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MANDATORY PENSIONS AND PERSONAL SAVINGS IN THE NETHERLANDS*

BY

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1 INTRODUCTION

The study of the relation between contractual savings and personal (or free) savings has a venerable history. Feldstein (1974) used the framework of an extended life-cycle model to study the depressing effect social security wealth may have on household savings. On the basis of aggregate U.S. data he estimates that social security wealth depresses personal saving by about 30 to 50 percent. Feldstein and Pellechio (1979) study the same issue, but use microdata. They find a considerable depressing effect of social security wealth on ordinary fungible wealth. Their range of estimates includes the possibility that each extra dollar of social security wealth is offset by a corresponding drop of one dollar in fungible wealth.

Munnell (1976) investigates the impact of coverage by social security and pensions on private saving. She uses microdata for the U.S. and finds, using once again a life cycle framework, that both social security coverage and pension coverage depress private saving. The depressing effect of pension coverage on savings is, however, lower than the total contributions to private pensions. Hence the net effect on savings is still positive. Since social security is not funded, its effect on savings is unambiguously negative.

Diamond and Hausman (1984) use essentially the same framework as mentioned above, but their analysis is more sophisticated from an econometric viewpoint. They use a panel of males (the National Longitudinal Survey 1966–1976), eliminating all individuals with wealth below $4000 in 1966. This selection is motivated by the possibility that low wealth individuals may be liquidity-con-

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trained if it is difficult to borrow against future income. This would make the conventional life cycle model less applicable as a description of behavior. Diamond and Hausman take into account individual effects and the endogeneity of retirement. They estimate a proportional hazard model to describe retirement behavior. They then use this model to construct instruments for retirement age in a model of wealth accumulation. They find that both social security and pensions reduce free savings, with the effect of social security being bigger than the effect of pensions. Their estimates of these saving depressing effects are, however, substantially smaller than obtained by other authors.

Since generally the estimates of the effects on savings of social security and pensions vary quite a bit across different studies, Dicks-Mireaux and King (1984) perform extensive tests of robustness for the effect of social security wealth and pension wealth on private savings. They use Canadian household data, employing the methodology advocated by Leamer (1978). Their results suggest that the net negative effect of social security and private pensions on household savings (the 'displacement effect') is rather small, in the order of 0.25. Of course the exact effect depends on prior assumptions.

Bernheim (1987) questions the routine use of actuarial valuation of social security benefits (i.e. future benefits are weighted with survival probabilities) in view of the absence of perfect annuity insurance markets. He shows that under a rather wide variety of circumstances simple discounting of future benefits gives a better measure of social security wealth than actuarial discounting. In his empirical analysis he finds that regressions based on simple discounting work substantially better than regressions based on actuarial discounting. The implied displacement effect of social security on private savings is much larger than found by others.

Mirer (1992) investigates the robustness of Bernheim's findings, in particular for the assumption that mortality rates are constant. Essentially, his findings is that neither simple discounting nor actuarial discounting may give a very good approximation of the annuity value of social security benefits.

In a recent paper, Gale (1995) re-evaluates the literature so far and points out a number of biases in the existing literature. Some of these have been acknowledged by earlier authors, others are new. Gale notes that the prototypical equation in this literature has the following form:

$$W = Z\alpha + \beta P + \epsilon, \tag{1.1}$$

where W is a measure of non-pension wealth or saving, Z is a vector of explanatory variables, P is a measure of pension status (e.g. present discounted value of a future stream of pension benefits, to be called pension wealth), α and β are parameters to be estimated, and ϵ is an error term. The displacement effect of private pensions on savings (or offset as he calls it) is measured by β. If β is equal to -1, there is complete displacement, i.e. for every extra dollar of pension wealth non-pension wealth falls by an equal amount. Gale notes eight different sources of bias when using an equation of this type:

1. Controlling for cash earnings rather than total compensation. If one compares two individuals with equal earnings but with different levels of pension wealth the parameter β will pick up both the substitution effect of the difference in pension wealth and the income effect of the differences in total life time resources. By way of a number of examples Gale shows that this can lead to a serious underestimation of the displacement effect. He also shows how this bias will vary across the life cycle.
2. Ignoring differences in life expectancy. This also implies a downward bias, since a higher life expectancy implies both a higher pension wealth and a higher non-pension wealth. If expectancy is omitted a spurious positive correlation between these two quantities is induced.
3. Omitting retirement age. It may be expected that an individual with a more generous pension scheme is likely to retire earlier than someone with a less generous scheme. But such a person has an incentive to save more while working to prepare for a longer retirement period. This induces a positive correlation between pension wealth and non-pension wealth.
4. Omitting age. Assuming that people run down both their non-pension wealth and their pension wealth after retirement (pension wealth falls with age by construction), older people will have both lower non-pension wealth and lower pension wealth than younger people. This induces a positive correlation between both types of wealth if age is omitted as an explanatory variable.
5. Heterogeneity in savings propensity. Most likely, people who tend te save a lot also prefer to have generous pension plans. To the extent that a pension plan reflects a choice by an individual, this induces positive correlation between both types of wealth, and this biases the estimated displacement effect towards zero.[1]
6. Pension wealth should be measured net of taxes. Otherwise one overestimates pension wealth and hence underestimates the associated regression parameter β.
7. Narrow measures of non-pension wealth. The literature shows a large variation in measures offsets and a tendency to find smaller offsets if a narrower measure of non-pension wealth is being used.
8. Measurement error in pension wealth. This will mostly induce a bias in the estimate of β towards zero. Since pension wealth is notoriously hard to measure, this is a difficult problem.

1 Although in The Netherlands occupational pension plans are typically mandatory, one can still imagine that people with a high savings propensity will tend to choose jobs with good pension plans.

In the current paper we also investigate the displacement effect of social security and pensions on savings, but in a somewhat different institutional context, namely that of The Netherlands. Very little research has been carried out to date on the displacement effect of social security and pensions on private savings in The Netherlands. Kuné (1981) used aggregate time-series data for the period 1952-1978 in a regression equation where personal saving of households is explained by various sorts of income, the interest rate, inflation, the amount of public sacial security contribution, and the amount of pension saving. He finds insignificant effects for social security contributions on savings (and with an unexpected sign: if more is contributed, personal savings go up). The pension savings do have a significantly positive effect on total personal savings and in some specificatoins this effect does not differ significantly from one. To interpret these results one should notice that the left hand variable 'personal savings' is the sum of a number of components, including pension savings. Thus a coefficient equal to zero for pension savings would imply a one-for-one displacement of free savings by pension savings, whereas a coefficient equal to one would imply a zero displacement rate.

As acknowledged by Kuné, the use of social security contributions in a given year as an indicator of social security wealth is somewhat hard to defend in a life cycle framework. Van der Laan and Zwezerijnen (1983) take up the task of constructing a wealth variable representing the present value of the future old age benefits. (The Netherlands has a public old age benefit system covering every citizen, see below.) They then run a regression with aggregate data where savings per household are explained by disposable income per household, average household size, inflation, and social security wealth. They find a negative but not very significant effect of social security wealth on household savings.

Draper (1994) uses a representative agent model where a consumer maximizes utility from consumption, nonhuman wealth and pension rights. He finds some displacement of free savings by pension savings. However, his estimates are partly based on parameters that had to be fixed a priori, so that the conclusions may not be robust.

In this paper we use micro (panel) data to investigate the impact of the amount of pension and social security wealth a household has at its disposal on hte household's savings. In section 2 we give some background on relevant facts and institutions in The Netherlands. In section 3 we describe the construction of variables needed in the empirical analysis, in particular pension wealth and social security wealth. To this end we also need to model the income process of households.

In section 4 we then go on to investigate the effect of social security and pension wealth on household savings. This is done in line with the literature discussed above, by specifying equations which explain the private wealth of households on the basis of income, pension and social security wealth, and various demographic characteristics.

Section 5 presents and discusses results. Section 6 concludes.

2 SOCIAL SECURITY, PENSIONS, AND SAVINGS IN THE NETHERLANDS

2.1 *Institutional Framework*

Everyone in The Netherlands is covered by a general old age pension starting at the age of 65. The level of the benefit is independent of other income but does depend on household composition. For a couple benefits are equal to the minimum wage.

In addition, the vast majority of employees are covered by an occupational pension scheme of one sort or another. In *Pensioenkaart van Nederland* ('Pension Map of The Netherlands' to be denoted by PN (1987) from now on), it is estimated that in 1985 more than 80% of all employees were covered by an occupational pension scheme. Most likely this percentage has increased since then. Table 1 gives an impression of the importance of the general old age pension and other pensions for the incomes of the elderly in 1989. One observes that among the elderly 20% do not draw benefits from a private pension. This does not imply that these households do not have any income other than social security benefits (i.e. the general old age pension benefits). Out of the 242,000 households with only social security benefits, 142,000 draw additional income from other sources like capital income (Meuwissen (1993)). To put the numbers in the table in some further perspective, we note that in 1989 the after-tax income associated

TABLE 1 – IMPORTANCE OF GENERAL OLD AGE PENSION BENEFITS AND OTHER PENSION BENEFITS (1989)

	with other pensions			only general old age pension benefits	
	number × 1000	total inc. per househ. Dfl. × 1000	other pension benefits Dfl. × 1000	number × 1000	inc. per household Dfl. × 1000
H.h. comp.					
single	395	26.7	8.4	113	20.2
couple	426	40.3	13.7	67	38.5
other h.h.	121	23.8	7.2	54	19.5
Age					
65-69	330	36.4	13.2	66	29.1
70-74	249	33.1	11.3	68	25.0
75-	383	28.9	8.0	108	23.4
Total	962	32.6	10.6	242	25.4

(Source: Meuwissen (1993))

with a general old age pension benefit was equal to Dfl. 13,416 for singles and Dfl. 19,368 for couples.

