The Retirement-Savings Puzzle Revisited:
The Role of Housing as a Bequeathable Asset

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Abstract

The so-called retirement-savings puzzle is a phenomenon by which, contrary to what the basic life cycle model predicts, households do not run down their wealth significantly during retirement. In this survey paper we review the literature on the retirement-savings puzzle and the literature on home equity during retirement. Establishing a link between the two streams of literature, we extensively review the work of Nakajima and Telyukova (2011), who find that homeownership interacts with the factors that explain the retirement-savings puzzle, notably with the bequest motive. Additionally, we review the literature on altruistic bequests, strategic bequests and housing as a commitment device, all of which give insights on the connection between homeownership and bequests. We complement the review of the literature with descriptive evidence for the Netherlands, which in general suggests that the insights stemming from the literature are relevant to understand the Dutch reality.

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1 Introduction

The most simple version of the life cycle model, *i.e.* without uncertainty and without bequest motive, predicts that households accumulate wealth throughout working life and they decumulate it during retirement to support consumption when income is low (Ando and Modigliani, 1963). However, there is a large body of evidence pointing at the fact that the older adults usually decumulate wealth at a slower pace than predicted by the basic life cycle model (Poterba *et al.*, 2011). This phenomenon is known as the retirement-savings puzzle (RSP). In the present context of economic crisis and population ageing, the sustainability of public pension systems is under pressure. Thereby, it is relevant to study the underlying motives behind the RSP, since it is a key element to understand whether individuals are financially prepared to face a decrease in the generosity of pension systems. In the present survey paper, we review the literature on the RSP and focus specially on highlighting the role of housing as a bequeathable asset, which, we argue, is a potential key driver of the RSP.

This survey paper starts out by briefly reviewing the general literature on the RSP, which can be classified according to the motive given to explain the puzzle. We distinguish three main motives: lifetime uncertainty, bequest motive and uncertainty regarding medical expenditures. Even though the evidence on the motives we discuss is rather mixed, depending on the context, and after controlling for the relevant factors, they all appear as relevant enough to be considered as meaningful additions to the basic life cycle model. In parallel to the RSP literature, there is a stream of literature that studies the evolution of home equity during retirement (HER), which we review more in depth. The general conclusion of the HER literature is that homeowners are in most cases reluctant to draw dawn their home equity during retirement. However, most studies conducted so far are rather descriptive and the link with RSP literature is generally missing. Therefore, the present paper aims at emphasizing the connection between these two streams of the literature.

The RSP literature and the HER literature come together in the recent work by Nakajima and Telyukova (2011), who introduce a model of retirement savings with housing which constitutes an extension to the previous work by De Nardi *et al.* (2010). The latter consider a model for single retirees which includes lifetime uncertainty, bequests and uncertain medical expenditures. The addition by Nakajima and Telyukova (NT) consists of extending the model to couples and analysing the housing asset separate from the rest of the assets in the portfolio, which turns out to have crucial consequences for the understanding of the RSP. The main conclusion of their work is that homeownership interacts with factors that explain the RSP, notably with the bequest motive. We review in depth the NT model and, furthermore, we complement it with additional literature that contributes towards the understanding of the link between homeownership, bequests and the RSP. The extensions that we consider are altruistic bequests, strategic bequests, and housing as a commitment device.

We complement our review of the literature with descriptive evidence for the Netherlands. To that end, we rely on data from the Dutch National Bank Household Survey (DHS), which

is an internet based panel survey that collects data on economic, financial and psychological aspects of household behaviour. It provides data for around two thousand Dutch households every year between 1993 and 2013. We mostly use the last ten waves, which provide a recent and large enough sample for our purposes. Households without a computer and/or access to internet are provided with a basic computer and internet connection to complete the survey, and attrition is dealt with by biannually refreshing the sample with new households to keep the panel representative of the Dutch population. The evidence that we provide mostly supports the idea that, in the Netherlands, the role of housing as a bequeathable asset is potentially an important factor to understand the underlying causes of the RSP.

The rest of the paper is structured as follows: Section 2 reviews the RSP literature which we classify according to the motive given to explain the puzzle; Section 3 reviews the HER literature which we classify according to the origin of the data, *i.e.* US studies, international studies and Dutch studies; Section 4 summarizes the NT model; Section 5 complements the NT model by reviewing the literature on alternative bequest motives, *i.e.* altruistic bequests and strategic bequests; Section 6 complements the NT model by reviewing the literature on housing as a commitment device; Section 7 closes the paper with a short conclusion.

2   The Retirement-Savings Puzzle

The literature on the RSP shows that, in general, households do not decline their wealth during retirement in the way the basic life cycle model suggests. Additionally, it attempts to determine the reasons behind this phenomenon. Poterba *et al.* (2011) and Van Ooijen *et al.* (2015) provide thorough reviews of this literature. In the present document we limit ourselves to a brief summary, which we use as a stepping stone for the rest of the paper.

Most of the literature on the RSP can be classified into three branches according to the motive given as a key to explain the puzzle. First, there is a branch of the literature, initiated by Yaari (1965), which investigates the role of lifetime uncertainty as an explanation for the RSP. Recent contributions to this literature are De Nardi *et al.* (2009), Cocco and Gomes (2012) and Post and Hanewald (2013). A life cycle model without lifetime uncertainty implies that households are perfectly aware of their time of death. Therefore, they can plan with full accuracy to gradually draw down their wealth and deplete it completely just before they die. With lifetime uncertainty in the model households do not have full certainty about their time of death, and thus they generate an expectation about it. If households die earlier expected, their wealth will not be totally depleted and involuntary bequests will result. On the other hand, the risk of outliving their net worth induces households to deplete their wealth more slowly compared to the case without lifetime uncertainty.

