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Knut A. Magnussen

Old-Age Pensions, Retirement Behaviour and Personal Saving

A Discussion of the Literature

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Abstract

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Old-Age Pensions, Retirement Behaviour and Personal Saving
A Discussion of the Literature

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Since the early 1970s, a large literature has studied the effects of social security, in particular old-age pensions, on the economic behaviour of households. In order to survey this literature, we start by introducing a simple overlapping generations model where the main theoretical effects are discussed. In a traditional life-cycle setting, it is shown that personal saving is likely to decline when public pensions are introduced. This result is modified by allowing for liquidity constraints and endogenous labour supply, but could be strengthened by income uncertainty. Many direct empirical tests, based on different types of data for different countries and periods, of the effects on saving are surveyed. Since results show that this literature fails to find unambiguous effects on saving, we also review studies that have been concerned with modifying factors. Empirical evidence suggests that pension schemes to some extent affect labour supply and that consumer behaviour is affected by both liquidity constraints and uncertainty.

Keywords: Social security, Saving, Retirement behaviour, Liquidity constraints, Income uncertainty

JEL Classification: D12, D91, E21, H55.

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Sammendrag

Knut A. Magnussen

Alderspensjon, pensjoneringsatferd og privat sparing
En diskusjon av litteraturen

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Fra tidlig på 1970-tallet har det vokst frem en omfattende litteratur om sammenhengen mellom alderspensjon og økonomisk atferd blant husholdninger. Vi analyserer de viktigste teoretiske effektene ved hjelp av en enkel modell med overlappende generasjoner. Det vises at dersom en legger livsyklusmodellen til grunn, vil introduksjon av en offentlig finansiert alderspensjon sannsynligvis redusere den private sparingen. Dette resultatet må imidlertid modifiseres dersom en åpner for kredittrestriksjoner og endogent arbeidstilbud i modellen, mens usikkerhet omkring inntekten kan styrke den opprinnelige effekten. En rekke direkte empiriske tester, basert på ulike data fra forskjellige land og perioder, blir gjennomgått. Siden resultatene ikke gir grunnlag for å trekke entydige konklusjoner om virkningen på sparingen, tar vi også for oss analyser som har vært opptatt av de modifiserende effektene. Empirisk forskning antyder at alderspensjoner i noen grad påvirker arbeidstilbudet og at både kredittrestriksjoner og usikkerhet påvirker konsumentenes atferd.

Emneord: Alderspensjon, sparing, pensjoneringsatferd, kredittrestriksjoner, inntektsusikkerhet.

Contents

1. Introduction*

Private saving is for several reasons an important economic factor. In the short term, oscillations in the savings ratio are a major determinant of business cycles, while over a longer horizon saving can stimulate economic growth by giving room for investment. In this respect it seems important to analyze factors behind the development in private saving. The life-cycle model seeks to explain saving behaviour for a representative consumer by pointing at the fact that consumers normally prefer a more stable development in consumption than is feasible by spending current income. If no pensions are assumed to be received after retirement, the consumer will therefore save during working years in order to maintain the level of consumption after retirement. Introduction of a public pension scheme will alter the conditions for the consumer. In this survey we first seek to explain theoretically how saving is likely to be affected and how the effects depend on assumptions regarding labour supply, income uncertainty and bequests. In the main part of the survey, we look into a number of empirical studies that have analyzed these issues empirically.

The relationship between social security and personal saving has been discussed intensively both theoretically, often in connection with the Ricardian equivalence debate, and in many empirical studies since the seminal contribution by Feldstein (1974). His major concern was the depressing effect on saving from a build-up of un-funded public pension schemes. In a world of many ageing populations the pertinent question to ask now is whether reductions of benefits through the social security system [1] will increase aggregate saving. Many studies of the subject were undertaken in the period 1974-85, but some recent studies also shed more light on both theoretical and empirical issues. Despite the large number of empirical analyses, no consensus has been reached of whether old-age pensions from an

* The author would like to thank E. Bowitz for useful comments to an earlier draft.

1 The social security system usually includes other benefits in addition to old-age pensions. In the literature public old-age pensions is often referred to as social security, and we follow that usage in this survey.

empirical point of view have a negative impact on personal saving or not, and more studies are likely to follow. Previous surveys have been given by Gultekin and Logue (1979) and Atkinson (1987). This survey seeks to look into both theoretical and empirical matters and update former surveys.

In order to discuss effects of old-age pensions theoretically, we apply a simple two-period overlapping generations model without production. Consumers are supposed to follow the life-cycle model, taking the whole life-span into account when planning consumption. In the simple version of the model it is shown that introduction of a pay-as-you-go (PAYG) social security system, implying that current benefits are financed by levying taxes on the working generation, will reduce personal saving. Several factors can, however, modify the depressing effect on saving. Feldstein (1974) focused on the possibility that consumers could reduce their labour supply, implying that a part of the increase in life-time income leads to increased leisure rather than increased consumption. Credit constraints can also modify negative effects on saving if consumers are prevented from consuming expected increases in future income. Barro (1974) showed that if the life-cycle model is extended with altruistic bequests, saving might not be affected at all, but the neutrality result may no longer apply when consumers regard their future labour income as uncertain. The neutrality result can also be obtained in a model with myopic consumers where uncertainty is less important, making it difficult to address empirical results to a specific theoretical model.

The main part of empirical studies considered in this survey tests effects of social security by using reduced form saving or consumption functions and are usually divided into three sub-groups according to type of data. When discussing these analyses we are particularly interested in effects on aggregate saving and consumption. Many time-series studies were carried out following Feldstein's seminal paper in 1974, and a majority of these analyses fails to find significant effects of social security. We argue that results may be affected by multicollinearity, as most analyses estimate equations in level-form. In addition, results seem to depend on the econometric specification, the estimation period and on how data are constructed. Cross-country analyses do find negative effects on saving but also effects on work participation of pensioners. It is therefore difficult to draw conclusions from these studies, but analyses that account particularly for country-specific effects do not find negative effects on saving. Cross-section analyses are often undertaken for a particular age-group and reveal less evidence of aggregate behaviour. Among studies concerned directly with aggregate effects, a majority seems to find a depressing effect on saving. Some cross-section analyses also test explicitly for bequest behaviour, but small and weak effects are found.

Empirical studies mentioned so far do all apply some measure of prospective social security benefits, sometimes corrected for future tax contributions, when testing for effects on personal saving. It has been argued that these studies are of little importance since expected social security wealth is unobservable and has to be approximated, see Bernheim (1987b). The same argument could, however, also be used against approximations of human capital i.e. discounted future labour

income. In a life-cycle setting all future income, both labour income and pensions, should be included. Since pensions are only received by retirees, the remaining group of the population has to form expectations of future pensions based on labour income, social security legislation etc. This contrasts expectations of labour income that can be based on currently received and lagged payments. Different ways of approximating future pensions are adopted in the literature. In particular, there has been a debate on how expected benefits should be discounted, and we review main points in the survey.

Since direct empirical tests of effects of old-age pensions on saving fail to show unambiguous results, we also investigate the literature that is concerned with some of the major underlying assumptions. A large number of empirical studies have focused on retirement behaviour and labour supply among elderly. From a theoretical point of view it could be argued that social security should reduce labour supply and give incentives for early retirement. However, when the age of retirement is flexible, there are often also economic incentives (i.e. possibilities for obtaining higher pensions) to work beyond the lowest possible retirement age. This is the case for the system in the U.S. that has been under consideration in most of the empirical literature. With two opposing effects on the retirement decision, it is not surprising that empirical results are divided over the question related to retirement. However, most of the studies surveyed here find significant but small effects on retirement behaviour.

In the last part of the survey we look into empirical studies on liquidity constraints and income uncertainty. A large part of the consumption literature started focusing on the imperfections in the capital market as an explanation to the failure of accepting the rational expectation permanent income hypothesis proposed by Hall (1978). In later years, the focus in the consumption literature has been turned towards effects of income uncertainty, or more precisely precautionary saving. Even if it is hard to analyze both credit restrictions and precautionary saving, particularly due to problems in obtaining closed form models of consumption, some evidence in favour of both explanations is found. Seen in relation to our main focus in this survey - the effects on personal saving of old-age pensions - this is not adding much to the overall conclusion since liquidity constraints are likely to reduce effects on saving while the opposite is true for income uncertainty.

2. Theoretical effects of old-age pensions

This chapter provides a theoretical discussion of the main effects in the relationship between public old-age pensions and personal saving. The framework for the discussion is a simple overlapping-generations model where each generation acts as life-cycle consumers. Effects of pensions are analyzed by introducing a pay-as-you-go (PAYG) pension scheme where pension benefits are currently financed by taxation. An alternative way of financing pensions is the fully funded system where each generation has to finance its own pensions. Theoretically a funded system will not deviate much from a situation without public pension schemes. In addition the PAYG scheme is by far the most utilized system in western economies. On this background, we do not consider funded systems in this survey.

Effects of PAYG pensions on saving depend heavily on which assumptions are made regarding the environment in which the consumers operate, e.g. the capital market, and on consumer behaviour, e.g. the specification of the utility function. We analyze in particular three main assumptions that are often discussed in the theoretical literature and which have also been tested in many empirical studies. First, we discuss how old-age pensions are likely to affect retirement behaviour and labour supply. We then look at labour income uncertainty and the role of bequests. The consequences of liquidity constraints are also discussed in this chapter.

2.1 A simple overlapping generations model

Overlapping generations models have proved useful in analyzing how transfers between generations affect economic growth. The first model of this kind was presented by Samuelson (1958). Diamond (1965) introduced an overlapping generations model with a neoclassical production setting, later extended by Barro (1974) to discuss effects of altruistic bequests within the same framework. In two-period models labour income is usually assumed to be received in period one only. Here we present a simple overlapping generations model without production, where labour income is received in both periods. This is useful when analyzing effects of uncertainty, and a similar model is used by Feldstein (1988).

The economy consists of two overlapping generations of identical individuals. Each generation lives for two periods, has no initial assets but receives labour income in both periods. The retirement age is assumed to be fixed and occurs in the second period. Bequests and uncertainty are ignored at this stage but will be introduced later.

Since generations are identical, we only consider a representative generation in this section. Consumer spending in accordance with the life-cycle theory is planned in the first period and agents are assumed to have information about all relevant variables. The utility function is given by

$$(1) \qquad U_t = U\,(C_{t,1},\, C_{t,2})\,,\ \delta U/\delta C_{t,i} > 0,\ \delta^2 U/\delta C_{t,i}^2 < 0,\ \ i = 1,2$$

where $C_{t,i}$ is consumption per capita of generation t in period i. Utility is maximized subject to the two-period budget constraint given by

$$(2) \qquad C_{t,1} + C_{t,2}/(1+r) = Y_{t,1} + Y_{t,2}/(1+r)$$

where $Y_{t,i}$ is labour income per capita for generation t in period i and r is the real interest rate. It is assumed that the capital market is perfect: the consumer can lend or borrow at the going rate of interest. Labour supply is in this section assumed to be inelastic in both periods, making income exogenous to the consumer. The first order condition then simply tells us that the marginal rate of substitution should be equal to the (exogenously given) capital market yield

$$(3) \qquad (\delta U/\delta C_{t,1})/(\delta U/\delta C_{t,2}) = (1+r)$$

Equations (2) and (3) determine consumption in each period as a function of life-time income. Period one consumption can be written

$$(4) \qquad C_{t,1} = C_1(Y_{t,1} + Y_{t,2}/(1+r))$$

showing that consumption depends on total discounted income only. By assuming that consumption is a normal good, income effects are positive. The effect of changes in the interest rate is, as usual, ambiguous. Saving in period one is defined as income less consumption in the same period and could be positive or negative

$$(5) \qquad A_{t,1} = Y_{t,1} - C_1(Y_{t,1} + Y_{t,2}/(1+r))$$

Consumption in period two is, since we abstract from bequests, given by the sum of accumulated assets (or outstanding debt) from period one and second period income

$$(6) \qquad C_{t,2} = A_{t,1} + Y_{t,2}$$

Saving in period two is by definition equal to income less consumption in the same period

$$(7) \qquad A_{t,2} = Y_{t,2} - C_{t,2}$$

Equation (6) and (7) show that total saving for the two periods is zero.

It should be underlined that this model is partial in that the capital market is ignored. More realistically, effects from saving would influence the interest rate, thereby create second order effects on saving. In a more realistic model, labour income would also be affected by interactions with the labour market. However, the simple model without production is sufficient to discuss most of the theoretically interesting issues.

In the remaining part of this chapter we will discuss effects of introducing a pay-as-you-go (PAYG) pension scheme into the model. As most western economies have such schemes already, a more appropriate question would be to analyze marginal changes in the existing pension scheme. From an empirical point of view, this distinction is important. Theoretically we can abstract from it since the qualitative effects of introducing a system are equal to an expansion of an existing pension scheme.

We assume for simplicity that the only purpose of the government sector is to collect taxes in order to finance pension benefits. Taxes are charged in both periods while consumers receive pension benefits in period two only. We assume that all benefits (or increases in benefits) have to be financed by taxes. One argument could be that increasing government debt is not a sustainable policy in the long-run. When all taxes are lump-sum, the PAYG budget constraint for a period is given by

$$(8) \qquad P_{t,2} - T_{t,2} = (1 + n)\, T_{t+1,1}$$

where $P_{t,2}$ is pension benefits for generation t in period two, $T_{t,i}$ is taxes paid by generation t in period i and n denotes the growth rate of the population, assumed to be constant. Taxes are assumed to be strictly positive in each period.

The system is introduced (or expanded) in period two of the life of generation t and it is supposed that the behaviour during period one is unaffected. Even before the system is introduced/expanded, it could be that consumers change their consumption plan due to expectations of receiving (more) benefits during retirement. However, we assume that no information is available to generation t in period one so that the consumption plan is made without taking account of the pension scheme. Alternatively one could assume that some information was available but was not taken into account before period two due to adjustment costs. Accordingly, generation t behave in period one as if nothing unexpected was going to happen in period two. Consumption in period one is therefore given by (4). In period two this generation will receive pension benefits, but will also be taxed according to (8). Since generation t+1 has to pay a part of the tax needed to finance benefits, there is a net gain for generation t. Period two consumption is now given by

$$(9) \qquad C_{t,2} = Y_{t,1} + Y_{t,2}/(1+r) + P_{t,2}/(1+r) - T_{t,2}/(1+r) - C_1(Y_{t,1} + Y_{t,2}/(1+r))$$

Consumption in period two increases by the discounted value of net benefits, i.e. benefits less taxes. This follows from the fact that we assume life-cycle consumers without any possibility for leaving bequests. As long as the marginal utility of consumption is positive, all extra income will be consumed. Saving for generation t in period two will not be affected since income and consumption increase by the same amount.

