogeneity regarding household wealth. After all, house value is a component of household wealth. Nevertheless, given the reference date of wealth this is unlikely to bias results. Household wealth is observed the first of January only, whereas transactions can occur anytime during the year. The negotiated transaction price of a house, therefore, has no direct effect on observed wealth.

Nevertheless, as biases due to these two reasons cannot be excluded we re-estimate the previous model with a second wealth variable, that is, wealth excluding components related to the house. This second wealth variable thus excludes both the house value (subtracted) and the mortgage (added) compared to the earlier applied total wealth. This second wealth definition deals with both earlier mentioned issues as it excludes the net value of house and mortgage for all households and excludes the potential endogeneity.

The estimation results can be found in table 2.5. The effects of differenced income and differenced wealth (excluding house related components) are clear. The higher the relative income, compared to the other party, the lower the bargaining power. The use of the alternative wealth variable –

[12]Regressions per house type, with calendar dummies for all time periods (2006-2010), corroborate the results mentioned above.

that is, wealth excluding house related wealth components – shows that the results are not driven by a bias due to the total wealth variable that was used in the previous estimation. Not only have the effects in this alternative specification the same sign as the previous estimates, overall the income and wealth coefficients also have the same magnitude.[13] The main difference between this specification, which uses wealth excluding housing, and the previous one, which uses total wealth, is that for the years 2007 and 2009 the coefficients of the wealth categories are strictly decreasing.

2.6.2 Asymmetric bargaining

Asymmetric bargaining might also lead to biased estimates. We will, therefore, focus on the symmetric bargaining power assumption that we have made earlier. Of main interest here are sellers' equity constraints. Research has provided evidence that houses of low equity sellers are sold at a premium. Sellers with negative housing equity, the value of the house is less than the outstanding mortgage, sell their homes at higher average prices (Anenberg, 2011; Genesove and Mayer, 1997, 2001). Even though the negative equity effect can be interpreted as a rise in bargaining power for sellers, it violates the symmetric bargaining power assumption. Bargaining would no longer be fully symmetric as negative equity only has an effect on seller bargaining power.

Down-payment constraints are generally given as the explanation for a negative equity effect. In the Netherlands house buyers are not confronted with a formal down-payment requirement on a new house (Dröes and Hassink, 2014). However, Van der Cruijsen et al. (2014) suggest that low equity effects, corresponding to high loan-to-value (LTV) ratios, might not only be an institutional constraint but also a psychological barrier. Genesove and Mayer (2001) endorse the conclusion that price markups can be explained by both formal requirements and a psychological reluctance to sell.

Thus, even if equity effects are not caused by formal requirements house prices could still be affected. The LTV ratio is used as a measure of the

[13]At first glance it might seem that the wealth effects, particularly of the higher wealth categories, are less significant. However, the effects relative to the category with wealth lower than 0 euro have only changed because a change within the reference category. Compared to, for instance, wealth between 0 and 10,000 euros the coefficients of the higher wealth categories remain highly significant. We have purposely kept the reference category the same.

Table 2.5: Regression results with wealth excluding housing

	2006		2007		2008		2009		2010	
ΔY 20-30	0.008*	(0.004)	-0.002	(0.004)	0.002	(0.005)	0.008	(0.006)	0.002	(0.010)
ΔY 30-40	0.009*	(0.004)	0.002	(0.004)	0.006	(0.005)	0.012	(0.006)	0.003	(0.009)
ΔY 40-50	0.003	(0.004)	-0.002	(0.004)	0.001	(0.005)	0.005	(0.006)	-0.001	(0.009)
ΔY 50-60	-0.005	(0.004)	-0.011*	(0.004)	-0.003	(0.005)	-0.007	(0.006)	-0.010	(0.009)
ΔY 60-70	-0.012**	(0.004)	-0.020***	(0.004)	-0.013**	(0.005)	-0.014*	(0.006)	-0.019*	(0.009)
ΔY 70-80	-0.019***	(0.004)	-0.027***	(0.004)	-0.019***	(0.005)	-0.020***	(0.006)	-0.027**	(0.009)
ΔY 80-90	-0.027***	(0.004)	-0.038***	(0.005)	-0.028***	(0.005)	-0.029***	(0.006)	-0.044***	(0.009)
ΔY 90-100	-0.034***	(0.004)	-0.042***	(0.005)	-0.039***	(0.006)	-0.037***	(0.007)	-0.047***	(0.009)
ΔY >100	-0.057***	(0.004)	-0.065***	(0.005)	-0.061***	(0.005)	-0.059***	(0.006)	-0.072***	(0.010)
ΔW 0-10	0.009***	(0.002)	0.012***	(0.002)	0.001	(0.003)	0.009**	(0.003)	0.004	(0.004)
ΔW 10-25	0.003	(0.003)	0.007**	(0.003)	-0.004	(0.003)	0.002	(0.003)	-0.002	(0.005)
ΔW 25-50	0.000	(0.003)	0.002	(0.003)	-0.009***	(0.003)	0.000	(0.003)	-0.001	(0.005)
ΔW 50-100	-0.003	(0.002)	-0.002	(0.003)	-0.012***	(0.003)	-0.002	(0.004)	-0.006	(0.004)
ΔW 100-200	-0.006*	(0.003)	-0.003	(0.003)	-0.015***	(0.003)	-0.004	(0.004)	-0.016***	(0.004)
ΔW >200	-0.001	(0.003)	-0.010***	(0.003)	-0.015***	(0.003)	-0.005	(0.004)	-0.012**	(0.004)
Δage 25-30	0.003	(0.007)	-0.006	(0.007)	-0.004	(0.008)	-0.014	(0.007)	0.006	(0.014)
Δage 30-35	-0.003	(0.007)	-0.012	(0.007)	-0.006	(0.008)	-0.023**	(0.007)	0.006	(0.014)
Δage 35-40	-0.004	(0.007)	-0.015*	(0.007)	-0.012	(0.008)	-0.026***	(0.007)	-0.001	(0.014)
Δage 40-45	-0.000	(0.007)	-0.013	(0.007)	-0.011	(0.009)	-0.024**	(0.007)	-0.001	(0.014)
Δage 45-50	0.001	(0.007)	-0.012	(0.007)	-0.007	(0.009)	-0.023**	(0.008)	-0.000	(0.014)
Δage 50-55	-0.001	(0.008)	-0.009	(0.008)	-0.003	(0.010)	-0.024**	(0.008)	-0.000	(0.014)
Δage 55-60	-0.004	(0.008)	-0.010	(0.008)	-0.009	(0.009)	-0.026***	(0.007)	0.004	(0.015)
Δage 60-65	-0.006	(0.008)	-0.017*	(0.008)	-0.018	(0.009)	-0.032***	(0.010)	0.007	(0.015)
Δage >65	-0.016*	(0.008)	-0.032***	(0.008)	-0.032***	(0.010)	-0.060***	(0.009)	-0.015	(0.016)
Δmale	0.004	(0.002)	0.003	(0.002)	0.001	(0.003)	-0.002	(0.003)	0.006	(0.004)
Δadults	-0.004	(0.002)	-0.004	(0.002)	-0.001	(0.002)	0.002	(0.003)	-0.002	(0.003)
Δmarried	-0.006***	(0.002)	-0.007***	(0.002)	-0.007***	(0.002)	-0.004	(0.002)	-0.006**	(0.002)
Δdivorced	0.028***	(0.004)	0.028***	(0.004)	0.025***	(0.005)	0.023***	(0.007)	0.027**	(0.009)
Δchildren	-0.006***	(0.002)	-0.004**	(0.001)	-0.005***	(0.002)	-0.007**	(0.002)	-0.005*	(0.002)
Δfixfulperm	0.002	(0.006)	0.002	(0.007)	-0.013	(0.007)	0.000	(0.010)	0.016	(0.010)
Δflexfulperm	0.023*	(0.010)	0.014	(0.011)	-0.014	(0.011)	-0.015	(0.012)	0.016	(0.017)
Δfixparperm	0.007	(0.007)	-0.000	(0.007)	-0.014	(0.008)	0.007	(0.011)	0.024*	(0.011)
Δflexparperm	-0.006	(0.013)	0.016	(0.019)	-0.021	(0.019)	0.031	(0.020)	0.031	(0.025)
Δfixfultemp	0.007	(0.006)	0.005	(0.007)	-0.006	(0.008)	0.002	(0.010)	0.012	(0.011)
Δflexfultemp	0.005	(0.011)	0.014	(0.011)	-0.015	(0.012)	0.017	(0.022)	0.022	(0.017)
Δfixpartemp	0.007	(0.008)	0.004	(0.008)	-0.001	(0.009)	-0.005	(0.012)	0.017	(0.012)
Δselfwithjob	0.001	(0.006)	-0.000	(0.007)	-0.013	(0.008)	0.001	(0.011)	0.008	(0.011)
Δselfwithoutjob	0.004	(0.006)	0.003	(0.007)	-0.011	(0.008)	-0.008	(0.010)	0.005	(0.011)
Δjobother	-0.002	(0.006)	0.001	(0.007)	-0.017*	(0.008)	-0.005	(0.010)	-0.002	(0.011)
House characteristics	yes		yes		yes		yes		yes	
Municipality dummies	yes		yes		yes		yes		yes	
Month dummies	yes		yes		yes		yes		yes	
Vector of sums	yes		yes		yes		yes		yes	
Constant	10.931***	(0.059)	11.037***	(0.083)	10.849***	(0.052)	11.254***	(0.107)	10.957***	(0.046)
N	40,509		37,913		31,095		19,845		15,242	
Adj. R-sq	0.852		0.857		0.856		0.844		0.852	

Notes: Dependent variable: log(house price). Robust standard errors clustered by municipality in parentheses. Income (Y) and wealth (W) are measured in thousands of euros. Summed variables and house characteristics can be found in table 2.10 in appendix 2.A. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

equity position of the seller. A low LTV ratio is an indication of a good equity position, while a high LTV ratio is an indication of a poor equity position. An LTV ratio larger than one indicates the existence of negative equity. In the existing literature LTV ratios of 0.8 (80 percent) and 1 (100 percent) have received most attention as it is assumed that 0.8 and 1.0 function as thresholds (Anenberg, 2011; Genesove and Mayer, 1997, 2001). Given that the Dutch institutional setting might be different we do not impose this structure and add higher and lower LTV groups as well.

The estimation results can be found in table 2.6. The LTV ratios are only defined for house sellers, indicating that symmetric behavior does not hold here. Even though these estimates show that sellers with high LTV ratios sell their homes for higher prices, it is not possible to conclude whether this is caused by unobserved house characteristics or a price markup. After all, without further assumptions the bargaining effects cannot be distinguished from the so-called demand effects, see section 2.4. Still, these results indicate that bargaining might not be entirely symmetric.

The results show that allowing for seller equity effects has virtually no effect on the coefficients of income. However, adding LTV groups for sellers does lead to a more pronounced non-monotonic relation between house prices and wealth. That is, the negative wealth effect is overall largest for wealth between 50,000 and 100,000 euros, while the results show almost no effect anymore for the highest wealth category, wealth above 200,000 euros. The results thus confirm that the larger the difference in relative income, the worse the households do in bargaining. Besides, the estimated wealth effects suggest a U-shaped relation between bargaining power and wealth.

All in all, there is no evidence that the (symmetric) bargaining effects of wealth (or income) are driven by sellers' low equity effects. Even if we allow for these asymmetric equity channels we find convincing evidence that higher relative wealth and/or income deteriorate bargaining power. It seems, however, that bargaining power is not monotonically decreasing in wealth.

Table 2.6: Regression results with total wealth, including seller LTV

	2006		2007		2008		2009		2010	
ΔY 20-30	0.007*	(0.004)	-0.002	(0.004)	0.003	(0.005)	0.008	(0.006)	0.001	(0.010)
ΔY 30-40	0.008*	(0.004)	0.003	(0.004)	0.006	(0.005)	0.011	(0.006)	0.001	(0.010)
ΔY 40-50	0.002	(0.004)	-0.001	(0.004)	0.001	(0.005)	0.004	(0.006)	-0.004	(0.009)
ΔY 50-60	-0.006	(0.004)	-0.009*	(0.004)	-0.003	(0.005)	-0.009	(0.006)	-0.012	(0.009)
ΔY 60-70	-0.012**	(0.004)	-0.019***	(0.004)	-0.012*	(0.005)	-0.014*	(0.006)	-0.021*	(0.010)
ΔY 70-80	-0.019***	(0.004)	-0.025***	(0.004)	-0.018***	(0.005)	-0.021***	(0.006)	-0.028**	(0.009)
ΔY 80-90	-0.026***	(0.004)	-0.036***	(0.005)	-0.028***	(0.005)	-0.030***	(0.006)	-0.046***	(0.010)
ΔY 90-100	-0.034***	(0.004)	-0.040***	(0.005)	-0.038***	(0.006)	-0.037***	(0.007)	-0.047***	(0.009)
ΔY >100	-0.054***	(0.004)	-0.063***	(0.005)	-0.060***	(0.005)	-0.059***	(0.006)	-0.073***	(0.010)
ΔW 0-10	0.001	(0.002)	0.003	(0.002)	-0.003	(0.003)	0.002	(0.004)	0.008*	(0.003)
ΔW 10-25	-0.007**	(0.003)	-0.006*	(0.002)	-0.011***	(0.003)	-0.010**	(0.003)	-0.004	(0.004)
ΔW 25-50	-0.010***	(0.002)	-0.015***	(0.002)	-0.014***	(0.003)	-0.009**	(0.003)	-0.004	(0.004)
ΔW 50-100	-0.014***	(0.002)	-0.018***	(0.002)	-0.016***	(0.003)	-0.015***	(0.004)	-0.006	(0.004)
ΔW 100-200	-0.013***	(0.002)	-0.016***	(0.002)	-0.016***	(0.002)	-0.010**	(0.003)	-0.006	(0.003)
ΔW >200	-0.002	(0.002)	-0.011***	(0.002)	-0.007*	(0.003)	-0.003	(0.003)	0.001	(0.004)
Δage 25-30	0.002	(0.007)	-0.005	(0.007)	-0.005	(0.008)	-0.016*	(0.007)	0.005	(0.014)
Δage 30-35	-0.003	(0.007)	-0.009	(0.007)	-0.006	(0.008)	-0.024**	(0.007)	0.007	(0.014)
Δage 35-40	-0.002	(0.007)	-0.011	(0.007)	-0.010	(0.008)	-0.027***	(0.008)	0.000	(0.014)
Δage 40-45	0.001	(0.007)	-0.010	(0.007)	-0.009	(0.009)	-0.023**	(0.007)	0.001	(0.014)
Δage 45-50	0.001	(0.008)	-0.009	(0.007)	-0.006	(0.009)	-0.023**	(0.008)	0.002	(0.014)
Δage 50-55	-0.001	(0.008)	-0.006	(0.007)	-0.002	(0.010)	-0.022**	(0.008)	0.001	(0.014)
Δage 55-60	-0.004	(0.008)	-0.007	(0.008)	-0.007	(0.009)	-0.025**	(0.007)	0.006	(0.015)
Δage 60-65	-0.006	(0.008)	-0.015	(0.008)	-0.015	(0.009)	-0.030**	(0.010)	0.010	(0.015)
Δage >65	-0.017*	(0.008)	-0.031***	(0.008)	-0.028**	(0.009)	-0.055***	(0.010)	-0.008	(0.016)
Δmale	0.003	(0.002)	0.002	(0.002)	0.000	(0.003)	-0.002	(0.003)	0.006	(0.004)
Δadults	-0.004	(0.002)	-0.004	(0.002)	-0.001	(0.002)	0.001	(0.003)	-0.003	(0.003)
Δmarried	-0.005***	(0.001)	-0.006***	(0.002)	-0.007***	(0.002)	-0.003	(0.002)	-0.006**	(0.002)
Δdivorced	0.027***	(0.004)	0.027***	(0.004)	0.026***	(0.005)	0.022**	(0.007)	0.025**	(0.009)
Δchildren	-0.006***	(0.002)	-0.004**	(0.001)	-0.004*	(0.002)	-0.007**	(0.002)	-0.005	(0.002)
Δfixfulperm	0.002	(0.006)	0.003	(0.007)	-0.009	(0.007)	0.001	(0.010)	0.015	(0.010)
Δflexfulperm	0.023*	(0.010)	0.014	(0.011)	-0.011	(0.011)	-0.017	(0.012)	0.013	(0.017)
Δfixparperm	0.009	(0.007)	0.002	(0.007)	-0.009	(0.008)	0.007	(0.011)	0.021	(0.011)
Δflexparperm	-0.006	(0.013)	0.023	(0.019)	-0.011	(0.018)	0.030	(0.020)	0.035	(0.025)
Δfixfultemp	0.007	(0.006)	0.006	(0.007)	-0.003	(0.008)	0.002	(0.010)	0.011	(0.011)
Δflexfultemp	0.002	(0.011)	0.011	(0.011)	-0.010	(0.012)	0.018	(0.022)	0.013	(0.015)
Δfixpartemp	0.007	(0.008)	0.005	(0.008)	0.002	(0.009)	-0.004	(0.012)	0.015	(0.012)
Δselfwithjob	0.002	(0.006)	0.001	(0.007)	-0.009	(0.008)	0.002	(0.011)	0.006	(0.011)
Δselfwithoutjob	0.005	(0.006)	0.004	(0.007)	-0.007	(0.008)	-0.006	(0.010)	0.004	(0.011)
Δjobother	-0.002	(0.006)	0.002	(0.007)	-0.013	(0.008)	-0.005	(0.010)	-0.001	(0.011)
LTV $\leq$ 0.2	-0.027***	(0.004)	-0.022***	(0.004)	-0.040***	(0.005)	-0.054***	(0.006)	-0.051***	(0.008)
LTV 0.2-0.4	-0.019***	(0.004)	-0.021***	(0.004)	-0.026***	(0.004)	-0.029***	(0.006)	-0.021**	(0.007)
LTV 0.4-0.6	-0.011**	(0.004)	-0.012***	(0.003)	-0.018***	(0.004)	-0.020***	(0.006)	-0.009	(0.006)
LTV 0.6-0.8	-0.002	(0.003)	-0.003	(0.003)	-0.007	(0.004)	-0.012*	(0.005)	0.001	(0.005)
LTV 0.8-1.0	0.008**	(0.003)	0.006*	(0.003)	0.004	(0.004)	0.002	(0.004)	0.009	(0.005)
LTV 1.0-1.2	0.010**	(0.003)	0.011***	(0.003)	0.017***	(0.003)	0.006	(0.004)	0.014**	(0.005)
House characteristics	yes		yes		yes		yes		yes	
Municipality dummies	yes		yes		yes		yes		yes	
Month dummies	yes		yes		yes		yes		yes	
Vector of sums	yes		yes		yes		yes		yes	
Constant	10.947***	(0.063)	11.063***	(0.079)	10.882***	(0.052)	11.276***	(0.111)	10.956***	(0.046)
N	39,620		37,173		30,437		19,577		15,102	
Adj. R-sq	0.853		0.859		0.858		0.845		0.853	

Notes: Dependent variable: log(house price). Robust standard errors clustered by municipality in parentheses. Income (Y) and wealth (W) are measured in thousands of euros. Summed variables and house characteristics can be found in table 2.11 in appendix 2.A. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

2.7 Conclusion

The chapter has presented clear evidence that sellers with a good relative financial position receive less for a given house, while buyers with a good relative financial position pay more. After correcting for differences in house characteristics, both relative income and relative wealth influence house prices. Bargaining power strictly decreases for higher income categories, whereas the wealth effect subsides for the highest wealth categories. It seems, therefore, that the underlying process that relates income to house price is not entirely the same as that of wealth. All in all, there is clear evidence that the relative financial positions of buyers and sellers explain part of the heterogeneity in house prices. These findings are robust to a variety of specifications.

First, the findings are robust to different market conditions. We have estimated a separate model for every year, thereby allowing for differences between the boom and the bust years. Our results are independent of market conditions and possible changes in the composition of buyers and sellers. Second, the findings are robust to the use of a different wealth variable, which takes into account potential endogeneity of housing wealth and limitations of the administrative wealth data. Third, the findings are robust to an extension allowing for asymmetric bargaining. Following literature on sellers in the housing market we have allowed the equity position of sellers to influence house prices, thereby loosening the symmetric bargaining assumption we made.

Throughout this chapter we have interpreted the effects of financial position on house prices as a decrease in bargaining power. After all, we have been applying a broad bargaining definition that does not differentiate between search and bargaining. Bargaining power has been studied relative to the expected market price, not relative to the buyer and seller reservation prices. A limitation of our research is that empirically it was not possible to distinguish the bargaining mechanism from the search mechanism. Applying a narrower bargaining definition would have implied the use of additional information on both the search and the bargaining process, which was not available.

The main contribution of the search and matching models, however, would not be the use of a narrower bargaining definition but the possibility to model search and bargaining time. After all, the 'better' bargaining outcome for financially less well-off households is likely to be related to longer periods of search and bargaining. Including data on the time that buyers and sellers spend on search and bargaining could provide important insights into the 'cost' of obtaining a better bargaining outcome.

Future research could also look into the symmetry assumptions that we have been using. However, loosening the symmetric bargaining and symmetric demand assumptions would require data sets that do not only incorporate an extensive set of buyer and seller characteristics but, in addition to this, an even more extensive set of house characteristics than we have used (including particularly luxury attributes). It seems, therefore, that for now limitations to the data remain the bottleneck in bargaining research.

2.A Appendix

Table 2.7: Difference between seller and buyer characteristics

	2006	2007	2008	2009	2010
Gross income (in euros)	8127	8187	8933	10896	9216
	(59783)	(67659)	(65774)	(63013)	(64835)
Wealth (in euros)	-10974	-1825	3949	-49458	-44166
	(925209)	(927483)	(807499)	(1421073)	(1129433)
Wealth excl. housing (in euros)	4828	19294	25264	621	-13622
	(674177)	(725902)	(724550)	(1397004)	(1103533)
Mortgage (in euros)	106637	116052	116901	159093	131442
	(592552)	(569265)	(310204)	(247308)	(230520)
Multiple adults (1 = yes)	-0.006	-0.013	-0.016	-0.029	-0.044
	(0.528)	(0.528)	(0.526)	(0.549)	(0.573)
Children (1 = yes)	0.099	0.099	0.110	0.157	0.103
	(0.677)	(0.678)	(0.674)	(0.671)	(0.682)
Married (1 = yes)	0.189	0.187	0.201	0.204	0.171
	(0.660)	(0.655)	(0.658)	(0.659)	(0.666)
Divorced (1 = yes)	0.014	0.016	0.016	0.014	0.017
	(0.223)	(0.226)	(0.226)	(0.216)	(0.216)
Self-employed (1 = yes)	0.021	0.024	0.027	0.037	0.043
	(0.453)	(0.463)	(0.469)	(0.459)	(0.445)
Age (in years)	7.6	8.1	8.6	9.6	9.9
	(14.6)	(14.8)	(14.7)	(14.9)	(15.0)
Male (1 = yes)	0.006	0.002	0.001	-0.004	0.001
	(0.412)	(0.410)	(0.410)	(0.435)	(0.443)
Fixed contract (1 = yes)	0.007	0.011	0.011	0.004	0.005
	(0.185)	(0.194)	(0.201)	(0.201)	(0.195)
Permanent contract (1 = yes)	0.012	0.018	0.014	-0.005	-0.002
	(0.530)	(0.559)	(0.545)	(0.496)	(0.483)
Full-time contract (1 = yes)	0.005	0.004	-0.003	-0.007	-0.001
	(0.392)	(0.377)	(0.373)	(0.382)	(0.394)
Observations	40,509	37,913	31,095	19,845	15,242

Notes: Standard deviations are shown under the means.

Table 2.8: House characteristics

	2006	2007	2008	2009	2010
Transaction price (in euros)	261,510	275,501	279,758	265,808	267,545
	(123,568)	(137,310)	(138,900)	(128,143)	(128,521)
Number of rooms	4.8	4.9	4.9	4.9	5.0
	(1.2)	(1.6)	(1.1)	(1.1)	(1.1)
Lot size (in m^2)	284.7	292.9	281.4	259.1	279.6
	(465.5)	(494.5)	(462.1)	(406.8)	(479.2)
Floor size (in m^2)	132.8	132.9	132.0	129.6	130.1
	(37.1)	(37.5)	(36.0)	(34.0)	(34.8)
Interior quality (range 1–10)	7.2	7.2	7.2	7.2	7.2
	(0.8)	(0.8)	(0.8)	(0.8)	(0.8)
Exterior quality (range 1–10)	7.2	7.2	7.2	7.2	7.2
	(0.8)	(0.8)	(0.7)	(0.7)	(0.8)
Build before 1500 or unknown	0.000	0.000	0.000	0.000	0.000
	(0.020)	(0.010)	(0.014)	(0.010)	(0.000)
Build 1500-1905	0.033	0.032	0.032	0.034	0.034
	(0.179)	(0.176)	(0.177)	(0.181)	(0.181)
Build 1906-1930	0.089	0.088	0.088	0.091	0.087
	(0.285)	(0.283)	(0.283)	(0.287)	(0.282)
Build 1931-1944	0.069	0.067	0.065	0.069	0.072
	(0.254)	(0.250)	(0.246)	(0.254)	(0.259)
Build 1945-1959	0.045	0.050	0.049	0.052	0.055
	(0.208)	(0.218)	(0.217)	(0.222)	(0.228)
Build 1960-1970	0.110	0.112	0.111	0.105	0.110
	(0.313)	(0.315)	(0.315)	(0.307)	(0.313)
Build 1971-1980	0.188	0.185	0.186	0.179	0.183
	(0.391)	(0.388)	(0.389)	(0.383)	(0.387)
Build 1981-1990	0.190	0.193	0.181	0.179	0.178
	(0.392)	(0.394)	(0.385)	(0.383)	(0.383)
Build 1991-2000	0.230	0.220	0.212	0.203	0.188
	(0.421)	(0.414)	(0.409)	(0.402)	(0.391)
Build $>$ 2001	0.044	0.054	0.075	0.088	0.092
	(0.206)	(0.226)	(0.263)	(0.284)	(0.289)
Parking lot	0.047	0.051	0.055	0.055	0.058
	(0.212)	(0.220)	(0.228)	(0.229)	(0.234)
Carport	0.043	0.043	0.041	0.042	0.042
	(0.202)	(0.204)	(0.198)	(0.201)	(0.201)
Garage	0.306	0.305	0.293	0.266	0.280
	(0.461)	(0.460)	(0.455)	(0.442)	(0.449)
Garage & carport	0.023	0.026	0.028	0.026	0.026
	(0.150)	(0.159)	(0.166)	(0.159)	(0.158)
Garage (multi.)	0.031	0.036	0.033	0.028	0.033
	(0.173)	(0.186)	(0.178)	(0.165)	(0.179)
No parking lot	0.550	0.539	0.551	0.583	0.561
	(0.497)	(0.498)	(0.497)	(0.493)	(0.496)
Garden north	0.074	0.078	0.076	0.074	0.071
	(0.262)	(0.268)	(0.266)	(0.261)	(0.256)
Garden north-east	0.070	0.075	0.078	0.079	0.080
	(0.255)	(0.264)	(0.269)	(0.269)	(0.271)
Garden east	0.104	0.103	0.104	0.097	0.104
	(0.305)	(0.305)	(0.306)	(0.296)	(0.305)
Garden south-east	0.107	0.109	0.111	0.120	0.113
	(0.309)	(0.311)	(0.315)	(0.325)	(0.316)
Garden south	0.166	0.165	0.170	0.168	0.160
	(0.372)	(0.371)	(0.375)	(0.374)	(0.367)
Garden south-west	0.131	0.133	0.135	0.145	0.143
	(0.337)	(0.340)	(0.342)	(0.352)	(0.350)
Garden west	0.117	0.119	0.122	0.125	0.122
	(0.321)	(0.324)	(0.327)	(0.330)	(0.328)
Garden north-west	0.075	0.071	0.082	0.084	0.081
	(0.263)	(0.257)	(0.274)	(0.278)	(0.272)
No garden	0.156	0.146	0.121	0.108	0.126
	(0.363)	(0.353)	(0.326)	(0.310)	(0.332)
Insulation	0.862	0.879	0.914	0.928	0.941
	(0.345)	(0.326)	(0.280)	(0.258)	(0.236)
Gas or coal	0.016	0.014	0.011	0.013	0.009
	(0.127)	(0.119)	(0.105)	(0.111)	(0.095)
Central heating	0.960	0.960	0.959	0.964	0.969
	(0.196)	(0.197)	(0.198)	(0.185)	(0.174)
No heating	0.024	0.026	0.030	0.023	0.022
	(0.152)	(0.159)	(0.170)	(0.150)	(0.148)
Quiet road	0.522	0.530	0.525	0.536	0.546
	(0.500)	(0.499)	(0.499)	(0.499)	(0.498)
Busy road	0.023	0.022	0.019	0.015	0.015
	(0.149)	(0.146)	(0.135)	(0.123)	(0.122)
Unknown road	0.455	0.448	0.456	0.448	0.439
	(0.498)	(0.497)	(0.498)	(0.497)	(0.496)
No ground lease	0.842	0.916	0.915	0.920	0.943
	(0.365)	(0.278)	(0.279)	(0.271)	(0.231)
Ground lease	0.021	0.024	0.022	0.026	0.019
	(0.143)	(0.153)	(0.146)	(0.159)	(0.135)
Unknown ground lease	0.137	0.060	0.063	0.054	0.038
	(0.344)	(0.238)	(0.244)	(0.226)	(0.191)
Observations	40,509	37,913	31,095	19,845	15,242

Notes: Ratios are given unless it is mentioned differently. Standard deviations are shown under the means.