Second, there is a branch of the literature, initiated by Becker (1974), Bernheim *et al.* (1985) and Hurd (1989), which explores the role of voluntary bequests as an explanation for the RSP. More recent contributions are Laitner (2002), Kopczuk and Lupton (2007) and De Nardi and Yang (2014). In the basic life cycle model, households aim at dying with zero wealth. Intro-

ducing a bequest motive implies that they derive utility from dying with positive net worth, which flattens the wealth trajectory during retirement. Kopczuk and Lupton (2007) classify the literature according to three different types of bequest motive: the *egoistic* motive Hurd (1989), in which the housholds leave a bequest simply to increase their own utility; the *altruistic* motive (Becker, 1974; Laitner, 2002), in which the utility of the recipient plays a role in determining the bequest; and the *strategic* motive (Bernheim *et al.*, 1985; Perozek, 1998), in which, besides being altruistic, older adults use the bequest to strategically influence the quantity of services provided to them by the recipients. In addition to intentional bequests, there is a related branch of the literature that focuses on inter-vivos transfers (*e.g.* Cox, 1987; Hochguertel and Ohlsson, 2009; and Alessie *et al.*, 2010), which are expected to have an effect effect on the saving behaviour of older adults similar to the bequest motive.

Third, there is a more recent branch of the literature (*e.g.* Palumbo, 1999; Coile and Milligan, 2009; De Nardi *et al.*, 2010; and Dobrescu, 2015) that considers the role of uncertain out of pocket medical expenditures (OPME), *i.e.* non-insured medical expenses, as an explanation for the RSP. The basic life cycle model does not include health as a determinant of saving and consumption. The introduction of the health status allows for considering the role of uncertainty regarding OPME. The basic idea is that, depending on age, health status and a stochastic term, households face a risk of incurring medical expenditures in the future. If they are not able to fully insure against this risk, they will engage in precautionary saving and, as a result, they will retain a buffer-stock of savings that will flatten the wealth trajectory during retirement.

Even though the empirical evidence on the motives discussed in this section is rather mixed, depending on the context, and after controlling for the relevant factors, they all appear as relevant enough to be considered as meaningful additions to the basic life cycle model. However, note that the different motives need not be incompatible. It can well be that households rank the different motives according to their preferences. In this case, the unfolding of exogenous events will crucially determine which purpose is eventually given to the savings of a retired household.

3 Home Equity in Retirement

Parallel to the literature on the RSP, there is a stream of literature that studies the evolution of housing equity during retirement (HER). Housing is an asset that deserves special attention due to its dual role as consumption and investment good, as well as due to its associated transaction costs which make adjustments in housing wealth rather infrequent. Furthermore, in developed countries housing is very often the most important asset in household portfolios. This is the case in the Netherlands, where in the last decades there has been an important increase in homeownership, which appears to remain high as households enter retirement.[1] Table 1 shows that, according to DHS data, among three cohorts of Dutch households above 60 years of age,

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[1]According to OECD and Eurostat, the homeownership rate in the Netherlands increased by around twenty percentage points between 1990 and 2010, from 47.5% to 67.2%. This is the largest increase among OECD countries during this period.

homeownership and the ratio of housing equity over total net worth are rather high and have not significantly changed between 2009 and 2013. Furthermore, Table 1 shows that there are relevant cohort effects indicating that younger generations increasingly rely more on housing in their portfolios.

Table 1 Homeownership and Housing Wealth among Dutch Older Adults

	Homeownership rate			Housing equity over net worth		
	Cohort 1	Cohort 2	Cohort 3	Cohort 1	Cohort 2	Cohort 3
2009	59.36%	51.11%	49.07%	39.14%	36.86%	34.13%
2010	62.71%	52.50%	50.22%	43.48%	38.12%	36.70%
2011	60.12%	49.89%	49.60%	41.81%	37.74%	36.02%
2012	61.56%	53.29%	53.02%	40.50%	36.39%	35.22%
2013	60.39%	53.53%	51.94%	40.65%	37.96%	35.81%

Source: DHS. *Notes:* Cohorts 1, 2 and 3 include households with household heads aged 60 to 64, 65 to 69 and 70 to 74 in 2009. The second panel provides the average share of housing equity (*i.e.* house value minus remaining mortgage debt) over total net worth (assets minus liabilities) of households.

Most of the HER literature is rather descriptive and the link with the literature on the RSP is rather limited. In general, the HER literature aims at answering the question of whether retirees regard home equity as a source of funds for general consumption. According to Venti and Wise (2004), answering this question is important for two reasons. First, it can help assess the potential demand for releasing wealth locked in illiquid housing, which has implications for the development of financial products such as reverse mortgages; and, second, it contributes to understanding the adequacy of saving for retirement. If financial wealth and housing wealth are used interchangeably to finance consumption, then the latter might as well be given the same treatment as financial wealth when evaluating whether households save enough for retirement.

3.1 US Studies

One of the first to tackle the question of whether retirees use home equity to fund general consumption were Venti and Wise (1990), who using the Retirement History Survey (RHS) find that on average older adults that move do not downsize their housing equity. They conclude that older adults are in general not willing to use home equity for consumption, and thus the demand for reverse mortgages is rather thin. On the contrary, Sheiner and Weil (1992) find, using the Panel Study of Income Dynamics (PSID), that average levels of homeownership among the older adults decline significantly with age and conclude that housing wealth is used for consumption. However, even though the results are statistically significant, their economic significance is questionable since the observed decline in homeownership is rather small. Hurd (2002)confirms, by exploiting a panel data set derived from the Asset and Health Dynamics among the Oldest Old (AHEAD), a modest decline in housing wealth and homeownership rates among older adults. In addition, he points out that households experiencing a health shock or a widowhood event

display larger declines in home equity and are more likely to terminate homeownsership.

Following on the work by Hurd (2002), Venti and Wise (2004) perform a comprehensive analysis of the evolution of home equity during retirement, paying special attention to the effect of precipitating events, *i.e.* widowhood and nursing home entry. They combine the Health and Retirement Study (HRS) with the AHEAD survey and consider two ways by which homeowners can change their home equity: by discontinuing homeownership or by selling and moving to a newly purchased residence. By means of cohort specific analysis, they find that households who experience a widowhood event or nursing home entry display considerable declines in homeownership and in housing equity; while for households who do not experience any of these events housing equity remains almost intact throughout retirement. Overall, they find that older adults are rather unlikely to move or to terminate homeownership.[2] They conclude that housing equity is generally not used for consumption, which implies two things: first, that the demand for reverse mortgages is low, and second, that housing wealth should not be counted when assessing retirement savings, since it is not interchangeable with financial wealth. Instead, it might be suited to think of housing equity as a consumption good that, at the same time, provides a preventive buffer for adverse shocks.