In general, if an employer offers a pension scheme, then participation in such a scheme is compulsory. More than 99% of the pension schemes is of the defined benefit type whereas the remainder (0.6%) is of the defined contribution type. More than 72% of the pension benefits are defined on het basis of final pay, the remainder being a mixed bag of various combinations of final pay, fixed amounts, and average pay.

Combining the effects of the general old age pension scheme and the private pension schemes leads to the following before-tax replacement rates for those individuals who have contributed for a sufficient number of years: 34% receives less than 60% of the final pay, 27% receives between 60 and 69, 20% receives between 70 and 79%, 19% receives at least 80% of final pay (PN(1987)). One should keep in mind that after tax the replacement rates are usually substantially higher. For instance, if the before-tax replacement rate is 70 than the after-tax replacement rate exceeds 90 (Keesen (1990)).

2.2 *Savings in The Netherlands; Aggregate Data*

Figure 1 gives a time series of both contractual and free savings for the period 1982–1995. To appreciate the graphs, it is of some importance to be precise about

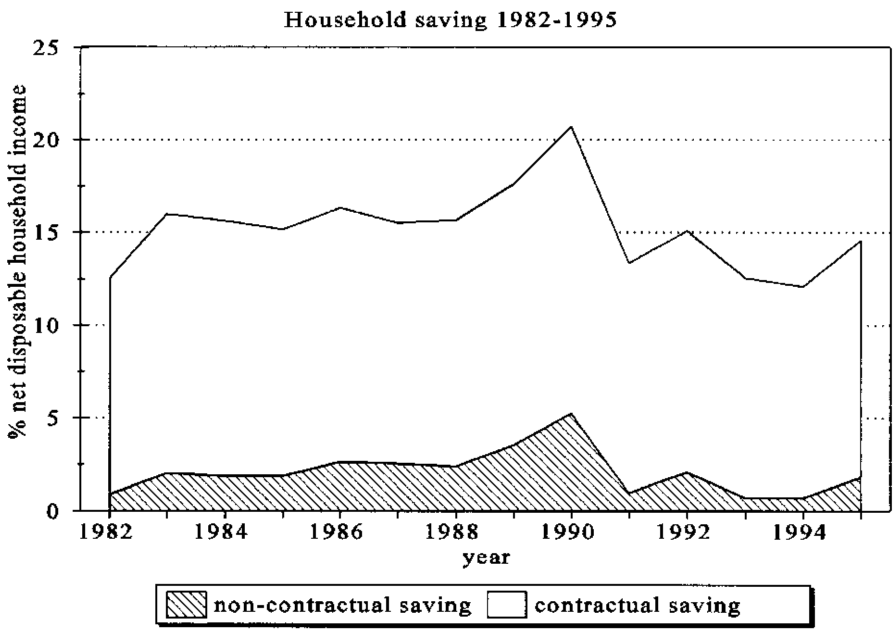

Figure 1 – Breakdown of Dutch household saving, 1982–1995 (source: National Accounts)

the definition of household savings. Household savings are defined as disposable income minus consumption. Disposable income includes wages (also imputed wages of self-employed), social security benefits, income transfers from the government, corporate income (dividends, rent, imputed rent for owner-occupied housing), interest received, pension and life insurance benefits, and capital income of pension funds and life insurers. Taxes and social security premiums are subtracted. Consumption is defined to be equal to the purchase of goods and services. This implies in particular that the purchase of durables is measured as consumption.

The aggregate savings measure can be split up in two parts, contractual savings, defined as wealth increases of pension funds and life insurers, and the remainder which is called non-contractual or 'free' savings.

One notices a fairly constant contractual savings rate over the period considered, and an apparent decline of the free savings rate after 1990.

2.3 *Savings in The Netherlands; Microdata*

For the empirical analysis in the next sections the Socio-Economic Panel has been used.[2] The SEP has been run by Statistics Netherlands since 1984 and has been patterned after the Panel Study of Income Dynamics of the University of Michigan. The SEP is representative of the Dutch population, excluding those living in special institutions like nursing homes. The sample size of the SEP is approximately 5000 households. Between 1984 an 1989 households were interviewed twice a year, in April and in October. Since 1990 interviews take place once a year (in May). We will employ the waves of 1987 through 1991.

From 1987 onwards the April questionnaires include questions concerning assets and liabilities. Information is collected for the following assets: 1) checking accounts; 2) saving and deposit accounts; 3) saving certificates (certificates of deposit); 4) bonds, mortgage bonds; 5) shares, options, and other securities; 6) value of the primary residence; 7) other real estate (not used for own residence); 8) value of the car(s); 9) cash value of the life insurance mortgage; 10) claims against private persons (friends, acquaintances)[3]; 11) other assets.

The survey collects information on the liabilities of every respondent. In the SEP questionnaires of April 1987 and April 1988, the following categories are listed: 1) personal loan or revolving credit; 2) purchase on credit, hire-purchase; 3) remaining mortgage debt; 4) other loans; 5) other debt. In 1989, the CBS sub-

2 A large part of the analysis presented in this section has been carried out by Alessie, Lusardi, and Aldershof (1997).

3 As of 1989, the questionnaire does not include the asset component 'claims against private persons,' but it retains the component 'other assets.' As of 1990, the self-employed do not have to record assets and liabilities. We have therefore exluded the self-employed from the analysis. As of 1990, the 'cash value of the life insurance mortgage debt' cannot be computed from the SEP data. However, the 1987–1989 data suggest that this is a rather small item (*cf.* Alessie, Lusardi, and Aldershof (1997)).

stantially revised the questions concerning the liabilities. Ten liability categories can now be distinguished: 1) personal loans; 2) revolving credit; 3) debt with mail order firms, retail debt; 4) other purchases on credit; 5) hire-purchase; 6) remaining mortgage debt; 7) equity-based loans; 8) debt with relatives and friends; 9) other outstanding debt, unpaid bills; 10) other debt. Household assets and liabilities are obtained by respectively summing all assets and liabilities of each respondent in the household. Net worth is obtained by subtracting total liabilities from total assets. In this paper we also consider the variable financial wealth, which is equal to net worth minus housing equity (i.e. the value of the primary residence plus the cash value of the life insurance mortgage minus the mortgage debt and minus the value of the real estate. For confidentiality reasons, the values of the assets and liabilities have been top-coded for each category and set at the value of Dfl. 999,997 if the values exceed that amount.[4]

Summary statistics on the size and composition of net worth have been presented by Alessie, Lusardi, and Aldershof (1997). Alessie, Pradhan, and Zandvliet (1993) compare the asset and liability data with some external data sources, in particular with (aggregate) data from the 'Collective Bank Study' (CBO), the Dutch Central Bank, and the Society of Real Estate Agents. The comparison with external data sources is limited, however, since there are no aggregate statistics for some of the asset and liability components. In addition, the SEP does not oversample rich households, which is important for comparisons with macrodata. Alessie, Pradhan, and Zandvliet (1993) find that the data on home-ownership (the most important asset category) are consistent with external data sources. The same is true for checking accounts and the debt items. However, savings and deposit accounts seem to be underestimated in the SEP. This problem is also encountered in the U.S. SCF and is rather common in wealth surveys (Avery, Elliehausen, and Kennickell, 1988; Davies, 1979). Meuwissen (1994) compares the SEP data with a data set constructed from administrative sources (e.g. tax social security records). While the ownership rate of most asset components compares reasonably well across the two data sets, the conditional mean of shares and options is substantially higher in the data from tax records than in the SEP.

One of the questions in the April 1988 questionnaire was:

Do you expect to be able to save money in the next 12 months?
1 yes, certainly
2 yes, maybe
3 probably not
4 certainly not

4 For asset categories such as the value of real estate and the value of someone's own company, top-coded values are present. Very few households in our analysis are affected by the top-coding, partly because it is heavily concentrated among the self-employed which we have excluded from the sample.

For those who answered 'yes, certainly' or 'yes, maybe,' the following question then was:

What would you spend this money on?
More than one answer is possible here.
car
house
holidays
durable goods
extra income (e.g. interest)
unforeseen circumstances
old age
children
other purpose, that is ...
no particular purpose

For some of the categories in the latter question, Figure 2 presents the proportions of respondents who mentioned these categories (the graphs have been con-

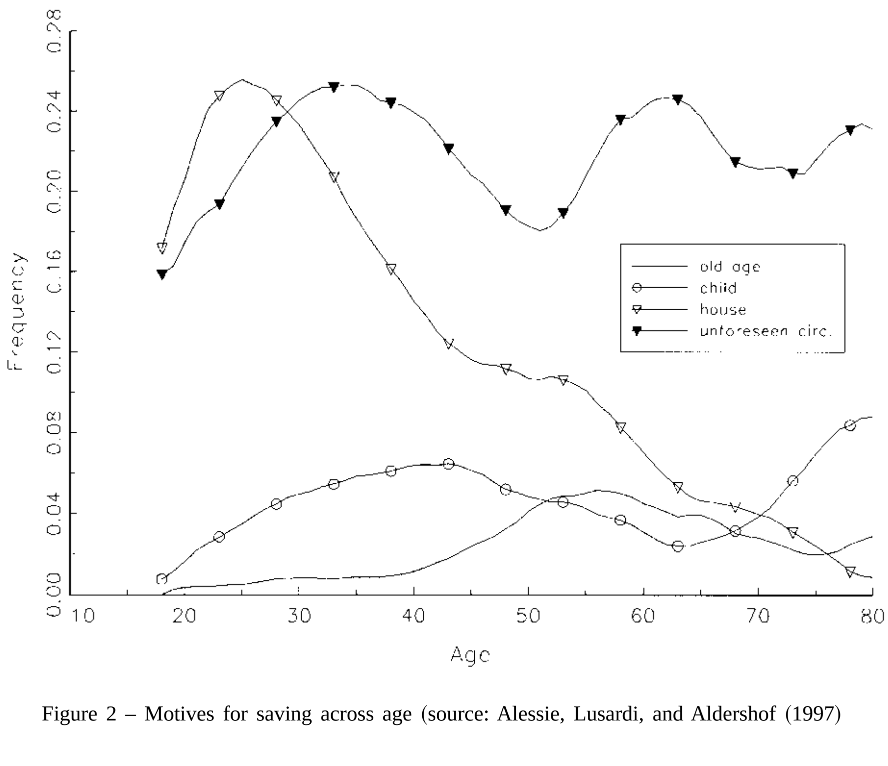

Figure 2 – Motives for saving across age (source: Alessie, Lusardi, and Aldershof (1997)

structed by a kernel regression of the zero-one variables corresponding to each category on age). Clearly, old age is not a very important motive to save money, although this motive becomes slightly more prominent among middle-aged people. There are of course various ways to interpret this result. One possibility is that the coverage by social security and private pensions is considered to be so generous that one need not worry about old age very much. This would then indicate a displacement effect on savings.

