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**Conference Paper**

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52nd Congress of the European Regional Science Association: "Regions in Motion - Breaking the Path", 21-25 August 2012, Bratislava, Slovakia

**Provided in Cooperation with:**

European Regional Science Association (ERSA)

Suggested Citation: Rouwendal, Jan; de Graaf, Marcus (2012) : The demand for mortgage debt, increases in house prices and the elderly home equity puzzle, 52nd Congress of the European Regional Science Association: "Regions in Motion - Breaking the Path", 21-25 August 2012, Bratislava, Slovakia, European Regional Science Association (ERSA), Louvain-la-Neuve

This Version is available at:

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

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*This version: February 17, 2012*

## **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 argue that the absence of a downpayment constraint is important and focus on two other issues. The first is the impact of the prolonged boom in house prices in the period 1985-2005, which makes it interesting to investigate how much of this increase in housing wealth has been 'cashed' by households. The second is the elderly home equity puzzle, or the habit of elderly people to leave their housing wealth untouched when aging. Recent analyses for the US have suggested that this behavior may be caused by the combination of a strong precautionary savings motive and a high risk of large health care costs. However, in the Netherlands long term care is publicly financed, which makes this explanation unlikely to be valid. It is therefore interesting to see if Dutch households liquefy substantial parts of their housing wealth by increasing the size of the mortgage loan.*



## 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 are lower than on other consumption loans. 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 is realized. They also offer elderly households the possibility to liquefy some of their home equity without having to move, which could provide a partial explanation of the elderly home equity puzzle.

It is therefore somewhat surprising to observe that the demand for mortgage debt is not intensively studied in the economic literature. In this paper we contribute to that literature by investigating the demand for mortgage debt. We concentrate on two issues: the role of house price increases and the demand of the elderly.

The theoretical background of our analysis is the lifecycle theory (Modigliani and Brumberg, 1954), which tells us that households smooth consumption over their lifetime. Mortgages can contribute to the realization of this goal since they relax the constraint on house purchases implied by one's saving. As noted above, they are also potentially helpful in transmitting gains in housing wealth resulting from house price increases into consumption expenditure which can be of special importance to elderly households intending to consume most of their wealth towards the end of the lifecycle.

Our empirical work refers to the Netherlands which is an interesting country to study the demand for mortgage debt for several reasons. First, like 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 2005 real house prices more than tripled, 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 Americans, 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 34. In section 54 we proceed to estimation of mortgage demand equations on cross section data. In section 65 we present a panel analysis based on synthetic age cohorts. Section 76 concludes.

## 2. Literature and research strategy

### 2a) 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 the downpayment constraint is an important restriction for first-time homebuyers who often did not have the chance to save much. In the Netherlands, to which our empirical work refers, this constraint is less relevant because mortgage insurance is cheap 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 a downpayment constraint a payment-to-income constraint is often relevant at the time of purchasing a house. However, incomes change over time and it is therefore hard to use this constraint in a mortgage demand equation unless one is informed about past incomes.

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 over time.

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 households will maximize the size of their mortgage loan. That is, they will increase the size of their loan until either the downpayment constraint or the mortgage payment-to-income 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. Although in this situation the ratio can become smaller than 1, it is documented in the Appendix that actually this never happened. This leaves the possibility open that the ratio is smaller than one for households investing in risky assets that have a higher expected net return than the net mortgage interest rates. However, Brueckner (1994) shows that in this situation 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, but do not want to become outright owners.

For such households increases in the value of their house may be a reason to withdraw some of the home equity and invest it in other assets. This suggests that we should include the increase in the value of the house since the time of buying as an additional determinant of the size of the mortgage loan. Apart from the desire to invest some wealth in assets with an expected return that is higher than the net mortgage interest rate, there is an important other reason for this behavior: the housing wealth effect.

Muellbauer and Murphy (1990), Case, Quigley and Shiller (2005, 2011) and others have argued that there is a strong impact of house prices on consumption. They 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 these two variables is due to the business cycle that affects both. For the purposes of the present paper it is relevant to observe that the increase in consumption implies a reduction in savings which may well become negative during a boom period. To finance the additional consumption, consumers may decide to increase the size of their mortgage debt. Indeed, mortgage debt is the cheapest type of debt that is available to consumers and they should be expected to prefer a higher mortgage to other types of consumer loans even in the absence of mortgage interest deductibility. The only drawback of mortgage credit is the high transaction costs involved with refinancing or taking a second mortgage.

