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Permanent Income Hypothesis and Saving in Finland

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Abstract

The permanent income hypothesis combined with rational expectations has led to an important insight into saving as a way of offsetting the expected decline in labour income. This saving-for-a-rainy-day motive is tested and confirmed in Finland. The paper concentrates on evaluating the effects of financial liberalization on the saving rate. It is found that the saving rate decline in the late 1980s was largely a reflection of increased indebtedness. The collapse in the saving rate was due to expenditure on housing and durables as a consequence of relaxed liquidity constraints (downpayment ratio and reference rates) and increased income expectations (eg. lowered taxes). The current recovery in the saving rate has also been affected by the exceptionally rapid increase in unemployment that reflects increased uncertainty about earnings.

Changes in the aggregate saving rate are motivated by both backward and forward looking behaviour. According to estimates, the share of credit-constrained consumers could be as high as 30—50 percent. Habits and rules of thumb tend to make saving correlate with current and past income, whereas forward looking behaviour is underlined in the dependence of saving on income expectations and the real interest rate. Based on these three factors affecting the saving rate, we estimate an empirically well-fitting saving rate model. This separation, emphasizing both backward looking and forward looking determinants, can be understood intuitively by separating households into liquidity constrained and forward looking consumers. Therefore, saving rate changes can be explained as a reaction to ability to save (past and current income), willingness to save (income expectations and income uncertainty) and intertemporal price of consumption (real interest rate).

This paper also evaluates the criticism aimed at the rational expectations version of permanent income hypothesis for various anomalies, including excess smoothness and excess sensitivity of consumption. Empirical tests reject almost unambiguously the REPIH restrictions including orthogonality of consumption revisions to income changes and the smoothness condition for consumption variance. Excessive sensitivity of consumption to income changes is found, which casts doubts on stringent REPIH formulations of consumption functions that attempt to model saving without explicitly modelling liquidity constraints. The rest of the paper evaluates the precautionary buffer-stock theory of saving as an alternative to the PIH.

Tiivistelmä

Pysyväistulohypoteesia voidaan perustellusti pitää keskeisimpänä kulutus-säästämisfunktioteoriana. Milton Friedman (1957) jätti myös kaukokatseisesti teoriansa muotoilun riittävän väljäksi jatkotarkasteluja varten. Rationaalisten odotusten yhdistäminen pysyväistulohypoteesiin (Hall 1978) on sittemmin täsmentänyt ratkaisevasti kulutusta, tuloja ja säästämistä koskevien testattavien hypoteesien muodostamista. Teoreettisesta virtaviivaisuudesta huolimatta osa näistä oletuksista on ollut ristiriidassa Friedmanin alkuperäisten oletusten kanssa.

Rahamarkkinoiden vapautumista seurannut säästämisasteen romahtaminen sekä säästämisasteen nousu yhdistyneenä työttömyyden jyrkkään nousuun ovat

asettaneet erityisiä vaatimuksia säästämistä kuvailevalle teorialle. Säästämisasteen lasku Suomessa 1980-luvun lopulla liittyi likviditeettirajoitusten purkautumiseen ja velkaantumisen nousuun, joka johti kestokulutushyödykkeiden, asuntokaupan ja asuntoinvestointien lisääntymiseen. Tulo-odotusten nopea heikkeneminen johti kuitenkin nopeasti säästämisasteen nousuun. Teorian muodostuksen ja aikaisempien empiiristen tutkimusten perusteella säästämiskäyttäytymistä ei voida täysin selittää yhden teoriakehikon avulla. Pysyväistulohypoteesi pystyy kuitenkin ilmeisen hyvin selvittämään aggregaattimuuttujien dynaamisen kehityksen mm. säästämisen 'pahan päivän varalle' (Campbell 1987). Sen sijaan Flavinin (1993) muotoilemat rationaalisiin odotuksiin perustuvat systeemitestit pysyväistulon ristiyhtälörajoituksista (liikaherkkyys, tasaisuus ja ortogonaalisuus) eivät päde Suomen aineistolla. Eräs tulkintamahdollisuus näille havainnoille löytyy säästämiskäyttäytymisen erilaistumisesta taloudenpitäjäryhmien kesken. Osa kotitalouksista ei kykene säästämään, vaan toimii likviditeettirajoitusten alaisena. Vanhat suurempituloiset kotitaloudet vastaavat suurimmasta osasta syntyvää rahoitussäästämistä. Kaikesta päätellen säästämiskäyttäytyminen ei ole kovinkaan homogeenista toimintaa.

Selvityksessä tarkastellaan säästämisasteen selittämistä kolmen taustamuuttujajoukon avulla. Esityksessä argumentoidaan, että hyvän säästämisyhtälön ainekset sisältävät aina 1. nykytulon ja tulohistorian 2. tulo-odotukset sekä 3. kulutuksen intertemporaalisen hinnan. Vanhaa tulokehitystä tarvitaan likviditeettirajoitteisten kotitalouksien käyttäytymisen selittämiseen, vaikka kulutus periaatteessa olisikin eteenpäin katsovaa toimintaa. Taloudellista toimintaansa suunnittelevien kotitalouksien kulutus määräytyy sen sijaan tulojen ja nettovarojen muodostaman pysyväistulon funktiona. Asuntojen hintakehitystä tai velkaantumista voidaan käyttää apuna muodostettaessa käsitystä kotitalouksien tulo-odotuksista. Tämä perustuu asuntojen tuottaman palveluvirran ja tulevan tulokehityksen väliseen riippuvuuteen. Intuitio tälle on myös ilmeinen, sillä ihmiset maksavat asunnoista sen verran kuin mihin he arvioivat tulevaisuudessa olevan varaa budjettirajoite huomioonottaen. Tulevan kulutuksen ja nykykulutuksen suhteellista hintaa (ts. luottokorkoa) tarvitaan niinikään säästämisen ja kulutuksen lyhyen aikavälin dynamiikan selittämisessä.

Viime vuosina on julkaistu selvästi keskenään ristiriitaisia tuloksia aikasarja- ja poikkileikkaus (tai paneli-) aineistojen erilaisista tuloksista koskien varautumissäästämistä. Suomessa suurituloisilla työssäolevilla säästäminen on kasvanut, vaikka he eivät ennustaneet oman työttömyysriskinsä kasvua. Vaikka aikasarja-aineistolla löytyy selkeä varautumismotiivi pahan päivän varalle, tätä on vaikea löytää kyselytutkimuksista. Työttömyyden kasvu on merkinnyt tuloepävarmuuden kasvua, jota pysyväistulohypoteesi ei varsinaisesti käsittele. Tämän vuoksi lopussa arvioidaan lyhyesti myös ns. varovaisuussäästämisteoriaa (buffer-stock teoria, Campbell 1992). Varovaisuusmotiivin perusteella rahoitusvarallisuutta voidaan käyttää kulutuksen tasoittamiseen puskurina työtulojen vaihtelulle.

Contents

1 Introduction

Among both theoretical and empirical consumption functions Friedman's (1957) permanent income hypothesis (PIH) has gained a dominating position. The basic idea of consumption smoothing by replacing current disposable income with a notion of permanent income has widely been accepted. The permanent income hypothesis was at first only one proposed solution to the observed difference between the short-run and long-run propensity to consume out of disposable income. Friedman's idea was to decompose consumption and income into permanent and transitory components and to assume that consumption depends only on permanent component of income. Permanent income was originally operationalized as a sort of averaged or expected income, but it has been taken to be the annuity value of lifetime resources. This last interpretation brings PIH close to the life cycle theory. The emphasis in PIH is however more on short-run dynamics and dependence on income than in age and asset accumulation (Deaton 1992 p. 76).[1]

In addition to the proper measurement of permanent income, there is a discrepancy concerning the existence of temporary consumption. The random walk implications of the permanent income hypothesis depend crucially on the existence and form of the time series process for temporary consumption. Therefore results from testing the implications of the PIH have not been unambigious or straightforward to interpret, since there exist many different versions of the PIH.

Comparison of theoretical and empirical results therefore requires some clarification of the different operational assumptions concerning permanent income. Several early versions combine the PIH with the life-cycle hypothesis (LC-PIH) by assuming the decision horizon to coincide with the exogenously given lifetime.[2] Most of the interesting and far-reaching implications of the PIH have been attained when the PIH has been combined with "Muthian" rational expectations (Hall-Flavin REPIH) assuming an infinite horizon and expectations regarding the return on non-human and human wealth coinciding with permanent income. In addition there is a pure time series representation of the PIH (Sargent TS-PIH), which assumes that the cross-correlation function between temporary consumption and income is zero (Sargent, 1979 p. 322). This version relaxes most of the stringent implications of REPIH including Granger non-causality of income changes with respect to consumption. There are other assumptions that may be altered or relaxed with respect to the PIH. The representative agent formulation requiring separate utility functions, time separability of intertemporal consumption decisions, constant real interest rate and subjective time preference are examples of such assumptions.

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[1] The assumptions needed for PIH to be equivalent with life cycle models are quite severe and not harmless in practice, namely, infinite lives of consumers, quadratic preferences and a constant positive real interest rate that equals the rate of time-preference (Deaton 1992 p. 82).

[2] Insights gained from the life-cycle model differ to some extent from the PIH since it is assumed that the evolvement of consumption over a lifetime is not determined by income but rather preferences and life-cycle needs. Of course, the life-time budget constraint is to be fulfilled and lifetime resources determine the level of consumption, but anticipated income changes should not affect consumption (Deaton 1992 p. 25–26).

Empirical studies have found numerous potential anomalies in consumption behaviour with respect to permanent income, including excess smoothness of consumption, excess sensitivity of consumption to changes in labour income and rejection of cross equation restrictions posed on the system of savings and labour income. A wide range of tests and explanations has emerged concerning anomalies of the PIH (Quah 1990, Flavin 1985 and 1993, Deaton & Campbell 1989, Deaton 1992 and Falk & Lee, 1990).

This paper attempts to evaluate the PIH using Finnish data. The empirical part concentrates on testing both the random walk properties of consumption and the income and cross-equation restrictions of the PIH between savings and labour income. We also test the particular implication of REPIH viewing saving as an offset to earnings decline as proposed by Campbell (1987). The PIH also includes an implicit precautionary motive for saving. Therefore the purpose of the paper is focused in understanding the role of saving behaviour in consumption smoothing. The role of financial liberalization and the unemployment are studied in detail with respect to saving rate.

2 The basic permanent income hypothesis

Permanent income hypothesis can be modified so that consumption is equal to the yield of lifetime wealth (Flavin 1981, Quah 1990 and Deaton 1992)[3]

$$c_t = rW_t,$$

$$W_t = A_t + [(1+r)^{-1} \sum_{i=0}^{\infty}(1+r)^{-i}E_t y_{lt+i}],$$

$$A_{t+1} = (1+r)[A_t + y_{lt} - c_t]$$

Lifetime wealth (W) is the sum of physical non-human wealth (A) and the expected value of human wealth, which is based on the present value of future labour income (y_l). The current market value of non-human wealth consists of net wealth including financial wealth, real estate wealth and debt. It is assumed that non-human capital does not depreciate, although this is strictly true only for financial wealth and debt. However, the discounted present value of the future net yield (interest income – interest payments, imputed net rents etc.) of **net wealth is more or less directly observable** from the market value of net wealth. On the other hand expected human capital is **uncertain and unobservable** and also much larger than the stock of non-human wealth. However, what might be assumed is, that current labour income flow and expected permanent labour income should be cointegrated. Otherwise permanent income would be biased with respect to income in the long run, which conflicts with the assumption of rational expectations.[4] The value of human capital is sensitive to misfortunes like unemployment. The current return of human capital is directly observable from labour

[3] We might also assume that the principal is consumed in models where lifetime is finite.

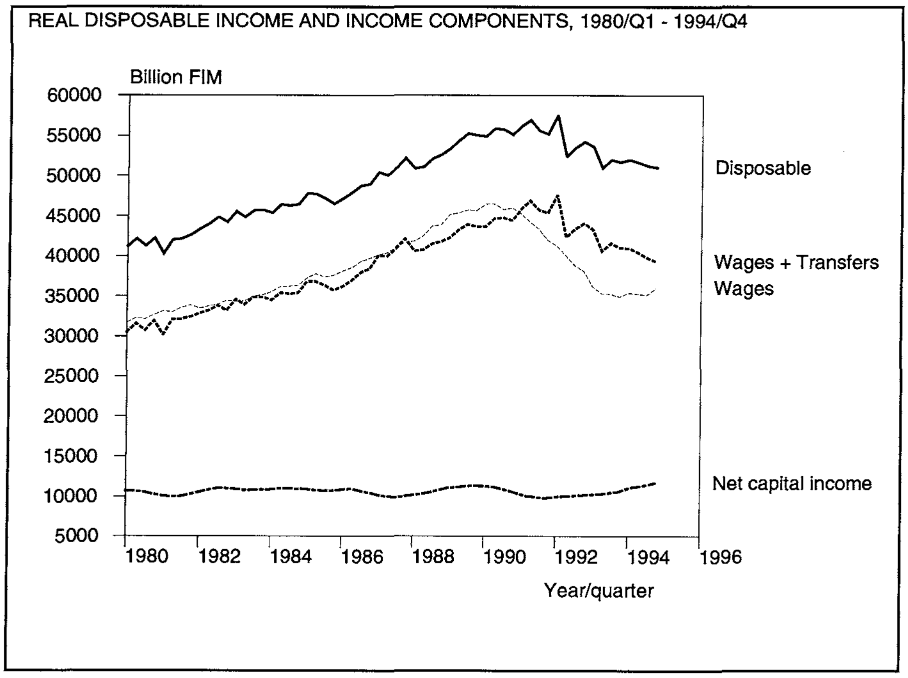
[4] In the Finnish data net capital income is stationary, but labour income and disposable income are integrated of order one.

income, but people may have in mind some expected more normal level of earnings. Return on non-human capital is not directly observable either, eg. the imputed rents from owner-occupied housing or land property are not realized in money terms neither are unexpected capital gains.

However, surely we might expect that disposable income and permanent income (in logs) are cointegrated over the long run, which assumes that the saving rate and real capital gains are stationary.[5] The permanent component of labour income should not be confused with permanent income, which also includes capital income (Quah 1990, p. 458). The difference between labour income and permanent income is the capital income annuity.[6]

Labour income is assumed here to be exogenous with respect to consumption decisions, in order to avoid modelling labour supply simultaneously, but total income depends on past decisions on consumption. For example purchases of real estate — especially debt-financed — restrict expenditure and imputed capital income. This formulation also includes the perfect capital market assumption of a constant real interest rate in borrowing and lending, which implies the absence of unexpected capital gains (Flavin, 1993). We may suppose, however, that the real interest rate is stationary in the long run.

