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Discussio

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Abstract:
A precautionary saving model is extended to include old-age pensions and provides the framework for an empirical analysis of the relation between old-age pensions and private consumption. Norwegian macro-data for socioeconomic groups of households are used to estimate consumption functions for workers and pensioners. We find no effects from various approximations of expected pension-income to consumption for workers, but results indicate some influence from labour-income uncertainty. Income elasticities are found to differ considerably between the two groups of households. Implications for effects on aggregate saving from pension policies and of ageing populations are discussed.

JEL classification: D91, E21, H55

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1. Introduction

Economists have for a long time been interested in the impact of public old-age pension schemes on private saving. This concern is connected to the fact that most pension schemes have a pay-as-you-go structure, implying that effects on personal saving also influence aggregate saving and conditions for growth in the economy. Traditionally one investigated whether the build-up of pension schemes depressed personal saving and Feldstein (1974) is an important contribution to this discussion. At present, the prospects of ageing populations leading to huge increases in social security budgets in many western countries give another reason for studying the same subject. Will expectations of reduced benefits increase private saving?

Feldstein's seminal paper gave rise to a number of other time-series studies and many cross-section analyses have also been carried out, see Magnussen (1993) for a survey. Former time-series studies have not discussed effects of uncertainty about future income[1]. According to many recent studies, see Deaton (1992) for a survey, the precautionary motive for saving seems to be important in explaining consumer behaviour. The main idea of precautionary saving is that consumers self-insure against future uncertain income streams by saving more than they would have done if income were certain. It is usually assumed in these models that all future income is labour-income. However, when taking the whole life span into account, it may be important to distinguish between labour-income received during the working period and pension-income received in the retirement period. By using the same approach as Caballero (1990) we show that consumption in general depends on wealth, interest rates, labour-income, pension-income and uncertainty connected to the two latter variables. We argue, however, that when pensions are based on the labour-income history, the variability related to pensions could be considerably lower than for labour-income.

Macroeconomic analyses of effects from social security on saving usually test effects of a social security wealth variable on aggregate consumption and do obviously not reveal anything about consumer behaviour for different age-groups. Macroeconomic data for consumption and household income are in the Norwegian national accounts divided to three socioeconomic groups; pensioners, wage-earners and self-employed. This allows separate

[1]Leimer and Richardson (1992) take explicit account of uncertainty in a cross-section analysis.

empirical analyses for pensioners and wage-earners (workers). We are therefore able to test whether consumption for workers is affected by expectations of pensions, while aggregate data cannot separate between pensioners reacting to current pensions and workers reacting to expected pensions. Another aspect is that we can investigate to which extent labour income uncertainty affects workers' consumption. If uncertainty is of importance, then an increase in social security taxation will have both a positive and a negative effect on saving for workers. Furthermore, separate income elasticities can be estimated for the two groups, also important when analysing effects of pension policies. Finally, it is also possible to take into account other differences in consumer behaviour between the two groups, e.g. effects from interest rates. Compared with former studies on macro-data, we may therefore obtain more precise estimates by reducing some of the aggregation problems.

The empirical specification of consumption models used in time-series models is often very simple. Most studies estimate linear models in levels form only. Including a trend-like social security wealth variable in such models may therefore lead to multicollinearity problems, and make it difficult to obtain precise estimates. Browning (1982) using an error-correction approach, is an important exception. He finds significant short-term effects from social security wealth in a macro consumption function. In this study we also apply error-correction models when estimating consumption functions.

As usual in empirical studies of social security and saving we construct a measure of future old-age pension benefits based on the current scheme. This approach has been discussed by e.g. Bernheim (1987) who suggests that simple discounting should be employed rather than the commonly used actuarial discounting principle. The latter approach imposes assumptions about expected life-time and implicitly assumes existence of a perfect annuity market. In a life-cycle setting this should imply that no accidental bequests are given, obviously not in accordance with reality. Effects of using the simple discounting method (treating life-time as indefinite) was by Bernheim found to improve results in a cross-section analysis. Even if Mirer (1992) argues that the simple discounting principle also has shortcomings, we investigate effects of using this method in a time-series approach. In another cross-section study, Leimer and Richardson (1992) estimate discounting factors for several measures of prospective wealth and find this factor to be negative for social security, implying a (large) negative risk premium. Negative discount factors do, however, not go along with simple discounting since the wealth variable will be indefinite. We therefore test effects of negative discount factors by using the actuarial method. If Bernheim's critique is to be taken seriously, one should, however, avoid the actuarial principle. As in approximations of human capital we therefore also include expected benefits and current pensions in the empirical analysis.

The paper proceeds as follows. In section 2 we introduce a theoretical precautionary saving model and discuss in particular pension-income uncertainty. Section 3 deals with data and estimation of consumption functions. In section 4 we look at implications for saving of our empirical estimates while a conclusion is given in section 5.

2. The model

Our aim is to study consumption and saving for two generations of identical consumers and we start out with a model for a typical generation. At time t the representative consumer has accumulated a certain amount of assets, W_t, and expects to receive both after-tax labour-income, Y_t, and pension-income, P_t, in the future. Both income variables are assumed to be uncertain. A constant subjective discount factor is denoted by δ and the real rate of interest by r. We allow the interest rate to vary over time, but assume, as is common in precautionary saving models, that no uncertainty is connected to this variable. Skinner (1988) includes uncertain interest rates but finds only small effects on saving, suggesting that effects from uncertain interest rates may be small. We also assume that the life time is known to end at date T and R is the fixed retirement age i.e. the last period when labour-income is received.

Consider the following standard maximization problem where the expectation operator E_t represents expectation of future variables conditioning on all information known at date t and C_t is consumption in period t

$$\max \; E_t \sum_{i=0}^{T-t} (1+\delta)^{-i} U(C_{t+i})$$

$$s.t. \quad \sum_{i=0}^{T-t} \beta_i \, C_{t+i} = W_t + \sum_{i=0}^{R-t} \beta_i \, Y_{t+i} + \sum_{i=R-t+1}^{T-t} \beta_i \, P_{t+i}$$

$$where \quad \beta_0 = 1 \;, \quad \beta_i = [\prod_{j=1}^{i} (1+r_{t+j})]^{-1}, \quad i > 0$$

The Euler-equations are given by

$$(1) \qquad U'(C_t) = \left(\frac{1+r_{t+i}}{1+\delta}\right) E_t \left(U'(C_{t+1})\right), \quad t = 1,\ldots,T$$

The utility function (U) is often approximated by a quadratic function giving the well known certainty equivalence result. Even if convenient, the quadratic function eliminate precautionary saving. Leland (1968) showed that precautionary saving is dependent on the third derivative of the utility function. In the case of time-separability, precautionary saving is a result of a positive third derivative, i.e. convex marginal utility. Precautionary saving therefore is consistent with non-increasing absolute risk aversion, see Kimball (1990) for a discussion of the relationship between risk aversion and precautionary saving. In the literature two utility functions with the above characteristic are usually applied; the isoelastic and the exponential function. The advantage with the former is that negative consumption is ruled out. This is important e.g. when simulating consumption trajectories, see Deaton (1992), ch. 6. The exponential function on the other hand, has the advantage that closed form solutions for consumption can be obtained. For our purpose, this function is therefore the most convenient. The following discussion is based on Caballero (1990), but is extended to include pension-income and time-varying interest rates[2]. In addition, we treat life-time as fixed, while Caballero has indefinite life horizon.