Indeed, because the house serves as a collateral, the mortgage is the most attractive type of loan for the consumer, and it seems probable therefore that consumers who want to borrow in order to increase consumption do so by increasing the mortgage.

## 2b) The elderly home equity puzzle

The incentive to increase the size of the mortgage loan for consumption purposes should, according to many life cycle models, become stronger when the consumer ages. The reason is

that utility maximizing consumers want to consume all their resources before passing away. However, it has been observed repeatedly that homeowners often do not move to smaller or rental housing after retirement (see, among others, Venti and Wise, 1989, 1990, 2004 and Feinstein and McFadden, 1989). This is called the elderly home equity puzzle.

There are several ways in which one may try to solve this puzzle. The most obvious one is to introduce a bequest motive into the lifecycle model (see, for instance, Kotlikoff and Summer, 1981 and Hurd, 1987). However, careful considerations on the validity of this explanation, for instance by comparing elderly with and without children, have in general not found much evidence for a strong bequest motive of the average elderly person.

A second important consideration is uncertainty. It's not attractive to run out of resources at the end of one's lifetime. 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.

It has also been argued recently that there could be a strong relationship between the high costs of long term care and the large amounts of wealth kept by the elderly until advanced age. If a strong precautionary savings motive is present, even a small probability that large expenditures will be necessary in the future can induce people to keep large amounts of wealth (Kimball, 1990). If nursing home care is not provided by public health care, as is the case in the US, this can indeed provide a forceful incentive to keep large amounts of wealth.

In this line of thought home equity is an attractive asset, see for instance Skinner (2004) As long as one is healthy it provides returns in kind and when a move to a nursing home becomes unavoidable, selling the house provides the necessary means to finance the necessary long-term care. If one finally runs out of resources, Medicaid is a last resort. This suggests that a precautionary savings motive may be important as a possible explanation for the elderly home equity puzzle, especially when considered in combination with an operational bequest motive (Dyner, Skinner and Zeldes, 2002; Palumbo, 1999). 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. One difficulty with this explanation for the purposes of the present paper is that in the Netherlands, to which our empirical work refers, long term care is financed completely by the public sector. This implies that the precautionary savings motive should be expected to be much weaker among elderly homeowners than it is in the US.

In principle the home equity can be liquefied without moving by extending the size of the mortgage loan. An earlier literature has emphasized that housing wealth is not easy to liquefy. 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. Their model therefore 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 as well by the illiquidity of housing wealth. In the current circumstances where flexible mortgages are available, the relevance of this explanation seems limited and it is interesting to study if and to which extent elderly homeowners use the mortgage for this purpose, as we will do in the work reported below.

It is well known from the literature that demand for reverse mortgages, a product especially developed to relax the borrowing constraint for the elderly, is limited (see Skinner (1996) and Leviton (2001)). However, 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) argues that elderly frequently choose to liquefy some of their housing wealth by saving on the costs of maintenance. This suggests that constraints on liquefying wealth are still very strong.

The life cycle framework thus suggests that in the absence of a strong precautionary savings motive and strong borrowing constraint 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 may in many cases imply 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.

In this paper we investigate how elderly Dutch households deal with their housing wealth. To do so, our empirical work will 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.

### **3. The Data and some first results**

In this paper the WBO/WoON data are used, which contain a series of cross section household surveys containing information on the current house value, the presence and size of mortgage(s) and housing as well as household characteristics. Data are collected about every 4 years since 1981. The most recent wave was held in 2009. The questionnaires are modified and extended most of the times when a new wave was launched. There was an exceptionally large change in 2002, which is also indicated by the change in the name of the survey 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. When analyzing the data, 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 1985-2005. Real house prices more than tripled during a long boom period, with exceptionally large price increases in the late 1990s.