In contrast to Venti and Wise (2004), Sinai and Souleles (2007) study the evolution of home equity in retirement but do not consider homeowners that move. Instead, they look at homeowners that stay in the same residence and study how they react to the remarkable increase in house prices experienced in the US market between 1983 and 2004. Using the Survey of Consumer Finances (SCF), which provides repeated cross sections over time, they report that households, specially the youngest among the older adults, have offset the rise in housing equity by increasing their housing debt through home equity loans. However, they point out that the offset effect is rather small and that it could be larger were there less restrictions to borrow against housing wealth. Contrary to Venti and Wise (2004), Sinai and Souleles conclude that households are potentially willing to liquidate housing wealth to finance consumption. Therefore, only the share housing wealth that cannot be borrowed against should be considered as not interchangeable with financial wealth.

3.2 International Studies

Moving away from only US based studies, Banks *et al.* (2012) conduct a study that compares downsizing among retirees in Britain and in the US. Their work is similar to Venti and Wise (2004) in the sense that they study downsizing by focusing on households that move to a new location. The study is based on data from PSID for the US, and on data from the British Household Panel Survey (BHPS) for Britain. They find that, upon moving, British older adults downsize more than Americans. However, the percentage of older households that actually move is much higher in the US. As a consequence, considering the whole population above retirement

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[2]Venti and Wise (2004) do find a very slight decrease in the home equity among the oldest households (75+) that do not experience any precipitating event. However, they attribute it to depreciation of the housing asset, which can actually be considered as a form of home equity withdrawal.

age, there is more downsizing in the US than in Britain even though in both countries the bigger majority of older households do not actually move. These comparative results hold when controlling for marital status, family size and employment transitions. Once this fact is established, Banks *et al.* focus on studying the factors that explain the difference in mobility. They conclude that it is a mix of geographical − in the US there is more climate diversity and variation in environmental amenities − and institutional factors − in Britain there are more transaction costs due to taxation of home sales − that explain the higher share of moving households in the US. These results suggest that, in Europe in general, moving house during retirement might be even less popular than in the US due to higher institutional restrictions and less within country variation in tax regimes and in geographical amenities.

In some of the very few fully international studies, Chiuri and Jappelli (2010) use data on 15 OECD countries, while Angelini *et al.* (2014), in the only Europe-wide study so far, use data on 13 European countries. The former employ data from different country specific surveys which allow them to construct a dataset of repeated cross-sections over time. They look at ownership rates and find that they decline considerably after age 60. However, after controlling for cohort effects, the decline becomes much more moderate and it does not start until after age 75. In addition, they find that cross-country variation in terms of institutions, such as tax regimes and mortgage market regulations, have an impact on the degree to which housing wealth is withdrawn during retirement. On the other hand, Angelini *et al.* (2014) use life history data from the Survey on Health Ageing and Retirement in Europe (SHARE) and, similarly to Venti and Wise (2004) and Banks *et al.* (2012), study the behaviour of homeowners and renters that move. Even though they assert that moves are rare all over Europe, they find, controlling for country characteristics and family transitions (divorce, widowhood and nest-leaving by children), that older retirees that are cash-poor and house rich are the most likely to downsize.

3.3   Dutch Studies

Narrowing the focus to the Dutch case, Van der Schors *et al.* (2007) employ data from the Dutch Social Economic Panel (SEP) for the period 1990-2010 and find a strong negative relation between age and homeownership among Dutch households. However, a detailed analysis indicates that this age gradient is mostly due to cohort and time effects. They conclude that due to macroeconomic and housing market related variables younger generations of Dutch households display larger homeownership rates compared to older generations. On the other hand, De Graaf and Rouwendal (2012) study to what extent older Dutch households liquidate housing wealth by increasing the size of the mortgage loan. Using data from the Dwelling Research Netherlands (WoON) survey for the period 1985-2009 they find that the oldest old do not increase their mortgage debt, not even when house prices were increasing at considerably high rates. They conclude that the vast majority of older homeowners do not use mortgage debt to decumulate home equity, which suggest that the housing element might be a relevant factor to understand the RSP in the Netherlands.

More recently, Van Ooijen *et al.* (2015) describe the saving behaviour and the portfolio choice of Dutch retirees by exploiting high quality administrative data for the period 2005-2010. Although they find strong differences between cohorts, both homeownership rates and the amount of housing equity held by older households do not appear to decline significantly with age, which agrees with the previous evidence provided by Van der Schors *et al.* (2007) and De Graaf and Rouwendal (2012) as well as with the evidence in Table 1. Table 2 takes the analysis a step further by showing that, according to DHS data, most Dutch older households do not move. Among those who move, less than a half (42%) do it to downsize their housing asset either through own-to-rent or own-to-own transitions. In addition, Table 3 shows that Dutch households are generally not willing to use the surplus value of their residence in property, which could be done by either moving, increasing mortgage debt or taking out an extra mortgage. This evidence is in accordance with the findings by Suari-Andreu (2014), who, using the same DHS dataset employed in the present study, reports that Dutch households of all ages do not compensate house price declines by increasing their stock of savings. This type of behaviour suggests that Dutch households do not plan to tap home equity during retirement to finance regular consumption.

Table 2 Housing Moves among Dutch Older Adults (2003-2013)

Total older households interviewed	1043	
Registered moves	118	100%
Rent-to-own	8	6.77%
Own-to-rent	24	20.33%
Own-to-own	48	40.67%
Downsize	24	20.33%
Upsize	24	20.33%
Rent-to-rent	38	32.20%

Source: DHS. *Notes:* Older households are defined as households with a household head who is 60 or older. The survey does not capture nursing home entries.

Table 3 Intention to Use Surplus Value of Owned Residence (2004-2013)

	Certainly yes	Probably yes	Probably not	Definitely not	Do not know	N of obs.
Full sample	2.40%	4.35%	36.14%	54.54%	2.58%	9458
Older households	2.23%	4.37%	32.94%	58.65%	1.80%	3773

Source: DHS. *Notes:* Older households are defined as households with a household head who is 60 or older. The year 2003 is excluded from the sample since the question on the use of the surplus value was not included in that year's wave of the survey.