Generation t+1 will take into account tax-payments in both periods and pensions to be received in period two when they find their optimal consumption plan. Consumption in the first period is given by

$$(10) \qquad C_{t+1,1} = C_1(Y_{t+1,1} - T_{t+1,1} + Y_{t+1,2}/(1+r) - T_{t+1,2}/(1+r) + P_{t+1,2}/(1+r))$$

The possible effect on consumption for generation t+1 is dependent on the relative size of taxes and benefits paid by this generation. If we assume that net-benefits in period 2 (NP_2) are to be held constant for all generations, i.e.

$$(11) \qquad P_{t,2} - T_{t,2} = (1+n)T_{t+1,1} = NP_2 \;\forall\; t,$$

then taxes paid will equal benefits received for every generation (except generation t) due to (8). Substituting from (11) into (10) then gives

$$(12) \qquad C_{t+1,1} = C_1(Y_{t+1,1} + Y_{t+1,2}/(1+r) + (1+n)/(1+r)T_{t+2,1} - T_{t+1,1})$$

and consumption for this generation and all following generations will remain unchanged as long as r is equal to n [2]. If n is greater than r, the pension scheme creates an additional source of income for generation t+1 (and succeeding generations) that will increase consumption in both periods. The opposite applies when n is smaller than r. In the rest of the theoretical discussion we assume for simplicity that r=n=0.

Introduction of the pension scheme keeps total income in the economy unchanged. The increase in aggregate consumption will equal the increase in consumption for generation t (keeping r=n), since aggregate consumption in the period of introduction of the pension scheme (C) is given by

$$(13) \qquad C = C_{t,2} + C_{t+1,1}$$

Since aggregate consumption has increased while total income remains unchanged within the period we consider, aggregate saving has declined. The whole reduction is due to reduced saving for generation t+1 in period 1, therefore depending on their belief in receiving benefits in period 2.

We have so far assumed that the capital market is perfect in the sense that consumers can lend or borrow at the going rate of interest, without any restrictions imposed by financial intermediaries or public authorities. This is obviously an unrealistic assumption for many economies. More reasons can be given for why credit might be restricted: one is that the total level of credit is constrained by the authorities in a regulated market, another is asymmetric information in a market without regulations, see e.g. Stiglitz and Weiss (1981). A special reason for justifying restrictions in the above model is that expected pensions in period two might not be accepted as collateral for generation t+1 (and succeeding generations). Borrowing constraints can accordingly affect generation t+1 since this generation wishes to sustain optimal consumption in period one despite the decline in income following from the pension tax [3]. The less saving in period one before introduction of the system, the more likely is the need for credit to sustain optimal consumption. If credit constraints are binding, optimal consumption might not be attainable. A reduction in consumption for generation t+1 would counteract the increase in consumption for generation t, reducing (or eliminating) the effect on aggregate consumption and saving.

Another modification would be to relax the assumption of lump-sum taxation. Let us instead introduce the more realistic and commonly used income taxation

2 This follows from (11) which states that $T_{t+i,1}$ is constant for all i's.

3 In a more disaggregated setting, one could argue that individuals close to the retirement age would face an increase in permanent income. Borrowing restrictions are less likely to bite for this group, since they normally would be able to reduce their stock of financial assets.

(14) $T_{t,i} = t_i Y_{t,i}$, $0 < t_i < 1$

where t_i is the tax rate in period i.

Since labour supply (and production) is given, the income tax has no distortionary effects in our model. If labour supply were elastic, income taxation could reduce the supply of labour and thereby also labour income (assuming a fixed wage rate). The result would be lower disposable income in period two for generation t and in both periods for generation t+1. The initial increase in con- sumption for generation t would be lower and consumption for generation t+1 would decrease in both periods. In total income taxation could therefore reduce (or eliminate) the initial increase in aggregate consumption.

The above model assumes that consumers take the whole life cycle into account when planning consumption in the first period. If consumers were myopic and just considered income in the same period as consumption was going to take place [4], the outcome of the analysis would be different. For generation t, the increase in consumption would have been the same, but for generation t+1 consumption would have been reduced since disposable income in the same period decreases due to taxation. The total effects would then depend on the relation between the marginal propensities to consume (MPC) for each generation and relative popu- lation sizes, the latter variable not specified in the above model. The marginal propensity to consume out of unexpected pensions for generation t is by definition equal to one in the above model, while there is no constraint on the MPC for generation t+1. If bequests can be given, a lower marginal propensity to consume is possible for generation t.

Almost every empirical study concerned later in the survey rely on the life-cycle hypothesis, and we therefore do not discuss myopic behaviour further. However, it is important to bear in mind that one explanation of a failure to accept the pro- posed outcome from the life-cycle model could be myopia.

2.2 Retirement behaviour

In the analysis so far we have assumed that labour supply and the retirement age are unaffected by introduction of the pension scheme. If it is possible for the con- sumer to adjust labour supply after introduction of the pension scheme, this might be the case for generation t. A decrease in labour supply (e.g. implemented by reducing the retirement age) could be chosen since the extra income received in period two reduces the need for labour income in the same period. This effect depends on the substitutability between leisure and consumption and can easily be shown by altering the basic model. First let us introduce leisure into the utility function

4 This does not imply a high degree of shortsightedness since a period in this model equals half the life-time of a generation.

(1') $U_t = U(C_{t,1}, L_{t,1}, C_{t,2}, L_{t,2}),\ \delta U/\delta L_{t,i} > 0,\ \ i = 1,2$

where $L_{t,i}$ is leisure for generation t in period i. If the wage rate is assumed constant and equal to 1, labour income (by appropriate scaling of the leisure variable) is given by 1 less the amount of leisure. The budget constraint for generation t is therefore given by

(9') $C_{t,2} = (1 - L_{t,1}) + (1 - L_{t,2}) + P_{t,2} - T_{t,2} - C_1((1 - L_{t,1}) + (1 - L^*_{t,2}))$

In period two, C_1, $L_{t,1}$ and $L^*_{t,2}$(planned leisure) are given, but the consumer can now adjust $L_{t,2}$ in addition to consumption in this period. Maximization of (1') with respect to (9') yields $L_{t,2}$ as a function of pension income. Introduction of the pension scheme will lower the supply of labour, and the increase in consumption would be lower than the amount of pension benefits. The actual mix of increases in consumption and leisure that is chosen by the consumer will depend on how the utility function in (1') is specified.

Generation t+1 would, on the other hand, not alter their supply of labour as long as total disposable income remain unchanged, i.e. when r=n. The increase in aggregate consumption would therefore in this case be lower than with fixed labour supply. As a special case generation t would not increase consumption at all, leaving aggregate saving unchanged as well.

In our stylized model labour supply is likely to decrease when old-age pensions are introduced. However, in more realistic specifications of the social security system, there might also be factors that induce labour supply among elderly. One obvious case is when the level of pensions depends on some average of the years with highest earnings. In this case pensions could often be increased by postponing retirement and likewise by increasing labour supply during late working years. On the other hand, taxation of labour income received in the retirement period (or between flexible retirement ages) will normally be seen as a disincentive effect of the pension scheme. The overall effect on labour supply therefore has to be determined empirically. In chapter 4 we review studies of retirement behaviour.

2.3 Labour income uncertainty

So far all variables and the lifetime have been treated as certain to the consumer. In this section we introduce uncertainty by assuming that period two income is regarded as uncertain when planning consumption for both periods. There are many reasons why period two income should be treated as uncertain, e.g. the possibility of unemployment and health deterioration. All other variables and the lifetime remain certain, i.e. we disregard the fact that future changes in the pension scheme could make pensions uncertain. It may seem unrealistic to regard lifetime as certain, but this can be seen as equivalent to assuming a perfect annuity

market. We still ignore bequests, but will return to discuss the combi- nation of income uncertainty and bequests in section 2.4.

Effects on consumption of uncertain future labour income have been discussed in the precautionary savings literature since the seminal paper of Leland (1968), see Deaton (1992) for a survey of some recent papers. An important distinction is between certainty equivalence which follows from a quadratic utility function and precautionary saving which arises if the third derivative of a time-separable utility function is positive. Certainty equivalence is convenient since all uncertain variables can be replaced by their expectations and results will coincide with those in the certainty case. It might, however, be more realistic to assume precautionary saving, which is equivalent to non-decreasing absolute risk aversion. In this case uncertainty about future income will depress current consumption compared to the certainty case. We discuss effects of precautionary saving in this survey.

The increase in period two consumption for generation t will not be affected by income uncertainty. Planned consumption in period two will be higher than in the certainty case but the increase in consumption induced by net pension benefits will remain the same since nothing is uncertain to generation t in period two. This holds regardless of how the tax system is specified (lump-sum or income taxation).

Generation t+1 is planning consumption over two periods and will take account of the pension scheme as far as this changes the degree of uncertainty. Expected utility will be maximized subject to the budget constraint (2). The Euler equation (3) then becomes (r=0)

$$(3') \qquad \delta U/\delta C_{t,1} = E_1(\delta U/\delta C_{t,2})$$

where E_1 is expectations conditional on information in period 1. If the utility function is time-separable and the third derivative of the utility function is negative, consumption in period one has to be reduced (compared to the certainty case) in order to restore the equality given by (3'), see e.g. Leland (1968). The intuition says that in the case of uncertain labour income, expected (but not actual) consumption in period two is reduced by a risk-premium, implying increased expected marginal utility. Since (expected) marginal utility should be equal in the two periods, period one consumption has to be reduced. The higher the degree of uncertainty, the larger reduction in consumption in the first period.

If pensions are financed by lump-sum taxation, introduction of a pension scheme will not affect the degree of uncertainty since the variance of gross income is unaffected and no uncertainty is connected to taxation. In this case, uncertainty will have no effect on consumption/saving at all.

In the more interesting case with income tax, given by (14), some of the uncertain period two income is taken away from the consumer by taxation and replaced by

more certain pension benefits in the same period. By using (8) and (14) we have that benefits depends on period two labour income

$$(16) \qquad P_{t,2} = t_2 Y_{t,2} + t_1 Y_{t+1,1}$$

If uncertainty connected to labour income ($Y_{t,2}$) is measured by its variance, the tax rate will give a lower variance (uncertainty) for pensions

$$(17) \qquad Var\, P_{t,2} = (t_2)^2 Var Y_{t,2}$$

Even if total resources are unchanged, the degree of uncertainty will be reduced after introducing the pension scheme. According to the above discussion this will imply an increase in first period consumption for generation t+1 com- pared to the situation without the pension scheme. As far as aggregate saving is concerned, uncertainty will enlarge the negative effects by increasing aggregate consumption further.

In the discussion of income uncertainty, we have so far ignored capital market imperfections. Liquidity constraints will be less effective when future income is uncertain. Since uncertainty implies reduced period one consumption, the need for credit is reduced and restrictions are less likely to bite. If they do bite, the preferred increase in consumption for generation t+1, due to lower overall uncertainty, could be prevented.

To sum up we can say that uncertainty is likely to strengthen the main conclusion from section 2.1, given that we consider the most interesting case with income taxation. Saving is more likely to decrease than in the certainty case as long as consumers are life-cycle planners. If they are myopic, period two uncertainty becomes irrelevant in this model.

2.4 Intergenerational transfers

So far we have excluded endogenous transfers between generations in the model. There is, however, no doubt that transfers occur both as bequests, education spending and gifts. Analyses have shown that intergenerational transfers matter, see e.g. Kotlikoff and Summers (1981) and Bernheim (1991), and should therefore be taken into account when analyzing effects of old-age pensions.

The effects of allowing for bequests in the model presented in 2.1 are, however, dependent on the motivation (if any) for leaving bequests. Consider first Barro (1974), arguing in favour of a purely altruistic bequest motive. This can be represented by introducing the utility of the succeeding generation in the current generation's utility function (1) and implies that all generations are linked together in a dynastic framework. The utility function is then

(1") $U_t = U(C_{t,1}, C_{t,2}, U_{t+1})$

We still assume that the pension scheme is introduced in the second period in the life of generation t. The budget constraint for this generation will therefore include both received bequests, pensions and bequests given to the next generation

(18) $C_{t,1} + C_{t,2} + B_{t,2} = Y_{t,1} - T_{t,1} + Y_{t,2} - T_{t,2} + P_{t,2} + B_{t-1,2}$

where $B_{t,i}$ denotes bequests given by generation t in period i.

Since all generations are linked together through utility functions, the maximization problem has to be solved backwards, starting with the last generation. We choose generation t+2 as the last generation, but this procedure can be extended to many generations as in Barro (1974). Since generation t+2 is the last, it will neither receive net-pensions nor leave bequests. The budget constraint for generation t+2 is accordingly

(19) $C_{t+2,1} + C_{t+2,2} = Y_{t+2,1} - T_{t+2,1} + Y_{t+2,2} + B_{t+1,2} = W_{t+2}$

where W_t denotes total wealth for generation t. The maximization problem for this generation is therefore trivial since total wealth is independent of future generations. Utility can be written indirectly by

(20) $V_{t+2} = V(W_{t+2})$

Generation t+1 would like to maximize (17) wrt. $C_{t+1,1}$, $C_{t+1,2}$ and $B_{t+1,2}$ subject to (20) and the following budget constraint

(21) $C_{t+1,1} + C_{t+1,2} + B_{t+1,2} = Y_{t+1,1} - T_{t+1,1} + Y_{t+1,2} - T_{t+1,2} + B_{t,2} + P_{t+1,2}$

The outcome is that generation t+1 will transfer the net pensions (equal to $T_{t+2,1}$) to generation t+2, compensating this generation for loss of period one income. This implies that (19) collapses to the initial budget constraint (2). If we stick to assumption (11), we have from the PAYG budget constraint (8) that total tax payments equal received benefits, and we also know that $B_{t+1,2} = T_{t+2,1}$. Consequently, the budget constraint (21) will equal the budget constraint for generation t+2 (19), and the optimization problem for generation t is equal to the problem

for generation t+1. Accordingly generation t+1 will also be compensated for loss of income due to taxation.

In total, consumption remains unchanged for all generations since total disposable resources are the same as before the pension scheme was introduced. It should be underlined that this result is only valid for marginal changes in the pension scheme and bequests should also be operative before the change takes place (interior solution), see Barro (1974).