Wave	Median mortgage debt	Average mortgage debt	Median current value of the house	Homeownership rates (%)	Mortgage rates among homeowners (%)	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	74874	98087	205000	52.23	86.38	75043
2006	102000	126970	250000	53.70	86.59	55958
2009	130000	147989	250000	56.80	86.32	69149

Table 1: Descriptives of the WBO/WoON data

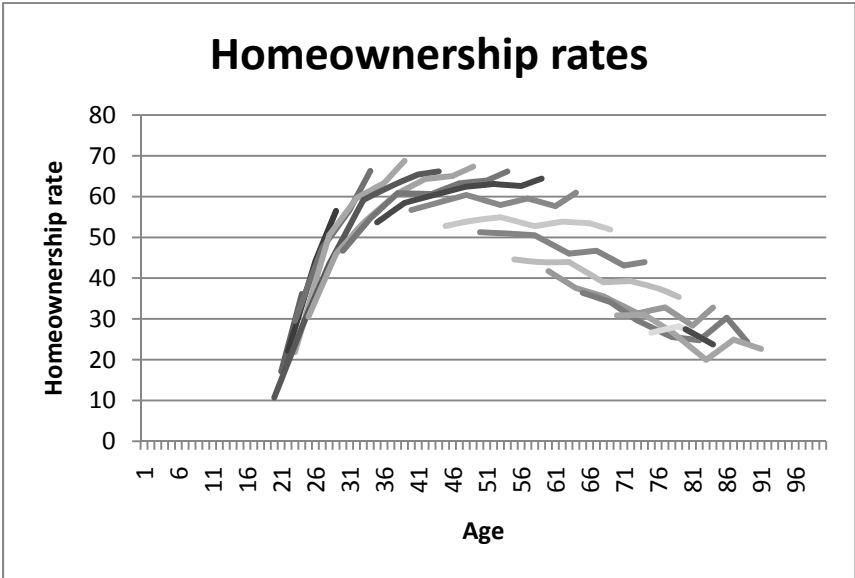


Figure 1: Homeownership in synthetic age cohorts

Figure 1 shows the development of homeowners among 5-year birth cohorts. It clearly shows the lower share of homeowners among the elderly, and also that this is largely a cohort effect. Among the relatively young cohorts homeownership rates are increasing. Among the middle-aged cohorts the rates are constant, while among the old cohorts the rates are somewhat

decreasing (this is in line with Van der Schors, Alessie and Mastrogiacomo, 2007). The decreasing homeownership rates start around the retirement age and continue in more advanced ages. However, the rate of decrease is small and homeownership rates among the very old are not much lower than at the time of their retirement. Nevertheless, 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)).

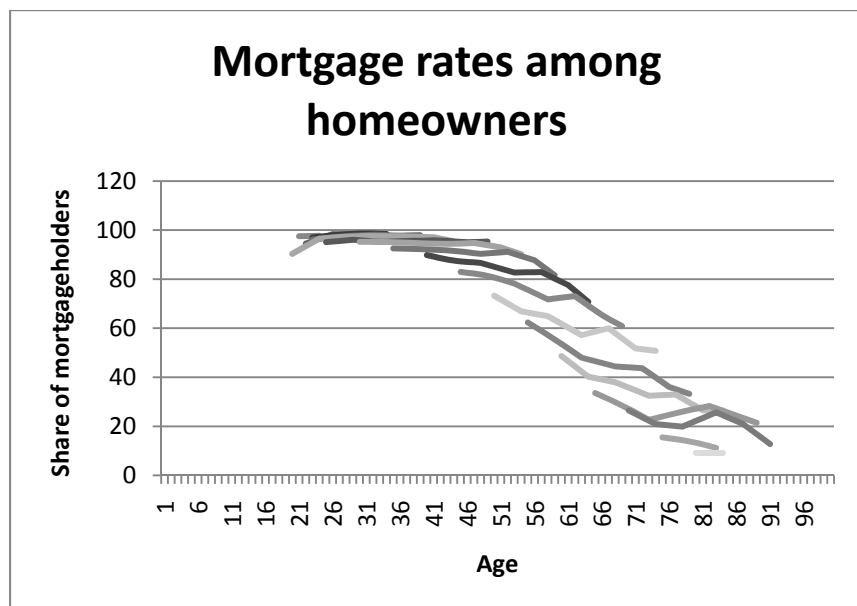


Figure 2: Development of the relative number of mortgages among homeowners

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 risk averse households who stick to the mortgage contract 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 a younger cohort. 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 interest payments received while keeping the deductibility of mortgage interest paid unchanged. This increases the incentive to maximize the mortgage size that is central in Brueckner's model, and may therefore be interpreted as evidence in favor of that model.