Consider the following (negative) exponential utility function

$$U(C_t) = -(1/\theta)\exp(-\theta C_t) \tag{2}$$

Replacing the first derivatives of this function into (1) gives

$$\exp(-\theta C_t) = [(1 + r_{t+i})/(1 + \delta)]\ E_t(\exp(-\theta C_{t+1})), \quad t = 1,..,T \tag{3}$$

which has to be satisfied by the solution of the above maximization problem. As in Caballero (1990) we assume that consumption follows linear processes given in (4) and (5)

$$C_{t+i} = \Gamma_{t+i-1} + C_{t+i-1} + w_{t+i}, \quad 0 \le i \le R - t \tag{4}$$

[2]Time variation in interest rates complicates the theoretical model but allows a more comprehensive empirical analysis.

(5) $$C_{t+i} = \Omega_{t+i-1} + C_{t+i-1} + v_{t+i} \quad , R - t + 1 \le i \le T - t$$

where w_{t+i} and v_{t+i} are shocks (error terms) in the labour-income process and the pension-income process respectively. Since pension-income is connected to labour-income through balancing of the pension scheme, the error terms will be dependent and we discuss this connection later on. By plugging (4) and (5) into (3) we find the following solutions for Γ and Ω

(6) $$\Gamma_{t+i-1} = (1/\theta)\ \ln[E_{t+i-1}(\exp(-\theta w_{t+i}))]$$

$$+ \ln(1 + r_{t+i}) - \ln(1 + \delta), \quad 0 \le i \le R - t$$

(7) $$\Omega_{t+i-1} = (1/\theta)\ \ln[E_{t+i-1}(\exp(-\theta v_{t+i}))]$$

$$+ \ln(1 + r_{t+i}) - \ln(1 + \delta), \quad R - t + 1 \le i \le T - t$$

If w_{t+i} and v_{t+i} are both normally distributed with mean 0 and variances σ^2_{wt+i} and σ^2_{vt+i} respectively, then

(8) $$(1/\theta)\ \ln[E_{t+i-1}(\exp(-\theta w_{t+i}))] = (\theta/2)\ \sigma^2_{wt+i} \quad , 0 \le i \le R - t$$

(9) $$(1/\theta)\ \ln[E_{t+i-1}(\exp(-\theta v_{t+i}))] = (\theta/2)\ \sigma^2_{vt+i} \quad , R - t + 1 \le i \le T - t$$

The next step is to replace from (6) and (7) into (4) and (5) and further into the intertemporal budget constraint applying the approximation

$$r_{t+i} \approx \ln(1 + r_{t+i})$$

For simplicity of notation we also define k= -ln(1+δ). This gives

$$(10) \qquad \sum_{i=0}^{T-t} \beta_i (C_{t+i-1} + r_{t+i} + k) + \sum_{i=0}^{R-t} \beta_i ((\theta/2)\ \sigma^2_{wt+i} + w_{t+i})$$

$$+ \sum_{i=R-t+1}^{T-t} \beta_i ((\theta/2)\ \sigma^2_{vt+i} + v_{t+i}) = W_t + \sum_{i=0}^{R-t} \beta_i Y_{t+i} + \sum_{i=R-t+1}^{T-t} \beta_i P_{t+i}$$

By taking expectations through (10), all error terms disappear. Furthermore, by replacing backwards for consumption using (4) and (5), the following consumption function is obtained

$$(11) \qquad \sum_{i=0}^{T-t} \beta_i C_t = W_t + \sum_{i=0}^{R-t} \beta_i E_t Y_{t+i} + \sum_{i=R-t+1}^{T-t} \beta_i E_t P_{t+i}$$

$$- \sum_{i=0}^{R-t} \beta_i E_t \sum_{j=1}^{i} (\theta/2)\ \sigma^2_{wt+j-1}$$

$$- \sum_{i=R-t+1}^{T-t} \beta_i E_t \sum_{j=1}^{i} (\theta/2)\ \sigma^2_{vt+j-1}$$

$$- \sum_{i=0}^{T-t} \beta_i \sum_{j=1}^{i} r_{t+j-1} - \sum_{i=0}^{T-t} \beta_i ik$$

In (11) we can easily get C_t alone on the left hand side and so obtain a closed-form solution for consumption. As usual in life-cycle models, we find that consumption depends on total resources, given by accumulated wealth and expected future discounted income. In our model the latter variable consists of both labour-income and pension-income. It is quite common to ignore pension-income in analyses of consumer behaviour. Later on we argue that the process for pension-income often will be smoother than for labour-income and thereby justify the focus on both income variables. Consumption is also dependent on future interest rates and expected uncertainty of future income components. Effects of uncertainty increase with risk aversion (θ is the risk aversion coefficient).

All coefficients in the consumption function will be time-varying due to time variation of interest rates. This is an example of the Lucas-critique. As pointed out by Auerbach and Kotlikoff (1983), this might be a severe critique in analyses of public pensions since policies affecting such schemes are likely to impact expected interest rates. However, stability of coefficients can be tested empirically and we return to this in section 3.

Traditionally unfunded pension schemes link pension-income closely to the labour-income history of the individual. In the U.S. for example, pensions are based on average lifetime earnings and in Sweden 15 years of the income record have been counting. In Norway, the 20 years with highest income relative to a basic pension value are important when calculating pension-income for most individuals. The fact that pension-income often is some average of labour-income has implications for uncertainty (i.e. the variance) connected to the former variable.

Even if the variance of labour-income might be relatively large due to unemployment, temporary layoffs etc., the corresponding expected variance for pension-income could be considerably smaller. When pension-income is a filter of labour-income, fluctuations in labour-income will be dampened. Assume for instance that pension-income is given as a constant multiplied by average net labour-income. We also introduce a government sector levying a constant social security tax on labour-income in order to finance pension benefits. Assume that the tax rate is constant. Pension-income is then given by

(12) $$P_j = \alpha(1/R) \sum_{i=0}^{R} Y_i^* = [\alpha \ / \ (1-\tau)] \ (1/R) \sum_{i=0}^{R} Y_i \ , \quad j = R+1,..,T$$

where
- Y^* is the gross income $[Y = (1-\tau)Y^*]$
- R is the number of working years
- τ is the tax rate
- α is an exogenous policy parameter

By assuming that wage-income has constant variance and is not correlated, we get

(13) $$\sigma_v^2 = (1/R)\ [\alpha\ /\ (1\ - \tau)]^2\ \sigma_w^2$$

As an example assume that R=40, α is 0.5 and τ is 0.5. Then the variance of pension-income is only 2.5 per cent of the variance of wage-income, i.e. negligible. In the Norwegian case α and τ should more realistically be set equal to 0.6 and 0.1 respectively, and R to 20. This yields around the same relation between pension-income variance and labour-income variance as in the above example.