Table 2.9: Regression results with total wealth (continued)

	2006		2007		2008		2009		2010	
ΣY 20-30	-0.019***	(0.004)	-0.016***	(0.004)	-0.022***	(0.005)	-0.018**	(0.007)	-0.015	(0.009)
ΣY 30-40	-0.006	(0.004)	-0.004	(0.004)	-0.015**	(0.005)	-0.011	(0.006)	0.001	(0.008)
ΣY 40-50	0.007	(0.004)	0.008*	(0.004)	-0.002	(0.005)	0.009	(0.007)	0.010	(0.009)
ΣY 50-60	0.019***	(0.004)	0.020***	(0.004)	0.012*	(0.005)	0.017*	(0.007)	0.027**	(0.009)
ΣY 60-70	0.031***	(0.004)	0.032***	(0.004)	0.021***	(0.005)	0.029***	(0.007)	0.040***	(0.009)
ΣY 70-80	0.044***	(0.004)	0.043***	(0.004)	0.033***	(0.005)	0.040***	(0.007)	0.048***	(0.009)
ΣY 80-90	0.059***	(0.004)	0.058***	(0.005)	0.049***	(0.006)	0.056***	(0.007)	0.055***	(0.010)
ΣY 90-100	0.068***	(0.005)	0.070***	(0.005)	0.061***	(0.006)	0.060***	(0.008)	0.067***	(0.010)
ΣY >100	0.118***	(0.005)	0.118***	(0.006)	0.106***	(0.006)	0.112***	(0.008)	0.118***	(0.010)
ΣW 0-10	-0.018***	(0.002)	-0.013***	(0.002)	-0.016***	(0.003)	-0.011**	(0.004)	-0.020***	(0.004)
ΣW 10-25	-0.007**	(0.002)	-0.007**	(0.002)	-0.006*	(0.003)	-0.004	(0.003)	-0.018***	(0.004)
ΣW 25-50	-0.001	(0.002)	-0.002	(0.002)	0.001	(0.003)	0.000	(0.003)	-0.012**	(0.004)
ΣW 50-100	0.004	(0.002)	0.005*	(0.002)	0.004	(0.002)	0.008*	(0.003)	-0.006*	(0.003)
ΣW 100-200	0.015***	(0.002)	0.011***	(0.002)	0.014***	(0.003)	0.008**	(0.003)	0.003	(0.003)
ΣW >200	0.052***	(0.003)	0.046***	(0.003)	0.045***	(0.003)	0.036***	(0.004)	0.035***	(0.004)
Σage 25-30	0.032***	(0.007)	0.020**	(0.007)	0.019*	(0.009)	0.004	(0.007)	0.022	(0.014)
Σage 30-35	0.046***	(0.008)	0.037***	(0.007)	0.036***	(0.009)	0.019**	(0.007)	0.033*	(0.014)
Σage 35-40	0.060***	(0.008)	0.049***	(0.007)	0.046***	(0.009)	0.029***	(0.007)	0.043**	(0.014)
Σage 40-45	0.063***	(0.008)	0.053***	(0.008)	0.049***	(0.009)	0.036***	(0.007)	0.048***	(0.014)
Σage 45-50	0.064***	(0.008)	0.052***	(0.008)	0.050***	(0.009)	0.034***	(0.007)	0.047***	(0.014)
Σage 50-55	0.066***	(0.008)	0.053***	(0.008)	0.044***	(0.009)	0.032***	(0.007)	0.049***	(0.014)
Σage 55-60	0.078***	(0.008)	0.060***	(0.007)	0.061***	(0.010)	0.051***	(0.008)	0.057***	(0.015)
Σage 60-65	0.096***	(0.008)	0.082***	(0.008)	0.077***	(0.010)	0.059***	(0.008)	0.070***	(0.015)
Σage >65	0.105***	(0.009)	0.092***	(0.009)	0.094***	(0.010)	0.080***	(0.009)	0.096***	(0.015)
Σmale	-0.008***	(0.002)	-0.008**	(0.003)	-0.004	(0.003)	-0.011**	(0.004)	-0.006	(0.004)
Σadults	0.019***	(0.002)	0.018***	(0.002)	0.019***	(0.002)	0.019***	(0.004)	0.016***	(0.004)
Σmarried	0.003	(0.001)	0.004**	(0.001)	0.000	(0.002)	0.001	(0.002)	-0.003	(0.002)
Σdivorced	0.006	(0.003)	0.002	(0.004)	0.003	(0.005)	-0.013*	(0.006)	-0.003	(0.010)
Σchildren	0.008***	(0.001)	0.005***	(0.002)	0.008***	(0.002)	0.010***	(0.002)	0.013***	(0.002)
Σfixfulperm	0.028***	(0.006)	0.018**	(0.006)	0.010	(0.007)	0.037***	(0.010)	0.010	(0.010)
Σflexfulperm	0.026**	(0.009)	0.004	(0.010)	-0.006	(0.010)	0.021	(0.014)	0.001	(0.017)
Σfixparperm	0.032***	(0.007)	0.021**	(0.007)	0.015	(0.008)	0.039***	(0.011)	0.012	(0.011)
Σflexparperm	0.016	(0.015)	0.027	(0.017)	0.001	(0.019)	0.044*	(0.020)	0.012	(0.024)
Σfixfultemp	0.029***	(0.006)	0.020**	(0.006)	0.012	(0.008)	0.038***	(0.010)	0.007	(0.010)
Σflexfultemp	0.026*	(0.011)	0.012	(0.010)	-0.001	(0.012)	0.029	(0.021)	-0.019	(0.017)
Σfixpartemp	0.031***	(0.008)	0.021*	(0.008)	0.020*	(0.009)	0.038**	(0.011)	0.001	(0.012)
Σselfwithjob	0.041***	(0.007)	0.030***	(0.007)	0.019*	(0.008)	0.046***	(0.011)	0.026*	(0.011)
Σselfwithoutjob	0.054***	(0.007)	0.039***	(0.007)	0.027***	(0.008)	0.058***	(0.011)	0.028**	(0.010)
Σjobother	0.037***	(0.007)	0.031***	(0.007)	0.023**	(0.008)	0.049***	(0.011)	0.019	(0.011)
Corner house	0.029***	(0.002)	0.027***	(0.002)	0.029***	(0.003)	0.027***	(0.004)	0.022***	(0.004)
Semi-detached	0.097***	(0.005)	0.100***	(0.006)	0.095***	(0.006)	0.097***	(0.006)	0.081***	(0.007)
Detached	0.211***	(0.008)	0.215***	(0.009)	0.215***	(0.010)	0.199***	(0.011)	0.196***	(0.010)
Number rooms	0.012***	(0.002)	0.006*	(0.003)	0.013***	(0.002)	0.016***	(0.002)	0.015***	(0.002)
Lot size (10 m^2)	0.001***	(0.000)	0.001***	(0.000)	0.001***	(0.000)	0.001***	(0.000)	0.001***	(0.000)
Floor size (10 m^2)	0.035***	(0.001)	0.037***	(0.001)	0.038***	(0.001)	0.039***	(0.001)	0.039***	(0.001)
Interior quality	0.019***	(0.002)	0.018***	(0.002)	0.019***	(0.002)	0.025***	(0.003)	0.024***	(0.003)
Exterior quality	0.011***	(0.002)	0.010***	(0.002)	0.013***	(0.002)	0.009**	(0.003)	0.008*	(0.003)
Build 1500-1905	-0.025	(0.051)	-0.033	(0.077)	0.089*	(0.043)	-0.305**	(0.105)	0.000	(.)
Build 1906-1930	-0.055	(0.052)	-0.055	(0.076)	0.066	(0.040)	-0.321**	(0.105)	-0.017	(0.013)
Build 1931-1944	-0.035	(0.052)	-0.029	(0.076)	0.085*	(0.039)	-0.291**	(0.105)	0.021	(0.014)
Build 1945-1959	-0.067	(0.052)	-0.066	(0.076)	0.046	(0.038)	-0.338**	(0.104)	-0.016	(0.016)
Build 1960-1970	-0.108*	(0.053)	-0.112	(0.076)	-0.007	(0.038)	-0.396***	(0.103)	-0.086***	(0.016)
Build 1971-1980	-0.103	(0.054)	-0.106	(0.076)	0.000	(0.038)	-0.390***	(0.103)	-0.086***	(0.017)
Build 1981-1990	-0.067	(0.054)	-0.072	(0.076)	0.036	(0.038)	-0.356***	(0.103)	-0.045**	(0.017)
Build 1991-2000	-0.015	(0.055)	-0.022	(0.076)	0.082*	(0.038)	-0.308**	(0.103)	0.003	(0.017)
Build > 2001	0.017	(0.056)	0.008	(0.076)	0.114**	(0.038)	-0.271**	(0.104)	0.035	(0.020)
Parking lot	0.035***	(0.005)	0.032***	(0.004)	0.027***	(0.004)	0.034***	(0.005)	0.024***	(0.005)
Carport	0.052***	(0.005)	0.054***	(0.005)	0.047***	(0.005)	0.043***	(0.005)	0.035***	(0.007)
Garage	0.095***	(0.003)	0.094***	(0.003)	0.091***	(0.003)	0.083***	(0.003)	0.087***	(0.004)
Garage & carport	0.107***	(0.006)	0.102***	(0.006)	0.108***	(0.007)	0.089***	(0.007)	0.084***	(0.010)
Garage (multi.)	0.091***	(0.007)	0.091***	(0.007)	0.081***	(0.008)	0.089***	(0.009)	0.080***	(0.010)
Garden north	-0.023***	(0.004)	-0.016**	(0.005)	-0.010*	(0.005)	-0.010	(0.006)	-0.015*	(0.006)
Garden north-east	-0.019***	(0.004)	-0.015**	(0.005)	-0.010*	(0.004)	-0.014*	(0.006)	-0.016**	(0.006)
Garden east	-0.024***	(0.003)	-0.022***	(0.004)	-0.014**	(0.004)	-0.015**	(0.006)	-0.025***	(0.005)
Garden south-east	-0.020***	(0.004)	-0.015***	(0.004)	-0.007	(0.004)	-0.009	(0.006)	-0.013*	(0.006)
Garden south	-0.017***	(0.003)	-0.009*	(0.004)	-0.009*	(0.004)	-0.012*	(0.005)	-0.010	(0.005)
Garden south-west	-0.012***	(0.004)	-0.013**	(0.004)	-0.004	(0.004)	-0.013*	(0.005)	-0.009	(0.005)
Garden west	-0.022***	(0.004)	-0.018***	(0.005)	-0.012**	(0.004)	-0.009	(0.006)	-0.015**	(0.005)
Garden north-west	-0.019***	(0.004)	-0.012*	(0.005)	-0.010*	(0.004)	-0.006	(0.006)	-0.009	(0.006)
Insulation	-0.000	(0.003)	-0.003	(0.004)	0.000	(0.004)	0.000	(0.005)	0.005	(0.006)
Gas or coal	-0.092***	(0.010)	-0.108***	(0.011)	-0.103***	(0.012)	-0.118***	(0.015)	-0.121***	(0.018)
Central heating	-0.006	(0.006)	-0.003	(0.006)	-0.006	(0.007)	-0.004	(0.010)	-0.012	(0.010)
Quiet road	0.006**	(0.002)	0.007***	(0.002)	0.003	(0.002)	0.005	(0.003)	0.011***	(0.003)
Busy road	-0.012	(0.008)	-0.020*	(0.008)	-0.005	(0.008)	-0.019*	(0.009)	-0.010	(0.013)
No ground lease	-0.005*	(0.003)	-0.011*	(0.005)	-0.007	(0.004)	-0.003	(0.006)	-0.002	(0.009)
Ground lease	-0.048***	(0.014)	-0.054*	(0.022)	-0.051*	(0.022)	-0.061*	(0.027)	-0.067**	(0.026)
N	40,509		37,913		31,095		19,845		15,242	
Adj. R-sq	0.852		0.858		0.857		0.844		0.852	

Notes: Dependent variable: log(house price). Robust standard errors clustered by municipality in parentheses. Income (Y) and wealth (W) are measured in thousands of euros. Differenced variables can be found in table 2.4. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 2.10: Regression results with wealth excluding housing (continued)

	2006		2007		2008		2009		2010	
ΣY 20-30	-0.018***	(0.004)	-0.016***	(0.004)	-0.021***	(0.005)	-0.019**	(0.007)	-0.014	(0.009)
ΣY 30-40	-0.006	(0.004)	-0.004	(0.004)	-0.015**	(0.005)	-0.011	(0.006)	0.002	(0.009)
ΣY 40-50	0.007	(0.004)	0.008	(0.004)	-0.003	(0.005)	0.009	(0.007)	0.011	(0.009)
ΣY 50-60	0.018***	(0.004)	0.019***	(0.004)	0.011*	(0.005)	0.016*	(0.007)	0.028**	(0.009)
ΣY 60-70	0.031***	(0.004)	0.031***	(0.004)	0.021***	(0.005)	0.027***	(0.007)	0.040***	(0.009)
ΣY 70-80	0.043***	(0.004)	0.042***	(0.004)	0.033***	(0.005)	0.039***	(0.007)	0.048***	(0.009)
ΣY 80-90	0.059***	(0.004)	0.058***	(0.005)	0.049***	(0.006)	0.055***	(0.007)	0.056***	(0.010)
ΣY 90-100	0.067***	(0.005)	0.069***	(0.005)	0.061***	(0.006)	0.059***	(0.008)	0.068***	(0.010)
ΣY >100	0.115***	(0.005)	0.117***	(0.006)	0.104***	(0.006)	0.110***	(0.008)	0.118***	(0.010)
ΣW 0-10	-0.011***	(0.002)	-0.004	(0.002)	-0.017***	(0.003)	-0.006	(0.004)	-0.025***	(0.004)
ΣW 10-25	0.001	(0.002)	0.006*	(0.003)	-0.005	(0.003)	0.007	(0.004)	-0.017***	(0.004)
ΣW 25-50	0.008**	(0.003)	0.014***	(0.003)	0.002	(0.003)	0.009*	(0.004)	-0.010*	(0.004)
ΣW 50-100	0.017***	(0.003)	0.021***	(0.003)	0.008*	(0.003)	0.023***	(0.004)	-0.005	(0.004)
ΣW 100-200	0.027***	(0.003)	0.029***	(0.003)	0.018***	(0.003)	0.020***	(0.005)	-0.000	(0.004)
ΣW >200	0.062***	(0.004)	0.054***	(0.003)	0.046***	(0.003)	0.045***	(0.005)	0.035***	(0.004)
Σage 25-30	0.031***	(0.007)	0.018*	(0.007)	0.018*	(0.009)	0.003	(0.007)	0.021	(0.014)
Σage 30-35	0.045***	(0.008)	0.034***	(0.007)	0.035***	(0.009)	0.016*	(0.007)	0.030*	(0.014)
Σage 35-40	0.059***	(0.008)	0.046***	(0.008)	0.046***	(0.010)	0.026***	(0.007)	0.040**	(0.014)
Σage 40-45	0.063***	(0.008)	0.051***	(0.008)	0.048***	(0.009)	0.033***	(0.007)	0.045**	(0.014)
Σage 45-50	0.064***	(0.008)	0.050***	(0.008)	0.051***	(0.010)	0.032***	(0.007)	0.045**	(0.014)
Σage 50-55	0.068***	(0.008)	0.053***	(0.008)	0.045***	(0.010)	0.031***	(0.007)	0.047***	(0.014)
Σage 55-60	0.080***	(0.008)	0.061***	(0.008)	0.063***	(0.010)	0.050***	(0.008)	0.056***	(0.015)
Σage 60-65	0.099***	(0.008)	0.083***	(0.008)	0.080***	(0.010)	0.059***	(0.009)	0.069***	(0.015)
Σage >65	0.110***	(0.009)	0.094***	(0.009)	0.100***	(0.011)	0.080***	(0.009)	0.098***	(0.015)
Σmale	-0.008***	(0.002)	-0.009**	(0.003)	-0.004	(0.003)	-0.011**	(0.004)	-0.007	(0.004)
Σadults	0.019***	(0.002)	0.017***	(0.002)	0.018***	(0.002)	0.018***	(0.004)	0.016***	(0.004)
Σmarried	0.003*	(0.001)	0.005***	(0.001)	0.000	(0.002)	0.001	(0.002)	-0.003	(0.002)
Σdivorced	0.006	(0.003)	0.002	(0.004)	0.004	(0.004)	-0.012*	(0.006)	-0.002	(0.010)
Σchildren	0.008***	(0.001)	0.005***	(0.002)	0.007***	(0.002)	0.009***	(0.002)	0.013***	(0.002)
Σfixfulperm	0.028***	(0.006)	0.017**	(0.006)	0.010	(0.007)	0.035***	(0.010)	0.011	(0.010)
Σflexfulperm	0.025**	(0.009)	0.002	(0.010)	-0.008	(0.010)	0.021	(0.014)	0.002	(0.017)
Σfixparperm	0.032***	(0.007)	0.020**	(0.007)	0.016	(0.008)	0.038***	(0.011)	0.014	(0.011)
Σflexparperm	0.013	(0.015)	0.023	(0.017)	0.001	(0.019)	0.045*	(0.019)	0.012	(0.024)
Σfixfultemp	0.029***	(0.006)	0.019**	(0.006)	0.011	(0.008)	0.036***	(0.010)	0.008	(0.010)
Σflexfultemp	0.026*	(0.011)	0.011	(0.010)	-0.002	(0.012)	0.026	(0.021)	-0.018	(0.017)
Σfixpartemp	0.031***	(0.008)	0.020*	(0.008)	0.020*	(0.009)	0.037**	(0.011)	0.000	(0.013)
Σselfwithjob	0.040***	(0.007)	0.029***	(0.007)	0.018*	(0.008)	0.043***	(0.011)	0.027*	(0.011)
Σselfwithoutjob	0.052***	(0.007)	0.038***	(0.007)	0.026**	(0.008)	0.055***	(0.011)	0.028**	(0.011)
Σjobother	0.038***	(0.007)	0.031***	(0.007)	0.022**	(0.008)	0.048***	(0.011)	0.021	(0.011)
Corner house	0.030***	(0.002)	0.028***	(0.002)	0.029***	(0.003)	0.027***	(0.004)	0.022***	(0.003)
Semi-detached	0.099***	(0.005)	0.101***	(0.006)	0.097***	(0.006)	0.098***	(0.006)	0.082***	(0.007)
Detached	0.216***	(0.008)	0.220***	(0.009)	0.219***	(0.009)	0.202***	(0.011)	0.199***	(0.010)
Number rooms	0.012***	(0.002)	0.006	(0.003)	0.014***	(0.002)	0.016***	(0.002)	0.015***	(0.002)
Lot size (10 m^2)	0.001***	(0.000)	0.001***	(0.000)	0.001***	(0.000)	0.001***	(0.000)	0.001***	(0.000)
Floor size (10 m^2)	0.035***	(0.001)	0.037***	(0.001)	0.038***	(0.001)	0.039***	(0.001)	0.039***	(0.001)
Interior quality	0.018***	(0.002)	0.018***	(0.002)	0.019***	(0.002)	0.024***	(0.003)	0.024***	(0.003)
Exterior quality	0.011***	(0.002)	0.010***	(0.002)	0.013***	(0.002)	0.009**	(0.003)	0.008*	(0.003)
Build 1500-1905	-0.026	(0.051)	-0.036	(0.080)	0.091*	(0.043)	-0.326**	(0.101)	0.000	(.)
Build 1906-1930	-0.057	(0.052)	-0.058	(0.079)	0.067	(0.039)	-0.342***	(0.101)	-0.017	(0.013)
Build 1931-1944	-0.036	(0.052)	-0.031	(0.079)	0.087*	(0.039)	-0.311**	(0.101)	0.021	(0.014)
Build 1945-1959	-0.068	(0.052)	-0.068	(0.079)	0.047	(0.038)	-0.358***	(0.100)	-0.017	(0.016)
Build 1960-1970	-0.111*	(0.053)	-0.115	(0.079)	-0.006	(0.037)	-0.417***	(0.099)	-0.087***	(0.016)
Build 1971-1980	-0.105	(0.054)	-0.109	(0.079)	0.001	(0.037)	-0.411***	(0.099)	-0.087***	(0.017)
Build 1981-1990	-0.068	(0.054)	-0.075	(0.078)	0.038	(0.037)	-0.377***	(0.099)	-0.046**	(0.017)
Build 1991-2000	-0.015	(0.055)	-0.023	(0.079)	0.085*	(0.037)	-0.329**	(0.099)	0.003	(0.018)
Build > 2001	0.014	(0.056)	0.004	(0.079)	0.115**	(0.038)	-0.292**	(0.100)	0.034	(0.020)
Parking lot	0.035***	(0.005)	0.032***	(0.005)	0.027***	(0.004)	0.033***	(0.005)	0.025***	(0.005)
Carport	0.052***	(0.005)	0.055***	(0.005)	0.048***	(0.005)	0.043***	(0.006)	0.035***	(0.007)
Garage	0.097***	(0.003)	0.097***	(0.003)	0.093***	(0.003)	0.083***	(0.003)	0.089***	(0.004)
Garage & carport	0.110***	(0.007)	0.106***	(0.006)	0.112***	(0.007)	0.091***	(0.007)	0.086***	(0.010)
Garage (multi.)	0.092***	(0.007)	0.093***	(0.007)	0.083***	(0.008)	0.089***	(0.009)	0.084***	(0.009)
Garden north	-0.024***	(0.004)	-0.016**	(0.005)	-0.010*	(0.005)	-0.009	(0.006)	-0.015*	(0.006)
Garden north-east	-0.020***	(0.004)	-0.016**	(0.005)	-0.010*	(0.004)	-0.013*	(0.006)	-0.016**	(0.006)
Garden east	-0.025***	(0.003)	-0.023***	(0.004)	-0.014**	(0.004)	-0.014*	(0.006)	-0.025***	(0.005)
Garden south-east	-0.021***	(0.004)	-0.016***	(0.004)	-0.007	(0.004)	-0.009	(0.006)	-0.013*	(0.006)
Garden south	-0.018***	(0.003)	-0.009*	(0.004)	-0.009*	(0.004)	-0.011*	(0.006)	-0.010*	(0.005)
Garden south-west	-0.013***	(0.004)	-0.014**	(0.004)	-0.004	(0.004)	-0.013*	(0.006)	-0.009	(0.005)
Garden west	-0.023***	(0.004)	-0.019***	(0.005)	-0.011**	(0.004)	-0.008	(0.006)	-0.015**	(0.005)
Garden north-west	-0.020***	(0.004)	-0.012*	(0.005)	-0.010*	(0.004)	-0.005	(0.006)	-0.009	(0.006)
Insulation	-0.001	(0.003)	-0.003	(0.004)	-0.000	(0.004)	-0.000	(0.005)	0.005	(0.006)
Gas or coal	-0.092***	(0.010)	-0.107***	(0.011)	-0.103***	(0.012)	-0.118***	(0.015)	-0.121***	(0.018)
Central heating	-0.006	(0.006)	-0.003	(0.006)	-0.006	(0.006)	-0.005	(0.010)	-0.013	(0.010)
Quiet road	0.006**	(0.002)	0.008***	(0.002)	0.004	(0.002)	0.005	(0.003)	0.011***	(0.003)
Busy road	-0.011	(0.008)	-0.020*	(0.008)	-0.006	(0.008)	-0.019*	(0.009)	-0.011	(0.013)
No ground lease	-0.004	(0.003)	-0.011*	(0.005)	-0.008	(0.004)	-0.003	(0.006)	-0.002	(0.009)
Ground lease	-0.047***	(0.014)	-0.054*	(0.022)	-0.052*	(0.021)	-0.060*	(0.026)	-0.067*	(0.026)
N	40,509		37,913		31,095		19,845		15,242	
Adj. R-sq	0.852		0.857		0.856		0.844		0.852	

Notes: Dependent variable: log(house price). Robust standard errors clustered by municipality in parentheses. Income (Y) and wealth (W) are measured in thousands of euros. Differenced variables can be found in table 2.5. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 2.11: Regression results with total wealth, including seller LTV (cont.)