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.

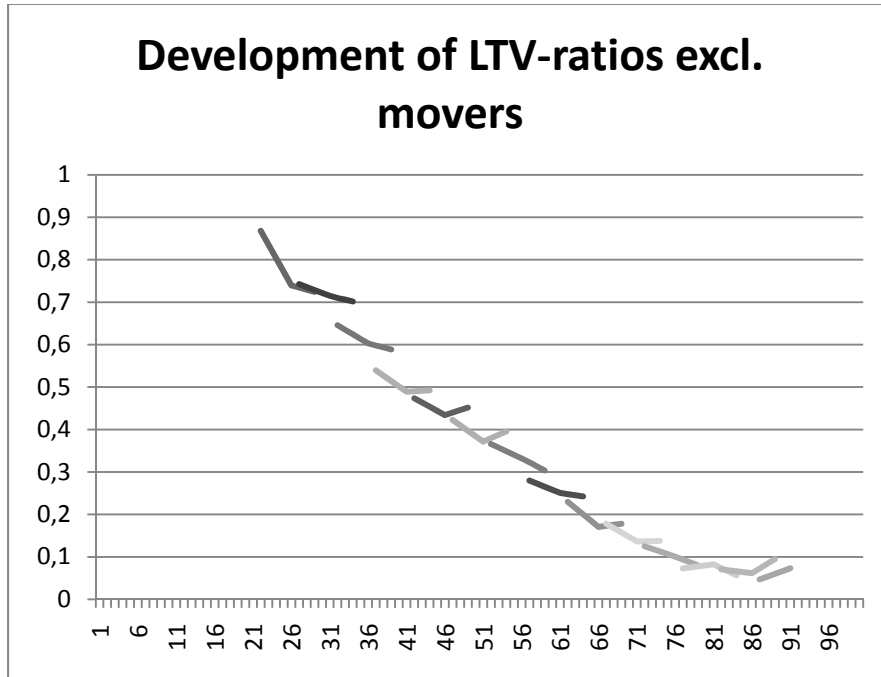


Figure 3: Development of LTV-ratio for synthetic age cohorts excluding movers in 2002-2009

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 findings. The downward trend (which is observed in most of the cohorts) shows that the elderly home equity puzzle clearly exists. The average LTV-ratios of homeowners between the ages of 75 and 91 are smaller than 10%. This implies that 90% of home equity is not liquefied among the oldest homeowners.

#### 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) and a crossterm of the period the household lives in the house and the purchase price.

The purchase price explains mortgage demand at the time of buying the house. The price change indicates the possibility to increase mortgage debt. When the current value of the house is

larger than the purchase price (i.e. a positive price change), a household could use the additional value for consumption purposes, or transfer money from the house to other investments with an expected return that exceeds the net mortgage interest rate, as is suggested by Brueckner (1994). by converting this value to mortgage debt (i.e. liquefying home equity). The number of years the household lives in the house indicates how far the household proceeded in repaying mortgage debt. The estimating equation which will be estimated is:

$$MD = \alpha_0 + \alpha_1 PP + \alpha_2 dP + \alpha_3 (DO * PP) + \varepsilon$$

Where MD denotes mortgage demand. The alphas denote the constant and the coefficients of the purchase price (PP), price change (dP) and the crossterm duration of ownership (DO) times the purchase price (PP). Control variables for income, the level of education and the location of the house have been included in the 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. 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. Brueckner (1994) therefore suggests to instrument the house price with housing characteristics, and we follow this suggestion.<sup>1</sup> We also instrument the cross term (LP\*PP) using the analogously crossed housing characteristics as instruments. The characteristics used are the surface of the living room, dummy variables for the house type and cross term variables which multiply the living period by the house type dummy variables. The instrumental variables tobit model follows Newey (1987).

The most recent wave (2009) of the dataset will be used for the regression analyses. When performing the first stage (2SLS) regressions, it appears that the F-statistics are significant in all basic analyses, implying that the instruments can be considered as strong. Additionally, testing for overidentifying restrictions (by Sargan test, or Amemiya-Lee-Newey test) does not reject the null hypothesis (that the instruments are not overidentified). Thus the instruments are valid and relevant. The results of the estimations are provided in table 2.