However, there are some factors contributing to increase the variance of pensions. First, policy parameters are not given, but can be changed by the authorities due to the general economic development and changes in the age-composition of the population. This is likely to be important, in particular for workers facing a long time horizon before pensions are received. Second, the variance of labour-income might not be constant. While this is the case for a deterministic trend, a stochastic trend (which is often regarded as a more credible process for income) implies that the variance is increasing over time. Even so, it can easily be shown that the pension-income variance still is considerably lower than the average labour-income variance.

On this background we neglect the pension-income variance from the consumption function (11), which can be decomposed into two aggregate consumption functions, one for each generation. By writing the equation in general form and omitting all time notation, the representative consumption function for the "young" generation of workers, denoted by W, is given by

(14) $$C^W = f(W^W,\ EY,\ EP^W,\ r,\ E\sigma_w^2)$$

For the "old" generation of pensioners, the labour-income term and the variance of labour-income are both omitted, and the representative consumption function is denoted by P

(15) $$C^{P} = g(W^{P},\ EP^{P},\ r)$$

Even if we omit the variance of pension-income, we would not like to ignore totally the fact that expected pension-income (in particular for workers) can be regarded as vulnerable to changes in e.g. social security legislation. In the empirical analysis we therefore allow for effects of uncertainty connected to the level of prospected pension wealth for workers by using different discount factors. A high probability of a downward adjustment of pensions should be associated with a high risk premium and accordingly a high value of the discount factor.

3. Empirical analysis

In this section we first introduce main data sources and explain construction of particular data series. Then the econometric specification and the empirical results are discussed.

3.1 Data

The main data source is the official national accounts for Norway, see e.g. Statistics Norway (1991), but some data are calculated separately or collected from other sources. Consistent series are not available for all variables over the period 1962-91, so for some variables, e.g. consumption and income, data from different sources had to be utilized. Appendix A contains a description of how data from different sources are combined. All real variables are measured in 1990-prices, applying the national account price index for total consumption.

Disposable income and consumption (included housing services and purchase of other durable goods) are in the national accounts divided into three socioeconomic groups; wage-earners, self- employed and pensioners. The socioeconomic split is based on which income components is dominating, e.g. a wage-earner has a majority of wage-income. If students receive more transfers than wage-income they are classified as pensioners and some pensioners for whom the largest proportion of their income is wage-income, will be classified as wage-earners. In the following we ignore such "inconsistencies", assuming that major results are not affected. Non-property income, the relevant income measure according to theory, is approximated by deducting net interest income from disposable income[3]. To obtain a consistent income series for pensioners from 1962-91, the sum of total old-age pensions and disability pensions is used despite the fact that some of these pensions according to the national accounts are received by other socioeconomic groups. For consumption the division on socioeconomic groups is based on information from the Consumer Expenditure Survey. Data for consumption after 1987 are not published but was made available for this analysis.

Assets and liabilities are not divided among socioeconomic groups in the national accounts. The Income and Property Statistics, see Statistics Norway (1967-88), includes gross debt,

[3]This is not entirely correct since no correction is made for taxes levied on capital income. We have neither deducted social security benefits from the total income series.

financial assets and housing capital for each of the socioeconomic groups. Appendix A presents ratios calculated from these surveys used to divide financial assets, gross debt and housing capital between the socioeconomic groups. The housing price index in the national accounts is aimed at measuring costs of building new units. To obtain a better approximation of second hand prices, more relevant for evaluating current wealth, we apply a housing price index provided by the Norwegian association of real estate agents. This series starts in 1970 and is linked to series based on other sources covering the period 1962-69.

Real after-tax interest rates are calculated by deducting the inflation rate from an after-tax interest rate. Inflation is measured by the national account consumption price deflator. The interest rate is an implicit loan rate on total debt for the household sector based on average rates charged by private and public banks. For pensioners, a deposit rate might be more relevant than a loan rate, but results are not much affected due to the similar time development of the two rates. Interest income is taxed at the same rate as total income less interest payments, and the corresponding average tax-rate is used for calculating after-tax interest rates.

An important question is how to measure labour-income uncertainty. Flacco and Parker (1990) estimate the variance of labour-income by using squared residuals from an estimated random-walk model. In another study, Muellbauer and Murphy (1989) use standard deviation of real income growth in the previous four years as a proxy for income uncertainty. Batchelor and Dua (1992), on the other hand, base their uncertainty measure on survey data. Unfortunately, consumer confidence surveys are not undertaken in Norway, excluding the latter approach. The former approach relies on residuals from an estimated wage-income process. For the Norwegian case, wage-income is through the estimation period affected by three considerable shocks. One is a sharp rise in income growth after OPEC I and the other two are related to income regulation acts occurring both in late 1970s and late 1980s. Attempts to estimate the income process should take such shocks into account e.g. by using dummies. However, modelling the income process is nevertheless somewhat arbitrary, in particular when the process depends on specification of dummy-variables. Consequences for estimated residuals might therefore be large. These are the main arguments for not following this strategy in search for a proxy for labour-income uncertainty. As an optional approach we therefore use, in line with Gylfason (1981), the change in the unemployment rate as our approximation of uncertainty. Carroll (1992) also argues strongly for the connection between unemployment expectations and precautionary saving, even if his empirical evidence is not very convincing. It might be that changes in the unemployment rate will be connected to the expected level of future labour-income and not to the variability of the same variable. In the following we assume that this is not the case without trying to separate the two effects or justify formally the connection to labour-income variance. However, we test whether short-term unemployment, which could be a better approximation of income variability, has different effects on consumption than total unemployment.

Old-age pensions in Norway are for most individuals a relatively complicated function of their labour-income history, but individuals with low or no income receive a minimum pension, unrelated to income. A measure of average pension-income is found by adding minimum pensions and income dependent pensions

$$P = mB[1 + E] + (1 - m)B[1 + PP\ W\ A\ ] \tag{16}$$

where
- P is average pension-income
- m is the proportion of people with minimum pension
- B is the basic pension
- E is the extra pension rate
- PP is the average pension points
- W is the ratio of counting working years to the maximum of 40
- A is the additional pension rate (equal to 0.45)

The basis for calculating pension-income is the basic pension, determined by the parliament annually. In recent years it has been increased in accordance with the inflation rate. By adding the extra pension rate[4], also decided by parliament each year, we find minimum pension received by low-income and non-income earners.

To find old-age pension-income for the remaining part of population, an income dependent additional pension term is added to the basic pension value. Additional pensions are based on

[4]This rate varies between single and married pensioners, but we have ignored such differences in the construction of expected pensions.

pension points, number of working years and the additional pension rate. Individual pension points are acquired in each working year and based (with some restrictions) on the relative size of income to the basic pension value. PP is the average pension points of the 20 years of highest points. Additional pensions are reduced if the number of counting working years are less than 40, and W takes this into account. Since additional pensions were introduced in 1967, the maximum of 40 years cannot be obtained before 2008. The additional pension rate has been constant at 0.45 from introduction of additional pensions in 1967 to 1991, but was reduced to 0.42 in 1992.

