

The demand for mortgage debt, increases in house prices and the elderly home equity puzzle

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2012 – 13
November 2012



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Acknowledgement: The authors thank Rob Alessie for helpful discussions and comments

ASRE research papers ISSN 1878-4607

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Abstract

This paper studies the demand for mortgage debt in the Netherlands. Currently the size of this debt exceeds that of GDP, which makes it interesting to look at its determinants. We focus on two issues: the impact of the prolonged boom in house prices in the period 1985-2009, and the habit of elderly people to leave their housing wealth untouched when aging. We investigate how much of the increase in home equity realized during the boom has been 'cashed' by households, perhaps to help finance the increase in consumption expenditure. We allow this effect to depend on age to allow for different behavior of elderly people. Recent analyses for the US have suggested that the desire of elderly people to keep large amounts of wealth, often including home equity as an important component, may be caused by the combination of a strong precautionary savings motive and large health care costs. However, the increasing in house prices in the period 1985-2009 was arguably in large part unexpected, which makes a precautionary savings motive for keeping the wealth increases completely untouched less convincing. Moreover, long term care in the Netherlands is publicly financed, which makes this explanation even more unlikely to be valid. It is therefore interesting to consider if Dutch households liquefy substantial parts of their housing wealth by increasing the size of the mortgage loan.)

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1 Introduction

The mortgage loan is an important financial instrument for most homeowners. It allows them to buy a house without having accumulated enough wealth to pay it immediately. Well developed financial markets also allow for the possibility to refinance or take an additional mortgage. The possibility to borrow while using the house as collateral is attractive since interest rates on mortgages are lower than those on other loans available to consumers. Flexible mortgages also offer the possibility to liquefy increases in house prices and are therefore a potentially important channel through which the housing wealth effect on consumption is realized. They also offer elderly households the possibility to liquefy some of their home equity without having to move, which (if they do so) would help explain the reluctance of many of those households to downsize so as to consume the wealth they accumulated earlier in the lifecycle.

It is therefore somewhat surprising to observe that the demand for mortgage debt is not intensively studied in the economic literature. Most of the recent empirical work concentrates on subprime loans and defaults in the US. The connection between increasing house prices and mortgage conditions has been documented in several papers, including Mian and Sufi (2009, 2011). The focus in this paper is on the impact of house price changes on demand for regular mortgages. A number of studies have shown that there is a connection between house prices and consumption spending and a plausible background of this relationship is that higher house prices enable a consumer to increase the size of the mortgage loan and use that money for additional consumption expenditure. Mian and Sufi (2011) provide evidence for this channel for subprime mortgages, but it is also of interest to see if higher house prices do induce consumers to borrow more under less specific circumstances. A second major interest of the paper is in the role of age in this process. On the basis of conventional life cycle theory it is easy to argue that elderly consumers have a strong interest to transform an unexpected increase in home equity into consumption expenditure, while it is also well known that residential mobility among the elderly is very low. Increasing the size of the mortgage should therefore be expected to be particularly attractive as a means to consume the higher wealth for this group.

Our empirical work refers to the Netherlands which is an interesting country to study the demand for mortgage debt for several reasons. First, like in the US, mortgage interest paid is usually deductible from taxable income, which makes it relatively attractive to have a large amount of mortgage debt. Currently the total amount of mortgage debt of all Dutch households exceeds GDP. Second, the Netherlands has experienced a long period of house price growth. Between 1985 and 2009 real house prices more than doubled, implying large gains in housing wealth for those who owned a house in 1985 or bought one at the beginning of this period. If the large gains in housing wealth have increased consumption expenditure, as seems likely, one would expect some of the additional consumption to be realized via second or larger (refinanced) mortgages. Third, it has recently been argued that a precautionary savings motive related to large health care expenditure at advanced age provides a convincing explanation for the

large amounts of wealth kept by elder Americans¹, see De Nardi et al (2009 and 2010). This precautionary savings motive is unlikely to be important in the Netherlands where long term care is provided through the public health care system. One would therefore expect elderly Dutch households to be more eager to consume at least some of their wealth than their American counterparts.

The paper proceeds as follows. The next section discusses some relevant literature and our empirical strategy. The data that we use, and some preliminary analyses, will be presented in section 3. In section 4 we proceed to estimation of mortgage demand equations on cross section data. In section 5 we present a panel data analysis based on synthetic age cohorts. Section 6 conclusion.

¹ In the US and elsewhere home equity is usually the largest component of total wealth of homeowners.

2 Literature and research strategy

2.1 Explaining mortgage demand

The primary reason households demand a mortgage loan is, of course, that they buy a house without having enough wealth to finance it. First time buyers therefore often borrow the maximum amount banks are willing to offer them. Artle and Varaiya (1978) provide an early analysis of the decision to buy a house in a life cycle setting. This provides an elementary starting point for the specification of a demand equation for mortgage loans: the price of the house in which the household lives is probably an important determinant of the size of the loan.

In many countries a downpayment is required when buying a house and the loan-to-value constraint (LTV) is an important restriction for first-time homebuyers who often did not have the chance to save much. In the Netherlands, this constraint is less relevant because cheap mortgage insurance is available and for those households that are eligible, banks are willing to lend 100% of the purchase price. Currently more than 50% of the homebuyers make use of this mortgage insurance. In order to qualify for the mortgage insurance, net mortgage payments should not exceed a percentage of net income that lies around 30%. This means that instead of the LTV a loan-to-income (LTI) constraint is often relevant at the time of purchasing a house.

Mortgages are available in different types and many of them are self-amortizing. This means that households who stick to the contract agreed upon when buying the house will often gradually repay the mortgage and become outright owners after 20 or (usually) 30 years. This gives us a second determinant of the demand for mortgage loans of a household that lives in a house for some years: the size of the loans tends to decrease with the elapsed duration of stay. Moreover, the decrease is likely related to the size of the original loan².

However, the Netherlands has a well-developed mortgage market and households have the ability to increase their demand for mortgage loans after some time by refinancing or taking a second (or third) mortgage. Brueckner (1994) presents an elementary analysis of the demand for mortgage loans in relation to the net mortgage interest rate and the (expected) return on investing the money in alternative assets. In the simplest case, the alternative asset could be a conventional savings account. If there is mortgage interest deductibility and returns on savings remain untaxed, it is possible that the ratio of the net mortgage interest rate to the net return on savings is less than 1, and in this situation Brueckner's model predicts that risk-neutral households will maximize the size of their mortgage loan. That is, they will increase the size of their loan until either the LTV constraint or the MTI constraint binds. In the Netherlands there is full mortgage interest deductibility at a marginal tax rate of 52% for most households, while the tax rate on savings is 1.2% annually. In this situation the ratio can become smaller than 1, even if a conventional savings account is used.

² With a constant amortization mortgage the size of the loan decreases linearly in the duration, while the relationship is somewhat more complex with a fixed payment mortgage.