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<sup>1</sup> One may argue that these characteristics of the house are endogenous as well as they are important determinants of the house price. We will therefore use the average local house price as an instrument in an extension of the analysis that will be carried out in the coming weeks.

	OLS	Tobit	IV 2SLS	IV Tobit
Purchase price	0.585***	0.625***	0.672***	0.760***
Price change	0.076***	0.066***	0.118***	0.128***
Dur of own * purchase price	-0.022***	-0.027***	-0.038***	-0.051***
Constant	28794	10181***	35697***	18843***
R <sup>2</sup>	0.35		0.32	
First stage F (PP)			2238	2238
n	37111	37111	37111	37111

Table 2: Estimation results. \*, \*\* and \*\*\* indicate a 10%, 5% and 1% confidence interval;

The coefficient of the purchase price is large, but significantly 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 price change also has a significant positive effect on mortgage demand. The order of magnitude is that of the ‘housing wealth effect’ on consumption suggested by Case et al. (2004). This result may be interpreted as suggesting that this effect is realized in large part by extensions of mortgage loans as was suggested by, for instance, Muellbauer and Murphy (1990). The cross term has a significant negative effect on mortgage demand, which confirms the idea that households (at least partially) pay off mortgage debt, causing the mortgage debt to be smaller when the duration of ownership is longer.

One could 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 analyses we extend the basic formulation of our model by including dummy variables representing different periods of time. The corresponding estimating equation is as follows:

$$MD = \alpha_0 + \alpha_1 PP + \alpha_2 dP + \alpha_3 (DO * PP) + \beta_1 TP1900 + \beta_2 TP1960 + \beta_3 TP1965 + \dots + \beta_{10} TP2000 + \varepsilon$$

The betas denote the coefficients of the dummy variables for the time period (TP) in which the house was bought. We used 5-year periods (i.e. TP1960 represents the period 1960-1964), except for the first period (TP1900) which covers the time period 1900-1959. The most recent time period 2005-2009 is the reference period. The estimation results are provided in Table 3.

	OLS	Tobit	IV 2SLS	IV Tobit
Purchase price	0.457***	0.469***	0.558***	0.571***
Price change	0.111***	0.112***	0.114***	0.113***
Dur of own * purchase price	-0.014***	-0.016***	-0.026***	-0.031***
TP1900	-86971***	-178372***	-43523***	-127624***
TP1960	-93986***	-173511***	-63676***	-139424***
TP1965	-90863***	-143714***	-59136***	-108427***
TP1970	-81167***	-114985***	-43788***	-73138***
TP1975	-69370***	-85267***	-27544***	-38321***
TP1980	-52572***	-58354***	-13591**	-14897**
TP1985	-52905***	-55893***	-19727***	-19196***
TP1990	-45220***	-46220***	-14801***	-12410**
TP1995	-30754***	-29123***	-6473	-1959
TP2000	-2243	-247	11104***	15001***
Constant	65610***	54779***	47624***	36714***
R <sup>2</sup>	0.37		0.36	
First stage F (PP)			1486	1486
n	37111	37111	37111	37111

Table 3: Estimation results including Time Period dummy variables. \*, \*\* and \*\*\* respectively indicate a 10%, 5% and 1% confidence interval.

The coefficients for the TP indicators reflect the gradual increase in house prices over time. The coefficients for the original purchase price and the repayment of the original loan decrease, while the estimated effect of the price change remains roughly equal.

In order to return to the elderly home equity puzzle and the lifecycle perspective dummy variables for age groups were added be included in the next estimations. These dummy variables represent 5-year age groups (i.e. age30 corresponds with age 30-34). This allows the demand for mortgage debt to vary along with age and, for instance, to follow the U-shaped path over life is expected discussed in section 2. The estimating equation is:

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

The dummy variables for the 20-29 years old have been left out of the estimating equation in order to avoid the dummy trap. The results are provided in table 4.