	2006		2007		2008		2009		2010	
ΣY 20-30	-0.019***	(0.004)	-0.015***	(0.004)	-0.021***	(0.005)	-0.018**	(0.007)	-0.016	(0.009)
ΣY 30-40	-0.007	(0.004)	-0.004	(0.004)	-0.014**	(0.005)	-0.011	(0.006)	0.000	(0.008)
ΣY 40-50	0.006	(0.004)	0.008*	(0.004)	-0.002	(0.005)	0.008	(0.007)	0.008	(0.009)
ΣY 50-60	0.017***	(0.004)	0.020***	(0.004)	0.011*	(0.005)	0.015*	(0.007)	0.025**	(0.009)
ΣY 60-70	0.030***	(0.004)	0.031***	(0.004)	0.021***	(0.005)	0.027***	(0.007)	0.037***	(0.009)
ΣY 70-80	0.042***	(0.004)	0.042***	(0.004)	0.033***	(0.005)	0.039***	(0.007)	0.044***	(0.009)
ΣY 80-90	0.057***	(0.004)	0.058***	(0.005)	0.049***	(0.006)	0.054***	(0.007)	0.052***	(0.010)
ΣY 90-100	0.066***	(0.005)	0.069***	(0.005)	0.060***	(0.006)	0.058***	(0.008)	0.063***	(0.010)
ΣY >100	0.114***	(0.005)	0.115***	(0.006)	0.103***	(0.006)	0.109***	(0.008)	0.114***	(0.010)
ΣW 0-10	-0.019***	(0.002)	-0.014***	(0.002)	-0.019***	(0.003)	-0.013**	(0.004)	-0.021***	(0.004)
ΣW 10-25	-0.008***	(0.002)	-0.008**	(0.002)	-0.010***	(0.003)	-0.005	(0.003)	-0.019***	(0.004)
ΣW 25-50	-0.002	(0.002)	-0.003	(0.002)	-0.002	(0.003)	-0.001	(0.004)	-0.013**	(0.004)
ΣW 50-100	0.006*	(0.002)	0.006*	(0.002)	0.004	(0.003)	0.009*	(0.004)	-0.005	(0.004)
ΣW 100-200	0.020***	(0.003)	0.014***	(0.002)	0.018***	(0.003)	0.014***	(0.003)	0.008*	(0.004)
ΣW >200	0.059***	(0.003)	0.053***	(0.003)	0.054***	(0.003)	0.047***	(0.004)	0.048***	(0.004)
Σage 25-30	0.029***	(0.007)	0.019**	(0.007)	0.018*	(0.009)	-0.000	(0.007)	0.020	(0.014)
Σage 30-35	0.044***	(0.008)	0.036***	(0.007)	0.036***	(0.009)	0.014*	(0.007)	0.032*	(0.013)
Σage 35-40	0.058***	(0.008)	0.049***	(0.007)	0.046***	(0.009)	0.025***	(0.007)	0.042**	(0.014)
Σage 40-45	0.062***	(0.008)	0.054***	(0.007)	0.050***	(0.009)	0.033***	(0.007)	0.048***	(0.014)
Σage 45-50	0.063***	(0.008)	0.053***	(0.008)	0.052***	(0.010)	0.031***	(0.007)	0.048***	(0.014)
Σage 50-55	0.066***	(0.008)	0.055***	(0.008)	0.047***	(0.009)	0.030***	(0.007)	0.050***	(0.013)
Σage 55-60	0.076***	(0.008)	0.063***	(0.007)	0.065***	(0.010)	0.050***	(0.008)	0.059***	(0.014)
Σage 60-65	0.096***	(0.008)	0.084***	(0.008)	0.082***	(0.010)	0.060***	(0.008)	0.073***	(0.015)
Σage >65	0.106***	(0.009)	0.097***	(0.009)	0.100***	(0.011)	0.079***	(0.009)	0.101***	(0.015)
Σmale	-0.009***	(0.002)	-0.008**	(0.003)	-0.004	(0.003)	-0.011**	(0.004)	-0.007	(0.004)
Σadults	0.019***	(0.002)	0.016***	(0.002)	0.018***	(0.002)	0.017***	(0.004)	0.015***	(0.004)
Σmarried	0.004*	(0.001)	0.005***	(0.001)	0.001	(0.002)	0.002	(0.002)	-0.002	(0.002)
Σdivorced	0.004	(0.003)	0.002	(0.004)	0.002	(0.004)	-0.013*	(0.006)	-0.004	(0.010)
Σchildren	0.008***	(0.002)	0.006***	(0.002)	0.008***	(0.002)	0.010***	(0.002)	0.013***	(0.002)
Σfixfulperm	0.027***	(0.007)	0.016**	(0.006)	0.008	(0.007)	0.035***	(0.010)	0.009	(0.010)
Σflexfulperm	0.024*	(0.009)	0.005	(0.010)	-0.008	(0.010)	0.019	(0.014)	0.001	(0.017)
Σfixparperm	0.032***	(0.007)	0.020**	(0.007)	0.013	(0.008)	0.038***	(0.011)	0.012	(0.011)
Σflexparperm	0.016	(0.015)	0.020	(0.017)	-0.007	(0.018)	0.042*	(0.019)	0.007	(0.024)
Σfixfultemp	0.028***	(0.007)	0.018**	(0.006)	0.009	(0.007)	0.036***	(0.010)	0.005	(0.010)
Σflexfultemp	0.022*	(0.010)	0.007	(0.010)	-0.004	(0.011)	0.028	(0.021)	-0.026	(0.015)
Σfixpartemp	0.029***	(0.008)	0.019*	(0.008)	0.017*	(0.008)	0.036**	(0.011)	0.002	(0.013)
Σselfwithjob	0.039***	(0.007)	0.028***	(0.006)	0.017*	(0.007)	0.044***	(0.011)	0.025*	(0.011)
Σselfwithoutjob	0.053***	(0.007)	0.036***	(0.007)	0.024**	(0.007)	0.056***	(0.011)	0.026*	(0.011)
Σjobother	0.037***	(0.007)	0.028***	(0.006)	0.020*	(0.008)	0.048***	(0.011)	0.020	(0.011)
Corner house	0.028***	(0.002)	0.027***	(0.002)	0.028***	(0.003)	0.026***	(0.004)	0.022***	(0.003)
Semi-detached	0.098***	(0.005)	0.101***	(0.006)	0.094***	(0.006)	0.097***	(0.007)	0.082***	(0.007)
Detached	0.211***	(0.008)	0.215***	(0.009)	0.216***	(0.010)	0.199***	(0.011)	0.194***	(0.010)
Number rooms	0.012***	(0.002)	0.006	(0.003)	0.013***	(0.002)	0.016***	(0.002)	0.015***	(0.002)
Lot size (10 m^2)	0.001***	(0.000)	0.001***	(0.000)	0.001***	(0.000)	0.001***	(0.000)	0.001***	(0.000)
Floor size (10 m^2)	0.035***	(0.001)	0.037***	(0.001)	0.037***	(0.001)	0.039***	(0.001)	0.039***	(0.001)
Interior quality	0.018***	(0.002)	0.018***	(0.002)	0.019***	(0.002)	0.024***	(0.003)	0.024***	(0.003)
Exterior quality	0.011***	(0.002)	0.010***	(0.002)	0.012***	(0.002)	0.009**	(0.003)	0.008*	(0.003)
Build 1500-1905	-0.019	(0.055)	-0.030	(0.076)	0.081	(0.042)	-0.302**	(0.105)	0.000	(.)
Build 1906-1930	-0.051	(0.056)	-0.053	(0.075)	0.056	(0.037)	-0.319**	(0.105)	-0.016	(0.013)
Build 1931-1944	-0.029	(0.056)	-0.026	(0.075)	0.079*	(0.037)	-0.288**	(0.105)	0.022	(0.014)
Build 1945-1959	-0.062	(0.056)	-0.065	(0.075)	0.037	(0.036)	-0.333**	(0.104)	-0.015	(0.016)
Build 1960-1970	-0.103	(0.058)	-0.109	(0.075)	-0.013	(0.036)	-0.392***	(0.104)	-0.087***	(0.016)
Build 1971-1980	-0.096	(0.058)	-0.103	(0.075)	-0.006	(0.036)	-0.387***	(0.104)	-0.086***	(0.017)
Build 1981-1990	-0.060	(0.058)	-0.068	(0.075)	0.030	(0.036)	-0.354***	(0.104)	-0.045**	(0.017)
Build 1991-2000	-0.008	(0.059)	-0.017	(0.075)	0.076*	(0.036)	-0.305**	(0.104)	0.002	(0.017)
Build > 2001	0.024	(0.060)	0.013	(0.075)	0.108**	(0.036)	-0.270*	(0.104)	0.035	(0.020)
Parking lot	0.036***	(0.004)	0.032***	(0.004)	0.028***	(0.004)	0.033***	(0.005)	0.024***	(0.005)
Carport	0.053***	(0.005)	0.053***	(0.005)	0.046***	(0.005)	0.043***	(0.005)	0.033***	(0.007)
Garage	0.095***	(0.003)	0.094***	(0.003)	0.091***	(0.003)	0.083***	(0.003)	0.088***	(0.004)
Garage & carport	0.107***	(0.007)	0.104***	(0.006)	0.110***	(0.007)	0.091***	(0.007)	0.085***	(0.010)
Garage (multi.)	0.091***	(0.007)	0.092***	(0.007)	0.081***	(0.008)	0.089***	(0.009)	0.081***	(0.009)
Garden north	-0.022***	(0.004)	-0.016***	(0.004)	-0.010*	(0.005)	-0.009	(0.006)	-0.014*	(0.006)
Garden north-east	-0.017***	(0.004)	-0.015**	(0.005)	-0.011*	(0.004)	-0.013*	(0.006)	-0.017**	(0.006)
Garden east	-0.023***	(0.003)	-0.022***	(0.004)	-0.013**	(0.004)	-0.014*	(0.006)	-0.025***	(0.005)
Garden south-east	-0.020***	(0.004)	-0.016***	(0.004)	-0.007	(0.004)	-0.009	(0.006)	-0.014*	(0.006)
Garden south	-0.016***	(0.003)	-0.009*	(0.004)	-0.010*	(0.004)	-0.011*	(0.006)	-0.009	(0.005)
Garden south-west	-0.012**	(0.004)	-0.013**	(0.004)	-0.004	(0.004)	-0.012*	(0.006)	-0.008	(0.005)
Garden west	-0.022***	(0.004)	-0.018***	(0.004)	-0.012**	(0.004)	-0.009	(0.006)	-0.015**	(0.005)
Garden north-west	-0.018***	(0.004)	-0.012**	(0.004)	-0.010*	(0.004)	-0.005	(0.006)	-0.010	(0.006)
Insulation	-0.001	(0.003)	-0.003	(0.004)	-0.001	(0.004)	0.000	(0.005)	0.004	(0.006)
Gas or coal	-0.089***	(0.010)	-0.105***	(0.011)	-0.099***	(0.012)	-0.112***	(0.014)	-0.116***	(0.018)
Central heating	-0.006	(0.006)	-0.004	(0.006)	-0.005	(0.007)	-0.004	(0.009)	-0.012	(0.010)
Quiet road	0.006**	(0.002)	0.007***	(0.002)	0.003	(0.002)	0.005	(0.003)	0.011***	(0.003)
Busy road	-0.011	(0.008)	-0.021**	(0.008)	-0.003	(0.008)	-0.017	(0.009)	-0.013	(0.013)
No ground lease	-0.006*	(0.003)	-0.012*	(0.005)	-0.005	(0.004)	-0.003	(0.006)	-0.002	(0.009)
Ground lease	-0.055***	(0.014)	-0.057**	(0.021)	-0.057**	(0.020)	-0.060*	(0.027)	-0.072**	(0.025)
N	39,620		37,173		30,437		19,577		15,102	
Adj. R-sq	0.853		0.859		0.858		0.845		0.853	

Notes: Dependent variable: log(house price). Robust standard errors clustered by municipality in parentheses. Income (Y) and wealth (W) are measured in thousands of euros. Differenced variables can be found in table 2.6. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Chapter 3

Decreasing house prices and household mobility

3.1 Introduction[1]

House prices in the Netherlands have been rising from the early 1980s until prices peaked in 2008. The following drop in house prices led to a sharp decrease in transaction numbers, making the housing market come to a standstill. Loss aversion and negative equity can both explain how decreasing house prices affect household mobility. The decrease in house prices and its effects on household mobility have been debated widely, but there seems to be no agreement on the exact mechanisms. The relation between decreasing house prices and household mobility, therefore, deserves further attention.

We will study the effects of decreasing house prices in the owner-occupied market on sales rates and household mobility as it is not clear whether the decrease in transaction numbers is caused by financial constraints or by loss aversion. We will investigate whether households did not want to move or were no longer able to do so after prices started dropping. Studying the difference between the binding and non-binding constraints will lead to a better understanding on how the housing market functions.

[1] An earlier version of this chapter won the Graduate Student-led Paper Competition of the NARSC conference in Portland (OR) in November 2015 and was published as a working paper: Steegmans, J., Hassink, W., 2015. Decreasing house prices and household mobility: An empirical study on loss aversion and negative equity. U.S.E. Discussion Paper Series No. 15-12, Utrecht University School of Economics.

Two main strands of literature exist within the study of reduced household mobility due to decreasing house prices. The first strand focuses on loss aversion. Loss averse households are not willing to sell their home for less than they paid themselves (Engelhardt, 2003; Genesove and Mayer, 2001). Facing a prospective loss thus reduces mobility. Even though these households could move from a financial point of view they are not willing to do so at a nominal loss. The second strand focuses on reduced mobility due to financial constraints (Chan, 2001; Ferreira et al., 2010, 2012; Henley, 1998; Schulhofer-Wohl, 2012). Negative equity may severely limit possibilities of obtaining a mortgage for a new home. Households with negative equity are spatially locked-in as they are not able to move. Even though there is no formal down-payment constraint in the Netherlands, the residual debt causes a barrier in obtaining a new mortgage.

Most scholars have studied the effects of loss aversion and negative equity on household mobility individually. We argue, as did Engelhardt (2003), that loss aversion and negative equity effects should be studied simultaneously. We contribute to the existing literature by making a clear distinction between loss aversion and negative equity effects, while estimating the effects simultaneously. Besides, we provide estimates of negative equity effects conditional on household savings and look into voluntary and involuntary mobility. To the best of our knowledge, loss aversion and negative equity have not been investigated this extensively before in connection with housing markets.

Our analysis makes use of a unique administrative data set of Statistics Netherlands that contains the stock of Dutch owner-occupied houses and the traits of the households living in them. The period under investigation, 2006-2011, contains the peak in house prices and the following decline. Differences in housing durations and price decreases provide the variation that we need for estimation and identification. This chapter makes use of duration analysis to estimate the hazard rates of moving. The hazard rates are estimated with an extended Cox model.

The results suggest a strong effect of loss aversion. Households facing a prospective loss are over 50 percent less mobile than households not facing a loss. We find limited evidence of negative equity effects. Moderately underwater households seem to have a somewhat reduced mobility but heavily underwater households are the most mobile of all. Furthermore, the positive effect of household savings on mobility for underwater households provides evidence that the mobility is voluntary.

The remainder of this chapter is organized as follows. Section 3.2 presents the theoretical background. Section 3.3 discusses the data set and variables. Section 3.4 describes the empirical model. Section 3.5 reports the estimates, while section 3.6 summarizes and concludes.

3.2 Theoretical background

3.2.1 Loss aversion

Loss aversion is one of the mechanisms that explains how decreasing house prices can deter household mobility. The nominal price that was originally paid for a house functions as a reference point in the household's selling decision. Loss aversion describes the behavior that households are not willing to incur a nominal loss if they sell their house (Genesove and Mayer, 2001). Prospective losses thus deter residential mobility (Engelhardt, 2003). Loss aversion was first introduced in prospect theory to describe the behavior that people give more importance to avoiding losses than to obtaining equivalent gains (see Kahneman and Tversky, 1979; Tversky and Kahneman, 1991).[2]

In their seminal paper Genesove and Mayer (2001) apply loss aversion to the housing market and study the effect of nominal loss aversion on asking prices, selling prices, and time-on-the-market. They corroborate that sellers use the transaction price that they originally paid as a reference point in their selling decision. Based on data of downtown Boston for the years 1990-1995 they conclude, as hypothesised, that facing a nominal loss leads to a higher selling price. The higher selling price is the result of a higher list price and a lower probability of sale. Genesove and Mayer (2001) do not study household mobility itself, but following their paper mobility studies have started to incorporate loss aversion into their studies.

Engelhardt (2003) studies the effect of equity constraints and loss aversion on household mobility in the United States. The focus is on the identification of these effects as both occur when prices start falling; periods of declining house prices are required for both binding equity constraints and nominal loss aversion. High equity households that are (financially) unconstrained

[2] It is important to note that in most housing market studies the gain domain is not defined; that is, nominal losses are not compared to equivalent gains but to the more general situation where losses do not occur (e.g. Genesove and Mayer, 2001; Anenberg, 2011).

are used for the identification of the nominal loss effect, while household potentially at risk of being constrained are used for the identification of negative equity effects. Engelhardt (2003) concludes that: "Household mobility is significantly influenced by nominal loss aversion. There is little evidence that low equity because of fallen house prices constrains mobility" (p. 171). Anenberg (2011) focuses on the effects of loss aversion and negative equity on house prices. He finds strong evidence that nominal losses and high loan-to-value (LTV) ratios have a positive effect on the selling price.

Loss aversion in the Dutch housing market has received almost no attention. Eichholtz and Lindenthal (2013) are a notable exception. They study loss aversion through the centuries based on housing transactions of the Herengracht in Amsterdam, spanning 324 years. They conclude that loss aversion has gotten more important over time. Still, a major concern of this paper is that it does not differentiate between loss aversion and equity effects. Financial constraints are even explicitly mentioned as an explanation for the psychological barrier that is loss aversion (Eichholtz and Lindenthal, 2013, p. 13).

3.2.2 Negative equity

Negative equity is the second mechanism that relates decreasing house prices and household mobility. Decreasing house prices can lead to the mortgage being larger than the contemporaneous house value, that is, negative (housing) equity. Having negative equity, or being 'underwater' as it is also called, can make it impossible to obtain a mortgage for a new home. These households are said to be spatially locked-in (Chan, 2001). Nonetheless, negative equity could also increase mobility through defaults and foreclosures.

Henley (1998) is one of the first to study the effects of negative equity on household mobility. He finds strong evidence that negative net housing equity deters residential mobility and labor market flexibility. The estimates suggest that owner-occupiers with negative equity encounter a down-payment constraint as they are no longer able to sell their house and make a down-payment on a next house, restricting geographical and labor market mobility.

Chan (2001) studies whether falling house prices reduce mobility of households with little equity (high LTV ratios). If such a household sells its house it is left with insufficient funds to repay its mortgage and make a down-payment on a new home, leading to a spatial lock-in. The household's contemporaneous LTV ratio is the variable of main interest. The crucial value for the LTV is set at 80 percent, as it is assumed that higher LTV ratios make a down-payment on a new house impossible. Chan (2001) recognizes that loss aversion may affect mobility and incorporates a cumulative house price change variable in the estimated models.[3] She does conclude that there is clear evidence of "severe constraints to mobility as a result of negative housing market shocks" (p. 584).

The exact opposite results are found by Coulson and Grieco (2013). They find that underwater households are more mobile than households with positive equity. That is, moderately underwater households have the same mobility rate as above-water households, while heavily underwater households are the most mobile category. The results, therefore, go against the predictions of the lock-in mechanism. Coulson and Grieco (2013) give both increased mobility due to defaults and increased mobility in order to prevent an approaching default as possible explanations for the empirical findings. The results found by Coulson and Grieco (2013) indicate that lock-in may not be the only mechanism through which negative equity can affect household mobility.

It is regularly hypothesized that defaults and foreclosures may increase mobility (Chan, 2001; Ferreira et al., 2010; Schulhofer-Wohl, 2012). Andersson and Mayock (2014) explicitly differentiate between voluntary mobility and default-induced mobility (due to strategic behavior or the inability to pay), i.e. they disentangle the lock-in mechanism from the default mechanism. Their results show a U-shaped relationship between equity and household mobility; at moderate debt levels an increase in debt decreases mobility, while at high debt levels an increase in debt increases mobility.[4] In other words, they find that for low levels of negative equity the lock-in effect dominates, while for high levels of negative equity the default mechanism dominates.[5]

[3] In this specification the cumulative house price change measures more than only loss aversion, so no conclusive results of a loss aversion effect are presented.

[4] Andersson and Mayock (2014) lump all LTV ratios between 0 and 0.8 together in a single group (over 53 percent of their sample). Equity effects for above-water households with LTVs under 0.8 can therefore not be distinguished, while Henley (1998) shows that household mobility increases with positive house equity. Coulson and Grieco (2013) also provide estimates that show that household mobility increases with positive house equity for above-water households, up to an LTV of 0.9.

[5] Ghent and Kudlyak (2011) study differences in default between recourse and non-recourse states in the US. The results indicate that having a recourse loan affects default through a decrease in the sensitivity to negative equity. In recourse states defaults are

That the effect of negative equity on mobility is still being debated is probably best illustrated by the polemic that developed between Ferreira et al. (2010, 2012) and Schulhofer-Wohl (2012). Ferreira et al. (2010) have found a negative effect of negative equity on household mobility while based on the same data Schulhofer-Wohl (2012) finds the contrary, i.e. that homeowners with negative equity are more mobile. Schulhofer-Wohl (2012) argues that Ferreira et al. (2010, 2012) underreport household mobility by excluding 'temporary moves', that is, moves by households that do return to their (unsold) original home. The conclusions in these three articles seem to be driven by the definition of moving that is used. However, more important than the discussion of what moves to include or exclude is the fact that neither of these articles distinguishes between negative equity and loss aversion effects.

3.2.3 Simultaneous mechanisms

Both loss aversion and negative equity effects are driven by decreasing house prices, resulting in a positive correlation between them. The correlation between the two mechanisms seems to make it impossible to study one without the other. Estimating the effect of negative equity without incorporating loss aversion will overestimate the absolute effect of negative equity, that is, the true effect of negative equity is likely to be less negative than found in studies that do not account for loss aversion.

Strong evidence exists that loss aversion has a negative effect on mobility, whereas the evidence for a negative effect of negative equity is less conclusive. Prior studies that take loss aversion into account have found little evidence that negative equity hampers mobility (Engelhardt, 2003). Studies that do find a lock-in effect of negative equity have generally refrained from distinguishing between loss aversion and negative equity effects (Ferreira et al., 2010, 2012; Henley, 1998; Struyven, 2015).

In our analysis we will distinguish between loss aversion and negative equity effects. We will look into non-housing wealth of underwater households as being locked-in is conditional on household savings; it is not evident that negative housing equity hinders mobility if a household has additional

involuntary (due to liquidity constraints), while in non-recourse states defaults may also be strategic. In the Netherlands mortgages are recourse loans, leaving defaulting households with a residual debt if the mortgage debt exceeds the sale revenues. Default-induced mobility is thus expected to be substantially lower in the Netherlands than in countries with non-recourse loans.

sources of wealth. By taking into account non-housing wealth we are able to investigate the U-shaped relationship between negative equity and household mobility that is suggested by Andersson and Mayock (2014). To our knowledge this study is the first to investigate the relationship between decreasing house prices and household mobility in such detail.

3.3 Data

3.3.1 Data set

The data set, covering the period 2006-2011, consists of housing spells and characteristics of households living in the stock of owner-occupied existing row houses in the Netherlands.[6] Most of our observations have housing spells that started before our stock sampling date, January 2006. Houses and households are observed annually until 2011, or until the moment that the house is sold. The data set is extended with new housing spells beginning between 2006 and 2011. That is, houses and households can re-enter the data set after a sale. These latter observations have spells that started after the stock sampling date. The data set is thus constructed as a stock sample extended with an inflow sample. In total the data set consists of 2,474,839 observations of 574,145 unique spells.[7]

The data set has been constructed by making use of unique administrative data of Statistics Netherlands (CBS). The data set combines individual data from the Cadastre records (*Bestaande Koopwoningen*), the Housing Stock Register (*Woonruimteregister verrijkt*), the Population Register (*Adresbus, Huishoudensbus, Persoontab*), the Job Register (*Baankenmerkenbus, Baansommentab, Hoofdbaanbus*), the Integrated Capital Data Set (*Integraal Vermogensbestand*), and the Integrated Income Data Set (*Integraal Huishoudens Inkomen*).

The Cadastre records are matched with the Housing Stock Register to identify the owner-occupied houses in the Netherlands. The Cadastre records contain information on transactions of existing homes, thereby providing in-

[6]The housing stock is divided into existing homes and newly-build houses. Newly-build houses only enter the analysis after they have been sold, that is, after they have become an existing home.

[7]Including the observations with an unobserved spell start the data set counts 2,612,267 observations of 627,515 unique spells.

formation on mobility and housing duration. The transaction records consist of both voluntary and involuntary sales.[8] The Population Register, based on information from the municipalities, contains information on household composition and demographic characteristics. The Job Register has been compiled by Statistics Netherlands out of administrative sources from the tax office and the Employee Insurance Agency (UWV). It provides information on all employment relationships in the Netherlands (see Schoonhoven and Bottelberghs, 2014). The Dutch tax authority is the main source of information for both the Integrated Capital Data Set and the Integrated Income Data Set. The former provides information on the assets and liabilities of the households, while the latter contains information on household income and the income composition.

The panel data set that we have constructed contains the stock of owner-occupied row houses in the Netherlands and the characteristics of the households living in these homes. It is due to data limitations that we restrict our analysis to owner-occupied row houses. Compared to the other types of family homes row houses have a major advantage: households in row houses tend to have shorter durations than households in corner houses, semi-detached houses, and detached houses. This implies that left-censoring, an unobserved spell start, is less of a problem for row houses (see section 3.4.3).

3.3.2 Spell length and mobility

The Cadastre records (1995-2011) are the main source for our owner-occupied housing duration variable. For the stock-sampled observations house sales in the period 1995-2005 provide the beginning of the spell if a house is an existing home; the duration start of houses that were newly build in the period 1995-2005 is found in the Housing Stock Register. Durations of houses last sold before 1995 are not observed directly.[9] For the inflow-sampled observations the spell begins as soon as a house is bought after the stock sampling date. House sales in the period 2006-2011 provide, if a house is sold, the end of a spell for both the stock-sampled and the inflow-sampled observations. A

[8] While forced sales are included in the data, it is not possible to distinguish them from the other sales.

[9] The Housing Stock Register provides the date that a (newly build) house is added to the housing stock. These addition dates go back until January 1992. However, as (re)sales between 1992-1994 are not observed the spell start of the houses that were newly build between 1992-1994 cannot be determined with absolute certainty.

move is thus defined as a house sale after the stock sampling date.

Table 3.1: Year of duration start

	Frequency	Percent	Cum. percent
pre-1995	52,399	11.47	11.47
1995	23,486	5.14	16.61
1996	27,339	5.99	22.60
1997	30,799	6.74	29.34
1998	35,371	7.74	37.09
1999	38,311	8.39	45.47
2000	36,755	8.05	53.52
2001	41,761	9.14	62.66
2002	45,486	9.96	72.62
2003	45,712	10.01	82.63
2004	44,274	9.69	92.32
2005	35,065	7.68	100.00
Total	456,758	100.00	

Notes: Statistics of stock-sampled row houses in 2006.

Table 3.1 shows the distribution of the starting years of the housing spells at the stock sampling date. The table shows that of the spells that started before January 2006 11.47 percent (52,399 observations) did start before 1995. For these observations the exact spell start is not observed; these observations are said to be left-censored. The way to handle left-censored observations is discussed in detail in section 3.4.3.

Figure 3.1 shows the regional distribution in median duration in the Netherlands. The economic core, the *Randstad*, has relatively long durations compared to the periphery. However, major differences are observed in the so-called shrinking regions: the south-west corner (Zeeuws-Vlaanderen) and the north-east corner of the Netherlands (Groningen) have relatively long durations, whereas the durations in the southernmost province (Limburg) are relatively short. Evidently, the regional differences in duration imply differences in mobility as well.