However, it is documented in the Appendix that this has actually only been the case during short periods. In case the ratio exceeds 1 when a savings account is used, it is still possible that the average returns on other investments are high enough to make the expected value of the ratio smaller than 1. However, we should then expect that risk aversion makes households reluctant to maximize the size of the mortgage. Indeed, Brueckner (1994) shows that risk aversion may give rise to an interior solution in which households do not maximize their mortgage loan, but choose to invest some of their wealth in the house in which they live, although they do not become outright owners. Indeed, it appears that most Dutch households do not attempt to maximize the size of the mortgage loan.

If the interior solution is relevant, households that observe an increase in the value of their house may withdraw some of the home equity and invest it in other assets. In the appendix we develop a simple version of Brueckner's model in which higher house prices leads to larger mortgage loans. However, this effect is not only caused by the desire to benefit from the higher average return on savings, but also from a desire to consume part of this wealth increase. This is known as the consumption wealth effect to which we now turn our attention.

Muellbauer and Murphy (1990) and Case et al. (2005, 2011), among others, have argued that there is a strong impact of house prices on consumption. Case et al. find the marginal propensity to consume housing wealth to be about 10% which is surprisingly high. The causality of this relationship has been disputed by Attanasio and Weber (1994) and Attanasio et al. (2011), who argue that the strong correlation between house prices and consumption is due to expectations with respect to the development of productivity related to the business cycle that affects demand for housing and through inelastic supply its price, as well as the demand for other consumption goods. The present paper is agnostic with respect to this causality issue, but for its purposes it is relevant to observe that increasing the size of their mortgage debt may be an attractive way to help realizing a desired increase in consumption expenditure. Since mortgage debt is relatively cheap consumers they should be expected to prefer a higher mortgage to other types of loans even in the absence of mortgage interest deductibility. Indeed Muellbauer and Murphy (1990) argue that liberalization of the mortgage market in the course of the 1980s has contributed to the correlation between house prices and consumption expenditure, and Abdallah, and Lastrapes (2012) provide evidence that relaxation of borrowing constraints increases consumption expenditure. The only drawback of mortgage credit is the high transaction costs involved with refinancing or taking a second mortgage. The first and main hypothesis to be considered in this paper is therefore if higher house prices induce consumers to increase their mortgage borrowing. The impact of the higher house price on the size of the loan may be that (i) it allows the household to benefit from arbitrage opportunities related to mortgage interest deductibility, or (ii) it causes a desire to increase consumption expenditure that is financed through refinancing or taking a second mortgage, or it (iii) may just facilitate a desire to increase consumption that is related to more optimistic expectations with respect to future income. Of course, a mixture of these considerations may also be relevant.

2.2 The elderly home equity puzzle

One of the ways Attanasio and Weber (1994) distinguish between their view on the connection between house prices and consumption and the alternative one that hypothesizes a causal effect of the former on the latter is the relative impact of the increase in house prices on consumption expenditure of old and young persons. The incentive to increase consumption after an unexpected increase in wealth should, according to many life cycle models, become stronger when the consumer ages. In contrast, the elderly should not expect to benefit much from future increases in productivity. They find indeed that the relation between house prices and consumption is strongest for younger households.

However, Attanasio and Weber's (1994) argument is not completely without problems. Although the elderly cannot hope to benefit as much from future increases in productivity as younger persons, they often live in large houses and therefore realize larger gains in wealth. Since their expected remaining lifetime is smaller, they should also be expected to increase their annual consumption more for every euro they gain in home equity than younger owners. Moreover, in contrast with younger people they have less reason to anticipate mean-reverting of house prices, for instance a bust in the remote future, that sweeps away some of their current wealth gains. This suggests strongly that elderly people should be expected to react stronger to the increase in house prices *per se* than younger persons. Put differently, one should expect a stronger wealth effect of increasing house prices (independent of its cause) for elderly people. Admittedly, this does not exclude the possibility that expectations with respect to future productivity should still induce younger homeowners to increase their mortgage loan even more than the elderly, but the important thing to note is that we should expect a positive relationship between house prices and the size of the mortgage loan for elderly households.

There is nevertheless strong evidence that elderly households' propensity to consume is much lower than would be the case if they were standard life-cycle consumers. There is, for instance, the well-known reluctance of these households to downsize or move to rental house in later life (see, among others, Venti and Wise, 1989, 1990, 2004 and Feinstein and McFadden, 1989), which is generally interpreted as implying that their home equity does not come available for consumption. This is called the elderly home equity puzzle.

Several attempts have been made to solve this puzzle. The most obvious one is the presence of a strong bequest motive (see, for instance, Kotlikoff and Summers, 1981). However, careful examination of the validity of this explanation, for instance by comparing elderly with and without children, has not produced strong confirmation of this effect (Dynan et al., 2002; Hurd, 1987, 1989; Hurd and Smith, 2002). Note also that even if a strong bequest motive is present, it is far from obvious that this should induce households to abstain completely from translating an unexpected gain in housing wealth into consumption³.

³ Perhaps one might argue that an increasing housing price reinforces the bequest motive because children will have more difficulty in purchasing a house.

A second, probably more important, consideration is uncertainty with respect to events in later life. Even if one does not intend to leave a large bequest, a strong desire to avoid running out of resources at the end of one's lifetime may induce elderly people have a strong precautionary motive for keeping a large amount of wealth (Kimball, 1990)⁴. Home equity may be an attractive asset in this context. For instance, Skinner (2004) argues that it provides returns in kind as long as the owner is in good health and when transition to a nursing home becomes unavoidable, selling the house provides the necessary means to finance the necessary long-term care. Medicaid is a last resort. The analyses of De Nardi et al (2009 and 2010) show that the precautionary savings motive can indeed provide a convincing explanation for the large amount of wealth owned by elderly Americans.

However, the existence of a precautionary motive does not necessarily imply that elderly consumers are unwilling to consume at least a part of an unexpected increase in wealth caused by a shock in house prices. Moreover, a difficulty with accepting the precautionary savings explanation (for the desired level of wealth) for the Netherlands, to which our empirical work refers, is that long term care in this country is financed completely by the public sector. The precautionary savings motive of elderly homeowners should be expected to be absent, or at least to be much weaker than it is in the US.

As noted in the introduction, increasing the mortgage in later life may – nevertheless – allow a homeowner to consume at least a substantial part of his wealth without having to reduce housing consumption and it is useful to investigate if this happens. This will be done in the sections that follow, but before proceeding to this empirical analysis, we should note that an earlier literature has emphasized that liquefying housing wealth is not easy. For instance, Artle and Varaiya (1978), analyzed the case in which owner-occupied housing can only be financed by an annuity mortgage, while households have no other access to credit. For this reason their model predicts a large amount of home equity and a relatively small level of non-housing consumption among elderly homeowners, which suggests that the elderly home equity puzzle may be explained by the illiquidity of housing wealth. The current mortgage markets seem to offer better opportunities for liquefying home equity than they did in the late 1970s. However, the demand for reverse mortgages, a product especially developed to relax the borrowing constraint for the elderly, is limited (see Skinner (1996) and Leviton (2001)). Davidoff (2006 and 2009) has argued that these mortgages are both costly and risky, which suggests that it is less attractive than using a flexible credit line to consume some of one's home equity. Davidoff (2006) even argues that elderly frequently choose to liquefy some of their housing wealth by saving on the costs of maintenance, which suggests that constraints on liquefying wealth are still very strong. A recent paper by Nakajima and Telyukova (2011) also suggests nevertheless that home equity is still difficult to liquefy.