To get some further feeling for the data we present in Figure 3 two graphs of savings across age groups for the middle year of our sample period. The graphs are based on kernel regressions of quartiles.

Savings in a given year is defined here as the difference in wealth between the beginning and the end of the year. Notice that although net savings drop to a low level at the age of 60, dissaving (at the median) hardly occurs. Figure 3a makes clear that there is considerable dispersion across households in savings within a given year. At all ages the first quartile of the savings distribution is negative. If we exclude housing then median savings are more or less zero, with sizeable dissavings for a substantial fraction of the population. One should be aware of the fact that measurement of household wealth may be subject to sizeable error.

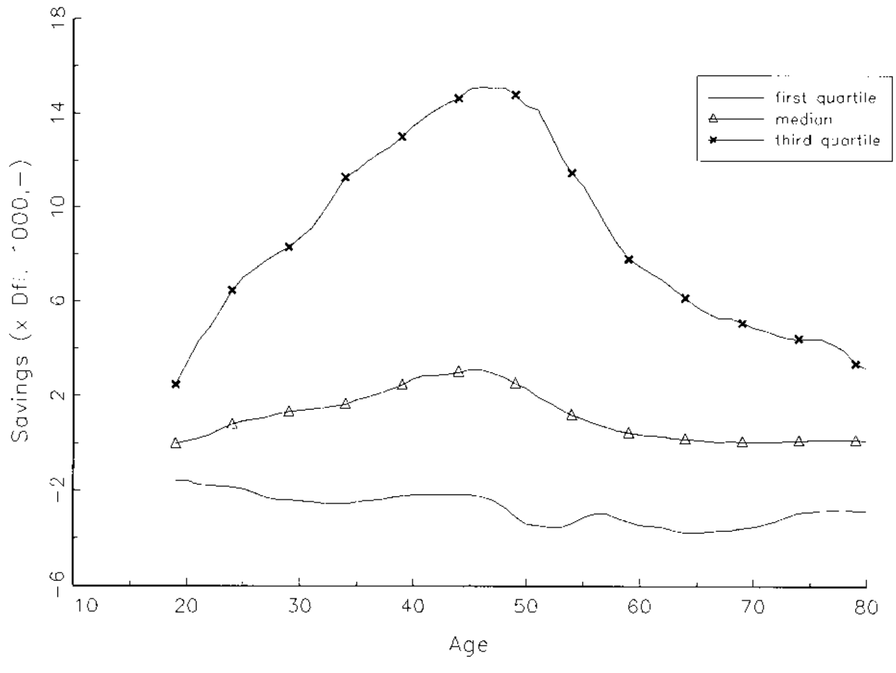

Figure 3a – Distribution of savings across age in 1989 (including housing; source: Alessie, Lusardi, and Aldershof (1997))

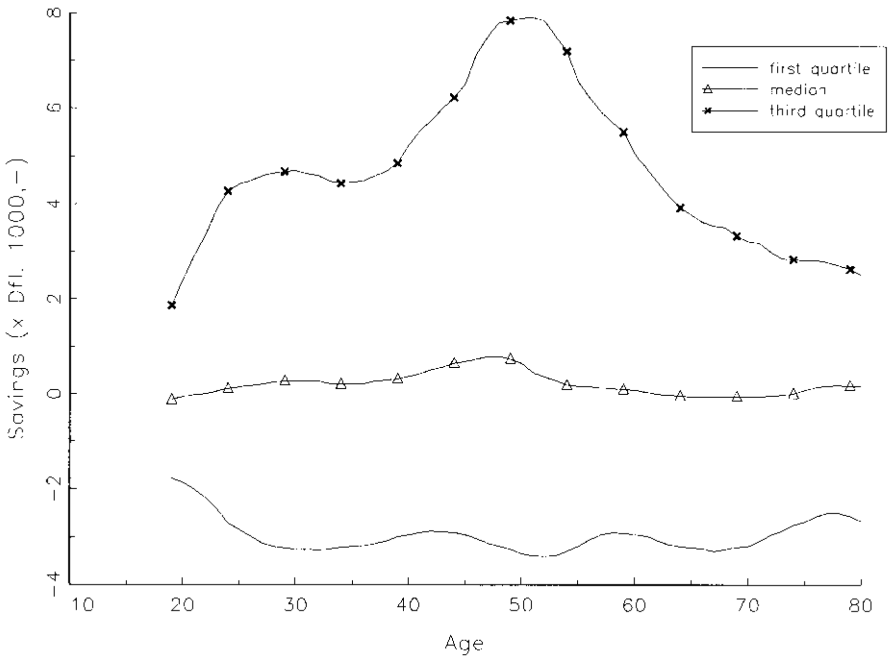

Figure 3b – Distribution of savings across age in 1989 (excluding housing; source: Alessie, Lusardi, and Aldershof (1997))

Since saving in a given year is defined as the difference between two quantities measured with error, saving defined this way will probably suffer from substantial measurement error itself.

3 THE INCOME PROCESS, SOCIAL SECURITY WEALTH AND PENSION WEALTH

We assume that individuals who are not retired yet form rational expectations concerning their future social security and pension benefits.[5] Under this assumption we can use a model of income processes of each individual or household to construct Social Security Wealth (*SSW*) and Pension Wealth (*PW*). For individuals who are retired, the contruction of *SSW* and *PW* is much simpler as we assume that their benefits will grow at an annual rate of 1%. This percentage is consistent with medium-term projections of the real per capita growth rate of the Dutch economy.

5 One may question what sort of expectations are rational exactly. We have assumed that individuals expect the current rules to continue. So, for instance, individuals do not take into account the possibility that social security would become less generous in the future.

Actually, since pension benefits are generally linked to earnings and social security benefits to non-capital income, we have to model two income processes, one for the construction of *SSW* and one for the construction of *PW*.

3.1 *Non-capital Income and* SSW

For the construction of *SSW* the most important aspect is the evolution of income around age 65. For single people the situation is quite simple, once they qualify they get social security benefits (i.e. the general old age pension benefits). For couples the situation is much more complicated, as for instance the general old age pension received by a household head who is over 65 will depend on the non-capital income of his (or her) spouse in case she (or he) is under 65. As a result, we have to model the non-capital income for both heads of households and spouses. Appendix A provides an extensive description of the models employed.

3.2 *Earnings Process for* PW

Again we model separate processes for heads and spouses. The details are to be found in Appendix B. There is one important complication, which should be mentioned here. If one simply takes annual earnings as a dependent variable, then the earnings path of spouses shows a strong hump shape. The reason for this is that older cohorts of women appear to work considerably fewer hours per week than the younger cohorts. The number of waves of the panel used appears to be too small to allow for cohort effects explicitly. We have 'solved' the problem by standardizing the earnings of spouses by dividing by the number of hours worked per week and used that as a dependent variable. In the forecasts the assumption is that the number of hours worked will remain constant in the future.

3.3 *Construction of* SSW *and* PW

Given the equations for non-capital income, the construction of *SSW* is straightforward, though extremely tedious. In all cases we assume a one percent real income growth across the board, i.e. the intercepts of the equations are increased annually in an appropriate manner. See Appendix A for details.

For the construction of pension wealth it is not only necessary to predict earnings, but also to use the probability that someone will leave the labor force and either become disabled or retire early. Estimation of these probabilities is part of the modelling described in Appendix B. If one leaves the labor force at a certain age, say into disability, then we can approximate the income as of that moment as a function of earnings in the year prior to the exit. By taking the various exit routes out of the labor force into account, we can calculate the final pay at age 65 and also the number of years counting towards the calculation of pension benefits.

In the calculation of the present value of future benefits we have somewhat arbitrarily assumed a three percent real interest rate. Since the analysis is based on a comparison of the *SSW* and *PW* of different households, the exact interest rate is not particularly important as it influences *SSW* and *PW* of all households in the same direction.