Figure 1 **Income components**



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[5] Using the accounting identity Y = C + S, we can write log(S/Y) = log(1) – log(C/Y) = –log(C/Y).

[6] We may expect that a major part of net capital income is stable, since real interest rates should be stationary. Imputed rent from housing and utility from other durables are also likely to be very stable. The actuarial net capital income (gross interest income — gross interest payments and other capital income) has been very smooth in comparison to wages and income transfers, since household deposits and lending are close to each other (Figure 1). It is possible that both pairs, disposable income and y_{pt} as well as labour income and y_{pt}, could be cointegrated, since net capital income and transfer income could be stationary.

Friedman (1957) formulated the general PIH by arguing that consumption would be proportional to permanent income ($y_{pt} = rW_t$)

$$c_{pt} = \beta y_{pt}, \quad 0 < \beta < 1.$$

Permanent income is not identical to lifetime wealth, but rather to the yield of lifetime wealth. It should be noted that Friedman assumed that ß would be strictly less than one, which means that consumers could have a positive saving rate and positive bequest motive (Falk and Lee 1990). At death (in infinity) the value of human wealth (as well as consumption) falls to zero but non-human wealth could be left as a bequest and consumed eg. by the children. In this representative consumer framework, inheritances could be seen as a form of capital gain.

Thus Friedman assumed that consumption and income could be divided into permanent and transitory components

$$c_t = c_{pt} + \delta_t$$
$$y_t = y_{pt} + \eta_t,$$

where the subscript p refers to permanent. The idea was to separate temporary noise from a more fundamental perception of income and consumption, as these permanent components are unobservable. Since Muth (1960) suggested that permanent income could follow a random walk, it has been become acceptable to assume that consumption follows a random walk with noise, although this possibility was not strictly allowed by Friedman himself.[7] In the PIH the marginal propensity to consume (MPC) out of current income depends on the stochastic properties of income. If income is random walk then MPC is one. High values of MPC would result from binding liquidity constraints or highly autocorrelated income.

The observed near random walk of non-durable consumption gained a lot of attention after Hall's (1978) famous Euler equation formulation of the permanent income hypothesis. This formulation started from the infinite-lived representative consumer facing a utility maximization problem depending on time-separable utility and a momentary quadratic utility function with constant discount rate. Originally Friedman argued that consumers would smooth their consumption for about 3—5 years rather than over a lifetime.[8] Friedman himself used a geometrically declining weighted sum of past income as a proxy for permanent income. Assumption about the infinite life could be seen merely as a technical assumption or means to incorporate intergenerational aspects into utility maximization. Flavin (1981) continued the formalization of Hall's rational expectations version of PIH by testing the relationship between current income to permanent income (consumption).

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[7] To make these definitions operational, Friedman proposed that both transitory components would have mean zero and finite variances and be uncorrelated with the permanent components and uncorrelated with each other. Therefore the following unconditional expectations hold $E(y_{pt}\eta_s) = E(c_{pt}\delta_s) = E(\eta_t\delta_s) = 0$, for all t and s.

[8] Even though long-run evidence on the relationship between consumption and income is strong, Deaton (1992 p. 208) concludes that these variables are largely detached in the short run. Despite this, the evidence is in favour of a consumption planning horizon of only few years rather than a lifetime (see also Carroll and Summers 1989).

Following the Hall-Flavin version of PIH, consumption is defined as the annuity value of an agent's net worth, which includes both the present discounted value of expected future labour income and non-human wealth (Flavin 1993)

$$c_t = \beta\, y_{pt} = \frac{r}{(1+r)}\,[A_t + \sum_{i=0}^{\infty}(1+r)^{-i}\, E_t y_{lt+i}]$$

$$= \frac{r}{(1+r)}[A_t + y_{lt} + \sum_{i=1}^{\infty}(1/1+r)^{i}\, E_t y_{lt+i}],\ 0<\beta\leq 1.$$

where A_t denotes real non-human wealth, r real rate of return and y_{lt} labour income. The Hall-Flavin formulation of PIH leads to the random walk property of consumption, which is based on the absence of transitory consumption ($\delta_t = 0$). It may seem unreasonable to assume that consumers are able to separate innovations into labour income to permanent and transitory components. If the coefficient of proportionality (ß) is not unity then permanent and transitory income will be correlated and not orthogonal (Falk and Lee 1990 p. 269).

In the PIH, consumption depends on integrated non-human wealth and income from human wealth, which could be separated into known current earnings and expected discounted value of future labour income. Since the future path of income is uncertain, consumption plans will be revised as new information about future income becomes available, ie.

$$\Delta c_t = c_t - c_{t-1} = \frac{r}{(1+r)}\,[\Delta\, E_t y_{lt} + \sum_{i=1}^{\infty}(1+r)^{-i}\,\Delta\, E_t y_{lt+i}]$$

$$= \frac{r}{(1+r)}\sum_{i=0}^{\infty}(1+r)^{-i}\,\Delta\, E_t y_{lt+i}$$

It is seen that consumption change is a function of **expectation revisions** of current and future labour income. Once the exogenous labour income process is specified, changes in consumption can be tested against the excess smoothness or sensitivity hypotheses.

2.1 Permanent income and unexpected capital gains

The possibility of unexpected capital gains from non-human wealth was previously ruled out by the assumption that the rate of return of real assets, r, is constant. Therefore only human capital was uncertain in the model. In reality unanticipated capital gains and losses due to net wealth may have an important effect on representative agent consumption. If we decompose the yield of real estate wealth (housing, land, summer cottages etc.) or stocks into capital income (rents or imputed rent) and appreciation (price change), we notice at once that the latter part dominates the short-run variation (Figures 2—3).

Figure 2 **House and stock prices**

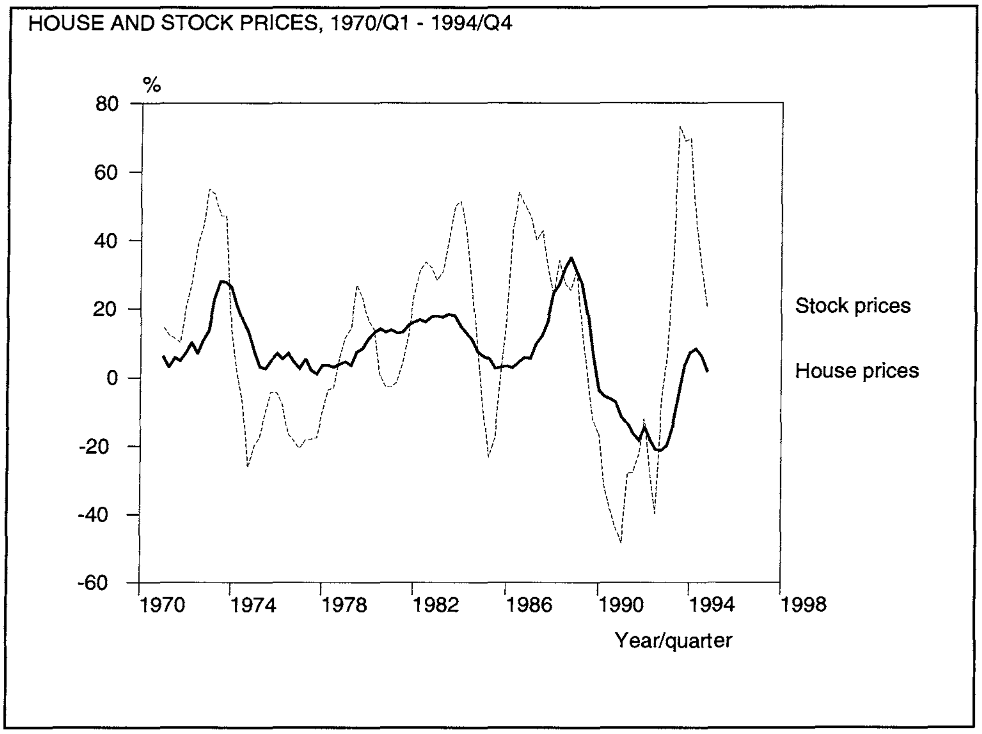
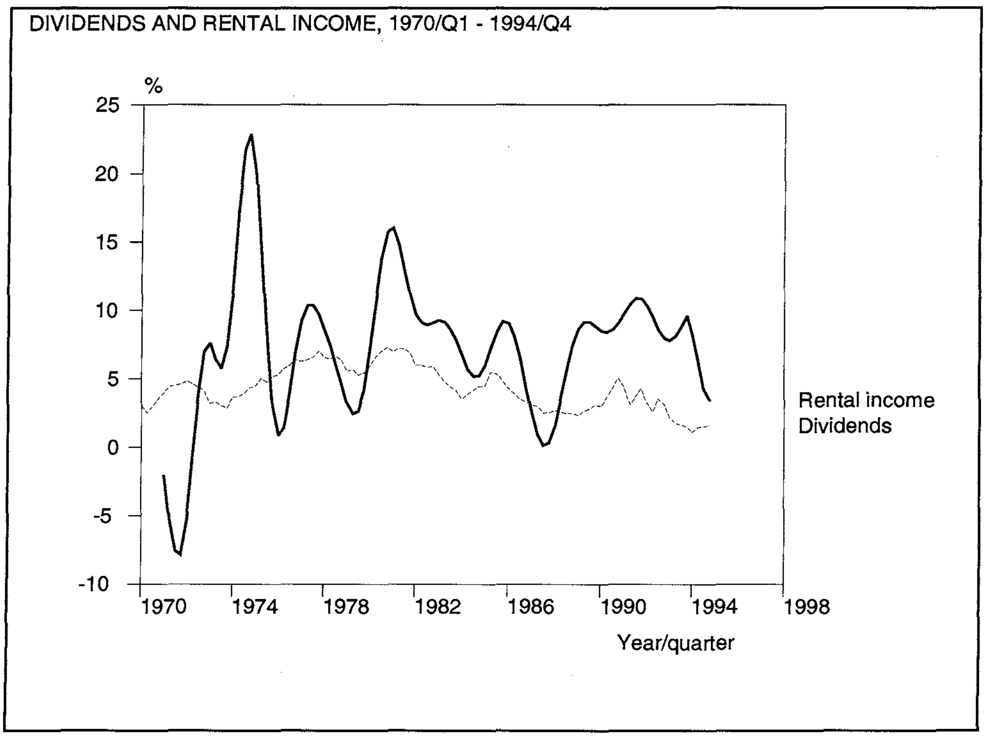


Figure 3 **Dividends and rents**



In the housing market price changes due mainly to demand shocks — albeit probably related to excessive credit supply — also correlate with the business cycle.[9] It could be argued, however, that on the aggregate level, eg. capital gains due to housing purchases, deposit return and borrowing interest payments will be equated through a zero-sum game within the household sector. Of course these changes could have equalizing or unequalizing distributional effects, which may be hard to observe.[10]

The change in net non-human wealth can be written as the following

$$\Delta A_t = A_t - A_{t-1} = P_t Q_t - P_{t-1} Q_{t-1} =$$
$$P_t Q_t - P_t Q_{t-1} - P_{t-1} Q_{t-1} + P_t Q_{t-1} =$$
$$P_t \Delta Q_t + \Delta P_t Q_{t-1} \approx s_t + \Delta G_t$$

where s_t is net savings and ΔG capital gains. The first term in the equation reflects the accumulation of wealth through net savings. The second term describes the change in the value of assets due to price changes. NIPA concept of property income in principle includes the imputed rental income from owner-occupied housing but not capital gains on illiquid assets. A proposed correction of this bias is to use non-property (labour) income instead of disposable income. Analogously, the saving rate could be calculated with respect to labour income (Muellbauer 1994, p. 7).

If there are no capital gains, the change in net wealth is equal to net savings. It is further assumed that in nominal terms financial wealth and debt are not subject to depreciation; in real terms depreciation due to expected inflation is taken into account in interest rate premiums, as the nominal interest rate consists of the real rate of interest and the expected inflation rate. Real estate wealth is to some extent subject to depletion and technical depreciation even when it is not a consequence of asset consumption. The total return on an asset comprises of capital income and capital gain due to changes in relative prices.

The assumption of no depreciation and constant interest rate combined with exogenously determined labour income also restricts the behaviour of A_t to be purely endogenous in the model (Flavin 1993, p. 654). The dynamic evolution of assets is determined by

$$A_t = (1+r)[A_{t-1} + y_{lt-1} - c_{t-1}]$$
$$\Delta A_t = rA_{t-1} + (1+r)(y_{lt-1} - c_{t-1})$$

and using the accounting definition of savings

$$s_t = (r/1+r)A_t + y_{lt} - c_t$$

[9] House price changes could due to rising markets because of significant downpayment ratio depending on buyer liquidity. In falling house price markets the ability of house movers is reduced for the same effect, which affects negatively to the transaction volume in housing market.

[10] In an open economy shifts in terms of trade could cause unexpected capital gains and losses between the home country and foreign countries.

we get the relationship between savings and asset accumulation

$$s_t = \Delta A_{t+1}/(1+r).$$

Using the savings definition for writing consumption as

$$c_t = \frac{r}{1+r} A_t + y_{lt} - s_t$$

and calculating the difference

$$\Delta c_t = \frac{r}{1+r} \Delta A_t + \Delta y_{lt} - \Delta s_t$$

we may modify this equation, using

$$\Delta A_t = (1+r)s_{t-1}$$

as follows

$$\begin{aligned} \Delta c_t &= \Delta y_{lt} + (1+r)s_{t-1} - s_t \\ &= \Delta y_{lt} - \Delta s_t + rs_{t-1} \end{aligned}$$

This equation points out already **how lagged saving reveals information about how consumption will change** (see Deaton 1992, p. 129). However, this is merely an actuarial relationship and changes in savings affect consumption through changes in income.[11]

This dependence is in accordance with the Hicksian notion of savings apart from the zero-restriction imposed on unanticipated capital gains. This restriction may not be crucial if we consider long-run relationships but is strongly rejected on short-run evidence.

Flavin (1981, p. 988) defines unanticipated capital gains as the present value of the revision in the **expected capital income**

$$\Delta G_{t+1} = \sum_{i=0}^{\infty} (1/1+r)^{i+1} \Delta E_{t+1}\, r_{t+i} A_t,$$

where $\Delta E_{t+1} = E_{t+1} - E_t$.

The evolvement of capital income reflects changes in the return of capital (r_{t+i}) and endogenous changes in labour income, which are reflected in the value of non-human wealth (A_t). The expression is based on the fact that the current stock of non-human wealth can be written as the present value of the future

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[11] Using the above definitions it can be verified also that savings is the difference between total income and consumption:

$$\begin{aligned} s_t &= r[A_{t-1} + y_{lt-1} - c_{t-1}] + y_{lt} - c_t \\ &= y_{kt} + y_{lt} - c_t, \end{aligned}$$

where y_{kt} is capital income, y_{lt} is labour income and c_t total consumption.

stream of labour income. The intuition behind this is straightforward; the value of non-human wealth is related to earnings through imputed rent describing the value of consumption. Non-human wealth has value only through expected value in consumption. The value of this utility is related to the affordability of durables and real estate wealth. Earnings affect reproduction costs of assets, although few assets like land are not reproducable. The ratio of assets to income tends to vary over the business cycle, which relates to changing income expectations. The cyclical variation of the net wealth/income ratio points out that we should not expect a stable relationship between the real interest rate and asset values.