	OLS	Tobit	IV 2SLS	IV Tobit
Purchase price	0.493***	0.508***	0.591***	0.594***
Price change	0.133***	0.140***	0.138***	0.142***
Dur of own * purchase price	-0.013***	-0.015***	-0.023***	-0.025***
TP1900	2,118	-49,334***	38,477***	-13,668
TP1960	-11,156*	-62,596***	16,357**	-37,192***
TP1965	-17,525***	-50,653***	11,114	-24,110***
TP1970	-18,571***	-39,960***	14,358**	-8,628
TP1975	-16,587***	-25,410***	19,557***	9,556
TP1980	-13,849***	-16,497***	20,325***	16,424**
TP1985	-21,772***	-22,793***	8,121	5,650
TP1990	-21,828***	-21,510***	5,478	4,680
TP1995	-16,409***	-14,255***	5,317	6,804
TP2000	1,894	3,885**	13,394***	15,436***
age30	14,101***	14,696***	11,638***	12,494***
age35	18,097***	18,626***	13,293***	14,599***
age40	7,762***	8,439***	1,962	3,743
age45	-4,085	-4,090	-10,372***	-9,079***
age50	-13,015***	-12,500***	-18,835***	-17,042***
age55	-29,990***	-30,652***	-35,843***	-35,077***
age60	-51,659***	-56,886***	-57,247***	-60,846***
age65	-69,411***	-81,201***	-74,288***	-84,090***
age70	-78,638***	-96,848***	-83,829***	-100,008***
age75	-97,851***	-130,741***	-102,418***	-132,963***
age80	-110,366***	-173,422***	-114,052***	-174,531***
age85	-108,940***	-178,815***	-111,598***	-178,417***
Constant	69,771***	61,120***	55,581***	48,604***
R <sup>2</sup>		0.42		0.41
First stage F (PP)			1063	1063
n		37111	37111	37111

Table 4: Estimation results including Time Period and age dummy variables. \*, \*\* and \*\*\* respectively indicate a 10%, 5% and 1% confidence interval.

The results in table 4 do not show a U-shaped pattern of mortgage debt, but clearly 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.

One problem that one may have with the previous analyses is that the coefficients of the other variables do not vary among different age groups, what may bias the results. In order to test for this, the basic analyses (which excludes the dummy variables) will be repeated for individual age groups. This will provide insight into the effect of the variables per 10-year age group. The results are shown in table 5.

	age 20-29	age 30-39	age 40-49	age 50-59	age 60-69	age 70-79	age 80-89
Purchase price	0.565***	0.669***	0.606***	0.457***	0.396***	0.193***	0.047
Price change	0.273***	0.195***	0.190***	0.129***	0.092***	0.080***	0.026*
Dur of own*purchase price	-0.042***	-0.035***	-0.025***	-0.011***	-0.008***	-0.003*	0.000
Constant	83035***	60421***	49799***	4217***	-1712	18932	38076**
n	2422	7242	8910	7879	6499	3161	998
Purchase price	0.571***	0.670***	0.609***	0.463***	0.404***	0.208***	0.015
Price change	0.268***	0.194***	0.190***	0.126***	0.091***	0.102***	0.056*
Dur of own*purchase price	-0.044***	-0.036***	-0.026***	-0.012***	-0.009***	-0.004*	0.003
Constant	77991***	86955***	11280***	11980***	12820***	13450***	14840***
n	2422	7242	8910	7879	6499	3161	998
Purchase price	0.779***	0.752***	0.654***	0.475***	0.510***	0.199**	0.083
Price change	0.372***	0.208***	0.179***	0.126***	0.099***	0.079***	0.027*
Dur of own*purchase price	-0.050***	-0.039***	-0.043***	-0.015***	-0.016***	-0.005	-0.001
Constant	54569***	47536***	44968***	38815***	-28930	17679	30286
n	2422	7242	8910	7879	6499	3161	998
Purchase price	0.790***	0.752***	0.660***	0.493***	0.530***	0.175	-0.351
Price change	0.373***	0.207***	0.177***	0.121***	0.100***	0.097***	0.050
Dur of own*purchase price	-0.051***	-0.039***	-0.045***	-0.018***	-0.021***	-0.009	0.016
Constant	49780***	47089***	42552***	31579***	-53230***	-24930	39502
n	2422	7242	8910	7879	6499	3161	998

Table 5: Estimation results per age group. \*, \*\* and \*\*\* respectively indicate a 10%, 5% and 1% confidence interval. In this 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 5 shows a consistent pattern for the coefficients among the age groups. The coefficients of both the purchase price and the price change are decreasing as the age group is older. The duration of ownership gets insignificant among the old in both the IV estimations. The results imply that demand for 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.