⁴ Since the length of life is uncertain, the consequence is that most people will have some wealth left at the end of their life. Indeed, according to Hurd (1989) this explains a large part of actual bequests.

2.3 Summing up

First time buyers usually have to borrow a large part of the value of their house, implying that mortgage demand is strong immediately after the purchase. Since most mortgage contracts in the Netherlands are self-amortizing, the size of the loan will on average tend to decrease with the duration of residence, unless action is taken. Increasing house prices provide reason for such action as it relaxes credit constraints and is cheap relative to other types of consumer debt.

The life cycle framework suggests that in the absence of a strong precautionary savings motive and strong borrowing constraints homeowners want to decrease home equity towards the end of life. In midlife homeowners who are relatively risk averse will minimize the size of their mortgage, which in many cases implies that they simply stick to the original mortgage contract. Others, who are less risk averse, may refinance and increase the size of the loan relative to the original contract or take a second mortgage. For both groups, in later life the desire to decrease home equity will become more important and they should be expected to increase the size of their mortgage. This means that we expect mortgage demand to be U-shaped over the life cycle: it is high just after the house is bought and for the elderly, but lower in midlife. Our empirical work will thus be guided by the following ideas: (a) the size of the mortgage is large relative to the value of the house just after it is bought, (b) it tends to decrease over time as most mortgage contracts are self-amortizing, (c) increases in the value of the house may lead to extensions of the mortgage through refinancing or taking a second mortgage, (d) mortgage demand is U-shaped over the life cycle, which implies an increase in mortgage demand in later life. In the next three sections we first introduce the series of cross sections, then estimate mortgage demand in the most recent wave, and finally report results of a panel data analysis using synthetic cohorts

3 The Data and some first results

We use the WBO/WoON data. This is a series of cross section household surveys containing information on housing and households. Data are collected about every 4 years since 1981. The most recent wave refers to 2009. The questionnaires are roughly identical in subsequent waves but a more substantial change occurred in 2002 when also the name of the survey was changed from WBO to WoON. Questions on mortgage size have, for instance, been included since that year, while questions on mortgage type were included in earlier waves as well. Some descriptives are given in Table 1. In Table 1 we can observe that the value of mortgage debt and the current value of the house increased between 2002 and 2009. Homeownership and mortgage rates increased since 1985. In this section weights are applied to ensure that the dataset is representative for the Dutch population. Not shown in the table is the substantial increase in house prices over the whole period 1985-2009. Real house prices more than doubled during a long boom period, with exceptionally large price increases in the late 1990s.

Wave	Homeowner-ship rates (%)	Mortgage rates among homeowners (%)	Median mortgage debt	Average mortgage debt	Median current value of the house	Average current value of the house	Number of respondents
1985	41.87	74.00	--	--	--	--	46095
1989	44.18	76.82	--	--	--	--	46851
1993	45.77	79.67	--	--	--	--	63049
1998	49.14	84.09	--	--	--	--	117569
2002	52.23	86.38	74874	98087	205000	250435	75043
2006	53.70	86.59	102000	126970	250000	297001	55958
2009	56.80	86.32	130000	147989	250000	307177	69149

Table 1: Descriptives of the WBO/WoON data

Figure 1 shows the development of homeownership among 5-year birth cohorts. The share of homeowners among the elderly is relatively small but it increases with the year of birth. Among the middle-aged cohorts the homeownership rate is almost constant, while it is modestly decreasing among the older cohorts (this is in line with Van der Schors, Alessie and Mastrogiacomo, 2007). The fact that the share of homeowners is decreasing after age 65, may be interpreted as being consistent with Artle and Varaiya (1978). Note also that differential mortality probably introduces an upward bias on the observed share of homeowners among the older cohorts (see for instance Attanasio and Hoynes (2000).