3.3.3 Decreasing prices

The price development of row houses in the Netherlands is presented in figure 3.2. The repeat sales price index that we have estimated shows that house

Figure 3.1: Median duration of stock-sampled row houses in 2006 (COROP region level)

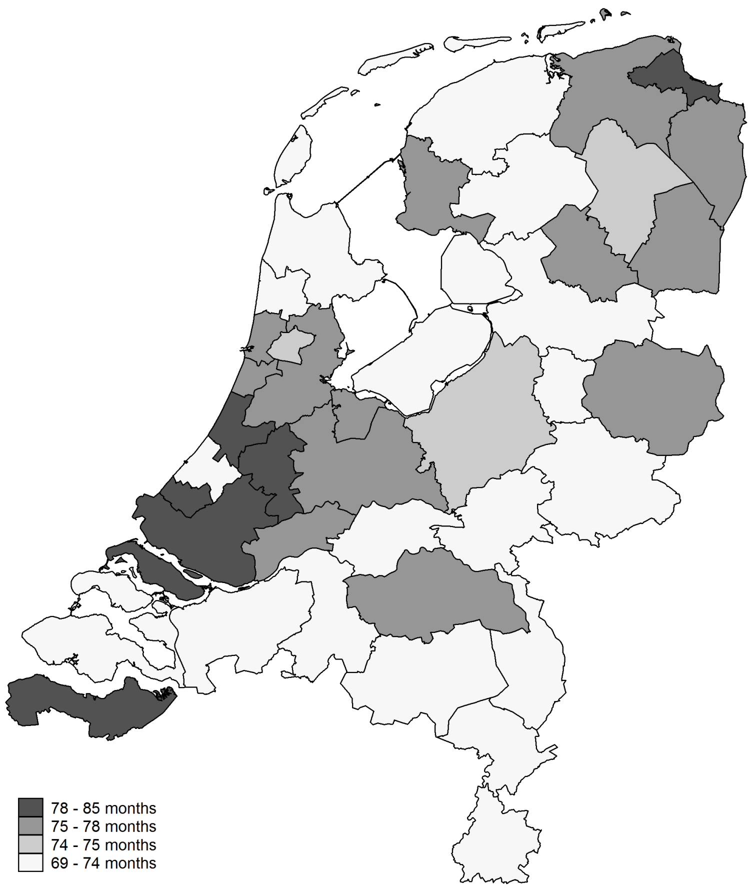
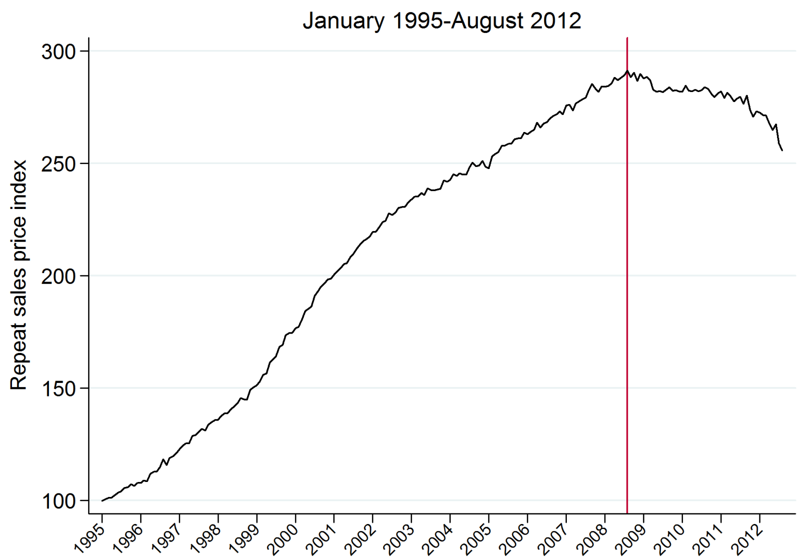


Figure 3.2: Repeat sales price index for row houses in the Netherlands (nominal price development)



prices peaked in 2008.[10] Prices gradually increased up to 2008 and started decreasing afterwards; for row houses prices decreased 6.2 percent on average between August 2008 and December 2011. The price decreases are important as they are the main driver for both negative equity and loss aversion. In the following subsections we will look into the measures of negative equity and loss aversion. Summary statistics of the remaining covariates can be found in appendix 3.B.

3.3.4 Prospective losses

Observed sale prices cannot be used to identify loss aversion as unsold houses are the likeliest to be affected by loss aversion and their sale prices are by definition not observed. Instead of actual losses we have to resort to prospective losses. After all, whether a nominal gain or loss would occur depends on the price that could be obtained if the house was to be sold, while potential losses could result in transactions not taking place.

[10]The estimation of the repeat sales price index is discussed in appendix 3.A.

In this study we define the market value of a house as the purchase price adjusted by the cumulative change in the repeat sales price index.[11] In other words, the market value of a house is determined by the price at which the house was bought (P_0), the price index at the time the house was bought (I_0), and the contemporaneous price index (I_t).

$$P_{it} = P_{i0}\left(1 + \frac{I_{ct} - I_{c0}}{I_{c0}}\right) \tag{3.1}$$

where subscript c of the price index denotes the region.

A household faces a prospective loss if the contemporaneous value (P_t) is less than the price that was initially paid (P_0). Given that P_t is expressed in terms of P_0 this can be expressed in terms of the price index.

$$pros.\ loss = \begin{cases} 0 & \text{if } I_{ct} \geq I_{c0} \\ 1 & \text{if } I_{ct} < I_{c0} \end{cases} \tag{3.2}$$

We have estimated monthly repeat sales price indices for forty COROP regions in the Netherlands.[12] That means that loss aversion is identified through the use of the regional repeat sales price index.[13] The estimation of the repeat sales price index is discussed in appendix 3.A.

Figure 3.2 shows that only houses that were bought not that long before the stock sampling date are confronted with potential losses, while the magnitude of the prospective losses is relatively small. Consequently, no distinction in size is made within the prospective loss variable. Even though regional differences exist, it is only towards 2011 that prices had decreased until the price level of around 2006. This means that the lion's part of the households facing a prospective loss have spells that started after the stock sampling date. For the households with a spell starting before January 2006

[11] As we are interested in the (relative) price development only, the smoothed repeat sales price index fits our purpose very well. A comparison between various price indices for the Netherlands is done by De Vries et al. (2009) and Jansen et al. (2008).

[12] The COROP regions were defined in 1971 by a committee named *Coördinatiecommissie Regionaal Onderzoeksprogramma*, hence the name COROP. A COROP is an administrative region, in size between provinces and municipalities, that joins together regional labor markets based on commuting flows. Most COROPs, therefore, consist of a larger city and its periphery. Estimation at a lower level of aggregation is not posible as observations become too sparse.

[13] The regional indices have been smoothed through (second degree) local polynomial smoothing in order to limit monthly fluctuations from the trend.

0.2 percent of the observations (3,462 obs.) have a prospective loss, while for the households with a spell starting after January 2006 30.0 percent of the observations (107,808 obs.) have a prospective loss.

3.3.5 Loan-to-value ratios

The effects of negative equity will be studied by making use of the household's LTV ratio, i.e. the value of the mortgage relative to the value of the house, which is observed annually.[14] A ratio of one indicates that the value of the mortgage equals the value of the house, while ratios larger than one indicate the existence of negative equity. It has to be noted though that the LTV ratios are overestimated as the asset side in endowment mortgages (in Dutch *beleggingshypotheek* and *spaarhypotheek*) are not taken into account.[15]

Table 3.2: Percentiles of loan-to-value ratios

	Non-left-cens.	Left-cens.	Total
p1	.000	.000	.000
p5	.255	.000	.122
p10	.398	.000	.288
p25	.596	.167	.529
p50	.831	.341	.786
p75	1.016	.553	1.001
p90	1.153	.836	1.142
p95	1.282	1.087	1.271
p99	1.641	1.662	1.643
Observations	404,359	52,399	456,758

Notes: Statistics of stock-sampled row houses in 2006. Spells starting before 1995 are left-censored. The respective percentiles are given by p1 until p99.

The LTV ratios in the Netherlands are amongst the highest in the world (Dutch Central Bank and Netherlands Authority for the Financial Markets,

[14] As LTV data are available only from 2006 onwards we are not able to differentiate the effect of the initial LTV, that is, the LTV at the moment of origin of the mortgage, from the overall LTV effect, which incorporates the price decreases.

[15] Using Dutch survey data Schilder and Conijn (2012) exploit information on mortgage expenditures and interest payments to estimate the asset side of endowment mortgages and include endowment mortgage assets in the calculated potential residual debt. Nevertheless, as this information is not available in our data set we are not able to follow this approach.

2009; Dröes and Hassink, 2014). The high LTV is explained by the existence of a fiscal policy that encourages mortgage debt through the full deductibility of mortgage interest payments (Rouwendal, 2007). Besides, there is no down-payment requirement in the Netherlands contrary to, for instance, the United States (Dröes and Hassink, 2014).

Table 3.2 shows the distribution of LTV ratios for left-censored and non-left-censored observations.[16] The table shows that households with the longest spells, that is the spells that started before 1995, have lower LTV ratios. The median LTV for spells that started before 1995 is 0.341, whereas the median LTV for spells starting after 1995 is 0.831. The table also shows that within the left-censored observations many more households have paid off their mortgages than within the non-left-censored observations, between 10-25 percent and 1-5 percent respectively. These differences suggest that simply discarding the left-censored observations when analyzing equity effects might affect the results.

The LTV ratios have been used to create seven LTV groups, which increase 0.2 (20 percent) per category (see table 3.3). The latter two groups, LTV between 1.0 and 1.2 and LTV above 1.2 respectively, are so-called 'underwater' households as their mortgage is larger than their house value. In table 3.3 the underwater households have also been subdivided into different groups based upon additional wealth, i.e. wealth excluding housing wealth. The table shows that the great majority of underwater households has additional wealth, but that the additional wealth is smaller than the amount that the household is underwater. This holds for both the moderately ($1.0<\text{LTV}\leq 1.2$) and the heavily ($\text{LTV}>1.2$) underwater households.

[16]LTV ratios larger than 2.0 have been excluded. As information on loans and values originates from the same data set we consider the (remaining) large LTV ratios plausible. The distribution of LTV ratios seems to corroborate this. Furthermore, the conclusions in this chapter are robust to lowering the LTV upper limit.

Table 3.3: Ratios of LTV groups with and without left-censored obs.

	Non-left-cens.	Left-cens.	Total
LTV≤0.2	.0396	.2926	.0686
0.2<LTV≤0.4	.0613	.2895	.0875
0.4<LTV≤0.6	.1533	.2035	.1590
0.6<LTV≤0.8	.2113	.1039	.1990
0.8<LTV≤1.0	.2592	.0471	.2349
1.0<LTV≤1.2	.1993	.0263	.1794
LTV>1.2	.0759	.0370	.0715
Moderately underwater, 1.0<LTV≤1.2 (subgroups):			
W<0	.0040	.0007	.0036
0≤W<U	.1925	.0245	.1732
W≥U	.0028	.0011	.0026
Heavily underwater, LTV>1.2 (subgroups):			
W<0	.0017	.0011	.0017
0≤W<U	.0729	.0345	.0685
W≥U	.0013	.0014	.0013
Observations	404,359	52,399	456,758

Notes: Statistics of stock-sampled row houses in 2006. Moderately underwater (1.0<LTV≤1.2). Heavily underwater (LTV>1.2). Additional wealth (W). Amount underwater (U).

3.4 Empirical model

3.4.1 Specification of the hazard rate

Duration analysis is particularly well-suited to study mobility in the housing market as it easily allows for the inclusion of (right) censored observations and duration dependence; that is, duration analysis does not exclude households that do not move or sell from the analysis, while at the same time duration length itself is allowed to have an impact on the moving or selling probability of a household. Mobility is generally studied by estimating hazard rates, i.e. the probability that a household will move in a given period conditional on not having moved before. In order to analyse housing duration we will be estimating an extended Cox model. We will be applying a continuous time specification as the ratio of the interval length (duration is measured in months) to the typical housing duration is relatively small (Jenkins, 2005, p. 21).

The Cox proportional hazard model (Cox, 1972, 1975) has empirically been very successful (Cameron and Trivedi, 2005). The Cox proportional hazard is a semiparametric method: non-parametric regarding the baseline hazard, parametric regarding the effects of the set of covariates. The starting point is the standard proportional hazards framework. The hazard rate is given as follows (see Cameron and Trivedi, 2005):

$$\lambda(t|\boldsymbol{x}, \beta) = \lambda_0(t)\phi(\boldsymbol{x}, \beta) \tag{3.3}$$

where t is duration, $\boldsymbol{x}$ is the set of covariates, and λ_0 is the baseline hazard. The baseline hazard is a function of t alone and $\phi(\boldsymbol{x}, \beta)$ is a function of $\boldsymbol{x}$ alone. As $\phi(\boldsymbol{x}, \beta)$ is generally specified in an exponential form, i.e. $exp(\boldsymbol{x}'\boldsymbol{\beta})$, the conditional hazard rate becomes:

$$\lambda(t|\boldsymbol{x}, \beta) = \lambda_0(t)exp(\boldsymbol{x}'\boldsymbol{\beta}) \tag{3.4}$$

The hazard functions $\lambda(t|\boldsymbol{x})$ are all proportional to the baseline hazard, hence its name. Differences in characteristics simply imply a scaling of the baseline hazard. The scaling factor is given by $exp(\boldsymbol{x}'\boldsymbol{\beta})$. In other words, the hazard ratios depend on the covariates but not on t. Cox (1972, 1975) suggested a partial likelihood approach that allows for estimation of the parameters without estimating the baseline hazard.

The Cox proportional hazard model can easily be extended to include time-varying covariates.

$$\lambda(t|\boldsymbol{x}(t)) = \lambda_0(t)\phi(\boldsymbol{x}(t), \beta) \tag{3.5}$$

However, as $\boldsymbol{x}$ depends on t the proportionality factor now varies with survival time, that is, the proportional hazard assumption is no longer satisfied. Still, as long as the partial likelihood is adjusted accordingly, the model can be estimated (Cameron and Trivedi, 2005; Jenkins, 2005). It is the Cox model with time-varying covariates that is called the extended Cox model. Even though it is not a proportional hazard model in a strict sense, it is often referred to as a proportional hazard with time-varying covariates (Cameron and Trivedi, 2005, p. 991).[17]

[17]Estimating a frailty model, a model that incorporates unobserved heterogeneity, is not possible from a theoretical point of view; the frailty term cannot be identified in the stock sample we use (see Van den Berg and Drepper (2016) for a thorough discussion). Besides, estimation would not have been feasible empirically.

3.4.2 Left truncation

The above model could directly be estimated if one uses an inflow sample, that is, a random sample of all households starting a (housing) spell in a given time interval. However, a large part of our data set consists of a stock sample: a random sample of all households that had already started their spell at our stock sampling date. The spell start date is found before the moment of observation. The problem here is that the probability of observing a short duration is smaller than observing a longer duration; the longer the typical spell length, the greater the proportion of long spells in a stock sample.

The best way to understand this is with an illustration from our data. We have information on housing spells that started in the period 1995-2011. If we look at the stock of owner-occupier households in January 2006 the average expected spell length – expected because these spells have not ended yet by definition – is longer than the expected spell length of *all* the spells that started before 2006. After all, most of the short spells that occurred between 1995 and 2005 are not observed in our stock sample as they ended before 2006; only short spells that started close to our (stock) sampling date can be observed. Thus, if our population comprises all households that bought a house after 1995 our random stock sample causes a sample selection problem as observations are missing non-randomly.

This sample selection problem is known as left truncation (Cameron and Trivedi, 2005). Kiefer (1988) uses the term length-biased sampling to describe it. It is also referred to as delayed entry as the individuals in the sample are not 'at risk' from the beginning of their spells. They survive until the sampling date per se and become at risk at the moment that they are sampled (Jenkins, 2005). Nevertheless, the sample selection problem is easy to deal with as long as we observe the starting dates of the spells and have observations of some spells after the sampling date (Cameron and Trivedi, 2005). We can correct for the sample bias by taking into account the time between the start of the spell and the moment of sampling. Put differently, we can analyse the observations conditional on surviving up to the sampling date (Jenkins, 2005, pp. 64-66).

3.4.3 Left-censoring

Some of the houses in our stock sample have not been sold between 1995 and 2005. The exact starting dates of these housing spells remain unobserved.

These observations are said to be left-censored. Left-censoring could lead to a selection bias as the longest durations are excluded from the analysis (Iceland, 1997). The possibility of a selection bias leads us to investigate the methods that are used to handle left-censored data even though the proportion of left-censored spells is relatively small: 11.47 percent at the stock sampling date. Ex ante there is no reason to assume that households who bought before 1995 react differently to prospective losses or to being underwater than households with shorter durations.[18]

Left-censoring is most commonly handled by discarding the left-censored data altogether. Although Allison (1984, p. 57) calls this the “safest approach” – claiming that “it should not lead to any biases” – the contemporary view is that discarding the left-censored observations could cause serious selection bias (Gottschalk and Moffitt, 1994; Iceland, 1997; Moffitt and Rendall, 1995; Stevens, 1999).[19] Consequently we consider it necessary to investigate whether excluding left-censored spells causes selection bias in our results.

The simplest way to include the left-censored observations is to substitute the left-censoring moment as the beginning of the spell (Guo, 1993). An empirical application of this approach can be found in Lawrance and Marks (2008). However, this approach is only optimal if the hazard rate is constant, which is generally not the case (Allison, 1984; Guo, 1993; Iceland, 1997). For obvious reasons we will call this the naive approach. A more elaborate approach is ‘integrating out’ over all possible durations (see Gottschalk and Moffitt, 1994; Moffitt and Rendall, 1995). This approach, however, is not feasible with time-varying covariates as is the case in our analysis (Gottschalk and Moffitt, 1994; Stevens, 1999). The remaining approaches estimate the durations of the left-censored spells through additional assumptions on the distribution of the durations (e.g. Guo, 1993).

Our preferred way of handling the left-censored data makes optimal use of a not yet exploited feature of the left-censored observations in our data set.

[18]Following Stevens (1999) we have run a regression with an artificial stock sampling date, that is, we excluded durations that started in 1995 and 1996 from the sample of non-left-censored observations. The estimates of the standard (left-censored) sample and the artificially left-censored sample are virtually the same, suggesting no effect of a sample selection bias due to left-censoring.

[19]Apart from simply discarding the left-censored data one could also refine the research question to exclude the left-censored observations (Iceland, 1997). In our analysis that would have meant restricting the research question to exclude the longest durations from our analysis.

That is, for a part of our left-censored observations we observe the date that the house has been added to the housing stock. While the transaction records of the Cadastre records do not go back further than 1995, the Housing Stock Register goes back until 1992, providing likely starting dates for houses that have been added to the housing stock between 1992 and 1994. While the spell start is not observed directly, it is not likely that these 'left-censored homes' have been sold twice in a very short period. The date (in the period 1992-1994) that the newly build house has been added to the housing stock can serve as a proxy for the beginning of the housing spell.

Furthermore, these observed 'left-censored' durations can be matched with the remaining left-censored observations. Given the strong correlation between the age of the owner and the duration of the left-censored observations, age is used to match the proxied observations with the left-censored observations lacking this proxy. Even though the majority of the left-censored observations is likely to have started between 1992 and 1994 (see table 3.1), the estimated left-censored durations will be an underestimation of the actual durations as no matched spells start before 1992. The main advantage of this approach, however, is that we do not need any further distributional assumptions while optimally using the available information.

To make sure that our results are not driven by selection bias due to the exclusion of the left-censored observations we will provide estimation results with and without the left-censored spells. The left-censored data will be incorporated by employing both the naive approach – substituting the left-censoring date as the spell start – and the proxy/matching approach. The comparison of the results with and without the left-censored spells will show whether omitting the left-censored spells leads to selection bias (Iceland, 1997; Stevens, 1999).

3.4.4 Covariates

The variables of main interest are the loss indicator, indicating whether the regional house price index at the time the house was purchased was higher than the house price index at the time of observation, and the LTV indicators. The other covariates that will be used to estimate equation (3.5) include a loan-to-income (LTI) indicator (six categories), an age indicator (ten categories), a household type indicator (seven categories), a labor market indicator (five categories), a gender indicator, a divorce indicator, and a region indicator (forty COROPs).

The LTV categories are LTV below 0.2, 0.2-0.4, 0.4-0.6, 0.6-0.8, 0.8-1.0 (reference category), 1.0-1.2, and LTV above 1.2. The LTI categories are LTI below 1.0 (reference category), 1.0-2.0, 2.0-3.0, 3.0-4.0, 4.0-5.0, and LTI above 5.0. The age groups are under 25 (reference category), 25-30, 30-35, 35-40, 40-45, 45-50, 50-55, 55-60, 60-65, and over 65. The household types are single person household (reference category), unmarried couple without children, married couple without children, unmarried couple with children, married couple with children, one parent household, and other household types. The labor market categories are no job, no change in job or jobs (reference category), loss of a job, getting a (or an extra) job, and losing a job while getting another.

3.5 Estimates

The estimation results of equation (3.5) can be found in table 3.4. The table presents the estimated hazard ratios of the semi-parametric extended Cox model. A ratio of one indicates that the effect is the same as the baseline hazard. Coefficients below one indicate a probability lower than the baseline, whereas coefficients above one indicate a higher probability.

The first column of table 3.4 shows the results where the left-censored observations have been discarded.[20] The coefficient for the prospective loss variable is 0.497, indicating that a prospective loss results in a probability of selling that is only 49.7 percent of the situation where there is no such loss. The probability of selling is thus 50.3 percent lower in case of a prospective loss.[21]

Compared to households that have a mortgage between 80 and 100 percent of the house value (the reference category), those with a mortgage between 100 and 120 percent of the house value have a 16.4 percent lower probability of moving (the coefficient is 0.836). These moderately underwater households thus have a lower probability of moving than the group that

[20] All results are robust to the inclusion of cohort dummies (i.e. year dummies indicating the spell start) and municipality fixed effects (instead of COROP fixed effects). Estimation with duration in years instead of months does not alter the conclusions either.

[21] An additional regression confirms that dropping the prospective loss variable from the regression leads to smaller coefficients for the negative equity categories (see the discussion in section 3.2.3). In other words, not including the measure of loss aversion in the regression model indeed leads to an overestimation (in absolute terms) of the effect of negative equity on mobility.

Table 3.4: Hazard ratios of households mobility: regression results of equation (3.5)

	(1) Left-censored		(2) Matching		(3) Naive		(4) Left-cens		(5) Matching		(6) Naive	
Prospective loss	0.497***	(0.012)	0.467***	(0.011)	0.464***	(0.011)	0.499***	(0.012)	0.469***	(0.011)	0.466***	(0.011)
LTV≤0.2	0.428***	(0.012)	0.813***	(0.015)	0.850***	(0.016)	0.434***	(0.012)	0.822***	(0.015)	0.860***	(0.016)
0.2<LTV≤0.4	0.826***	(0.016)	1.058***	(0.015)	1.078***	(0.015)	0.833***	(0.016)	1.067***	(0.015)	1.087***	(0.015)
0.4<LTV≤0.6	1.009	(0.013)	0.952***	(0.010)	0.935***	(0.010)	1.014	(0.013)	0.957***	(0.011)	0.940***	(0.010)
0.6<LTV≤0.8	1.056***	(0.011)	0.977*	(0.009)	0.960***	(0.009)	1.058***	(0.011)	0.980*	(0.009)	0.963***	(0.009)
1.0<LTV≤1.2	0.836***	(0.008)	0.890***	(0.009)	0.898***	(0.009)						
LTV>1.2	2.117***	(0.025)	2.488***	(0.026)	2.553***	(0.026)						
1.0<LTI≤2.0	0.602***	(0.011)	0.740***	(0.009)	0.700***	(0.009)	0.605***	(0.011)	0.741***	(0.009)	0.701***	(0.009)
2.0<LTI≤3.0	0.347***	(0.007)	0.497***	(0.007)	0.467***	(0.007)	0.351***	(0.007)	0.501***	(0.007)	0.470***	(0.007)
3.0<LTI≤4.0	0.274***	(0.006)	0.428***	(0.007)	0.403***	(0.007)	0.277***	(0.006)	0.432***	(0.007)	0.407***	(0.007)
4.0<LTI≤5.0	0.338***	(0.008)	0.556***	(0.010)	0.522***	(0.010)	0.342***	(0.008)	0.562***	(0.010)	0.528***	(0.010)
LTI>5.0	0.687***	(0.015)	1.124***	(0.019)	1.065***	(0.018)	0.695***	(0.016)	1.133***	(0.020)	1.075***	(0.018)
Age 25-30	0.767***	(0.038)	0.778***	(0.039)	0.781***	(0.039)	0.768***	(0.038)	0.778***	(0.039)	0.782***	(0.039)
Age 30-35	0.659***	(0.033)	0.676***	(0.033)	0.678***	(0.033)	0.658***	(0.033)	0.676***	(0.033)	0.677***	(0.033)
Age 35-40	0.518***	(0.026)	0.512***	(0.025)	0.499***	(0.025)	0.517***	(0.026)	0.510***	(0.025)	0.497***	(0.025)
Age 40-45	0.358***	(0.018)	0.343***	(0.017)	0.341***	(0.017)	0.356***	(0.018)	0.341***	(0.017)	0.338***	(0.017)
Age 45-50	0.257***	(0.013)	0.271***	(0.014)	0.276***	(0.014)	0.256***	(0.013)	0.269***	(0.013)	0.274***	(0.014)
Age 50-55	0.210***	(0.011)	0.256***	(0.013)	0.265***	(0.013)	0.209***	(0.011)	0.254***	(0.013)	0.263***	(0.013)
Age 55-60	0.200***	(0.011)	0.273***	(0.014)	0.289***	(0.015)	0.199***	(0.011)	0.270***	(0.014)	0.286***	(0.014)
Age 60-65	0.212***	(0.011)	0.281***	(0.014)	0.309***	(0.016)	0.211***	(0.011)	0.278***	(0.014)	0.306***	(0.016)
Age >65	0.208***	(0.011)	0.279***	(0.014)	0.332***	(0.017)	0.206***	(0.011)	0.276***	(0.014)	0.328***	(0.017)
Male	0.949***	(0.015)	0.995	(0.013)	1.017	(0.013)	0.950**	(0.015)	0.996	(0.013)	1.018	(0.013)
Unmarried w/o children	0.824***	(0.012)	0.887***	(0.012)	0.871***	(0.011)	0.825***	(0.012)	0.887***	(0.012)	0.871***	(0.011)
Married w/o children	0.763***	(0.011)	0.922***	(0.010)	0.916***	(0.010)	0.764***	(0.011)	0.923***	(0.010)	0.917***	(0.010)
Unmarried with children	0.736***	(0.011)	0.754***	(0.010)	0.741***	(0.010)	0.736***	(0.011)	0.754***	(0.010)	0.741***	(0.010)
Married with children	0.662***	(0.008)	0.716***	(0.007)	0.705***	(0.007)	0.662***	(0.008)	0.716***	(0.007)	0.705***	(0.007)
One parent household	1.019	(0.020)	1.025	(0.017)	1.027	(0.017)	1.019	(0.020)	1.025	(0.017)	1.027	(0.017)
Other household type	0.556***	(0.056)	0.593***	(0.053)	0.578***	(0.051)	0.558***	(0.056)	0.596***	(0.053)	0.581***	(0.051)
Divorced	4.433***	(0.080)	3.258***	(0.054)	3.423***	(0.054)	4.440***	(0.080)	3.264***	(0.054)	3.429***	(0.055)
No job	1.019	(0.011)	1.007	(0.009)	1.009	(0.009)	1.018	(0.011)	1.007	(0.009)	1.009	(0.009)
Job plus	1.176***	(0.028)	1.162***	(0.025)	1.149***	(0.025)	1.173***	(0.028)	1.158***	(0.025)	1.144***	(0.025)
Job minus	1.123***	(0.018)	1.114***	(0.015)	1.114***	(0.015)	1.122***	(0.018)	1.114***	(0.015)	1.114***	(0.015)
Job plus and minus	1.162***	(0.012)	1.141***	(0.011)	1.139***	(0.011)	1.163***	(0.012)	1.142***	(0.011)	1.140***	(0.011)
1.0<LTV≤1.2 & W<0							0.731***	(0.037)	0.748***	(0.036)	0.752***	(0.036)
1.0<LTV≤1.2 & 0≤W<U							0.827***	(0.009)	0.877***	(0.009)	0.885***	(0.009)
1.0<LTV≤1.2 & W≥U							1.536***	(0.074)	1.869***	(0.080)	1.880***	(0.081)
LTV>1.2 & W<0							1.636***	(0.099)	1.848***	(0.096)	1.866***	(0.097)
LTV>1.2 & 0≤W<U							2.098***	(0.025)	2.459***	(0.026)	2.523***	(0.027)
LTV>1.2 & W≥U							4.374***	(0.260)	5.305***	(0.254)	5.538***	(0.263)
Number obs.	2,474,839		2,612,267		2,612,267		2,474,839		2,612,267		2,612,267	
Log-likelihood	-1120652		-1555687		-1576926		-1120493		-1555398		-1576630	

Notes: Exponentiated coefficients (hazard ratios) with clustered standard errors in parentheses. The estimated coefficients for the COROP effects are excluded from the table. Models are estimated for row houses. Job plus indicates getting a (or an extra) job, job minus indicates losing a job, job plus and minus indicates losing a job while getting another. Additional wealth (W). Amount underwater (U). Reference categories: LTV between 0.8-1.0, LTI below 1.0, age below 25, single person household, and no job change(s). For details on the matching and naive approach see section 3.4.3.
* $p<0.05$, ** $p<0.01$, *** $p<0.001$.

has a slightly better financial position. Note, however, that the moderately underwater households have a higher probability of moving than do households with LTVs between 0 and 40 percent.[22] The coefficient for households with mortgages over 120 percent of the house value is 2.117, meaning that these heavily underwater households have a 111.7 percent higher probability of moving than the reference category ($0.8<\text{LTV}\leq 1.0$). The heavily underwater households, therefore, have the highest mobility of all LTV categories.[23]

The results in column 1 also show that, overall, mobility decreases with age; people under 25 (the reference category) have by far the highest mobility. There are just significant differences between men and women, while divorced people have a 343.3 percent higher probability of selling/moving than non-divorced people. Job mobility is also related to housing duration and hazard rates: getting a job (or an additional job for that matter) increases the probability of selling by 17.6 percent, while losing a job (possibly out of multiple jobs) increases mobility by 12.3 percent (both compared to the group without any job changes).[24] Losing one job and getting another increases selling probability by 16.2 percent. Furthermore, the coefficients of the LTI ratios show a U-pattern; households with a moderate LTI have the lowest mobility.

