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ABSTRACT

Simple life cycle and permanent income hypotheses imply that changes in consumption should be unforecastable. Rational forward-looking agents ought to smooth consumption over the life cycle and exhaust the asset stock accumulated during the working career in retirement. Empirical observations seem not to conform to these predictions of the simple theory of intertemporal choice which has given rise to elaborations on the benchmark model. The theoretical discussion of this paper concentrates on the litareture dealing with the seemingly problematic empirical regularities and on proposed explanations. The review of literature focuses particularly on the life cycle issues of consumption behaviour.

JEL Classification: B22, D11, D91, E21

Keywords: consumption, life cycle, permanent income

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1. INTRODUCTION

The theory of intertemporal choice as it stands today is based on life cycle and permanent income hypotheses introduced in the 1950s. These models were the first ones to address the behaviour of a consumer whose planning horizon extends over several periods instead of one period like in the models stemming from the Keynesian tradition. In the life cycle-permanent income framework, total lifetime resources available to the economic agent are an important determinant of consumption. Lifetime resources are comprised both of the stream of labour income expected to receive over the remainder of the working life and of assets owned by the consumer. Keynesian theory, in contrast, asserts that disposable income is the only relevant variable with respect to consumption decisions.

The key implication of the benchmark life cycle-permanent income framework is that the economic agent smooths consumption over the life cycle. Hall (1978) showed using his rational expectations version of the permanent income hypothesis that consumption should follow a martingale. As a result, any past or otherwise predictable information should not help to forecast changes in consumption. Current and past values of income especially should have no predictable power whatsoever. However, empirical studies on time-series data have renderred this implication suspect. Consumption has been observed to exhibit both excess sensitivity and excess smoothness. Whether excess sensitivity and excess smoothness of consumption are puzzles from the theoretical point of view depends in large part on the specification of the time-series model describing the dynamics of labour income. Two commonly proposed rationales for these empirical puzzles include constraints on borrowing and the failure of the life cycle-permanent income framework to take into account the long lasting service flows that durable goods produce.

The simple life cycle model predicts that during the working years of life assets are accumulated in order to finance consumption in retirement. Since the economic agent smooths consumption over the whole life span, there should be no change in spending after retirement. Rational forward-looking behaviour also requires that wealth is exhausted by the end of the life cycle. The observed behaviour of retirees seem not to accord with these theoretical implications. Elderly seem to reduce consumption after retirement. Furthermore, they do not appear either to decumulate their wealth at all or to dissave at a rate fast enough to be consistent with the benchmark theory. As a solution to these contradictory regularities, the theory of intertemporal choice has been modified to allow for uncertainty over the time of death and for a desire to leave a bequest.

The empirical puzzles associated with life cycle and permanent income hypotheses are puzzles with respect to the certainty or certainty equivalence benchmark. When proper accountance is made for uncertainty through a more plausible specification of utility function, the behavioural implications of the intertemporal choice theory are significantly different from those of conventional models. More precisely, the observed patterns of consumption and wealth holdings, in fact, arise from rational optimising behaviour on the part of the consumer. Another troublesome feature of the benchmark life cycle-permanent income framework is the assumption about the representative agent. In Deaton’s (1992) words, the representative agent knows too much and lives too long relative to reality. Hence, it is highly controversial if the behaviour of the representative agent corresponds to the behaviour of actual consumers. Finally, in empirical analysis aggregate consumption is often treated as if it had been generated by the decisions of a single consumer. Such a straightforward simplification is clearly unvalidated.

An important role in the life-cycle consumption and saving decisions of economic agents is played by housing. Housing wealth is the most significant asset in their overall portfolios for many households. Real estate assets differ substantially from financial assets due to their dual role. Housing wealth is demanded both as an investment good and as a durable consumption good. The consumption of housing services need not be combined with the ownership of real estate assets. Banks, Blundell, Oldfield and Smith (2004) have examined the implications of housing price uncertainty for the life cycle path of consumption and wealth. A risk averse consumer can always choose to avoid risky holdings of financial assets, whereas it is impossible to avoid consuming housing services. The necessary level of housing consumption typically increases with family size. Since owning is usually preferred to renting, house price fluctuations might cause rather large utility losses unless there is a way to insure against them. In the absence of a suitable financial instrument, the insurance can be achieved by purchasing the asset itself. In other words, housing has a third role as an insurance against price fluctuations. Banks, Blundell, Oldfield and Smith (2004) show that in this case increasing house price volatility will lead to increase both in homeownership and in consumption of housing services early in the life cycle.

According to the life cycle model, desired consumption of housing services should fall with age after retirement and the stock of real estate assets should be liquidated in order to finance retirement consumption. Hurd (1990) and Jones (1996) survey studies showing that in contrast to this prediction elderly households are relatively reluctant to move out of homeownership. The simulation experiment of Heiss, Hurd and Börsch-Supan (2003) seems to accord with this result. Hurd (1990) points out that the behaviour of elderly does not necessarily imply that there is no change in the desired stock of housing wealth. In order to adjust its actual consumption of housing services to the desired level, the household is required to move. Transition from owning to renting may entail large transactions costs, both monetary and psychic, that can eventually prevent old households from downsizing their housing consumption to the desired level. Another factor prohibiting the change in tenure is the absence of reverse mortgages (see for example Skinner 1993). As a consequence, elderly households may be forced to consume too much housing services and hold an excessive stock of real estate assets in their total wealth portfolios. According to Jones (1996), systematic liquidation of housing wealth does take place in old age but not immediately after the retirement. He also argues that tenure transitions among the oldest elderly are not motivated by life cycle dissaving objectives. The decision to cease ownership is more likely to be associated with a decrease in household size.

2. LIFE CYCLE HYPOTHESIS

2.1. Background

After the introduction of Keynes' *General Theory* in 1936 it was generally accepted, according to Friedman (1957) and Branson (1972), that one of the key macroeconomic relationships is the one between income and consumer expenditure. This relationship is termed the consumption function. Keynes assserted that real consumption is a function of real disposable income, total income net of taxes. Even though Keynes did not impose restrictions on the functional form, usually within Keynesian framework consumption is expressed as a linear function of income with a positive intercept. The linear formulation was supported by empirical findings of budget studies as Modigliani (1986) recollects in his Nobel Prize lecture.

The obvious implication stemming from Keynes' consumption function is that the fraction of income saved increases with income (for example Friedman 1957 and Branson 1972). Hence, the marginal propensity to consume out of income decreases as income rises. When this assumption of Keynes is applied to a cross section of a population, rich people could be expected to save proportionally more than poor people.

Post-Keynesians like Kaldor (1955 – 1956) divided income into earnings from labour and into profits by which Kaldor referred to income from property in general and not just to dividend income. Kaldor (1955 – 1956) assigned different propensities to consume out of the two forms of income. The marginal propensity to consume out of profits was to be smaller than that out of wages.

At first, empirical investigations on cross section data seemed to verify Keynes' theory. Current consumption expenditure was highly correlated with income. Moreover, when rich and poor households were compared with each other at one moment in time the proportion of income saved increased along with income. These facts have been recorded by Friedman (1957) and Branson (1972) among others.