4 WEALTH REGRESSIONS

As a starting point we take the basic life cycle permanent imcome hypothesis. In its basic formulation the life cycle PIH model with homothetic intertemporally additive preferences implies the following consumption equation:

$$C_t = \kappa_t \left[(1+r)A_{t-1} + \sum_{\tau=t}^{L} (1+r)^{t-\tau} \mathrm{E}_t y_\tau \right] \tag{4.1}$$

The term in square brackets is total wealth, i.e. present wealth[6] plus the discounted sum of expected future incomes, where the expectation is taken at time t; C_t is comsumption at time t. The parameter κ_t is inversely related to life expectancy. For instance, if we assume that instantaneous utility is quadratic in consumption, with constant bliss level, and time preference equals the interest rate, then κ_t is equal to $(1/[\sum_{\tau=t}^{L}(1+r)^{t-\tau}]$, where $L-t$ is the number of years one may expect to live after t. If the bliss level is allowed to shift over time, then the equation will in general have an additive term representing taste effects.[7] Ignoring taste effects for the moment and using the intertemporal budget constraint

$$A_t = (1+r)A_{t-1} + y_t - C_t\,, \tag{4.2}$$

we obtain the following equation for the evolution of private wealth over time:

$$A_t = (1-\kappa_t)[(1+r)A_{t-1} + y_t] - \kappa_t \sum_{\tau=t+1}^{L} (1+r)^{t-\tau} \mathrm{E}_t y_\tau\,. \tag{4.3}$$

6 That is, exclusive of *SSW* or *PW* and measured at the end of the year.

7 Let the bliss level in period τ be equal to cb_τ. Then the expression for consumption at time t for household h becomes:

$$C_t = \kappa_t \left[\left((1+r)A_{t-1} + \sum_{\tau=t}^{L} (1+r)^{t-\tau} \mathrm{E}_t y_\tau \right) - \left(\sum_{\tau=t}^{L} (1+r)^{t-\tau} \mathrm{E}_t (cb_\tau - cb_t) \right) \right].$$

The time-varying bliss levels break the homotheticity of preferences in lifetime wealth. For the rest one immediately sees the additive dependence of consumption on the time-varying bliss levels.

Since wealth is measured per household, income also has to be defined as household income. To form the expectation of future household income we estimate a separate model for household income, similar to the models described in Appendix A.[8] With this model in hand one can construct expected future incomes of households by constructing a time path such that it passes through the income in the year of observation, while taking into account the 1% real income growth per annum assumed before. Obviously we only have to sum through the age of 64, since after that we can use the *SSW* and *PW* variables constructed before. Furthermore, we allow wealth at a given moment to be influenced by demographic variables and taste shifters by adding such variables to the right hand side of (4.3).[9] Let us collect these latter variables in a vector x_t and let us denote $\sum_{r=t+1}^{64}(1+r)^{t-r}\mathrm{E}_t y_r$ by PY_{pt}, then the final specification of the equation to be estimated is

$$A_{ht} = \beta' x_{ht} + \delta_1 A^*_{h,t-1} + \delta_2 y^*_{ht} + \delta_3 PY^*_{h,pt} + \delta_4 SSW^*_{ht} + \delta_5 PW^*_{ht} + \epsilon_{ht}\,, \tag{4.4}$$

where we have added a subscript *h* to identify the household under consideration. The asterisks indicate normalization with respect to life expectancy. That is, $A^*_{h,t-1} = (1-\kappa_{ht})A_{h,t-1}$, $y^*_{ht} = (1-\kappa_{ht})y^*_{ht}$, $PY^*_{h,pt} = \kappa_{ht} PY_{h,pt}$, $SSW^*_{ht} = \kappa_{ht} SSW_{ht}$.

The permanent income hypothesis as formulated here implies complete displacement. That is, δ_3 and δ_4 in equation (4.4) both have to be equal to -1. A value of these parameters greater than minus one implies a less than complete displacement.

4.1 *Results*

The proper estimation method for (4.3) will have to rely on the assumed properties of the error term ϵ_{ht}. Most likely, measured wealth will suffer from considerable measurement error and hence OLS applied to (4.3) will be heavily biased. Secondly, fixed effects may play an important part in the sense that some people are more thrifty than others and hence one might find a spurious positive relationship between private pensions and free savings (people who choose a job because of its excellent pension scheme are also the ones who save more). Hence we estimate three variants of (4.3). The first one is (4.3) as it stands, the second one moves the term $(1-\kappa_t)(1+r)A_{t-1}$ to the left-hand side of the equation, hence this equation reads:

8 Household income is not simply the sum of incomes as used in sections 3.1 and 3.2. In 3.1 and 3.2 we ignored variables like family allowance, alimony, etc.

9 That means we drop the assumption of constant bliss levels.

$$S^*_{ht} \equiv A_{ht} - (1-\kappa_t)(1+r)A_{h,t-1}$$
$$= \beta' x_{ht} + \delta_2 y^*_{ht} + \delta_3 PY^*_{h,pt} + \delta_4 SSW^*_{ht} + \delta_5 PW^*_{ht} + \epsilon_{ht}\,. \tag{4.5}$$

This amounts to imposing the restriction that $\delta_1 = 1$ in (4.3). By moving the term $(1-\kappa_t)(1+r)A_{t-1}$ to the left-hand side the measurement error problem has been taken care of at the cost of an extra assumption. One may think of S^*_{ht} as a generalized savings measure. We have also considered estimates with S^*_{ht} replaced by observed savings (*i.e.* the first difference of wealth), but the outcomes are broadly the same.

In the third variant we allow for fixed effects in (4.4). Furthermore we consider two wealth definitions, total net wealth (including home equity) and financial (or liquid) net wealth (excluding real estate). The reason for the latter distinction is that home equity is non-liquid. This may create liquidity constraints, which would make the model inconsistent with the life cycle hypothesis as we are using it. In all variants we have considered two specifications, one with and one without demographic variables. Although the demographic variables are often insignificant, we only present variants with demographics included to guard against any omitted variable bias. The estimates for the variables of interest do not appear to be very sensitive to inclusion or exclusion of the various controls. Since the controls are not of interest in themselves, we do not present their coefficients.[10]

The estimates are presented in Table 2. In the first row the theoretical values of the coefficients are given, if the LCH were exactly right.

Various noteworthy features emerge from Table 2. First of all the estimation of equation (4.3) in its form for total net worth yields estimates that have the wrong sign for social security and pension wealth, whereas the coefficients for current income and permanent income have the right sign, but are significantly different from their theoretical values. Only the coefficient for lagged wealth corresponds to theory. Furthermore, lagged wealth explains the bulk of the variance in current wealth. These results are qualitatively the same for financial wealth, although for financial wealth social security wealth has the right sign (but a large standard error). The estimation results with the savings measure as a dependent variable show a very small R^2 confirming our intuition that the measurement of savings as the first difference of wealth suffers from substantial measurement error. Of the two significant coefficients, the one for pension wealth has the wrong sign. The significantly positive coefficient for pension wealth indicates the presence of a fixed effect, where people who choose jobs with good pensions are also the ones who provide for their old age in different ways.

10 Demographics included are: # children below 6, # children 7-12, # children 13-17, family size, gender of head of household, a cubic spline in the age of the head of household with knots at ages 30, 40, 50, 60, 65, and 85.

TABLE 2 – ESTIMATION RESULTS (t-VALUES IN PARENTHESES)

	$A^*_{h,t-1}$	y^*_{ht}	$PY^*_{h,pt}$	SSW^*_{ht}	PW^*_{ht}	R^2	Nobs
Theoretical predictions	1	1	−1	−1	−1		
Dependent variable							
A_{ht} (total)	1.03	0.26	−0.08	0.003	0.28	0.86	7495
	(206)	(4.44)	(−1.04)	(0.01)	(4.93)		
A_{ht} (financial)	0.95	0.16	−0.07	−0.14	0.21	0.72	7495
	(132)	(3.62)	(−1.12)	(−0.96)	(4.85)		
S^*_{ht} (total)	–	0.27	−0.05	0.05	0.31	0.03	7495
	–	(4.72)	(−0.72)	(0.27)	(5.53)		
S^*_{ht} (financial)	–	0.16	−0.09	−0.20	0.18	0.01	7495
	–	(3.52)	(−1.47)	(−1.33)	(4.06)		
S^*_{ht} (total) FE	–	0.16	−1.01	−2.19	0.16		6848
	–	(1.68)	(−1.54)	(−2.58)	(1.40)		
S^*_{ht} (financial) FE	–	0.12	0.23	−2.63	0.17		6848
	–	(1.55)	(0.36)	(−3.60)	(1.78)		

Explanation: FE: fixed effects. Nobs: number of observations.

This possibility is accounted for by the fixed effects specification, which is therefore the preferred specification. The number of observations for the fixed effects specification is lower than for the other one, since we need observations per household for at least three consecutive years, whereas for the specification without fixed effects alle observations with at least two consecutive years of information could be used. We note that now pension wealth also has an insignificant coefficient for both wealth definitions, but still with the wrong sign. Social security wealth has a significantly negative effect indicating a strong displacement effect on private savings.

It is striking that pension wealth and social security wealth would have such different effects. One of the problems may be that the information used with respect to pension entitlement is far from perfect (see Appendix B) in the sense that there is no direct information about the level of future benefits that people can expect. We have essentially assumed that everyone who is covered and that the rules of the biggest pension fund in The Netherlands (the civil servants pension fund) apply to all occupational pension funds. This limits variability in the sample and makes pension wealth a function of current income. Since current income also enters as a separate explanatory variable this easily introduces severe multicollinearity. There is one piece of information about pension coverage that has not been used yet. Respondents in the panel were asked in 1988 whether they had any entitlements to pension benefits. We have used this variable by setting pension wealth to zero for all repsondents who said they had no entitlement

(18%). The results of this variant change a bit relative to what has been reported in Table 2, but qualitatively they are the same.

Yet another variant is to compute the present value of pension and social security wealth by simple discounting rather than by actuarial discounting, as suggested by Bernheim (1987). This variant also leads to slightly different results; the signs of the coefficients do not change. The results for this variant are given in Appendix C.