The second and third column of table 3.4 show the estimates when the left-censored observations have been included. Column 2 shows the results for the matching approach, column 3 shows the results for the naive approach (see section 3.4.3). Facing a prospective loss is estimated to decrease mobility by 53.3 percent in the matching approach and 53.6 percent in the naive approach. Compared to the reference category being moderately underwater reduces mobility by 11.0 and 10.2 percent respectively, while being heavily underwater increases mobility by 148.8 and 155.3 percent. Overall the patterns and the magnitudes of the estimated effects are very similar for all three approaches, that is, the inclusion or exclusion of the left-censored

[22]The results indicate that for above-water households mobility is lowest for the lowest LTV groups. This corresponds to the findings of Henley (1998) and Coulson and Grieco (2013), who find that (positive) house equity decreases mobility. This result is consistent, for instance, with low LTV households taking larger steps on the property ladder, resulting in less moves over a life-time.

[23]Lowering the upper limit of the highest LTV category leaves the conclusion unaltered. Heavily underwater households remain (by far) the most mobile LTV category if LTV ratios between 1.5 and 2.0 are excluded from the analysis.

[24]Note that this latter group might very well identify past job transitions.

observations does not drive our results.

In the estimates that are presented in the columns 4, 5, and 6 of table 3.4 the moderately underwater households (1.0<LTV≤1.2) and the heavily underwater households (LTV>1.2) have been divided into three different groups based on wealth excluding net housing wealth (savings, etc.). The first group has negative wealth/savings, that is, the household has additional debt. The second group has positive wealth/savings but the total is smaller than the amount that the household is underwater, while the third group has positive wealth/savings that is larger than the amount that it is underwater.

The results in the columns 4, 5, and 6 confirm that the mobility of the moderately underwater households is lower than the mobility of the heavily underwater households. The estimates also show that the moderately underwater households with additional debt are the least mobile subgroup. These households are between 24.8 and 26.9 percent less mobile than the group with an LTV between 80 and 100 percent. Another important observation is that the coefficients for the subgroups increase with additional wealth, thereby showing that mobility of households with negative equity rises with additional (non-housing) wealth. This holds for both the moderately and heavily underwater households. Apparently the high mobility of the heavily underwater households is not caused by involuntary mobility. After all, the heavily underwater households with additional debt are the likeliest to be confronted with forced house sales.

3.6 Conclusions

In this study we make a clear distinction between loss aversion and negative equity. The prospective loss indicator is used to identify loss aversion, while LTV ratios larger than one indicate the existence of negative equity. The analysis has shown that a prospective loss decreases mobility in the owner-occupied housing market by more than 50 percent. Being moderately underwater (LTV between 1.0 and 1.2) reduces mobility by about 15 percent compared to the group that has a mortgage that is not larger than its house value (LTV between 0.8 and 1.0). Nevertheless, the mobility rate of the moderately underwater households remains higher than the households with the lowest LTVs. The analysis shows that heavily underwater households have the highest mobility: over 100 percent higher than those with an LTV between 0.8 and 1.0. The analysis also shows that additional wealth/savings increases mobility for underwater households. The effects are similar for moderately and heavily underwater households, the difference being that mobility is roughly 2.5 times higher for the heavily underwater households.

The conclusions are threefold. First, our results – consistent with the findings of Engelhardt (2003) – indicate the existence of loss aversion as prospective losses decrease mobility substantially. Second, there is much less evidence for negative equity effects; moderately underwater households are less mobile than households with mortgages between 80 and 100 percent of their house values, but moderately underwater households are more mobile than households with very low LTV ratios. This finding is similar to the findings of Schulhofer-Wohl (2012) and Coulson and Grieco (2013). Moderately underwater households might have encountered some negative effects – especially households with additional debt – but heavily underwater households have the highest mobility. Third, non-housing wealth increases mobility for underwater households, suggesting that the high mobility for heavily underwater households is not default-driven. If the higher mobility for heavily underwater households was default-driven then we would have seen higher mobility rates for the households with negative wealth/savings. After all, households with positive wealth are likelier to be able to make their mortgage payments even if their house is underwater. The high mobility of heavily underwater households is an interesting phenomenon that needs attention in future research. Possibly heavily underwater households use their financial means to move instead of continuing mortgage payments on their underwater home.

This study has presented evidence that decreasing house prices have hampered household mobility through loss aversion. There is less evidence that negative equity limits household mobility even though some particular groups with negative equity are indeed less mobile. All in all, it seems that households did not want to move in a market with decreasing prices, while they generally could have from a financial perspective.

3.A Appendix: Repeat sales price index

The repeat sales index makes use of repeated sales of houses or pairs of transactions as Bailey et al. (1963) call them in their seminal paper. Under the assumption that house quality is constant, house price changes over time can be estimated without house characteristics being observed (e.g. Wang and Zorn, 1997). The starting point for the repeat sales index is a standard hedonic pricing model with a time indicator for the moment of sale.

$$ln(P_{it}) = \beta_0 + \sum_{k=1}^{K} \beta_k z_{ik} + \sum_{t=2}^{T} \gamma_t D_{it} + \mu_{it} \tag{3.6}$$

where P_{it} is the price of property i at time t, z_{ik} is the k^{th} house characteristic, D_{it} is the sale time indicator, and μ_{it} is a random error term.

The price change for a house that is sold twice is easily found by subtracting the price at time t_1 from the price at time t_2 (where $0 \leq t_1 < t_2 \leq T$). It follows that the difference in price between sale and resale is given by:

$$\begin{aligned} ln(P_{it_2}) - ln(P_{it_1}) &= ln\left(\frac{P_{it_2}}{P_{it_1}}\right) \\ &= \sum_{t=2}^{T} \gamma_{t_2} D_{it_2} - \sum_{t=2}^{T} \gamma_{t_1} D_{it_1} + (\mu_{it_2} - \mu_{it_1}) \\ &= \sum_{t=2}^{T} \delta_t D^{\star}_{it} + \epsilon_{it} \end{aligned} \tag{3.7}$$

where $D^{\star}_{it}$ is a time indicator that is equal to one in the period of the resale, minus one in the period of the (original) sale, and zero otherwise. The random error term is given by ϵ_{it}.

The repeat sales index I_t is found by exponentiating the Ordinary Least Squares regression results of equation (3.7). By multiplying the coefficients with 100 we set the base for I_0 at 100.

$$I_t = 100 exp(\widehat{\delta_t}) \tag{3.8}$$

We have estimated a separate price index, I_{ct}, per COROP region. Thus, we have estimated a total of forty regional repeat sales price indices.

3.B Appendix: Summary statistics

Table 3.5: Household summary statistics

	Non-left-cens.	Left-cens. obs.	Total
Age	41.2	55.1	42.8
	(10.5)	(12.7)	(11.6)
Male	0.917	0.873	0.911
	(0.277)	(0.333)	(0.284)
Single person household	0.129	0.176	0.134
	(0.335)	(0.381)	(0.341)
Unmarried couple w/o children	0.136	0.035	0.125
	(0.343)	(0.183)	(0.330)
Married couple w/o children	0.157	0.324	0.176
	(0.364)	(0.468)	(0.381)
Unmarried couple with children	0.095	0.028	0.087
	(0.293)	(0.164)	(0.282)
Married couple with children	0.446	0.390	0.439
	(0.497)	(0.488)	(0.496)
One parent household	0.036	0.046	0.037
	(0.187)	(0.209)	(0.189)
Other household types	0.001	0.001	0.001
	(0.035)	(0.032)	(0.035)
Divorced	0.009	0.018	0.010
	(0.096)	(0.134)	(0.101)
No job	0.157	0.394	0.184
	(0.363)	(0.489)	(0.387)
Same job	0.673	0.499	0.653
	(0.469)	(0.500)	(0.476)
Job plus	0.018	0.012	0.017
	(0.133)	(0.109)	(0.130)
Job minus	0.036	0.034	0.035
	(0.185)	(0.182)	(0.185)
Job plus and minus	0.117	0.060	0.110
	(0.321)	(0.238)	(0.313)
Loan-to-income	3.1	1.7	3.0
	(39.8)	(5.0)	(37.5)
Observations	404,359	52,399	456,758

Notes: Statistics of stock-sampled row houses in 2006. Standard deviations are shown under the means. Age and loan-to-income have been divided into different groups in the analysis. Job plus indicates getting a (or an extra) job, job minus indicates losing a job, job plus and minus indicates losing a job while getting another.

Chapter 4

House price determination, loss aversion, and negative equity

4.1 Introduction[1]

Households selling their house may receive a different price for a similar home. Financial position and paper (or nominal) losses, the house value being lower than the original purchase price, are among the seller characteristics that can influence house prices. Households with negative housing equity, the value of the mortgage is larger than the house value, may sell at above-market prices because their financial position does not allow them to sell at market value and obtain a mortgage for a new home, whereas nominal loss aversion makes households reluctant to accept a lower price than they originally paid themselves.

In prior studies, focusing on the US housing market, down-payment requirements in the mortgage market have been seized upon to explain why low equity households may sell for higher prices (Anenberg, 2011; Genesove and Mayer, 2001). In this study we focus on the Netherlands, where a formal down-payment constraint does not exist. Moreover, in the Netherlands there was no formal limit to the mortgage loan relative to the house value during the period of investigation; that is, borrowing the house price in full was not uncommon, nor was borrowing more than that. In the Dutch housing market we thus expect equity constraints to be smaller than in the US housing market. Consequently, loss aversion is expected to be relatively more important

[1]The study presented in this chapter is co-authored by Wolter Hassink.

in the Netherlands. That is, unless the mortgage relative to the house value is not only a financial constraint but also a psychological barrier. In that case the value of the mortgage could function as a reference point as does the original purchase price.

In an institutional setting without down-payment constraints and non-recourse loans, what is the effect of loss aversion and negative equity on house prices? That is, to what extent are households mitigated for facing a prospective loss or for having a mortgage that is larger than the value of the house? Does the absence of a formal down-payment constraint increase the importance of loss aversion relative to equity constraints?

In a market downturn decreasing house prices can lead to paper losses and negative housing equity. Households facing paper losses might be reluctant to sell because they are not willing to accept a nominal loss, while negative equity could make households unable to sell. It is important to distinguish between loss aversion and negative equity effects when studying house prices. Previous studies have shown that, due to the positive correlation between them, loss aversion and low housing equity should be studied simultaneously (Anenberg, 2011; Genesove and Mayer, 2001).[2] Not incorporating loss aversion, as did Genesove and Mayer (1997), will overestimate the effect (in absolute terms) of having low housing equity.

The main empirical challenge in our analysis is the same as in Genesove and Mayer (2001) and Anenberg (2011), that is, dealing with the unobserved house characteristics and the unobserved market premium in the prior transaction. The value of a house is an essential element of both loan-to-value (LTV) ratios and prospective losses. Unobserved house characteristics and unobserved market premiums paid in prior transactions might, therefore, be correlated with measures of loss aversion and negative equity. It is because of these difficulties in estimation that the price effects of loss aversion and equity constraints have received relatively little attention in the empirical literature. Our analysis makes use of a unique administrative data set of Statistics Netherlands (CBS), the Netherlands' Cadastre (Kadaster), and

[2] Using the indexed purchase price as the house value (see sections 4.3 and 4.4), we indeed observe that decreasing prices lead to a positive correlation between negative equity and prospective losses in our sample. The annual correlation coefficient – insignificant in 2006 and 2007 – becomes highly significant from 2008 onwards: 0.042 in 2008, 0.063 in 2009, 0.179 in 2010, and 0.277 in 2011. Still, the magnitude of the correlation coefficient and its annual development depend on the house value that is used. The use of alternative house values leads overall to higher correlation coefficients in our sample.

the Dutch Association of Realtors (NVM). The data set contains extensive house and households characteristics. It is through these data that we are able to estimate the effects of loss aversion and equity constraints in various specifications. The data from the recent Dutch housing market crisis have not yet been used in a similar analysis.

This chapter investigates house prices in relation to loss aversion and negative equity in a housing market with no formal down-payment constraint. The lack of a down-payment requirement implies that there is no binding financial constraint for low (yet positive) equity households; if there is a financial constraint in the Netherlands it is due to negative equity. Nevertheless, a formal limit to the LTV ratio did not exist during the period of investigation. The difference in institutional setting makes studying the Dutch housing market particularly interesting as it indirectly allows us to verify whether the down-payment constraint is as important as generally assumed. The extensive administrative data enable us to use a variety of measures for loss aversion and negative equity, based on different house values, thereby limiting the possibility that results are driven by misspecification. This study, therefore, provides important insights to the literature on equity constraints and loss aversion.

The remainder of this chapter is organized as follows. Section 4.2 presents the theoretical framework with the ideal econometric specification. Section 4.3 discusses the data set and variables. Section 4.4 describes the empirical model and strategy. Section 4.5 reports the estimates, while section 4.6 summarizes and concludes.

4.2 Literature

Loss aversion and credit constraints can both explain how household characteristics driven by market circumstances influence house prices. Loss aversion can explain how households are unwilling to accept a lower price than the purchase price they paid themselves. Credit constraints explain how households with low or negative equity might not be able to obtain a mortgage for a new home, thereby making them unable to sell and buy another house. More often than not these mechanisms have been treated as mutually exclusive explanations for market premiums, which they are not. Genesove and Mayer (2001) were the first to recognize that loss aversion and credit constraints affect house prices simultaneously.

4.2.1 Loss aversion

Loss aversion was first introduced in the prospect theory of Kahneman and Tversky (1979) to describe the behavior that individuals give more importance to avoiding losses than to obtaining equivalent gains. After observing that price rigidity is particularly important in falling markets, Case and Shiller (1988) are among the first to suggest prospect theory as an explanation for downward nominal price rigidity in the housing market.[3]

Genesove and Mayer (2001) are the first to explicitly apply loss aversion to the housing market by investigating the effect of nominal loss aversion on asking prices, selling prices, and time-on-the-market. Based on data of downtown Boston for the years 1990-1997 they present clear evidence that sellers use the nominal purchase price as a reference point. They observe that homeowners facing nominal losses have higher list prices, realize higher transaction prices, and have a considerably lower probability of sale. They conclude that the higher selling price is the result of a higher list price. The higher selling price, therefore, comes at the cost of a longer time-on-the-market and a lower probability of sale. While credit constraints are found to be significant, the results show that loss aversion is more important in explaining sellers' behavior.[4] The results also indicate that the households most sensitive to losses will be driven out of the market, that is, they will withdraw their house from the market instead of selling it. For the sold properties – that is, the least loss sensitive sellers – they find that a 1 percent increase in prospective loss increases the house price by between 0.18 and 0.03 percent, ceteris paribus. However, the lower bound is found to be insignificant.

Anenberg (2011) also studies the relation between prices, loss aversion, and equity constraints. His empirical approach allows him to present point estimates of the effect of loss aversion. He presents results in line with the

[3] Case and Shiller (1988) suggest that the regret theories of Bell (1982) and Loomes and Sugden (1982) have similar implications. We agree that avoiding or minimizing regret could indeed lead to the use of the purchase price as a reference point. Hence, – for the purpose of this study – the implications would be the same.

[4] Genesove and Mayer (1997) focus on the effect of equity constraints on list prices, time-on-the-market, and transaction prices. Loss aversion, however, is *not* included in their models. The large effect of equity constraints that Genesove and Mayer (1997) find is explained by not including loss aversion. Given the correlation between prospective losses and equity constraints part of the loss aversion effect is picked up by their equity constraints measure. Thus, as Genesove and Mayer (2001) make clear, the results presented in Genesove and Mayer (1997) are biased.

findings of Genesove and Mayer (2001) by applying a different estimation technique on a more extensive data set. Based on data of the San Francisco Bay area, covering the period 1988-2005, Anenberg finds that a seller who faces a prospective loss of 1 percent receives a 0.355 percent higher price, all else equal. As he lacks information on list prices and time-on-the-market he is not able to investigate the mechanism through which households facing a prospective loss obtain higher transaction prices.

4.2.2 Equity constraints

Stein (1995) presents a theoretical model that explains how equity constraints have a positive effect on house prices. The model relates the down-payment constraint in the mortgage market to prices and trading volume. The model implies that a longer time-on-the-market, on average, leads to higher transaction prices. Stein's down-payment model is the basis of most of the empirical studies on equity constraints. He presented his model to counter behavioral explanations that relate prices and trading volume, particularly the view that sellers might fail to 'recognize reality' during housing market busts. Stein claims that, contrary to behavioral theories, his "theory is predicated on rational behavior and does not rely on fads or bubbles" (Stein, 1995, p. 380).

The theoretical model of Stein (1995) describes housing trades when there is a (binding) down-payment constraint in the absence of a rental market. Home-owners need sufficient liquidity to make a down-payment in order to obtain a mortgage for a new home. If house prices decrease some households will not be able to move even if they move to a smaller house, as the proceeds will not allow for the down-payment on a new home. These households need to obtain above-market prices that would allow them to make the down-payment. They have higher reservation prices leading to a longer time-to-sale and higher transaction prices. The model thus explains a higher volume of sale and shorter time-to-sale in rising markets than in falling markets.

Anenberg (2011) suggests an additional explanation for the relation between market premiums and equity constraints: the existence of nonrecourse loans. Home-owners in a nonrecourse setting have the opportunity to strategically default on their mortgage, thereby resetting their loan balance to zero. The outside option results in higher reservation and transaction prices for households with negative housing equity as defaulting might be preferred over selling for less than the outstanding mortgage. Even when recognizing the costs of default, such as a decrease in credit score, strategic default can lead to higher transaction prices for households with negative equity.

Genesove and Mayer (1997) are the first to empirically study the market premiums received by equity constrained sellers. However, as they neglect loss aversion, the estimated effect of equity constraints is biased upwards (in absolute terms). Genesove and Mayer (2001) do estimate equity effects while controlling for loss aversion. They find that an increase in LTV ratio from 80 to 100 leads to a 1.2-1.4 percent higher transaction price, ceteris paribus. While the equity constraint is significant they conclude that it is less important than loss aversion in explaining transaction prices. Anenberg (2011), also controlling for loss aversion, finds a larger effect: a seller with an LTV ratio of 100 receives a 3.3 percent higher price than a seller with an LTV ratio of 80, all else equal.

4.2.3 The Netherlands

The aforementioned mechanisms of equity constraints, the down-payment requirement and strategic default, do not exist in the Netherlands. Mortgages are based upon income, while no down-payment has to be made. Mortgages are recourse loans so defaulting would leave a household with a residual debt. The lack of a down-payment requirement implies that there is no binding financial constraint for low equity households. It is only since the end of 2011 that there has been set a formal limit at all to the size of loans, that is, previously there was not even a maximum LTV ratio.[5] Based upon the down-payment hypothesis (or the strategic default hypothesis) low equity households in the Netherlands are not expected to receive market premiums.

Whether equity effects on house prices exist in the Netherlands is an empirical issue. However, it is likely that if they exist it is not necessarily the low equity households, but the negative equity households – those with a mortgage larger than the house value – that are affected. Thus, although there is no formal down-payment requirement in the Netherlands, it could be that borrowing more than the house value does encounter institutional constraints. Mortgage lenders might be restrictive in granting mortgages that have relatively little collateral. Besides, it could also be that the prospective

[5] A code of conduct for mortgage loans (GHF) was introduced in 2007 in order to limit excessive lending (indebtedness) by specifying limitations to mortgages based on income. However, this code of conduct was in no way binding.

residual debt functions as a psychological barrier instead of an institutional one.

In the previous chapter we investigated how loss aversion and negative equity affect household mobility in the Netherlands. The results show a strong detrimental effect of loss aversion on household mobility: facing a prospective loss reduces mobility by more than 50 percent. The results also indicate that moderately underwater households, that is households with an LTV between 1.0 and 1.2, have a mobility that is about 15 percent lower than households with an LTV between 0.8 and 1.0. Heavily underwater households, that is households with LTVs larger than 1.2, have a higher household mobility. Regarding price effects these results imply larger market premiums for households facing a prospective loss than for households that are (moderately) underwater. The price effects for heavily underwater households are not clear as it is uncertain what drives the high mobility for this group.

4.2.4 Ideal econometric specification

The ideal econometric model that is presented below closely follows Anenberg (2011) and Genesove and Mayer (2001). It focuses on the difficulties in estimation as – by construction – unobserved house quality and the market premium at the time of purchase cannot be separately identified within a housing transaction.

We start with a hedonic model and assume that the expected log selling price, q_{it}, is a function of observable characteristics, month of sale, and unobservable quality.

$$q_{it} = X_i\beta + \delta_t + v_i \tag{4.1}$$

where X_i is a vector of observable characteristics, δ_t is a time effect, and v_i is unobservable quality of the house. q_{it} is the expected log selling price in the absence of loss aversion and equity constraints. For reasons that become obvious below we will refer to the hedonic price as the value of the house.

The actual selling price differs from the value of the house due to overpayment or underpayment at the time of selling.

$$p_{it} = q_{it} + w_{it} \tag{4.2}$$

where p_{it} is the actual log selling price, q_{it} is the log house value, and w_{it} is the overpayment or underpayment. The difference between the actual selling price and the value is explained by both endogenous and exogenous components, that is, by the seller's characteristics and an idiosyncratic error.

$$w_{it} = \alpha_1 LTV^*_{it} + \alpha_2 LOSS^*_{its} + \epsilon_{it} \tag{4.3}$$

where LTV^*_{it} is a measure of the equity position of the households living in house i at time t, $LOSS^*_{its}$ is prospective loss at time t compared to the moment the house was purchased, i.e. time s, and ϵ_{it} is a random error term.

Combining equations (4.1), (4.2), and (4.3) gives us the actual selling price as a function of observable and unobservable characteristics, time effects, equity position, and prospective losses:

$$p_{it} = X_i\beta + \delta_t + v_i + \alpha_1 LTV^*_{it} + \alpha_2 LOSS^*_{its} + \epsilon_{it} \tag{4.4}$$

The household's equity position is, by definition, a function of the value of the house. Given the characteristics of the Dutch mortgage market we expect only negative equity to have an effect on house prices. The household's true equity position, LTV^*_{it}, can thus be modeled as a spline function.

$$\begin{aligned} LTV^*_{it} &= \left(\frac{l_{it}}{exp(q_{it})} - 1\right)^+ \\ &= \left(\frac{l_{it}}{exp(X_i\beta + \delta_t + v_i)} - 1\right)^+ \end{aligned} \tag{4.5}$$

where l_{it} is the nominal loan amount and $exp(q_{it})$ is the nominal house value.[6] LTV^*_{it} is defined as the maximum of $(l_{it}/exp(q_{it}) - 1)$ and zero. Therefore, LTV^*_{it} is zero for positive equity households and $(l_{it}/exp(q_{it}) - 1)$ for negative equity households.

The true loss term is given by

$$\begin{aligned} LOSS^*_{its} &= (p_{is} - q_{it})^+ \\ &= ((\delta_s - \delta_t) + w_{is})^+ \end{aligned} \tag{4.6}$$

[6]We are well aware that the exponentiated expected value of the log is an underestimation of the actual expected house value in nominal terms. The proposed adjustment to prevent a bias in the nominal value is $\frac{1}{2}\sigma^2$, where σ is the standard deviation of the random error term (see Coulson, s.a.; Van Dalen and Bode, 2004). Not including the adjustment term here is a result of excluding an additional random error term in equation (4.2). The inclusion or exclusion is not relevant for the argument that we are making here; we will look into the adjustment term in more detail in sections 4.3 and 4.4.

where $(p_{is} - q_{it})^+$ is the maximum of zero and the original log purchase price minus the log house value. After all, there is no prospective loss if the house value is higher than the purchase price. Equation (4.6) shows that $LOSS^*_{its}$ consists of the change in the market index between time s and time t and the overpayment or underpayment at the time of purchase, w_{is}. $LOSS^*_{its}$ measures the prospective loss expressed as a percentage of the purchase price.

Substituting equations (4.5) and (4.6) in equation (4.4) results in

$$\begin{aligned} p_{it} = X_i\beta + \delta_t + v_i + \alpha_1 \left(\frac{l_{it}}{exp(X_i\beta + \delta_t + v_i)} - 1 \right)^+ \\ + \alpha_2((\delta_s - \delta_t) + w_{is})^+ + \epsilon_{it} \end{aligned} \tag{4.7}$$

The above equation cannot be estimated as v_i and w_{is} are unobserved and enter the model nonlinearly. Section 4.4 discusses what feasible alternatives we can estimate. In doing so we will point out important differences with the approaches used by Anenberg (2011) and Genesove and Mayer (2001).