In summary, the evidence provided by the HER literature appears to be somewhat mixed. However, it comes forth as a general conclusion that older households do not usually withdraw housing equity during retirement. Therefore, the next step to take is to question why does

this happen. Is it because of lifetime uncertainty? Is it because housing wealth is used as precautionary savings? or is it because housing is regarded as an asset to be bequeathed? While these are questions that are crucial for policy implications and for the understanding the RSP, the HER literature summarized in this section is generally descriptive and does not tackle them directly. In the next section we introduce a theoretical framework that aims at tackling these questions, and, by doing so, it connects the HER literature with the literature on the RSP discussed in Section 2.

4   A Model of Retirement Savings with Housing

The two streams of literature outlined in Sections 2 and 3 come together in the work by Nakajima and Telyukova (2011), who argue that the RSP cannot be explained without putting an emphasis on the role of the housing asset. Using HRS data, Nakajima and Telyukova (NT) find that the post-retirement evolution of assets shows a very different picture for homeowners compared to renters; while the former do not withdraw their wealth during retirement, the latter do. This suggests that homeownership interacts with factors that explain the RSP, notably with the bequest motive. These insights are of clear potential importance for explaining the RSP in the Netherlands, where, as shown by Tables 1 to 3, it is very likely to be driven by the lack of home equity withdrawal during retirement.

NT are the first to study housing equity in retirement in the context of a structural life cycle model, similar to the ones employed in the RSP literature. The model constitutes an extension to the previous work by De Nardi *et al.* (2010), who consider a model for single retirees which includes lifetime uncertainty, bequests and uncertain medical expenditures. The addition by NT consists of extending the model to couples and analysing the housing asset separate from the rest of the portfolio, which turns out to have crucial consequences for the understanding of the RSP. In this section we explain in detail the NT model and the results they obtain when estimating its parameters using HRS data. Furthermore, we propose several extensions to their framework: altruistic bequests, strategic bequests, and housing as a commitment device.

4.1   Utility Function

In the NT model, every household is born as a retiree at age $i = 1$ and potentially lives up to age I. In every period, the household chooses consumption, saving and housing such as to maximize remaining lifetime utility, which is time-additive. The within-period utility function has the form:

$$V(c, h, s, o, b) = s \frac{\left(\frac{1}{\mu_s} c^\eta (\omega_o h)^{1-\eta} \right)^{1-\sigma}}{1-\sigma} + \gamma \frac{(b+\zeta)^{1-\sigma}}{1-\sigma}, \tag{1}$$

where the first element captures the utility derived from consumption and housing, and the second element captures utility derived from leaving posthumous wealth as a bequest. In the first element, c is (non-housing) consumption, h is consumption of housing services, s is the number

of adults in the household and the subscript o is the tenure status, with $o = 1$ indicating owner, and $o = 0$ indicating renter. μ_s is the effective household size, while ω_o captures the extra utility from owning a house.[3] $0 \leq \eta \leq 1$ is a parameter capturing the relative weight of non-housing consumption versus housing services, and $\sigma \geq 0$ is the coefficient of relative risk aversion. In the second element in (1), b is posthumous wealth, $\gamma \geq 0$ captures the strength of the bequest motive, and $\zeta \geq 0$ is a parameter determining the extent to which bequests are luxury goods.

Regarding the first element in (1), there are two relevant features worth mentioning. The first is that utility is non-separable in consumption and housing, which allows for marginal utility of consumption to be (positively) dependent on housing, *i.e* $\partial u(\cdot)/\partial c = f(h, c)$ and $\partial f(h, c)/\partial h > 0$. The intuition is that the quantity of housing services consumed, which is assumed to increase linearly with the size of the house, increases the marginal utility derived from an additional unit of consumption. The second relevant feature refers to the way couples are modelled. NT follow the unitary assumption, implying that both members in a couple have the same utility function and consumption is split equally between the two. However, each member enjoys more than half of the consumption flow because of the returns to scale within couples, captured by the *household size multiplier*, given by $s/\mu_s^{1-\sigma}$.[4]

As indicated by the second element in (1), additional to utility from consumption and housing, a household gains utility from leaving a bequest once all members in it have died. A bequest is composed by all of the wealth posthumously left behind, which includes the house if the household dies as a homeowner. Similarly to Hurd (1989), Kopczuk and Lupton (2007) and De Nardi *et al.* (2010), NT assume that bequests follow an egoistic motive, since the utility derived from leaving a bequest does not depend on the utility of the recipient. Furthermore, there is no room for bequest to be used strategically as a compensation for services provided by the recipients.

4.2 Housing

For a homeowner, the housing decision consists of two options: staying in the present residence or becoming a renter. For a renter the only housing choice is the size of the rental property. Own-to-own and rent-to-own moves are assumed away by NT due to their low frequency in the HRS.[5] The nominal value of a house is given by ph, where p is the price of a unit of housing. Upon the sale of the house, a homeowner receives its value net of any remaining debt and net of a proportional transaction cost κ. In addition, a homeowner pays every period a proportional maintenance cost δ.

Unlike owners, renters can move from one rental property to another at no moving cost. Therefore, a renter chooses the size of the rental property h every period. All rental contracts

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[3]NT set $\omega_0 = 1$, while $\omega_1 > 1$.

[4]NT assume that $\mu_1 = 1$ and $\mu_2 \in \{1, 2\}$, which implies that the household size multiplier for a single is $1/\mu_1^{1-\sigma} = 1$; while for a couple it is $2/\mu_2^{1-\sigma}$, which is equal to 2 if $\mu_2 = 1$ and it is equal to 2^σ if $\mu_2 = 2$.

[5]Table 2 shows that this is not the case in the DHS dataset since own-to-own moves are more popular than own-to-rent moves. However, note that here we are describing the NT model as presented in Nakajima and Telyukova (2011)

are for one period, and the per-period rental rate is given by:

$$r_h = r + \delta, \tag{2}$$

where r is the market interest rate. The rental rate reflects the competitive cost to a landlord of holding a house and renting it out.