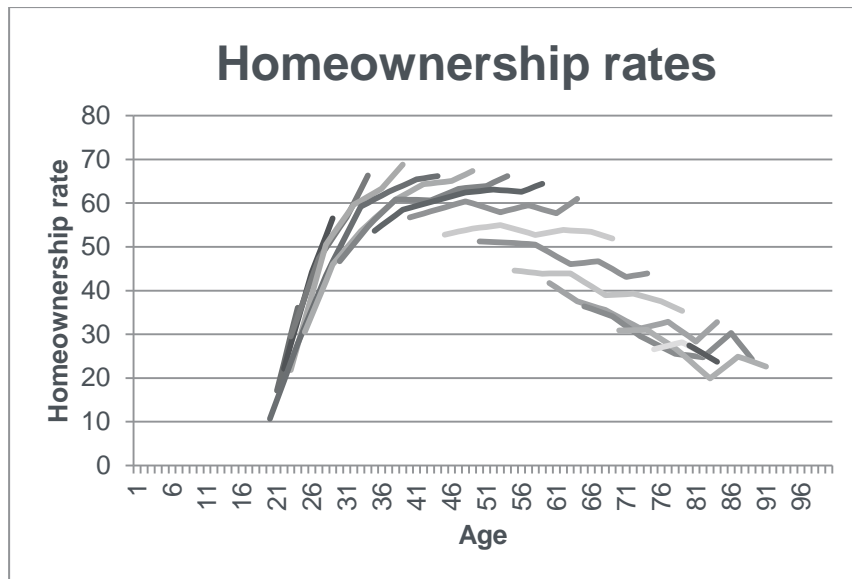


Figure 1: Homeownership in synthetic age cohorts

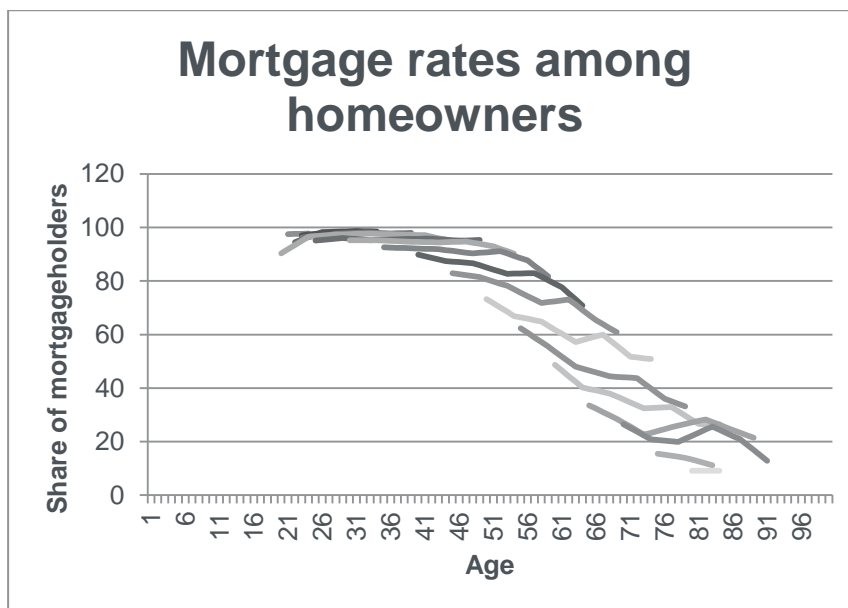


Figure 2: Development of the relative number of mortgages among homeowners

In Figure 2 we show the development of the share of homeowners with at least one mortgage for the same age cohorts. The share is very high among the young and it decreases for higher ages. This is consistent with a large share of households who stick to the mortgage contract which they accepted when buying the house. Notice, however, that there are important cohort effects: the share of owners that still has a mortgage at a given age increases when we move to younger cohorts. An intriguing issue is that the lines are not monotonically decreasing: they move upwards between 1998 and 2002 for most of the older cohorts. This could be related to a tax reform around the year 2000 that introduced lower taxation on received interest payments and other returns on assets received while keeping the deductibility of mortgage interest

paid unchanged. This increased the incentive to maximize the mortgage size that is central in Brueckner's (1994) model, and may therefore be interpreted as evidence in favor of that model. Nevertheless, this effect seems to have been a temporary effect. Indeed, in 2004 the Dutch government restricted the tax deductibility for mortgage loan extensions to investments in the house, which removed much of the incentive for tax arbitrage.

LTV ratios are only available since 2002, when WBO switched to WoON. They are shown in figure 3. There is a strong cohort effect as the LTVs for younger cohorts are consistently higher than those of older cohorts at all ages. It is remarkable that some lines are (partly) upward sloping, which indicates that for some cohorts the LTV ratios increase over time. However, the increases are relatively small, except for the oldest cohorts for which the number of observations is small.

Figure 3 is based on all homeowners who bought their house before 2002. This implies that movers (including movers which are homeowners but changed their house during this period) do not affect the curves. The downward trend (which is observed in most of the cohorts) illustrates the elderly home equity puzzle. The average LTV-ratios of homeowners between the ages of 75 and 91 are smaller than 10%.

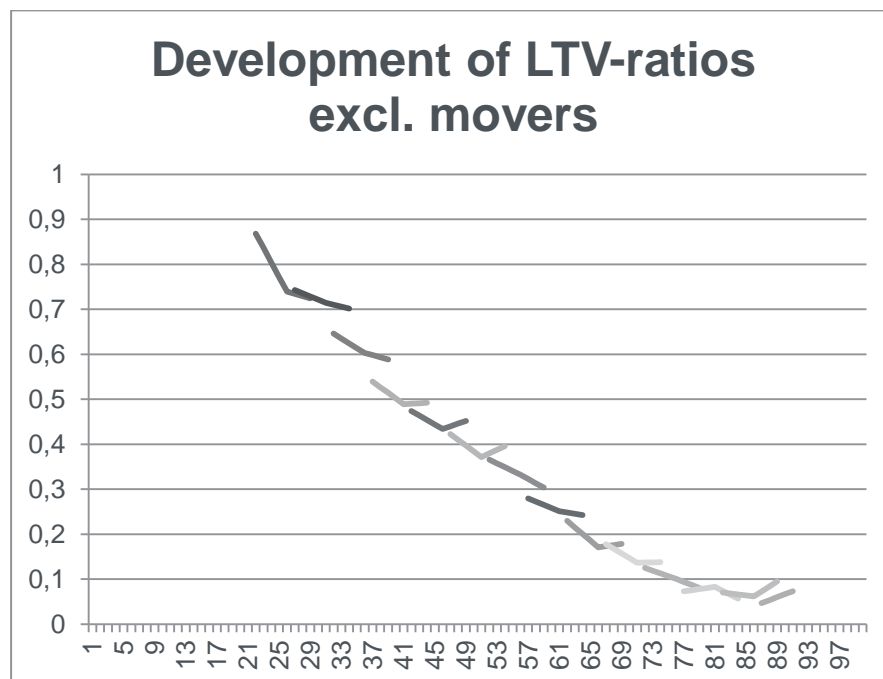


Figure 3: Development of LTV-ratio for synthetic age cohorts excluding movers in 2002-2009

4 The demand for mortgage debt: an empirical analysis on cross-section data

In this section we report a number of results based on the most recent cross section data available: the WoON2009 survey. We start with a simple equation in which mortgage demand is explained by the purchase price of the house, the price change after it has been bought (which is specified as the current value of the house minus the purchase price of the house). The impact of self-amortizing mortgage contract is included by a cross term of the initial purchase price and the elapsed duration of stay. To investigate the effect of age on the propensity to liquefy increases in housing wealth the age of the head of the household is crossed with the price change. Recall from the discussion in earlier sections that elderly households should be expected to be less reluctant to liquefy such (unexpected) gains than younger generations. For this reason this specification appears to be a good one to start with. The estimating equation is:

$$MD = \alpha_0 + \alpha_1 PP + \alpha_2 (DR * PP) + \alpha_3 dP + \alpha_4 ((Age - 20) * dP) + \varepsilon$$

Where MD denotes mortgage demand. The α 's denote the constant and the coefficients of the purchase price (PP), the crossterm of the duration of residence (DR) and the purchase price (PP), the price change (dP), and the crossterm of age (minus 20 years) and the price change (dP). To generate the expected U-shaped pattern, elderly households should be more inclined to liquefy increases in the value of their house than others. Control variables for income, the level of education and the location of the house have been included in all analyses as well, but are not presented in the tables. The demand equation will be estimated by applying ordinary least squares (OLS) and tobit regressions.

A possible concern with this equation is that the purchase price is endogenous. It is determined simultaneously with the size of the mortgage when buying the house. For instance, households with easier access to mortgage loans for unobserved reasons could bid more for a house (see Adelino et al., 2011). It is conceivable that those with a relatively large mortgage demand are also those who accept a higher house price easier, which suggests a correlation between the purchase price and the error term in the mortgage demand equation. Therefore we instrument the house price with the 5-year average local house prices per postcode (which come from the "Nederlandse Vereniging van Makelaars"). We also instrument the cross term (DO*PP) using the analogously crossed 5-year average local house prices per postcode as instruments.

The instrumental variables tobit model follows Newey (1987). When performing the first stage (2SLS) regressions, the F-statistics are large in all first stage regressions, implying that the instruments can be considered as strong.