Studies of consumption and saving behaviour on time series data, however, refuted Keynes' prediction that there is a downward trend in the ratio of consumption expenditure to income. Kuznets showed originally in 1946 that on average the fraction of income consumed had not fallen in the United States since the end of the 1860s although real income had increased substantially. Instead, his estimates summarised in Kuznets (1952) indicated that in the long run the ratio of consumption to income had remained more or less at the same level. On the other hand, in the short run this ratio did vary inversely with income due to cyclical fluctuations in economic environment as Keynes had postulated.

Kuznets (1952) also found that regardless of the marked rise in aggregate income the ratio of savings to income had secularly declined at the individual level. In other words, households had not saved a larger fraction of their income as they had become richer over time. Kuznets (1952) suggested that this phenomenon could be attributable to an increase in consumer demand. Branson (1972) states that in contrast to expectations based on Keynesian theory private demand increased sharply after World War II. It was proposed that during the war consumers were forced to accumulate an excess stock of liquid assets because of rationing. During the postwar era the decumulation of these assets resulted in a rise in consumption expenditure. Along with other contradictory evidence this phenomenon implied that consumption is not determined by current income alone, but it depends on assets or wealth as well.

One of the analytical attempts to account for the observed phenomena was Modigliani and Brumberg's (1980)[1] life cycle hypothesis. It was designed to reconcile the discrepancy between cross-sectional findings and the findings of time-series analysis. In addition, the model was meant to capture the effect of liquid assets on consumption.

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[1] The seminal paper of Modigliani and Brumberg was originally published in Kurihara, K.K. (ed.) (1954): *Post-Keynesian Economics*. Rutgers University Press, New Brunswick, New Jersey.

2.2. The Stripped-Down Life Cycle Model

Unlike Keynes' hypothesis, Modigliani and Brumberg's (1980) life cycle model is based on microeconomic theory of consumer choice. Modigliani and Brumberg (1980) assumed that the decision horizon of a finitely lived consumer consists of the whole life span instead of one period as in the static Keynesian and Kaldorian models. The consumer derives utility from his own aggregate consumption in current and in future periods. The decision problem of the representative agent is thus to maximise lifetime utility subject to total resources available to him over the life cycle.

In addition to current income, lifetime resources during age period *t* are comprised of assets owned at the beginning of the period and of discounted nonproperty income which the agent expects to earn during the remainder of his working life. It follows that the intertemporal budget constraint takes the form

$$(1) \qquad \sum_{i=0}^{T-t} \frac{c_{t+i}}{(1+r)^{t+i}} = A_t + y_t + \sum_{i=1}^{T-t} \frac{y_{t+i}}{(1+r)^{t+i}}.$$

In equation (1), c_t denotes consumption expenditure, y_t nonproperty income, and A_t assets during the *t*-th year of consumer's life. Interest rate, assumed to be constant, is denoted by *r*. *T* refers to the remaining years of life. According to Branson (1972), this budget constraint conveys the idea that the consumer can both borrow and lend in order to separate the time paths of income and consumption from each other as long as the present value of consumption does not exceed the present value of lifetime resources. Branson (1972) also asserts that the value of assets measured at the beginning of period *t* can be assumed to equal the present value of income from these assets if capital markets are reasonably efficient. Hence, there is some similarity between Modigliani and Brumberg's (1980) hypothesis and Kaldorian models. In the so called stripped-down version of the life cycle model, there is only one change in labour income. It takes place when the consumer retires. During the earning span of life income is constant, but after retirement it falls to zero.

What comes to the shape of the utility function, Modigliani and Brumberg (1980) assumed that preferences are homothetic. Furthermore, they insisted that the consumer neither inherits any assets nor intends to leave a bequest to his heirs. Consequently, the only way for the agent to accumulate assets is to save himself. On the basis of these two assumptions, Modigliani and Brumberg (1980) concluded that the representative agent plans to consume a constant fraction of his total lifetime resources over the remainder of his life span; that is, regardless of the change in income, the consumer aims to maintain the time path of consumption smooth. The assumption of homothetic preferences is not, however, required for this result to arise. It suffices to assume that marginal utility is decreasing (see for example Campbell and Viceira 2002).

After imposing the simplifying assumption that interest rate is zero, Modigliani and Brumberg (1980) arrived at the individual consumption function

$$(2) \qquad c_t = c(y_t, y_t^e, A_t, t) = \alpha_1 y_t + \alpha_2 y_t^e + \alpha_3 A_t$$

where y_t^e is expected average nonproperty income at the age period *t*. The coefficients α_i, $i = 1,\ldots,3$, depend on the age of the consumer. During retirement $y_t = y_t^e = 0$ by assumption, so that the consumption path of the retiree is described by the last term on the right hand side of equation (2) alone. Because the retiree finances his consumption by running down the assets accumulated over the working life, wealth holdings follow a hump-shaped age profile with a peak at the end of the earning span as stressed in Modigliani (1986).

2.3. Comments on the Life Cycle Model

One of the novel ideas of Modigliani and Brumberg (1980) was to include expectations into budget constraint. In their original paper they failed to specify the meaning of expectations; hence, their model is not closed and cannot be regarded as a truly intertemporal model. Later Ando and Modigliani (1963) amended this flaw in order to statistically test the life cycle model. They hypothesized that average expected income is a multiple of current labour income $y_t^e = \beta y_t,\ \beta > 0$. From the current point of view Modigliani and Brumberg's (1980) life cycle hypothesis is, naturally, a perfect foresight model. The time path of income is given and interest rate as well as price level are fixed by assumption. As a consequence, there is no uncertainty in the model.

The simplifying assumptions concerning consumer's opportunities and tastes which Modigliani and Brumberg (1980) made are obviously special and unrealistic. Two particularly drastic assumptions are the ones that interest rate is zero and that income is constant until retirement.

Deaton (1992) asserts that the introduction of a positive interest rate does not significantly change the main features of the life cycle model. In the beginning of the life cycle consumption path shifts downwards, whereas at the end it shifts upwards. Income path is more realistically described by a hump-shaped age profile. During the early years of working career income is typically low, but increases along with ageing. Eventually earnings decline at the end of the working career. According to Deaton (1992), in this case consumption smoothing implies that a young worker might in fact want to borrow rather than to save during the early years of his earning span.

Further incentives to borrow during the early years of the life cycle are offered by the presence of dependent children and productivity growth (Deaton 1992). In the stripped-down model there are only two phases of life, working life and retirement. It is assumed that consumer starts working and accumulating retirement wealth immediately after the birth, so that the additional burden children place on young workers is ignored. Productivity growth, in turn, may give rise not only to income growth across individual life cycles but also to income growth within them. Expected income growth encourages consumers to borrow and the larger the growth rate the more they want to borrow.

3. PERMANENT INCOME HYPOTHESIS

Contemporaneously with Modigliani and Brumberg (1980) Friedman (1957) developed his permanent income model in an attempt to explain the behaviour observed in cross-sectional budget studies. While the life cycle model focuses on the relationship between age, consumption, savings, and the accumulation of assets, the permanent income theory concentrates on the dynamic behaviour of consumption. In particular, the permanent income theory is concerned with the evolution of consumption expenditure over the short term and in relation to income.