On this background the following approximations of expected pension-income and expected pension wealth is calculated;

1) The current average pension-income which takes into account the extra pension rate and additional pensions. Since the additional pension component has been growing considerably since 1967 and probably will continue to rise in the future (despite the downward adjustment of additional pensions from 1992), average pension-income could be a pessimistic expectation of future pension-income.

2) Expected pension-income is calculated for several age groups for men and women below 67 years, the official retirement age since 1973, and aggregated. In the period 1962-66 we used the basic pension value, equal for every age-group. In the period after 1966, the calculation was based on (16), with actual values of m, B, A and E in the respective year. The number of pension points, PP, was adjusted by using corresponding figures for older groups and the number of counting working years, W, was adjusted in accordance with the average year of retirement for each group. Unlike current pensions this series jumps in 1967 due to introduction of income dependent pensions.

3) Expected pension wealth is calculated using expected pension-income from 2), multiplying with expected years as pensioner and discounting. These variables are accordingly affected both by introduction of income dependent pensions in 1967 and by the reduction in the retirement age from 70 to 67 years in 1973, giving a sharp rise in pension wealth. The rates used for discounting were 0, 2.5, and -2.5 per cent. The 0 rate can be viewed as a benchmark, while the 2.5 per cent option should take account of a higher risk premium. The negative rate is tried to compare our result with Leimer and

Richardson (1992) who estimate negative rates using micro-data. They argue that negative rates are reasonable as this wealth component is more secure than others, giving rise to a negative risk premium. In addition we constructed a variable by discounting with 2.5 per cent for an infinite life-span (simple-discounting) as suggested by Bernheim (1987). He argues that using the actuarial value of benefits in a life cycle setting is inconsistent with the fact that consumers leave bequests, since the actuarial value approach relies on a perfect annuity market.

More details about the calculation of pension variables are given in Appendix B, while statistical properties of data are tested in Appendix C.

3.2 Econometric specification and empirical results

The general consumption functions (14) and (15) show variables that should be included in the empirical analysis. According to (11), we should differentiate between current and expected explanatory variables. Expected pension-income is approximated by construction of variables described in section 3.1. To approximate other future variables and to obtain a good description of the consumption processes, we specify dynamic consumption functions. Our approach starts with a general distributed lag model, then necessary restrictions are imposed in order to obtain a parsimonious error-correction specification. The general functions can be written as follows, where small letters indicate that variables are on log-form

$$(17) \quad \Delta c_t^{\,i} = \alpha_0 + \Delta z_t^{\,i}\, \alpha' + \gamma\, \Delta c_{t-1}^{\,i} + \beta_0 c_{t-1}^{\,i} + z_{t-1}^{\,i}\, \beta' + \delta\, VAT_t + e_t^{\,i}\,, \quad i = W,P$$

where	z	is the vector of explanatory variables
	α, β	are vectors of coefficients
	α_0, γ, δ	are coefficients
	e	is a random error
	VAT	is a dummy variable for introduction of VAT in 1970
	Δ	is the first difference operator

In the general models we estimate the difference in consumption on first differences and lagged levels of all explanatory variables in addition to the lagged level and lagged first difference of consumption. Due to the discussion of labour-income uncertainty, unemployment was only included as a first difference variable in the equation for workers. In a similar modelling approach on quarterly data, Browning (1982) finds that expected pension wealth should be included as a short-term variable only. An argument could be that changes in the pension scheme will last for one generation only. Since pension wealth and particularly pension-income in our model has a similar function as labour-income, usually included as a long-run variable, we allow for both short-run and long-run effects. In addition to ordinary explanatory variables, a dummy variable, aimed at taking account of introduction of VAT in 1970 was also included in the models.

The following test statistics and goodness-of-fit measures, described in Pesaran and Pesaran (1991), are attached to the estimation results

R^2:	the determination coefficient
DW:	the Durbin Watson statistic
SER:	the standard error of regression
Auto:	a residual based test of 1. order autocorrelation
Func:	the RESET misspecification test
Norm:	the Jarque and Bera test of normality
Hete:	a test of heteroscedasticity
Sargan:	Sargan's test of misspecification of the model and the instruments

Consumption for workers

In the general model for workers all six different variables for expected pension wealth, discussed in section 3.1, are included. Table 1 explains which variable is included in which corresponding equation in table 2.

Table 1. Pension-income and pension wealth variables

Equation	Variable
(1)	Actuarial discounting: 0 per cent (Ep1)
(2)	Actuarial discounting: 2.5 per cent (Ep2)
(3)	Actuarial discounting: -2.5 per cent (Ep3)
(4)	Simple discounting: 2.5 per cent (Ep4)
(5)	Expected pension-income (Ep5)
(6)	Current pension-income (Ep6=p)

Ordinary wealth for a year is, in equations for workers, measured as the average of wealth in the beginning and at the end of the respective year. From a theoretical point of view, there is no reason why housing capital and financial wealth should affect consumption similarly. We therefore allow the two components of private wealth to have different weights. By experimentation we found that best results were obtained when housing wealth has weight 0.35 in the wealth aggregate. Due to the deregulation of credit markets in the early 1980s, we also allowed for a shift in the coefficient for the level of total wealth.

The estimation procedure in the equations for workers is IV (2SLS) estimation, see Pesaran and Pesaran (1991). The reason for using the instrumental method is that we would seek to avoid simultaneity problems between consumption and income, unemployment and the real interest rate. In addition to symbols explained in the theoretical section, the regressions for workers also include the unemployment rate (U) and a dummy variable (d84) which is equal to 0 before 1984 and 1 from 1984 and onwards.

The general result is that none of the pension-wealth variables, in level or difference form, are significant in the respective equations and all coefficients even have wrong signs. The simple discounting rule suggested by Bernheim (1987) did not prove to be of any importance in our macro approach. The variation in the values of the discounting factor proved neither to be important, and equation (1) to (5) are almost similar according to effects of pension variables. A reason could be that we have a long discounting horizon in our calculations of pension wealth, reducing the difference between separate ways of discounting.

Table 2. General distributed lag models for workers.
Left-hand side variable: Δc^W. Estimation period: 1966-90.