	OLS	Tobit	IV 2SLS	IV Tobit
Purchase price	0.574***	0.606***	0.665***	0.674***
Dur of own * purchase price	-0.020***	-0.023***	-0.022***	-0.031***
Price change	0.420***	0.537***	0.443***	0.535***
(Age-20)*price change	-0.009***	-0.012***	-0.009***	-0.012***
Constant	30537***	12340***	21568***	12962***
R ²	0.38		0.37	
First stage F (PP)			2807	2807
N	37111	37111	36703	31998

*, ** and *** indicate a 10%, 5% and 1% confidence interval with robust standard errors. The estimated equation also includes control variables for income, level of education and the location of the house

Table 2: Estimation results

The coefficient of the purchase price is significantly positive, and substantially smaller than one in all cases. Especially the more expensive houses are not completely financed by mortgage loans as they are often bought by households who have already accumulated some equity in their former house. The cross term of duration of ownership and the purchase price has a significant negative effect on mortgage demand, which confirms the expectation that many households (at least partially) pay off mortgage debt. The price change has a large and statistically significant positive effect on mortgage demand. The order of magnitude is that of the ‘housing wealth effect’ on consumption suggested by Case et al. (2005). This result may be interpreted as confirming that this effect, or alternatively the effect of improved expectations on future productivity, is realized (partly) by extensions of mortgage loans as was suggested by, for instance, Muellbauer and Murphy (1990). The cross term (age-20) times the price change illustrates that this effect is *decreasing* along with age. We note that the net effect of a price change on mortgage demand turns *negative* around the age of 65-70 years old. Contrary to the suggestion of life cycle theory, it seems like the old only wish to pay off mortgage debt. Even large increases in home equity do not induce them to increase mortgage debt for consumption purposes.

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	OLS	Tobit	IV 2SLS	IV Tobit
Purchase price	0.497***	0.511***	0.621***	0.626***
Price change	0.239***	0.233***	0.264***	0.257***
(Age-20)*price change	-0.003***	-0.003***	-0.003***	-0.003***
Dur of own * purchase price	-0.013***	-0.015***	-0.018***	-0.019***
TP1900	9115	-42306***	46036***	-4885
TP1960	-6551	-57927***	23837***	-29322***
TP1965	-13072**	-46473***	19843***	-14508**
TP1970	-15176***	-36920***	18870***	-4176
TP1975	-14942***	-24037***	19171***	8401
TP1980	-13187**	-16061***	19019***	14544**
TP1985	-21959***	-23069***	7330	4652
TP1990	-23070***	-22749***	2980	1880
TP1995	-18171***	-15949***	1175	2236
TP2000	983	2959	9378***	10848***
age30	13116***	13855***	10412***	11341***
age35	16412***	17202***	9426***	10666***
age40	5788**	6792**	-2838	-1247
age45	-5606**	-5282*	-15446***	-14447***
age50	-13037***	-12337***	-22156***	-20825***
age55	-28069***	-28710***	-37334***	-37164***
age60	-47430***	-52827***	-57349***	-61812***
age65	-62657***	-74892***	-72192***	-83393***
age70	-68903***	-87769***	-77862***	-95449***
age75	-85481***	-119317***	-95783***	-128458***
age80	-95276***	-159509***	-103227***	-165040***
age85	-90086***	-161015***	-97715***	-165970***
Constant	66702***	58604***	48638***	41820***
R ²	0.42		0.41	
First stage F (PP)			1032	1032
N	37111	37111	36703	36703

*, ** and *** indicate a 10%, 5% and 1% confidence interval with robust standard errors. The estimated equation also includes control variables for income, level of education and the location of the house

Table 3: Estimation results including time period and age dummies

In alternative estimations, not reported in the table, we have used regional house prices in 2007 as instruments while, in a third variant, we followed Brueckner's (1994) suggestion to use housing characteristics as instruments by using the surface of the living room, dummy variables for the house type and cross term variables which multiply the living period by the house dummy variables as instruments. The regional house price refers to a much larger area than the postal code area, which makes it perhaps better suited as an instrument than the five-year average of a small postal code area. It can be argued that the Brueckner's (1994) suggestion to use housing characteristics as instrument does not entirely solve the endogeneity problem, since housing characteristics are determined by the same choice process as the house price and the mortgage loan. The results are robust through all these specifications.

One can argue that the size of mortgage debt is also determined by the period in which the house was bought, since house prices increased rapidly during the past decades. In the next analysis we extend the basic formulation of our model by including dummy variables representing different periods of time. Moreover, we also add dummy variables for 5-year age groups to investigate the presence of an age effect that is independent of the price change. The estimating equation is:

$$MD = \alpha_0 + \alpha_1 PP + \alpha_2 dP + \alpha_3 ((Age - 20) * dP) + \alpha_4 (DO * PP) + \beta_1 TP1900 + \beta_2 TP1960 + \beta_3 TP1965 + \dots + \beta_{10} TP2000 + \gamma_1 age30 + \gamma_2 age35 + \dots + \gamma_{12} age85 + \varepsilon$$

The results, reported in table 3, still do not show a U-shaped pattern of mortgage debt, but strongly confirm the presence of the elderly home equity puzzle. In all analyses, mortgage debt is rapidly decreasing along with age (from age35 onwards). The coefficients of the oldest age groups show that elderly are not decumulating home equity by means of mortgage maximization.

To investigate this issue further we report separate estimations of the demand equation for different age groups in Table 4. This allows all coefficients to change with age and therefore allows more flexibility. Table 4 shows a consistent pattern for the coefficients among the age groups. The coefficients of the purchase price are decreasing in age. Since older households bought their current house on average a longer time ago (as housing mobility decreases sharply with age), this confirms the trend towards larger LTV ratios at the time of purchasing a house⁵. The absolute value of the coefficient of the cross-term of purchase price and elapsed duration of stay decreases in age, suggesting that repaying the mortgage is more important for the young than for the old. If elderly people still have a mortgage, they seem to be less eager to repay it than the younger. This is in line with the popularity of the interest only mortgage among elderly people and it may be interpreted as being in line with life-cycle theory. However, we still find that the propensity to increase the mortgage loan in response to a change in the value of the house is strongly *decreasing* in the homeowner's age. Neither the coefficient of the uncrossed price change since the time of purchase nor that of the cross term with age show a consistent relationship with the age of the owner, but the net effect is clearly decreasing, starting at roughly 0.25-0.35 among the young and gradually decreasing to 0.05-0.10 among the old. The results confirm that demand for

⁵ Note that the constant terms are also decreasing in age.

mortgage debt does *not* follow the U-shaped path which was suggested in section 2, since the old are reducing mortgage debt rather than increasing it.

Another possible concern without results is that second mortgages can be used for financing investments in the house, which may in turn affect the housing price. This may be especially relevant for the most recent years, because a change in the tax rule in 2004 implied that mortgage interest paid on second mortgages is only deductible from taxable income when the money is used to finance investments in the house.

We should note, first of all that not all such investments have an effect on the value of the house. Owners may choose to finance substantial maintenance or repair outlays by a second mortgage. Even if they invest in quality, like a better kitchen or an improved bathroom it may be the case that the idiosyncrasy of their tastes precludes a substantial effect on the value of the house. There are numerous stories about families moving into another house and immediately replacing the kitchen and bathroom with something of their own taste, independent of their technical condition.