Therefore, assuming no depreciation

$$A_t = \sum_{i=0}^{\infty} (1/(1+r_{t+i}))^{i+1} \, r_{t+i} A_t,$$

which simplifies to the following with constant interest rates (r_t=r)

$$A_t = \sum_{i=0}^{\infty} (1/1+r)^{i+1} \, rA_t.$$

Flavin (1981) seems to feel that changes in the rate of return to capital r_{t+i} would be larger than valuation changes in non-human wealth, A_{t+i}. This is true if we consider only the stream of observed capital income, but is unclear when we consider the unobserved expected capital income, including capital gains. Portfolio reallocation decisions are still based on expected real after-tax returns.

Again, using the permanent income formulation,

$$c_t = y_{pt} + \delta_t = r[A_t + \sum_{i=0}^{\infty}(1/1+r)^i \, E_t y_{lt+i}] + \delta_t$$

which gives the consumption change evolution

$$\Delta c_t = r[\sum_{i=0}^{\infty}(1/1+r)^i \, \Delta E_t y_{lt+i}] - (1+r)\delta_{t-1} + \delta_t.$$

Flavin (1981, p. 989) shows that unanticipated capital gains in non-human (physical) wealth can be incorporated into the consumption function in the same way as labour income

$$\Delta c_t = r[\sum_{i=0}^{\infty}(1/1+r)^i \, \Delta E_t \, (y_{lt+i} + y_{kt+i})] - (1+r)\delta_{t-1} + \delta_t,$$

where y_l refers to labour income and y_k to capital (non-labour) income.

This result shows that **unexpected capital gains can affect consumption in the same way as revisions in labour income**. Expectations affect consumption decisions, as they are considered to be permanent. And because they can change through revisions and we cannot directly observe them, we discover their effects through consumption. Revisions of non-capital income can include unexpected changes in earnings and income transfers. In this sense money is not ear-marked. Anything that ends up in the hands of a representative consumer as a resource that could be used for consumption or saving must be taken into account. In practice the problem is to formulate a proxy for unanticipated capital gains. One question concerning the permanent income hypothesis is the appropriate measure for labour income. Especially during current recession it has become clear that wages are not the proper measure of labour income. The role of income transfers has increased in maintaining and smoothing disposable income (Figure 1). This effect is due mainly to unemployment benefits and other forms of social transfers. Therefore, the variability in permanent income can not be approximated by using variability in earnings alone. In addition it is misleading to use just the labour income of the head of the household as a basis for the present value of human capital.

2.2 Restrictions on the permanent income hypothesis

2.2.1 Orthogonality

The most striking implication of the REPIH with quadratic preferences is the random walk property of non-durable consumption (Hall 1978). In practice this means that consumption changes are unpredictable. Another implication of this equation is that no variable dated at t−1 or earlier should affect consumption at t. This is the martingale difference property of consumption changes. Using this implication recursively, there should not be any present variable that can forecast future changes in consumption. Current consumption should include all the relevant information about the expected permanent income. This implication could be tested using Granger causality tests.

In empirical tests, it has frequently been found that consumption changes can be explained to some extent by lagged income changes (Flavin 1981). Hall (1978) himself found that stock price changes predict consumption revisions, although he concluded that the evidence was otherwise quite favourable to the REPIH formulation. His main result was that lagged income changes did not predict consumption changes in the US. On the other hand, current income changes are correlated with permanent income innovations and cannot therefore be included in the PIH consumption function.[12]

The martingale property of consumption implied by the REPIH depends critically on the existence of temporary consumption. Quah (1990) has also shown, that the excess smoothness property due to the REPIH version is related to the difference stationarity of labour income changes. If labour income is assumed to be trend stationary, excess smoothness of consumption does not exist.

The unpredictability of consumption with respect to income changes is closely related to aggregation time interval. Empirical tests with Finnish data have shown that the relationship between consumption and income is a feedback relationship and consumption cannot be analysed without specifying the labour income process (Takala 1995). In empirical tests we must choose the testing time interval. This could certainly have some effect on test results. Theory does not say much about the proper economic decision horizon, but we may assume that consumption decisions could be related eg. to the income process (monthly wage payments etc.). Aggregate economic data is unfortunately available at best on a quarterly basis. If the planning horizon for consumption is short and the time-aggregation of the data is long, endogeneity bias is likely in the results. Intuitively

[12] The pure time series versions of PIH do not imply that consumption evolves as a random walk. Therefore it is also allowed that other variables may Granger cause changes in consumption (Sargent 1979).

this can be understood by considering the long-run cointegration between consumption and income. The question of planning horizon is indirectly addressed by the spectral and bivariate spectral analysis performed on consumption and income in section 3.2. The results from a questionaire concerning the economic planning horizon are presented later in section 3.6.

2.2.2 Excess smoothness

The desire for smoothing consumption follows from the need to maximize utility under the assumption of concave utility functions. This idea has been formulated more precisely as the martingale property of the marginal utility process (Deaton 1992). However, Campbell and Deaton (1989) showed consumption smoothing does not follow directly from PIH if permanent income has a unit root and temporary consumption is absent. Deaton (1987) argued that consumption could be even too smooth with respect to noisy permanent income. If income shocks are highly permanent and income is a random walk series, then under the REPIH consumption should be as volatile as income. Since we know this is not the case, we must have some explanation of the false assumptions in the REPIH that cause this. Evidently, this excess smoothness hypothesis also depends crucially on the existence and variance of temporary consumption.

The excess smoothness of consumption relative to income depends on the result that permanent income is more volatile than actual income, which is based on the assumption that transitory income is perfectly negatively correlated with permanent income. In addition this result assumes that observed income will have unit root with positively autocorrelated first differences (Falk and Lee 1990, p. 281). This contradicts Friedman's original assumption that permanent and transitory income are uncorrelated. Likewise the pure time series version of PIH does not imply random walk consumption. In fact, it does not imply Granger non-causality of income changes to consumption changes either.

If ß is one ($c_t = y_{pt}$) permanent income is a martingale, and current consumption should diverge from the previous-period consumption by the current revision in permanent income. A martingale process keeps a record of the expected value, but allows heteroscedasticity in the residuals eg. ARCH-residuals in the consumption process. Therefore the residuals of the random walk model do not need to be pure white noise. At least, the residuals should be serially uncorrelated innovations with time-varying variance. However, ARCH residuals are rather rare in empirical tests of non-durable consumption. Permanent income and consumption will evolve as pure random walks only if the transitory consumption is identical to zero ($\delta_t \equiv 0$).

Divergence from Friedman's own formulations would be appropriate, if these further restrictions would be consistent with empirical evidence. So far it seems that this is not the case. However, it must be remembered that Friedman's original formulation is somewhat loose and vague, and therefore it is not surprising to find that restrictions are rejected. Muellbauer (1994, p. 15) discusses a sort of return-to-normality behaviour of rational consumers, when they observe wide gaps from potential long-run growth. He argues that there are forces (like policy makers) in the economy that try to turn the economy around to a more balanced growth path. Therefore rational consumers will expect permanent income to be smoother than current income and as an implication of this there would not be any excess smoothness.

2.2.3 Excess sensitivity

By excess-sensitivity consumption is meant the phenomenon that consumption responds excessively to changes in labour income. This is in contradiction with the REPIH implication that consumption changes should be orthogonal to the known information at the time consumption decisions are made. Usually these tests are performed with the assumption that at time t representative consumers know all the relevant variables dated at t–1. Information lags could therefore be one reason for correlation between consumption and income changes. However, if income follows a stochastic process, then a positive contemporaneous correlation appears between income and consumption. However, the most common reason mentioned for correlation between consumption and income is liquidity constraints. Consumers are defined to be liquidity constrained if they would like to increase their consumption by borrowing.

We first consider the excess sensitivity evidence using a weaker form test, regressing changes in consumption on income changes and income expectation revisions. The null hypothesis is that income changes or income expectations revisions should not predict changes in consumption, since the relevant information about future labour income is incorporated already in the consumption level. As the income expectations and expectation revisions are unobservable, we used a simple AR(2) model to decompose the income process into anticipated and unanticipated parts.[13]

Following Deaton (1992, p. 87–91) the excess sensitivity hypothesis can be written as consumption changes responding to current and lagged income changes

$$\Delta c_t = \mu + \beta_1 \Delta y_t + \beta_2 \Delta y_{t-1} + \theta \varepsilon_t + u_t,$$
$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \alpha_2 y_{t-2} + \varepsilon_t,$$

where the parameters ß measure the excess sensitivity. If the PIH is true these parameters will be zero. In addition to the moving average terms of the income process, the equation also includes an additional error term in the consumption equation. This, u_t, term could be interpreted as a measurement error or temporary consumption (Ermini 1989). If u_t and ε_t are assumed to be correlated, parameter θ is not recoverable.

Combining the above mentioned reduced form of the income process with the consumption changes, we obtain

$$\Delta c_t = (\mu + \beta_1 \alpha_0) + (\beta_2 - \beta_1(1 - \alpha_1))\Delta y_{t-1} - \beta_1(1 - \alpha_1 - \alpha_2) y_{t-2} + u_t + (\beta_1 + \theta)\varepsilon_t$$
$$y_t = \alpha_0 + \alpha_1 \Delta y_{t-1} + (\alpha_2 + \alpha_1) y_{t-2} + \varepsilon_t$$

This system is exactly identified and therefore OLS is equivalent to FIML estimation (Deaton, 1992 p. 89). However this system cannot be estimated as such

[13] The fitted values from an AR(2) model are somewhat more variable than e.g. the trend of an estimated structural time series model.

if income is not a stationary process, which is more or less the stylized fact. Provided that the lagged saving ratio has predictive power for the change in labour income, the orthogonality condition and the condition for smoothness are identical. This will happen when consumption and disposable income are cointegrated. If consumption changes cannot be predicted by past changes in consumption itself or income, current consumption change must be equal to the change in permanent income under the REPIH (see Campbell and Deaton 1989).

Deaton (1992 p. 93—94) is also concerned with additional econometric problems due to the joint presence of integral regressions on the right hand side of the regression, which affects the power of the excess sensitivity tests. Asymptotic failure is encountered with integral regressors. These problems can be avoided by considering an asymptotically valid test proposed by Stock and West (1988). The model is written as

$$c_t = b_0 + b_1 c_{t-1} + b_2 \Delta y^d_{t-1} + b_3 y^d_{t-2} + u_t,$$

which can be written as

$$c_t = b_0 + (b_1+b_3)c_{t-1} + (b_2-b_3)\Delta y^d_{t-1} + b_3 s_{t-1} + u_t,$$

where savings $s_t = y^d_t - c_t$ and y^d_t is disposable income. In this model parameters b_2 and b_3 measure the excess sensitivity, which can be properly estimated even if the regression includes I(1) integrated variables like lagged consumption and the linear time trend (Sims, Stock and Watson 1990).

A natural interpretation of excess sensitivity is the existence of liquidity constraints. Consumers may be unable to borrow sufficiently to fulfil their expectations about future income. Therefore a revision in income expectations could have a large effect on permanent income and consumption. Another direct consequence of liquidity constraints is that consumers cannot realize expected income increases and they will have to wait until income rises are realized. This may cause excess reaction to realized disposable income.

Excess-sensitivity results may be subject to bias since consumers could be able to predict their labour income more accurately than simple econometric models (Quah 1990 and Flavin 1993). If the PIH is correct, expectations of future earnings could be revealed from saving behaviour.[14]

A somewhat different way to deal with liquidity constraints is to start with the assumption that there are two district types of consumers (Darby and Ireland 1993). Those consumers who are credit constrained may be limited to consume only their current income. In this sense their consumption is based on habits and current earnings. The other group of agents is able to smooth their consumption by lending. This group of forward looking consumers can plan their consumption based on their net wealth, ie. their consumption is determined by the sum of expected future earnings and value of net financial and physical wealth.

In a two-variable VAR system for labour income and saving, it is possible to verify that if consumption is a random walk, there is no need to test excess sensitivity since the consumption innovation equals the change in permanent

[14] Orthogonality tests for consumption changes are, moreover, not affected by agents possible superior information, since consumption revisions should be orthogonal to any current and past information (Deaton 1992, p. 122).

income (Deaton 1992, p. 130). In this case the excess smoothness test is no different from the test of excess sensitivity, since consumption is orthogonal to any lagged information. This result also allows for the possibility that consumers might be better informed than the econometrians studying the consumption patterns.

3 Empirical tests

3.1 Random walk properties of consumption and income

The important question in predictive models about consumption is surely how good a forecast we expect to get. This is relevant, because of the proposed randow walk property of consumption based on the Euler equation approach. Economic theory should give us the set of explanatory variables that affect consumption, but it cannot provide the exact functional form. Although we apply here only linear models to consumption, consumption may include significant non-linear features. Eg. durables consumption includes certain threshold effects. Forecasting a series could be separated from this issue, but surely better results are available if modelling is in accordance with theory. Therefore we try to characterize the consumption and income time series processes by means of structural time series models that introduce several extensions of random walk models (see Harvey 1989). Structural time series models could be used to decompose a series into intuitively appealing components like stochastic trend, seasonal component and irregular variation.

Permanent income will change as new information about disposable income becomes available. If we allow transitory components both in permanent income and consumption, we are dealing with an empirical issue, how to operationalize and measure these components. A straightforward statistical way to approach this question is to define information set for both variables and then decompose income and consumption series to expected and innovation component and then simply study the relationship between them. If there are no capital gains, changes in consumption are driven by innovations in labour income. Through modelling the labour income process, we are able to assert whether labour income is difference stationary. If labour income follows closely a random walk with drift, we know something about how persistent the innovations in labour income are. If on the other hand income is trend-stationary we know that income shocks die away rather quickly. Innovations in the income process could be partly anticipated by the consumer making consumption decisions.

Estimation results indicate that the evolvement of consumption is dominated by shocks to the **level** of consumption. Therefore consumption is a relatively pure random walk model. There is no significant drift in consumption, and the noise added to the model is not significant. By adding stochastic (local) trend the explanatory power with respect to the pure random walk model can be improved by only less than 5 percent. The calculated signal-noise ratio for consumption is about 4.3.