Another central difference between life cycle and permanent income hypotheses is the length of the planning horizon. Modigliani and Brumberg (1980) introduced finite life span in order to extract the effects of systematic variations in income and in needs occuring over the life cycle that maturing, retiring and changes in family size cause. In contrast, Friedman's (1957) permanent income model applies to an infinitely long planning horizon.

Like the life cycle hypothesis, the permanent income model is founded on the assumption of individual consumer's utility maximisation. The maximisation of lifetime utility is, again, constrained by the requirement that all lifetime resources need to be exhausted. Because consumer makes his expenditure plans by taking into account expected lifetime income instead of income received during the current period, Friedman (1957) stressed the need to distinguish the concepts of consumption and current expenditure as well as those of income and current receipts from each other.

Friedman (1957) proposed that measured income, *y*, is the sum of two components the one of which is permanent component, y^p, and the other transitory component, y^t. According to Friedman (1957), the permanent component of income reflects the effects of the factors that determine the capital value or wealth of the consumer. Such factors include, for instance, the nonhuman wealth the consumer owns and personal characteristics that have an effect on the consumer's earning potential. As explained by Branson (1972), this means that the present value of the agent's future labour income stream, his human capital, is included in y^p. The transitory component, y^t, on its part is supposed to reflect the effect of the factors that the consumer has not been able to predict for one reason or another. By assumption, there is no correlation between transitory and permanent income, so that y^t is just a random variation around y^p.

In accordance with the definition of income, consumption expenditures are comprised of permanent, c^p, and transitory, c^t, components. By the permanent component of consumption Friedman (1957) referred to the value of planned consumption during a certain period which will maximise lifetime utility. Without uncertainty, permanent consumption would coincide with the value of actual expenditures. The transitory component of consumption is defined in the similar fashion as transitory income: it captures the effects of all other factors. The covariance between permanent and transitory consumption is assumed to be zero. Furthermore, Friedman (1957) assumed that there is no relationship between transitory consumption and transitory income.

Formally, Friedman (1957) presented the most general form of the permanent income hypothesis as a model given by the equations

$$\begin{aligned} & c^p = k(r,w,u)y^p \\ (3) \qquad & y = y^p + y^t \qquad . \\ & c = c^p + c^t \end{aligned}$$

Letters without a superscript denote current values, *r* is the rate of interest at which the consumer can freely borrow and lend, and *w* is the ratio of nonhuman wealth to income. Variable *u* symbolizes consumer's tastes and willigness to postpone consumption to the future, that is, the elasticity of intertemporal substitution. The ratio of permanent consumption to permanent income, $k(\cdot)$, is known as the marginal propensity to consume out of permanent income. It is independent of the size of the permanent income, but does depend on variables r, w, and u. The other two equations of (3) are identities that connect the permanent components of relevant variables with the measured magnitudes.

For the model to be closed, permanent income needs to be defined. As Friedman (1957) admitted himself, there are several possible definitions. According to the broadest of all, the permanent component of income is the result of any factors whose influence lasts more than one period. The narrowest definition, in turn, identifies the permanent component with expected lifetime income. On the basis of his empirical studies on time series data, Friedman (1957) suggested that the appropriate approximation for permanent income is given by a weighted average of current and past actual incomes with weights declining geometrically.

One particularly significant implication of Friedman's (1957) model is that the nature of income shocks matters. Since consumers make their decisions on the grounds of their estimate of the resources available over the life cycle, transitory shocks should not have as forceful an effect on consumption as permanent shocks have.

4. RATIONAL EXPECTATIONS PERMANENT INCOME HYPOTHESIS

In his famous article published in 1976, Lucas critisized the fixed distributed lag formulation used in empirical research to relate current and past observed income to expected income (Hall 1978). This practice naturally emanated from the work of Friedman (1957). As Deaton (1992) and Fernandez-Corugedo (2004) mention, Lucas argued that under rational expectations such a stable structure between observed and future income should not exist. Consumers make inferences about future income on the basis of realized income, so that changes in economic environment, like in policy, have an influence on the optimal way in which income forecasts are formed. Therefore, under rational expectations there is no reason for consumption to be eventually determined by observed income as the distributed lag formulation implies. Instead, consumption depends on current and expected income.

4.1. Assumptions of the Rational Expectations Permanent Income Hypothesis

Lucas' critique inspired Hall (1978) to adapt the life cycle-permanent income framework under uncertainty by assuming that in forming expectations about future variables consumers use all information available in period t. As Deaton (1992) points out, this assumption of rational expectations brings about the need to model income along with consumption. The need to model income as well stems from the fact that under rational expectations consumption depends on expected future income.

Hall (1978) considered a representative consumer who maximises the expected present value of his time-separable utility function

(4) $$\max\ E_t \sum_{i=0}^{T-t} (1+\delta)^{-i} u(c_{t+i}).$$

Here E_t denotes the mathematical expectation conditional on all information available during period t. Utility is defined over consumption, c_t, and each of the one-period utility functions, $u(\cdot)$, is – in a standard fashion – assumed to be strictly concave. The symbol δ refers to the rate of subjective time preference and T to the length of economic life.

The consumer is able to separate the time paths of consumption and income by investing in assets. The intertemporal budget constraint requires that assets next period equal current savings multiplied by their return

(5) $$A_{t+1} = (1+r)(A_t + y_t - c_t).$$

In equation (5), A_t is financial wealth at the beginning of period t and r is the real rate of interest. Hall (1978) assumed that the real rate of interest is constant over time and satisfies the condition $r \geq \delta$. The requirement that the rate of time preference does not exceed the interest rate is introduced to prevent impatient consumers from accumulating substantial liabilities. The notation y_t refers to earnings from labour. According to Hall's (1978) assumptions, earnings are stochastic and the only source of uncertainty. Although earnings are random, the consumer knows the value of current period's income, y_t, when he is choosing c_t. The only assumption about the stochastic properties of income that Hall (1978) made was that the conditional expectation of future earnings given today's information, $E_t y_{t+i}$, exists.

The first-order condition for maximising (4) subject to (5) implies the euler equation (Hall 1978)

(6) $$E_t u'(c_{t+1}) = \left[\frac{1+\delta}{1+r}\right] u'(c_t).$$

As Fernandez-Corugedo (2004) explains, equation (6) states that at the optimum the marginal cost of giving up a unit of consumption must equal the marginal benefit. The marginal cost is given by the right hand side of (6). The marginal benefit is the expected marginal utility of consuming the proceeds of the extra saving next period, $E_t u'(c_{t+1})$.

The Euler equation (6) as such implies Hall's (1978) principal finding: The only information available in period t having such an effect on the expected marginal utility that will help predict future consumption, c_{t+1}, is the level of current consumption, c_t. All past or otherwise predictable information is embodied in c_t, and hence all other information is irrelevant. In particular, current and past values of income and wealth have no predictable power whatsoever.

4.2. Consumption Evolution under Certainty Equivalence

On the basis of the Euler equation (6), it is not possible to derive explicit solution for consumption in general. However, for specific utility functions and assumptions about asset returns and labour income such a solution exists. Blanchard and Fischer (1989) and Fernandez-Corugedo (2004) provide the details. One of the main cases in which an explicit solution can be derived is that of quadratic utility.