	(1)	(2)	(3)	(4)	(5)	(6)
constant	0.25 (0.13)	0.25 (0.15)	0.44 (0.25)	-0.10 (0.08)	0.14 (0.12)	-0.17 (0.13)
Δy	0.34 (1.38)	0.34 (1.38)	0.33 (1.38)	0.34 (1.87)	0.33 (1.79)	0.31 (1.45)
Δu	-0.05 (1.91)	-0.06 (2.06)	-0.05 (1.86)	-0.05 (2.18)	-0.05 (2.13)	-0.10 (3.23)
Δr	-0.06 (0.52)	-0.06 (0.47)	-0.07 (0.54)	-0.07 (0.57)	-0.07 (0.58)	0.04 (0.21)
ΔW^W	0.4E-6 (1.73)	0.4E-6 (1.95)	0.4E-6 (1.65)	0.4E-6 (1.88)	0.3E-6 (1.80)	0.4E-6 (1.41)
Δc^W_{-1}	-0.16 (1.16)	-0.17 (1.15)	-0.16 (1.16)	-0.20 (1.49)	-0.18 (1.38)	-0.40 (3.19)
ΔEpi	-0.01 (0.37)	-0.02 (0.41)	-0.01 (0.35)	-0.02 (0.50)	-0.02 (0.43)	-0.20 (1.21)
c^W_{-1}	-0.39 (3.76)	-0.38 (3.39)	-0.40 (3.94)	-0.37 (3.76)	-0.39 (3.97)	-0.40 (3.19)
y_{-1}	0.38 (2.55)	0.39 (2.52)	0.38 (2.60)	0.40 (3.54)	0.38 (3.47)	0.46 (2.45)
r_{-1}	-0.05 (0.41)	-0.04 (0.33)	-0.05 (0.44)	-0.04 (0.35)	-0.05 (0.42)	-0.04 (0.22)
W^W_{-1}	0.3E-6 (3.77)	0.3E-6 (3.63)	0.3E-6 (3.81)	0.3E-6 (4.34)	0.3E-6 (4.26)	0.1E-6 (1.49)
$d84W^W_{-1}$	0.2E-6 (4.92)	0.2E-6 (4.99)	0.2E-6 (4.90)	0.2E-6 (5.32)	0.2E-6 (5.22)	0.2E-6 (3.42)
Epi_{-1}	-0.02 (0.57)	-0.03 (0.62)	-0.02 (0.55)	-0.04 (1.21)	-0.03 (1.07)	-0.05 (0.76)
VAT	0.04 (4.15)	0.04 (4.20)	0.04 (4.11)	0.04 (4.26)	0.04 (4.22)	0.04 (3.12)
R^2 adj.	0.90	0.90	0.90	0.91	0.90	0.83
SER	0.011	0.010	0.011	0.010	0.010	0.013
DW	2.56	2.52	2.57	2.77	2.75	2.58
Auto	3.44	2.90	3.77	7.32*	7.20*	7.48*
Func	1.63	2.53	1.27	2.19	1.45	0.93
Norm	3.49	4.41	2.99	0.73	0.94	0.44
Hete	0.30	0.22	0.34	0.25	0.34	1.29
Sargan	5.79	5.99	5.67	4.95	5.08	6.14

* - significant on 5 per cent level. Asymptotic t-values in parentheses. Additional instruments for Δy, Δu and Δr: y_{-2}, y_{-3}, u_{-1}, u_{-2}, u_{-3}, W_{-2}, W_{-3}, r_{-2}, r_{-3}

Economic theory offers three explanations to the result that expected pensions do not effect consumption for workers. The first is that consumers could be myopic and not concerned about future pensions when making consumption decisions. This could apply to the group of workers in total, even if some individuals have a different behaviour. Results from cross-section studies indicate that expected pensions influence savings for pre-retirement groups. If so, our results could be determined by the dominating group of younger workers, not yet worried about their future pensions. Another explanation would be to rely on Barro's neutrality result, i.e. that the explanation for not caring about reductions in future pensions is that today's workers expect to be compensated by their (altruistic) successors. This hypothesis has, however, been subject to much criticism, based on both theoretical and empirical arguments. Feldstein (1974) offered the third explanation by pointing to the fact that consumers could adjust their retirement age or continue to work (part-time) after retirement. A reduction in expected benefits would accordingly be offset, not by higher saving today, but by saving in a period after the normal retirement age. Each of these theories is probably not the sole explanation, but taken together they might explain our result. Besides these theoretical considerations there are of course also empirical problems connected to our macro-approach, both regarding construction of expected pensions and the division of aggregate data into series for socioeconomic groups.

As all equations in table 2 contains insignificant variables, we search for a more specific model. The simplification process started by removing both the two variables for expected pensions and the two real interest rate variables which also turned out as insignificant. The latter result is quite common in analyses of consumer behaviour and consistent with the ambiguous theoretical effect of interest rates on consumption. The change in ordinary wealth was then removed and the coefficients of the two level of wealth variables were restricted to a common value. As the difference in income and lagged level of income also could be restricted to have equal coefficients, we ended with the following preferred equation for workers

$$(18)\quad \Delta c^{W} = \underset{(1.83)}{-0.63} - \underset{(1.67)}{0.04\Delta u} - \underset{(6.45)}{0.53c^{W}_{-1}} + \underset{(6.03)}{0.47y} + \underset{(4.18)}{0.15E\text{-}6\ W^{*}_{-1}} + \underset{(3.72)}{0.03VAT}$$

Estimation period: 1966-91, $W^{*} = W(1 + d84)$

Additional instruments for Δu and y: y_{-1}, y_{-2}, u_{-1}, u_{-2}, u_{-3}, W^{*}_{-2}, W^{*}_{-3}

None of the test statistics are significant on a 5 per cent level, indicating good statistical properties. To investigate stability properties for the estimated coefficients, the equation was also estimated over two shorter periods ending in 1980 and 1985. This revealed strong stability concerning the income elasticity and the unemployment coefficient. The wealth coefficient is stable from 1985 to 1991, but is not significant before 1985. Nevertheless we included this variable as it improved the properties of the equation considerably.

An important feature of equation (18) is that the annual change in the unemployment rate seems to have a significant effect on consumption for workers through the 1980s, even though it is only significant at the 12 per cent level in the preferred equation. As far as the change in unemployment approximates the variance of labour-income, the expected depressing effect on consumption is confirmed by data. We also replaced total unemployment with short-term unemployment without finding any marked differences in the results. This is, however, not surprising since the development of the two series coincide for most of the estimation period.

Another important result from the preferred equation is that the income elasticity is close to, but significantly below 1. Since the wealth variable is included in level (rather than log) form, the corresponding elasticity will vary over time. In 1991, we calculated this elasticity to 0.08. When added to the income elasticity (0.9) we get almost the theory consistent value of 1, assuring a stable long-run equilibrium between income, wealth and consumption.

Institutional changes in the credit market seems to matter for consumption. As in Muellbauer and Murphy (1989), we find that the importance of wealth has been rising through the 1980s. A positive shift in the wealth coefficient is found to occur in 1984, when direct regulation of credit from private banks in Norway ended and the role of indirect credit-regulation was played down[5]. Deregulation probably made housing capital more liquid and thereby also changed its impact on consumption, but it is not obvious that effects of financial wealth should be altered. Credit market liberalization should reduce the need for precautionary saving, an effect that could have been captured by the wealth coefficient. It would have been more satisfying, though, to relate this effect to a shift in the unemployment coefficent. Our way of modelling wealth effects is similar to the modelling of aggregate consumption of non-

[5]One might argue that there should also be a shift in the income coefficient, but we found no evidence for such an effect.

durables in the Norwegian macro-model MODAG, see Bowitz and Holm (1993), but differs from the approach taken in Brodin and Nymoen (1992). In the latter paper, a stable effect of total wealth is found (without use of dummies) in an aggregate quarterly consumption function for Norway when using a housing prices index different from the one employed in our analysis.