Many theoretical arguments have been put forward in order to violate Barro's neutrality result, see e.g. Feldstein (1976), Tobin and Buiter (1980) and Bernheim (1987b). Liquidity constraints and distortionary taxes are both among factors discussed in this connection. Here we concentrate on the discussion of altruism as a bequest motive. As an alternative to altruism other reasons for leaving bequests have been suggested. As long as such motives are not combined with altruism there is, however, nothing in these models to secure that effects of PAYG pensions are offset by changes in bequests. For example, Bernheim, Shleifer and Summers (1985) introduce the strategic bequest motive which explains bequests as a result of a game between generations and show that this assumption distorts Barro's neutrality condition. Another motivation, "joy of giving", takes into account that the size of bequests in itself yield utility to the individual who bequeaths.

It might be the case that altruism exists along with other motives. Abel and Bernheim (1991) analyze altruism combined with a "joy of giving" motivation. They find that the neutrality result still holds approximately if altruism is dominating. This is important because it shows that altruism is crucial. The critique raised by introducing other bequest motives is therefore not convincing as long as empirical studies cannot exclude altruism. It seems reasonable that at least a part of bequests and other transfers are motivated by the utility of the receivers.

A more important critique of the Ricardian equivalence result is given by Bagwell and Bernheim (1988). They relax the representative agent assumption and analyze implications of introducing inter-family linkages (through marriage between unrelated individuals). In this case "everything" i.e. all redistributional policies, distortionary taxes and prices, is neutral. Since this is far from what is observed they argue that conclusions following Ricardian equivalence are suspect.

So far in the discussion of intergenerational transfers we have ignored uncertainty regarding life-time, future income or social security benefits. Uncertainty could be introduced in a model with non-altruistic bequests. Since neutrality is not obtained without altruism, we find this less interesting as uncertainty is already discussed for the non-bequest case in 2.3. In this section we therefore analyze uncertainty when an altruistic bequest motive is present, following Feldstein (1988). As in 2.3 labour income in period two is assumed to be uncertain. The important result here is that the neutrality result does not necessarily hold anymore.

When income in period two is uncertain, it also becomes uncertain whether bequests are given. Consider generation t+1 and regard consumption in period one as given. The optimality condition for positive bequests are then that marginal utility of period two consumption is lower than marginal utility of bequests, given that no bequests are given

$$(22) \quad \delta U_t/\delta C_{t,2} < (\delta U_t/\delta U_{t+1})\,(\delta U_{t+1}/\delta B_{t,2}), \text{ given that } B_{t,2} = 0$$

As a formalization of uncertainty, Feldstein considers two possible outcomes of income (with given probabilities) in period two. There is no uncertainty connected to pension benefits. He then analyses effects of retirement pensions given that no bequests are given when the low outcome appears, while optimal bequests are given when the high outcome emerges. This is a crucial assumption that will be discussed later in this section.

When the consumer is faced with the opportunity that no bequests might be the optimal solution in period two, it is optimal to increase consumption in period one. If bequests are not to be given (the low income case) the consumer can optimize without considering consequences for utility of the next generation and it is optimal to distribute extra pension benefits on consumption in both periods. The increase in first period consumption is, however, not as large as the increase in old-age pensions, leaving some precautionary saving (if low income appears) or saving for bequests (if high income appears). If income in period two turns out to be high, bequests cannot be increased equal to pension benefits, since consumption was increased in period one. A higher bequest than without the pension scheme will be given to the next generation, but it will not fully compensate the loss due to increased taxes.

As mentioned above this result depends crucially on the possibility that no bequests might be the optimal outcome in period two. This is a realistic assumption if the difference between the high and low income outcomes is large, e.g. if unemployment benefits are low compared to labour income. On the other hand, when social security benefits guarantee a relatively high level of the low income case, the probability of no bequest will be small. The result might also depend on the extension of the second period. If it is long, a small difference between high and low income could become important when the bequest decision is to be taken.

2.5 Conclusion

In a simple life-cycle based overlapping generations model, it is shown that introduction of a PAYG pension scheme will normally reduce the level of personal saving. When labour supply is allowed to be varied freely by the consumer, this conclusion is no longer obvious since (a part of) the increase in consumption could be substituted by leisure. The main conclusion is also affected by liquidity constraints that may prevent consumers from increasing consumption, in particular when the pension wealth is the main collateral. Altruistic bequests will, under

certain assumptions, offset the original negative effect on saving completely. However, income uncertainty might reduce the importance of the two latter factors, leaving induced retirement to be the main modifying element. These conclusions are based the assumption that consumers are forward looking. Under myopic behaviour, the effect on saving is dependent on differences in marginal propensities to consume between generations.

The theoretical model has given an overview over the main effects that apply in the relationship between public pensions and private saving. In order to evaluate the effects one has to turn to empirical analysis, which is the subject of the next three chapters. We start by looking at analyses that address direct (gross) effects on saving, then move to studies entirely concerned with retirement behaviour and a chapter on liquidity constraints and uncertainty ends the survey.

3. Empirical tests of effects on saving

In this chapter we survey studies that test effects of public pensions (social security) directly by using consumption or saving functions. The empirical analyses can be divided into three main groups according to the type of data used: time-series analyses, cross-section analyses (within a country) and cross-country studies. In addition one study based on panel data has been undertaken. This chapter provides a brief review with a critical assessment of all types of studies. Analyses of each category are compared and each section ends with a summary of main findings and problems. Compared to Atkinson (1987), this survey includes both more time-series and cross-section studies and a discussion of problems connected to calculation of social security wealth.

Despite many analyses over a long period, it still seems hard from an empirical point of view to argue in favour of any result as the most convincing. This might be due to problems connected to data, model specification and econometric techniques. Critical assessments are given in Auerbach and Kotlikoff (1983) for time-series studies and in Mariger (1986) for both time-series and cross-section analyses. In Bernheim (1987a) problems connected to the use of a social security wealth variable, utilized in almost every analysis, are discussed.

3.1 Time-series analyses

The aggregate time-series approach has been to include a social security wealth term in a life-cycle consumption (or saving) function and investigate whether this additional wealth term has any significant positive effect on consumption. If so, the conclusion is that the PAYG old-age pension scheme has contributed to decrease aggregate saving. The estimated coefficients are usually interpreted as net effects, i.e. corrected for the impact of social security on retirement behaviour. In this section we give a brief survey of time-series studies, listed in table 1, and point to what seems to be major problems. We start by discussing Feldstein's seminal paper in more detail and then proceed by looking at the number of time-series studies that followed.

Table 1. Time series analyses

Authors	Estimation period	Country	Conclusion[1]
Feldstein (1974)	1930-71	US	Y
Munnell (1974)	1929-69	US	Y
Barro (1978)	1929-74	US	N
Darby (1979)	1929-74	US	?
Markowski and Palmer (1979)	1954-75	Sweden	Y
Boyle and Murrey (1979)	1946-69	Canada	N
Denny and Rea (1979)	1946-75	Canada	N
Pfaff, Hurler and Dennerlein (1979)	1965-78	Germany	Y[2]
Carmichael and Hawtrey (1981)	1961-79[3]	Australia	N
Leimer and Lesnoy (1982)	1930-74	US	N
Feldstein (1982)	1929-76	US	Y
Browning (1982)	1966-76[3]	UK	Y
Bentzel and Berg (1983)	1955-79	Sweden	N
Lee and Chao (1988)	1930-74	US	N
Magnussen (1994)	1966-90	Norway	N

1) Answer to the following question: Is there any evidence that social security reduce personal saving?
2) Conclusion for this study does not coincide with that of the authors.
3) Quarterly data.

Feldstein (1974) is an important contribution to the literature for two main reasons. First, he put the study of the importance of social security with respect to private saving on the research agenda. Only a few earlier analysis had raised this question and their results were counterintuitive: a finding was that social security might even cause savings to increase. Secondly, Feldstein initiated research on retirement behaviour, which we will discuss in more detail in chapter 4. The analytical framework in Feldstein's analysis was the life-cycle hypothesis and his main point was that the first order negative impact on saving (discussed in chapter 2) is likely to be counteracted by induced retirement. He argued that workers who would have worked beyond the age of 65 in the absence of social security, have incentives to retire earlier when social security is present. A reason is the so called earnings test that prevent the individual from receiving benefits if he earns more than a certain income level. In the empirical section of the paper, a measure of social security wealth is included in a consumption function containing current income and wealth. In some regressions Feldstein obtains significant effects of social security wealth, but for reasons that will be discussed later, the empirical results should not be regarded as an important part of the paper.

Feldstein's study was followed by several analyses using data for the U.S. and in particular using Feldstein's social security wealth series, see Munnell (1974) who estimates a saving function, Barro (1978) and Darby (1979). These studies are reviewed and compared both in the latter study and in von Furstenberg (1979) and in Modigliani and Hemming (1983). The main conclusion seems to be that results depend crucially on specification of the consumption function and to some extent on which approximation is used for social security wealth. It was later discovered

that Feldstein's social security wealth data contained a programming error which seemed to be of importance for the result, see Leimer and Lesnoy (1982). On this background we only examine results obtained by corrected data. We also look at studies based on data for several other countries than the U.S., to see whether similarities in results can be found.

Leimer and Lesnoy (1982) correct for the programming error in Feldstein's social security data and re-estimate the Feldstein function over two slightly extended estimation periods, 1930-1974 (omitting 1941-46) and 1947-74 (Feldstein's sample ended in 1971). The coefficient of both gross and net social security wealth is changed from being positive and significant to becoming positive and non-significant for the first period, and from being positive and non-significant to becoming negative and significant for the latter period. The authors conclude that the replica variables do not provide statistical support for the hypothesis that social security decreases personal saving and that results are extremely sensitive to the estimation period. Results are, however, not dependent on whether the terminal year is 1971 or 1974. The authors also argue that time-series estimates hardly will provide a definitive answer, in part because we do not know how individuals perceive their social security wealth. This critique is in fact more general since almost every empirical study of social security and saving (not only time series analyses) applies a measure of social security wealth, see section 3.5 for further discussion of this issue.

Feldstein (1982) tried to restore his original result by revising the corrected social security variable used by Leimer and Lesnoy. The revision seeks to take into account a change in the American social security law in 1972 and contributes to rise the values of both the coefficient and the t-value when estimating over the period 1929-74. According to Leimer and Lesnoy (1982) Feldstein's correction is inconsistent with the new legislation, and even if it were not, his results only strengthen the conclusion of an unstable and at least partly non-significant effect of social security on personal saving.

Markowski and Palmer (1979) estimate an aggregate saving function for Sweden, including lagged saving, lagged income and inflation in addition to a pension variable as regressors. Three dummies take account of shocks from changes in indirect taxation. The DW statistic is 2.14. The authors find that Swedish old-age pensions (ATP) have reduced saving with on average two per cent. Bentzel and Berg (1983) using revised data for the same country, find no effect on saving for the period 1955-79. The specification of their model is different from the one in Markowski and Palmer (1979). A wealth variable and a variable measuring the degree of credit market regulation are included, while no inflation terms occur in their model. In addition, two of the dummies are removed. In three presented models, the DW statistic is very low, from 0.84-1.58, indicating that the models are misspecified. More weight should therefore be put on the Markowski and Palmer study, concluding with a small negative effect on saving.

For Canada we also briefly discuss two studies. Boyle and Murray (1979) estimate consumption and saving functions specified as in Feldstein (1974) and Munnel (1974) respectively, over the period 1946-69. Effects from five different measures of social security wealth are estimated, but none have significant impact on consumption. This finding is consistent with the so called Ontario study, referred in Denny and Rea (1979), in which a reduced form saving function is estimated. The function includes both income and several measures of population ratios in addition to pension benefits. Benefits are found to increase saving and this counter-intuitive effect is explained by a strong impact from pension benefits on retirement, esti- mated in a separate equation. Both equations seem well specified, at least according to the DW statistic, but it could be argued that a simultaneous regress- ion procedure would have been more appropriate than single equation regressions.

In a German study by Pfaff, Hurler and Dennerlein (1979), several saving equations are estimated. A measure of total social security contributions is included as a representation of social security wealth. In two equations this variable is significant but with a "wrong" sign, while in the third (the only including household income) the effect is, as one would expect, negative and the t-value for the coefficient is 1.73. Based on these results the authors conclude that there seems to be no apparent negative effect on saving. Simply by looking at the DW statistic, the conclusion could be altered. For the two equations supporting a positive impact on saving, the DW statistics are 0.88 and 0.96 respectively, clearly indicating miss-pecification. In the equation that supports a negative effect on saving, the value of the DW statistic is 1.61. In addition R^2 has risen from 0.74 to 0.93, also favouring this equation.

Carmichael and Hawtrey (1981) take a slightly different approach when trying to test the Ricardian neutrality hypothesis, outlined in section 2.4 of this survey. Support of this hypothesis indicates that social security does not effect personal saving. A two-generation model, similar in spirit to the one presented in chapter 2, is aggregated to allow for testing by macro data. In addition to income less social security taxes and current social security transfers, government debt, base money and government expenditure are also included in the consumption function. The equation is estimated by using quarterly Australian data from 1961 to 1979. Results show that both the hypothesis that the effect of net income equals the effect of social security and other aspects of the neutrality hypothesis cannot be rejected. The main problem with this analysis is that expected social security for the young generation is omitted, see the model in chapter 2 of this survey for a discussion of this wealth effect. The test which is performed and cannot be rejected, is therefore only whether the marginal propensities to consume are equal for the two generations, i.e. a redistribution effect. It seems also ad hoc to include government debt and expenditure, and base money in the consumption function. The instrument variable approach should also have been applied to the latter variables, not only to net income. In general this analysis shows that there are major problems in applying aggregate data to analyze a model which is based on behaviour for different generations.

Lee and Chao (1988) estimate labour supply among pensioners and personal saving separately, by using data taken from Leimer and Lesnoy (1982). The two equation model makes it possible to control for the retirement effect and find the net effect of social security on personal saving. Labour supply for individuals 65 and over depends according to the results significantly on social security wealth, but not on (private) pension wealth and the stock of net other household wealth. In the saving equation, current contributions of private pensions and social security are used rather than constructed wealth variables. An argument for this is that consumers are better informed about the flow variables. Results show that estimated effects of social security benefits and labour-force participation are not significant in the saving regression. There is, on the other hand, a significant negative effect from the flow of private pension contributions on saving. The authors argue that pension contribution, unlike social security contributions, visibly increase consumer's personal retirement assets. It is, however, difficult to make a serious judgement of the estimated equations since no misspecification tests are reported. It is also puzzling that both equations are static, and that insignificant variables are not removed in order to obtain a more parsimonious model. The use of current social security benefits in the saving equation and social security wealth in the labour supply function seems inconsistent.