If the investment in the house would result in a non-negligible change in its value, the result will be that the current price is higher than it would have been without the investment, and the second mortgage used to finance it. In our estimating equation the price change is therefore too high, and this will result in a downward bias on our estimated coefficient for the price change. Unfortunately our data contain little information about such investments. Respondents are only used to indicate investments that took place in the previous year. We must therefore conclude that our results probably provide an underestimate of the impact of the change in the house price on the size of the mortgage.

Although our a priori expectations of the potential explanatory power of a bequest motive are low, as explained earlier in this paper, we have investigated this issue by repeating the analysis for households with and without children. We found qualitatively similar results for both groups when we replicated the regressions of Table 3 and 4. The impact of the original purchase price was usually larger for children with households, which may have to do with a stronger demand for housing associated with larger family size, and more binding liquidity constraints that are related to the larger consumption expenditures associated with the presence of children in the household. The difference in the impact of age on mortgage demand in both groups was negligible.

The demand for mortgage debt, increases in house prices and the elderly home equity puzzle

	age 20-29	age 30-39	age 40-49	age 50-59	age 60-69	age 70-79	age 80-89
OLS							
Purchase price	0.563***	0.670***	0.602***	0.460***	0.364***	0.175***	0.050
Dur of own*pp	-0.042***	-0.036***	-0.025***	-0.011***	-0.007***	-0.002	0.000
Price change	0.254**	0.185	0.738***	0.566***	0.483***	0.618***	-0.038
(Age-20)*Δprice	0.003	0.001	-0.022***	-0.013***	-0.009***	-0.010***	0.001
Constant	83389***	61117***	47857***	41436***	7936	18186	38576**
N	2421	7219	8805	7765	6405	3106	982
Tobit							
Purchase price	0.570***	0.671***	0.604***	0.466***	0.370***	0.183***	0.026
Dur of own*pp	-0.045***	-0.036***	-0.025***	-0.011***	-0.007***	-0.002	0.002
Price change	0.249***	0.186***	0.760***	0.601***	0.652***	1.071***	-0.028
(Age-20)* Δprice	0.003	0.001	-0.023***	-0.014***	-0.013***	-0.018***	0.001
Constant	79880***	60550***	45578***	36583***	-12510	-31970**	-40600
N	2421	7219	8805	7765	6405	3106	982
IV 2SLS							
Purchase price	0.712***	0.798***	0.686***	0.587***	0.392***	0.115	-0.058
Dur of own*pp	-0.046***	-0.028***	-0.037***	-0.011**	-0.005	0.005	0.005
Price change	0.354***	0.213	0.724***	0.646***	0.490***	0.637***	-0.001
(Age-20)* Δprice	-0.002	0.002	-0.021***	-0.014***	-0.009***	-0.010***	0.001
Constant	62825**	37086***	33268***	11619	577	31277	61357***
N	2421	7219	8805	7765	6405	3106	982

The demand for mortgage debt, increases in house prices and the elderly home equity puzzle

	age 20-29	age 30-39	age 40-49	age 50-59	age 60-69	age 70-79	age 80-89
IV Tobit							
Purchase price	0.717***	0.798***	0.688***	0.584***	0.387***	0.045	-0.394*
Dur of own*pp	-0.048***	-0.028***	-0.037***	-0.010***	-0.005	0.008	0.020***
Price change	0.352***	0.214***	0.746***	0.681***	0.657***	1.092***	0.105
(Age-20)* Δprice	-0.002	0.001	-0.022***	-0.015***	-0.013***	-0.019***	-0.001
Constant	59085***	36651***	31130***	8722	-17050	-1075	48529
N	2421	7219	8805	7765	6405	3106	982

*, ** and *** respectively indicate a 10%, 5% and 1% confidence interval with robust standard errors. In these analyses the TP dummy variables and control variables have been included, but are not presented in the table. The first stage F-statistic (PP) is not presented either, but is significant in all estimations.

Table 4: Estimation results per age group

5 Panel study based on synthetic age cohorts

In this section, elderly saving behavior will be investigated further by focusing on the change in mortgage demand over time rather than the level of mortgage demand. The repeated cross-section character of the WBO/WoON data offers the opportunity to set up synthetic age cohorts and use the cross-sectional waves for a panel study. The size of the mortgage loan is only available since 2002, so we can only use the last three cross sections. The method of synthetic cohorts was introduced by Deaton (1985). Mean values of age cohorts rather than individual (micro-level) data are used, which reduces the number of observations substantially. To limit the damage done by this transformation, we distinguish synthetic cohorts *per postal code*, which implies that we still have 6790 – 7646 data-points for all periods. Since residential mobility is low, especially among the older cohorts, and often refers to moves over very short distances, this spatial subdivision should not be expected to be problematic. Table 5 provides the median change in mortgage demand (MD) and the median change in house prices over time. In line with Table 1, the *average* change in mortgage demand is also shown.

	2002-2006	2006-2009	2002-2009
All age categories			
Median Price change	41598	11347	49714
Average Price change	55921	13688	62663
Median Mortgage Change	2269	2863	2836
Average Mortgage Change	9603	5596	10524
N	7331	7646	6790
Age below 67			
Median Price change	40000	10473	48404
Average Price change	52755	15630	62184
Median Mortgage Change	6401	7227	8622
Average Mortgage Change	11843	6854	13630
N	5973	6127	5577
Age 67 and older			
Median Price change	52227	4413	59360
Average Price change	67835	2069	65219
Median Mortgage Change	0	0	-2871
Average Mortgage Change	-982	-522	-2925
N	1191	1190	1097

Table 5: changes in mortgage demand and house prices over time

According to section 2, elderly households are expected to increase mortgage debt in order to decumulate home equity during their final stage of life. In section 4, we did not observe such an increase. We now want to check if this conclusion still holds if we introduce a time dimension and are therefore better able to check what happens in the course of time. We thus perform a regression which considers the change in mortgage debt and explain it by the change in the current value of the house. In order to take the age-related differences in behavior into account, we include the same cross term as

before. This results in the following estimating equation where MD denotes mortgage demand and CV denotes the current value of the house:

$$(MD_t - MD_{t-1}) = \alpha_0 + \alpha_1(CV_t - CV_{t-1}) + \alpha_2(\text{Age} - 20) * (CV_t - CV_{t-1}) + \varepsilon$$

ALL	2002-2006	2006-2009	2002-2009
Price change	0.457***	0.374***	0.422***
(Age-20)*price change	-0.0070***	-0.0052***	-0.0071***
Constant	-2541*	2215	-1165
R ²	0.12	0.09	0.08
N	7331	7646	6790

*, ** and *** indicate a 10%, 5% and 1% confidence interval with robust standard errors.

Table 6: Regression results of synthetic cohort analyses excluding new homeowners and movers.