Consumption for pensioners

For pensioners we did not use the IV (2SLS) approach. The reason is that we regard neither pension-income nor real interest rates to be considerably affected by pensioners' consumption, accounting for only around 20 per cent of total consumption in the last part of the estimation period, and even less in the first part.

As for labour-income in the model for workers, we approximate expected pension-income by using lagged and current pensions in the regressions. For pensioners we also tried the same wealth approach as for workers, i.e. adding the two components of wealth, using the level rather than the log form, measuring wealth as an average of consecutive observations and allowing for shifts in the coefficients. No significant effects of wealth were found by this approach though. Wealth variables included in table 2 is measured at the end of each year, and housing capital (WH) and financial wealth (WF) are included separately. The general model also includes the real (after-tax) rate of interest.

Table 3. Models for pensioners.
Left-hand side variable: Δc^P. Estimation period 1964-91.

	(1)	(2)	(3)	(4)	(5)
const.	4.00 (3.71)	1.91 (3.14)	1.56 (3.80)	1.64 (4.07)	1.58 (3.89)
Δc^P_{-1}	0.92 (4.53)	0.80 (3.75)	0.84 (4.23)	0.82 (5.34)	0.81 (5.21)
Δp	0.49 (1.62)	0.42 (1.31)	0.21 (0.89)		
Δr	-0.02 (0.11)				
Δwh^P_{-1}	0.08 (0.77)	-0.04 (0.37)			
Δwf^P_{-1}	0.14 (0.91)	0.25 (1.54)	0.29 (2.28)	0.28 (2.25)	0.25 (1.98)
c^P_{-1}	-0.61 (3.90)	-0.49 (3.11)	-0.41 (3.42)	-0.35 (3.56)	-0.28 (3.31)
p_{-1}	0.48 (2.96)	0.41 (2.42)	0.28 (2.78)	0.22 (3.01)	0.16 (2.72)
r			-0.29 (1.60)	-0.20 (1.33)	
r_{-1}	0.03 (0.11)				
wh^P_{-2}	0.07 (0.65)	-0.08 (0.79)			
wf^P_{-2}	-0.24 (2.28)				
VAT	-0.01 (0.51)				
R^2 adj.	0.63	0.57	0.60	0.60	0.59
SER	0.034	0.037	0.035	0.035	0.036
DW	2.49	2.07	2.12	2.08	1.91
Auto	3.43	0.26	0.38	0.19	0.016
Func	15.54*	14.88*	10.91*	9.89*	9.91*
Norm	2.29	0.98	0.49	0.74	1.15
Hete	0.20	2.43	1.70	2.96	3.91

* - significant on 5 per cent level. t-values in parentheses

We present the simplification process from the most general model to the preferred equation in table 3. From equation (1), we can see that financial wealth is significant, but with a negative sign for the long-run term. When searching for a simple model we first removed the long-run financial wealth variable and the dummy variable for introduction of VAT. The insignificance of the latter variable, contrasting the results for workers, could be a sign of myopic behaviour for pensioners. After removing the above variables, both housing wealth coefficients turned negative and were therefore also removed. The two real interest rate coefficients were quite similar in size, and we tried to restrict them to become equal in order to raise the t-value. As can be seen from equation (3) this succeeded, but when the difference in pension-income was removed, the importance of the interest rate variable decreased. This result contrasts Cappelen (1980) finding significant interest rate effects when estimating over the period 1962-77 for the same group of consumers. Eventually the preferred model (5) turned out to be quite simple with pension-income and financial wealth as the only explanatory variables. The financial wealth variable is significant on a 7 per cent level and contribute to reduce the SER. It was therefore kept in the equation even if we discovered some parameter instability for this variable.

Except from the functional form test, which is significant on a 5 per cent level, the equation seems to have good econometric properties. Due to the specification problem, which applies to all equations in table 3, we also estimated the preferred model on linear rather than log-linear form. This improved the functional form test somewhat, but since the (time varying) income elasticity in 1990 was almost the same as in the log-model, we concentrate the remaining discussion on the log-form version. The functional form problem which is connected to the falling consumption/income ratio over time, is nevertheless a worrying feature of this model.

As for workers we also estimated the preferred model for shorter estimation periods ending in 1980 and 1985 respectively. The pension-income elasticity is stable and lies around 0.6, while the wealth coefficient is declining through the period 1980 to 1991. The most important result in our context is though that pension-income has a considerably lower elasticity than labour-income for workers, and that this result seems to be robust to different specifications of the model. The somewhat low income elasticity, which could be due to a cohort effect, has important consequences for the discussion of effects on saving.

4. Effects on saving

To discuss effects on total saving, we define per capita saving for workers and pensioners respectively. Saving for workers in a given period (S^W) is equal to labour-income less consumption, while saving for pensioners (S^P) is defined as pension-income less consumption

(19) $$S^W = Y - C^W$$

(20) $$S^P = P - C^P$$

Total saving is accordingly

(21) $$S = [(Y - C^W)\, N^W + (P - C^P)\, N^P] \,/\, N, \quad N = N^W + N^P$$

where N^W is the number of workers and N^P is the number of pensioners.

In a pay-as-you-go pension scheme, pension benefits have to be financed by taxes in the same period. We do not consider the possibility that benefits can be financed partly by borrowing since this is not a sustainable policy in the long run. The balancing of the pension scheme is consequently given by

(22) $$P\, N^P = \tau\, Y^*\, N^W = T\, N^W$$

where T is tax income. In the following, we assume that gross income is unaffected by changes in the tax-rate and pensions.

4.1 Pension policies

In this section we analyse effects of a change in the pension program that maintain the balance given by (22). Since such changes do not affect total income for workers and pensioners, effects on average saving will equal effects on consumption, corrected for population ratios. By combining (21) and (22) aggregate saving can be written

(23)
$$S = [Y^{*} N^{W} - C^{W} N^{W} - C^{P} N^{P}] \,/\, N$$

Assume that taxes are raised to finance higher pension-income. Tax income is by (22) a linear function of pension-income and the derivative of tax income with respect to pension-income is equal to the population ratio

(24)
$$\frac{dT}{dP} = (\frac{N^{P}}{N^{W}})$$

Effects on saving can accordingly be analysed by changing pension-income and taking into account that taxes also have to be raised. By inserting (14) and (15) in (23), and differentiating with respect to P, we obtain the following

(25)
$$\frac{dS}{dP} = -\frac{N^{W}}{N}[\frac{\delta C^{W}}{\delta EY}\frac{\delta EY}{\delta T} + \frac{\delta C^{W}}{\delta E\sigma_{w}^{2}}\frac{\delta E\sigma_{w}^{2}}{\delta \tau}\frac{\delta \tau}{\delta T}]\frac{dT}{dP}$$

$$-\frac{N^{W}}{N}[\frac{\delta C^{W}}{\delta EP^{W}}\frac{\delta EP^{W}}{\delta P}] - \frac{N^{P}}{N}[\frac{\delta C^{P}}{\delta EP^{P}}\frac{\delta EP^{P}}{\delta P}]$$

The first (right-hand side) term in (25) is the usual income effect following from a tax increase. Expected (and current) income will be reduced, thereby reducing consumption and increasing saving. The second effect describes effects via uncertainty. Increased taxation will reduce after-tax labour-income through the tax-rate, and hence also the variance of this variable. Reduced uncertainty will increase consumption and the total effect on saving from a tax increase is ambiguous. Increased pension-income will increase consumption for both generations if expected pension-income also increases, according to terms three and four.