Most of the studies mentioned so far have estimated consumption or saving functions in levels of the variables only. It is well known that this approach is vulnerable to collinearity between regressors, in particular since most of the variables considered have a distinct trend pattern. The social security wealth variable adds to this problem both because of the trend pattern and the relationship with labour income (see equation (16) in the theoretical discussion). There are also few test statistics attached to the estimated equations, making it difficult to assess their econometric properties.

The study by Browning (1982) has some advantages compared to the above studies, both regarding econometric specification and diagnostic testing of estimated regressions. He uses quarterly data for the period 1962 to 1979 from the U.K. to estimate an aggregate consumption function. Social security wealth is approximated by the gross present value of future state pensions, based on the basic pension payable to a single person. To obtain a measure of total pensions, the gross market value of private pension funds was added. The framework for the empirical analysis was a distributed lag function which included personal disposable income, the retail price index, gross pension wealth, ordinary wealth and a dummy variable. By imposing restrictions and specifying an error-correction model, this analysis makes multicollinearity to a less important problem than in former time-series studies. A large number of regressions were tried out and the preferred model was supported by a set of test statistics. Results show that social security wealth has a small, but significant, short-run effect on consumption. This estimated short-run effect is consistent with the theoretical analysis in chapter 2: the effect of an once and for all increase in pensions will diminish as the current old generation is replaced by the succeeding one. A small effect is easily justified

by modifications of the same model. According to Browning, a likely explanation is that most non-pensioners are unaware of marginal changes in pensions.

Magnussen (1994) finds no effects of perceived social security wealth in an estimated equation of consumption for workers in a study based on Norwegian macro-data for socioeconomic groups. The econometric specification is similar to the approach employed in Browning (1982), i.e. an error-correction model. The estimation period (1966-90) covers two major innovations in the Norwegian social security scheme: introduction of income related old-age pensions and a reduction in the retirement age. Both events should according to theory have an impact on saving behaviour, but the empirical results deny effects of social security wealth. The income elasticity in the equation, which also incorporates ordinary wealth and the change in the unemployment rate, is estimated to 0.9. In a separate consumption function for pensioners, the corresponding elasticity is estimated to 0.6. Redistribution of income through the social security system is therefore more likely to stimulate than to depress aggregate private saving.

3.2 Cross-country analyses

Cross-country studies usually utilize data for several countries over a period of at least 5 years. Two major approaches are taken with respect to estimation. Some studies use the time average value for each variable and estimate by OLS. An advantage with this procedure is that effects of cyclical fluctuations are reduced, while a problem is that the low number of degrees of freedom eliminate the possibility to take country specific differences into account. Other studies try to take advantage of the panel structure of the data and extend the number of observations considerably by pooling all observations for each variable, based on data for different countries. The latter method has the advantage that country specific intercept terms, aimed at taking account of institutional differences etc., can be added to the regressions. In both setups, a consumption-income ratio (or saving-income ratio) is regressed on a measure of social security benefits and other relevant variables, often including the labour participation ratio for pensioners. The latter variable is included to account for the induced retirement effect. Some studies apply two-stage least squares (2SLS) and estimate separately the effects of social security benefits on the participation ratio.

As can be seen from table 2, conclusions are mixed. The two Feldstein studies, which use the time averaging technique, support a negative impact on saving, while Barro and MacDonald (1979) and Koskela and Viren (1983) favour the opposite conclusion based on the other estimation procedure. Even if it looks as if conclusions are determined by the estimation method, comparisons between the different studies find that other differences also are of importance.

In the appendix in Feldstein (1980), written by C.Y. Horioka, the results in Feldstein (1977) and in Barro and MacDonald (1979) are carefully compared. The conclusion is that all the following different factors contribute, more or less, to differences in results: the specification of the model, the sample of countries, variable definitions, the data sources and the estimation period. Koskela and Viren

Table 2. Cross country analyses

Authors	Period	Countries[1)]	Method[2)]	Conclusion[3)]
Feldstein (1977)	1954-60	15	O, 2SLS	Y
Barro and MacDonald (1979)	1951-60	16	P	N
Feldstein (1980)	1969-75	12	O, 2SLS	Y
Modigliani and Sterling (1983)	1960-70	21	O	N
Koskela and Viren (1983)	1960-77	16	P, 2SLS	N

1) Number of countries included in the analysis
2) O indicates ordinary least squares on average data for each country,
P indicates regression on pooled data. 2SLS shows that the labour force participation rate is estimated separately.
3) Answer to the following question: Is there any evidence that social security reduce personal saving?

(1983) compare their results with Feldstein (1980) and argue that his measure of social security benefits are the important factor. They replicate Feldstein's estimations and show that it is only when the benefit variable is divided by the population that a significant coefficient is obtained. However, it is nevertheless tempting to argue in favour of Feldstein's results since he uses a measure of expected benefits rather than actual benefits, and the former measure should be more relevant considering the young part of the population, see section 3.5. Modigliani and Sterling (1983) confirm the results in Feldstein (1980) as far as the direct effect on saving is concerned, by including more countries in the data set. The reason why they fail to find a negative overall effect on saving is a strong effect from social security benefits on the working participation rate for pensioners. In particular this effect is stronger than the one estimated in Feldstein (1980). It is, however, difficult to compare the effects on the participation rate, since both specification and definition of data are different in the two studies. Modigliani and Sterling suggest that the difference in results depend on the countries included and the different estimation periods. So even if some factors support Feldstein's analysis, the main conclusion is still ambiguous due to the findings in Modigliani and Sterling (1983).

To sum up, it seems difficult to argue in one direction with reference to the above studies. A general problem with international comparisons is that factors specific to the different countries could be ignored. One cannot be sure that all such effects (e.g structural breaks) will be incorporated in country specific intercept terms. A specific factor is that the extent to which private pensions are an alternative to social security differs considerable both between countries and over time. From a theoretical point of view, the relevant measure of social security is the expected discounted value of future benefits, see section 3.5 for a discussion. In the international studies, one rely (with one exception) on current benefits. This is probably necessary in order to be able to undertake such analysis, but is nevertheless a problem, since this variable is of main interest in these analyses. However, future research on international data sets could benefit both from the increased

number of observations and the advances made in panel data estimation techniques over the last decade.

3.3 Cross-section studies

Cross-section analyses for individuals usually investigate the association between accumulated assets and appropriate measures of social security wealth, labour income and other relevant variables for a particular age-group of consumers. A few studies estimate consumption functions rather than asset equations. The majority of the analyses include approximations of expected future (net) social security benefits, but a few also test for effects of past tax contributions. Most studies look at the behaviour of a group of individuals prior to retirement, and are therefore not aimed directly at testing for effects on aggregate saving. Results can, however, give support to hypothesis about aggregate behaviour. In addition to investigate gross effects on saving, some studies also seek to explain retirement behaviour, bequest behaviour and effects from credit constraints: all important factors in trying to determine aggregate effects on saving. After discussing each study in particular we conclude by comparing studies based on different sources of data.

We will discuss most cross-section studies by applying approximations of the theoretical model from chapter 2. Assume that generation t+1 is studied in a pre-retirement period, i.e. during the first part of period two. The following relationship gives an expression of accumulated assets for this age group

$$A_{t+1,2} = a_1 + a_2 T_{t+1,1} + a_3(P_{t+1,2} - T_{t+1,2} - T_{t+1,1}) + a_4(Y_{t+1,1} + Y_{t+1,2}) + Z'_{t+1}\, a_5 + e \tag{23}$$

where Z is a vector of other relevant variables and e is an error term. Other variable are defined in chapter 2.

Accumulation of assets should decrease by past pension taxes and by net old-age pension benefits (implying that a_2 and a_3 are negative), but increase by life time earnings (indicating that a_4 should be positive). According to theory social security taxes paid in period one should be expected to transform totally into benefits in period two. This is called the replacement effect. It should be noted that a significant replacement effect should not be interpreted as support of effects on aggregate saving since reduced saving for a pre-retirement group might be offset by increased saving among pensioners. When estimating (23) one should therefore expect to find estimates of a_2 close (or equal) to -1. In the theoretical model net benefits were assumed to be zero for generation t+1. However, for generation t net benefits were positive, due to the fact that the social security system was introduced late in this generation's life-time. Other reasons could also justify positive net benefits, i.e. that the growth rate of the population is larger than the real interest rate, see section 2.1. If net benefits are positive, equation (23) predicts an effect on net assets, often referred to as the wealth increment effect of the

Table 3 . Cross-section analyses

Authors	Data[1)]	Period	Observations	Age-group[2)]	Conclusion[3)]
Kotlikoff (1979)	NLS	1966	2124	45-59	Y
Feldstein and Pellechio (1979)	SFC	1962	126	55-64	Y
King and Dicks-Mireaux (1982)	CSCF	1977	12734		Y
Feldstein (1983)	LRHS	1969	2087	58-63	Y
Blinder, Gordon and Wise (1983)	LRHS	1971	4130	60-65	N
Dicks-Mireaux and King (1984)	CSCF	1977	8279		Y
Kurz (1984)	PCPP	1979	4293		N
David and Menchik (1985)	WS	1947-64	720		N
Mariger (1986)	SFC	1962	623		Y
Bernheim (1987)	LRHS	1969	5267	58-63	Y
Leimer and Richardson (1992)	CES	1982-83	2715		Y

1) All data except for CSFC are American. Abbreviations are as follows:
LRHS = Longitudinal Retirement History Survey
PCPP = President's Commission on Pension Policy
CES = Consumer Expenditure Survey
WS = Wisconsin Survey
SFC = Survey of Financial Characteristics
NLS = National Longitudinal Survey
CSFC = Canadian Survey of Consumer Finances (Supplement)

2) Only specified where a single age group is investigated
3) Answer to the following question: Is there any evidence that social security reduce personal saving?

social security system. Positive social security wealth should reduce the need for private accumulation in a life-cycle context. The expected sign of a_3 is therefore negative. In a model based on altruistic bequests, there should, however, be no such wealth effect. The third term in (23) simply reflects the theoretical notion that accumulation of assets should increase by the size of life-time earnings, while the last term is added to allow a more comprehensive investigation than the simple theoretical model suggests, e.g. by including age and retirement effects.

In the following we start by looking at some studies that build on a framework similar to (23). Then we proceed by imposing a restriction on parameters in (23) in order to obtain a simpler equation that is the foundation for many empirical analyses. Main features of all studies are summarized in table 3.

Kotlikoff (1979) estimates a relation for a sample of 2124 American male household heads who were between 45 and 59 years in 1966. Equation (23) is the framework for this analysis, and the Z vector can be said to include the retirement age, which is modelled separately, a variable for home ownership, in order to study effects from credit constraints, and socioeconomic characteristics describing race, marital status, age and family size. Life-time income was approximated by using a two-year average of disposable labour income, and the square of this variable was also included to capture rising accumulation for bequests as lifetime resources increases. The main estimate of a_2 is -0.666 with a standard error of

0.305 and the estimate of a_3 is 0.237 with standard error of 0.202. Kotlikoff also finds that the effect of the retirement age is to small to rule out the replacement effect. Since the wealth effect has "wrong" sign and is insignificant, one cannot on basis of these results alone argue that there is an effect from social security to aggregate saving, but the study supports a replacement effect.

In another study, Kurz (1984) takes an almost similar approach by including both past taxes and net social security wealth in an asset equation. Estimation is undertaken for several age groups from 25 years and upwards. According to Kurz, a positive coefficient of a_3 would conflict Feldstein's life-cycle hypothesis while a negative would conflict Barro's intergenerational transfer hypothesis. Results for households with single males support the life-cycle theory, results for households with single female heads support the transfer hypothesis while results for two-headed households support neither hypothesis. For the latter groups the coefficients a_3 are negative but not significant for any age group. In contrast to Kotlikoff (1979), estimates of a_2 are uniformly above +1, denying any replacement effect. In total this study therefore gives marginal support for effects on saving. Effects on bequests are also studied, but no significant results are found.

David and Menchik (1985) study effects on assets by differentiating between two main motivations for accumulation of assets: life-cycle accumulation aimed at smoothing the consumption profile over the life-cycle and bequest accumulation. Expected gross social security benefits reduce the need for life-cycle accumulations (the replacement effect) while wealth increments allow bequests to be given (the wealth effect). Both these variables are accordingly included in an asset equation which is estimated using data for a cohort of 720 men born in the period 1890-99. A special advantage with this data set is that the wealth increments are large due to a considerable expansion of the social security system over the life time of the individuals in the sample. Another privilege of this study is that expected social security wealth can be validated against actual benefits. A small but not significant effect of wealth increment is found, giving only limited support to Barro's hypothesis which implies that there should be no such effect. The effect of social security wealth is insignificant, giving no support to the life-cycle model. The conclusion is accordingly that consumers in the sample did not increase consumption due to expected gains from the pension scheme, but did consume this gain when it materialized (rather than leaving it for their successors). These results therefore seem to favour the myopic behaviour, briefly touched upon in section 2.1.

A problem with (23) is to obtain relevant data, in particular on past tax contributions. By imposing the restriction $a_2 = a_3$ in (23), the following simpler equation is obtained

$$(24) \quad A_{t+1,2} = b_1 + b_2(P_{t+1,2} - T_{t+1,2}) + b_3(Y_{t+1,1} + Y_{t+1,2}) + W'_{t+1}\, b_4 + v$$

where W is a vector of other variables and v is the error term. Other variables are defined in chapter 2.

If the estimate of b_2 in (24) is negative, this is taken as an indication that saving is reduced. The problem with (24) is the implicit assumption that past wealth expectations have been realized for the individuals in the sample, or that the restriction $a_2 = a_3$ in (23) is imposed without explicit testing. If this restriction does not hold, estimates of b_2 could be biased. The less pronounced data problems have nevertheless made this equation to a more commonly used starting point for empirical research than (23).

Feldstein and Pellechio (1979) start their theoretical discussion by assuming that total wealth (including social security wealth) is proportional to final year net labour income. This approach leads to an equation similar to (24), the main difference being that squared labour income is a separate regressor. In addition an age variable is added in a majority of the estimated equations. The sample comprises 126 couples where the man is employed and between 55 and 64 years of age in 1962. 12 additional couples are added in some regressions. Both weighted and unweighted estimations are undertaken, where the former procedure gives more weight to middle income families. All estimates of b_2 are negative, mostly around 1 in value. The degree of significance varies with the specification of the rest of the equation, but the conclusion is, despite the limitations of the data set, that social security significantly depresses private wealth accumulation for the group considered.