In terms of the structural time series model real disposable income is also dominated by shocks to the level of the series and no apparent drift is present. The only divergence from the basic random walk model is the significant noise, which makes the real income follow a random-walk-with-noise model. Because of the significant noise, the signal-noise ratio is 0.60. Therefore according to the buffer-stock motive for saving, the random walk property due to income uncertainty implies a significant amount of savings.

It is widely known that the relative smoothness of consumption compared to disposable income is one of the most robust empirical regularities in household behaviour. In fact, this was also originally the major motivation for the PIH. A more crucial question is whether income has a unit root or not. So far we may not even want to be very conclusive on this issue. However, what can be said at this point is that during normal periods income can be approximated as a trend-stationary variable, but few large shocks force the income process towards having a unit root. The question of a unit root relates to the forecastability of income changes.

Structural time series models indicate that the trend of consumption has more variation than the trend of real disposable income (Figures 4—5). A comparison of irregular components also reveals few outliers in the series (Figures 6—7).

Since consumption (or more properly non-durable consumption) and real disposable income are most likely random walk processes, it is helpful to look at the development of the AR(1) coefficient over the sample period to get an idea of whether there have been any changes due eg. to possible liquidity constraints during the period.

Figure 8 presents recursive AR(1) coefficients of the series, which indicate that the random walk property of non-durable consumption improved in the second half of the 1980's, but has deteriorated slightly during 1990's. We may assume that the easing of liquidity constraints due to financial liberalization has certainly been a factor here. This observation is even more pronounced in the rolling AR(1) coefficient estimates.

Figure 4 **Consumption trend**

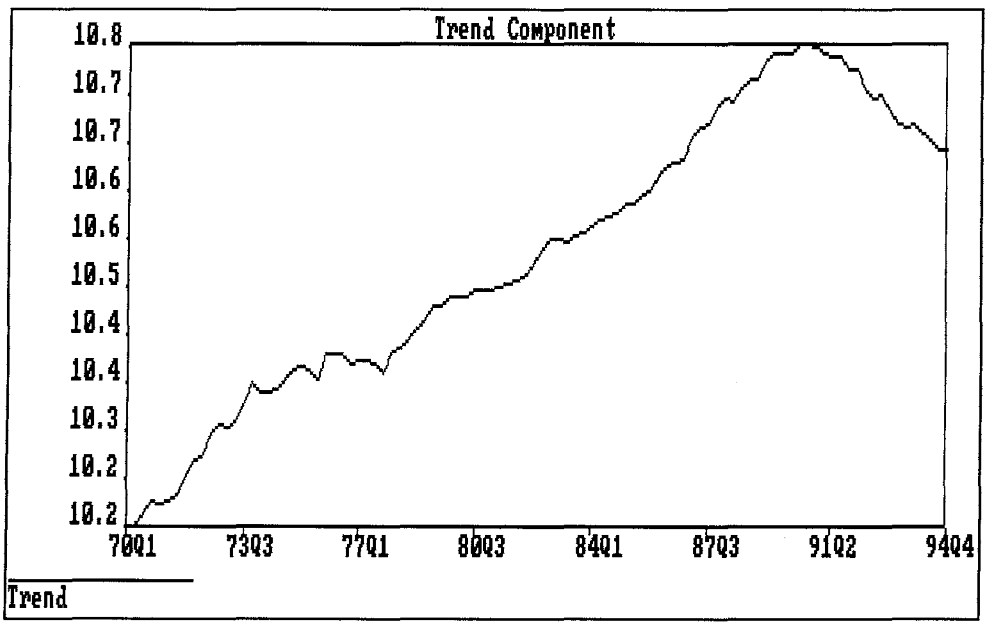


Figure 5 **Income trend**

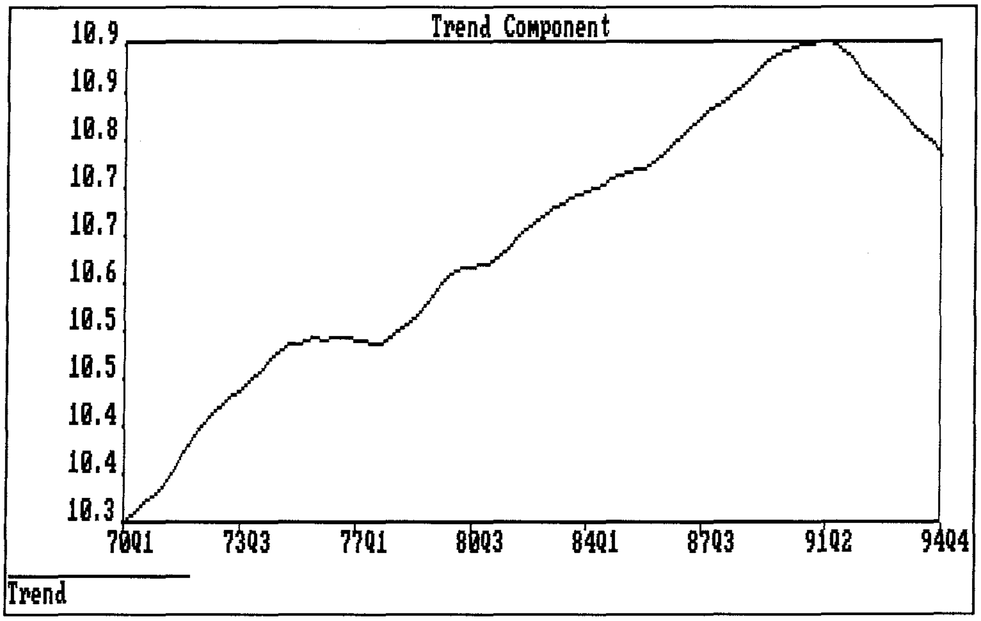


Figure 6 **Consumption noise**

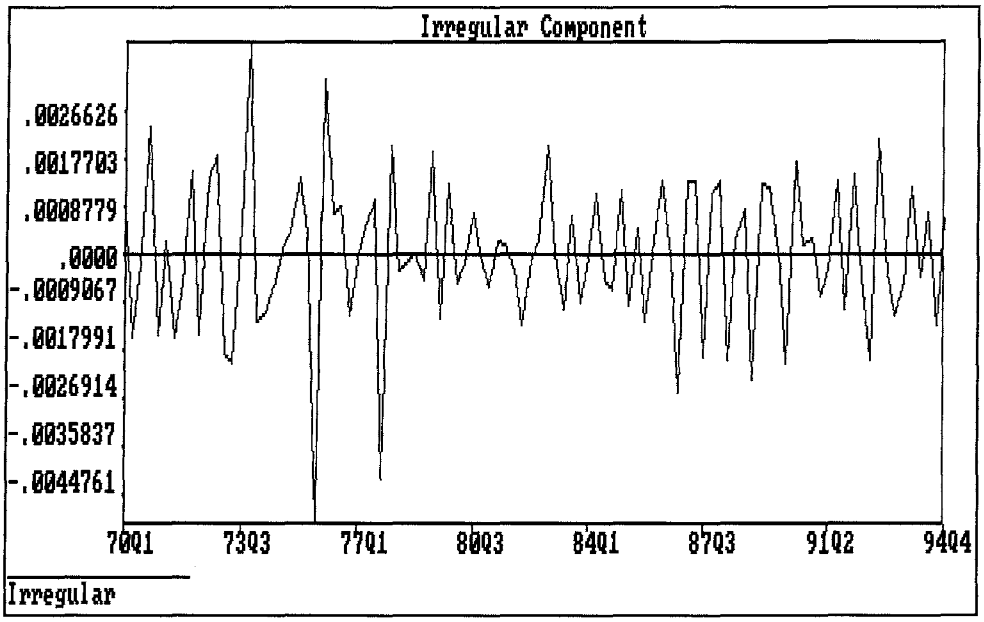


Figure 7 **Income noise**

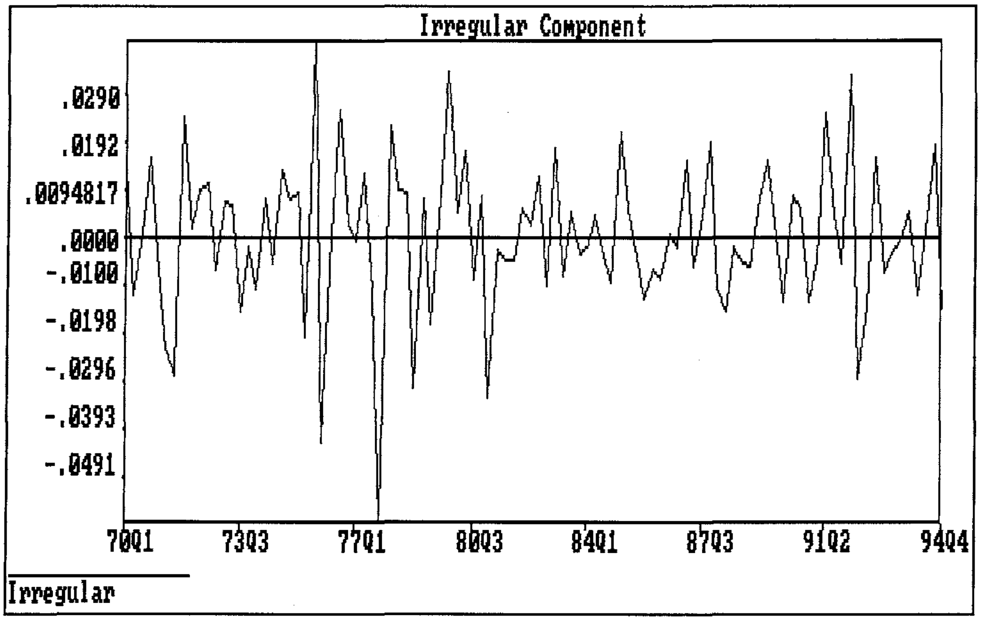
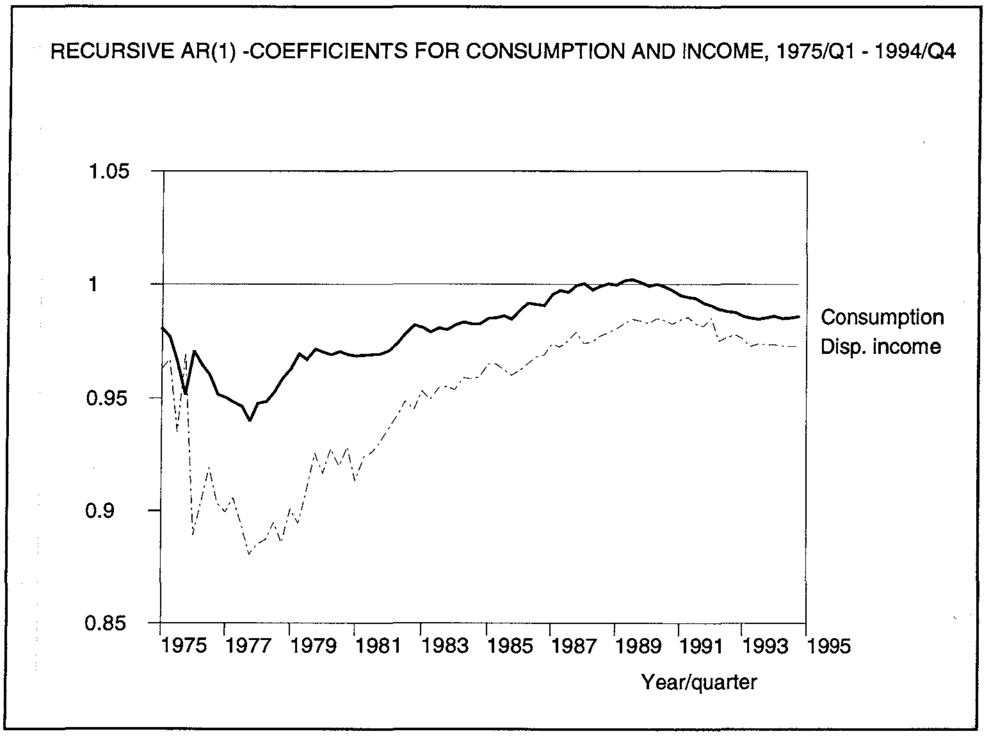


Figure 8 **AR(1) coefficients**



3.2 Measuring the persistency of consumption, income and the saving rate

Major differences in the persistency of labour income and consumption shocks obtain depending on whether these series are stationary or integrated. The unit root in consumption is quite well documented, and it is reasonable to assume that income cannot be stationary or that income would contain a deterministic trend. From the point of view of permanent income the stochastic nature of the income process is extremely important, since it affects strongly eg. tests of excess smoothness.

The persistency of income is also related to the excess sensitivity implications of the REPIH model. The more persistent is income, the more persistent are income innovations and the closer is consumption to current income. Persistency is complete if income has a unit root. One simple way to approach this question is to follow Deaton (1992, p. 111) and estimate trend-stationary and difference-stationary models for income and compare the innovations of these models. If innovations in permanent income generate larger changes in consumption, there cannot be excess smoothness.

The unit root tests in table 1 show that the presence of unit root cannot be rejected either for consumption or income. Real disposable income trend is quite nearly linear between 1970—1990, but if the latest recession is taken into account the probability of a unit root increases. It is widely known that structural breaks and other shocks bias the unit root tests towards the presence of a unit root and therefore greater persistency (Perron 1989). It is quite natural that saving rate is stationary, since it is ratio between two integrated variables. The power of the ADF test seems to decrease as the lag length in the ADF increases.

Table 1 **Unit root tests for basic variables**, Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) unit root tests, 1970/Q1—1993/Q4
Test statistics

	Without Trend			With Trend		
	DF	ADF(1)	ADF(4)	DF	ADF(1)	ADF(4)
Consumption	−2.77	−2.46	−1.75	1.12	.89	.03
Real disposable income	−2.11	−2.60	−2.31	−2.72	−1.30	−1.14
Non-durable consumption	−2.62	−2.14	−1.39	1.59	1.05	0.38
Saving rate	−4.78	−3.08	−2.19	−4.83	−3.10	−2.19
Real labour income	−1.74	−2.37	−1.87	−3.49	−1.67	−1.47
Real capital income	−1.92	−3.51	−2.70	−1.57	−3.42	−2.09
Critical 95 % levels	**−2.89**	**−2.89**	**−2.89**	**−3.46**	**−3.46**	**−3.47**

The persistency issue could also be approached using spectral analysis. As such, non-parametric spectral analysis is not suitable for model building. However, it could be helpful in checking the effects of the transformations applied. We use spectral analysis to study whether our series are difference or trend stationary. Cross-spectrum analysis could also be used to examine the strengthness of the relationship between consumption and income in different frequencies.

The long-run properties of these processes could be identified near the zero frequency. The estimated spectral densities at zero frequency could be used as measures of persistency. If the mass of the density function is concentrated near zero frequency the power is in the long-term components. In the limiting case where a series is trend stationary, the power spectrum of the first differences of the series goes through origin. When a series is difference stationary the mass of the spectrum differs markedly with off-zero frequencies and some mass at zero frequency.