Blanchard and Fischer (1989) postulate that with quadratic utility there is no need to impose any restrictions on labour income. The marginal utility is now a linear function of consumption. This property of the quadratic utility function is referred to as certainty equivalence. The term certainty equivalence is meant to describe the fact that it seems as if expected consumption was known with certainty. When it is further assumed for convenience that r equals δ the Euler equation simplifies to

$$(7) \qquad E_t c_{t+1} = c_t$$

which can also be stated in the alternative form

$$(8) \qquad c_{t+1} = c_t + \varepsilon_{t+1}.$$

In equation (8), ε_{t+1} is a disturbance whose conditional expectation given the information available in period t is zero, $E_t\varepsilon_{t+1} = 0$. It summarises the impact of all new information that the consumer receives during period $t + 1$ about his lifetime well-being.

According to (8), consumption follows a martingale. Given the information at time t, the best forecast about the level of consumption next period is current period's level of consumption. Deaton (1992) remarks that although (8) is often called a random walk it is not a random walk in a strict sense; the properties of the variance of ε_{t+1} are left unspecified.

Applying the formula (7) forward through time yields the condition

$$(9) \qquad E_t c_{t+i} = c_t$$

which formalises the notion of consumption smoothing as pointed out in Hayashi (2000). A consumer who wants to avoid fluctuations in the standard of living adjusts consumption in period t to such a level that no change in future consumption is anticipated.

Combined with the consumer's plan to exhaust all resources, assets and labour income, until the end of the life cycle, the intertemporal budget constraint (5) implies the following realised budget constraint:

$$(10) \qquad \sum_{i=0}^{T-t}(1+r)^{-i}c_{t+i} = A_t + \sum_{i=0}^{T-t}(1+r)^{-i}y_{t+i}.$$

Taking expectations of (10) conditional on information available at time t and applying the result of (9) gives the consumption function presented in Deaton (1992) as well as in Fernandez-Corugedo (2004)

$$(11) \qquad c_t = y_t^p = \lambda_t W_t = \frac{(1+r)-(1+r)^{-T}}{r}\left[A_t + \sum_{i=0}^{T-t}(1+r)^{-i}E_t(y_{t+i})\right].$$

Consumption, c_t, is equal to the permanent income, y_t^p. Permanent income is now defined as being a constant proportion, λ_t, of expected lifetime wealth, W_t, which is comprised of both financial and human wealth. In other words, consumption and further on permanent income equals the annuity value of total wealth. When T goes to infinity, the consumption function (11) simplifies to

$$(12) \qquad c_t = y_t^p = \lambda_t W_t = \frac{r}{1+r}\left[A_t + \sum_{i=0}^{\infty}(1+r)^{-i}E_t(y_{t+i})\right].$$

It is worth noting the point raised in Deaton (1992). The rational expectations permanent income model as presented here allows consumption to be nonpositive. This may produce absurd predictions. Furthermore, quadratic preferences rule out the incentives for intertemporal substitution that real returns on assets provide. Another unattractive feature of the quadratic utility function is that it implies increasing risk aversion. As explained in Blanchard and Fischer (1989) and in Campbell and Viceira (2002), increasing risk aversion means that the consumer is willing to pay more to avoid a gamble of given absolute size as wealth increases.

5. EMPIRICAL FINDINGS AND THE RATIONAL EXPECTATIONS PERMANENT INCOME HYPOTHESIS

There are two puzzles that challenge the empirical validity of the rational expectations permanent income hypothesis, if aggregate consumption is to be treated as that of the representative agent. These puzzles are known as excess sensitivity and excess smoothness of consumption

5.1. Excess Sensitivity of Consumption

Using the asset evolution equation (5), the first difference of the consumption function (12) can be written in the following form initially presented by Flavin (1981):

$$(13) \qquad c_t - c_{t-1} = \Delta c_t = \frac{r}{1+r}\sum_{i=0}^{\infty}(1+r)^{-i}(E_t - E_{t-1})y_{t+i}.$$

This formulation of the permanent income hypothesis gives a deeper insight into the martingale property of consumption. As Blanchard and Fischer (1989) and Deaton (1992) explain, equation (13) shows that the change in consumption, unpredictable at time t – 1, is determined by revisions in expectations about future labour income. Revisions in expectations, in turn, are attributable to new information revealed between

$t-1$ and t. If consumption is identically equal to permanent income in each period, then $\Delta c_t = \Delta y_t^p$. Thus, equation (13) links the revisions in expectations of future labour income with revisions in permanent income.

Campbell (1987) reminds that several authors, including Deaton (1986), have questioned the microfoundations of equation (13). It is the solution to a consumer's optimisation problem only under the familiar assumptions that restrict utility function to be quadratic and subjective time preference rate to equal interest rate. In addition, for (13) to hold exactly the consumer has to be effectively infinitely lived.

Since (13) is consistent with the equation (8) of the previous section, the present value of innovations in expected labour income is equal to the innovation in consumption, ε_t. Hence under rational expectations, the expected value of the revision in income expectation, $(E_t - E_{t-1})y_{t+i}$, is zero and equation (13) implies in accordance with Hall's (1978) hypothesis that conditional on information at time $t-1$, no lagged variable should help predict the change in consumption that takes place between periods $t-1$ and t. In particular, according to Hall (1978) all past information about future income is irrelevant, since that information is already incorporated in consumption at time $t-1$.

5.1.1. Flavin's Test for Excess Sensitivity

Because the innovation in consumption can be expressed in terms of labour income, it is possible to test the empirical validity of the implication that consumption follows a martingale by exploiting any information that might be available about future labour income. Flavin (1981) was among the first ones to take up this task.

Flavin (1981) argues that when rational economic agents form their expectations of future earnings, they will take into account the fact that income is a stochastic process which exhibits fairly high degree of serial correlation. Due to the serial correlation, the fluctuations in current income will be correlated with fluctuations in permanent income and further on correlated with changes in consumption. On the basis of this notion, Flavin (1981) introduced a test for excess sensitivity of consumption to income. For the test, equation (13) is extended to include lags of income change. The modelling and testing procedure itself consists of the joint esimation of the extended equation and an autoregressive specification for labour income. According to Deaton (1986), autoregressive models are well suited to describe the process governing actual labour earnings.

Under the null hypothesis that consumption follows a martingale, and hence that permanent income hypothesis is true, the regression coefficients of lagged income changes should equal zero. However, Flavin's (1981) results did not support the null hypothesis. Instead, the parameter estimates of lagged changes in income reported in her paper are statistically significantly positive. In other words, anticipated changes in income positively predict changes in consumption. This finding clearly contradicts the implication of the permanent income hypothesis. The phenomenon that consumption responds to anticipated changes in labour income is known by the name excess sensitivity.

5.1.2. Other Tests for Excess Sensitivity

In principle, Flavin's (1981) test for excess sensitivity is equal to the test Hall (1978) performed to find out if the change in consumption is orthogonal to lagged income, but their results are contradictory. Hall (1978) regressed current consumption on the first lag of consumption and on lags of income. On the basis of this regression, he found no evidence of a relationship between consumption and lagged income conditional on lagged consumption. Deaton (1992) suggests that the discrepancy in Flavin's and Hall's results may in part stem from the choice of sample period and in part from the modelling technique. Provided the restriction implied by equation (8), that the lagged consumption equals unity is correct, Flavin's (1981) test may be expected to be more efficient.