If we assume that the fixed model for S^*_{ht} is approximately well-specified then it would tell us quite different stories about the displacement effects of *SSW* and *PW*. For both wealth definitions the coefficient of PW^*_{ht} is not significantly different from zero, but in both cases the coefficient is significantly different from minus one at reasonable significance levels. Thus we can reject the possibility of one-for-one displacement of free savings by pension savings, but not the possibility of the displacement effect being zero. The outcomes for *SSW* indicate a significant displacement effect. In particular, we can reject the null of a zero displacement effect, while a null of a complete offset cannot be rejected.

As a final comment on the quality of the model specification we notice that for total wealth the coefficient of $PY^*_{h,pt}$ is not significantly different from its theoretical value. The coefficient of y^*_{ht} is too low.

5 CONCLUDING REMARKS

We will summarize the hypotheses we have investigated in this paper. The permanent income life cycle hypothesis implies full displacement between pension savings and social security on the one hand and private (non-contractual) savings on the other hand. This implication is the result of a number of assumptions, including perfect capital markets and the absence of precautionary motives. The hypothesis of full displacement is equivalent with coefficients being equal to minus one for the variables SSW^*_{ht} and PW^*_{ht}. If the hypothesis is not corroborated by the data we ask the question whether there is partial or more than full displacement (the coefficients corresponding to SSW^*_{ht} and PW^*_{ht} are smaller than zero) or no displacement at all (the coefficients corresponding to SSW^*_{ht} and PW^*_{ht} are greater than or equal to zero). For pension wealth we find no displacement and for social security we find (more than) full displacement.

To evaluate the robustness of our results, it is of interest to confront our outcomes and procedure with the list of possible biases provided by Gale (1995), *cf.* section 1: Our specification does not only control for cash income, but actually for lifetime resources, hence the first pitfall mentioned by Gale has been avoided. Similarly, we have accounted for differences in age and for heterogeneity in savings propensities (by using a fixed effects specification), and we have computed pension wealth net of taxes. Furthermore, our net wealth measure is quite broad.

As to differences in life expectancy, we have only corrected for differences across sexes, since we simply do not know the individual life expectancies beyond what can be learned from a life table. It is not quite clear whether this will really bias the results, since this procedure reduces measured variation in social security wealth and pension wealth relative to their true variation. Such reduction in variation is somewhat similar to the instrumentation of life expectancy (in this case by age and sex), which need not induce bias.

We score less well on the remaining sources of bias. We have not endogenized retirement age. We did model variations in labor force exits, but in an exogenous manner.

A serious problem with our analysis lies in the measurement error in pension wealth, as already indicated in the previous section. Clearly, it would be important to have data available that contain more direct information on pension entitlement. In addition to the data problems, one may question the specification of the utility function underlying the wealth equations we have estimated. In particular one would like to allow for the possibility of precautionary savings and for imperfect capital markets. Our choice of a quadratic utility function and the neglect of liquidity constraints has allowed for a closed form solution for household wealth. More general specifications, allowing for instance for liquidity constraints, habit formation or precautionary motives make it impossible to find such a closed form solution. In that case one has to revert to simulation studies as in Carroll (1992), which greatly complicates the model. Such complications are far beyond the scope of the present paper.

If our present finding, i.e. that displacement effects of pension wealth are not 100%, were to keep up even if we employed better data on pension entitlements and used more general models, it seems that a policy of encouraging broad coverage by private pension schemes is an effective means to maintain a high level of savings.

APPENDICES

APPENDIX A: CALCULATION OF SOCIAL SECURITY WEALTH

In the calculation of social security wealth we distinguish the following regimes:

1. One person household, 65 years and over
2. One person household, younger than 65
3. Couple, both the head and the partner are at least 65 years old
4. Couple, head is at least 65 years old, partner younger than 65
5. Couple, partner is at least 65 years old, head younger than 65
6. Couple, head and partner younger than 65, head at least as old as the partner
7. Couple, head and partner younger than 65, partner older than the head

In Table A1 the computation of social security wealth is explained for each of these regimes. Social security wealth is defined as the actuarially discounted sum of current and future social security benefits (AOW benefits). In case of the first three regimes the *SS* benefit does not depend on the level of income earned before retirement: the *SS* system is basically a flat rate system which is financed on a pay-as-you-go basis. The level of *SS* benefit is equal to the full-time minimum wage for couples of which both the head and partner are at least 65 years old. Singles who are older than 64 receive an *SS* benefit which is equal to 70% of the minimum wage. Since 1988 the *SS* benefit is income dependent for households belonging to groups 4 or 5.[11] In principle, such households receive at least 70% of the *SS* benefit of a couple (i.e. the SS benefit of a one person household). Depending on the income of the spouse, one may receive a bonus which depends on the income $INCP_{ti}$ of the spouse who is younger than 65. The maximum bonus is equal to *AOWA* (30% of the net minimum wage). This implies that households receiving the maximum bonus, receive the 'full' *SS* benefit of a couple. The relation between the bonus and the income of the spouse is as follows:

$$Bonus_{\tau i} = xp_{\tau i} I_{[xp_{\tau i}|xp_{\tau i} > 0]}(xp_{\tau i}) \tag{A1}$$

where

$$xp_{\tau i} = AOWA - 0.66 yp_{\tau i} I_{[xp_{\tau i}|xp_{\tau i} > 0]}(yp_{\tau i})$$

$$yp_{i} = INCP_{\tau i} - 0.15 minwage$$

$INCP_{ti}$ = non-asset income of the spouse who is younger than 65
minwage = minimum wage

Some comments on Table A1 are in order. First, we have to make some assumptions concerning the real interest rate and growth rate of the *SS* benefit.We assume the interest rate to be equal to 3% and the growth rate of the *SS* benefit equal to 0%. Second, we assume that apart from the fact that head or spouse may die, no changes in the family composition occur in the future. For instance, this assumption implies that we do not allow for marriages or divorces. The assumption might be reasonable for the older single person households, but it is quite a strong assumption to make for the younger households. However, the calculations become much more complicated if we allow for such possibilities. The third assumption concerns the survival probabilities of the head and the spouse. We assume that these probabilities are mutually independent.

Given the assumptions made above, the calculation of social security wealth is rather straightforward for the households belonging to groups 1 till 4. For the other groups social security wealth is income dependent due to the existence of

11 Before 1987 households in groups 4 and 5 received the same amount as households in group 3.

TABLE A1 – FORMULAE OF SOCIAL SECURITY WEALTH

Group	Household type	Social security wealth
1	Single, $ageh >= 65$	$SSW_i = \sum_{\tau = ageh_i}^{\infty} \left(\frac{1+g}{1+r}\right)^{\tau - ageh_i} ph_{ageh_i,\tau} AOWS$
2	Single, $ageh < 65$	$SSW_i = \sum_{\tau = 65}^{\infty} \left(\frac{1+g}{1+r}\right)^{\tau - ageh_i} ph_{ageh_i,\tau} AOWS$
3	Couple, $ageh >= agep >= 65$	$SSW_i = \sum_{\tau = ageh_i}^{\infty} \left(\frac{1+g}{1+r}\right)^{\tau - ageh_i} ((ph_{ageh_i,\tau} + pp_{agep_i,\tau^*} - ph_{ageh_i,\tau} pp_{agep_i,\tau^*}) AOWS + ph_{ageh_i,\tau} pp_{agep_i,\tau^*} AOWA)$ where $\tau^* = \tau - (ageh - agep)$
4	Couple, $ageh >= 65, agep < 65$	$SSW_i = \sum_{\tau = ageh_i}^{64 + ageh_i - agep_i} \left(\frac{1+g}{1+r}\right)^{\tau - ageh_i} (ph_{ageh_i,\tau} AOWS + ph_{ageh_i,\tau} pp_{agep_i,\tau^*} Bonus_i) +$ $\sum_{\tau = 65 + ageh_i - agep_i}^{\infty} \left(\frac{1+g}{1+r}\right)^{\tau - ageh_i} ((ph_{ageh_i,\tau} + pp_{agep_i,\tau^*} - ph_{ageh_i,\tau} pp_{agep_i,\tau^*}) AOWS +$ $ph_{ageh_i,\tau} pp_{agep_i \tau^*} AOWA)$ where $\tau^* = \tau - (ageh - agep)$
5	Couple, $agep >= 65, ageh < 65$	analogous to 4 (switch $ageh_i$ and $agep_i$)

6	Couple, $65 > ageh >= agep$	$SSW_i = \sum_{\tau=65}^{64+ageh_i-agep_i} \left(\frac{1+g}{1+r}\right)^{\tau-ageh_i} (ph_{ageh_i,\tau} AOWS + ph_{ageh_i,\tau} pp_{agep_i,\tau*} Bonus_i) + \sum_{\tau=65+ageh_i-agep_i}^{\infty} \left(\frac{1+g}{1+r}\right)^{\tau-ageh_i} ((ph_{ageh_i,\tau} + pp_{agep_i,\tau*} - ph_{ageh_i,\tau} pp_{agep_i,\tau*}) AOWS + ph_{ageh_i,\tau} pp_{agep_i,\tau*} AOWA)$ where $\tau* = \tau - (ageh - agep)$
7	Couple, $65 > agep > ageh$	analogous to 6

i: = household index
$ageh_i$: = age of the head of household i
$agep_i$: = age of the partner
$ph_{ageh,\ \tau}$: = probability that the head of the household aged $ageh_i$ still lives at age τ (survival probability of the head)[12]
$pp_{agep,\ \tau}$: = survival probability of the partner
$AOWS$: = AOW benefit of a single person in the sample year
AOW: = AOW benefit of a couple
$AOWA$: = $AOW - AOWS$
$Bonus_i$: = bonus received when the head is at least 65 years old and the partner younger than 65 or *vice versa*
g: = real growth rate of the AOW benefit
r: = real interest rate
SSW_i: = social security wealth of household i

12 The survival probabilities are taken from CBS (1992).

the bonus. In order to calculate social wealth for these regimes we need two models which explain non-capital income of the head and partner. We model the evolution of non-capital income for heads of households as follows:

$$\Delta log(y_{it}) = \delta_t + \beta' \Delta splines_{it} + \epsilon_{it} \tag{A2}$$

where y_{it} is non-capital income of individual i in year t and δ_t are year dummies. $Splines_{it}$ is a cubic spline in age with knots at 18, 25, 35, 45, and 65 years of age.[13] This equation has been estimated separately for three education classes: 1) primary or lower secondary education, 2) higher secondary education, 3) higher than secondary education. By taking first differences fixed effects are allowed in the log income equation in levels. We have used income observations of the following years: 1986, 1987, 1988, 1989, and 1990. Since age, cohort and time effects cannot be disentangled,[14] we have to make an identifying assumption. We chose to drop one time dummy in the log income equation in levels. This identifying assumption is equivalent to estimating equation A2 without a constant term.[15] The estimation results are presented in Table A2.