4.3 Income, saving and borrowing

The non-financial income of a household is given by $\psi_s y$, where y is the pension income, which changes across households but not over time, and ψ_s adjusts it according to the number of adults in the household. In addition, households can save at an interest rate r, and homeowners can borrow against the value of their house at a rate $r + \xi$, where ξ is the mortgage premium. The value of the house sets the borrowing limit, which is defined by:

$$a \geq -(1 - \lambda_i)hp, \tag{3}$$

where a denotes the stock of financial wealth and λ_i determines the share of housing wealth that can be borrowed against, which NT allow to vary with age (hence the subscript i) to capture age-specific variation in the costs of borrowing against housing wealth.

4.4 Health, Mortality and Medical Expenditures

The health status of a household is denoted by $m \in \{0, 1, 2, ..., M\}$, where $m = 0$ represents death. NT assume that m follows a first-order Markov process in which $\pi_{i,m,m'}^m$ denotes the transition probability form a health state m to a health state m', which is dependent on the present health state and on the age of the household, i. In addition, at any period a household can transit from $s = 2$ to $s = 1$, which captures the death of a spouse. NT assume away divorces and remarriages due to their low frequency in HRS. Household size transition probabilities from s to s' are given by $\pi_{i,s,s'}^s$.[6] These transition probabilities imply that one spouse can die first via a stochastic shock to s, or both spouses can die at the same time via the household-wide mortality shock, the probability of which is given by $\pi_{i,m,0}^m$.

The inclusion of the health status in the model allows defining the probability of incurring out of pocket medical expenditures (OPME). Realized OPME are denoted by x, and the probability that a given x is drawn is denoted by $\pi_{i,m,x}^x$, which is dependent on age and health status. Similarly to De Nardi *et al.* (2010), NT assume that health expenditures are uninsurable and do not include in the model any type of coverage for long term care expenditures.[7] Different from De Nardi *et al.* (2010), in the NT model the health status does not affect the marginal utility of consumption. The way medical expenditures are modelled could imply that because of a large OPME shock a household is forced to have negative consumption. Therefore, NT

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[6]By assumption, $\pi_{i,1,1}^s = 1$ and $\pi_{i,1,2}^s = 0$ for all i.
[7]For a similar model that includes the possibility to insure long term care expenditures, see Dobrescu (2015)

introduce a consumption floor guaranteed by the government and denoted by $\underline{c}$. This insurance provided by the government is means tested, which implies that consumption of each member of a household is subsidized up to a level $\underline{c}$ only after the household sells all of its assets and chooses the minimum rental property available.

4.5   Household Problem

Households choose consumption, saving and housing such as to maximize present and future streams of utility. The latter are discounted by the rate of time preference, β, and the probability of survival. Furthermore, for all future periods, households weight the discounted utility of bequests with the probability of death. In addition, couples take into account the possibility of a transition into a one person household by weighting both possible future scenarios (remaining a couple or become a single household) by its respective probability.

For the case of a household that rents the house it occupies, utility is maximized subject to the following restrictions:

$$\tilde{c} + a' + r_h h p + x = (1 + r)a + \psi_s y, \tag{4}$$

$$c = \begin{cases} \max\{s\underline{c}, \tilde{c}\} & \text{if } a' = 0 \text{ and } h = h_1 \\ \tilde{c} & \text{otherwise,} \end{cases} \tag{5}$$

$$p' = (1 + g)p, \tag{6}$$

where a prime is used to denote a variable in the next period. Equation (4) is the periodic budget restriction; Equation (5) introduces the consumption floor, where h_1 is the smallest rental property available; and Equation (6) provides the evolution of house prices, where g is the house price growth rate.

The maximization problem of a homeowner consists of a choice between staying in his current house or becoming a renter. The homeowner will choose at any point in time the option that provides the higher stream of current and future utility. A homeowner that chooses to sell the house and become a renter maximizes utility subject to (5), (6) and

$$\tilde{c} + a' + x + (\kappa + \delta)h p = h p + (1 + \bar{r})a + \psi_s y, \tag{7}$$

$$\bar{r} = \begin{cases} r & \text{if } a' \geq 0 \\ r + \xi & \text{if } a' \leq 0. \end{cases} \tag{8}$$

The budget constraint (7) does not include the rental cost since the household still owns in the current period, but it includes the proceedings from selling the house net of the maintenance cost δ and of the transaction cost κ. Equation (8) shows that the interest rate is different depending on whether a homeowner is a saver or a borrower. Upon the sale of the house a homeowner can still be indebted. However, once she is a renter the borrowing constraint (3) turns into $a \geq 0$.

Finally, a homeowner who does not move maximizes utility subject to (3), (6), (8) and

$$c + a' + x + \delta hp = (1 + \bar{r})a + \psi_s y. \tag{9}$$

In this case there is no access to the consumption floor since the homeowner decides not to sell the house, which is a necessary condition to benefit from it.

4.6 Estimation and Results

NT estimate the model in two steps. Fist they calibrate the parameters that can be identified without explicitly using the model. These are defined in the vector $\Theta = (\mu_2, \psi_2, \delta, \kappa, r, \xi, g)$. In addition, in the first step they compute the health status and household structure transition probabilities, as well as the probability of incurring medical expenditures, $i.e.$ $\chi = (\pi^m_{i,m,m'}, \pi^s_{i,s,s'}, \pi^x_{i,m,x})$. In the second step, they use the method of simulated moments to estimate the rest of the parameters in the model, $i.e.$ $\Upsilon = (\beta, \eta, \sigma, \omega_1, \gamma, \zeta, \underline{c}, \lambda_i)$. The latter are estimated such as to provide the best match between the model and several moments in a sample of three HRS cohorts (those of age 65, 75 and 85 in 1996), which are followed over time between 1996 and 2006. The targets are homeownership rate profiles, life cycle profiles of median total, financial and housing assets, proportion of households in debt, median debt of debtors, and median net worth profiles for homeowners and renters separately.