Excess sensitivity of consumption to income seems to be a characteristic feature of aggregate time series data in the United States and elsewhere. Subsequent literature, extensively overviewed in Deaton (1992), has not been able to refute Flavin's (1981) finding despite the improvements that have been made to econometric method she used. The purpose of these methodological improvements has been to increase the asymptotic efficiency of the test. For instance, the estimation procedure has been adapted to account for the possibility of nonstationary income as well as for the discrepancy between the lenght of the period over which data is measured and the length of the period over which consumers make their decisions.

Hall and Mishkin (1982) used micro data on food expenditure to test if consumption is responsive to expected fluctuations in income. Their excess sensitivity parameter is also statistically significant, but in contrast to parameters estimated using macro data the sign is negative. Hayashi's (1985) investigations on micro data have produced similar estimates. Furthermore, it is worth noting that Campbell's (1987) results show only weak evidence for excess sensitivity. Some of the theoretical explanations for the existence of excess sensitivity will be taken up after the introduction of a related puzzle, namely the excess smoothness of consumption.

5.2. Excess Smoothness of Consumption

5.2.1. Test for Smoothness of Consumption

The permanent income theory was ultimately designed to explain why consumption is smoother than income. According to the model, consumption is smooth because permanent income is smoother than measured income. Deaton (1986) has rendered the ability of the permanent income hypothesis to account for the smoothness of consumption expenditure suspect.

Formula (13) states that the change in consumption ought to equal the amount warranted by revisions in expectations about future labour income. The warranted consumption change can be calculated once a forecasting rule for labour income is specified. The standard practice, which Deaton (1986) also follows, is to describe the process generating income with a time series model. Flavin (1981) showed that when aggregate income is generated by a general ARMA process of order (p,q), the change in consumption is given by

$$(14) \qquad \Delta c_t = \frac{r}{1+r} \frac{1 + \sum_{i=1}^{\infty} (1+r)^{-i} \theta_i}{1 - \sum_{i=1}^{\infty} (1+r)^{-i} \phi_i} \varepsilon_t$$

where θ_i is the moving average and ϕ_i the autoregressive coefficient of the ARMA representation of income.[2] Equation (14) is valid not only for stationary process but also for nonstationary process which according to Deaton (1986) was shown by Hansen and Sargent in their paper published in 1981. A comparison between the consumption change predicted by (14) and actual change provides another means to check if the behaviour of (aggregate) consumption is consistent with the permanent income model.

Deaton (1986) found that there is no single time series model that is superior to all other models in describing the US quarterly data on aggregate income. The evidence presented in Campbell and Deaton (1987) tend to favour difference-stationary autoregressive representations. Deaton (1986) also claims that even though statistical tests cannot decisively tell the alternative models apart, on the theoretical grounds difference model of income is a plausible and attractive one.

5.2.2. Results of the Test for the Smoothness of Consumption

The estimated AR(1) models in first differences presented in Deaton (1986) and in Campbell and Deaton (1987) have positive autoregressive parameters. Hence, the multiplier of the income innovation ε_t in (14) should be greater than unity. In this case, the permanent income model predicts that the change in consumption should be larger than the innovation to income itself. This means that shocks to income process are more persistent than they would be if income followed a random walk. The deviations of income from its mean in either direction during a given period tend to be succeeded, at least partly, by subsequent deviations in the same direction.

Deaton's (1986) and Campbell and Deaton's (1987) findings of persistent and positively autoregressive income innovations further implies that changes in consumption ought to be more variable than innovations in measured income. The comparison of the predicted variance of the consumption innovation with the variance of the actual change showed that in reality this is not the case. The actual change in consumption was less variable than predicted by the permanent income hypothesis, that is, consumption is excessively smooth. The same result arises even though Campbell and Deaton (1987) take into account in their analysis the fact that consumers may have more information about their future labour income than econometricians do. In such cases, only a fraction of the estimated income shocks are actually unexpected from the consumer's point of view. In brief, consumption is indeed smoother than measured income, but instead of being consistent with the permanent income theory, smoothness in fact contradicts its prediction.

Above all, Cambell and Deaton (1987) were able to show that excess smoothness of consumption is essentially the same phenomenon as excess sensitivity. The reasoning

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[2] Flavin (1981) points out that although ARMA representation of income is applicapable at the aggregate level, it need not imply that individuals view their income as a pure time series when they form expectations about the future.

leading to this conclusion is elucidated in Deaton (1992). If consumption is not responsive to anticipated changes in income, then it must follow a random walk. The change in consumption is thus an unpredictable innovation and there cannot be excess sensitivity. Moreover, if consumption change is an innovation, it must be equal to the change in permanent income which in itself is an innovation. Therefore, consumption cannot be excessively smooth either.

6. DEVIATIONS FROM THE RATIONAL EXPECTATIONS PERMANENT INCOME HYPOTHESIS

6.1. Liquidity Constraints

The empirical failure of the certainty equivalent version of the permanent income model is often attributed to the presence of liquidity constraints. Deaton (1991) claims that besides being able to account for the excess sensitivity and excess smoothness of consumption, limited borrowing opportunities may help explain why consumption appears to track income quite closely over the life cycle and why most households hold very few assets. Both of these phenomena contradict the predictions arising from most versions of the permanent income-life cycle models.

In the permanent income model, the representative consumer is by assumption free to borrow and lend at the same riskless interest rate. However, all consumers are not necessarily able to borrow in order to finance their consumption needs that exceed the proceeds of contemporaneous labour supply. As mentioned in Attanasio (1994), in Deaton (1991) and in Zeldes (1989a), the standard argument for the presence of liquidity constraints is adverse selection problem arising from asymmetric information on consumer’s future earnings.

Liquidity constraints can take either of the following two forms (Attanasio 1994, Fernandez-Corugedo 2004 and Zeldes 1989a): (1) The consumer is not able to borrow at all or is unable to borrow beyond a certain positive limit. (2) The rate at which consumer is able to borrow differs from the rate at which he can lend. Fernandez-Corugedo (2004) argues that in both of these cases the resulting behaviour is very similar.

Following Deaton (1991), the effect of liquidity constraints on consumption can be analysed by modifying the consumer’s optimisation problem, comprised of maximisation of equation (4) subject to equation (5), to include the additional constraint

$$A_t \geq 0. \tag{15}$$

This is the simplest form for the borrowing restriction. It would be equally legitimate to assume some negative limit on assets (that is $A_t \geq -B$ where B is the limit on net indebtedness). The optimum of this constrained problem is described by the Euler equation

$$u'(c_t) = \max\left[u'(A_t + y_t), \beta E_t u'(c_{t+1})\right] \tag{16}$$

where $\beta = (1+r)/(1+\delta)$ and $A_t + y_t$ denotes current resources or cash in hand as Deaton (1991) calls it. If the liquidity constraint is binding, current resources are the maximum that can be spent on consumption. Clearly, the constraint (15) will bind if the marginal utility of current resources, $u'(A_t + y_t)$, is higher than the discounted expected marginal utility next period, $\beta E_t u'(c_{t+1})$. Otherwise, the optimum is described by the standard Euler equation (6). Consumption of the borrowing constrained agent is lower than that of the unconstrained agent. Furthermore, in the presence of binding liquidity constraints, consumption depends more on current resources and less on the present value of future income. Another method to investigate the impact of liquidity constraints on the optimal time path of consumption expenditure is the Euler equation approach used in Zeldes (1989a) and in Attanasio (1994).