It should be underlined that this model only includes partial equilibrium effects. There are no feedback effects from interest rates and labour-income from the capital market following from changes in saving. Furthermore, there is no option for leaving (altruistic) bequests or choosing the retirement age endogenously. Effects of relaxing the latter assumptions have been discussed extensively in the literature starting with Barro (1974) and Feldstein (1974). As discussed earlier, both factors contribute to make it an open question whether increased old-age pensions reduce private saving. We will, however, not discuss these effects further in this analysis. As in many former empirical studies, we rather interpret effects on saving as net effects, corrected for the two above mentioned factors.

Empirical effects on saving can be discussed by applying the results from 3.2. Theoretically such effects were outlined in equation (25), showing four separate effects from a tax-financed increase in old-age pensions. Empirically we found that expected pension-income did not influence consumption for workers. As far as unemployment figures can be interpreted as a proxy for uncertainty, data did support a depressing effect on consumption. However, in this discussion we do not try to quantify the uncertainty term, for two main reasons. First, we have not justified that the change in unemployment is an approximation of the variance of labour-income. The change in unemployment might also account for income expectations. Secondly, even if the estimated effect is closely related to uncertainty, the magnitude of the impact on saving would be small. In particular, it would not outweigh effects that stem from the difference in income elasticities between workers and pensioners. The two remaining effects are connected to redistribution of income between the two generations. By combining (24) and (25) and omitting all expectation notation, we obtain the following equation which shows these effects

$$(26) \qquad \frac{dS}{dP} = -\frac{N^P}{N}\left[\frac{\delta C^W}{\delta Y}\frac{\delta Y}{\delta T} + \frac{\delta C^P}{\delta P}\right]$$

Estimates of income-elasticities provide together with population figures a basis for calculating the effects in (26). Estimated income elasticities should be converted to MPCs by multiplying by the consumption income ratio to match the theoretical model. The ratio will vary over time and we therefore assume, for simplicity, that consumption is equal to income (a reasonable average in the long-run). Further we need the number of workers and pensioners respectively. To make a simple example we assume that the number of workers is twice the number of pensioners. This was almost the case in Norway in 1990 when there were around 2 mill. people in the work-force (self-employed included) and somewhat above 900 000 individuals receiving different kinds of pension benefits. The total effect is then, according to (26), equal to 1/3 times the income elasticity for workers less the income elasticity for pensioners.

Based on our assumptions, a marginal tax increase would raise saving by 0.3 (0.9 times 1/3). The corresponding increase in pension-income would reduce saving by 0.2 (0.6 times 1/3) making the overall increase in saving equal to 0.1. Our results based on preferred models therefore show that a redistribution of income through the pension scheme will increase saving[6]. In order to obtain the elasticity of saving with respect to pensions, we should multiply by the pension-income saving ratio. As an example, if pension-income is five times saving, the elasticity is equal to 0.5.

Compared to e.g. Feldstein (1974) who finds a negative effect on saving, we find that increased pensions is more likely to stimulate than to reduce personal saving. A reason is that there are no effects from expected future pensions on consumption for workers. According to (25) such effects would contribute to reduce saving. It is also important to emphasize that we maintain the pension budget in balance when discussing effects on saving. If increased pension-income could be financed partly by borrowing, this would tend to reduce positive effects on private saving. Another reason for our result is the difference in income elasticities between workers and pensioners. If elasticities were equal, the overall effect on saving is zero.

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[6]This is a steady-state effect based on long-run elasticities, and is contingent on the assumption of exogenous gross-income. If the tax increase would raise gross-income (by e.g. increasing labour supply) by 1/3, there would be no effect on aggregate saving.

4.2 Ageing populations

When discussing effects of changes in the pension scheme we have treated population ratios, pensions and labour-income as constant. More realistically, let us look at consequences of an ageing population.

Let us assume that the total number of workers and pensioners (N) is constant. More pensioners is then equivalent with fewer workers. If we replace N^W with N-N^P in equation (21), saving is a function of N^P and we have

$$\frac{dS}{dN^P} = \frac{1}{N} [-(Y^* - C^W) + (P - C^P)] \tag{27}$$

Equation (27) gives the first order effects of an ageing population. If workers are saving less (on average) than pensioners, total saving will increase.

The second order effects are related to financing of pensions for the increased number of retired individuals. Recall the pension budget given in (22), which can be written as follows

$$P\,(\frac{N^P}{N^W}) = T \tag{22'}$$

In order to maintain the budget balance, taxes can be raised or pensions reduced (or a there can be a combination of the two policies). Since there are twice as many workers as pensioners, a reduction in pensions must be twice the tax increase per capita. With reference to estimation results in 3.2 and assumptions made in 4.1, we can easily find effects on saving of each policy. A marginal tax-increase will reduce saving per worker by 0.1, which gives an aggregate effect of -0.07. A reduction in pensions, which is twice the size of the tax-increase, will reduce saving per capita by 0.8, giving an aggregate effect of -0.27. The increase in taxes will accordingly depress saving less than a reduction in pensions.

5. Conclusion

In the theoretical analysis we argued that labour-income uncertainty should be included in consumption functions for workers. Pension-income uncertainty (measured by its variance) could, however, be omitted from consumption functions for both workers and pensioners if we regard uncertainty arising from changes in social security legislation to be of little importance. By using disaggregated macro-data for Norway we estimated empirical consumption functions for workers and pensioners respectively. In the equation for workers we found some effect of the change in the unemployment rate, indicating that uncertainty might be important for consumer behaviour. Our results denied effects of (several approximations) of expected pensions for the same group of consumers. We also found that the income elasticity for pensioners is considerably lower than the one for workers. Based on these estimates and the small effect of labour-income uncertainty, we argued that a tax-financed increase in pensions through the pension scheme is likely to stimulate saving. Consequences of an ageing population should, according to our estimates, be met by raising taxes rather than decreasing pensions if we are concerned of depressing effects on saving.

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Appendix A. Data construction

Three sources are used to construct series for consumption and income for the entire period 1962-91. Data from the national accounts cover 1975-91, Johnsen (1987) covers the period 1970-75, while series from 1962-78 are presented in Cappelen (1980). In general we use Johnsen's data from 1970-74 and national account data from 1975-91. For the period 1962-69 we have made an adjustment of Cappelen's data, based on simple regressions of data in Cappelen (1980) and series based on the two other sources for the period 1970-78.

For consumption, the following estimated regressions were used, t-values in parentheses

(A1) $$\underset{}{CW = \underset{(259.82)}{1.0315} * CW^{Ca}}$$

(A2) $$CP = \underset{(65.62)}{1.1447} * CP^{Ca}$$

where Ci indicates consumption for group i, i = W (wage-earners), P (pensioners).
Ca indicates data from Cappelen (1980).