Once the model is estimated, NT investigate the role of several model features on the saving behaviour of retirees. They do so by shutting down each mechanism one at a time and comparing the outcome to the benchmark model. The mechanisms they consider are the following: bequest motive, medical expenses, extra utility from homeownership, collateral constraints and the housing boom of 1996-2006. The results show that leading motivators for homeownership in retirement are the bequest motive and utility benefits of homeownership. Upon shutting down the bequest motive, $i.e.$ setting $\gamma = 0$, NT observe considerably faster declines in homeownership and net worth of homeowners compared to the benchmark. The net worth withdrawal rate of renters is also increased, however, less so than the one of homeowners. Similar results are found for homeowners when the utility benefits of homeownership are shut off, $i.e.$ $\omega_1 = 0$.[8]

Another key feature of the results is that there seems to be potential demand for home equity loans and reverse mortgages. Regardless of the importance of the bequest motive and of the utility benefit of homeownership, owner-occupiers react to a lower λ_i by somewhat increasing debt through home equity loans. However, due to tight borrowing conditions that apply in practice, many older households remain unable to liquidate housing. In addition to this result, by manipulating the value of g, NT find that the house price boom in the US, even though it increased home equity borrowing somewhat, it contributed substantially to the low net worth withdrawal rate among homeowners. Finally, NT find a rather modest effect of OPME. They

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[8]The utility benefits of homeownership capture factors such as attachment to one's house and neighbourhood. As well, they capture financial benefits of ownership not explicit in the model, $e.g.$ tax exemption of imputed rents, mortgage interest payment deduction, or insurance against rental rate fluctuation.

do find that when setting $x = 0$, the youngest retirees shift towards a slightly faster decline in their net worth. However, the effect is almost negligible for older retirees.

In summary, NT find that housing interacts with factors that explain the RSP, notably with the bequest motive. In addition, homeownership decreases the net worth withdrawal rate through the utility benefits it provides and the high costs of home equity borrowing. On the other hand, OPME do not seem to play a major role in explaining homeownership late in life. These results differ importantly from those in De Nardi *et al.* (2010), who find a smaller effect of the bequest motive and a larger role for OPME. The main difference is that they do not consider housing as an element of the portfolio, and employ data on singles who, arguably, are less prone to have a bequest motive than couples.

5 Alternative Bequest Motives

The correlation between homeownership and the bequest motive pointed out by NT serves as a link between the two streams of literature discussed in Sections 2 and 3, and has relevant implications for the understanding of the RSP. Table 4 shows how in a sample of DHS households running from 2003 to 2013, homeownership clearly correlates with the bequest motive. On the one hand, households are asked to rank the importance of saving for a bequest on a scale from 1 (very unimportant) to 7 (very important). On the other hand, households are asked what is the chance that they leave a bequest. On both cases, homeowners seem more inclined than renters to leave a bequest, which holds when considering both the mean and median of the responses' distribution. The relationship between homeownership and bequests becomes even more clear when only older households are considered.

Table 4 Correlation between Homeownership and the Bequest Motive (2003-2013)

		Homeowners		N. of	Renters		N. of
		Mean	Median	obs.	Mean	Median	obs.
Importance of saving	Full sample	2.99	3	9493	2.35	2	3981
for a bequest	Older adults	3.30	3	3793	2.38	2	1508
Chance of leaving	Full sample	81.50	99	9233	48.60	50	3967
a bequest	Older adults	83.26	100	3798	42.24	25	1587

Source: DHS. *Notes:* Older households are defined as households with a household head who is 60 or older. Importance of saving for a bequest is measured on a scale from 1 (very unimportant) to 7 (very important). Chance of leaving a bequest is measured on a scale from 0 (no chance) to 100 (100 % chance).

The results of the work by NT, as well as the evidence for the Netherlands shown in Table 4, suggest that an important reason why housing is held through retirement is because it is viewed as an asset to be bequeathed. This insight has relevant implications for understanding the RSP, specially in the Netherlands, where due to public coverage of long term expenses, precautionary saving is unlikely to play a role (De Graaf and Rouwendal, 2012), which opens

the door to consider bequests as playing a major role. In this section, we consider alternative ways of modelling bequests in order to better grasp this issue.

5.1 Altruistic Bequests

Following previous work such as Hurd (1989) and Kopczuk and Lupton (2007), NT model the bequest motive as an egoistic motive, which implies that bequests are generated purely by the desire of individuals to have positive net worth upon death, *i.e.* their aim to be the richest in the cemetery. The egoistic motive is thus independent of the economic situation of the heirs and it can be present even when a household has no descendants.

As an alternative to the egoistic motive, Laitner (2002) proposes a model in which the bequest function depends on the consumption possibilities of the heirs. This idea originated from earlier work by Barro (1974) and Becker (1974), and, in its simplest form, it consists of rewriting the within period utility in the NT model as follows:

$$V^P = u(c, h, s, o) + \alpha V^K(b), \tag{10}$$

where $V^P(\cdot)$ is the utility function of the parents and $V^K(\cdot)$ is the utility function of the heirs. The first element in (10) is simply the same as in Equation (1), whereas the second element substitutes the bequest motive in the NT model by $\alpha V^K(b)$, where α indicates to what extent a household cares about its offspring. The size of the bequest influences the consumption level of the recipient and thus it has a positive effect on her utility, *i.e.* $\partial V^K(b)/\partial b > 0$. However, the higher the wealth of the recipient, the lower is the marginal utility of additional bequeathed wealth. Therefore, if the heirs have already high wealth prior to receiving the bequest, the amount bequeathed is likely to be comparatively small.

Employing a sample of US pension holders, Laitner and Juster (1996) note that most of the annuitants' behaviour conforms with the altruistic model. In addition, Laitner and Ohlsson (2001) find evidence of parental altruism in Sweden and the US. However, this evidence contradicts with the work by Altonji *et al.* (1997) and Poterba (2001), who find that in the US parents do not modify inter vivos transfers in response to changes in their children's permanent income. In addition, Kopczuk and Lupton (2007), who employ panel data on singles from the AHEAD survey, make a case against the altruistic model by showing that there are households who save for a bequest without having children, and thus argue that children and bequests are independent of each other. However, we must note that altruism is not necessary only towards children. There can be as well altruism towards other family members or non-family members.

Table 5 shows that, according to DHS data, among Dutch older households, those who have children give higher importance to saving for a bequest. This difference is the most clear when only homeowners are considered. Considering altruism only towards children, this descriptive result suggests that the altruistic model is likely to apply in the Dutch case. However, regarding the chances of leaving a bequest, having children does not seem to play such an important role.