Zeldes (1989a) stresses that compared to the case in which consumer is able to transfer resources from the future, the presence of liquidity constraints may lead to lower consumption even if the restriction is not in effect during the current period. Forward-looking consumer recognizes that the liquidity constraint may bind in the future. As a result, risk-averse agent lowers his current consumption.

Attanasio (1994) mentions that according to Hayashi’s paper from 1987, the expectation of future binding constraints is equivalent to a shortening of consumer’s planning horizon. Shortened horizon is the reason why consumption is more likely to depend on current resources than on future ones. This has been interpreted to imply Keynesian consumption behaviour. Zeldes (1989a), however, points out that restrictions on borrowing will not in general imply Keynesian behaviour. In the presence of currently binding liquidity constraints, the only valid form of Keynesian consumption function would be the specific example $c_t = y_t$. For this to hold, it is required that the consumer does not have any assets either at the beginning or at the end of period t. Therefore, the borrowing constraint must be binding during the previous period as well as during the current period. It follows that either the liquidity constraint is binding period after period, so that the consumer chooses never to save, or that there must be restrictions on both borrowing and lending. Yet, in general, borrowing constrained consumers are not constrained from saving. By saving they are able to smooth consumption in response to income fluctuations. Zeldes (1989a) argues that most individuals choose to save when they receive an exceptionally good draw of income. Hence, the behaviour of the liquidity constrained consumer is not, in general, consistent with the Keynesian theory of consumption.

Despite Zeldes’ (1989a) and Deaton’s (1991) supportive evidence, it is a controversial issue if the presence of liquidity constraints explains the empirical failures of the permanent income hypothesis. Zeldes (1989b) assumed that consumer’s preferences are characterised by an isoelastic utility function and showed that even in the absence of liquidity constraints consumption exhibits excess sensitivity. Deaton (1991) and Carroll (2001), in turn, have shown that impatience combined with precautionary motive for saving results in consumption behaviour that resembles the behaviour of a liquidity constrained consumer. Thus, the findings of Zeldes (1989b), Deaton (1991) and Carroll (2001) verify that many of the implications that can be derived from the presence of binding borrowing restrictions are also consistent with preference specifications that are more plausible than quadratic utility. These utility functions are discussed in Blanchard and Mankiw (1988).

6.2. Durable Goods

Hall's (1978) framework is based on the assumption of intertemporal separability of utility. Since the marginal rate of substitution between any two periods is independent of the level of consumption in any other period, separability rules out goods whose service flows provide benefits over several periods. Consequently, models with time-separable utility omit the existence of durable goods. Durable goods have been offered as an alternative for liquidity constraints in attempts to explain the empirical failures of the permanent income hypothesis, see for instance Hayashi (1985). In particular, it has been suggested that durable goods could rationalise the excess sensitivity of consumption to income.

Mankiw (1982) generalized Hall's (1978) framework to account for consumption expenditure on durable goods. Though the model is simple and does not take into account all the complexities related to durables consumption, it illustrates sufficiently enough the consequences of durable goods.

Since consumers derive utility from the service flow provided by durable goods, under the permanent income hypothesis they should smooth out this flow rather than the stock level of durables or expenditure on them. According to Fernandez-Corugedo (2004), the argument of the utility function (4) should therefore relate to the flow of services durables yield. As a result, the argument c_{t+i} is replaced by θK_{t+i} in Mankiw's (1982) model.[3] K_t denotes the stock of durables that provide services to the consumer. Parameter θ makes the service flow proportional to the stock that is, θK_{t+i} is the service flow.

Within Mankiw's (1982) framework, lifetime utility is maximised subject to two constraints. The first one

(17) $$K_{t+1} = (1-\gamma)K_t + c_{t+1}^d$$

describes the evolution of the durables stock. Parameter γ is the depreciation rate of the stock and c_t^d expenditure on durable goods. If γ is equal to unity, Mankiw's (1982) model reduces to that of Hall (1978). The second constraint is the asset evolution equation which is equal to (5) except for the consumption expenditure, c_t, that is changed into expenditure on durables, c_t^d.

The service flow of the durable consumption, θK_t, must satisfy an Euler equation similar to (6). Assuming that utility function is quadratic and that the time preference rate is equal to interest rate implies that instead of c_t the stock of durable goods, K_t, follows a martingale. On the basis of this result and equation (19), Mankiw (1982) arrived at

(18) $$\Delta c_{t+1}^d = \varepsilon_{t+1} - (1-\gamma)\varepsilon_t .$$

Equation (20) tells that the change in consumer expenditure on durables should follow an MA (1) process whose moving average parameter is a function of the depreciation

[3] This is a slight modification to Mankiw's (1982) original framework. The argument Mankiw (1982) used is the stock of durables, K_t. Despite the modification, the implications of the model are the same. The modified model is presented in Deaton (1992) and in Fernandez-Corugedo (2004).

rate of the durable stock. In the special case that Hall (1978) considered, $\gamma = 1$ and nondurables expenditure is a martingale.

Unlike expenditure on nondurables, expenditure on durables is predictable according to equation (18). The error term in this framework developed by Mankiw (1982) is comprised of two components of which ε_t is correlated with information available at time t. Because ε_t thus reflects past income innovations, durables expenditure should indeed be excessively sensitive.

Mankiw (1982) used quarterly US data to test the predictability of durables expenditure. His estimates indicate that in contrast to the implication of the theory, the level of durables expenditure follows a martingale, the same stochastic process that expenditure on nondurables and services follow. Caballero (1990) points out that this contradictory finding is consistent with Mankiw's (1982) model if the time interval is short enough, so that $\gamma \approx 0$. Once longer lags are allowed, the stochastic behaviour of durables expenditure is in accordance with that predicted by equation (18). The slow reversion of the aggregate series can, according to Caballero (1990, 1993), be explained by the permanent income framework. It only needs to be complemented to take into account the fixed transactions costs associated with durables purchases. Because of fixed costs, consumers generally let their durable stocks drift some way away from the optimum before they make an abrupt adjustment.

It is obvious that Mankiw (1982) implicitly assumed that the utility function is additively separable between durable and nondurable goods as well as leisure. Moreover, the utility function is assumed to be separable over time. Attanasio (1994) and references therein postulate that the observed correlation between changes in consumption and income innovations may just as well be attributable to leisure being nonseparable in utility from the nondurables as to liquidity constraints. According to Padula (1999) and Attanasio (1994), nonseparability between durable and nondurable consumption may also lead to behaviour that is observationally equivalent to the behaviour in the presence of binding liquidity constraints.

7. AGGREGATION OF INDIVIDUAL BEHAVIOUR

As is apparent from the discussion in previous sections, the results of the empirical analysis on aggregate data are interpreted within the permanent income framework although the theory applies to single individuals. More precisely, the behaviour of aggregate consumption is assumed to reflect the decisions of a representative agent.