Spectral analysis also allows bivariate estimation using a few helpful concepts to study the relationship of two variables with different frequencies. Looking first at the spectral densities, we note that there are very clear differences between consumption and income (Figures 9 and 10). While both series have reasonable variation in the short run (a couple of years), the power of the long-run frequencies is concentrated in low frequencies (long periods) in the case of consumption. This means that the permanent variation in consumption is dominating. Almost the opposit could be said about income spectral density. Since the permanent component in income changes is small, the income process tends to return back to an almost linear trend in the series. The spectral densities of the saving rate and real net wealth tend to emphasize also the permanent effects of the innovations that drive these processes (Figures 11—12). These results seem to confirm also that the trend in consumption is clearly stochastic, ie. that consumption is difference stationary. The interpretation of the nature of the income process is much less clear. Without the few major collapses in the income process, which increase the probability of unit root, income could be trend stationary.

Examination of the relationship between income and consumption can be started with an inspection of the cospectral density, which gives the largest power to low frequencies (Figure 13). Therefore the co-variation in these series is largest in the long-run. Cospectral density measures the correlation of cosini and sini functions, ie. it describes relationship between components that are in the same phase. According to the calculated phase-shift, the time differences between these cyclical series were not large.

The analogue of correlation in spectral analysis is coherence. Coherence could be interpreted as a correlation measure between frequency components of variables X (independent) and Y (dependent). The plotted squared coherence refers to the same fact, ie. that the long-run relationship dominates the dependence between these series (Figure 14). This interpretation becomes even more pronounced from cospectral densities and coherence plotted against the length of the period in quarters in Figures 15 and 16. Gain measures a unit impulse in the independent variable until a new equilibrium is found. The gain could be interpreted as the regression coefficient of the particular frequency of the independent variable X on the corresponding frequency component of Y.

Figures 17 and 18 plot the gains calculated for both directions. The results do not contradict expectations. Although disposable income and consumption have a significant feedback relationship, it turns out the gain of income increases continuosly as time approaches infinity, whereas in the opposite case the gain decreases. This observation matches with the idea that Granger causality should be stronger from income to consumption than the other way around. Consumption functions are based on the same fact, although income cannot be assumed to be weakly exogenous in the system (see Takala 1995). Next, we will take up these questions.

Figure 9

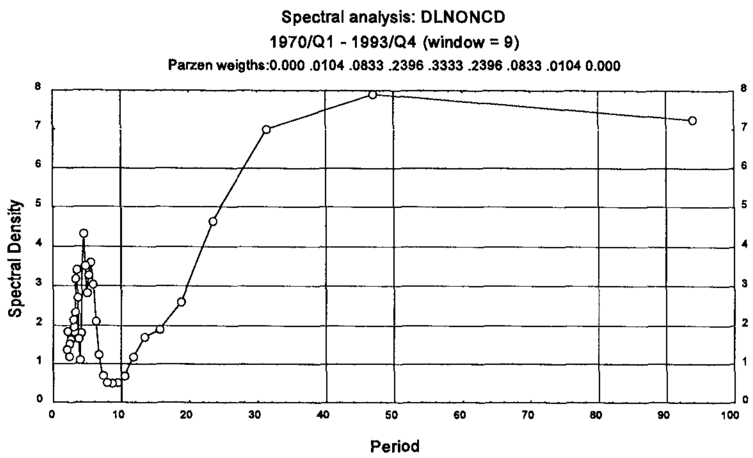


Figure 10

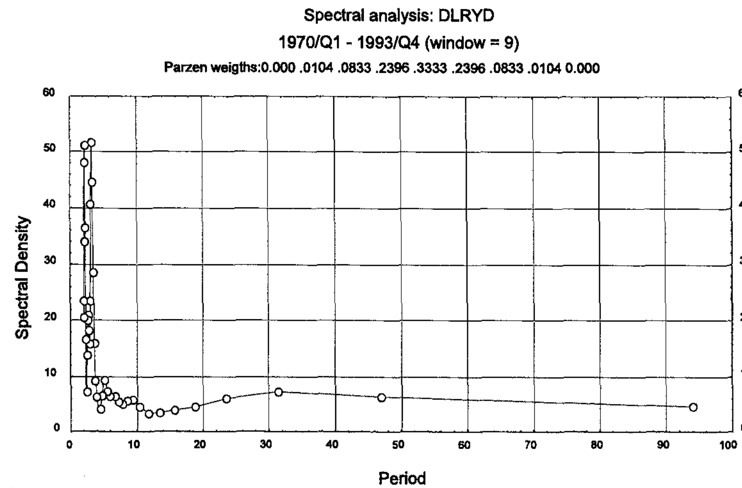


Figure 11

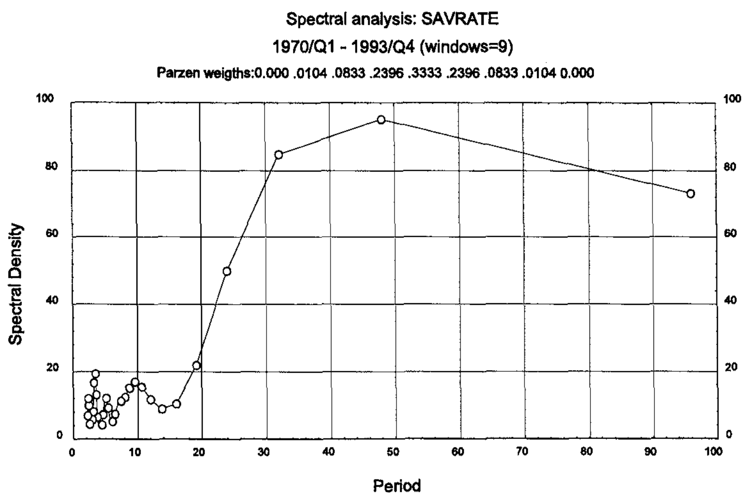


Figure 12

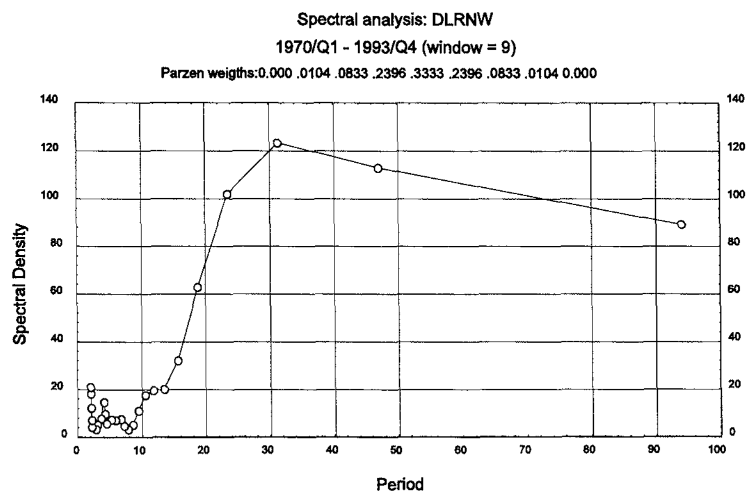


Figure 13

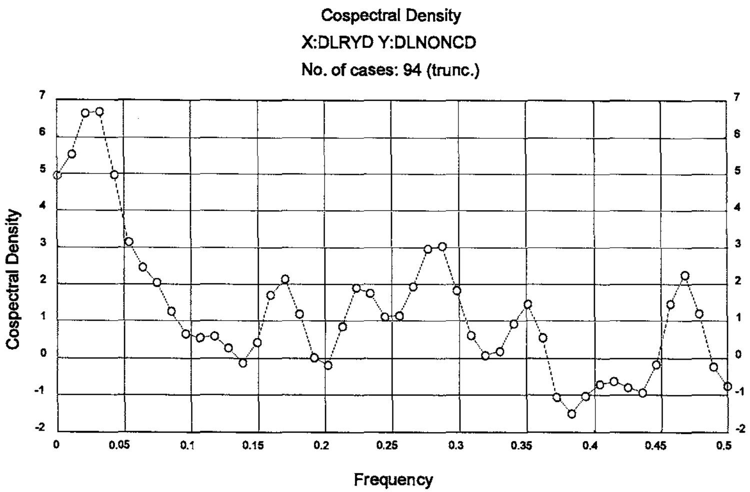


Figure 14

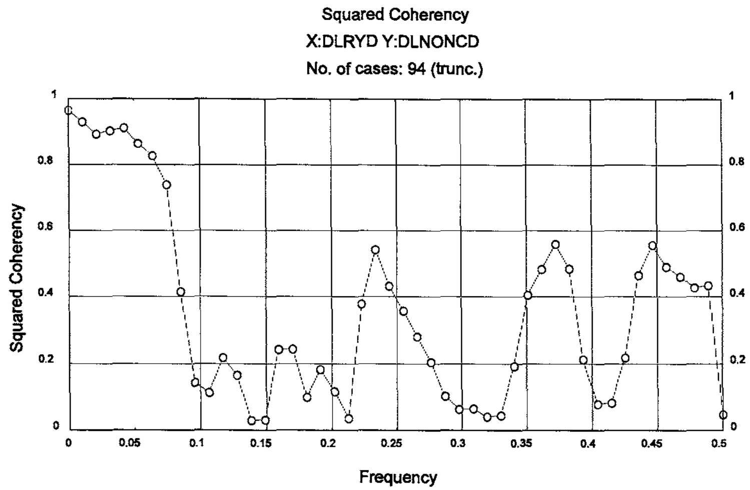


Figure 15

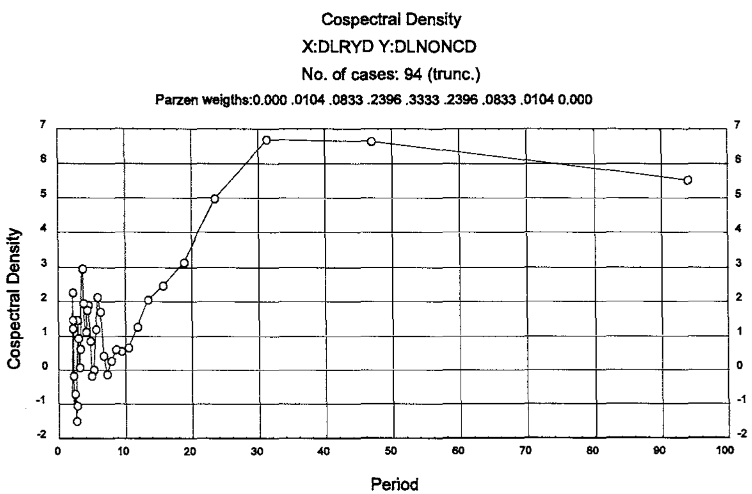


Figure 16

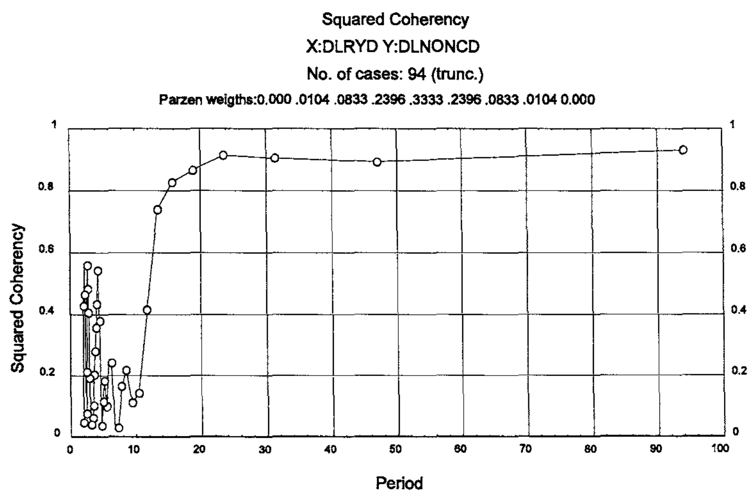


Figure 17

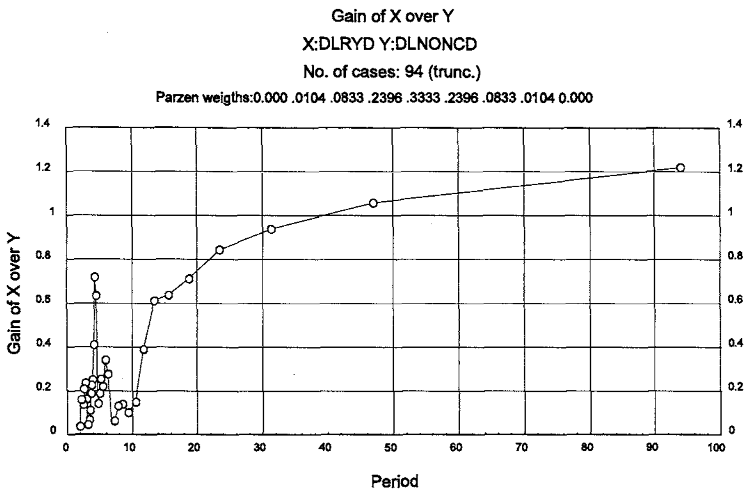
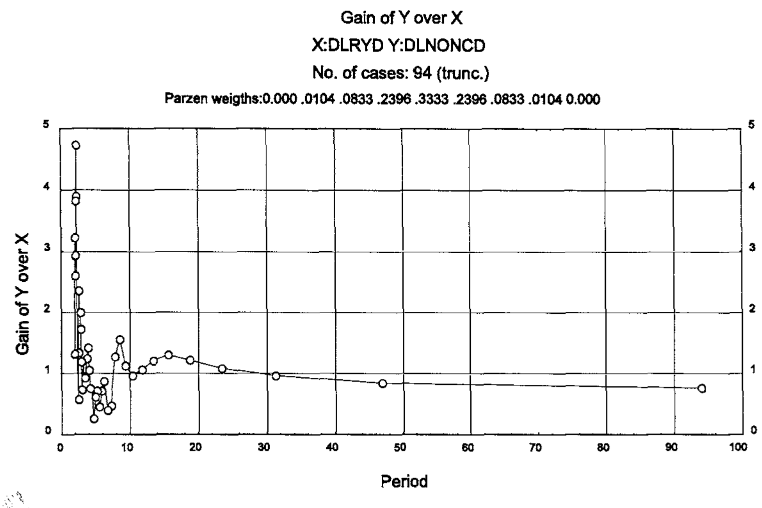


Figure 18



3.3 Granger causality and savings

Campbell (1987) derived an important implication of the REPIH, which gives savings as the present value of expected future labour income changes. This "saving-for-a-rainy-day" equation follows from the cointegration relationship between disposable income and consumption, where saving correlates closely with the error-correction term between consumption and income (Engle and Granger 1987). Saving is used to protect and smooth consumption during income short-falls (see also Deaton 1992, p. 123—125). Repeating Campbell's (1987) derivation, we start with the basic PIH formulation for consumption,

$$c_t = \frac{r}{(1+r)} [A_t + \sum_{i=0}^{\infty}(1+r)^{-i} E_t y_{lt+i}]$$

substitute consumption into the definition of savings $s_t = (r/1+r)A_t + y_t - c_t$ to obtain

$$s_t = \frac{y_{lt}}{1+r} - \frac{r}{1+r} \sum_{i=1}^{\infty}(1+r)^{-i} E_t y_{lt+i}.$$

This can be rewritten as

$$s_t = \frac{y_{lt}}{1+r} - \frac{r}{(1+r)^2} E_t y_{lt+1} - \frac{r}{1+r} \sum_{i=2}^{\infty}(1+r)^{-i} E_t y_{lt+i}$$

and rearranging terms, we obtain

$$s_t = -\frac{E_t \Delta y_{lt+1}}{1+r} + \frac{E_t y_{lt+1}}{(1+r)^2} - \frac{r}{1+r} \sum_{i=2}^{\infty}(1+r)^{-i} E_t y_{lt+i}.$$

Continuing this process, we obtain Campbell's (1987) saving-for-a-rainy-day equation

$$s_t = - \sum_{i=1}^{\infty}(1+r)^{-i} E_t \Delta y_{lt+i}.$$

This equation gives savings as the discounted present value of future changes in earnings. In fact it tells that positive saving indicates an expected fall in income in the future. It also gives us the important insight that saving should be a good predictor of forthcoming income changes. This implication holds even if we know lagged changes in income. This is one of the most useful results in consumption function theory and gives an important insight to the nature of saving behaviour. This implication was tested and found to accord with Finnish data already in Haaparanta, Starck and Vilmunen (1988). With Finnish data it has been observed that the cointegration of non-durable consumption relates to permanent income, which could be proxied better with a linear combination of disposable income and net wealth rather than disposable income alone (Takala 1995). Since the major part of the variation in permanent income is due to income rather than net wealth, the interpretation of savings does not change.