Table 5 Correlation between Having Children and the Bequest Motive (2003-2013)

Homeowners		Children		N. of	No children		N. of
		Mean	Median	obs.	Mean	Median	obs.
Importance of saving	Full sample	3.32	3	7107	1.746	1	1823
for a bequest	Older adults	3.45	3	3357	1.683	1	322
Chance of leaving	Full sample	81.12	99	6962	80.37	99	2271
a bequest	Older adults	83.37	100	3327	82.48	100	471
Renters		Children		N. of	No children		N. of
		Mean	Median	obs.	Mean	Median	obs.
Importance of saving	Full sample	2.65	2	2256	1.87	1	1415
for a bequest	Older adults	2.47	2	1244	1.65	1	194
Chance of leaving	Full sample	41.86	25	2302	60.48	75	1665
a bequest	Older adults	40.14	20	1310	52.16	50	277

Source: DHS. *Notes:* Older households are defined as households with a household head who is 60 or older. Importance of saving for a bequest is measured on a scale from 1 (very unimportant) to 7 (very important). Chance of leaving a bequest is measured on a scale from 0 (no chance) to 100 (100% chance).

In fact, among renters, those who declare not having children report a higher chance of leaving a bequest compared to those who declare having children. Just like Table 4, Table 5 shows that homeowners are more likely to leave a bequest and give more importance to saving for that end.

Even though in general the evidence appears to be mixed, the altruistic model should not be dismissed since it has important implications for understanding the rationale behind the bequest motive, as well as for understanding how wealth inequality is transferred from one generation to the next. In addition, as it will become clear below, the altruistic model can help explain the interaction between homeownership and the bequest motive that stems from the NT model.

5.2 Strategic Bequests

A different approach to the bequest motive was introduced by the early work of Bernheim *et al.* (1985), who suggest that bequests are generated in a context of intergenerational exchange. In this context, parents are still altruistic in that they care about the utility of their descendants. However, at the same time, they try to strategically influence the descendants' actions in their favour by using the bequest as an incentive. In the strategic model, it makes sense to separate housing from the other elements of the household portfolio, since it is an asset that parents can easily use to signal a reward to their children's services. In that way, the strategic model can help understand better the interaction between homeownership and the RSP.

Strategic bequests can be introduced in a very stylized way in the NT model by modifying the within period utility of the altruistic version of the model, given by Equation (10), as follows:

$$V^P = u(c, h, s, o, \tau) + \alpha V^K(b, \tau), \tag{11}$$

where τ denotes the services provided by the children to their parents, which increase parental utility, *i.e.* $\partial u(\cdot)/\partial \tau > 0$, but affect the utility of the children negatively, *i.e.* $\partial V^K(b, \tau)/\partial \tau < 0$. In Bernheim *et al.*'s model, the household commits herself to a bequest rule. The latter specifies the fraction of the bequest given to each recipient for each amount of services provided, and establishes that a descendant will be disinherited in favour of other recipients if she does not contribute with a minimum amount of services. For the rule to be credible, parents must be credibly committed to retain enough wealth as a bequest. This can be done by holding wealth in illiquid form such as housing equity. If transactions costs are high and financial products to liquidate housing are hardly available, holding a house can be a way for the older adults to signal a future bequest to the heirs.

The empirical literature on the strategic model generally follows a strategy that consists of regressing the number of visits by the heirs to the parents on parental wealth. The main challenge is to take into account the endogeneity of parental wealth, since, if strategic behaviour applies, parents will increase their wealth holdings in response to increased attention. Furthermore, there may be unobserved factors affecting both parental wealth and the number of contacts. The literature generally tackles this issue by instrumenting for wealth. Bernheim *et al.* (1985) instrument wealth with life-time earnings and, based on US data, find evidence supporting the altruistic model. Perozek (1998) instruments with an index that maps occupations into a socio-economic ranking and controls for additional individual and family characteristics. Using a different US dataset, he claims that the results by Bernheim *et al.* are not entirely robust. Additionally, Angelini (2007) uses the educational level and the number of rooms in the parental house as instruments. Using data on several European countries finds empirical support for the strategic model. The effect appears to be the strongest when using illiquid forms of wealth, such as housing, as explanatory variable. This finding helps understand the interaction between homeownership and bequests observed by NT.

Table 6 Strategic and Altruistic Bequests among Dutch Households (2003-2013)

	Full sample		Older households	
	Homeowners	Renters	Homeowners	Renters
(1) Strategic bequest	3.33%	1.38%	3.54%	1.98%
(2) Altruistic bequest	21.66%	9.01%	30.74%	9.43%
(3) No explicit plans about bequests	66.55%	55.12%	57.53%	51.79%
(4) No bequest	1.55%	6.44%	1.51%	8.30%
(5) None of the above	6.90%	28.05%	6.68%	28.49%
Number of observations	7563	2531	2515	1060

Source: DHS. *Notes:* Conditional on having children, respondents are asked which statement is closest to their opinion: (1) Leaving a bequest if children provide services; (2) Leaving a bequest regardless of services provided; (3) No explicit plans about leaving a bequest; (4) No intention to leave a bequest; (5) None of the above. Older households are defined as households with a household head who is 60 or older.

Table 6 shows that, according to DHS data, the strategic motive is not so popular among Dutch households. Homeowners who are above 65 years of age appear to be the most prone to use bequests strategically. However, only 3.54% of them report a strategic bequest motive. There are three caveats to keep in mind when using these data: first, the majority of households, especially among homeowners, report to have still no preconceived bequest plans; second, households may be inclined towards reporting altruistic bequests to hide their self-indulgence; and, third, those willing to leave a bequest regardless of the services provided, might be willing to increase it if services are actually provided. These are all arguments suggesting that strategic bequests might be more important than reflected in Table 6. In any case, Table 6 shows that both strategic and altruistic bequest motives are present, and that they are more popular among homeowners than among renters.

6   Housing as a Commitment Device

An additional complement to the NT model that might shed light on how housing equity during retirement can help explain the RSP is provided by the literature on temptation and self-control. In two seminal contributions to this literature, Gul and Pesendorfer (2004) develop a model in which an agent chooses between different sets of alternatives for consumption, some of which contain a tempting good. The later is a good that the agent may crave for, however, consuming it represents a sub-optimal choice. If the agent chooses the set of alternatives that contains the tempting good, she will either consume it or exert self-control in order not to do so, which comes at a utility cost. A different option consists of choosing a set of alternatives that excludes the temptation good and thus commits the agent to not choosing it. This option saves the cost of self-control.