The income process for the partner has to be modelled differently because in the sample a sizeable fraction of partners does not receive any income. In order to take this phenomenon into account we specify a random effect probit equation explaining whether the spouse will have income or not. This random effect probit model contains the following right-hand side variables: a full set of year dummies, gender, dummies indicating the education level, dummy variables indicating the sector of education, and a cubic spline age function with the following knots: 18, 25, 35, 45, and 65. The estimation results of the random effects probit model are presented in Table A3. For those spouses who have an income, we estimate a similar model as model (A2).[16] For the spouse we do not allow for education-specific effects in the income equation. The estimation results of the spouses' income equation are also presented in Table A3. Notice that the fixed effect of the log income equation cannot be estimated for those spouses in the sample who did not receive any income between 1986 and 1990 (this period is covered by our sample). In order to compute social security wealth we need predictions of the fixed effect for all spouses in the sample. Therefore, we have estimated a model which explains the fixed effect by some non-time-varying individual characteristics.

13 The spline regressors are constructed in such a way that the estimated parameters can be interpreted as the ordinates of the spline function. Details concerning the contruction of the spline variables can be found in Poirier (1976).

14 In a fixed effect model cohort effects are subsumed in the fixed effect.

15 Jappelli (1995) makes a similar identifying assumption.

16 Notice that we implicitly assume that the error terms of the random effects probit model on the one hand and the error term in the fixed effect income equation on the other hand are mutually independent.

TABLE A2 – ESTIMATION RESULTS NON-CAPITAL INCOME EQUATION OF THE HEAD

		Primary or lower secondary education	Higher secondary education	Higher than secondary education
year88	estimate	−0.01	0.01	−0.01
	std. error	0.02	0.01	0.03
	t-value	−0.31	1.09	−0.31
year89	estimate	0.02	0.03	0.00
	std. error	0.02	0.01	0.03
	t-value	1.18	2.20	0.17
year90	estimate	0.11	0.11	0.07
	std. error	0.02	0.01	0.02
	t-value	7.26	11.05	3.05
spline25	estimate	0.71	0.50	0.51
	std. error	0.18	0.18	0.24
	t-value	3.89	2.83	2.13
spline35	estimate	0.97	0.74	0.99
	std. error	0.28	0.23	0.35
	t-value	3.52	3.24	2.83
spline45	estimate	1.10	0.73	1.20
	std. error	0.37	0.28	0.46
	t-value	2.97	2.58	2.62
spline64	estimate	0.97	0.77	1.08
	std. error	0.56	0.41	0.72
	t-value	1.74	1.87	1.50
σ^2	estimate	0.09	0.05	0.09

TABLE A3 – ESTIMATION RESULTS INCOME MODEL SPOUSE, A: RANDOM EFFECTS PROBIT MODEL

Variable	estimate	std. error	*t*-value
year86	14.257	1.806	7.895
year87	14.519	1.809	8.026
year88	14.686	1.811	8.108
year89	14.876	1.809	8.223
year90	15.255	1.815	8.406
gender	−5.341	0.878	−6.083
edlev2	0.678	0.252	2.695
edlev3	1.319	0.372	3.546
edlev4	1.519	0.292	5.206
edlev5	2.761	0.320	8.629
edlev6	3.510	0.814	4.314
sect234	−1.245	0.372	−3.347
sect5	−0.046	0.312	−0.148
sect6	−0.048	0.228	−0.209
sect7	0.435	0.505	0.860
sect8	−0.512	0.233	−2.200
spline25	−3.792	0.312	−12.163
spline35	−5.544	0.365	−15.181
spline45	−5.506	0.392	−14.037
spline64	−8.472	0.505	−16.790
$1/\sigma_u$	0.292	0.011	26.882

Legend:
σ_u=standard deviation of the random effect in the random effect probit model

education level *edlev*	1	Primary education or less
	2	Lower secondary education
	3	High school (Havo/Gymnasium completed)
	4	Middle vocational (MBO)
	5	Higher vocational (HBO)
	6	University
sector of education *sect*	0	General education for teacher
	1	Humanities, theology
	2	Agriculture
	3	Engineering, mathematics or physics
	4	Transport, communication
	5	Medical or paramedical education
	6	Economics, administrative or commercial education, law
	7	Sociol-cultural education
	8	Education in personal/social care
	9	Law and order, security/other

TABLE A3 CONTINUED – ESTIMATION RESULTS INCOME MODEL SPOUSE, B: FIXED EFFECTS INCOME MODEL

Variable	estimate	std. error	*t*-value
year88	−0.031	0.027	−1.136
year89	0.004	0.041	0.089
year90	0.131	0.048	2.741
spline25	−0.088	0.157	−0.563
spline35	0.022	0.284	0.077
spline45	0.970	0.425	2.283
spline64	1.318	0.723	1.822
σ^2	0.178		

APPENDIX B: CALCULATION OF PENSION WEALTH

Pension wealth is defined as the actuarially discounted sum of current and future supplementary pension benefits. In The Netherlands, the total pension benefit of employees consists of two parts. The first part is the social security benefit, AOW, which has been discussed in Appendix A. The second part is a supplementary pension benefit. The supplementary pension system is not financed on a pay-as-you-go basis but is fully funded. In the main text it has already been indicated that there is a great variety in supplementary pension systems because they are organised at firm level and not at government level. However, one can fairly say that most pension systems are of the defined benefit type and not of the defined contribution type. Moreover, most supplementary pension systems are based on the following rule: if one works for 40 years with the same employer, the pension benefit of a married person gross of taxes and social security premia is equal to 70% of final pay.[17] Since retirees do not pay social security premia, the net replacement rate amounts to 90% (cf. Van Aalst (1990)). In order to simplify the calculations we compute the net pension benefit directly by relation it to the last earned net wage.[18] Consequently we assume an accrual rate of 2.25% per year.

The SEP does not contain much information about the pension schemes of (ex-)employees who are younger than 65. Moreover, we do not have much information about the labor market history of the (ex-)employee. From the SEP it can be inferred how many years the (ex-)employee has worked full-time and part-time. Given this scarce information, we assume that all (ex-)employees in the sample participate in a pension scheme of which the net accrual rate is 2.25%. Moreover, we assume that the pension schemes do not contain any ‘vesting’ rules.

17 Pension contributions start at age 25.

18 We realise that most pension funds first calculate the pension benefit gross of taxes on the basis of the last earned gross wage and then withhold the taxes from the pension benefit.

Table B1 indicates how pension wealth is computed for seven different groups of households. In the computation of pension wealth a real interest rate of 3% has been assumed. The supplementary pensions are indexed on the basis of a real growth rate of 1% (g=0.01).[19] We have also made the same assumptions concerning the survival probabilities as in the calculation of social security wealth. Moreover, in the calculation of pension wealth we abstract from changes in family composition due to marriage or divorce.

In order to calculate pension wealth we need to know the amount of the supplementary pension benefits of the head and the partner. For heads and partners older than 64 we observe in the SEP the amount of supplementary pensions. For the other household groups mentioned in Table B1 we have to somehow predict the pension benefit of at least one of the household members. In principle the following model has been used to predict the supplementary pension benefit:

$$PENS_i = \max(accrual * \min(n_i, 40) * (earning_i - franchise), 0) \qquad \text{(B1)}$$

where $PENS_i$= level of supplementary pension benefits net of taxes at age 65
earnings= 'predicted wage level' at age 65 net of taxes and social security contributions
accrual= net accrual rate (=0.0225)
n_i= the number of participation years in a pension fund (in most cases equal to the (predicted) numbers of years worked in full-time equivalents until age 65)

As we have said above, we assume that the net total pension benefit of a married person who has worked for at least 40 years, is equal to 90% of after-tax final pay. In other words we assume an accrual rate in net terms of 2.25% per year (in most pension schemes the gross accrual rate is equal to 1.75% per year). The franchise is equal to 10/9 times the net *SS* benefit of a couple. For every head of the household and spouse observed in the SEP we have to construct the variables '$earnings_i$' and the number of participation years, n_i. We distinguish the following groups of respondents:

1. The respondent receives *an early retirement pension*. In line with most early retirement schemes we assume a net replacement rate of 90 percent. Given this assumption, $earnings_i$ is equal to 10/9 times the observed early retirement benefit times $(1+g_1)^{65\text{-age}}$.[20] The number of participation years is equal to the number of working years (in full-time equivalents) plus half of the number of years in early

19 The way of indexing varies by pension scheme. Several pension schemes use the consumer price index as the indexing device, whereas other pension schemes increase the yearly pension benefit on the basis of the wage index.