4.3 Data

Our data set contains sales of family homes in the Netherlands between 2006-2011. It combines house transaction records of the Netherlands' Cadastre (Kadaster) and house records of the Dutch Association of Realtors (NVM). These records are matched with the Housing Stock Register of Statistics Netherlands (CBS). Household characteristics of the selling households are also obtained from Statistics Netherlands. Through the Cadastre records all transactions of existing family homes during this period are observed, providing information on the transaction price and the date of sale (conveyance date). Roughly seventy percent of these houses are sold through brokers that are associated with the Dutch Association of Realtors.[7] For these transactions we observe the date the house was put on the market (entry date of the listing), the corresponding list price, the date the sale was closed (exit date of the listing), and an extensive set of house characteristics.[8]

[7]As mentioned already in chapter 2, there is no indication that non-exhaustive market coverage leads to selection effects.

[8]Regrettably no information on the withdrawn properties is available as the NVM provides these data exclusively to partner institutions.

The NVM house characteristics include the address, type of house (five categories), lot size (square meters), floor size (square meters), number of rooms, construction period (ten categories), type of parking lot (six categories), garden orientation (nine categories), insulation (two categories), type of heating (three categories), type of road the house is located on (three categories), and the ground lease status (three categories). We also observe both the interior and the exterior quality measured by a number in the range 1-10, as classified by the broker. The summary statistics of the NVM characteristics can be found in table 4.7 in appendix 4.A.

The financial characteristics of the household are obtained from Statistics Netherlands. The Housing Stock Register provides us with the valuation of the house, the so-called WOZ-value, that is determined by the municipalities. The Integrated Capital Data Set and the Integrated Income Data Set provide us with information on mortgage debt and household income.[9] As the annual mortgage debt is observed directly we do not have to make assumptions in order to calculate it, as do Genesove and Mayer (2001) and Anenberg (2011). Most importantly, mortgage debt is used to create LTV ratios that in turn are used to create a continuous negative equity variable and, alternatively, LTV groups (seven categories).[10]

There is, however, a limitation to the observed mortgage and the corresponding LTV ratio as the outstanding mortgage balance does not take into account the asset side of endowment mortgages. Thus, if a household has an endowment mortgage the mortgage balance and LTV ratio are not perfectly observed. Using Dutch survey data Schilder and Conijn (2012) look into the assets in endowment insurances that we ourselves do not observe. They find that during the period of our study households with negative equity or with an expected residual debt as they call them – that is, the households that we are interested in – have, on average, a capital insurance worth 5,950 euros. As this is particularly small compared to the average house value we will ignore the assets in capital insurances in the LTV ratios that we use.

Table 4.1 shows us the development of transaction prices and house values. The transaction prices are observed values, whereas the house value depends on the definition that is used. The naive hedonic value is the exponent of the expected log(price) of a standard hedonic model that uses the variables

[9] Loan-to-income groups (six categories) are used as an additional regressor to verify the robustness of the results.

[10] LTV ratios above 1.5 have been excluded from the analyses.

Table 4.1: Annual house prices and values (means)

Year	Price	Naive hed.	Adj. hed.	WOZ	WOZ ($y+1$)	Indexed
2006	232,125	230,265	233,482	199,696	213,909	229,675
2007	241,477	238,915	242,252	214,802	229,107	238,590
2008	246,576	243,351	246,750	225,821	233,375	240,557
2009	236,769	233,945	237,212	227,388	230,677	233,735
2010	237,487	234,215	237,486	230,809	230,475	233,443
2011	241,050	236,470	239,773	232,367	.	234,334
Obs.	99,821	99,821	99,821	98,931	88,237	98,569

Note: The naive hedonic price is the exponent of the expected log(price), the adjusted hedonic price additionally includes the adjustment term $0.5\sigma^2$. The WOZ value that is observed in year y has as reference date year $y-1$, consequently the WOZ value in year $y+1$ is used as an alternative house value. The indexed house value is the purchase price adjusted for the regional price development. House values over 500,000 euros have been excluded.

from table 4.7 in appendix 4.A, extended with 72 time dummies (months) and 431 location dummies (municipalities), as the regressors.[11] The adjusted hedonic value corrects for underestimation in the naive hedonic house value by adding an adjustment term, $\frac{1}{2}\sigma^2$, as discussed by Coulson (s.a.) and Van Dalen and Bode (2004). The root mean squared error of the above-mentioned hedonic regression provides us with an estimate of σ. Table 4.1 shows that the adjusted hedonic value is about 1.4 percent higher than the naive hedonic value. Besides, the table shows that the adjusted value is much closer to the observed transaction price.

The WOZ value is an administrative measure of the house value. The local municipality is responsible for the valuation; it takes into account local price developments and comparable properties.[12] Apart from the usual house

[11] Alternatively, location fixed effects at a different aggregation level could have been used to create the summary statistics. For simplicity we have chosen municipality fixed effects. However, due to computational limitations we are limited to COROP fixed effects in our nonlinear regressions.

[12] At the municipal level the WOZ value is used to determine property taxes (OZB). The valuation procedure is legally defined. Besides, property tax rates are allowed to vary between municipalities. This precludes upward pressure on valuations in order to increase local tax revenues.

characteristics the WOZ value takes into account, if necessary, the state of maintenance, quality level, house alterations, and so forth (Council for Real Estate Assessment, 2010). The WOZ reference date is January first of the year before.[13] Hence, one could also argue that the observed WOZ value of the following year should be used as the measure of the house value. Therefore, we include both of these house value measures in our analysis. The indexed house value is obtained by adjusting the purchase price with regional price developments, for details see section 4.4.

As the house value is an important component of the LTV ratio and the prospective loss, differences in house values translate into differences in LTV and prospective loss. Table 4.2 illustrates this: depending on the choice of house value between 19.0 and 33.2 percent of the households have a mortgage that is larger than the value of the house, whereas between 2.8 and 13.3 percent of the households have a paper loss. It should be noted though that in these summary statistics the WOZ values have not yet been adjusted for differences in valuation date and moment of sale. Obviously, we will take that into account in our analysis.

Table 4.2: Descriptives of equity and prospective losses

	Hedonic (adj.)	WOZ	WOZ ($y+1$)	Indexed
Mean house value	239,663	218,346	226,267	235,246
Median LTV	.784	.884	.839	.823
LTV>1.0 (ratio)	.19	.332	.241	.21
Pros. loss (ratio)	.079	.133	.057	.028
Observations	99,821	98,931	88,237	98,569

Note: The adjusted hedonic price includes the adjustment term $0.5\sigma^2$. The WOZ value that is observed in year y has as reference date year $y-1$, consequently the WOZ value in year $y+1$ is used as an alternative house value. The indexed house value is the purchase price adjusted for the regional price development. House values over 500,000 euros have been excluded.

[13] Before 2008 there was a longer period between the reference date of the valuation and its use; that is, the reference date of the 2007 WOZ value is 1/1/2005, while the 2006 WOZ value has reference date 1/1/2003. As the valuations are unique the estimated time effects should correct for price developments in between the valuation and its use.

4.4 Empirical strategy

The main empirical challenge in this chapter is dealing with unobserved house characteristics and the unobserved overpayment or underpayment in the prior transaction. Genesove and Mayer (2001) try to solve this issue by estimating an upper and a lower bound: for the estimation of the upper bound true loss is substituted with a noisy measure of loss, while for the lower bound an additional noisy proxy for unobserved quality is added.

Anenberg (2011) tries to solve the empirical issue by using a subsample of houses that have been sold at least three times. In the first stage, he restricts the sample to houses that sold at least two times when the housing market was hot. Under the assumption that sellers in the hot market were not equity constrained or facing a prospective loss he is able to recover the house fixed effects: "simply the average price for each house minus the average time effect for each house" (p. 72), which importantly includes the unobserved house quality. In the second stage, by substituting the house fixed effect in an equation similar to equation (4.7), he is able to estimate the effects of LTV^*_{it} and $LOSS^*_{its}$.[14]

An obvious concern about Anenberg's approach is that the use of the subsample of houses that are sold at least three times leads to sample selectivity bias. The summary statistics indeed show that the houses in his subsample are significantly smaller, cheaper, and have a smaller loan amount than both the overall sample and the subsample of houses sold twice: the differences range between 6.2 and 9.7 percent. Still, he concludes that "this [sub]sample is comparable in observables to the full sample" (p. 72). Anenberg (2011) also uses the Genesove and Mayer approach, which uses much more observations, to "ensure that the main results are not being driven by sample selection bias" (p. 72). However, this approach leads to insignificant results. While Anenberg (2011, p. 73) does mention the relevant standard errors, he refrains from mentioning that these latter results are highly insignificant.

In our analysis we will look into how different measures for house values, based on different assumptions for unobserved house quality, affect our results. We estimate several feasible models that deal with unobserved house

[14] Anenberg (2011) moves the (direct) house fixed effect, $X_i\beta + v_i$, to the left hand side of the equation. We prefer to leave the house fixed effect on the right hand side as it remains on the right hand side as a component of both LTV^*_{it} and $LOSS^*_{its}$ too. Besides, additional regressions show that our results remain unaltered if we move the house fixed effect or its equivalent to the left hand-side.

characteristics in different ways. The hedonic approach ignores the unobserved house characteristics, while they are incorporated in the administrative house value (WOZ) approach and the indexed purchase price approach. The hedonic model and the WOZ models will be estimated through nonlinear least squares, while the indexed purchase price will be used in a two-stage procedure.

4.4.1 Hedonic approach

For the first feasible model we assume that in the prior transaction no market premium was paid, that is $w_{is} = 0$ in equation (4.7). Given the enormous house price increases up to 2008 this seems like a very reasonable assumption, the more because during the 1990s and early 2000s mortgage requirements were very relaxed in the Netherlands. Besides, we also assume that there are no unobserved house characteristics affecting the transaction price, that is $v_i = 0$ in equation (4.7). We justify the latter assumption with the extensive set of house attributes that we have at our disposal (see section 4.3).[15] If these two assumptions are met the following model point identifies the effects of loss aversion and negative equity.

$$\begin{aligned} p_{it} = X_i\beta + \delta_t + \alpha_1 \left(\frac{l_{it}}{exp(X_i\beta + \delta_t + \frac{1}{2}\sigma^2)} - 1 \right)^+ \\ + \alpha_2(p_{is} - (X_i\beta + \delta_t))^+ + \epsilon_{it} \end{aligned} \tag{4.8}$$

where X_i, the house characteristics, include the location of the house.[16] The adjustment term $\frac{1}{2}\sigma^2$ corrects for the underestimation of the nominal house value due to the difference between the exponentiated log house value and the actual nominal house value.[17]

However, if the assumptions are not met the estimates of equation (4.8) will be biased. Genesove and Mayer (2001) plead that estimating the above

[15]In comparison: Anenberg (2011) has only information on square footage, lot size, year built, and location; Genesove and Mayer (2001) use only square footage, number of bedrooms, number of bathrooms, and location.

[16]Location is included through COROP fixed effects (for details see subsection 4.4.3). Due to computational limitations the use of a lower aggregation level is not feasible.

[17]We obtain an estimate of σ from the simple hedonic regression ignoring loss aversion and negative equity effects, equivalent to the first iteration of the nonlinear approach. Even though there are significant differences in house values with and without the adjustment term the estimation results are virtually unaffected.

equation overestimates the effect of loss aversion. As the argument of the direction of the bias is not straightforward – Genesove and Mayer note that biases run in both directions – they use a simulation to demonstrate that estimating equation (4.8) overestimates the true effect of loss aversion. This implies that the effect of negative equity would also be overestimated if the above assumptions are violated.

We will estimate the above model through nonlinear least squares. Note that both the equity position and the prospective losses depend on the house value. This coincides with the model specification of Anenberg (2011), who also identifies the effects of equity position and loss aversion through a nonlinear model specification. Genesove and Mayer (2001), on the other hand, have chosen a semi-nonlinear estimation procedure: loss aversion effects do influence the parameters β and δ_t, while equity position is taken to be exogenous.

4.4.2 Administrative valuation

The use of an administrative valuation at the individual level, the WOZ-value, is an alternative to the hedonic approach. The main advantage is that the WOZ-value is an administrative measure and can therefore be used as an exogenous house value that includes unobserved house characteristics.[18] It is important to note, once again, that the reference date of the valuation precedes the transaction date. If, once again, we assume that no market premium was paid in the original transaction at time s, equation (4.7) reduces to:

$$\begin{aligned} p_{it} = woz_{iy}\beta + \delta_t + \alpha_1 \left(\frac{l_{it}}{WOZ_{iy} * exp(\delta_t)} - 1 \right)^+ \\ + \alpha_2 (p_{is} - (woz_{iy} + \delta_t))^+ + \epsilon_{it} \end{aligned} \quad (4.9)$$

where WOZ_{iy} is the nominal WOZ value in year y, and woz_{iy} is its log.

Note that in the denominator of LTV_{it} in equation (4.9) the WOZ value is used in nominal terms, contrary to $LOSS_{its}$ where its log is used. The time effects of this specification capture developments in house values after the house has been valued. The WOZ value that is observed in a particular year

[18]Note that in this particular case the house quality unobserved by the researcher does not necessarily have to be constant over time as WOZ values can include changes in characteristics.

has as reference date January first of the year before. Thus, alternatively, we can also use the WOZ value in the year after as the house value. The cost of this approach is a reduced number of observations. Recognizing that the δ_t enter the model nonlinearly, the model has to be estimated through nonlinear least squares.

4.4.3 Indexed purchase price

Adjusting the purchase price for regional price developments is an alternative approach that takes into account the unobserved house quality v_i. Even though v_i is not observed by the researcher it is incorporated in the original purchase price. Under the assumption that no market premium was paid in the original transaction, the assumption that we have made before, the indexed purchase price gives us the value of the house. We thus define the value of the house as:

$$q_{it} = p_{is} + (\widehat{\delta_t} - \widehat{\delta_s}) \tag{4.10}$$

where $\widehat{\delta_t}$ and $\widehat{\delta_s}$ are retrieved from the estimation of a regional price index.

We estimate regional repeat sales price indices to retrieve the monthly price developments. The starting point is a hedonic pricing model where repeated sales of the same house are paired together. As we have assumed observed (X_i) and unobserved (v_i) house characteristics to be constant, subtracting the first sale from the second sale eliminates house characteristics from the equation altogether (see the previous chapter for details). We estimate repeat sales price indices for forty separate regions, the so-called COROPs.[19] In the estimation of the price indices we ignore loss aversion and equity constraints; even though market premiums will be paid in individual transactions, the overall effects on the price indices will be small.

The use of house values based on indexed purchase prices leads to the

[19]A COROP is a region in size between municipalities and provinces used for administrative purposes. It joins together regional labor markets based on commuting flows. Consequently, most COROPs exist of a larger city and a periphery. Estimating repeat sales price indices at a lower level of aggregation is not feasible as the repeat sales samples become too small.

following model:

$$p_{it} = (p_{is} + (\widehat{\delta}_t^c - \widehat{\delta}_s^c))\beta + \alpha_1 \left(\frac{l_{it}}{P_{is} * exp(\widehat{\delta}_t^c - \widehat{\delta}_s^c)} - 1 \right)^+ + \alpha_2 (\widehat{\delta}_s^c - \widehat{\delta}_t^c)^+ + \epsilon_{it} \tag{4.11}$$

where $\widehat{\delta}^c$ is the estimated regional time effect from the repeat sales price indices, that is the monthly time effect at the level of the COROP, and the capital P_{is} is the nominal purchase price.

As all time effects are identified in the repeat sales regressions, there is no need to estimate this model nonlinearly. However, as it is a two-stage procedure the standard errors should be adjusted accordingly. We, therefore, use bootstrapped standard errors in the second stage. For robustness purposes we will not only estimate the three feasible models as described above, we will additionally estimate the models where the LTV ratio is used to create seven LTV groups. These specifications allow for differences between positive equity households.

4.5 Estimates

4.5.1 Nonlinear estimation

The first column of table 4.3 shows the results for the hedonic approach, the estimation of equation (4.8).[20] The coefficient for negative equity is equal to 0.324, indicating that an increase in LTV ratio from 1.00 to 1.01 increases the expected transaction price with 0.324 percent, ceteris paribus.[21] The coefficient for prospective losses is 1.062, indicating that if the prospective loss increases with 1 percent the expected house price increases with 1.062

[20] Adding loan-to-income groups to the regressions has no effect on any of our conclusions.

[21] The interpretation of the coefficient is the standard approximation that is used in log-linear models. The true percentage change is given by $\%\Delta y = 100 * (exp(b_x \Delta x) - 1)$ where b_x is the estimated coefficient. Assuming a unit change of 1 in the x variable, the approximation is inaccurate for coefficients above 0.1. Due to the small increase in LTV that we use, in order to make the increase realistic, the approximation still holds: $100 * (exp(0.324 * 0.01) - 1) = 0.3245$.

percent.[22] These results imply that households that are underwater are only partially compensated for having negative equity, whereas facing a prospective loss is compensated more than full by the buyers of the house. These estimates should, however, be interpreted cautiously as Genesove and Mayer (2001) have argued that ignoring the unobserved quality of the house leads to an overestimation of the effects of equity constraints and loss aversion (see section 4.4).[23]

Table 4.3: Nonlinear transaction price regressions (continuous negative equity)

	(1) Hedonic (adj.)		(2) WOZ		(3) WOZ $(y+1)$	
Neg. equity	0.324***	(0.005)	0.182***	(0.004)	0.137***	(0.004)
Pros. loss	1.062***	(0.009)	0.470***	(0.013)	0.309***	(0.013)
House char.	Yes		No		No	
COROPs	Yes		No		No	
Months	Yes		Yes		Yes	
Log(WOZ)			0.989***	(0.001)	0.993***	(0.001)
Constant	10.420***	(0.057)	0.301***	(0.014)	0.160***	(0.011)
Observations	99,821		98,931		88,237	

Notes: Dependent variable is log (transaction price). Standard errors in parentheses. Initial values are based on noniterative regressions.[24] R-squared is not reported as it is an improper measure in nonlinear least squares. * $p<0.05$, ** $p<0.01$, *** $p<0.001$.

[22]Note that the coefficients of negative equity and loss aversion are not entirely comparible because the latter is in relative terms whereas the former is not. Thus, linear increases in LTV ratio do not correspond to linearly decreases in house value. Keeping the loan amount fixed, an increase in LTV ratio from 1.0 to 1.1, from 1.1 to 1.2, and 1.2 to 1.3 corresponds to a decrease in house value of respectively 9.1, 8.3, and 7.7 percent.

[23]Adding alternative household characteristics – such as composition of the household, marital status, gender, age, and labor market status – to proxy for unobserved house characteristics leads to a negligible reduction in the coefficients of negative equity and prospective loss.

[24]The initial values for the house characteristics are based on estimates from the one-stage hedonic model (ignoring equity constraints and loss aversion). In the hedonic approach the starting values for negative equity and prospective loss are based on a noniterative regression of house prices on the first stage (expected) house values, time effects, location effects, negative equity, and prospective losses. In the WOZ approach the initial values for negative equity and prospective loss have been determined by replacing the

The second column of table 4.3 shows the results of the estimation of equation (4.9). The results indicate that taking into account the unobserved quality of the house indeed decreases the coefficients for negative equity and prospective losses. The negative equity coefficient in the WOZ approach is 0.182, showing that an increase in LTV ratio from 1.00 to 1.01 leads to an increase in transaction price of 0.182 percent, ceteris paribus. The prospective loss coefficient shows that a 1 percent increase in prospective loss leads to a 0.470 percent higher house price, all else equal. These coefficients indicate that the prospective loss effect is more than twice as large as the effect of negative equity: prospective losses are mitigated for almost half, whereas negative equity is mitigated for less than a fifth.

Adjusting the reference date of the WOZ value, as is done for the estimation in column 3, also suggests that the negative equity effect is less than half the prospective loss effect. An increase in LTV ratio of 1.00 to 1.01 leads to an increase in expected transaction price of 0.137 percent, whereas a 1 percent increase in prospective loss leads to a 0.309 percent increase in expected transaction price. The differences in coefficients between columns 2 and 3 are explained by the time effects, which do not allow for different developments between regions.[25]

Table 4.4 shows the results of the regressions where seven LTV groups have been used instead of a continuous negative equity variable. The results show that compared to the reference category (LTV between 0.8 and 1.0) both the moderately underwater households (LTV between 1.0 and 1.2) and the heavily underwater households (LTV over 1.2) receive significant market premiums. The hedonic approach (column 1) leads to the largest coefficients for negative equity, suggesting – as we have argued before – that these estimates are overestimates. Columns 2 and 3, the specifications that include the unobserved house characteristics, show that moderately underwater households receive market premiums between 2.3 and 2.4 percent, whereas heavily underwater households receive premiums between 3.6 and 6.5 percent compared to the reference category.[26] Interestingly enough, the results show clear

(expected) hedonic house value with the WOZ value. Nevertheless, it turns out that the results are virtually independent of the starting values that are used.

[25]By dropping the 2011 observations from the estimation of equation (4.9) we have excluded the possibility that sample differences are driving the differences in estimates of negative equity and prospective losses.

[26]Note that these results have similar magnitudes as presented before; the coefficients shown here correspond to an increase that is 20 times larger than those presented before

differences between the positive equity households as well. Columns 2 and 3 show that sellers with low LTV ratios receive less for their house, although the magnitude of these effects is much smaller than those of the negative equity households. The estimated coefficients for prospective loss are very similar to the previously discussed results.

Table 4.4: Nonlinear transaction price regressions (LTV groups)

	(1) Hedonic (adj.)		(2) WOZ		(3) WOZ ($y+1$)	
LTV≤0.2	0.002	(0.002)	-0.024***	(0.002)	-0.019***	(0.001)
0.2<LTV≤0.4	-0.017***	(0.002)	-0.016***	(0.002)	-0.012***	(0.001)
0.4<LTV≤0.6	-0.021***	(0.002)	-0.012***	(0.001)	-0.009***	(0.001)
0.6<LTV≤0.8	-0.014***	(0.001)	-0.005***	(0.001)	-0.006***	(0.001)
0.8<LTV≤1.0						
1.0<LTV≤1.2	0.092***	(0.001)	0.024***	(0.001)	0.023***	(0.001)
LTV>1.2	0.098***	(0.002)	0.065***	(0.001)	0.036***	(0.001)
Pros. loss	1.049***	(0.009)	0.500***	(0.014)	0.324***	(0.013)
House char.	Yes		No		No	
COROPs	Yes		No		No	
Months	Yes		Yes		Yes	
Log(WOZ)			0.992***	(0.001)	0.997***	(0.001)
Constant	10.515***	(0.047)	0.224***	(0.014)	0.081***	(0.012)
Observations	99,821		98,931		88,237	

Notes: Dependent variable is log (transaction price). Standard errors in parentheses. Initial values are based on noniterative regressions. R-squared is not reported as it is an improper measure in nonlinear least squares. * $p<0.05$, ** $p<0.01$, *** $p<0.001$.

4.5.2 Two-stage estimation

Table 4.5 shows the results of the two-stage procedure. Column 1 shows that an increase in LTV ratio from 1.00 to 1.01 leads to a 0.297 percent increase in transaction price, ceteris paribus. It also shows that a 1 percent increase in prospective loss leads to a 0.655 percent increase in transaction price, ceteris paribus. These results, once again, indicate that the compensation for prospective losses is about twice the size of that of negative equity. The results in column 2 indicate that moderately underwater households receive a market premium of about 4.1 percent, while heavily underwater households

(increase in LTV from 1.00 to 1.01).

receive a market premium of about 7.8 percent. Column 2 also shows differences between positive equity households even though transaction prices are not strictly increasing in LTV. Households with an LTV between 0.2 and 0.4 receive the lowest price; they receive 3.4 percent less than the reference category. The estimated effect of prospective loss is virtually the same in column 2: a 1 percent increase in prospective loss leads to a 0.675 percent increase in transaction price, all else equal.

Table 4.5: Linear transaction price regressions (indexed house value)

	(1) Indexed price		(2) Indexed price	
Neg. equity	0.297***	(0.009)		
Pros. loss	0.655***	(0.094)	0.675***	(0.094)
LTV≤0.2			-0.018***	(0.003)
0.2<LTV≤0.4			-0.034***	(0.002)
0.4<LTV≤0.6			-0.030***	(0.001)
0.6<LTV≤0.8			-0.013***	(0.001)
0.8<LTV≤1.0				
1.0<LTV≤1.2			0.041***	(0.001)
LTV>1.2			0.078***	(0.003)
Log(indexed price)	0.792***	(0.004)	0.805***	(0.004)
Constant	2.619***	(0.039)	2.462***	(0.041)
Munic.	Yes		Yes	
Months	Yes		Yes	
Obs.	98,569		98,569	
Adj. R-sq	0.795		0.797	

Notes: Bootstrapped standard errors in parentheses. * $p<0.05$, ** $p<0.01$, *** $p<0.001$.

4.5.3 List prices

As theory suggests that higher transaction prices can be obtained through setting higher list prices we use list price regressions as a robustness check. As we prefer the administrative valuation to determine the house value we estimate a variation on equation (4.9). That is, we use the log list price as the dependent variable and replace the month of sale dummies with month of entry dummies. As before we estimate the equation through nonlinear least squares. The results are shown in table 4.6.[27]

Column 1 of table 4.6 shows the results of the nonlinear list price regression where the WOZ value is used as the basis of the house value.[28] The coefficients for negative equity and prospective losses are very similar to those of the transaction price regression although the coefficients are marginally larger: the negative equity and prospective loss coefficients have become 0.202 and 0.496 respectively, compared to 0.182 and 0.470 before.[29] Column 2, where the WOZ value of the year after is used, also shows little differences between the list price and the transaction price regressions.

Columns 3 and 4 show the estimates of the list price regressions when the continuous negative equity variable has been replaced with LTV categories. The results show that the estimates for the prospective loss effect and the market premiums for households with negative equity remain very similar. Most notable in column 3, where the WOZ value is used, is that the coefficients for the positive equity households have become smaller and less significant. In column 4, where the WOZ value of the year after is used, this is even clearer: there is no positive equity LTV group that differs significantly from the reference category, households with an LTV between 0.8 and 1.0. It seems, therefore, that the main difference between the list price and the transaction price regressions is that the differences within the positive equity categories tend to disappear. It suggests that differences in transaction outcomes between positive equity households cannot be explained through different listing strategies.

Our results differ from those of Genesove and Mayer (2001) as they find that prospective losses have a much larger effect on list prices than on transaction prices. However, this difference is easily explained: our data include only list prices of houses that actually sold, while they use list prices of houses that were either sold or withdrawn from the market. Therefore, our list price sample is likely to exclude the households most sensitive to prospective losses and negative equity. In line with this, Genesove and Mayer (2001) provide evidence that households with prospective losses that withdrew their prop-

[27]Linear regression results, using the indexed house price as house value, are presented in table 4.8 in appendix 4.A.

[28]The number of observations in the list price regressions is smaller than in the transaction price regressions because properties that entered the market before January 2006 have been excluded.

[29]Besides, the coefficient of log(WOZ) is increased marginally. This holds for all the list price regressions.