King and Dicks-Mireaux (1982) study wealth holding over the life-cycle for seven age groups of 12734 Canadian households. A logarithmic version of (24) is used to estimate effects on the wealth-income ratio of social security wealth and pension wealth (both divided by income), permanent income (estimated) and a non-linear function of age. Compared to many other studies this has the advantage of including a whole range of age groups, which makes it possible to look at aggregate effects. The effects for separate groups are an increasing function of wealth, and the mean or aggregate offsetting effect on saving per dollar of social security wealth is calculated to around 0.25, based on estimates from two separate equations. Results are confirmed in a later study by the same authors (Dicks-Mireaux and King (1984)) where they also seek to analyze effects of prior beliefs about relevant regressors and the outcome of the test. Beliefs about regressors are particularly important in cross-section studies since no battery of misspecification tests is available (as for time-series). Two different sets of regressors are (also due to prior beliefs!) chosen and give a range for the estimated effect from 0.107-0.273. The conclusion is therefore that the result from the previous study seems robust to the choice of regressors, but that the effect is more likely to be lower rather than higher than the estimate of 0.25.

In Feldstein (1983) an asset equation is estimated for 2087 married couples aged 58-63. Age variables for both husbands and wives are, in addition to social security wealth and an income measure, included in an asset equation. Current income

relative to life-time earnings are also included to account for differences in the time pattern of earnings. Estimates are carried out both with and without a quadratic income term. Since this term is significant in almost every estimated equation, we only consider equations which include this term here. In an OLS regression social security wealth is significant and the coefficient is estimated to -0.35. By instrumenting to account for possible errors of measurement of life-time earnings, the estimated effect rises to -0.42. Feldstein also combines correction for heteroscedasticity with two different methods of instrumenting. With one of the instrumenting procedures the estimated coefficient is changed to -0.72 with standard error 0.58. With the other method, which does not rule out bias, the coefficient is -0.03 with a standard error 0.46. On this background the analysis also gives support to a negative effect on saving for a preretirement group.

In a related study, Blinder, Gordon and Wise (1983) use the same data-source as Feldstein (but observations from 1971 rather than from 1969) for 4130 white American men aged 60-65. The authors argue that their estimate of lifetime earnings are more complete than Feldstein's approximations since earnings prior to 1936 and earnings not covered by social security records are included. Blinder, Gordon and Wise also find that per capita wealth is quite similar to Feldstein's data, but that the composition of wealth is different. Social security wealth counts for a smaller proportion of total wealth than in Feldstein's data. In addition private pensions are included as a regressor, while these pensions are omitted by Feldstein. The model is estimated by using a weighted least squares approach, but even if three parameters are set to specific values, it is very difficult to obtain significant estimates for the remaining. The coefficient analogue to b_2 in (24) is estimated to 0.39 with a standard error of 0.45, too imprecise to draw conclusions. In fact, only one of the estimated parameters is significant, so it is a question whether any conclusion at all could be drawn from this study. Bequest behaviour is also tested but the authors conclude that there is nothing in these data to suggest that the desire to leave bequests is important for saving.

Bernheim (1987a) presents cross-section estimates from an equation like (24). The main aim of his paper is to argue in favour of simple (rather than actuarial) discounting, when future social security benefits are to be discounted. We will return to this discussion in section 3.5. Separate equations based on 5267 couples and 1632 individuals respectively are estimated, including social security wealth calculated by both methods of discounting. Other explanatory variables are lifetime resources (also squared) and age (also interacted with social security wealth and lifetime resources). With actuarial discounting the effects of social security wealth are negative, but not significant. With simple discounting, coefficients both become larger (for couples) and significant (for both individuals and couples). This implies considerably larger saving elasticities since social security wealth calculated by simple discounting is 1.7 times the same variable calculated actuarially for couples and 3 times as large for individuals. Bernheim concludes that other analysts may have understated the depressing effect on accumulation by a factor of three or more.

Unlike the analyses discussed so far, Mariger (1986) applies a consumption function approach when testing for effects of social security wealth. Consumption is a function of life-time resources and socioeconomic characteristics such as family size, education etc. The former variable is decomposed into four different parts: current assets and the net present value of future labour income, future social security benefits and intergenerational transfers. An important aspect is to test if intergenerational transfers can, as is consistent with Feldstein's model, be regarded as random or whether they offset wealth increments from the pension scheme systematically, in accordance with the view of Barro. The model is estimated for 623 preretirement observations. It is argued that it is important to exclude pensioners because past intergenerational transfers are independent of social security contributions for preretired individuals, while this is not necessarily the case for pensioners. If offsetting transfers have already taken place, it will be impossible to differentiate between the two kinds of consumer behaviour outlined above. The empirical results support the Feldstein hypothesis and suggest that social security receipts and receipts from other sources have identical effects on consumption. Results are found not to be sensitive to liquidity constraints or to exclusion of the most wealthy families in the sample. A possible weakness related to this study is that labour supply effects are disregarded.

The last paper to be discussed in this section is a recent study by Leimer and Richardson (1992). A total of 2715 observations from the American Consumer Expenditure Survey in 1982-83 were used. Marginal propensities to consume for a total of 22 age-groups from 18-89 are estimated in the same consumption function. Uncertainty is introduced explicitly by allowing for separate discount rates for four different components of prospective wealth: human capital, social security wealth, other government transfers and private transfers. Altruistic behaviour, implying no effects from social security or other government transfers and reduced effects from private transfers, is tested explicitly. Results from the preferred equation imply a substantial bequest or contingency savings motive since consumption-wealth ratios for the oldest individuals are quite small. This is consistent with a rejection of the pure life-cycle theory. On the other hand, the pure altruistic model is also rejected and the evidence is in favour of a substantial impact from social security wealth on consumption and saving. Results imply that social security increases aggregate consumption with 18 percent. In addition, the estimated discount rates imply, by imposing reasonable values of real interest rates and growth rates, a negative risk premium for both social security and other government transfers, but positive premiums for human capital and private transfers. The negative discount factor for social security wealth suggests that the insurance aspect outweigh the uncertainty factor connected to changes in future programs.

Since a large number of studies are undertaken, we find it useful to sum up the total evidence by comparing analyses based on different sources of data, see table 3 for an overview. For example, Feldstein (1983), Blinder, Gordon and Wise (1983) and Bernheim (1987) all use data from the Longitudinal Retirement History Survey (LRHS). Based on earlier discussions of each paper, we have shown that studies based on this data source are divided on the issue of whether there is a

depressing effect of social security on accumulation for a preretirement group. Results in Blinder, Gordon and Wise seem more reliable than those in Feldstein (1983), according to the improvements in data. On the other hand, if Bernheim's suggested method is relevant, one should pay less attention to the results from the two other studies. Mariger (1986) and Feldstein and Pellechio (1979) are both based on different samples from the Survey of Financial Characteristics of Consumers, undertaken by Federal Reserve Board in 1963 and 1964. Conclusions in these analyses also support a negative effect from social security on personal saving for a preretirement group. The two studies of King and Dicks-Mireaux are based on the same Canadian data set, and a negative effect on aggregate accumulation is found. This contrasts macroeconomic evidence from Canada discussed in 3.1. The remaining four studies are all based on different data sources. Kotlikoff (1979), finding a negative replacement effect, uses National Longitudinal Survey data from 1966. The negative aggregate effect on saving in Leimer and Richardson (1992) is based on data from the 1982-83 Consumer Expenditure Survey. Kurz (1984) uses data from a study undertaken by the President's Commission on Pension Policy and finds evidence supporting both the life-cycle hypothesis and the inter-generational hypothesis by dividing data according to the household head. The study by David and Menchik (1985) is based on data from Wisconsin, and rejects a replacement effect on saving.

3.4 A panel data study

Diamond and Hausman (1984) is the only study based on panel-data from an individual country. Data cover the period 1966-76 and during this period considerable changes were made in the American social security system. The main advantage with panel-data compared to cross-section data is the ability to include some actual changes in the social security system over time. Some more weight should therefore be put on this study than on cross-section studies.

Interestingly social security wealth has a significant impact on retirement behaviour in this study. There is also evidence for decumulation of aggregate wealth after retirement, which is in line with the life-cycle theory. Social security benefits contribute to reduce after retirement wealth decumulation by 12 per cent according to this analysis. The authors also estimate saving equations and find that expected private pensions and social security benefits both reduce saving. A one per cent increase in expected social security benefits relative to permanent income reduces saving per year with 0.14 per cent. By making assumptions about the expected number of years of accumulation and retirement, and the real after tax interest rates, it is estimated that the total offsetting effect on saving lies in the interval 0.25-0.4 per cent. This is a considerably lower effect than found in the cross-section study by Kotlikoff (1979), but in line with results in King and Dicks-Mireaux (1982), Feldstein (1983) and Leimer and Richardson (1992).

3.5 Social security wealth

All empirical analyses use some measure of expected future social security benefits. Most studies calculate a wealth variable by making assumptions about future income growth, interest rates etc., but some, particularly cross-country

studies, include actual benefit payments as an approximation to expected benefits. From a theoretical point of view, the appropriate measure is (net) benefits individuals anticipate to receive during retirement. For preretirement groups, perceived benefits could differ considerably from benefits currently received by pensioners, in particular if the public pension program has changed recently. This makes anticipated rather than currently received benefits the relevant measure. The fact that this variable is unobservable should, however, not prevent us from using approximations in empirical studies.

As a prospective wealth variable, social security wealth should be seen in relation to human capital, not to accumulated ordinary wealth. Unlike human capital, where current (and lagged) income often is used to approximate prospective values, current social security benefits could be a poor point of departure for calculating social security wealth. The younger the individuals, the less relevant are current benefits likely to be. Social security wealth for a preretirement group (close to retirement) is therefore probably more reliable than a similar variable in aggregate. This is possibly one reason why such groups often are studied in cross-section analyses. In some studies, see e.g. David and Menchik (1985), it is also possible to validate that calculated expected benefits approximate actual values. The problem is that actual values might not coincide with anticipated values.

Social security wealth is usually calculated by predicting income growth, correcting for probable socioeconomic changes such as divorce, and discounting over the expected retirement period (actuarial discounting). The length of the retirement period is normally based on estimates of life-expectancy. As mentioned in 3.3, Bernheim (1987a) argues that this method reflects the implicit assumption that annuity markets are perfect. Along with the life-cycle hypothesis, this implies that consumers will leave no bequests at death, a counter-factual assumption. Furthermore, Bernheim argues that the simple discounted value of social security benefits, ignoring the survival probabilities, is a good approximation when there are imperfections in the annuity market. Results in most empirical studies could therefore be biased. Bernheim argues that the depressing effect of social security could be three times as high as previously estimated. Based on a single empirical analysis, this conclusion should not be interpreted as a general result.

In a reply to Bernheim's study, Mirer (1992) claims that the simple discounting principle is in fact no better than the actuarial, when seeking to approximate the true pension wealth. He calculates a so called modified simple discounted value, i.e. simple discounting up to the maximum length of life, and compares this method with actuarial and simple discounting. The "true value" is the compensating variation necessary to retain expected utility when an annuity (received each year during retirement) is decreased by a certain amount. This compensation is calculated by using a theoretical model, for different discount rates and other relevant para- meters. The accuracy of each valuation method is tested by comparing the out- come with the "true value". It is shown that simple discounting tend to perform better than actuarial discounting only when the discount rate is equal to 5 percent.

3.6 Conclusion

Seeking evidence of effects on aggregate saving from changes in old-age pension schemes, we have analyzed results in time-series, cross-country and cross-section studies. A majority of time-series analyses finds no effects on consumption and saving, but this could be due to collinearity problems, in particular since the social security wealth variable has a distinct trend pattern. Cross-country studies are not convincing because results vary considerably between different studies. However, analyses that have the largest number of observations and also try to account for institutional differences between countries, do not find evidence for negative effects on saving. This could be related to an induced retirement effect, of which there is found some support in separate equations in some of the studies. Most cross-section analyses find a negative effect on saving or wealth accumulation for groups of the population close to retirement, but only a minority considers aggregate effects. Among these, the majority favours a depressing effect on saving. Many studies address particularly the question of whether the empirical results support the life-cycle model or the intergenerational neutrality hypothesis, based on altruistic bequests. Most of these studies fail to find any support for bequest motives.

4. Empirical analyses of retirement behaviour

In the theoretical discussion in chapter 2 we emphasized that the negative effect from public old-age pensions to personal saving in a pure life-cycle model rely on several important assumptions. As we saw in chapter 3, many studies fail to find empirical evidence for a negative effect on aggregate saving, but few try to investigate the reason for this result. One possible explanation, which is studied separately in some papers, is reduced labour supply or early retirement. This explanation was first pointed out by Feldstein (1974), and his study gave rise to a separate literature on this topic, on which we will focus in this chapter.

As pointed out in the theoretical discussion, introduction of a PAYG pension scheme will (unexpectedly) increase income for agents in the older generation since their benefits will exceed their contribution to the system. From standard consumer theory we know that this increase in income can lead to more consumption of goods or leisure (or both) through the remaining life span, see section 2.3 for a discussion. More leisure implies either a lower retirement age or less labour supply during the retirement period (assuming that retirees to some extent continue working after retirement). The higher the effect on leisure (and the smaller the effect on consumption) the smaller is the effect on aggregate saving from the social security system.

Apart from being an explanation for missing effects on saving, early retirement (and retirement behaviour in general) is an interesting topic on its own. From a theoretical point of view the retirement decision can be seen as a part of a dynamic planning problem under uncertainty and incomplete information, and several factors might be of importance when seeking to explain behaviour. Retirement behaviour will generally depend on factors such as the tax system, the functioning of the labour market, health-care systems, expected life-time etc. It is therefore a challenging task to try to model this behaviour theoretically and likewise to perform comprehensive empirical tests. The large interest of this topic must also be seen in relation to the reduction in the actual age of retirement that is observed in many western countries over the past decades, often related to the rise in social security benefits.