For total income, the following estimated regressions were used, t-values in parentheses

(A3) $$YW = \underset{(477.59)}{1.01134} * YW^{Ca}$$

(A4) $$YP = \underset{(3.49)}{3716} + \underset{(81.96)}{1.03508} * YP^{Ca}$$

where Yi indicates income for group i.

In order to allow for a removal of net interest income from total income, the same procedure was undertaken for interest income and payments. Since interest income for socioeconomic groups in Cappelen (1980) does not include estimated interest income from insurance, we first divide this income by using constant weights of 0.73 for wage-earners and 0.12 for pensioners. Then the following regression results were used to correct interest income and payments

(A5) $IIW = 1.181 * IIW^{Ca}$
(81.05)

(A6) $IIP = 1.2314 * IIP^{Ca}$
(37.25)

(A7) $IPW = 299.79 + 0.7177 * IPW^{Ca}$
(3.26) (25.1)

(A8) $IPP = 63.12 + 0.5695 * IPP^{Ca}$
(13.63) (38.19)

where IIi indicates interest income for group i.

IPi indicates interest payments for group i.

Net financial assets, liabilities and housing capital were divided to the three socioeconomic groups by using the following ratios based on Income and Property Statistics, see Statistics Norway (1967-87). For years between observed ratios, interpolations were undertaken. After 1987, observations for this year were utilized. J denotes fixed capital, A assets and L liabilities.

	Wage-earners			Pensioners		
	J	A	L	J	A	L
1962	0.14	0.12	0.15	0.10	0.24	0.05
1967	0.16	0.16	0.15	0.10	0.25	0.06
1970	0.13	0.13	0.12	0.08	0.19	0.05
1973	0.16	0.14	0.16	0.08	0.18	0.04
1976	0.18	0.19	0.17	0.08	0.20	0.05
1979	0.19	0.19	0.24	0.07	0.20	0.04
1982	0.19	0.20	0.21	0.07	0.19	0.05
1984	0.17	0.21	0.21	0.07	0.19	0.03
1985	0.22	0.23	0.28	0.07	0.21	0.04
1986	0.24	0.24	0.31	0.08	0.21	0.04
1987	0.24	0.26	0.32	0.09	0.22	0.04

Appendix B. Calculation of old-age pension wealth[7]

The population was divided into the following age groups for men and women respectively; 16-39, 40-49, 50-59, 60-64, 65-66. Calculations were made for the period 1962 to 1990. From 1962-67 we used the basic pension value as expected pension-income for all consumers, while in the period 1967-91 the latter variable was calculated due to the pension act of 1967. Total pension for group k is given by

$$P_{tk} = m_{tk}\, B_t(1+E_t) + (1 - m_{tk})\, [B_t + A_t\, (B_t\, W_{tk}\, PP_{kt})] \tag{B1}$$

where
- B_t is the basic pension, year t
- E_t is the extra pension rate, year t
- PP_{tk} is the average pension points, year t, group k
- W_{tk} is the proportion of counting working years, group k
- m_{tk} is the rate of people above minimum pension, group k
- A_t is the additional pension rate, year t (equal to 0.45)

The basic pension, the extra pension rate and the additional pension rate are determined by the parliament every year and are equal for all groups. Individual pension points for each group is the average of the 20 years of highest acquired points. Expected points are set equal to average points for the groups older than the respective group according to annual reports from the Norwegian Social Security Administration (Rikstrygdeverket) in 1967 and 1990. From these figures we calculated the average pension point growth rate and interpolated for the remaining periods. The maximum number of working years counting are 40 and the variable W takes into account that this maximum cannot be reached for all individuals before 2008. The rate of people acquiring pension above minimum pension is set equal to the rate of people in the respective group obtaining pension points in the period.

Total pension for group k is the amount this group on average would have received as pensioners in year t, if they had gained pension points according to the estimates from Rikstrygdeverket. To find their future pension we assume that the legislation are expected to remain unchanged from the period of calculation to the pension period.

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[7] Thanks to E. Bowitz for providing the framework for the calculations.

To determine pension wealth variables, the pension period is calculated as average lifetime minus the retirement age, equal to 70 years before 1972 and 67 years from 1973. Expected remaining life-time is taken from Statistical Yearbook for Norway, several issues. Expected pension-income in the average (middle) year of retirement is calculated by discounting and multiplying with the expected number of retirement years.

Appendix C. DF and ADF-tests

According to table C1 consumption for wage-earners is I(1), but the a unit root for the difference of consumption for pensioners cannot be rejected leaving some doubt of the degree of integration for this variable. Non-property income for workers and pension-income seem to be I(1) and the tests also support that the real rate of interest and the unemployment rate are I(1). Expected pension-income and all pension wealth variables are also difference-stationary according to our sample. The same seems to be the case for housing capital and financial wealth for pensioners and the real rate of interest. For aggregate wealth for workers, tests are not equally convincing but we regard this variable to be difference stationary as well.

Table C1. DF and ADF tests for the period 1962-91

	DF	ADF(1)	DF w/trend	ADF(1) w/trend
c^W	-1.34	-1.17	-0.87	-2.09
Δc^W	-3.83	-3.07	-3.92	-3.18
c^P	-2.49	-2.18	-0.55	-1.86
Δc^P	-2.36	-2.57	-2.83	-3.28
r	-1.26	-1.05	-2.48	-2.18
Δr	-5.72	-5.51	-5.74	-5.86
y	-2.66	-1.42	-0.47	-1.51
Δy	-2.82	-3.13	-3.06	-3.95
p	-2.99	-3.40	-0.48	-0.61
Δp	-4.50	-2.48	-6.21	-4.12
u	0.23	-0.75	-1.30	-2.64
Δu	-3.71	-4.64	-4.00	-5.25
W^W	-1.26	-1.98	0.61	-1.55
ΔW^W	-1.97	-2.99	-2.31	-3.51
wf^P	0.66	0.22	-1.56	-2.16
Δwf^P	-3.78	-2.74	-3.96	-2.94
wh^P	-0.96	-1.20	-1.98	-3.95
Δwh^P	-3.31	-2.92	-3.29	-2.84
Ep1	-1.75	-2.23	-0.46	-0.37
ΔEp1	-4.98	-3.05	-5.74	-3.98
Ep2	-2.27	-1.91	-2.33	-1.02
ΔEp2	-6.56	-4.09	-7.05	-4.69
Ep3	-1.71	-2.18	-0.70	-0.63
ΔEP3	-5.11	-3.25	-5.81	-4.16
Ep4	-2.01	-2.59	-0.68	-0.92
ΔEP4	-4.73	-2.98	-5.72	-4.14
Ep5	-1.89	-2.40	-1.06	-1.32
ΔEp5	-4.89	-3.19	-5.68	-4.17

Critical values; DF/ADF: -2.97 , DF/ADF with trend: -3.58
A constant term is included in the DF/ADF regressions.

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