The purpose of Granger causality tests is to identify dynamic relations between stochastic variables. Identified causal links help in model building and in discovering the economic significance of different dependencies. Granger tests should therefore also be a guide in finding the exact specification of the savings model. Cointegration has implications for ordinary causal regressions as well. Granger causality tests are operationalized here by using residual variances from autoregressive models as indicators of predictability. If the model is not misspecified, the better model produces a smaller error variance, and the problem of model selection reduces to specifying the relevant conditioning information set.[15]

Here, we apply Granger causality tests in a bivariate setting although some advantage could be gained from multivariate VAR estimations. The scope of Granger causality tests is restricted to stationary series and cointegrated integrated variables. If cointegration relations are present between the stationary variables analyzed, the error correction term should be added to the Granger causality tests.

The conclusions we draw from these causality tests are as follows (Table 2). First income predicts consumption positively and strongly in the short run, and the long-run feedback from consumption to income is also strong. Secondly, positive saving anticipates very significantly the decline in real disposable income. The feedback relationship is also present between income and savings. However, it should be noted that there does not seem to be any predictive relationship between the saving rate and consumption in 5-lag tests. Therefore this relationship is not spuriously caused by a common trend in income and consumption. The dynamic causal relationship is much stronger between income and the saving rate than between the saving rate and consumption.

Thirdly, the saving rate strongly anticipates negative changes in expected income. The expected and unexpected income components were modeled with an AR(2) model. These conclusions match very well with Campbell's (1987) results, which follow directly from the cointegration relationship between consumption and income. One implication of the cointegration relationship is that the equilibrium error term (ECT) Granger causes at least one of the cointegrated variables. When consumption and disposable income are almost proportional, the saving rate is highly correlated with the ECT. In our case savings Granger causes income changes rather than consumption. In this sense savings has an anticipatory role predicting declines in income, which is also in accordance with the precautionary motive for savings. Campbell and Mankiw (1991, p. 729) argue that the ECT (lagged saving rate) cannot be seen to represent any kind of disequilibrium, but this is mostly a matter of semantics. Savings appears because of changes in expectation of future earnings, and the ECT just exposes the difference in consumption with respect to earnings beliefs.

[15] Again, unfortunately only seasonally adjusted data on disposable income is available. Seasonal adjustment does not affect cointegration properties, since it is a long-run restriction, but it alters the dynamic adjustment and exogeneity status (Ericsson, Hendry & Tran 1993). The disturbing effects of seasonal adjustment to dynamic tests are well known, but for the moment we must live with them.

Table 2 **Granger causality tests for saving rate, income and non-durable consumption**; 1970/Q1—1993/Q4
Two alternative lag lengths (m) [16]

Granger regression: $y_t = \sum_{i=1}^{m} \alpha_i \, y_{t-1} + \sum_{j=1}^{m} \beta_j \, x_{t-j} + \varepsilon_t$

F -test for constraint ($\beta_j = 0$)

Causality test		One lag (m=1)		5 -lags (m=5)	
y_t <== x_t		F-test Signif.		F-test Signif.	
Consumption and savings rate					
ΔLNONCD	LRYD-LC	0.01 (.941)		1.10 (.365)	
LRYD-LC	ΔLNONCD	6.04 (.002)	***	2.29 (0.53)	
Δ^4LNONCD	LRYD-LC	0.89 (.348)		1.71 (.143)	
LRYD-LC	Δ^4LNONCD	6.70 (.011)	**	1.28 (.282)	
Income and saving rate					
ΔLRYD	LRYD-LC	18.89 (.000)	***	4.06 (.003)	***
LRYD-LC	ΔLRYD	14.44 (.000)	***	3.57 (.006)	***
Δ^4LRYD	LRYD-LC	10.48 (.002)	***	13.77 (.000)	***
LRYD-LC	Δ^4LRYD	7.42 (.008)	***	2.46 (.040)	**
Income and consumption					
ΔLNONCD	ΔLRYD	4.60 (.035)	**	1.39 (.237)	
ΔLRYD	ΔLNONCD	2.98 (.088)	*	5.75 (.000)	***
Δ^4LNONCD	Δ^4LRYD	5.05 (.027)	**	1.65 (.156)	
Δ^4LRYD	Δ^4LNONCD	21.31 (.000)	***	6.60 (.000)	***
Expected income and saving rate					
ΔELRYD	LRYD-LC	15.88 (.000)	***	44.03 (.000)	***
LRYD-LC	ΔELRYD	0.39 (.535)		2.37 (.047)	*

Prefix L refers to logs, R for real, Δ for difference and E for expectation

Variables:

LNONCD = Log of non-durable consumption
LRYD = Log of real disposable income
LRYD-LC = Saving rate (in logs)
ELRYD = Expected income estimated from the AR(2)-model for income

F-tests for significance:

* F-test on restriction $\beta_j = 0$ significant at 10 % level
** F-test on restriction $\beta_j = 0$ significant at 5 % level
*** F-test on restriction $\beta_j = 0$ significant at 1 % level

[16] Granger causality tests are valid only for stationary variables. Therefore differences between consumption and income were used. The savings rate is stationary as a proxy for equilibrium error between consumption and income and as a ratio between two integrated variables.

It has been found that saving is also highly correlated with the expected value of changes in earnings, but the variance of savings is smaller than that of earnings (Campbell and Mankiw 1991, p. 727). From the PIH they also derive the following result concerning the relationship between saving and expected changes in earnings. This formulation obtains a separation between liquidity-constrained households consuming current income and non-constrained consumers that can consume based on permanent income. Liquidity constrained consumers spend the fraction λ of the total aggregate income and the life-cycle optimizers spend the rest.

Then the savings equation has the following form;

$$S_t = -(1-\lambda) \sum_{i=0}^{\infty} (1/R)^i E_t \Delta Y^e_{t+i},$$

and it can be seen that saving is perfectly correlated with expected earnings changes but less variable. Of course in practice we may suppose that the income share of non-liquidity constrained consumers (1−λ) will vary. The distinction between liquidity constrained and forward looking consumers has been developed more closely in papers Darby & Ireland (1993) and Sefton & Veld (1994). We return to the estimation of λ in section 3.6.

3.4 Financial deregulation and savings

Financial regulation means that consumers are not able to use their expected lifetime resources beyond some limit. Liquidity of real assets and present value of future earnings is therefore limited. This prevents consumers from smoothing consumption and they are restricted to a corner solution with respect to the budget constraint. Restrictions are usually formulated as explicit limits on borrowing. Another form of liquidity constraint is the situation, where the household faces a steeply rising interest rate and the corner solution is not chosen. Intuition regarding the situation is however quite similar. In this case households are required to treat precautionary saving as a form of loan agreement or extensive collateral is required. A measure of financial deregulation should include some features of these restrictions.

The most apparent macroeconomic consequence of financial deregulation has been the temporary collapse in the household saving rate. It is fairly easy to see that this was caused by increased household investment in fixed capital formation (housing wealth, land and summer cottages), which was largely financed by borrowing. Bayoumi (1992) has studied the effects of financial deregulation in an overlapping generations model and shown that **deregulation will make savings more sensitive to changes in income, wealth and interest rates**. In addition demographic factors could turn out to have a bigger effect on savings. Bayoumi also concludes that financial deregulation will have a temporary declining effect on savings, since the young cohorts are able to raise their consumption by borrowing, while there is no need for the older generations to restrict consumption. The older savers could increase savings if the increased borrowing of the young would raise the interest rate, but this does not need to happen in a small open economy with perfect capital movements. In practice it is difficult to know or measure whether consumers feel liquidity constrained or how great their demand for loans would be if interest rates were approximately constant for everyone without collateral limits.

One factor that has complicated the deep recession of 1990—1993 in Finland has been the increased foreign indebtedness, which has been exacerbated by changes in exchange rate. Fortunately, households were barred from direct currency lending until October 1991, just before the first devaluation of the markka. The Finnish experience shows at least ex post that consumers could not predict exchange rate changes and the interest rate increases followed. The biggest surprise for households has nevertheless been the rapid decline in real wages. Consumers may be forced to save according to nominal rather than real interest rates, if they want to keep their debt position stable.

To measure the effects of financial liberalization, we need a proxy for the easing of liquidity constraints. Following Bayoumi we could use the ratio between outstanding loans (or consumer credit) to GNP as a proxy for financial deregulation, and as a explanatory factor for the savings rate. This ratio measures the indebtedness of households and reflects the availability of lending. Other measures exist. For the UK Muellbauer and Murphy (1993) used a special construction to indicate the degree of credit availability, based on the ratio of after-tax debt service cost to income for first time house buyers. This proxy measures the ability of households to incur debt, based on their income. It is also correlated with the downpayment ratio, which is regulated by banks.

In Finland the downpayment ratio for first time buyers was 25 percent of housing value under a Bank of Finland banking regulation. This rule was abolished in October 1987, which was an important factor in increase in demand for housing loans in 1988. Another regulation lifted by the Bank of Finland from the beginning of 1988 was the one that prevented banks from applying 3- and 5-year market interest rates as reference rates for housing loans.[17]

Testing for financial deregulation cannot be effectively separated from other developments in the financial markets. There is no clear-cut difference between periods of financial regulation and liberalization, although the major liberalization measures took place in Finland in 1986—88. It is clear that financial liberalization gave households the opportunity to rearrange their portfolios and access more freely the illiquid wealth (housing) market. It has been estimated that about one third of the first time house buyers were new clients in the market. Households with no savings for downpayment were allowed to access the market temporarily in 1987—89.

Another matter that must be stressed in considering the housing boom in late 1980s is the issue of favourable income expectations. It is reasonable to assume that households would not go heavily into debt unless their income expectations were favourable. During the period of financial deregulation income expectations peaked because the government had planned to lower income tax rates permanently. In the past decade Finnish households had witnessed steady income growth and there were no expectations at the time that there would be any significant collapse eg. in trade with Soviet Union or in the terms of trade. Although there is no direct way to measure future income expectations, we may use house prices as a proxy for income expectations (see Muellbauer & Murphy 1990, p. 364). Asset prices

[17] Details concerning financial liberalization in Finland are available in Brunila & Takala (1993) and Nyberg & Vihriälä (1994).

adjust relatively quickly to shocks in future income and should serve as a proxy for the present discounted value of future income. This accords with intuition, as house prices reflect the value of imputed housing income, which should depend on income expectations. In the saving model we used house prices as an alternative to the indebtedness ratio and liquidity constraints. The real interest rate, inflation and changes in real disposable income were also used in the regression. The results are shown in table 3.

One of the problems with financial liberalization in Finland concerns the difference in the timing of deregulation for households and firms. Therefore an overall unique measure may be difficult to construct. In Finland the foreign borrowing and investment were first abolished for firms. Households were allowed currency borrowing in November 1991 after the "first" devaluation in October 1991.

We applied two separate proxies for financial deregulation, which correlated with each other. One was indebtedness as measured by the ratio of outstanding loans to disposable income and the other was the real house price index, which was greatly affected by the increased demand for housing loans. Increased indebtedness and the saving rate are strongly negatively correlated after 1985, as assumed. The estimation results for a static saving rate model are presented in table 3. In the first model real house prices are used as a proxy for the indebtedness and liquidity constraints, which negatively affect the saving rate. Real house prices could be seen also as a measure of changing income expectations. The importance of the linkage between housing markets and savings and the usefulness of house prices in saving rate equations has been documented in Koskela, Loikkanen and Viren (1992). However, they do not stress the role of housing prices as a proxy for income expectations, although they note the potential endogeneity of real house prices and the saving rate. Koskela and Viren (1994) discuss housing wealth and saving eg. from the standpoint of windfall gains increasing purchasing power and therefore leading to increased consumption. This correlates to some extent with the income expectations view. If we relate this view to different consumer groups (liquidity constrained or forward looking) it can be seen as a reflection of backward looking behaviour. In addition they discuss the bequest motive connected to the nonfungibility of housing wealth. This effect most surely must be included in the forward looking behaviour.

In the second model indebtedness as such was used to account for the major collapse of the saving rate in 1987—89. If lags of the income variable are included the inflation rate becomes unnecessary, as does the constant. After 1990 unemployment and the increasing uncertainty in income (change in unemployment) becomes a significant determinant of the saving rate raise. Recursive and rolling regression estimates seem to indicate that the motivation for savings varies a great deal from time to time.