The model by Gul and Pesendorfer has been applied to several fields within economics. There is a recently emerging literature (*e.g.* Angelini *et al.*, 2013; Kovacs, 2014; and Ghent, 2015) that applies it to the study of housing demand over the life cycle. This literature points out the role of housing as a commitment device. The idea is that if immediate consumption is a temptation good, households will suboptimally choose to consume too much in the present and will not save enough for retirement. In this context, households can commit themselves to save by investing their wealth in housing. This feature can be incorporated in the NT model of Section 4.1.1 by rewriting the utility function as follows:

$$V = u(c, h, s, o) - \rho(v(c^*, h, s, 0) - u(c, h, s, o)), \qquad (12)$$

where for simplicity we have excluded the bequest motive. The second element in (12) is the temptation term, which is weighted by ρ, and where $v(\cdot)$ is the level of utility attained when all wealth is liquidated, the household is a renter ($o = 0$), and consumption is set to its maximum immediate level, c^*. If the household chooses this utility level, the temptation term cancels out. Otherwise, the temptation term is assumed to be positive, *i.e.* $u(\cdot) < v(\cdot)$ if $c < c^*$, and it

can be seen as the utility cost of self-control, since it provides the utility difference between the tempting alternative and the actual choice.

To increase lifetime utility, a household should save for the future, but at the same time reduce the cost of self-control. This is possible by investing in illiquid assets, which will reduce the wealth disposable for immediate consumption and, in turn, will reduce as well the cost of self-control. Housing can play this role, since its liquidation usually implies high transaction costs and home equity lines are not always readily available. The temptation motive has the potential to explain the interaction between homeownership and altruistic or strategic bequests. If, in the presence of immediate consumption as a tempting alternative, one wants to make sure that a bequest is left for the following generation, using housing as a commitment device can come in handy, especially if one wants to strategically signal that a bequest will come.

To test the temptation motive for housing, Angelini *et al.* (2013) use European life history data and regress the hazard rate of homeownership, *i.e.* the probability for a renter to transit to homeownership, on the value of liquid and illiquid financial assets in the household portfolio. They find a considerable effect of holding illiquid financial assets, which is especially strong for individuals above forty years of age. The latter are the most expected to transit into home-ownership for commitment purposes, since earlier in life the purchase of a house is more likely related to family formation. On the other hand, Kovacs (2014) follows a different approach consisting of estimating a structural life cycle model with temptation preferences. Her model predicts that the interaction between housing services in the utility function and temptation preferences induces a high demand for housing as a commitment device. Housing demand appears to be about 30% higher at its peak over the life cycle when housing plays a commitment role compared to when it does not.

Table 7 Rent-to-own Moves and Remaining Mortgage Debt (RMD) (2003-2013)

		Below 40	40-50	50-60	60-70	70+	Total
Rent-to-own	Number	139	59	17	4	4	222
moves	%	62.61%	26.58%	7.66%	1.80%	1.80%	100%
RMD	% with RMD	26.60%	33.48%	38.10%	38.94%	32.19%	33.61%
	Average	46.82	46.94	45.44	40.75	27.56	42.53

Source: DHS. *Notes:* Average RMD is provided in thousands. The last colum of the RMD panel provides the % of households with RMD and the average RMD when all ages are pooled together. Renters are included when computing statistics regarding RMD.

Table 7 shows that 37.39% of the rent-to-own transitions registered in the DHS dataset correspond to households with a household head that is 40 years of age or more. According to Angelini *et. al.* (2013), rent-to-own transitions that take place above forty are likely to be for commitment purposes. In addition, the lower panel of Table 7 shows that remaining mortgage debt is still relatively high for households that are above 60, which suggests that a reasonable share of houhseholds have become homeowners (or have increased the size of their property)

late in life. In summary, Table 7 indicates that commitment demand for housing is an element to take into account in the Netherlands. Combined with the previous descriptive evidence on the relationship between homeownership and bequests, the commitment demand for housing potentially adds to the understanding of the RSP in the Netherlands.

7   Conclusion

The full understanding of the underlying causes behind the retirement-savings puzzle (RSP) is crucial for the assessment of the adequacy of retirement savings in a context of pension system reforms. To that end, we complement the RSP literature by reviewing the literature on home equity during retirement (HER). The HER literature indicates that retirees are generally reluctant to withdraw their housing equity, which has clear implications for the understanding of the RSP. This insight is picked up by Nakajima and Telyukova (2011), who develop a model of the retirement savings of couples with housing. One of their main conclusions is that housing as a bequeathable asset plays a major role in explaining the RSP. Further literature on altruistic and strategic bequests, as well as on housing as a commitment device, provide additional insights to understand the connection between bequests, homeownership and the RSP.

The descriptive evidence that we draw from the Dutch National Bank Household Survey (DHS) shows that a vast majority of Dutch homeowners do not sell their house to finance retirement, and it is likely that homeownership among retirees will increase in the near future due to cohort effects. In addition, the evidence shows that there is a strong correlation of homeownership with the importance given to leave a bequest, as well as with the self-perceived chance that a bequest will be left. Since there are still own-to-rent moves at advanced ages and mortgage debt is still high among older adults, it is likely that Dutch households use housing as commitment to signal a bequest and/or to altruistically pass it on to the next generation. This type of behaviour potentially explains a large share of the low wealth withdrawal rate among Dutch retirees pointed out by Van Ooijen *et al.* (2015). Furthermore, it is in accordance with the fact that retirees are not willing to withdraw their housing wealth to finance retirement, which can explain why financial products such as reverse mortgages have never rooted in the Netherlands.

The RSP literature is still a fertile ground for new contributions. Structural models in the line of De Nardi *et al.* (2010) and Nakajima and Telyukova (2011), as well as reduced form type of analysis, can bring on a better understanding of the connection between homeownership, bequests and the RSP. The literature on strategic bequests as well as the literature on temptation and commitment provide potentially fruitful lines of research for the further understanding of the stylized facts laid out in this survey paper.

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