Table 4.6: Nonlinear list price regressions

	(1) WOZ		(2) WOZ $(y+1)$		(3) WOZ		(4) WOZ $(y+1)$	
Neg. equity	0.202***	(0.004)	0.162***	(0.004)				
Pros. loss	0.496***	(0.017)	0.284***	(0.017)	0.519***	(0.017)	0.291***	(0.017)
LTV≤0.2					-0.005**	(0.002)	0.001	(0.001)
0.2<LTV≤0.4					-0.006**	(0.002)	-0.003	(0.002)
0.4<LTV≤0.6					-0.004**	(0.001)	-0.001	(0.001)
0.6<LTV≤0.8					0.000	(0.001)	-0.001	(0.001)
0.8<LTV≤1.0								
1.0<LTV≤1.2					0.020***	(0.001)	0.021***	(0.001)
LTV>1.2					0.068***	(0.001)	0.054***	(0.002)
House char.	No		No		No		No	
COROPs	No		No		No		No	
Months (entry)	Yes		Yes		Yes		Yes	
Log(WOZ)	0.995***	(0.001)	0.995***	(0.001)	0.997***	(0.001)	0.997***	(0.001)
Constant	0.248***	(0.014)	0.180***	(0.013)	0.221***	(0.014)	0.151***	(0.013)
Observations	93,647		82,949		93,647		82,949	

Notes: Dependent variable is log (list price). Standard errors in parentheses. R-squared is not reported as it is an improper measure in nonlinear least squares. * $p<0.05$, ** $p<0.01$, *** $p<0.001$.

erty had set higher list prices than households with prospective losses that sold their house, ceteris paribus. Most importantly, the results of our list price regressions corroborate the results of our transaction price regressions: prospective losses have a much larger effect on prices than negative equity.

4.6 Conclusions

Using a unique micro data set this chapter has investigated the effects of loss aversion and equity constraints on house prices in a market without down-payment constraints or strategic defaults. The study has presented new evidence that loss aversion and equity constraints do lead to market premiums. The results show that the effects of loss aversion are about twice the size of the effects of equity constraints. That is, the 'pain' of households facing a prospective loss is mitigated to a much larger extent than that of households that are underwater. While the point estimates do differ somewhat between specifications, the magnitude of the prospective loss effect is about twice the size of the negative equity effect in all the specifications.

The results of the nonlinear regressions show that an increase in LTV ratio from 1.00 to 1.01 leads to a 0.14-0.18 percent higher transaction price, all else equal. Besides, the results show that a 1 percent increase in prospective loss leads to a 0.3-0.5 percent higher price, ceteris paribus. These results coincide with those of Anenberg (2011) who finds that an increase in LTV ratio from 1.00 to 1.01 leads to a 0.163 percent higher transaction price and a 1 percent increase in prospective loss leads to a 0.355 percent higher price, ceteris paribus.[30] The effects that we find are larger than those found by Genesove and Mayer (2001) even though we do corroborate their conclusion that loss aversion is more important in explaining seller behavior than equity constraints.

The similarities of our results and the results found by Anenberg (2011) and Genesove and Mayer (2001) are remarkable if one takes into account the institutional differences between the Netherlands and the United States. In the Dutch institutional setting low, positive equity households do not encounter equity constraints as borrowing the full purchase price is common practice.[31] As a matter of fact, borrowing more than the house value seems

[30] Anenberg (2011) prefers saying that an increase in LTV ratio from 0.8 to 1.0 (or equivalently from 80 to 100) leads to a 3.3 percent higher price.

[31] Consequently, a difference between our study and those of Anenberg (2011) and

to have met few institutional constraints either. While the importance of loss aversion relative to equity constraints was to be expected in the Dutch institutional setting, the similarities in results between both institutional settings were not anticipated.

Although mortgages that are not fully secured by assets are likely to encounter some institutional constraints in the Netherlands, the equity constraints were expected to be smaller than in the US. Purely financial constraints are thus not likely to explain the entire negative equity effect that we find. Our results thereby indicate that equity constraints are not the sole explanation of market premiums for households with low or negative equity. We expect, therefore, that being underwater does not function as a purely financial constraint but as a psychological constraint as well. We suspect that the value of the mortgage creates a reference point as does the nominal purchase price.

Genesove and Mayer (2001) is that we have limited equity constraints to negative equity households; their main focus is on LTV ratios larger than 0.8, we focus on LTV ratios larger than 1.0.

4.A Appendix

Table 4.7: Descriptives of house characteristics

	Mean	Std. dev.
Lot size (m^2)	228.3	(309.8)
Floor size (m^2)	122.0	(27.4)
Number of rooms	4.7	(1.1)
Interior quality (range 1–10)	7.2	(0.8)
Exterior quality (range 1–10)	7.1	(0.7)
Row house	0.510	(0.500)
Terraced house	0.026	(0.160)
Corner house	0.185	(0.388)
Semi-detached	0.193	(0.395)
Detached	0.086	(0.280)
Build before 1500 or unknown	0.000	(0.012)
Build 1500-1905	0.042	(0.201)
Build 1906-1930	0.115	(0.319)
Build 1931-1944	0.081	(0.273)
Build 1945-1959	0.058	(0.234)
Build 1960-1970	0.119	(0.324)
Build 1971-1980	0.200	(0.400)
Build 1981-1990	0.201	(0.400)
Build 1991-2000	0.166	(0.372)
Build $>$ 2001	0.018	(0.133)
Parking lot	0.052	(0.222)
Carport	0.039	(0.195)
Garage	0.232	(0.422)
Garage & carport	0.020	(0.138)
Garage (multi.)	0.021	(0.145)
No parking lot	0.636	(0.481)
Garden north	0.079	(0.270)
Garden north-east	0.077	(0.266)
Garden east	0.110	(0.312)
Garden south-east	0.112	(0.315)
Garden south	0.166	(0.372)
Garden south-west	0.133	(0.340)
Garden west	0.126	(0.331)
Garden north-west	0.079	(0.269)
No garden	0.118	(0.322)
Insulation	0.896	(0.305)
Gas or coal	0.012	(0.110)
Central heating	0.962	(0.191)
No heating	0.025	(0.158)
Quiet road	0.520	(0.500)
Busy road	0.022	(0.145)
Unknown road	0.459	(0.498)
No ground lease	0.912	(0.283)
Ground lease	0.020	(0.140)
Unknown ground lease	0.068	(0.251)
Observations	99,821	

Note: Ratios are given unless it is mentioned differently.

Table 4.8: Linear list price regressions (indexed house value)

	(1) Indexed price		(2) Indexed price	
Neg. equity	0.323***	(0.018)		
Pros. loss	0.437*	(0.209)	0.460*	(0.204)
LTV≤0.2			-0.009	(0.006)
0.2<LTV≤0.4			-0.030***	(0.005)
0.4<LTV≤0.6			-0.026***	(0.004)
0.6<LTV≤0.8			-0.012***	(0.003)
0.8<LTV≤1.0				
1.0<LTV≤1.2			0.044***	(0.002)
LTV>1.2			0.089***	(0.006)
Log(indexed price)	0.804***	(0.006)	0.817***	(0.006)
Constant	2.509***	(0.073)	2.365***	(0.078)
Munic.	Yes		Yes	
Months	Yes		Yes	
Obs.	98,529		98,529	
Adj. R-sq	0.475		0.476	

Notes: Bootstrapped standard errors in parentheses. * p<0.05, ** p<0.01, *** p<0.001.

Chapter 5

Conclusion

In this dissertation we have studied the role of financial household characteristics in the determination of house prices and household mobility in the Dutch owner-occupied housing market. We have investigated how various financial characteristics – in particular income, wealth, housing equity, and prospective losses – influence the behavior of households in the housing market. The study focused on three research questions: (i) What is the effect of the relative financial positions of sellers and buyers on house prices? (ii) How do negative equity and loss aversion affect household mobility? (iii) What is the effect of negative equity and loss aversion on house prices?

Thus far limited availability of reliable data made it difficult to answer these questions accurately; after all, both extensive house and household characteristics are essential to do so. Through the use of unique administrative data of Statistics Netherlands (CBS), covering the period 2006-2011, extended with data from the Dutch Association of Realtors (NVM) we have been able to answer these questions. We present evidence that financial household characteristics play an important role in explaining household behavior in the owner-occupied housing market; that is, financial household characteristics influence both house prices and household mobility.

In section 5.1 we present the main findings of the dissertation. Section 5.2 discusses the extent to which the findings of the individual chapters are consistent with each other. Section 5.3 elaborates on the contribution to the literature. Section 5.4 discusses the limitations of the study and suggests directions for future research. Finally, section 5.5 considers the policy implications.

5.1 Summary of the findings

5.1.1 Financial position and house prices

Chapter 2 studies the effect of the relative financial position of buyers and sellers on house prices, distinguishing between income and wealth effects. The results demonstrate that a seller with a relatively good financial position compared to the buyer receives less for a given house, while a buyer with a relatively good financial position compared to the seller pays more. All else equal, both relative income and relative wealth influence house prices. Given the assumption that identical buyers and sellers have similar housing preferences and similar bargaining power (the symmetry assumptions of chapter 2), the results show that for sellers house prices decrease with higher income, while for buyers house prices increase with higher income. The results for wealth show a slightly different relationship as the effect subsides for the highest buyer and seller wealth categories.

The empirical findings are robust to various specifications. First, the results are robust to different market conditions. The data are used to estimate separate models for the years between 2006 and 2010.[1] As the findings hold for all years, we are able to show that the results are not driven by processes that are related to market circumstances. Second, the results hold for both total wealth and wealth excluding housing (that is, excluding net housing equity). The latter wealth variable takes into account potential endogeneity of housing wealth and limitations of the administrative wealth data due to unobserved asset sides of endowment mortgages. Third, the findings are robust to the inclusion of sellers' loan-to-value (LTV) ratios. With the inclusion of sellers' LTVs we take into account studies on equity constraints that suggest that sellers' LTVs affect house prices (e.g. Genesove and Mayer, 2001).

Chapter 2 provides clear evidence that income and wealth influence housing market behavior of buyers and sellers. The results are consistent with theories that suggest that higher income and wealth lead to higher search and bargaining costs, implying that households with better financial positions invest less time and effort in search and bargaining, leading to worse bargaining outcomes (Harding et al., 2003). Note, however, that empirically it was not possible to distinguish the bargaining mechanism from the search

[1] It is only due to practical reasons that 2011 is not included in the analysis in chapter 2; that is, the data for 2011 was not available yet at the time the chapter was written.

mechanism.

5.1.2 Equity constraints, loss aversion, and household mobility

Chapter 3 examines the effects of negative equity and loss aversion on household mobility. The chapter stresses the importance of studying these mechanisms simultaneously. Decreasing prices can make households unable to move due to financial constraints or unwilling to move if they are averse to selling their house for less than the original purchase price. Prior studies have almost exclusively focused on equity constraints without recognizing loss aversion. However, studying equity constraints separately from loss aversion leads to biased results. Engelhardt (2003) is the only study on household mobility that has actually distinguished the financial from the psychological constraint.

We use prospective losses, which occur when the house value drops below the original purchase price, to identify loss aversion and LTV ratios larger than one for the identification of equity constraints. The results show that prospective losses decrease household mobility by more than 50 percent, all else equal. Moderately underwater households (LTV between 1.0 and 1.2) have a mobility that is about 15 percent lower than households with an LTV between 0.8 and 1.0. Still, it has to be noted that the mobility of this group remains higher than that of the households with LTV ratios smaller than 0.2. Heavily underwater households (LTV larger than 1.2) have a mobility that is more than twice that of households with an LTV between 0.8 and 1.0, making heavily underwater households the home-owners with the highest mobility of all LTV groups. Additional results show that non-housing wealth increases household mobility for both moderately and heavily underwater households.

The results in chapter 3 indicate the existence of loss aversion as prospective losses decrease mobility substantially, thereby confirming the findings of Engelhardt (2003). In contrast, Engelhardt (2003) finds no evidence that price decreases lead to equity constraints, while the findings in this chapter present some evidence for negative equity effects. We observe negative equity effects for moderately underwater households even though these households remain more mobile than households with very low LTV ratios. Still, moderately underwater households with additional (non-housing) debt have particularly low mobility rates. Heavily underwater households, on the contrary, have exceptionally high mobility rates. Our findings are similar to the findings of Schulhofer-Wohl (2012) and Coulson and Grieco (2013) as they also find increases in household mobility as negative equity increases.[2] Our findings contradict those of Chan (2001) and Ferreira et al. (2010, 2012) who find unambiguous negative effects of equity constraints.

We have extended the analysis of financial constraints by including non-housing wealth; that is, we have also studied negative housing equity in relation to additional sources of wealth. After all, common sense suggests that households are not financially constrained if negative housing equity is offset by non-housing wealth (such as household savings). As expected, households with both negative equity and additional debt are less mobile than households with negative equity and positive non-housing wealth. The result that household mobility of negative equity households increases with additional wealth is an indication that household mobility for negative equity households is voluntary; there is no evidence that household mobility increases due to forced sales or defaults.

5.1.3 Equity constraints, loss aversion, and prices

Chapter 4 investigates the effects of negative equity and loss aversion on house prices. Theory suggests that households with negative equity or prospective losses could be able or willing to sell if they receive a market premium, that is, a price that is higher than the market value of the house. The regression results show that an increase in LTV ratio from 1.00 to 1.01 increases the transaction price with 0.14-0.18 percent, ceteris paribus. The results also show that a 1 percent increase in prospective loss increases the house price with 0.3-0.5 percent, all else equal. It shows that in terms of their effects loss aversion is more important than equity constraints.

The effects of loss aversion and equity constraints that we find in chapter 4 are larger than those found by Genesove and Mayer (2001). Still, we endorse the conclusion that the effect of loss aversion is larger than that of equity constraints. Furthermore, our findings are almost identical to those of Anenberg (2011). The similarities in findings are remarkable given the institutional differences between the Netherlands and the United States; in the Netherlands households can borrow the full purchase price (during the

[2]Note that these studies have not incorporated loss aversion. Thus, while the conclusions are similar, it is hard to compare the findings.

period of investigation households could even borrow more than that) and mortgages are recourse loans. In other words, down-payment constraints and strategic defaults do not exist. Households with negative equity that default on their mortgage are left with a residual debt. Thus, even though theory – given the institutional differences – suggests that in general equity constraints should be smaller in the Netherlands, we find no evidence of this.

The similarities between our results and those of Anenberg (2011) and Genesove and Mayer (2001) suggest that financial constraints might not be the sole explanation of negative equity effects. We suspect that the value of the mortgage creates a reference point, as does the nominal purchase price, and functions as a psychological constraint as well.

5.2 Discussion of the findings

In this dissertation the different mechanisms that relate financial characteristics to household behavior have been studied more or less in isolation. We relied on assumptions that made sense in the particular settings, while we have not applied an all-encompassing approach. Consequently, the extent to which the mechanisms are consistent with each other has not been discussed extensively yet. This is particularly important for the mechanisms studied in the chapters on house prices, chapters 2 and 4. The former studies bargaining effects of financial position (absolute income and wealth) on prices, while the latter studies the effect of financial constraints on prices. A consequence of the strict division between mechanisms is, for instance, that chapter 2 focuses on buyers and sellers, while chapter 4 focuses exclusively on sellers. A thorough discussion of the mechanisms in relation to each other is therefore still necessary.

In chapter 2 the effect of the financial position in terms of levels of income and wealth is studied. The effects of absolute income and wealth are thus studied separately from loss aversion and equity constraints even though income, wealth, and financial constraints are related. Still, constraints are included indirectly in chapter 2. The fact that the findings hold for all individual years is an important indication that sellers' constraints do not have a major impact on our estimates. Constraints are correlated to market circumstances as these are affected by house price decreases, whereas income and wealth effects are found in both boom and bust years. The inclusion of sellers' LTV ratios in the robustness checks (introducing asymmetry between buyers and sellers) is further evidence that the income and wealth effects of buyers and sellers remain if financial constraints are taken into account. Apart from that, the results in chapter 2 indicate that overall negative equity households sell their houses for higher prices than positive equity sellers. This finding is in line with the findings in chapter 4: negative equity households receive market premiums. However, due to unobserved house characteristics the LTV coefficients in chapter 2 cannot be interpreted causally. After all, without the symmetry assumptions the effect of sellers' LTVs can identify both unobserved house characteristics or bargaining effects (see section 2.6.2 for details).

The other way around, loss aversion and equity constraints are studied in chapter 4 without paying attention to income and wealth effects. Ergo, financial constraints are studied without incorporating the financial position in levels of income and wealth. Chapter 4 presents evidence that positive equity sellers receive less for their houses the better their financial positions expressed in terms of LTV ratios, see table 4.4 (p. 86) and table 4.5 (p. 87). In the framework of chapter 4 the heterogeneity within the financially unconstrained households (that is, within the positive equity households) cannot be explained; chapter 2 teaches us that the investment of less time and effort in the bargaining and search process is the likely explanation for this result. Furthermore, the relatively small effects of the positive equity households compared to the negative equity households provide evidence of the importance of loss aversion and equity constraints.

The chapters 3 and 4 focus on the effects of loss aversion and negative equity. Chapter 3 studies the effects on household mobility, while chapter 4 studies the effects on house prices. Contrary to the discussion of the relation between the chapters 2 and 4, the chapters 3 and 4 share the same theoretical framework. In this particular case, therefore, we focus on the consistency of the findings. Theory suggests that loss aversion and negative equity reduce household mobility and increase transaction prices, which is exactly what we observe for households with prospective losses and moderately underwater households (LTVs between 1.0 and 1.2). However, the results in chapter 3 indicate that the heavily underwater households (LTVs larger than 1.2) have the highest mobility of all groups. Given the fact that the heavily underwater households do receive market premiums that are higher than those of the moderately underwater households this finding deserves additional attention.

While chapters 3 and 4 both focus on loss aversion and negative equity different choices have been made empirically. In chapter 3, for instance, prospective losses are measured through the use of regional price indices, while administrative measures are used to create LTV ratios.[3] In chapter 4 a lot of attention is given to the consequences of using different measures of house value. Therefore, in this chapter a single house value measure is used to define both prospective losses and negative equity. That is, house values defined in terms of regional price indices are used to create measures of both prospective losses and LTV ratios. The hedonic house value is used to create alternative measures of prospective losses and LTV ratios. And, equivalently, the administrative house value is used for two more measures of prospective losses and LTV ratios. Given that the conclusions in chapter 4 hold for all measures of the house value, it is unlikely that the difference in operationalization explains the finding that heavily underwater households have both a high mobility and receive market premiums when selling.

Another difference in the operationalization between the chapters is the upper bound of the LTV ratio that is used. In chapter 3 few restrictions have been applied to the LTV ratios as mortgage loans and house values originate from the same tax authorities data set. The maximum LTV that is used is set at 2.0. In chapter 4, however, we have been more restrictive by using 1.5 as the LTV maximum. The reason for this more restrictive approach is that information of the loans and house values have different sources. Based on these results, it could, at least in theory, be the case that the high mobility in chapter 3 is driven by LTVs between 1.5 and 2.0, a group that is not included in the analysis in chapter 4. Nevertheless, additional regression results demonstrate that the high mobility of the highest LTV category remains if we introduce more restrictive bounds for the highest LTV category in chapter 3.[4]

However, the results for heavily underwater households are not necessarily an anomaly as there is an explanation that can account for both findings. It could be the case that relatively many heavily underwater households are trying to sell their house, which would be the case if, for instance, they fear

[3] The advantage of this approach is that it combines the simplicity of using an administrative measure of the LTV with observing nominal losses at the month of sale. Note also that hedonic house values cannot be used as house characteristics are only observed for sold houses.

[4] Excluding LTV ratios above 1.5 from the analysis does reduce the estimate of the mobility rate for the heavily underwater households; however, the heavily underwater households remain, by far, the most mobile LTV category. Furthermore, alternative upper bounds for the highest LTV category do not affect any of our conclusions.

foreclosures, implying that, regardless low individual probabilities of sale, heavily underwater households could still have a high mobility rate as a group and receive market premiums. Nevertheless, without data on properties that are withdrawn from the market we have not been able to formally test this hypothesis.

5.3 Contribution

The dissertation has presented ample evidence of the role of financial characteristics in household behavior in the owner-occupied housing market. To our knowledge, this is the most extensive study of the effects of financial household characteristics on house prices and household mobility. We have shown that the different assumptions that we have made in the chapters are not driving our results. As it turns out, the findings in the individual chapters are consistent with each other; that is, the studied mechanisms are complements rather than substitutes.

From a theoretical point of view, we have made three main contributions to the literature. First, we have incorporated household wealth in the analyses, most importantly absolute household wealth (including net housing equity) and absolute non-housing wealth (e.g. savings). Prior studies focusing on bargaining effects did not have access to wealth data. These studies were, therefore, not able to study wealth effects more thoroughly than based upon its correlation with household income (see Harding et al., 2003). By including income and wealth, both in absolute terms, it was possible to empirically differentiate income and wealth effects in chapter 2. The fact that both income and wealth influence transaction prices shows that traditional hedonic approaches are unable to fully explain transaction prices. It provides strong evidence that – contrary to what is generally assumed – the housing market is not a perfect asset market. In relation to household mobility we have also included (absolute) non-housing wealth, the argument being that negative housing equity is not necessarily a financial constraint if households have additional sources of wealth. By doing so, we have demonstrated that non-housing wealth increases mobility for households with negative housing equity. This indicates that the impact of defaults and foreclosures on (involuntary) mobility of underwater households is limited, at least in the Netherlands.

Second, we have made an explicit distinction between not wanting to move and not being able to move. We have separated them by distinguishing between loss aversion and equity constraints; the former is a psychological barrier, the latter is a financial constraint. In the literature on financial constraints only three studies have simultaneously studied loss aversion and equity constraints. To be precise, Engelhardt (2003) is the only household mobility study that differentiates between loss aversion and equity constraints, while Anenberg (2011) and Genesove and Mayer (2001) are the only ones that differentiate between them in relation to house price determination. We have presented convincing evidence that particularly loss aversion is important. Thereby, we have demonstrated that studies ignoring the psychological constraints overestimate the importance of the financial constraints.

Third, we have been the first to simultaneously study loss aversion and equity constraints in a different institutional setting; in the Netherlands neither formal down-payment requirements nor strategic defaults do exist. Therefore, the similarities between our results and those of the US-oriented studies do cast some doubt on the extent to which down-payments and negative equity are purely financial constraints. The absence of significant differences between equity constraints in both institutional settings, even though we know that in the Netherlands borrowing more than the value of the house was not uncommon during the period that was analyzed, suggests that the value of the mortgage might also function as a psychological reference point.

Apart from these theoretical contributions there are also empirical contributions worth mentioning. Noteworthy in this regard is, for instance, the analysis of the potential bias due to left-censoring, i.e. unobserved duration starts, in the household mobility chapter. We have compared several methods that allow us to include the often discarded left-censored observations; using the particularities of our data set we have even presented a novel method of including them. That is, we match proxied durations of left-censored observations of houses that were 'newly build' in the three years prior to the left-censoring moment (the moment a house was added to the housing stock is used as a proxy of the spell start) with the left-censored observations for which such information is not available (see chapter 3).

The nonlinear estimation of the hedonic price regression in chapter 4 is another empirical contribution worth mentioning. For reasons we can only speculate about Genesove and Mayer (2001) did not estimate a fully nonlinear model; they estimated a semi-nonlinear specification in which loss aversion was modeled nonlinearly but equity constraints were not. Contrary to Genesove and Mayer (2001), Anenberg (2011) did estimate a fully nonlinear model, but he eliminated all house characteristics from his specification by substituting the prior average price as a house fixed effect. His hedonic specification, therefore, does not actually contain house characteristics.[5]

5.4 Limitations and future research

In this section we discuss the limitations that apply to the research that we have done. The suggestions for future research follow naturally from them. The first limitation is related to the fact that – empirically – we have not been able to distinguish search from bargaining in the price determination process (see chapter 2). Following Harding et al. (2003) we have applied a broad definition of bargaining that incorporates both the search and the bargaining process. While the finding that household income and household wealth influence house prices is relevant in itself, understanding how household characteristics *exactly* influence the search process differently from the bargaining process would provide further insights in the determination of house prices.

Another limitation that applies to chapter 2 is that we relied on symmetry assumptions to deal with unobserved house characteristics. The symmetry assumptions, however, imply that we have not been able to study differences in effects of household characteristics between buyers and sellers. Asymmetries due to buyers' or sellers' markets (that is, at an aggregate level) are dealt with as these lead to changes in market prices, but asymmetries in the effects of household characteristics relative to the market price cannot be dealt with. Thus, unless we ignore the unobserved house characteristics, the effects of income and wealth have to be assumed symmetric.

The limitations encountered in chapter 2 provide clear opportunities for future research. Differentiating the price effects of search from the effects of bargaining would be a worthwhile avenue for research. That is, future research could look into a narrower definition of bargaining. However, it seems to us that more extensive data on the search and bargaining process

[5]Estimating the nonlinear hedonic specification with the extensive set of house characteristics was a true Sisyphean task. Note, for instance, that in the specification with LTV categories households close to the bounds can (repeatedly) move from one category to another during the iterative estimation process. In order to estimate the extensive nonlinear specifications, a comprehensive function evaluator program has been written in Stata.

is essential to do so. Information on, for instance, reservation prices, search time and intensity, number of house viewings, and bids would be required. However, for obvious reasons, these data are not administratively available. Studying asymmetries in the effects of income and wealth for buyers and sellers is another interesting research possibility. Such research would most likely require dealing with unobserved house characteristics in alternative ways.

In chapter 3 we analyzed how household mobility is affected by prospective losses and negative equity. As our sample includes stock sampled observations, among which left-censored observations, we have not been able to estimate a frailty model, a model that corrects for unobserved heterogeneity.[6] Future research could therefore look into the possibilities of incorporating unobserved heterogeneity through a frailty term, while taking into account potential selectivity bias of an inflow sample that incorporates many housing durations that start during a down-turn in the housing market. After all, we have argued that households are affected by loss aversion and negative equity. Using a sample of durations that starts under these conditions suggests that those households unresponsive to prospective losses and negative equity will be overrepresented, thereby biasing results. All in all, future research should incorporate unobserved heterogeneity into household mobility analyses while taking into account the related difficulties.

A limitation that is best discussed in relation to chapter 4 is the assumption of exogeneous house price decreases. Price decreases are the main drivers of loss aversion and negative equity in chapters 3 and 4, while the results in chapter 4 demonstrate that loss aversion and negative equity have mitigating effects when a negative price shock occurs. The drop in house prices, thus, would have been more severe without the existence of loss aversion and negative equity. This implies that the repeat sales price indices that we have estimated in chapters 3 and 4 underestimate the true decreases in house values. While particularly the nonlinear specifications in chapter 4, most notably the hedonic specification, are an attempt to include endogeneity in house prices, future research should elaborate on this. Besides, future studies that estimate house price indices to the describe the development in house values should account for the mitigating effects of loss aversion and negative equity (see also Anenberg, 2011).

The lack of information on withdrawn properties is another limitation in

[6]For a thorough discussion of the topic, see Van den Berg and Drepper (2016).

chapter 4. Chapter 3 studies all households in the owner-occupied sector, while chapter 4 only studies the households that sell. Households that put their houses on the market but did not sell are thus not included in the analysis of chapter 4 even though they provide valuable information on pricing strategies and the costs of obtaining higher transaction prices. Future research could fill this gap. After all, the households with prospective losses and/or negative equity that withdrew their properties from the market are as interesting as those that did sell. Finally, in chapter 4 we have made the suggestion that negative equity might not only be a financial constraint but also a reference point. This followed from the similarities between our results and those of earlier US-oriented studies. Obviously, our suggestion that LTV ratios could also function as a psychological barrier needs attention in future research.