From these regression results we would pose the question regarding the separate effect of financial deregulation.[18] For Finland it can be argued that the main part of the rise in real wealth is an indirect consequence of excess demand for housing due to financial deregulation (see Brunila and Takala 1993). The

[18] Bayoumi (1992) for example concludes that financial deregulation itself has only had a modest effect on the decline in savings. The major effect came from the rise in real wealth (houses and shares) while the autonomous effect of financial deregulation accounted for less than one-fifth of the decline in savings.

timing of price increases in housing match the timing of deregulation of housing loans ie. around the end of 1987. The boom in the housing market also coincides with the collapse in the savings rate. One could assume that in the longer-run rising indebtedness would show up an increase in the saving rate because of increased amortizations. But from our estimations we could observe only the short-run effects.

The inclusion of inflation may be seen to be due to the inconsistency in interest payments and capital gains into national income account. When inflation increases it increases nominal interest payments, which are included in expenditures. These increased payments are however partly deflated by capital losses, which are not accounted for in national income statistics. Therefore income and savings are overestimated under inflationary conditions. This effect has been observed by Hendry (1993 p. 218), Ando (1989, p. 240) and Muellbauer (1994, p. 7). Otherwise it would be more reasonable to assume that inflation should be zero degree homogenous in the long run, since saving is partly motivated by the desire to ensure real purchasing power. Nominal interest rates and real disposable income were also added to the model as significant determinants of saving. According to the regressions there is no real interest rate effect, since both the nominal interest rate and inflation have positive signs. Financial saving is surely motivated by a real interest return on deposits, and income changes affect through the ability to save. In addition it may be that income changes correlate with temporary income, which is saved according to the permanent income hypothesis.

The recent recovery of the saving rate and exceptionally high saving rate could not be understood without changes in unemployment. There are good grounds to expect that unemployment reflects the increased uncertainty about earnings. The saving rate has also reacted to the growth rate of unemployment. Unemployment also means declining labour income which correlates with the saving-for-a-rainy-day motive. It must be stressed that the significance of unemployment as a regressor is a quite recent phenomenon. It does not become significant before 1990s.

We could speculate that the effect of financial deregulation on liquidity constraints will last only until consumer debt reaches the point of free optimization. Of course, the optimal level of debt will depend on income expectations, the real interest rate and inflation. It has also been argued that the nominal interest rate (real interest rate plus inflation) will have a direct effect on consumption because indebted consumers are limited by nominal rates through nominal debt service costs. If debt service expenditure increases, households may have to cut other expenditures.

In order to compare these two models we need to perform encompassing tests, since the models are non-nested. Of the nested linear models, the best model can be found by using model selection criteria, which in principle compare residual variances but will penalize overparametrization. With a non-nested model, the question of better fitting is a bit more obscured. In a similar manner, encompassing entails variance dominance, since a better fitting model has to explain the observed data more closely.

Table 3 **Regression models for the saving rate,**
Estimation period: 1972/Q1—1993/Q4

Model 1 (static model)

Variable	Coefficient	Std.dev.	t-value	HCSE	Part.corr.
Constant	−1.8278	1.9835	−0.921	1.957	0.0099
D4LRYD	0.4420	0.0622	7.101	0.067	0.3724
RPHM	−0.0708	0.0123	−5.716	0.010	0.2777
UNEMPT	0.3539	0.0895	3.953	0.081	0.1553
D4LUNEMP	0.0147	0.0074	1.976	0.009	0.0439
D4LCPI	0.1566	0.0646	2.421	0.069	0.0645
RLB	0.8628	0.2119	4.070	0.205	0.1631

Model performance		Residual diagnostics	Statistic	P-value
R^2	= 0.63	DW	= 2.01	
R^2(seasonal)	= 0.65	AR(5); F(5,80)	= 2.41 *	.043
F(6,85)	= 24.33	ARCH; F(4,77)	= 0.36	.835
RSS	=251.34	NORMALITY; $\chi^2(2)$	= 3.02	.221
σ	= 1.72	HETEROSCED.; F(12,72)	= 1.18	.312
		FUNCT. FORM; F(27,57)	= 0.78	.759
		RESET F(1,84)	= 3.18	.078
		RESET F(2,83)	= 1.57	.213

Model 2 (dynamic model)

Variable	Coefficient	Std.dev.	t-value	HCSE	Part.corr.
D4LRYD	0.4467	0.04950	9.026	0.0502	0.4984
D4LRYD_4	0.2140	0.05316	4.026	0.0588	0.1651
UNEMPT	0.5664	0.06722	8.427	0.0584	0.4641
D4LUNEMP	0.0125	0.00639	1.965	0.0086	0.0450
DEBTRYD	−0.1905	0.01714	−11.115	0.0142	0.6011
RLB_2	1.0019	0.10852	9.232	0.1020	0.5097

Model performance		Residual diagnostics	Statistic	P-value
R^2	= 0.91	DW	= 1.76	
R^2(seasonal)	= 0.73	AR(5); F(5,77)	= 1.65	.157
F(6,85)	= 24.33	ARCH; F(4,74)	= 0.41	.799
RSS	=168.89	NORMALITY; $\chi^2(2)$	= 4.28	.118
σ	= 1.44	HETEROSCED.; F(12,69)	= 1.32	.227
		FUNCT. FORM; F(27,54)	= 1.92 *	.021
		RESET F(1,81)	= 0.28	.597
		RESET F(2,80)	= 1.20	.304

Encompassing tests

Test	Form	Model 2 vs Model 1	Model 1 vs Model 2
Cox	N(0,1)	−1.08 (.8599)	−8.19 (.9999)
Ericsson IV	N(0,1)	1.00 (.1587)	6.16 (.0000)
Sargan	Chi²(3)	19.76 (.0002)	32.74 (.0000)
Joint Model	F(3,78)	6.19 (.0008)	17.64 (.0000)

Variables:

D4LCPI = Inflation (from same quarter previous year), %
RBL = Average interest rate of bank lending (outstanding loans), %
RPHM = Real house price index
D4LRYD = Annual change in household real disposable income, %
UNEMPT = Unemployment rate, % (Statistics Finland)
D4LUNEMP = Annual change in unemployment rate, %
DEBTRYD = Ratio of household outstanding debt to disposable income, % (Indebtedness ratio, %)

These two savings models differ only in the change of one variable and in that one is static whereas the other is dynamic. According to residual variance dominance and other encompassing tests, the second model with indebtedness and dynamic responses of income and the interest rate is slightly preferred. The first model is dominated by the second, though it is not altogether rejected or encompassed. Although variance dominance does not imply encompassing, it is difficult to avoid basing model comparisons at least partly on residual variance tests.[19] Tests applied indicate almost unanimously that the second model outperforms the first one.

As an empirical conclusion we may say that saving behaviour depends on three distinct but interrelated effects;

1. **Ability to save** as determined by — current and lagged — disposable income.

2. **Willingness to save** as a response to changes in expected labour income (first moment) and income uncertainty (second moment), for which real asset prices can serve as a proxy, indebtedness and unemployment. Unemployment is a proxy for the uncertainty of future labour income.
3. Relative **intertemporal price of consumption** (and savings) as indicated in the nominal interest rate.

3.5 Results from the bivariate system tests

With bivariate models we could use the past values of saving behaviour also in the model system. This means that we allow consumption to depend on lagged values of income. In the REPIH income changes depend on lagged saving, as saving predicts future changes in earnings. In bivariate systems it becomes quite evident that the nature of the income process places restrictions on saving behaviour as well.

Next we present tests for these three closely related but distinct hypotheses of consumption orthogonality, excess sensitivity and excess smoothness. These tests will be performed in a bivariate VAR framework including stationary income changes and the saving rate. Following Flavin (1993) we can write the bivariate system for labour income and saving rate with respect to labour income as an unrestricted VAR as following

$$\begin{bmatrix} \Delta\log\ y_t \\ s/y_t \end{bmatrix} = \begin{bmatrix} b_{11}(L) & b_{21}(L) \\ b_{21}(L) & b_{22}(L) \end{bmatrix} \begin{bmatrix} \Delta\log\ y_{t-1} \\ s/y_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{yt} \\ \varepsilon_{st} \end{bmatrix}$$

The parameter restrictions for the following hypothesis are
(see Flavin 1993, p. 662)

[19] If a proposed model fails to encompass another model, the particular model is incomplete or inadequate. These tests are likely to be ambigous, since separate models may emphasis different features of the data. Variance dominance is a necessary but not a sufficient condition for parameter encompassing (Hendry 1993, p. 439).

1. **Orthogonality**

$$b_{21}(L) = b_{11}(L)$$
$$b_{22}(L) = b_{12}(L) + (1+r)L$$

2. **Excess smoothness**

$$b_{21}((1+r)^{-1}) = b_{11}((1+r)^{-1})$$
$$b_{22}((1+r)^{-1}) = b_{12}((1+r)^{-1}) + 1$$

3. **Exact excess sensitivity**

$$b_{21}(L) = (1-\beta)\, b_{11}(L)$$
$$b_{22}(L) = (1-\beta)\, b_{12}(L) + (1+r)L,$$

where L is the lag operator and ß is the MPC out of permanent income.

Results from the PIH restrictions are presented in tables 4–6. The orthogonality of consumption changes to income is tested in table 4. However, it is worthwhile noting first that according to AR models of non-durable consumption, is not a pure random walk, albeit very close to such. From dynamic lag regression models (DL), we may reject the REPIH orthogonality of consumption to income with lags 1–4. However, if we allow the information set to contain consumption history, orthogonality is not rejected (ADL, autoregressive-distributed lag models). This conclusion also holds for ADL models with expected revisions and innovations in income. The estimations and tests stress the near-random-walk property of consumption and emphasize the common trend in the consumption and income processes.

Table 5 shows the simple excess sensitivity tests for both total consumption and non-durables consumption. In two formulations of the test only models 3 and 4 indicate excess sensitivity of consumption to change in income. Although the coefficient for income differences are small, they are statistically significant. The unit root in consumption can be seen clearly from the coefficients of lagged consumption. In the absence of uncertainty, there should be no reason for consumption to track income over the life cycle. Rejection of this hypothesis is sensitive to the division of current income into permanent and temporary components, which are in practice unobservable. Therefore we cannot draw any firm conclusions.

The PIH restrictions tests in the bivariate models performed analogously to Flavin (1993) reject almost unambiguously the orthogonality, smoothness and excess sensitivity hypotheses (Table 6). Orthogonality is not rejected with one lag for ordinary saving rate and income change, but strongly rejected for five lags. Similarly the smoothness condition is rejected. The excess sensitivity restriction was estimated with different assumptions about the propensity to consume out of temporary income. In contrast to Flavin's (1993, p. 663) results we are able to reject excess sensitivity with high significance levels. We may however emphasize that excess sensitivity appears in relation to the expected component of income rather than to innovations in income. This accords with the observations of Muellbauer (1994).

Table 4 **Testing REPIH implication of income change orthogonality to non-durable consumption changes,**
Sample period: 1970/Q1—1993/Q4

	Disposable income					Income innov.	Exp. income revisions
	AR(2) Model 1	AR(5) Model 2	DL(2) Model 3	DL(5) Model 4	ADL(5,5) Model 5	ADL(5,5) Model 6	ADL(5,5) Model 7
Constant	0.334 (2.43)	.035 (0.23)	.422 (3.36)	.178 (1.25)	.038 (0.25)	.041 (0.21)	−0.247 (−0.73)
DLNONCD−1	.256 (2.44)	.140 (1.30)			.126 (1.08)	.127 (1.09)	.159 (1.41)
DLNONCD−2	.070 (0.66)	.010 (0.09)			−.008 (−0.07)	.005 (0.04)	.036 (0.31)
DLNONCD−3		.220 (2.07)			.122 (0.98)	.173 (1.39)	.241 (1.98)
DLNONCD−4		.245 (2.24)			.279 (2.28)	.309 (2.47)	.327 (2.63)
DLNONCD−5		.185 (1.65)			.125 (1.06)	.127 (1.03)	.179 (1.42)
DLRYD−1			.125 (2.70)	.138 (2.98)	.092 (1.76)	.061 (1.13)	.095 (0.85)
DLRYD−2			.025 (0.54)	.099 (1.97)	.013 (0.20)	−.031 (−0.57)	−.116 (−0.10)
DLRYD−3				.171 (3.39)	.076 (1.12)	.078 (1.42)	.105 (0.86)
DLRYD−4				.109 (2.11)	.002 (0.03)	−0.044 (−0.84)	.144 (1.22)
DLRYD−5				.034 (0.73)	−.031 (−0.58)	−0.049 (−0.96)	.100 (0.94)
R^2	.08	.22	.08	.20	.28	.29	.28
DW	2.04	2.04	1.63	1.73	2.05	2.05	2.06
P-values for residual diagnostic tests:							
AR(5)	.034	.584	.002	.242	.446	.411	.277
ARCH(5)	.992	.997	.474	.840	.736	.808	.861
HET.	.320	.865	.304	.739	.985	.735	.994
RESET	.072	.055	.962	.776	.233	.247	.192

Table 5 **Excess sensitivity tests**

Sample period: 1970/Q3—1993/Q4

Regressors	Total consumption Model 1	Non-durable consumption Model 2	Total consumption Model 3	Non-durable consumption Model 4
constant	0.22 (2.51)	0.17 (2.72)	0.22 (2.51)	0.20 (3.19)
c_{t-1}	1.02 (17.7)	1.03 (17.6)	0.98 (119.3)	0.98 (160.5)
y^d_{t-2} (β_3)	−0.04 (−0.76)	−0.04 (−0.71)		
Δy^d_{t-1} (β_2)	0.001 (1.32)	0.001 (1.30)	0.001 (2.24)	0.001 (3.03)
s_{t-1}			−.0005 (−.76)	−0.001 (−2.33)
F-test (β_2=β_3) = 0 for excess sensitivity	0.55 (p=.46)	0.49 (p=.48)	5.01 (p=.028)	9.17 (p=.0032)

Table 6 **Wald-tests of orthogonality, exact excess sensitivity and smoothness from bivariate VAR's of saving rate and real income changes**, Period: 1970/Q3—1993/Q4

1. Bivariate system: Real disposable income changes and saving rate

Hypothesis	VAR1 Test statistic $\chi^2(2)$	P-value	VAR5 Test statistic $\chi^2(2)$	P-value
Orthogonality	5.03	.0808	15.84	.0004
Smoothness	5.02	.0813	15.93	.0003
Excess sensitivity				
ß = .8	49.89	.0000	14.51	.0007
ß = .5	37.78	.0000	20.04	.0000
ß = .2	15.03	.0001	22.89	.0000
ß = .1	8.88	.0118	21.72	.0000

2. Bivariate system: Real labour income changes and saving rate from labour income

Hypothesis	VAR1 Test statistic $\chi^2(2)$	P-value	VAR5 Test statistic $\chi^2(2)$	P-value
Orthogonality	22.15	.0000	15.59	.0004
Smoothness	21.76	.0000	16.17	.0003
Excess sensitivity				
ß = .8	50.51	.0000	5.96	.0509
ß = .5	45.16	.0000	8.16	.0169
ß = .2	33.55	.0000	12.44	.0022
ß = .1	28.04	.0000	14.33	.0008

ß = MPC out of transitory income

For comparison, Attanasio and Browning (1993) present contrasting micro-economic evidence that the sensitivity of aggregate consumption to changes in disposable income could be related to demographic variables and in particular to family size. Excess sensitivity of consumption to income disappears once the effects of family composition are controlled. This evidence is based on the regression the cohort means of (non-durable and services) consumption on cohort means of various demographic variables, which seem to be amazingly smooth. This procedure is applied to remove the household-specific fixed effects. Although the evidence is restricted to UK household survey data it gives an explanation quite in opposition to the pure time series studies that have emphasized the role of liquidity constraints.