20 In the calculation of pension wealth we assume that g_1=0.01.

retirement. This way of computing the number of participation years is in line with the rules applied by the pension fund of civil servants (ABP). Notice that in the calculation of pension wealth, we implicitly assume that the state 'early retirement' is absorbing. We make a similar assumption for the state 'disability' (see below).

2. The respondent receives *a disability benefit.* Earnings_i is equal to 10/8 times the observed disability benefit times $(1+g_1)^{65\text{-age}}$. The number of participation years is equal to the number of working years (in full-time equivalents) plus the number of years in disability.

3. The respondent receives *an unemployment benefit.* Earnings_i is equal to 10/8 times the observed unemployment benefit $(1+g_1)^{65\text{-age}}$. The number of participation years is equal to the number of working years (in full-time equivalents) plus the length of the current unemployment spell.[21]

4. The respondent does not currently work but has worked in the past. He/she does not receive any of the wage-replacing transfers mentioned above. The number of participation years is equal to the number of working years in full-time equivalents (this variable has been observed in the SEP even for this type of respondent).[22] We have used the fixed effects wage models presented below to predict the wage level of these respondents at the moment they stopped working (see Table B3).[23] We should index this wage level by a yearly increase of g_1 (1%) in order to arrive at $earnings_i$, the 'predicted wage level' at age 65.

5. The respondent has never worked. Pension wealth is equal to zero for this type of respondent.

6. The respondent is an employee.[24] For this group of respondents, we need two kinds of models in order to estimate the expected pension benefit (*cf.* formula B1). The aim of the first model is the estimation of the transition probabilities from work to disability and to (early) retirement. We realise that other exit routes are also possible. For instance, it is possible that a respondent may become unemployed (i.e. receive an unemployment benefit). In order to simplify the analysis, we have assumed that such persons find a new job within two years after

21 We admit that we underestimate pension wealth for this group because we do not take into account that the unemployed might work again. However, the number of respondents in this group is rather small (60 observations in 1988).

22 We implicitly assume that these respondents will not work again in the future.

23 For the respondents under review we do not have estimates of the fixed effects at our disposal. The value of the fixed effect has been predicted by using a model which explains the fixed effect, using some non-time-varying characteristics.

24 We have removed the self-employed from the sample.

TABLE B1 – FORMULAE OF PENSION WEALTH

Group	Household type	Pension Wealth
1	Single, $ageh >= 65$	$PW_i = \sum_{\tau = ageh_i}^{\propto} \left(\frac{1+g_1}{1+r}\right)^{\tau - ageh_i} ph_{ageh_i,\tau} PENSH_i$
2	Single, $ageh < 65$	$PW_i = (1+r)^{ageh_i - 65} \sum_{\tau = 65}^{\propto} \left(\frac{1+g}{1+r}\right)^{\tau - 65} ph_{ageh_i,\tau} PENSH_i$
3	Couple, $ageh >= agep >= 65$	$PW_i = \sum_{\tau = ageh_i}^{\propto} \left(\frac{1+g}{1+r}\right)^{\tau - ageh_i} (ph_{ageh_i,\tau} PENSH_i + (pp_{agep_i,\tau^*} - ph_{ageh_i,\tau} pp_{agep_i,\tau^*}) 0.7 * PENSH_i +$ $pp_{agep_i,\tau^*} PENSP_i + (ph_{ageh_i,\tau} - ph_{ageh_i,\tau} pp_{agep_i,\tau^*}) 0.7 * PENSP_i$ where $\tau^* = \tau - (ageh - agep)$
4	Couple, $ageh >= 65, agep < 65$	$PW_i = \sum_{\tau = ageh_i}^{\propto} \left(\frac{1+g}{1+r}\right)^{\tau - ageh_i} (ph_{ageh_i,\tau} PENSH_i + (ph_{agep_i,\tau^*} - ph_{ageh_i,\tau} pp_{agep_i,\tau^*}) 0.7 PENSH_i) +$ $(1+r)^{agep_i - 65} \sum_{\tau = 65}^{\propto} \left(\frac{1+g}{1+r}\right)^{\tau - 65} (pp_{agep_i,\tau} PENSP_i + (ph_{ageh_i,\tau^{**}} - ph_{ageh_i,\tau^{**}} pp_{agep_i,\tau}) PENSP_i)$ where $\tau^* = \tau - (ageh - agep)$, $\tau^{**} = \tau - (agep - ageh)$
5	Couple, $agep >= 65, ageh < 65$	analogous to 4 (switch $ageh_i$ and $agep_i$)

6	Couple, $65 > ageh > = agep$	$PW_i = (1+r)^{ageh_i-65}\sum_{\tau=65}^{\propto}\left(\frac{1+g}{1+r}\right)^{\tau-65}(ph_{ageh_i,\tau}PENSH_i + (pp_{ageh_i,\tau^*} - ph_{ageh_i,\tau}pp_{agep_i,\tau^*})0.7PENSH_i)$ $+$ $= (1+r)^{agep_i-65}\sum_{\tau=65}^{\propto}\left(\frac{1+g}{1+r}\right)^{\tau-65}(pp_{agep_i,\tau}PENSP_i + (ph_{ageh_i,\tau^{**}} - ph_{ageh_i,\tau^{**}}pp_{agep_i,\tau})PENSP_i)$ where $\tau^* = \tau - (ageh - agep)$, $\tau^{**} = \tau - (agep - ageh)$
7	Couple, $65 > agep > ageh$	analogous to 6

i: = household index
$ageh_i$: = age of the head of household i
$agep_i$: = age of the partner
$ph_{ageh,\ \tau}$: = probability that the head of the household aged $ageh_i$ still lives at age τ (survival probability of the head)[25]
$pp_{agep,\ \tau}$: = survival probability of the partner
$PENSH_i$: = (predicted) supplementary pension benefit of a the head of household at age 65 (or in the sample year if the respondent is older than 64)
$PENSP_i$: = (predicted) supplementary pension benefit of a the partner at age 65 (or in the sample year if the respondent is older than 64)
g: = real growth rate of the pension benefit
r: = real interest rate
PW_i: = pension wealth of household i

25 The survival probabilities are taken from CBS (1992).

they became unemployed. According to Dutch legislation, such persons do not 'lose' pension rights in the sense that the length of the unemployment spell is included in the (expected) number of participation years. Another possibility is that the employee leaves the labor force without receiving any benefit. Such an exit route especially applies to married females who stop working in order to raise children. If we take this phenomenon into account, the computation of pension wealth becomes much more complicated because such persons may re-enter the labor market at a (much) later stage in the life cycle. Therefore, we have decided on selecting the sample and only including those households of which both head and partner (if present) are at least 30 years old. A study by Alessie, De Vos, and Zaidi (1996) indicates that the transition probability from 'employee' to 'no benefit' is very small for females older than 30 years.

The model which explains the transitions from work to disability and (early) retirement consists of two parts. The first part is a probit model and describes the transition from 'employee' to 'recipient of a disability or (early) retirement pension.' The following explanatory variables have been included in this model: gender, dummy variables indicating educational level, dummies indicating the sector of education and a cubic spline age function with knots at 30, 40, 50, 55, 60, and 63 years of age. This model has been estimated separately for the head of household and for the partner. The results are presented in Table B2. By means of the second submodel the probability can be predicted whether the person who left the labor force is an early retiree or a recipient of a disability benefit. Given the small number of observations, we have only included dummies indicating the age group as explanatory variables. The results are also presented in Table B2.

In order to predict the expected value of the supplementary pension benefit, we also need models which can be used to predict wages. For the head of the household we have chosen a fixed effects model with the following explanatory variables: year dummies and a cubic spline age function. The model has been estimated for three different levels of education: 1) primary or lower secondary education, 2) higher secondary education and 3) higher than secondary education. The October 1986, 1987, 1988, 1989 and the May 1991 waves of the SEP have been used to estimate this model.[26,27] The estimation results are summarised in Table B3. The wage level of the partner has also been modelled by means of ta fixed effect specification. However, in this case we do not allow for interaction terms between the year dummies and the cubic spline age function on the one hand and education level dummies on the other. The estimation results are also summarized in Table B3.

26 The May 1991 wave of the SEP contains information about the wage level prevailing in 1990.

27 Since cohort, age, and time effects cannot be disentangled, we have to make identifying assumption in order to estimate the fixed effect model. We have chosen to remove one time dummy (the 1987 time dummy).