In this survey we do not seek to discuss the econometric methods in detail, but focus more on empirical results. We do not claim that the survey in this section is as exhaustive as the one in chapter 3, but we seek to point at main conclusions and main approaches among the different econometric techniques. Most empirical studies are based on American data and are therefore designed to analyze the social security system in the U.S. One should therefore be careful not to draw conclusions for behaviour in other countries based on these studies. In most of the analyses, only retirement behaviour of older men is investigated. There is, however, a literature on work and retirement decisions of older women, see Weaver (1994) for a recent survey. We discuss both analyses based on time-series and cross-section/panel data. Like in the direct tests discussed in chapter 3, the studies involved here are dependent on measurement of prospective pensions. Most of the general arguments connected to choice of data and social security measurement from section 3.5 apply also to studies of retirement behaviour and will not be repeated.

In the first section we look at disincentive effects in the American social security system by reviewing main findings of two analysis. This discussion is important since disincentive effects naturally turn out to be a crucial part of the way in which social security affects labour supply. In the second section we take a closer look at different empirical studies of retirement behaviour. The final section of the chapter concludes.

4.1 Disincentive effects of social security

In the theoretical model in chapter 2, we regarded the retirement age as fixed. In practice, systems are often designed in a way that give the individual the opportunity to choose their own retirement age, at least within a certain age span. The choice of retirement age will, however, also tend to affect the amount of old-age pensions received, i.e. those who delay retirement could be offered higher annual benefits as a compensation. The relationship between the retirement age and benefits can give individuals incentives to postpone retirement but also to retire early, depending on the specification of the system. All empirical studies in this chapter are based on American data. In this section we therefore look at studies that discuss disincentive effects in the American social security scheme.

Blinder, Gordon and Wise (1980) focus on the disincentive effect connected to social security benefits. In the American system this effect is related to an earnings test that reduce benefits for individuals working during retirement. Benefits are reduced by 50 percent when earnings exceed an exempt value. The point of the authors is that there are two effects, often ignored in the literature, which may offset the earnings test effect. The first is that an American individual between 62 and 64, independent of the earnings history, will increase future benefits by continue working. This is a built-in effect of the flexible retirement system which aims at compensating those who delay their departure from the labour market. The discounted increase in future benefits will, among other factors, depend on the discount rate. For a 62 year old married man, the authors find that the increase in benefits will exactly offset the loss from the earnings test for a discount rate at

about 5 percent, but that lower discount rates implies overcompensation [5]. Blinder, Gordon and Wise argue that an after tax rate of 5 percent is unrealistically high and that there is a bonus for deferring benefits for a 62 year old. For a 3 percent rate, this bonus will become negative if the individual has no wife or dependent children. For 65 year old men, the bonus is always negative, adding to the disincentive effect of the earnings test. The second effect follows from the fact that benefits are based on the average of a certain number of years with highest earnings. By postponing retire- ment, an individual can increase average earnings and thereby benefits beyond what is provided by the system as compensation for postponing retirement. This effect, which on average is calculated to provide a wage subsidy (or a marginal return to work effort) of 50-60 percent, is stronger the younger the age of the individual, but also applies to people over 65. The conclusion is therefore that "the social security law - if understood by the public - should provide work disincentives for only a small minority of individuals" cf. page 441, section 3 of Summary and Conclusions.

The theoretical discussion in chapter 2 was based on the pure life-cycle theory of consumption, which is also the starting point for most of the analyses of retirement behaviour. Kahn (1988) argues that there are good reasons to depart from this theoretical model. In particular he focuses on the fact that consumers might be affected by liquidity constraints or by the possibility of facing such constraints in the future. There are many studies supporting this view for consumers in general (see section 5.1). Kahn argues that liquidity constraints might apply to older people as well because they often have a very low level of financial wealth.

Kahn shows that the retirement decision is an optimal stopping problem, determined by relating the wage net of taxes and foregone pension benefits to the rate of (positive) change in pension wealth associated with delayed retirement. These potential future benefits have to be discounted in order for the consumer to evaluate the disincentive effect. Kahn stresses the point that social security benefits should not be regarded as a marketable asset. Further, liquidity constraints have a crucial impact in rising the discount rate for future benefits. The higher the discount rate, the lower are potential future benefits obtained by postponing retirement and thereby also the incentives for doing so.

The empirical analysis in Kahn (1988) is based on the Retirement History Survey. Data indicate that the liquidity constraint argument is relevant since low wealth individuals tend to retire earlier than those with a high level of wealth, but this could also be due to other factors. The implicit earnings potential for retired workers is constructed by means of estimation for two different discount rates. It is found that when the discount rate is set to 12, there appears to be a clear reduction in the incentive for continued work, while a rate of 3 induces only a marginal effect on incentives. Kahn therefore argues that the results from Blinder, Gordon and Wise (1980) should be modified since liquidity constraints support the view of

5 Computations are based on the social security law from 1973. Amendments have later changed the system in 1977 and 1983, the latter revision in a way that increased overcompensation.

a high discount rate. According to this study there should be a disincentive effect from social security, justifying the research that is surveyed in the next section.

4.2 Estimated effects on retirement and labour supply

The literature discussed in this section can be divided into (at least) three main categories: structural form models that seek to estimate parameters in a specified utility function, estimation of hazard functions (i.e. the probability of retirement) and reduced form models that estimate equations for the retirement age or other measures of labour supply by including important variables from the budget set of the consumer. We have chosen to look at some articles from all of the above mentioned categories. The focus will be on main approaches taken in each study, but we also try to compare different studies when possible. Table 4 provides a summary of the main features of each model in this section.

Boskin and Hurd (1978) aim at modelling the probabilities for two transitions: from full-time work to retirement and from full-time work to part-time retirement (semi-retirement). A static, two-good, labour supply model under certainty is the framework for the analysis. By introducing a budget set for a representative agent, it is shown that these probabilities theoretically depend on slopes and intercepts of the segments through the indirect utility function. The following variables are found to characterize the budget constraint and will therefore contribute to determine transition probabilities: the gross wage rate, non-labour income (i.e. dividends, interest and imputed returns to assets and debts), the net (after tax) wage rate and social security benefits. The two latter variables are regarded as endogenous in the model.

Table 4 . Empirical studies of retirement behaviour

Authors	Data[1)]	Period	Observations	Age-group	Model[2)]	Conclusion[3)]
Boskin and Hurd (1978)	LRHS	1969	1000	45-59	T	Y
Fields and Mitchell (1984)	LRHS/BAS	1962/78	1024/8733	55-64	R	Y
Gustman and Steinmeier (1985)	LRHS	1977	494		S	Y
Burtless (1986)	LRHS	1969	4193	58-63	R	Y
Moffitt (1987)	CPS	1977			R	Y
Krueger and Pischke (1992)	CPS	1973-88	4293		R	N
Blau (1994)	LRHS	1969-79	7000	55-73	T	N

1),2) Abbreviations are as follows:
LRHS = Longitudinal Retirement History Survey
BAS = Benefits Amount Survey
CPS = Current Population Study
T = transition model
R = reduced form model
S = structural form model
3) Answer to the following question: Is there any evidence that social security reduce labour supply?

Estimation is done by non-linear two-stage least squares on data from the Longitudinal Retirement History Survey (LRHS) in 1969. The sample is designed to comprise around 1000 households with 62-65 year old white males who are working and not receiving welfare. In addition to the variables mentioned above, estimated equations also include variables that describe health, family situation and the age of the individual. Estimation results show that social security benefits have a significant positive effect on retirement. Most of the other variables in this model are also fairly precisely estimated and the model seems to be consistent with theory. The estimated effect of benefits on semiretirement is, contrary to expectation, found to be negative. The authors explain the unexpected results in this model by collinearity and measurement problems.

Fields and Mitchell (1984) take the age of retirement as the dependent variable and explicitly derives for each worker in the sample an intertemporal budget set for all possible retirement ages. Three empirical models are estimated on two data sets: the Benefits Amounts Survey (BAS) drawn from ten firms with detailed information on retirement income (private pension benefits included) for workers and the LRHS data, which have information on a national basis about marital status and health, but no information on private pension benefits. In the empirical model retirement is a function of two economic variables: the present discounted value of expected social security and private pension income if the worker retires at age 60, and the **change** in the present discounted value of the same benefits/ pensions if the worker defers retirement from age 60 to 65. Results confirm predicted effects which are negative for the former variable and positive for the latter. In an additional analysis, it is shown that including a health variable add little explanatory power to the model. Two other models are also estimated. A discrete choice model gives results consistent with theory, and a non-parametric approach indicates that consumers put more weight on leisure than on income in their utility function. All models are compared by simulating effects of a 10 percent cut in social security at each possible retirement age. Results are quite similar for different models and data sets in that the average retirement age increases by between 0.5 and 1 months. The outlier is one variant of the non-parametric model that yields an increase in the average retirement age of 1.7 months.

Gustman and Steinmeier (1985) use an estimated structural life-cycle model based on LRHS data to simulate effects of the 1983 amendments of the American social security law. The model which allows for part-time work at a lower wage rate than for full-time work, is a variant of a standard life-cycle model. A CES-utility function is estimated and the parameters imply that if workers' compensation were increased by 10 percent in later years, retirement would be delayed by about 5 months (i.e. by over five times the average of results in Fields and Mitchell (1984)). Further, the within-period elasticity of substitution between consumption and leisure is estimated to 0.87. Three elements of the 1983 amendments of the social security law are analyzed: the increase in the normal age of retirement to 67 which is planned to be implemented gradually from 2000, the increase in the delayed retirement credit from 3 to 8 percent per year and a reduction in the earnings test ratio (see section 4.1 for an explanation) from 50 percent to 1/3. All

changes are found to increase full-time work participation (in particular at age 65) and reduce both part-time work and retirement, as would be predicted. Only direct long-run effects are considered and liquidity constraints are disregarded. Additional simulations show that results are not sensitive to assumptions regarding the inflation rate, wage rates, pension benefits and private pension plans.

Burtless (1986) starts by focusing on the tradeoff between goods consumption and retirement. This tradeoff is crucial for the individual in deciding when to retire. On the margin, the utility of forgone goods consumption should equal the utility of increased leisure. When applying this model on the American social security system, it is pointed out that overcompensation of individuals between 62 and 65, will lead to a non-linearity in the tradeoff between consumption and retirement. Consumers therefore have to perform utility maximization under a kinked budget constraint. The nature of the kink will depend on the discount rate, cf. the discussion in Kahn (1988). There is no discontinuity in the budget set at age 62 in the model, which implies that agents are allowed to borrow against future benefits. Uncertainty is also ignored, apart from the explicit modelling of effects of unanticipated benefits. The model also abstracts from partial retirement: individuals are either in work or (fully) retired.

The model to be estimated relates the retirement age to the price of continued work and the level of wealth at some initial age. These variables represent the slope and the intercept of the lifetime budget constraint and they are in the empirical analysis determined by wages, taxes and social security benefits. In addition a set of personal characteristics describing health, marriage, household size and wealth are included to account for e.g. different attitudes toward work and retirement. Burtless argues that actual benefit increases in the period 1969-73 were unanticipated. Further, it is shown that such unexpected changes in benefits create more non-linearities in the budget set that are taken into account by dividing individuals into different groups according to the period in which their retirement decision took place. It is also presumed that workers react immediately to announced escalations of benefits. Results based on LRHS data show that if the gains by delaying retirement, i.e. the slope of the budget constraint is doubled, the retirement age would increase by nearly a year. On the other hand, if the social security wealth earned by a particular age, i.e. the intercept term in the model, is doubled, the reduction in the retirement age is slightly more than half a year. These estimates are used to simulate counterfactually the effects of the unanticipated increases in benefits in 1969 and 1972. Only small effects are found, for example an increase of 10 percent in benefits from 1970 will in the short run only reduce the average retirement age by 0.06 years (i.e. approximately 0.7 months), while the long-run impact is slightly stronger.

Moffitt (1987) is one of the few analyses that employs time series data in empirical studies of retirement behaviour. He pays special attention to the problems of high correlation between trend variables, particularly real income and social security wealth, also discussed in section 3.1 of this survey. His solution to the problem is to estimate the elasticity of labour supply from variations in unexpected changes in

social security wealth. A specific model is obtained by using a Stone-Geary utility function in labour supply and consumption. From utility maximization a labour supply function expressed in terms of earnings is obtained, and this function is extended to include the social security wealth shock. Lack of relevant data induce some alterations of this function and the equations to be estimated include the wage rate, a cohort trend, age and social security wealth. Two versions of the model (in level and first difference form) are estimated for four variants of the social security variable. Three of the latter variables are computed by using a linear trend and the fourth by using a log-linear trend. For the level model, results support a negative effect from social security on labour supply, while one can reject the hypothesis that social security has affected labour supply from the results obtained by the first-difference model. Results from the former model imply that increases in social security benefits have accounted for 3-5 percent of the reduction in labour supply in the 1950s, while corresponding figures for the 1970s are 13-19 percent. However, the author gives no good reason for why one should trust this model more than the other. In addition, the analysis suffers from lack of relevant data and from the arbitrary procedures for calculating shocks in social security wealth.

Krueger and Pischke (1992) focus on the abrupt and permanent decrease in benefits for the so called "notch" generation that was a result of the 1977 amendments of the social security law in the U.S. The amendments were designed to eliminate a double indexation problem created in 1972 and did probably lead to a large decline in anticipated benefits. A model similar in spirit to Burtless (1986) and Fields and Mitchell (1984), is designed to capture the wealth and substitution effects of social security. A social security wealth variable and the change in this variable were accordingly included in the empirical model. In addition age and time dummies were also added to the equations, specified as logit-models with the labour force participation ratio as a left-hand side variable. Based on data from the Current Population Study, the model is estimated for three periods. When estimating over the period 1968-73, i.e. without including the "notch" generation, social security is significant only when the time variables are omitted. The explanation could be that significant effects only reflect the coincidence of declining labour supply and increasing social security wealth. Estimating over a period that comprises the "notch" generation give, when time variables are included, not significant estimates of either social security wealth or the change in this variable. Estimation of the "notch" period only give similar results, but a positive and almost significant coefficient for the growth variable. Result are robust to different measures of labour force participation and the conclusion is accordingly that previous time-series estimates represent an overestimate, resulting from a negative correlation between social security and wealth in the 1970s. Krueger and Pischke propose several explanations for their result. It could be that the benefit changes were anticipated or that private pensions offset (part of) the fluctuations in social security, but these explanations are not very likely. Another explanation is that social security wealth constitutes only a modest component of lifetime wealth or that wealth elasticities are not very large.