The regressions are based on a sample which excludes new homeowners and movers in the second period, such that the results indicate mortgage demand of households that remain in the same house during the sample period. In all regressions differences between two years are compared. The last column of the table thus relates the change in the mortgage size tot that in the price over a longer period than the other two columns.

The results show a significant positive effect of the change in the current value of the house on the change in mortgage debt. The cross-term has a negative coefficient, implying that the older the household is, the smaller the effect of a change in the current value of the house on mortgage debt is. The results suggest that the young will increase mortgage debt when they can, probably because they are more liquidity constrained. The old however do not take on additional mortgage debt. The age in which the effect of a change in the current value of the house crosses zero is 79 for the time interval 2002-2009. Again we reject the hypothesis that the old increase their mortgage debt.

To take a closer look at the effect of age, we ran separate regressions for the young and middle-aged (age smaller than 67 in 2009) and for the old (age 67 and older). The results in tables 7 and 8 show significant effects only for the young, when we consider the short time windows (2002-2006 and 2006-2009). When we consider the longest time period, we find significant effects for both groups. This can be explained by the longer time interval, which implies that households have more time to realize increases in mortgage debt in response to changes in the value of their house, and this appears to be important for the elderly.

The net effect of a one euro price change since the time of purchase on the size of the mortgage for a 67 year old (which is the youngest in the 'old'-sample) according to column 3 of Table 8 is 0.114. Interestingly, this is almost perfectly in line with the effect of a price change on mortgage demand in the corresponding estimations for the age60 and age70 groups in table 3. According to column 3 of Table 8 the age at which the net effect of a price change crosses zero (and gets insignificant) is 80. This corresponds to the estimations for the age80 group as well. Figure 4 depicts the response to a 100.000

increase in house value (using the estimation results of all ages in Table 5 (labeled ALL) and of the old in Table 7 (labeled 67+), in both cases based on the 2002-2009 period. Both results are very much in line with each other. The small net effect of a price change among the old rejects the idea that the old are actively decumulating home equity while they age.

Age below 67	2002-2006	2006-2009	2002-2009
Price change	0.476***	0.433***	0.435***
(Age-20)*price change	-0.0075***	-0.0065***	-0.0077***
Constant	-1702	2632*	413
R ²	0.13	0.11	0.08
N	5973	6127	5577

*, ** and *** indicate a 10%, 5% and 1% confidence interval with robust standard errors.

Table 7: Regression results of young and middle-aged (below 67 years old) synthetic cohort analyses excluding new homeowners and movers.

Age 67+	2002-2006	2006-2009	2002-2009
Price change	-0.026	-0.117	0.528***
(Age-20)*price change	0.0026	0.0035	-0.0088**
Constant	-8168	-688	-7969**
R ²	0.05	0.02	0.03
N	1191	1190	1097

*, ** and *** indicate a 10%, 5% and 1% confidence interval with robust standard errors.

Table 8: Regression results of old (63-82 years old) synthetic cohort analyses excluding new homeowners and movers.

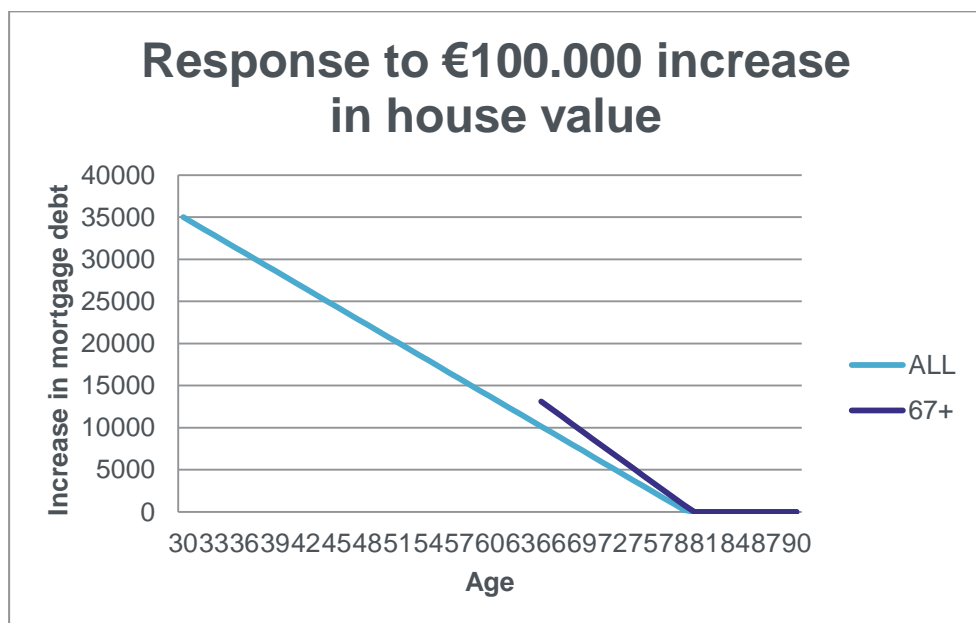


Figure 4: The response of ALL and the old (67+) to a €100.000 increase in house value

6 Conclusion

This paper studied the impact of house price changes and age on the demand for mortgage debt. We find a strong positive effect of increasing house prices for the young but a much smaller impact for elderly homeowners. The latter finding contradicts conventional life cycle theory. Contrary to the US, the Netherlands provides health care publicly, which makes it difficult to attribute this result to a strong precautionary savings motive.

In the literature review four specific expectations about the development of optimal mortgage debt over the lifecycle is discussed: (a) the size of the mortgage is large relative to the value of the house just after it is bought, (b) it tends to decrease over time as most mortgage contracts are self-amortizing, (c) increases in the value of the house may lead to extensions of the mortgage through refinancing or taking a second mortgage, (d) mortgage demand is U-shaped over the life cycle, which implies an increase in mortgage demand in later life.

Our empirical estimations of mortgage demand provide support for (a), (b) and (c). However, the support for (c) is strong among the young, but decreases along with age (ending up either small or insignificant among the oldest old). The impact of price changes on mortgage demand among younger homeowners is large and can be interpreted either as being consistent with a substantial causal effect of house prices on consumption (as argued by Case et al., 2005) or with a substantial increase in demand caused by a general economic upswing that is facilitated by easy mortgage credit (as argued by Muellbauer and Murphy). Our results contradict (d), since the increase in mortgage debt among the oldest old is not observed in any of the analyses. Note that this finding is in line with those of Attanasio et al.

Altogether, it can be concluded that the vast majority of elderly do not use mortgage debt as an instrument to decumulate home equity, even in absence of a strong precautionary savings motive like in the US and with subsidized mortgage interest rates. Our analysis suggests that the elderly home equity puzzle persists.