The age-specific analyses provides insight in the interpretation of the age effects in table 4 (which indicated that mortgage debt decreased along with age). Table 5 shows that the price change is insignificant in the tobit analyses of the age80 group. This suggests that in general the oldest old do not use mortgage debt as instrument to decumulate home equity. However, the OLS and iv2SLS estimations do find a small, but significantly positive coefficient for the price change variable. This result implies that the oldest old who have a mortgage, do take the price change into account which points at a modest use of mortgage debt to decrease the amount of home equity. It has to be emphasized, that although this effect looks promising, it only covers the small fraction of oldest homeowners which have mortgage debt.

## 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 offer the opportunity to set up synthetic age cohorts and use the cross-sectional waves for a panel study. This method was introduced by Deaton (1985). The number of observations is reduced because mean values of age cohorts are used rather than individual (micro-level) observations. However, we distinguish synthetic cohorts on the basis of postal codes, which implies that we still have 6790 – 7331 data-points for the periods 2002-2006 and 2006-2009 respectively.

According to section 2, elderly households are expected to increase mortgage debt in order to decumulate home equity during their final stage of life. We want to see whether households are actively refinancing mortgage debt or not. The most simple way to test for this is to perform a regression which considers the change in mortgage debt explained by the change in the current value of the house. In order to take the age-related differences in behavior into account, a cross term should be included as well. This results in the following estimating equation where MD denotes mortgage demand and CV denotes the current value of the house:

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

The regressions will be estimated for the sample which excludes new homeowners and movers, such that the results clearly indicate mortgage demand of households that remain in the same house during the sample period. Moving to more expensive houses (due to house price increases) do not bias our analyses. Table 6 provides the results.

<b>ALL</b>	2002-2006	2006-2009	2002-2009
Price change	0.596***	0.478***	0.563***
Age*price change	-0.0070***	-0.0052***	-0.0071***
Constant	-2541*	2215	-1165
R <sup>2</sup>	0.12	0.09	0.08
N	7331	7646	6790

Table 6: Regression results of synthetic cohort analyses excluding new homeowners and movers. \*, \*\* and \*\*\* respectively indicate a 10%, 5% and 1% confidence interval.

The results in table 6 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. An increase in mortgage debt among the old is not supported in this estimation.

In order to be able to draw stronger conclusions, we run separate regressions for the young and middle-aged (age smaller than 67 in 2009) and among the old ranging (age 67 and older). The results for the young and middle-aged homeowners on the one hand and the old homeowners on the other. Results are shown in table 7 and 8.

<b>Age below 67</b>	2002-2006	2006-2009	2002-2009
Price change	0.626***	0.563***	0.589***
Age*price change	-0.0075***	-0.0065***	-0.0077***
Constant	-1702	2632*	413
R <sup>2</sup>	0.13	0.11	0.08
N	5973	6127	5577

Table 7: Regression results of young and middle-aged (below 67 years old) synthetic cohort analyses excluding new homeowners and movers. \*, \*\* and \*\*\* respectively indicate a 10%, 5% and 1% confidence interval.

<b>Age 67+</b>	2002-2006	2006-2009	2002-2009
Price change	-0.078	-0.186	0.703***
Age*price change	0.0026	0.0035	-0.0088**
Constant	-8168	-688	-7969**
R <sup>2</sup>	0.05	0.02	0.03
N	1191	1190	1097

Table 8: Regression results of old (63-82 years old) synthetic cohort analyses excluding new homeowners and movers. \*, \*\* and \*\*\* respectively indicate a 10%, 5% and 1% confidence interval.

The results in table 7 and 8 show that the estimation yields significant results for the young, but not for the old for the time periods 2002-2006 and 2006-2009. For the period 2002-2009, we find significant effects for both groups. The longer 2002-2009 interval implies that households have more time to realize increases in mortgage debt in response to changes in the value of their house, and this appear to be important for the elderly.

The net effect of a price change for a 67 year old (which is the youngest in the ‘old’-sample) is 0.113. Interestingly this is perfectly in line with the effect of a price change on mortgage demand in the corresponding tobit estimations for the age60 and age70 group in table 5. It is also the case that 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. To sum up the results, figure 4 depicts the response to a 100.000 increase in house value (using the estimation results of ALL and the old for the time period 2002-2009). Both results appear to be very much in line with each other, but the decrease along with age of the old is somewhat larger compared to the decrease for the entire sample. 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.