In order for Euler equations to aggregate perfectly, three conditions need to hold (Deaton 1992). First of all, economic agents have to be infinitely lived. Instead of postulating that no one ever dies it may, marginally more realistically, be assumed that households form dynasties that live for ever.[4] Secondly, within period utility functions, $u(\cdot)$, need to be quadratic so that marginal utility functions are linear. Finally, the information about the economic environment available to individuals must be homogeneous.

[4] Alternatively, the time interval needs to be short. In this case, linearity is effectively satisfied under suitable assumptions on the evolution of returns as showed in Grossman and Shiller (1982). However, Deaton (1992) suspects the applicability of this result to quarterly or annual data.

According to Deaton (1992), the requirement of quadratic utility is likely to be the least essential. He shows that even if the condition fails it may be possible to define a consumption aggregate that approximates well the behaviour of micro consumption. On the other hand, Carroll (2000) strongly disagrees with this argument. Deaton (1992), however, suspects that the differences between micro and macro findings are likely to stem from the failure of the other two aggregation conditions.

7.1. Aggregation with Finite Lives

Clarida (1991) has demonstrated that in a life cycle model with finitely lived agents aggregate consumption exhibits excess smoothness relative to innovations in aggregate labour income. By assumption, labour income follows a random walk with drift both at the individual and at the aggregate level. The driving force behind this result is the fact that permanent shocks to aggregate income are transitory from the point of view of an individual worker. A permanent increment in labour earnings increases retirement saving, as the expected stream of consumption shifts to higher level. Hence, the marginal propensity to consume out of persistent innovation in income is less than one and it decreases monotonically with age. Consequently, the aggregate propensity to consume out of persistent income innovation, an average of the propensities of all working age cohorts, is significantly less than one.

Another noteworthy implication of Clarida's (1991) model is that changes in aggregate consumption are forecastable although individual consumption is assumed to follow a random walk. On the basis of Blanchard's paper from 1981, the reason for this is that the replacement of retirees with new entrants to the labour force and the difference in their consumption are predictable. Furthermore, because income grows from generation to generation as a result of productivity growth, there is an upward drift in aggregate consumption.

Despite its qualitative reconciliation with the theoretical predictions of the permanent income-life cycle framework and empirical findings, quantitatively Clarida's (1991) aggregate model does not perform all that well. The warranted change in aggregate consumption to an income innovation that Clarida's (1991) model predicts is still too large to account for the actual smoothness of the aggregate series. The model is not fully able to explain the extent of the predictability of consumption changes either.

7.2. Aggregate Information

When consumers observe aggregate income with a lag, the random walk version of the permanent income model holds exactly at the individual level. Yet the model is rejected in aggregate data. This conclusion is due to Goodfriend (1992). Miles (1997), on the other hand, believes that aggregate income variability poorly reflects the risks that are important for most consumers. Idiosyncratic shocks may be much more important to agents than the effects of economy-wide shocks. However, according to Pischke (1995), it is reasonable to assume that consumers are not particularly concerned with acquiring information on economy-wide variables. Aggregate information is not worth gathering because the gains from doing so are small.

The permanent income model considered by Pischke (1995) is the standard one with infinitely lived agents. Income is assumed to be comprised of two parts: a random walk with innovations, that are common to all individuals, and an individual innovation component. Individual innovations are white noise and uncorrelated across consumers which implies that in a large population they will sum to zero. When consumers are unable to distinguish the aggregate and individual income shocks, the observed income process takes a moving average form.

Using the formula (16) derived by Flavin (1981), Pischke (1995) showed that at the individual level consumption changes are a martingale with respect to the history of individual consumption and income. In contrast, changes in aggregate consumption follow an AR(1) process. The reason for this result is that individual consumers consider part of the aggregate shock as idiosyncratic and therefore as transitory. They adjust their consumption only by a fraction of what the persistence of the shock requires. During subsequent periods individuals make further adjustments to their consumption as they realise that their actual income differs from the expected one.

Both Goodfriend (1992) and Pischke (1995) are able to explain excess sensitivity and excess smoothness of aggregate consumption with their models. Because there is still discrepancy between the predicted and observed extent of these phenomena, neither information-aggregation bias, considered by Goodfriend (1992), nor incomplete information about aggregate variables, investigated by Pischke (1995), will provide the sole rationalisation for the empirical puzzles associated with the permanent income hypothesis.

8. LIFE CYCLE MODEL AND RETIREMENT

8.1. Retirement-Consumption Puzzle

The stripped-down life cycle model with one consumption good has been challenged by the observation that in the UK and the US consumption appears to decline during retirement (Banks, Blundell and Tanner 1998, Bernheim, Skinner and Weinberg 2001, Smith 2004 and Hurd and Rohwedder 2005). According to the model, forward-looking economic agents smooth out anticipated changes in income, earnings or annuities, in order to maintain a constant stream of consumption over the whole life span. Since income is likely to fall after retirement, it should be taken into account well in advance in the making of consumption decisions. Hence if retirement takes place as planned, consumption should not change at retirement.

The observed fall in spending at retirement has been labelled as the retirement-consumption puzzle. Several interpretations of this violation of the implication that consumption is smoothed over the life cycle have been proposed. Similarly with all the puzzles related to the life cycle-permanent income framework, economists have not been able to come to an agreement on the root cause of the retirement-consumption puzzle nor have they been able to reach a consensus as to whether such a puzzle even exists.

According to Hurd and Rohwedder (2005), there is no puzzle associated with the decline in consumption at retirement. They compared data on anticipated consumption changes at retirement with recollected changes following retirement and found that recollections were broadly consistent with anticipations. Smith (2004), on the other hand, stresses that the finding that spending is expected to fall in old age is not conclusive about the mechanism that causes actual consumption to fall.

Bernheim, Skinner and Weinberg (2001) consider that the retirement-consumption puzzle is not in accordance with forward-looking consumers making rational life cycle plans. Based on their study of the relations between accumulated wealth and consumption profiles, they suggest that people use rules of thumb in determining retirement saving. It follows that the adequacy of savings may become clear only after the time of permanent exit from employment. Inadequate savings require consumption to be adjusted downwards. Other rationalisations that Bernheim, Skinner and Weinberg (2001) consider are theories of mental accounting and models with dynamically inconsistent decision makers, that is, models with hyperbolic discounting.

It has also been suggested that the fall in consumption at retirement reflects a permanent decline in work-related expenditure or stocking up on durable goods prior to retirement. Both of these explanations have been, however, rejected by the data. According to Banks, Blundell and Tanner (1998), work-related expenses are not large enough to account for the observed decline in spending. Smith (2004) points out that the fall in spending at retirement captured by the studies is not necessarily the same as a fall in utility-producing consumption at retirement. If consumers stock up on durables immediately before retirement, their observed spending may fall, while their total consumption remains the same. The study by Miniaci, Monfardini and Weber from 2003 referred to in Smith (2004) shows no evidence of pre-retirement stocking up on durables.