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Appendix. The Dutch income tax

Anticipating our empirical work, some aspects of the tax treatment of homeowners in the Netherlands will now be discussed. Mortgage interest deductibility has been part of the Dutch income tax since its introduction in the beginning of the 20th century. Initially the general rule was that paid interest could be subtracted from taxable income, while interest received was taxed. The marginal tax rates for interest paid and interest received were thus equal. In the course of time, limitations on the tax deductibility of interest paid were imposed and ultimately only the deductibility of interest paid on mortgage loans was maintained. Although interest received was taxed like labor income, this was not true for other types of income from capital. There was a capital tax of 1% and on top of that dividends were taxed as income, but capital gains remained untaxed. In this situation the value of r_m/r_s was larger than one for someone investing in a conventional savings account, while it was a random variable with an expected value smaller than 1 for someone investing in stocks. The predictions of the mortgage demand model for this case thus depend on the risk aversion of the household. One should expect that a substantial fraction of the households will choose to minimize the value of the mortgage loan in this situation.

In 2002 a new capital tax was introduced. The tax on labor income remained essentially unchanged, and mortgage interest paid remained deductible from taxable labor income. All income from capital (including conventional saving accounts) was now taxed at a 30% rate on the basis of imputed returns of 4%. This implies a tax rate of 1.2% on all assets owned by a household, except the home. This means that maximizing the mortgage loan will be attractive to a household using a conventional savings account (which can be regarded as almost certain) unless the interest rate on conventional savings is very low. This means that even for very risk averse households it was now attractive to maximize the mortgage loan⁶.

In 2004 there was again a change in the tax system. First time home buyers were still allowed to deduct mortgage interest paid on the mortgage they accepted when buying their house, but interest paid on later extensions of the loan were not automatically deductible. There were two conditions under which the extra mortgage interest was still deductible. If the additional borrowed money was used to finance improvement of the house or if it was used to finance the difference between the revenues of selling the current house and the price paid for the next house. The second condition implies that homeowners could no longer substitute equity that has been accumulated in the house for a larger mortgage and claim mortgage interest deductibility for the increase in the

⁶ In the Netherlands the net interest rate on mortgages is equal to the gross mortgage interest rate times one minus the marginal tax rate. The latter is 55% for those with a high income. The net mortgage interest rate is therefore equal to 45% of the gross rate for high income households. Returns on savings and other investments are taxed on the basis of imputed returns of 4% against a constant rate of 30%. This means that net returns on savings and other investments are equal to gross returns minus 1.2%. The implication is that even if the interest rate on a savings account is somewhat lower than the gross mortgage interest rate, the net returns on savings will be higher. For instance, if the interest rate on a savings account is 4%, and the gross mortgage interest rate is 6%, net returns on savings are higher than the net mortgage interest rate.

mortgage size. It remained attractive to maximize the size of the mortgage loan when buying a house for the first time, but not to extend the loan.

The 2004 change in the tax system was clearly meant to limit the growth in tax deductions of mortgage interest payments and can therefore be interpreted as evidence in favor of the mortgage demand model discussed in section 2. For the period starting in 2004 this model predicts a simple basic strategy for homeowners: maximize the size of the mortgage loan when buying the house, and stick to the mortgage contract unless you want to improve your house or move to another one. In the first case, increase your mortgage by the size of the investment. In the second increase your mortgage by the price difference between the new and the old house.

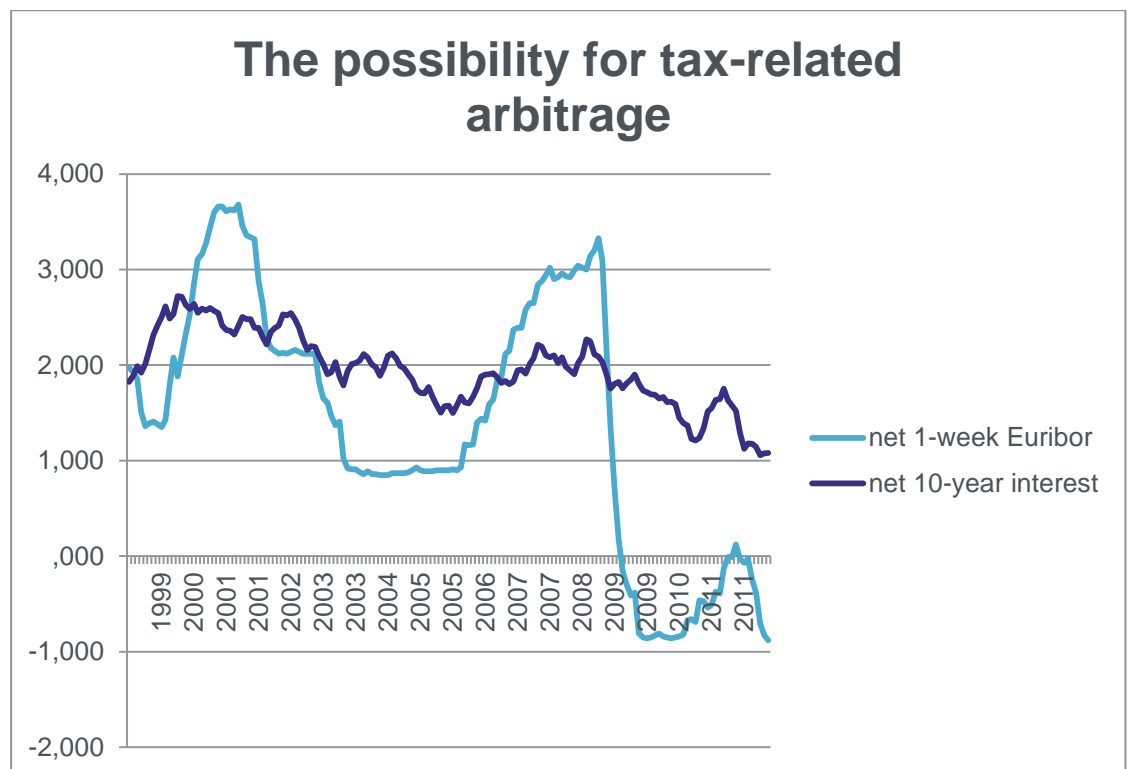


Figure A1: Development of net interest rates (own calculations based on DNB-data)

The net 1-week Euribor rate is an indicator for the risk free savings rate. The blue line in Figure A1 indicates the Euribor rate minus 1.2%-point. The red line indicates the 10-year interest rate multiplied by 0.52. The Figure therefore shows that during limited time periods (200-2002 and 2007-2009) it was beneficial to maximize the size of the mortgage loan and put the money on a bank account. It should, however, be noted that the difference between the two lines is small, that interest rates on bank accounts are in general somewhat lower than the Euribor rate and that mortgage interest rates are usually somewhat higher than the 10-year interest rate⁷. Moreover, there are significant transaction costs involved in mortgage refinancing. It seems therefore fair to conclude this arbitrage possibility was not of much significance.

⁷ We are currently looking for better data to document this

De activiteiten van de Amsterdam School of Real Estate zijn mede mogelijk dankzij de financiële steun van de Stichting voor Wetenschappelijk Onderwijs en Onderzoek in de Vastgoedkunde (SWOOV)

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November 2012