Blau (1994) uses the LRHS data to estimate a dynamic programming model of labour force transitions for older men. Quarterly transitions rates are constructed, based on reported ending dates of jobs, whereas previous studies have used annual or biannual data. Quarterly data reveal higher rates of labour force reentry (disregarded by other studies in this survey) and therefore give a better understanding of the labour force history of the individuals. This analysis also emphasizes the dynamic structure of labour supply of older workers. Lagged endogenous variables as work experience and previous spells of non-employment and part-time employment have important effects on transition rates. The importance of these variables suggests that preferences, and not only variables connected to life-cycle budget constraints (wage rates, pensions, social security benefits), are important. Predicted hazard rates based on model estimates track the actual rates well for most groups in the sample. The estimated model shows that social security benefits (calculated for each individual based on earnings records) have a large effect on labour force transition at older ages. The most substantial impact is on the transition from full time work to retirement, but changes in benefits over time can according to the model only account for a small part of the decline in male labour force participation in the US in the 1970s, which is consistent with results from former studies.

4.3 Conclusion

There are more aspects of the American social security system that affect labour supply for individuals above 62 years, the lowest possible retirement age. The so called earnings test implies a disincentive for continued work, since benefits are reduced if other earnings exceeds a certain amount. On the other hand, since benefits depend on average earnings prior to retirement, potential benefits will normally increase by postponed retirement. However, the discounted value of future benefits could be low if households are credit constrained.

Empirical studies of retirement behaviour should take the special features of the social security system into account. This seems to be the case for most of the studies. In particular Burtless (1986) provides a careful discussion of the relevant budget set facing the consumer, and addresses especially effects of unanticipated shocks in social security benefits. Such shocks are the main explanatory variable in Moffitt (1987), trying to avoid collinearity problems in a time-series analysis. Some analyses have taken advantage of major amendments in the American social security law, occurring in 1977 and 1983, when trying to estimate effects of social security on labour supply, see Krueger and Pischke (1992) and Gustman and Steinmeier (1985). Most studies disregard partial retirement and reentry to the labour market, thereby missing important aspect of the labour market for elderly individuals, according to Blau (1994). Another problem that can be important is that uncertainty is also ignored in the studies reviewed in this section. The general results, however, indicate a small impact on labour supply, too small to explain the marked decline in labour supply among elderly men in the US in the 1970s.

5. Tests of liquidity constraints and income uncertainty

Apart from the early retirement issue discussed in chapter 4, the theoretical analysis in chapter 2 showed that the presence of liquidity constraints could also contribute to offset a negative saving effect of (introducing) social security. On the other hand, income uncertainty is likely to strengthen the negative effect on saving. In this section we will look into empirical studies that test whether some of these assumptions are valid. The natural point of departure is the famous article by Hall (1978) that tests a joint hypothesis of rational expectations and the life-cycle hypothesis in a model that ignores credit restrictions and rely on quadratic utility, consistent with certainty equivalence. Since both Hall himself and many later studies reject his hypothesis, researchers have been looking for explanations by investigating crucial assumptions in Hall's study. The credit market assumption is a likely candidate and has been in the focus of the research on consumer behaviour for over a decade. In recent years the literature has focused more on the certainty equivalence assumption, and suggested a precautionary motivation for saving as another explanation for why the rational expectation life-cycle hypothesis is rejected. In this chapter we first review the main elements in Hall's study, then we move to discuss analyses that focus on credit restrictions and finally we take a closer look at the precautionary saving literature.

5.1 Hall's rational expectation life-cycle model

In his seminal article, Hall (1978) combines the traditional life-cycle model with the rational expectation hypothesis. Earnings are regarded as uncertain, while the real rate of interest is assumed to be constant over time. Consumers maximize expected future utility subject to a finite time life-cycle budget constraint and can borrow/lend in a perfect capital market. It is shown that under these conditions marginal utility can be written as a random walk with trend. Furthermore, if marginal utility is a linear function of consumption, which is the case for quadratic utility and when the utility function has the constant elasticity of substitution form,

then consumption itself is also a random walk with- trend [6]. Current consumption should therefore, apart from a stochastic error term and a constant, be explained solely by consumption lagged one period. This formu- lation can easily be tested without making assumptions of exogeneity: in a re- gression only consumption lagged one period should have a coefficient different from zero. All other variables lagged one period or more (in particular lagged income) and consumption lagged more than one period are irrelevant in explain- ing current consumption. The interpretation of the model is that all information prior to the current period is embodied in lagged consumption, while the error term summarizes the impact of new information that becomes available in the current period. The latter term therefore contains unanticipated changes in income.

Hall (1978) tests a version of the model, based on a quadratic utility function, by using quarterly time series data of consumption of nondurable goods and services. He rejects that consumption lagged more than one period influences current consumption and finds also that lagged values of real disposable income cannot provide explanatory power in the consumption equation. Lagged stock prices, however, contribute unambiguously to predicting current consumption (even if the estimated effect is small), thereby rejecting the rational expectation life-cycle model. Hall suggests as an explanation that it will take some time to adjust consumption [7], implying that any variable correlated with permanent income lagged one period will contribute to predict current consumption. This is in the literature often referred to as the excess sensitivity effect, i.e. the sensitivity in excess of the response that could be ascribed to new information contained in the current period. Two major explanations for why it could take time to adjust consumption are liquidity constraints and precautionary saving [8]. When consumers revise their expectations of permanent income upwards, borrowing restrictions may prevent them from adjusting consumption before the increase in income has materialized. Likewise, with a precautionary savings motive, consumers will save today in order to avoid low consumption as a result of low income states in the future. The intertemporal budget constraint must still hold, which implies sharper consumption growth than under certainty equivalence. The next two sections will survey articles that have considered these two explanations from an empirical point of view. First, we look at studies that test for liquidity constraints, then we move to discuss analyses of precautionary saving.

5.2 Consumer demand and credit restrictions

As we saw in the theoretical discussion, credit constraints could prevent young consumers from sustaining their optimal level of consumption when the social security system transfer a part of their income to the retirement period. From a

6 Note the difference from section 2.3 where it was assumed that the third derivative of the utility function was positive. When marginal utility is a linear function of consumption, the third derivative is equal to zero, and there can be no precautionary saving.

7 A more radical explanation would be to argue that consumers are not forward looking, thereby rejecting the pure life-cycle hypothesis.

8 Other explanations, e.g. including stochastic interest rates, have also been proposed but lies outside the scope of this survey.

theoretical point of view there are arguments for why it is optimal for banks to restrict lending, even in a market without regulations, see Stiglitz and Weiss (1981). In an economy with credit regulations banks may be forced to ration credit. Our interest is on the household side, i.e. we would like to know whether household behaviour is affected by liquidity constraints. Buffer-stock saving[9] (which is discussed in 5.3) could prevent consumers from being effectively restricted, i.e. they can draw on their reserves rather than applying for credit. In fact, liquidity constraints will intensify the precautionary motive for saving since the need for the consumer to self-insure against uncertain future income increases.

A distinction can be made between studies that reject the Hall hypothesis and interpret this to be caused by liquidity constraints for a part of consumers, see e.g. Hall and Mishkin (1982) and studies that seek to test explicitly for liquidity constraints. As we have seen in 5.1, there can be other reasons for why Hall's model cannot be accepted and we therefore look at studies that aim at testing more directly for liquidity constraints. The literature can be divided among microeconometric analyses that are using the Euler equation approach and macroeconomic studies that estimates consumption functions. Most microeconomic analysis use data on food consumption while macro analyses usually employ data on consumption of non-durable goods and services. A commonly used modelling strategy is to divide the sample between consumers that are likely to be restricted in the credit market and those who are not. The problem is how to model consumer behaviour for the former group. While some assumes that these individuals act as rule-of-thumb consumers, i.e. they consume all their income, others more correctly specify a model where the lagged change in income is allowed to affect the change in current consumption. Other papers construct dummy variables aimed at taking account of credit market restrictions and changes in these. A problem with the latter approach is that the dummy variables might also capture other effects than liquidity constraints.

Flavin (1985) takes the rejection of the rational expectation life-cycle model formulated by Hall as a stylized fact and seeks to test whether excess sensitivity can be attributed to myopic behaviour or to credit market imperfections. A Keynesian type consumption function which contains both current and permanent income is specified. As long as there is some effect from current income, the function can be viewed as a Keynesian function, favouring myopic behaviour. However, if omitted variables have a significant impact, this function is misspecified. In particular, Flavin aim at testing whether a variable related to liquidity constraints is significant when included in the consumption function. The chosen variable is the unemployment rate, the explanation being that unemployed people are likely to be constrained in the credit market. By referring to survey data, it is argued that the consumption path is affected by the negative transitory income shock associated with a moderate spell of unemployment for a significant proportion of the population. The model is estimated by a non-linear instrumental variable method for non-durable goods by using time series data for the periods 1933-41

9 The term buffer-stock saving is used equivalently to precautionary saving in this survey.

and 1950-81. It is first shown evidence of excess sensitivity, confirming earlier research. Then unemployment is included directly in the consumption function, making the excess sensitivity parameter (i.e. the coefficient of lagged change in consumption) insignificant. The conclusion accordingly supports the liquidity constraint as an explanation of excess sensitivity, rather than myopic behaviour. An obvious problem with this approach is that the unemployment rate is likely to be an important regressor for other reasons than credit restrictions. Changes in the unemployment rate could be an indicator both of expected future income[10], i.e. an approximation of human capital, and could also indicate income uncertainty which is likely to depress consumption (increase the precautionary savings motive). Results therefore deny myopia, but cannot distinguish between liquidity constraints and precautionary saving.

Zeldes (1989) is one of the few studies that tests explicitly for effects of credit constraints on micro data. In the model, an isoelastic utility function is maximized subject to liquidity constraints. This is shown to modify the Euler equation in that a Lagrange multiplier term has to be added. The model is estimated by using data from PSID for the period 1968-82, giving up to ten observations for each household. Prior to estimation, households are allocated to two groups: a low asset group (assumed to be constrained) and an (unconstrained) high asset group. Common explanatory variables for the two groups are disposable income, the age of the household head, family size and the real rate of interest. For the group assumed to be liquidity constrained, it is shown that one would expect a positive impact from income. One test is therefore to include income in the Euler equations for both groups of household. As expected estimation results show that the Euler equation is rejected for the low asset group while not for the high asset group. Another test is to estimate the Lagrange multiplier term and see if it is positive, as would be expected. The left-hand side variable is the growth rate of consumption. A positive Lagrange coefficient therefore implies that credit constraints induce higher consumption growth. If constraints are binding, today's consumption is lower, and thereby the growth rate higher than without binding constraints. Note that the consumption growth will never become lower due to constraints since saving is not restricted. This formulation is therefore more precise than the assumption that constrained consumers spend all their income. The sign of the estimated coefficient supports this explanation, but the level of significance is low. The third test is to see whether there is a negative relationship between the Lagrange term and disposable income: this is expected because higher income will relax the liquidity constraints. The estimated coefficient is negative but not statistically significant. On this background, the author concludes (with some reservations regarding data) by saying that the analysis supports the hypothesis that borrowing constraints affect consumption.

10 Flavin seeks to control for this effect by testing the model when unemployment is used as a predictor for future income, without including unemployment directly in the consumption function, but find that this does not alter the excess sensitivity coefficient.

The outline of the paper by Alessie, Kapteyn and Melenburg (1989) is similar in spirit to that of Zeldes (1989). An improvement compared to Zeldes' model is that credit restrictions are related directly to income, which makes the model estimable in observable variables only, i.e. one does not have to rely on the Lagrange multiplier associated with the net wealth constraint in the consumer's maximization problem. A panel of around 300 Dutch households, which includes consumption expenditure for all household members over 12 years, is used. Income, demographics, labour supply etc. are measured annually from 1984-87. A significant estimate is obtained for the liquidity constraint coefficient for a log-specification of the model. However, a general misspecification test, together with unacceptable values for one of the coefficients, indicate that the model is incorrectly specified. The conclusion is accordingly that no unambiguous effects of credit constraints can be found in this model. A possible reason suggested by the authors is the fact that only households with an employed working head are included in the sample.

Jappelli and Pagano (1990) investigate consumer behaviour in different countries and analyze whether differences in the degree of excess sensitivity can be attributed to differences in liquidity constraints. The analysis takes three steps. First, it is investigated how excess sensitivity varies between countries. The model that is estimated for seven countries divide consumers into two groups: one that is following the Hall-model and one that consumes total disposable income. Estimation is undertaken both by the nonlinear instrumental variable method used by Flavin (1985) and by FIML-estimation. Results show that the highest excess sensitivity parameters are found for Italy, Spain and Greece, the lowest for Sweden and the U.S. and intermediate ones for the U.K. and Japan. In the second step, countries characterized by high excess sensitivity are shown to be those where consumer debt is low, despite difficulties in comparing countries based on national statistics. A low debt level can theoretically be explained by little desire to borrow or by liquidity constraints (or both). In the third step of the analysis it is argued that the empirical evidence suggests that different degrees of rationing is the main explanation for the low debt level. This explanation is supported by differ- ences in two indicators of rationing: the down-payment ratio and the proportion of homeowners in young cohorts. The former variable is a requirement to provide a certain amount cash to obtain a mortgage loan, and is accordingly a direct indi- cation of liquidity constraints. Demand factors such as fiscal incentives to borrow (linked to the progressivity of the tax system), the life-time income profile and the age structure are unlikely to explain the differences in debt levels. The conclusion of this analysis is therefore that high levels of excess sensitivity can be explained by liquidity constraints.

Muellbauer and Murphy (1989) test effects of credit constraints in a macroconsumption function for non-durables by using UK time series data. The model comprises the behaviour of two groups of households: credit constrained and unconstrained. For the former group, restrictions are imposed by limiting net real debt to a fraction of income. This fraction is assumed to vary inversely with the nominal interest rate (common for loans and deposits), the reason being that the probability of default rises with the interest rate. In addition to income and relative

prices, the nominal interest rate therefore enters the consumption function for this group. For unconstrained consumers, the model is based on the life-cycle theory but extended with an uncertainty term. The basic equation includes the real interest rate, income, relative prices and the asset/income ratio. The two models are aggregated to obtain a macro consumption function. Credit-liberalization, which took place during the 1980s in the U.K., is introduced into the model in two different ways. First, illiquid assets are allowed to become more liquid over time and secondly the proportion of unconstrained households in the aggregate is allowed to grow over time. Both features are represented by the same dummy-variable (FLIB), which increases from 0.15 in 1982 to 0.95 in 1988. The income elasticity is fixed at 0.95 in the empirical model, and given this restriction relative prices between durables and non-durables, liquid and illiquid assets relative to income and the shift-coefficient for the latter variable were all significantly estimated. In addition, the uncertainty term was significant and positive. Results therefore support the view that credit liberalization has been important for the development in UK aggregate consumption. However, some of the assumptions underlying the estimated model are rather ad hoc. One example is the assumption that non-property income for an infinitely lived consumer is assumed to follow a random walk with drift, used to determine real life-cycle wealth. The values of the FLIB variable also seem arbitrarily chosen, but this only reflect a common problem encountered when trying to model credit restrictions.