As Smith (2004) and Hurd and Rohwedder (2005) explain, declining consumption on the part of the elderly is justified by the simple life cycle model with uncertainty if there are unexpected negative shocks to lifetime wealth. Banks, Blundell and Tanner (1998) believe that the proportion of the fall in consumption expenditure that they are unable to explain is evidence for unanticipated shocks taking place around the time of retirement. Retirement that occurs sooner than expected may consitute an unanticipated negative shock to lifetime wealth. Smith (2004) states that, for many, ill health or compulsory early redundancy is the main reason for early retirement in the UK. These factors reduce expected lifetime resources and make it necessary to adjust consumption downwards at retirement. The results of Smith's (2004) analysis on food spending are largely consistent with this interpretation. She found that when retirement is voluntary, that is occurs as planned, consumption is smoothed through the remainder of the life cycle. In contrast, food spending seems to fall when retirement is involuntary. Yet there is one group in Smith's (2004) study for whom retirement seems to be voluntary, but whose food spending falls.

One more rationale for consumption change around retirement is provided by a generalized version of the life cycle model in which utility depends on leisure as well as on consumption. If the utility function is nonseparable according to Smith (2004) and Hurd and Rohwedder (2005), consumption should not be smoothed over retirement.[5] As in the one-good model the condition of utility maximisation is that the marginal utility of consumption is smoothed across periods. In this case the smoothing of marginal utilities does not, however, imply that consumption itself should be smoothed. The

[5] According to Banks, Blundell and Tanner (1998), the nonseparability of consumption and leisure explains a significant proportion of the fall in consumption at retirement.

number of hours worked is rarely reduced gradually before retirement so that there is an abrupt increase in leisure when the working career ends. The one-off change in leisure at retirement combined with the nonseparability of the utility function causes consumption to change in a discontinuous fashion. If consumption and leisure are substitutes, the increase in leisure will lead to a reduction in consumption. Since the change in leisure at retirement is anticipated, the decline in consumption accords well with rational optimising behaviour.

8.2. Dissaving after Retirement

According to the stripped down life cycle model, assets accumulated during the working life are exhausted by the end of life. Due to the consumption smoothing, asset holdings should be clearly declining after retirement and the pace of the decumulation should be sufficiently fast in order for the intertemporal budget constraint to be satisfied. As underspending of the elderly implies, the actual behaviour of wealth by age does not seem to conform with this prediction. Usually the failure of wealth to decline with age is considered to be a characteristic of cross-section data. In fact, both cross-section and panel data evidence is mixed.

As Zeldes (1989b) summarises, in 1979 Mirer and later in 1983 Danziger, van der Gaag, Smolensky and Taussig argued on the basis of cross-section data that elderly do not dissave even at advanced ages. The opposite view was presented by Hurd in his 1987 article (Zeldes 1989b). Using panel data he showed that retired households do draw down their asset holdings. Subsequently Hurd (1990) has proved that wealth declines with age in cross-section data as well. Banks, Blundell and Tanner (1998) constructed a pseudo-panel. Since consumption appears to fall faster than income, they conclude that the elderly might even be resaving some of their retirement income. Furthermore, both Modigliani (1988) and Kotlikoff (1988) believe that the pace of the decumulation is too slow to be consistent with the stripped-down life cycle model.

Bernheim (1984) stresses that all forms of resources including Social Security and pension annuities must be considered when the life cycle model is tested. According to Hurd (1990), for example, a substantial fraction of the assets of the elderly is in the form of Social Security wealth. Once appropriately discounted value of benefits is included in total wealth, panel data evidence in Bernheim (1984) indicates that retirees dissave relatively little. In an interview by Barnett and Solow (2000) Modigliani insists that Social Security contributions should be treated as mandatory saving, income earned less consumption, and not as a kind of income tax. Pension, in turn, should be regarded as an income flow from accumulated pension claims rather than a handout. If these definitions are used, according to Modigliani pensions are largely consumed. Retirees are running down their Social Security wealth; they run down their own assets as well but not very much.

Zeldes (1989b) has proved that once the benchmark life cycle model is substituted by a model with random labour income and constant relative risk aversion utility function (isoelastic utility function) the low dissaving of the elderly accords with rational optimising behaviour. In a model like this, the agent is allowed to insure oneself against future contingencies, such as health shocks, with saving motivated by precaution.[6] With respect to the behaviour of an economic agent, the implications of the CRRA utility are in general more plausible than those of quadratic utility.[7]

Among the proposed causes for the slow dissaving of the elderly is uncertainty about the date of death. Hurd (1989, 1990) has shown using a life cycle model with uncertain lifetime that slow decumulation of wealth is associated with a rather smooth consumption path. According to his interpretation, modest current consumption and postponed decumulation are a means for a highly risk averse consumer to hedge against the possibility of having insufficient resources if he should live unexpectedly long. Davies (1981), on the other hand, claims that uncertainty over the length of life depresses consumption by a fraction that increases with age. The reduction in consumption then leads to lack of dissaving in old age.

The desire to leave a bequest is another leading justification for the fact that wealth does not appear to fall in old age as required by the simple life cycle model. As Banks, Blundell and Tanner (1998) and Hurd (1990) note, forward-looking behaviour implies that intended bequests lower consumption over a longer period of the life span and not just during the retirement. The time path of asset holdings should, however, be flatter. Moreover, a positive inheritance as such does not consitute evidence for an operative bequest motive. Because of imperfect annuity markets and uncertain lifetime, even a rational consumer will sometimes die earlier than expected and leave an unintentional bequest (Kotlikoff 1988 and Gale and Scholtz 1994). Dynan, Skinner and Zeldes (2002) argue further that bequest savings overlap with precautionary savings and hence are indistinguishable from each other.

9. CONCLUSION

According to the benchmark life cycle-permanent income framework, changes in consumption should be unforecastable. A rational forward-looking agent ought to smooth consumption over the life cycle and exhaust the asset stock accumulated during the working career in retirement. Empirical observations seem not to conform to these predictions of the simple theory of intertemporal choice which has given rise to elaborations on the benchmark model. Each modification adds to the understanding of the actual behaviour of consumption and wealth holdings. On the other hand, it is difficult to distinguish the underlying forces from each other and hence there is no consensus about what the evidence shows.

In addition to unpredictable shocks to income and uncertainty over the length of life, the consumer faces uncertainty over the rate of return on assets. Neither life cycle nor permanent income hypothesis allows for explicit relationship between consumption and portfolio choice. By suitably allocating his wealth across assets with different means and variances the economic agent is able to hedge his consumption stream against negative shocks to lifetime resources. Due to market imperfections, perfect hedging is,

[6] Generally, precautionary motive for saving arises when the marginal utility of consumption is convex (see for instance Deaton 1992 or Fernandez-Corugedo 2004).

[7] The specific feature of models with isoelastic utility is that changes in consumption are predictable provided there is a variable which helps to forecast future variations in consumption. On this ground, Deaton (1992) emphasizes that models with isoelastic utility are fundamentally different from the rational expectations permanent income hypothesis.

however, impossible. The way the consumer reacts to adverse shocks to his lifetime resources depends, among other things, on the length of his planning horizon and hence on the age of the consumer.

In the light of new information about the behaviour of long-term investors, the effect of monetary policy on asset allocation over the life cycle is an interesting avenue for future research. Interest rate is a central instrument of economic policy and changes in it may encourage the economic agent to change his consumption behaviour. Because consumption is at least partly financed with wealth, according to the prevalent view, monetary policy should affect asset allocation through consumption. It is not, however, self-evident that consumption determines saving; the causality may actually run the other way round.

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