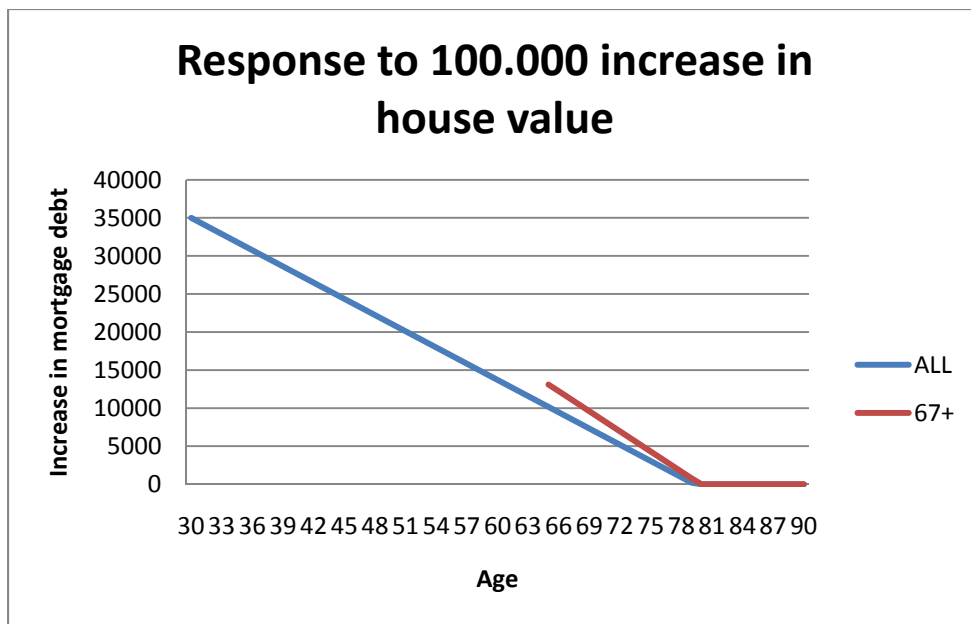


Figure 4: The response of ALL and the old (67+) to a 100.000 increase in house value

## 6. Conclusion and suggestions

The main goal of this paper is to focus on the demand for mortgage debt and the relation of mortgage demand with the elderly home equity puzzle. To the contrary of the US, the Netherlands provides health care publicly, which reduces the precautionary savings motive (Hubbard, Skinner and Zeldes, 1995). In addition the access to mortgage interest deductibility

suggests that especially for the Netherlands mortgage debt is an attractive instrument to decumulate home equity.

In the literature review specific expectations about the development of optimal mortgage debt over the lifecycle is discussed, which can be summarized as: (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). Our results contradict (d), since the increase in mortgage debt among the oldest old is not observed in any of the analyses. These results are supported throughout all analyses based on both the cross-section data and the synthetic panel data.

Altogether, it can be concluded that the vast majority of elderly do not use mortgage debt as 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 analyses point out that the elderly home equity puzzle persists and that the precautionary savings motive plus operational bequest motive (Dynan, Skinner and Zeldes, 2002; Palumbo, 1999) is not very convincing for the Netherlands.

Further research would benefit from more extensive panel datasets, which are not available at the time of writing this paper. Especially the panel study on synthetic age cohorts could be performed on the individual rather than on aggregate levels. This would yield more insight on personal characteristics and the relation to active behavior on the mortgage market (conditional on the development of the current value of the house).

Additionally, further research could focus more on the possibilities and the costs or risks of reverse mortgages. Davidoff and Welke (2005) suggests that the costs of reverse mortgages are large due to adverse selection and moral hazard (i.e. only households which expect to live long will apply and when they have a reverse mortgage, they will not maintain the house properly). Caplin (2002) showed that the average transaction costs to start a reverse mortgage (in the US) are 14% of the initial loan. Besides these transaction costs, the costs such as interest payments and additional taxation still have to be added. This implies that reverse mortgages are not only perceived as risky, but also as very costly. One could consider these costs in the Netherlands and compare it with the costs of an interest-only mortgage. This comparison could add to the understanding of mortgage choice.

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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 20<sup>th</sup> 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 loan.<sup>2</sup>

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

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<sup>2</sup> 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.

deductibility for the increase in the 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.