5.5 Policy implications

In chapter 2 we studied price effects due to differences in income and wealth between buyers and sellers. These effects seem to be driven by differences in search and bargaining costs. Lowering these search and bargaining costs leads to a better functioning market. Consequently, from a policy perspective the institutions that directly influence search and bargaining costs are most relevant. Among the institutions that have direct effects on search and bargaining costs are online platforms with the supply of houses – the website *Funda* is the largest real estate platform in the Netherlands – and the real estate agencies. The income and wealth effects that we study are best described as indirect effects. After all, changes in income and wealth policies influence housing market outcomes but do not influence search and bargaining costs itself. In other words, income and wealth policies do not make the housing market more efficient as the underlying search and bargaining costs remain unaffected. In relation to policy all we can say is that *if* tax deductibility would be curtailed, the income effects would be reduced. Similarly, *if* wealth would be taxed more heavily, the wealth effects become smaller. Still, based on chapter 2 one can conclude that the housing market functions relatively well. Buyers and sellers are able to engage in transactions despite differences in their financial positions. Besides, the income and wealth effects that we observe have an equalizing effect. One might therefore conclude that additional government intervention is not necessary; there is no evidence of market failure that should be addressed.

The current policy debate focuses on restricting LTV ratios. Do our results indicate that setting a maximum LTV ratio is welfare enhancing? The short answer is: hardly. In the Netherlands mortgage loans expressed as a percentage of the house value are high from an international perspective. The financial position of home-owners deteriorated after 2008 due to decreasing house prices. This led to a debate on financial stability as increased LTV ratios affect the balance sheets of banks. As a consequence, several policy changes were implemented to restrict excessive borrowing. A binding code of conduct for mortgage loans (GHF) was introduced in August 2011, setting a limit to the LTV ratio of new mortgages.[7] Restrictions were also introduced to the type of mortgage: the interest-only mortgage was limited to a maximum of 50 percent of the house value. Further policy measures were introduced in 2013, restricting eligibility for mortgage deductibility to linear and annuity mortgages. Besides, the maximum interest deductibility decreases from 52 percent in 2013 to 38 percent in 2041. The recent housing debate focuses on whether the maximum LTV ratio should be further reduced after 2018. The discussion concentrates on two related aspects: the balance sheets of banks and the balance sheets of households. The former relates to systematic banking risks or financial stability at the macro level, while the latter relates to financial constraints and risks at the micro level.

From a financial stability argument the Dutch Central Bank (DNB) and the Netherlands Authority for the Financial Markets (AFM) argue that the maximum LTV ratio should be reduced to 90 percent (DNB, 2015; AFM, 2015).[8] The CPB Netherlands Bureau for Economic Policy Analysis (CPB), however, has come to the conclusion that reducing the maximum LTV is not desirable (CPB, 2015). They claim that a reduction in the LTV ratio only moderately improves financial stability, while there are significant negative effects on consumption. Furthermore, lowering the maximum LTV ratio does not address the underlying problem: mortgage deductibility still creates an incentive to borrow heavily. The current dissertation suggests that banking risks are relatively small in the Netherlands as strategic defaults do not exist. Purposely defaulting on one's mortgage in order to dispose of negative equity

[7]The initial limit was set at 106 percent, decreasing with one percentage point per year to 100 percent in 2018.

[8]In 2013 the Committee Wijffels, as it is popularly known, advised to reduce the maximum LTV ratio to 80 percent in order to reduce risk profiles of banks (Commissie Structuur Nederlandse Banken, 2013).

is not possible as defaulting on recourse mortgages simply leads to residual debts. The often made international comparison that suggests exceptionally high LTV ratios in the Netherlands is therefore not fully informative. High LTV ratios in the Netherlands do not lead to the same systematic banking risks as they do in the US. This fundamental difference in institutional settings is rarely noted in relation to the financial stability argument. The existence of recourse loans notably limits systematic banking risks, thereby also limiting the need to implement stricter LTV limits from a macro perspective.

Chapters 3 and 4 have shown that at the micro level psychological constraints should be taken into account in the policy discussion. The idea that home-owners make purely financial decisions should be disposed of as psychological constraints turn out to be more important in explaining household behavior than financial constraints. As the constraints that we have studied are related to decreases in house prices, loss aversion and equity constraints are less compelling now that house prices are increasing again. In urban regions, such as Amsterdam and Utrecht, prices are rising sharply again. It thus seems that the market has started to recover from the financial crisis and the following recession. As policy implications related to the psychological constraints are hard to come by and house prices are increasing again one could argue that, also from a micro perspective, there is no need to further restrict LTV ratios.

Buying and selling a house belongs to the most important financial decisions a household will ever make. This dissertation has demonstrated that psychology plays an important role in these decisions. This implies that policy reforms that influence house prices should always be implemented gradually as reforms that lead to decreases in house prices have much more severe effects than reforms that do not lead to negative price developments. So, on the one hand, the dissertation has shown that there is little evidence of market failure that should be addressed by the government. On the other hand, the importance of psychology implies that policy measures should always be implemented with great circumspection. Therefore, in the future policy makers should not only include households' financial constraints in their considerations but also the households' psychological constraints.

References

Allison, P. D., 1984. Event history analysis: Regression for longitudinal event data. No. 46 in Quantitative Applications in the Social Sciences. Sage Publications, Inc.

Andersson, F., Mayock, T., 2014. How does home equity affect mobility? Journal of Urban Economics 84 (Nov), 23–39.

Anenberg, E., 2011. Loss aversion, equity constraints and seller behavior in the real estate market. Regional Science and Urban Economics 41 (1), 67–76.

Arnold, M. A., 1999. Search, bargaining and optimal asking prices. Real Estate Economics 27 (3), 453–481.

Bailey, M. J., Muth, R. F., Nourse, H. O., 1963. A regression method for real estate price index construction. Journal of the American Statistical Association 58 (304), 933–942.

Bell, D., 1982. Regret in decision making under uncertainty. Operations Research 30 (5), 961–981.

Cameron, A. C., Trivedi, P. K., 2005. Microeconometrics: Methods and applications. Cambridge university press.

Case, K. E., Shiller, R. J., 1988. The behavior of home buyers in boom and post-boom markets. New England Economic Review (November/December), 29–46.

CBS StatLine, 2016. Bestaande koopwoningen; regio; verkoopprijzen prijsindex [Data file]. Centraal Bureau voor de Statistiek, The Hague, http://statline.cbs.nl/Statweb/.

Chan, S., 2001. Spatial lock-in: Do falling house prices constrain residential mobility? Journal of Urban Economics 49 (3), 567–586.

Colwell, P. F., Munneke, H. J., 2006. Bargaining strength and property class in office markets. The Journal of Real Estate Finance and Economics 33 (3), 197–213.

Commissie Structuur Nederlandse Banken, 2013. Naar een dienstbaar en stabiel bankwezen [Towards a service oriented and stable banking system]. Report commissioned by the ministry of finance, The Hague.

Cotteleer, G., Gardebroek, C., Luijt, J., 2008. Market power in a gis-based hedonic price model of local farmland markets. Land economics 84 (4), 573–592.

Coulson, E., s.a. A brief survey and interpretation of hedonic parameters. In: Hedonic methods and housing markets (Chapter 2), Department of Economics, Penn State University.

Coulson, N. E., Grieco, P. L., 2013. Mobility and mortgages: Evidence from the psid. Regional Science and Urban Economics 43 (1), 1–7.

Council for Real Estate Assessment, 2010. Notitie modelmatige waardebepaling [Memo model property valuation]. November 2010, Waarderingskamer [Council for Real Estate Assessment], The Hague.

Cox, D. R., 1972. Regression models and life tables (with discussion). Journal of the Royal Statistical Society. Series B (Methodological) 34 (2), 187–220.

Cox, D. R., 1975. Partial likelihood. Biometrika 62 (2), 269–276.

CPB Netherlands Bureau for Economic Policy Analysis, 2015. De economische effecten van een verdere verlaging van de LTV-limiet [The economic effects of a further reduction of the LTV limit]. CPB notitie [memo], The Hague.

De Vries, P., de Haan, J., van der Wal, E., Mariën, G., 2009. A house price index based on the SPAR method. Journal of Housing Economics 18 (3), 214–223.

Delcoure, N., Miller, N. G., 2002. International residential real estate brokerage fees and implications for the US brokerage industry. International Real Estate Review 5 (1), 12–39.

Dröes, M. I., Hassink, W. H. J., 2014. Credit constraints and price expectations of homeowners. Housing Studies 22 (2), 92–99.

Dutch Central Bank, 2015. Effecten van een verdere verlaging van de LTV-limiet [Effects of a further reduction of the LTV limit]. DNB Occasional Study 13 (2).

Dutch Central Bank, Netherlands Authority for the Financial Markets, 2009. Risico's op de hypotheekmarkt voor huishoudens en hypotheekverstrekkers [Risks on the mortgage market for households and mortgage lenders]. Report, Amsterdam: DNB.

Eichholtz, P., Lindenthal, T., 2013. That's what we paid for it: The spell of the home purchase price through the centuries. Unpublished manuscript, Maastricht University, Netherlands.

Elder, H. W., Zumpano, L. V., Baryla, E. A., 1999. Buyer search intensity and the role of the residential real estate broker. The Journal of Real Estate Finance and Economics 18 (3), 351–368.

Engelhardt, G. V., 2003. Nominal loss aversion, housing equity constraints, and household mobility: Evidence from the United States. Journal of Urban Economics 53 (1), 171–195.

Ferreira, F., Gyourko, J., Tracy, J., 2010. Housing busts and household mobility. Journal of Urban Economics 68 (1), 34–45.

Ferreira, F., Gyourko, J., Tracy, J., 2012. Housing busts and household mobility: An update. Economic Policy Review (Nov), 1–15.

Genesove, D., Mayer, C., 1997. Equity and time to sale in the real estate market. The American Economic Review 87 (3), 255–269.

Genesove, D., Mayer, C., 2001. Loss aversion and seller behavior: Evidence from the housing market. The Quarterly Journal of Economics 116 (4), 1233–1260.

Ghent, A. C., Kudlyak, M., 2011. Recourse and residential mortgage default: evidence from us states. Review of Financial Studies 24 (9), 3139–3186.

Gilboa, I., Postlewaite, A., Samuelson, L., Schmeidler, D., 2014. Economic models as analogies. The Economic Journal 124 (578), F513–F533.

Glower, M., Haurin, D. R., Hendershott, P. H., 1998. Selling time and selling price: The influence of seller motivation. Real estate economics 26 (4), 719–740.

Gottschalk, P., Moffitt, R. A., 1994. Welfare dependence: Concepts, measures, and trends. The American Economic Review 84 (2), 38–42.

Guo, G., 1993. Event-history analysis for left-truncated data. Sociological methodology 23, 217–243.

Harding, J. P., Rosenthal, S. S., Sirmans, C., 2003. Estimating bargaining power in the market for existing homes. Review of Economics and statistics 85 (1), 178–188.

Henley, A., 1998. Residential mobility, housing equity and the labour market. The Economic Journal 108 (447), 414–427.

Hoffman, E., Spitzer, M. L., 1993. Willingness to pay vs. willingness to accept: legal and economic implications. Washington University Law Quarterly 71, 59–114.

Iceland, J., 1997. The dynamics of poverty spells and issues of left-censoring. PSC Research Report Series No. 97-378 (January 1997), University of Michigan.

Ihlanfeldt, K., Mayock, T., 2009. Price discrimination in the housing market. Journal of Urban Economics 66 (2), 125–140.

Jansen, S., de Vries, P., Coolen, H., Lamain, C., Boelhouwer, P., 2008. Developing a house price index for the Netherlands: A practical application of weighted repeat sales. The Journal of Real Estate Finance and Economics 37 (2), 163–186.

Jenkins, S. P., 2005. Survival analysis. Unpublished manuscript, Institute for Social and Economic Research, University of Essex, Colchester, UK.

Jud, G. D., 1983. Real estate brokers and the market for residential housing. Real Estate Economics 11 (1), 69–82.

Kahneman, D., Knetsch, J., Thaler, R., 1990. Experimental tests of the endowment effect and the coase theorem. Journal of Political Economy 98 (6), 1325–1348.

Kahneman, D., Tversky, A., 1979. Prospect theory: An analysis of decision under risk. Econometrica: Journal of the Econometric Society 47 (2), 263–291.

Kestens, Y., Thériault, M., Des Rosiers, F., 2006. Heterogeneity in hedonic modelling of house prices: looking at buyers' household profiles. Journal of Geographical Systems 8 (1), 61–96.

Kiefer, N. M., 1988. Economic duration data and hazard functions. Journal of economic literature 26 (2), 646–679.

Lawrance, A. B., Marks, R. E., 2008. Survival of firms and plants in a supply-constrained industry. Working paper, School of Economics, University of NSW, Sydney, Australia, http://www.agsm.edu.au/bobm/papers/lawrance_marks_wp0801.pdf.

Loomes, G., Sugden, R., 1982. Regret theory: An alternative theory of rational choice under uncertainty. The economic journal 92 (368), 805–824.

Malpezzi, S., 2003. Hedonic pricing models: A selective and applied review. In: O'Sullivan, A., Gibb, K. (Eds.), Housing Economics and Public Policy: Essays in Honour of Duncan Maclennan. John Wiley & Sons, pp. 67–89.

McQuinn, K., O'Reilly, G., 2008. Assessing the role of income and interest rates in determining house prices. Economic modelling 25 (3), 377–390.

Merlo, A., Ortalo-Magne, F., 2004. Bargaining over residential real estate: evidence from england. Journal of Urban Economics 56 (2), 192–216.

Moffitt, R. A., Rendall, M. S., 1995. Cohort trends in the lifetime distribution of female family headship in the United States, 1968–1985. Demography 32 (3), 407–424.

Netherlands Authority for the Financial Markets, 2015. Nota kredietnormen [Memo credit standards]. Memorandum, Amsterdam.

Overvest, B., Van der Poel, N., 2013. Verborgen gebreken: concurrentie op de markt van makelaarsdiensten [Hidden defects: Competition in the market of broker services]. TPEdigitaal 7 (3), 102–116.

Pennington-Cross, A., 2004. The value of foreclosed property. Working Paper Series No. 2004-022A (September 2004), Federal Reserve Bank of St. Louis.

Quan, D. C., Quigley, J. M., 1991. Price formation and the appraisal function in real estate markets. The Journal of Real Estate Finance and Economics 4 (2), 127–146.

Rosen, S., 1974. Hedonic prices and implicit markets: product differentiation in pure competition. The journal of political economy 82 (1), 34–55.

Rouwendal, J., 2007. Mortgage interest deductibility and homeownership in the Netherlands. Journal of Housing and the Built Environment 22 (4), 369–382.

Schilder, F., Conijn, J., 2012. Restschuld in Nederland: Omvang en consequenties [Residual debt in the Netherlands: Magnitude and consequences]. ASRE Research Paper 2012-01, Amsterdam School of Real Estate.

Schoonhoven, R., Bottelberghs, I., 2014. Baangegevens in microdata [Job information in microdata]. Unpublished manuscript, Statistics Netherlands, The Netherlands, 12-3-2014.

Schulhofer-Wohl, S., 2012. Negative equity does not reduce homeowners' mobility. Quarterly Review 35 (1), 2–14.

Sheppard, S. C., 1999. Hedonic analysis of housing markets. In: Mills, E. S., Cheshire, P. (Eds.), Handbook of Regional and Urban Economics Volume 3: Applied Urban Economics. Elsevier, pp. 1595–1635.

Song, S., 1995. Determination of bargaining outcome in single-family housing transactions: an empirical examination. Urban Studies 32 (3), 605–614.

Song, S., 1998. Home buyers' characteristics and selling prices. Applied Economics Letters 5 (1), 11–14.

Springer, T. M., 1996. Single-family housing transactions: Seller motivations, price, and marketing time. The Journal of Real Estate Finance and Economics 13 (3), 237–254.

Statistics Netherlands, 2012. Documentatierapport integraal-vermogensbestand. Voorburg, The Netherlands: Centrum voor Beleidsstatistiek.

Stein, J. C., 1995. Prices and trading volume in the housing market: A model with down-payment effects. The Quarterly Journal of Economics 110 (2), 379–406.

Stevens, A. H., 1999. Climbing out of poverty, falling back in. Journal of Human Resources 34 (3), 557–588.

Struyven, D., 2015. Housing lock: Dutch evidence on the impact of negative home equity on household mobility. Job market paper, Massachusetts Institute of Technology.

Tversky, A., Kahneman, D., 1991. Loss aversion in riskless choice: A reference-dependent model. The quarterly journal of economics 106 (4), 1039–1061.

Van Dalen, J., Bode, B., 2004. Estimation biases in quality-adjusted hedonic price indices. Paper presented at the SSHRC International conference on index number theory and the measurement of prices and productivity (Vancouver), October 2004, Erasmus University Rotterdam.

Van den Berg, G. J., Drepper, B., 2016. Inference for shared-frailty survival models with left-truncated data. Econometric Reviews 35 (6), 1075–1098.

Van der Cruijsen, C., Jansen, D.-J., van Rooij, M., 2014. The rose-colored glasses of homeowners. DNB Working Paper No. 421 (April 2014), De Nederlandsche Bank.

Van der Zeijden, P. T., Snoei, J., Vogels, R. J. M., 2011. Consumentengedrag op de makelaarsmarkt [Consumer behavior in the broker market]. Report commissioned by the Netherlands Competition Authority (NMa), EIM.

Wang, F. T., Zorn, P. M., 1997. Estimating house price growth with repeat sales data: What's the aim of the game? Journal of Housing Economics 6 (2), 93–118.

Wheaton, W. C., 1990. Vacancy, search, and prices in a housing market matching model. Journal of Political Economy, 1270–1292.

Wilhelmsson, M., 2008. Evidence of buyer bargaining power in the Stockholm residential real estate market. Journal of Real Estate Research 30 (4), 475–500.

Yavaş, A., 1992. A simple search and bargaining model of real estate markets. Real estate economics 20 (4), 533–548.

Nederlandstalige samenvatting

In deze dissertatie onderzoeken we prijsvorming en mobiliteit op de Nederlandse koopwoningmarkt. We bestuderen hoe verschillende financiële kenmerken – in het bijzonder inkomen, vermogen, eigenwoningvermogen, en nominale verliezen – beslissingen van huishoudens in de huizenmarkt beïnvloeden. Deze studie richt zich daarbij op drie onderzoeksvragen: (i) Wat is het effect van de relatieve financiële positie van kopers en verkopers op de woningprijs? (ii) Hoe beïnvloeden onder water staan (negatief eigenwoningvermogen) en verliesaversie huishoudensmobiliteit? (iii) Wat is het effect van onder water staan en nominale verliesaversie op woningprijzen?

Het onderzoek is gebaseerd op gegevens van het Centraal Bureau voor de Statistiek over de jaren 2006-2011, aangevuld met informatie van de Nederlandse Vereniging van Makelaars. De dataset vormt een ruime verzameling van huishoudens- en woningkenmerken. De bevindingen in deze dissertatie suggereren dat financiële kenmerken van huishoudens een belangrijke rol spelen bij het verklaren van hun gedrag in de koopwoningmarkt, met andere woorden: financiële huishoudenskenmerken beïnvloeden zowel woningprijzen als de mobiliteit van huishoudens. De eerdergenoemde onderzoeksvragen staan centraal in drie empirische analyses (hoofdstuk 2, 3 en 4). Hieronder volgt een kort overzicht van de belangrijkste bevindingen.

In hoofdstuk 2 bestuderen we de effecten van de relatieve financiële positie van kopers en verkopers op transactieprijzen. We maken daarbij onderscheid tussen de inkomens- en vermogenspositie. Zoektheoretische modellen en onderhandelingsmodellen voorspellen dat hogere inkomens en vermogens leiden tot hogere zoek- en onderhandelingskosten. Huishoudens met een goede financiële positie zullen dus minder tijd en moeite investeren in het zoeken/onderhandelen en daardoor genoegen nemen met een minder transactieresultaat.

De schattingsresultaten laten zien dat verkopers met een relatief goede financiële positie ten opzichte van de koper een lagere prijs ontvangen voor een vergelijkbare woning, terwijl kopers met een relatief goede financiële positie ten opzichte van de verkoper juist een hogere prijs betalen. Dit impliceert dat de woningprijs daalt als het inkomen van de verkoper toeneemt, terwijl de woningprijs stijgt als het inkomen van de koper toeneemt. De effecten van vermogen tonen een vergelijkbaar beeld, al neemt het vermogenseffect af voor de hoogste vermogensgroepen.

Verschillende robuustheidscontroles tonen aan dat (fluctuerende) marktomstandigheden, de relatie tussen woningwaarde en vermogen (zogenaamde endogeniteit), en financiële beperkingen die alleen verkopers raken geen alternatieve verklaringen vormen voor de door ons gevonden resultaten. Een beperking van dit onderzoek is dat het niet mogelijk is om het zoek- en het onderhandelingsmechanisme empirisch van elkaar te onderscheiden.

Hoofdstuk 3 onderzoekt hoe dalende huizenprijzen de huishoudensmobiliteit kunnen beïnvloeden. Enerzijds kan een daling van de huizenprijzen ertoe leiden dat de waarde van de woning daalt tot onder de waarde van de hypotheekschuld. Er is dan sprake van negatief eigenwoningvermogen: de huishoudens staan onder water en hebben een verwachte restschuld als ze hun woning verkopen. Het vormt een financiële barrière: de huishoudens kunnen niet verhuizen. Anderzijds kan het zijn dat de marktwaarde van de woning zakt onder de prijs die een huishouden oorspronkelijk zelf betaald heeft. Dit is een psychologische barrière: de huishoudens willen mogelijk niet verhuizen terwijl ze dit vanuit financieel oogpunt wel zouden kunnen doen. De afkeer van deze zogenaamde nominale verliezen wordt in de huizenmarktliteratuur verliesaversie genoemd.

Hoofdstuk 3 benadrukt het belang om onder water staan en verliesaversie gelijktijdig te bestuderen. Het bestuderen van één van beide mechanismen zonder rekening te houden met het tweede leidt in het algemeen tot een overschatting van het bestudeerde effect. Dit is precies wat het merendeel van de eerdere studies heeft gedaan: het effect van financiële beperkingen wordt bestudeerd zonder rekening te houden met verliesaversie. Engelhardt (2003) is vooralsnog de enige studie over huishoudensmobiliteit die een expliciet onderscheid maakt tussen de financiële en psychologische barrières.

We gebruiken verwachte nominale verliezen ten opzichte van de originele aankoopprijs voor het schatten van verliesaversie en *loan-to-value* (LTV) ratio's, dat wil zeggen: de hypotheekschuld gedeeld door de woningwaarde, groter dan één voor het schatten van financiële beperkingen. De schattingsresultaten laten zien dat huishoudens met een verwachte restschuld tussen de 0 en 20 procent van de woningwaarde een 15 procent lagere verhuiskans hebben dan huishoudens met een hypotheekschuld tussen de 80 en 100 procent van de woningwaarde. Huishoudens met een verwachte restschuld van meer dan 20 procent hebben daarentegen juist de hoogste verhuiskans. Een woningwaarde die lager is dan de aankoopprijs leidt tot een afname in de verhuiskans van meer dan 50 procent.

Het sterke effect van de oorspronkelijke aankoopprijs duidt op verliesaversie. Er is slechts beperkt bewijs dat onder water staan een negatief effect heeft op verhuismobiliteit. We vinden weliswaar een negatief effect voor huishoudens die maximaal 20 procent van hun woningwaarde onder water staan, maar niet voor de huishoudens die nog meer onder water staan. Het lijkt er dus op dat verliesaversie een grotere rol speelt dan onder water staan. Daarmee lijkt dus ook het effect van niet willen verhuizen belangrijker te zijn dan dat van niet kunnen verhuizen.

Hoofdstuk 4 bestudeert de effecten van negatief eigenwoningvermogen en verliesaversie op huizenprijzen. Dit hoofdstuk is daarmee een logisch vervolg op het vorige hoofdstuk. De gedachte is dat huishoudens die onder water staan of geconfronteerd worden met een nominaal verlies hun woning kunnen proberen te verkopen tegen een prijs boven de marktwaarde. Immers, een hogere prijs dan de marktwaarde kan helpen om de financiële barrière te beslechten of de psychologische barrière te verzachten.

De schattingsresultaten laten zien dat een toename in de LTV ratio van 1,00 naar 1,01 leidt tot een toename in de transactieprijs van 0,14-0,18 procent, ceteris paribus. Verder vinden we dat een toename van 1 procent in het verwachte nominale verlies leidt tot een prijstoename van 0,3-0,5 procent, ceteris paribus. Dit suggereert dat in termen van de respectievelijke effecten verliesaversie belangrijker is dan de zogenaamde financiële beperkingen.

De effecten van verliesaversie en onder water staan die we in dit hoofdstuk vinden zijn groter dan die gevonden zijn door Genesove and Mayer (2001). De conclusie is echter dezelfde: het effect van verliesaversie is groter dan dat van financiële beperkingen. Onze bevindingen zijn vrijwel identiek aan die van Anenberg (2011). De gelijkenissen zijn opvallend aangezien er belangrijke institutionele verschillen bestaan tussen Nederland en de Verenigde Staten. In Nederland kunnen huishoudens de volledige koopsom lenen (tijdens de periode die dit onderzoek beslaat kon zelfs meer geleend worden dan de volledige koopsom) en huishoudens kunnen na de verkoop van een woning met een restschuld blijven zitten. Met andere woorden: er hoeft in Nederland geen eigen vermogen ingebracht te worden bij de aankoop van een woning en er zijn geen strategische overwegingen voor huishoudens om van hun betalingsverplichtingen af te zien (in tegenstelling tot de respectievelijke *down-payment* en *strategic default* in de VS).

Al met al is er geen indicatie dat de institutionele situatie in Nederland leidt tot minder stringente financiële beperkingen in vergelijking met de VS. Dit zou kunnen suggereren dat onder water staan niet alleen een financiële beperking vormt, maar mogelijk ook een psychologische. Mogelijk fungeert de waarde van de hypotheek, evenals de nominale aankoopprijs, als een referentiepunt dat de verkoopbeslissing beïnvloedt.

De drie empirische analyses in deze dissertatie leiden allemaal tot de conclusie dat financiële kenmerken van huishoudens (of pseudofinanciële kenmerken in het geval van verliesaversie) een belangrijke rol spelen bij transacties in de koopwoningmarkt. Enerzijds is er sprake van beïnvloeding van de verhuisbeslissing, anderzijds wordt ook de transactieprijs beïnvloed. De transactieprijs van een woning wordt dus niet alleen bepaald door de kenmerken van de woning maar ook door de eigenschappen van de (huidige of toekomstige) bewoners. De les is daarmee dat in de huizenmarkt mensen zeker zo belangrijk zijn als huizen.

Curriculum vitae

Joep Steegmans (1982) was born in Utrecht. He studied Latin American and Caribbean Studies at Utrecht University, obtaining a master's degree (with honors) in 2005. In the following years he worked within the Latin American Studies program at Utrecht University, lecturing about Latin American culture and society. He obtained a master's degree in International Economics and Business (with honors) at Utrecht University in 2010. Afterwards he taught economics and methodology courses at Utrecht University School of Economics, where he started working as a PhD candidate in Applied Econometrics in September 2012. He worked briefly as a Scientific Employee at the CPB Netherlands Bureau for Economic Policy Analysis in the Hague in 2016. In January 2017 he returned to Utrecht University School of Economics, where he started working as a postdoctoral researcher.

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