TABLE B2 – ESTIMATION RESULTS TRANSITION MODELS OF HEAD AND SPOUSE, A: PROBIT MODEL

Variable	head			partner		
	estimate	std. error	*t*-value	estimate	std. error	*t*-value
gender	−0.074	0.158	−0.468	−0.435	0.434	−1.003
edlev2	−0.325	0.328	−0.989			
edlev3	0.021	0.165	0.125			
edlev4	−0.338	0.175	−1.934			
edlev5	−0.454	0.265	−1.714	−0.244	0.267	−0.912
edlev6	−0.417	0.187	−2.231	−0.244	0.267	−0.912
sect234	−0.093	0.136	−0.684			
sect5	−0.472	0.388	−1.217			
sect6	−0.461	0.180	−2.561			
sect7	−0.134	0.340	−0.392			
sect8	0.062	0.306	0.202			
spline40	0.277	0.226	1.224	0.172	0.432	0.398
spline50	0.446	0.187	2.384	0.603	0.350	1.723
spline55	0.947	0.217	4.369	0.856	0.428	2.001
spline60	2.262	0.200	11.284	2.005	0.379	5.288
spline63	1.655	0.321	5.151	0.802	0.910	0.882
constant	−2.083	0.275	−7.578	−1.935	0.905	−2.137

Legend:

education level		
edlev	1	Primary education or less
	2	Lower secondary education
	3	High school (Havo/Gymnasium completed)
	4	Middle vocational (MBO)
	5	Higher vocational (HBO)
	6	University
sector of education		
sect	0	General education for teacher
	1	Humanities, theology
	2	Agriculture
	3	Engineering, mathematics or physics
	4	Transport, communication
	5	Medical or paramedical education
	6	Economics, administrative or commercial education, law
	7	Sociol-cultural education
	8	Education in personal/social care
	9	Law and order, security/other

TABLE B2 CONTINUED – ESTIMATION RESULTS TRANSITION MODELS OF HEAD AND SPOUSE, B: ALLOCATION BETWEEN THE STATES 'DISABLED' AND 'EARLY RETIREMENT'

	head Pr(early retirement)	Std error	spouse Pr(early retirement)	Std error
age group				
$30 < = \text{age} < = 50$	0.000	–	0.000	–
$51 < \text{age} < = 55$	0.333	0.136	0.333	0.272
$55 < \text{age} < = 63$	0.793	0.043	0.667	0.111

TABLE B3 – ESTIMATION RESULTS WAGE EQUATION OF THE HEAD OF THE HOUSEHOLD AND OF THE SPOUSE

		head			partner
		primary or lower secondary education	higher secondary education	higher than secondary education	
year88	estimate	−0.017	0.036	0.042	−0.024
	std error	0.017	0.015	0.022	0.027
	t value	−0.992	2.406	1.889	−0.891
year89	estimate	0.001	0.061	0.056	0.018
	std error	0.025	0.022	0.034	0.041
	t value	0.046	2.715	1.660	0.450
year90	estimate	0.019	0.149	0.124	−0.022
	std error	0.030	0.026	0.040	0.048
	t value	0.647	5.658	3.072	−0.462
spline25	estimate	0.520	0.262	1.786	−0.070
	std error	0.107	0.119	0.155	0.153
	t value	4.841	2.201	11.551	−0.459
spline35	estimate	0.840	0.416	2.468	0.019
	std error	0.183	0.178	0.260	0.282
	t value	4.594	2.333	9.500	0.066
spline45	estimate	1.022	0.444	2.627	0.864
	std error	0.268	0.249	0.371	0.426
	t value	3.817	1.783	7.087	2.027
spline55	estimate	1.254	0.452	2.653	1.265
	std error	0.357	0.324	0.490	0.579
	t value	3.515	1.394	5.416	2.185
spline59	estimate	1.255	0.417	2.627	1.270
	std error	0.397	0.362	0.544	0.657
	t value	3.162	1.151	4.829	1.932
σ^2		0.036	0.037	0.057	0.117

APPENDIX C: ESTIMATION RESULTS IF SOCIAL SECURITY WEALTH AND PENSION WEALTH ARE COMPUTED BY SIMPLE DISCOUNTING (t-VALUES IN PARENTHESES)

	$A^*_{h,t-1}$	y^*_{ht}	$PY^*_{h,pt}$	SSW^*_{ht}	PW^*_{ht}	R^2	Nobs
A_{ht} (total)	1.03	0.21	−0.03	0.04	0.21	0.87	7495
	(206)	(3.54)	(−0.45)	(0.26)	(6.28)		
A_{ht} (financial)	0.96	0.12	−0.03	−0.05	0.17	0.72	7495
	(131)	(2.56)	(−0.43)	(−0.51)	(6.42)		
S^*_{ht} (total)		0.22	−0.01	0.07	0.23	0.03	7495
		(3.73)	(−0.10)	(0.50)	(6.98)		
S^*_{ht} (financial)		0.12	−0.05	−0.10	0.14	0.02	7495
		(2.60)	(−0.89)	(−0.95)	(5.40)		
S^*_{ht} (total) FE		0.12	−0.72	−0.67	0.14		6848
		(1.31)	(−1.10)	(−1.32)	(1.95)		
S^*_{ht} (financial) FE		0.09	0.41	−0.97	0.14		6848
		(1.16)	(0.65)	(−2.19)	(2.40)		

REFERENCES

Aalst, H.J. van, 1990, 'Ontwikkelingen,' in: C. Petersen (ed.) *Pensioenen, uitkeringen, financiering & beleggingen*, Leiden, Stenfert Kroese.

Alessie, R., A. Lusardi, and T. Aldershof, 1997, 'Income and Wealth over the Lifecycle: Evidence from Panel Data,' *Review of Income and Wealth*, 43, pp. 1–32.

Alessie, R., M. Pradhan, and C. Zandvliet, 1993, *Measurement of Household Saving Obtained from First Differencing Wealth Estimates*, VSB Progress Report 13, Center for Economic Research, Tilburg University.

Alessie, R., K. de Vos, and A. Zaidi, 1996, *Terms of Employment in the Public Service in International Perspective*, Economics Institute, Tilburg.

Avery, R.B., G.E. Elliehausen, and A.B. Kennickell, 1988, 'Measuring Wealth with Survey Data: An Evaluation of the 1983 Survey of Consumer Finances,' *Review of Income and Wealth*, 34, pp. 339–369.

Bakker, B.B., 1993, *Saving in The Netherlands: Sources, Trends and Mobility*, Groningen, Wolters-Noordhoff.

Bernheim, B.D., 1987, 'The Economic Effects of Social Security,' *Journal of Public Economics*, 33, pp. 273–304.

Besseling, P., 1993, *Pensions, Savings and the Labour Market in The Netherlands*, Central Planning Bureau, Working paper.

Carroll, C.D., 1992, 'The Buffer-stock Theory of Savings: Some Macroeconomic Evidence,' *Brookings Papers on Economic Activity*, 2, pp. 61–156.

CBS, 1992, *Overlevingstafels naar leeftijd en geslacht*, The Hague, Staatsuitgeverij.

Davies, J.B., 1979, 'On the Size Distribution of Wealth in Canada,' *Review of Income and Wealth*, 25, pp. 237–259.

Diamond, P.A. and J.A. Hausman, 1984, 'Individual Retirement and Savings Behavior,' *Journal of Public Economics*, 23, pp. 81–114.

Dicks-Mireaux, L. and M. King, 1984, 'Pension Wealth and Household Savings: Tests of Robustness,' *Journal of Public Economics*, 23, pp. 115–139.

Draper, D.A.G., 1994, 'Savings, Pension Rights and Taxation,' *De Economist*, 142, pp. 171–192.

Feldstein, M., 1974, 'Social Security, Induced Retirement, and Aggregate Capital Accumulation,' *Journal of Political Economy*, 82, pp. 905–926.

Feldstein, M. and A. Pellechio, 1979, 'Social Security and Household Wealth Accumulation: New Microeconometric Evidence,' *Review of Economics and Statistics*, 61, pp. 361–368.

Gale, W.C., 1995, *The Effects of Pensions on Wealth: A Re-evaluation of Theory and Evidence*, The Brookings Institution, Working Paper.

Jappelli, T., 1995, *The Age-Wealth Profile and the Life cycle Hypothesis: A Cohort Analysis with a Time Series of Cross sections of Italian Households*, mimeo, Istituto Universitario Navale, Naples, Italy.

Keesen, L.H.M., 1190, 'Pensioenregelingen: termen en begrippen,' in: C. Petersen (ed.), *Pensioenen: Uitkeringen, Financiering & Beleggingen*, Leiden, Stenfert Kroese.

Kuné, J.B., 1981, 'The Impact of Social Security on Personal Saving: Evidence for The Netherlands,' 1952-1978, *Het Verzekeringsarchief*, 58, pp. 33–41.

Laan, R. van der and W.J. Zwezerijnen, 1983, 'De invloed van de sociale zekerheid op de spaarquote van de gezinnen in Nederland,' *Het Verzekeringsarchief*, 6, pp. 149-165.

Leamer, E.E., 1978, *Specification Searches: Ad Hoc Inference with Nonexperimental Data*, New York, Wiley Interscience.

Meuwissen, P.J.J., 1993, 'AOW-ontvangers en aanvullend (pensioen)inkomen,' *Statistisch Magazine*, pp. 11–13.

Meuwissen, P.J.J., 1994, 'Het meten van vermogen via enquêtes en fiscale administraties,' *Sociaal-Economische Maandstatistiek*, S1, Central Planning Bureau, The Hague.

Mirer, T.W., 1992, 'Life Cycle Valuation of Social Security and Pension Wealth,' *Journal of Public Economics*, 48, pp. 377–384.

Munnell, A.H., 1976, 'Private Pensions and Saving: New Evidence,' *Journal of Political Economy*, 84, pp. 1013–1032.

Pensioenkaart van Nederland, 1987, The Hague.

Poirier, D.J., 1976, *The Econometrics of Structural Change*, Amsterdam, North Holland.

Summary

MANDATORY PENSIONS AND PERSONAL SAVINGS IN THE NETHERLANDS

The Netherlands has a relatively generous social security system and a wide coverage of individuals by private (occupational) pension schemes. Total household savings are rather high and fairly stable, although the amount of contractual savings apears to be going up at the expense of non-contractual ('free') savings. Using an approach originally pioneered by Feldstein (1974) we employ microdata to investigate the displacement effect of security and pension wealth on free household savings. It turns out that the data available are too noisy to make precise statements about the displacement effects. Our results do suggest, however, that a one-for-one displacement of free savings by social security is consistent with the data. For pensions such a complete offset is less likely. This suggests that increase of coverage by private pensions is an effective way of raising savings.