Weale (1990) also develops a model of aggregate consumer behaviour where a proportion of consumers is constrained and can consume from current and lagged income and wealth, while the rest of consumers behave rationally and spend out of the discounted values of future income (both labour income and social security) and current wealth. Under assumptions of a constant discount rate and quadratic utility, the model for unconstrained consumers can be shown to coincide with Hall's random walk model. Credit restrictions are modelled by assuming that capital market imperfections exist and that consumers (who form the constrained group) have a high subjective discount rate. This combination implies that a wealth constraint, i.e. the requirement of a non-negative steady state wealth level, will be binding for the attached group of households. Unlike liquidity constraints, wealth constraints can be rigorously incorporated into a forward looking model. The behaviour for this group is, according to Weale, indistinguishable from a limiting case of adaptive behaviour, represented by polynomial lags on income terms. The two models are aggregated and tested empirically using an instru- mental approach on detrended quarterly time-series data for the U.K. over the period 1973-84. It is accepted that there are two differently behaving groups of households in the economy: one holds all property and consume in accordance with rational behaviour, while the other group, can be characterized as spendthrift consumers. The behaviour of the latter group, which is not inconsistent with rational expectations, can empirically be explained by a high discount rate of future utility and indicates that the capital market is imperfect.

5.3 Precautionary saving

Referring to the theoretical discussion in section 2.3, we saw that income uncertainty could induce a negative effect on saving from introduction of old-age pensions. The crucial assumption is that pension income is less volatile than labour income, so that a transformation from the latter to the former will reduce uncertainty and therefore also saving. In this survey we take this assumption for granted and focus on the precautionary motive for saving connected mainly to labour income uncertainty. As pointed out in section 5.1, the precautionary savings literature can be viewed as an offspring from the failure of the Hall-model. Whereas Hall relied on quadratic or CES utility, studies of buffer-stock saving normally assume the utility function to be isoelastic. Exponential utility is an alternative that also allows closed form solutions for consumption, but has the disadvantage that negative values of consumption are not ruled out. As in the case of liquidity constraints, there are few direct tests of precautionary saving. However, many authors have tried to investigate this motive by stochastic simulations, based on previous estimates of labour income processes. We start by looking at some of these analyses and then move to some studies that aim at testing the precautionary motive for saving directly.

Skinner (1988) performs an analysis of precautionary saving in a stylized life-cycle model. His assumption of isoelastic utility normally excludes closed form solutions for consumption, but an analytical expression for consumption is obtained by applying a second order Taylor expansion to the Euler equation. Both interest rates and income are assumed to be risky in the model, but there is no correlation between these variables. Income is presumed to follow either an AR(1) process or a more persistent ARMA(1,2) process, where the parameters are taken from previous panel data estimations. Interest rate uncertainty is modelled by the variance of the return on bonds over the period 1967-86. The risk aversion parameter is chosen to be 3, while the subjective rate of time preference is set to 1.5 percent. Optimal consumption paths given the above assumptions and a constructed age-earnings profile, are constructed by a stochastic dynamic programming procedure, and compared to a certainty path. It is only to the extent that annual income variations signal a permanent change in income that the precautionary motive becomes important. For the AR process, precautionary saving counts for 12 percent of aggregate saving, while for the ARMA process the corresponding figure is 56 percent. Uncertainty in interest rates is shown to have only minor impact on saving in these simulations, while a risk aversion parameter of 6 (rather than 3) leads to an increase in precautionary saving from 56 to 76 percent.

Zeldes (1989) also relies on an isoelastic utility function, but he does not utilize the closed form solution proposed by Skinner. In addition Zeldes abstracts from interest rate uncertainty. Labour income is calibrated on panel data estimates of income processes and permanent income shocks (e.g. due to a job change) are separated from transitory income shocks (e.g. due to temporary unemployment). The risk aversion parameter is set equal to 3, while the interest rate and the subjective discount rate are both equal to 0. The analysis employs a stochastic dynamic programming technique for simulation purposes. Results show the optimal

consumption profile as a function of wealth. Low levels of consumption go along with low levels of assets, since the amount of expected future (uncertain) labour income is large in the beginning of the life-cycle. As times go by, the overall uncertainty decreases and the optimal level of consumption rises. The marginal propensity to consume out of transitory income is less than one, but considerably higher than in the certainty equivalence case. On the other hand, the effect of permanent shocks in income is lower than under certainty equivalence, which seems somewhat puzzling particularly compared to the results in Skinner (1988). The level of precautionary saving is shown to count for around 20 per cent of optimal consumption. Zeldes claims that his results can contribute to explain not only the excess sensitivity of consumption, but also the combination of high growth in consumption and a low risk-free interest rate, and the high savings rate of the elderly.

Pemberton (1993) criticizes former papers simulating consumption trajectories over the life-cycle for assuming that consumers actually plan in detail for such a long future period. He finds it unrealistic that models that can only be solved by immense computer power should represent economic behaviour. As an optional approach he proposes a model where consumers only have to distinguish between today and the future (i.e. a two-period model), without specifying any exact plan for many future periods. Consumption is a function of wealth and human capital as in the life-cycle case, but uncertainty enters as a part of the marginal propensity to consume. Precautionary saving is discussed for different income processes. When income is stationary there is only a small amount of buffer-stock saving, while a random walk with drift process generates a considerable amount of wealth accumulation. This approach seems to be more appealing than complicated simulation models and is strengthened by the results which are quite similar to what is obtained in Skinner (1988) and in Zeldes (1989).

Carroll (1993) uses both simulation techniques and time-series estimation to investigate buffer-stock saving and focuses on the importance of unemployment as the main contribution to income uncertainty. Data are taken from the Panel Study of Income Dynamics (PSID), which includes questions regarding saving, changes in aggregate unemployment and changes in individual income are used partly in combination with aggregate data for unemployment and personal saving. From the survey data Carrol finds that around one third of the households occasionally experience outcomes in which permanent income drops more than 15 percent and another third faces similar drops in transitory income. It is argued that these variations only to a minor extent are a result of measurement errors. Simulations, based on the assumption that there is 0.5 percent chance of a fall in transitory income to zero, show that changes in the expected probability of these bad outcomes have an influential impact on current consumption and saving. According to a comment on the paper written by Zeldes, this is a problematic exercise since consumers are forward looking and should take into account all possible future outcomes, including changes in the above probability. In the macroeconomic analysis, the expectation of a rise in unemployment and the level of unemployment, used as a proxy for income uncertainty, have positive effects on saving. Since

unemployment could also be an indicator of income expectations, this effect is controlled for in the analysis. However, results seem, however, to be vulnerable to simultaneity problems, which are discovered when applying instrumental variables. In addition, there are, according to Zeldes' comment, problems connected to the survey data employed in the analysis, in particular whether the unemployment expectation variable is a good approximation of future income uncertainty. Carrol finds significant negative effects of unemployment expectations in equations for the change in consumption and to justify this result he allows for habit formation or adjustment costs. In favour of the latter, it is shown that consumption of services is less affected by uncertainty than more easily adjustable goods consumption.

Dynan (1993) seeks to test precautionary saving directly by using data for 1875 households from the 1985 Consumer Expenditure Survey in the U.S. The Euler equations are, by a Taylor expansion of marginal utility, showed to express a relationship between the expected change in consumption and the expected squared change in consumption in the same period. The interpretation is that higher expected consumption growth, which goes along with higher (precautionary) saving, is induced by greater uncertainty (measured by squared consumption growth). Empirically, the test is performed by using the average of individual consumption growth. The appropriate estimation procedure is two-stage least squares, and the instruments used are occupation, industry, education, number of earners and interest- and dividend income earned prior to the survey. Results show that risk seems to affect consumption growth positively, which is in accordance with theory. However, the effects are small and not significantly estimated. The conclusion is therefore that the precautionary motive appears to be an unimportant part of consumer behaviour, contrasting most of the evidence gained by simulation techniques and also the estimation results in Carroll's study. In a comment on Dynan's test, Carroll (1993) argues that variability in consumption growth on quarterly frequencies is unlikely to be related to uncertainty. If this is correct, the interpretation is that the instruments used by Dynan are inappropriate. On the other hand, Dynan claims the instruments used should be good at predicting uncertainty.

Acemoglu and Scott (1994) reject the Hall hypothesis on British time-series data because of the predictive power of consumer confidence in a consumption function. Confidence is measured as the average of responses (graded from -1 to 1) to five questions regarding future economic conditions, household finance and planned purchase of durables. Other macroeconomic variables (including labour income) are, however, not found to predict consumption growth. Interestingly, this paper seeks to test whether the rejection of the Hall model is due to liquidity constraints or to income uncertainty. The most convincing (ad hoc) test of the former explanation is to look at the recursive estimates of the coefficient of consumer confidence variable in the consumption function. Since credit rationing is widely known to have been relaxed through the estimation period, the predictive power of consumer confidence should have decreased over time. The recursive coefficient is, however, remarkably stable from 1980 to 1990 and therefore suggest that liquidity constraints cannot explain the role of consumer confidence in the consumption function. In order to test for precautionary saving, a reduced-form approach is

taken, and a test of over-identifying restrictions is derived based on a two-equation model determining the change in consumption and the interest rate. A disadvantage with this approach is that the test is a joint test of the specification of the variance of consumption growth and the precautionary motive. Results indicate that a high value of consumer confidence today suggests greater uncertainty about future values of consumption growth, thereby depressing consumption today and increasing consumption growth. Precautionary saving is, according to this study, therefore the likely explanation of the rejection of the rational expectations permanent income model.

5.4 Conclusion

Almost every study surveyed in this chapter focuses either on credit restrictions or on income uncertainty. Since both factors theoretically can be a reason behind excess sensitivity, they should therefore also be seen as competitive explanations from the empirical point of view. This is only done in Acemoglu and Scott (1994) who find support for income uncertainty while not for liquidity constraints.

In the literature that focuses mainly on liquidity constraints, the most common approach is to divide the sample according to a priori assumptions of groups that are affected differently by financial constraints. There are several problems attached to these studies. The division of consumers into two separate groups seems rigid because the degree of rationing varies both between households and over time. Furthermore, microeconomic analysis using PSID data rely on food consumption only, which might not be a representative part of total consumption. The frequent and easily adjustable purchase of food makes it easier to get the Hall hypothesis accepted than for other groups of goods or for aggregate consumption. This is the point put forward by Shea (1994) who argues that tests of the life cycle hypothesis based on micro data therefore have low power. An additional obstacle is the difficulty in attaching credit restrictions to an observable variable. Empirical specifications therefore usually rely on dummies that can as well take account of other factors. This critique seems to be particularly relevant for macro analyses.

For analyses of income uncertainty two different procedures are taken. Dynamic stochastic simulations based on earlier estimates of income processes support the precautionary motivation for saving, but depend crucially on estimated income processes, the risk aversion coefficient, assumptions regarding the size of the subjective discount factor and the assumption of time-separability in consumption. Direct estimates of effects of uncertainty in consumption models, e.g. as obtained by Carroll (1992), seems to be a preferable test, but it is difficult to find appropriate measures of income uncertainty. Other estimation procedures have been tried by Dynan (1993) who rejects a precautionary saving motive and by Acemoglu and Scott (1994) who find support of such a reason for saving. An explanation for the contradicting results in these studies could both be related to different ways of testing the hypothesis and to data. Too few tests of precautionary saving have been undertaken to draw a clear conclusion on the matter, but this is very much an ongoing research area and many additional results will probably emerge in the years to come.

6. Summary

The main part of this survey has focused on empirical studies of the relationship between public old-age pensions and consumer behaviour, carried out over the last two decades. The motivation behind this research was to investigate whether the decline in personal saving could be explained by expansion of the social security system. A majority of studies on this topic was undertaken in the first of the two decades. The survey has also been concerned with new directions in the consumption literature, notably related to liquidity constraints and income uncertainty, which have been in focus in the last decade. Lately, the prospect of ageing populations in many countries has brought new interest into issues related to pension schemes. One might therefore ask what has been gained by 20 years of research that could be utilized in today's research on old-age pensions and consumer behaviour.

When work started on social security and saving 20 years ago, the life-cycle model of consumer behaviour was the natural point of departure for empirical analysis. During the last two decades both empirical techniques and economic theory have developed. The notion that labour supply and particularly the retirement age should be regarded as endogenous to the consumer, was immediately incorporated into empirical analyses. More sophisticated models, which outline the complexity of the economics of retirement, have been developed in the last decade. Future research should seek to incorporate these advanced models of retirement behaviour into analyses of social security and saving.

The confrontation of the life-cycle model and the rational expectation hypothesis induced a research program that has analyzed how and to which extent liquidity constraints and income related uncertainty affect consumer behaviour. The outcome of this research suggests that the pure life-cycle model is insufficient in explaining personal saving and has therefore also implications for the analysis of pension schemes and saving. In particular, it seems that the precautionary saving literature, which is very much an ongoing research program, has much to add to the traditional way of thinking about consumer behaviour.

Empirically, the seminal research relied on traditional procedures for analyzing time series data. It seems that the arbitrary outcomes of aggregate time series studies turned the research agenda towards cross section analysis, more aimed at investi- gating behaviour for particular age groups. Over the last decade, techniques for examining properties of time series data and for estimating and testing empirical time series models have improved considerably. In particular, the implications of time series properties for estimation have been underlined. It could be that these new guidelines can help time series data to give more insight into the original research topic. However, it is easily accepted that panel data in many respects are more appropriate. While this kind of data are widely adopted in studies exclusively concerned with retirement behaviour, only a few saving studies employ panel data. For example cross-country data seem underutilized in that only a few analyses were undertaken in the early 1980s. Only the fact that a lot more observations are now available should renew the interest in such studies.

On this background it seems clear that theoretical foundations have changed and empirical techniques have improved considerably during the last 20 years. In addition, the environment in which consumers operate has altered. There should accordingly be prospects for many interesting analyses of old-age pension schemes and saving to be undertaken in the future.

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