3.6 Precautionary saving and liquidity constraints

If we preserve the idea that saving is forward-looking behaviour, it is natural to assume that there is a precautionary motive for saving. The main reason for this is **income uncertainty**. Credit restrictions, uncertainty in inflation (unexpected inflation), capital gains and changes in real interest rates are related to the same problem. An important consequence of income uncertainty is that expected earnings must be discounted at a higher idiosyncratic rate than the real market interest rate. The market is able to pool some risk from the individual unanticipated risk. Therefore uncertainty may explain partly the excess sensitivity to current income. Savings could be related to income riskiness in many ways. First savings could arise from the need to smooth consumption as a hedge for income uncertainty and variation. This motive for saving is sometimes refered as the life-cycle motive for saving. Secondly savings could be used for intergenerational transfers. The need for these transfers may depend on the level of social security and private education costs. Increased social security has been blaimed also for the declining aggregate savings rate during the 1980s.

Therefore this view emphasizes the difference between the typical consumer and saver. Savings is done by a different sort of people than most of the (aggregate) consumption. Most of the saving is accounted by a relatively small number of wealthy, high-income earners. Savings is therefore much more unequally distributed than consumption. Liquidity constraints are more likely among those who have housing loans or consumer debt, since wealth and savings are so extremely unequally distributed. In practice this means that most consumers could be regarded as liquidity constrained.

Asset price changes could lead to capital gains and the amount of financial saving is also more sensitive to changes in real interest rates among the 'true savers'. Therefore the **distribution of asset portfolio** will matter to the **choice between saving and consumption**. These effects will surely be present in the short run, but may vanish in the long-run considerations. In any case these propositions tell us that changes in saving behaviour cannot be understood without taking into account changes in the wealth portfolio. Since wealth is owned in unequal shares among the wealthy and ordinary savers, different models are needed for ordinary liquidity constrained savers and for rich savers. Changes in households' portfolios also correlate with the division between forward-looking and liquidity constrained consumers. The behaviour of forward-looking consumers is affected by the value of real estate wealth (and therefore house prices), which correlates with their income expectations. The consumption of liquidity constrained households is determined by current income and to a lesser extent by financial wealth. This latter group could also be called rule-of-thumb consumers as they may save only according to a simple rule (Campbell and Mankiw 1989).

An important question concerns the relative sizes of these groups among consumers as a whole. If we assume that liquidity constrained consumers are forced to consume their current income in each period, we may proxy their share with a simple regression. Liquidity constrained consumers spend their disposable income, ie. $\Delta C_t = \Delta Y_t$, while the forward consumers follow the REPIH random walk, $\Delta C_{pt} = \varepsilon_t$ (Campbell and Mankiw 1989).

Therefore we may write the change in aggregate consumption as

$$\Delta c_t = \lambda \, \Delta y_t + (1-\lambda)\varepsilon_t,$$

where λ is the fraction of income that is received by constrained consumers. This means that the proportion of the population represented by constrained consumers could be much higher than λ, since liquidity constrained households earn much less than forward-looking savers.

Consumption innovation here is a weighted average of the innovation in permanent income (ε_t) for those who follow permanent income and of the current income for the credit constrained. If the variance of ε_t is not bigger than the variance of Δy_t, the innovation in total consumption could be even less than the variance of income. This equation cannot be estimated by OLS, since the error term could be correlated with Δy_t. However, we may use instrumental variables estimation with any lagged explanatory variables as they are orthogonal to ε_t. Campbell and Mankiw (1989) use regressors lagged by two periods as the observed variables where quarterly moving averages. Our variables are seasonally adjusted but not quarterly averages, therefore one lag should be enough. However, we may argue that due to information lags consumers may not know the value of aggregate disposable income immediately after the period ends. Thus we may choose to use two lags also. In our case the results did not differ much as between the use of one or two lags as a minimum. The results are shown below in Table 7. In contrast to Campbell and Mankiw (1989), we used only the single equation instrument model instead of a two-equation system.

The results depend somewhat on the maximum lag length used in instruments. In Campbell and Mankiw (1989) the estimate of λ increased significantly when the lag length of instruments was increased. These results show that a significant proportion of 30—50 percent of consumption is consumed by those whose plans are based only on current income. In a sense this separation of consumers into two groups helps to explain why consumption is excessively sensitive to recent changes in disposable income. Ando (1989, p. 238) points out that the estimated coefficients λ must be the weighted average of the coefficients applicable to two groups, which imposes the condition that the expected value of the estimated parameter in aggregate data coincides with the weighted average of zero and unity. This may not always be the case. In addition Campbell and Mankiw (1989) argue that it helps in understanding the small intertemporal substitution of consumption as well, ie. why consumption is relatively insensitive to changes in the real interest rate.

It becomes evident that by regarding consumption as the weighted average of backward-looking rule-of-thumb and forward-looking PIH consumers, we get consumption that is not a pure random walk and which therefore might be smoother than permanent income. Therefore disaggregation of consumption is better able to explain the excess smoothness phenomenon.

Table 7 **The instrumental estimation of the share of liquidity constrained consumers,**
Dependent variable: Non-durable consumption
Period: 1972/Q2–1993/Q4 *)

Instruments	Coefficient of determination	λ (std.dev.)	Specification test	Testing ß=0
None	.051	.097 (.042)	–	–
$\Delta y_{t-2},\ldots,\Delta y_{t-5}$	.108	.403 (.172)	3.08	–3.26
$\Delta c_{t-2},\ldots,\Delta c_{t-5}$	.117	.487 (.181)	3.18	–0.03
$\Delta y_{t-2},\ldots,\Delta y_{t-5}$ $\Delta c_{t-2},\ldots,\Delta c_{t-5}$	.229	.308 (.107)	2.63	–2.31
$\Delta y_{t-2},\ldots,\Delta y_{t-5}$ $\Delta c_{t-2},\ldots,\Delta c_{t-5}$ $r_{t-2},\ldots,r_{t-5}$	.275	.296 (.096)	1.93	–1.49
$\Delta y_{t-2},\ldots,\Delta y_{t-5}$ $\Delta c_{t-2},\ldots,\Delta c_{t-5}$ $r_{t-2},\ldots,r_{t-5}$ $y_{t-2}-c_{t-2}$	.278	.291 (.096)	1.80	–1.71

*) The coefficient of determination is the adjusted R^2 for the OLS regression, λ is the estimate of the liquidity constrained consumption and below in parenthesis is its standard error. The specification χ^2 statistic tests for the validity of the instruments. Finally, the χ^2 test for ß=0 tests the zero restriction of all the other coefficients except the constant.

3.7 Buffer-stock theory and unemployment

The theoretical underpinnings of buffer stock savings are pointed to explain some of the features left unexplained in the stringent REPIH formulation, namely excess sensitivity and non-orthogonality. Deaton's (1989) buffer stock view and Carroll's (1992) formulation of buffer stock theory similarly indicate that some consumers save a roughly fixed proportion of their income. Consumers who may be liquidity constrained or unwilling to borrow save because they prepare themselves for bad times. We may expect that consumers will accumulate liquid savings in order to smooth consumption and the size of this saving could be proportional eg. a few month's salary. The advantage of the buffer stock theory is that it explains the observed correlation between saving and income changes also **across different sosioeconomical groups** (Carroll and Summers 1989). Preliminary investigation with Finnish data show that although the long-run ratio between net wealth and income might be stable, there is no clear evidence of adjustment based on this ratio (Takala 1995). There is no cointegration between income and net wealth either. Moreover, it was found that there exists only one cointegration relationship between consumption, income and net wealth, which is more in line with the permanent income hypothesis.

The riskiness of earnings is related to macroeconomic income risks eg. through changes in unemployment. People often save during early pension years because of probable health costs. However, this savings motive is related rather to the attemps to smooth consumption than to prepare for income risk. Skinner (1988, p. 248) emphasizes the effect of earnings uncertainty for the precautionary motive of savings. Skinner also remarks that the closer earnings are to a random walk, the more important is precautionary savings, since the shocks in income are permanent. Carroll (1992) and Deaton (1992) have named the precautionary motive for saving as the buffer-stock theory of saving, where the motive for holding liquid assets is to maintain consumption even in cases where income changes are unpredictable eg. because of unemployment. Asset accumulation by means of saving is needed to protect consumption against low income periods like unemployment. Otherwise consumption is restricted and tracked income only in the long-run, ie. at low frequencies. Therefore consumption smoothing should be found only from high frequencies. As we saw in section 3.2 this was the case in our Finnish data as well.

A major effect of the precautionary motive for saving is the need to save more than what would be expected eg. by PIH (Deaton 1992). Even if it is likely that young consumers would be wealthier later in life, they will not borrow since they might be unlucky. Saving during youth and middle age may serve as a retirement fund in addition to a precautionary buffer for unfortunate accidents like unemployment. Campbell (1992) shows that models with the precautionary motive could explain the observed high correlation between consumption and income over the life-cycle and still provide an explanation for the excess sensitivity phenomenon. Carroll (1992, p. 100—102) argues that the REPIH model is misleading since the expected change in the unemployment rate affects current saving. This should be ruled out by the saving-for-a-rainy-day equation, since expected income changes should include all the relevant information concerning saving.

We present here some cross-sectional evidence on saving motives, habits (regularity) and dependencies on other economic determinants.[20] The existence of the savings motive is related to the question whether households are liquidity constrained. In the cross-section sample households were asked about their economic planning horizon. Figure 19 shows that about 60 percent of the households do not make plans for more than 6 months ahead. It is reasonable to assume that what households understand about planning concerns the decision between consumption and savings. In the next question households were asked whether they perform savings. Quite expectedly the majority of households indicated such a saving motive. However, as much as 35 percent of households were not able to save, even though they might have a positive saving motive (Figure 20). Among the savers (with positive savings) most of the households were regular or at least

[20] The cross-section sample is based on a questionaire made by the Finnish Banking Association. The sample size was 1627 households and the sample was taken in spring 1992.

temporary savers (Figure 21). Thus we may conclude that a significant fraction of households do plan their economic activities and saving behaviour.

It may not seem surprising that the planning horizon for savers is significantly longer than that of the non-savers (Figure 22). As such, the length of the planning horizon and regularity of saving are also correlated, not independent (Figure 23). It is clear that eg. investment in housing that is debt financed ties up savings through amortization. This will make saving somewhat regular. However, it is not always clear whether households classify amortizations as savings or just lagged consumption.

In the questionaire households were also asked about their expected unemployment. However, it turned out that most of the households that expected unemployment during next 12 months were non-savers (Figure 24). Regular and temporary savers belonged mainly to households that did not expect unemployment within the family in the following year. One possible explanation for this non-precautionary behaviour could be that unemployment is concentrated on low income groups where no money is left after living expenses are paid.

The relationship between the saving rate and unemployment was already used in the saving rate models in section 3.4. It appeared that both the unemployment rate and change therein were significant determinants of the saving rate. However, it is important to take another look at the dynamic relationship between these variables. Figure 25 shows both series against time, and according to the graph nothing other than the saving rate preceding unemployment can be observed. Granger causality tests also confirmed that saving has some predictive power over unemployment change, but no clear feedback exists.[21] Therefore it seems that households prepare themselves for increased unemployment by saving more. Another interpretation of this phenomenon could be the Keynesian view that increased saving will lower the effective demand and thereby cause unemployment through the multiplier effect. It should be noted also that the saving rate presented in section 3.4 seems to be misspecified, since the causality more likely runs from saving rate to unemployment, rather than the other way around.

Even though we can certainly argue that two-variable Granger causality tests could be misleading, changes in the saving rate at least predict unemployment changes. According to the buffer-stock theory, changes in unemployment reflect change in income uncertainty, which is neutralized by changes in savings. In any case, the results emphasize the relationship between the saving rate and unemployment in a crisis situation like the one in Finland. Households are forced to take unemployment risk into account more seriously than ever before in their economic life.

[21] The probability of the F(8,71)-test with 8-lags for unemployment rate causing saving rate was .565, while the F-test for saving causing unemployment was .038. The same conclusion was found for unemployment rate changes and the saving rate. The saving rate Granger causes the unemployment rate change with significant probability, below 5 percent (p=.02) and no feedback existed.

Figure 19

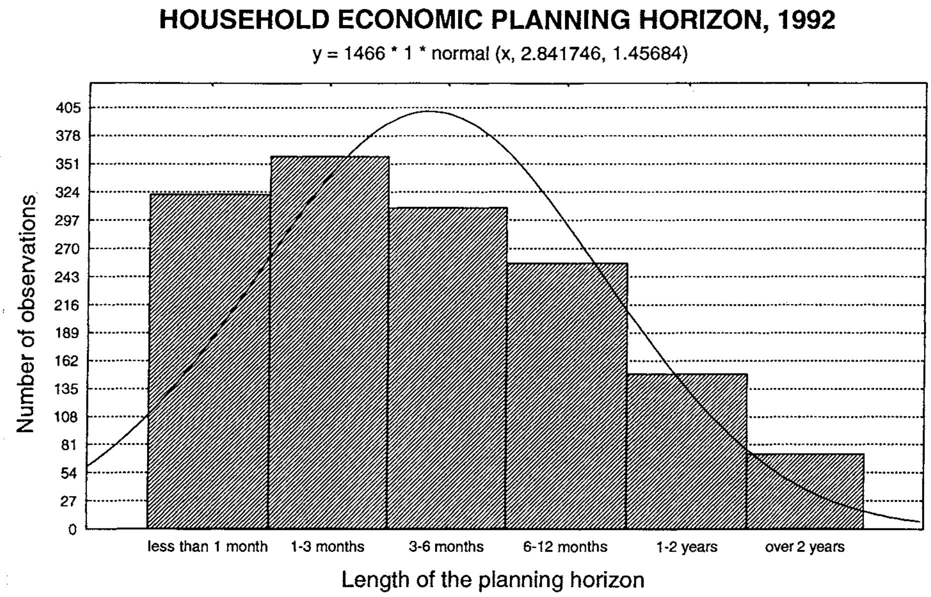


Figure 20

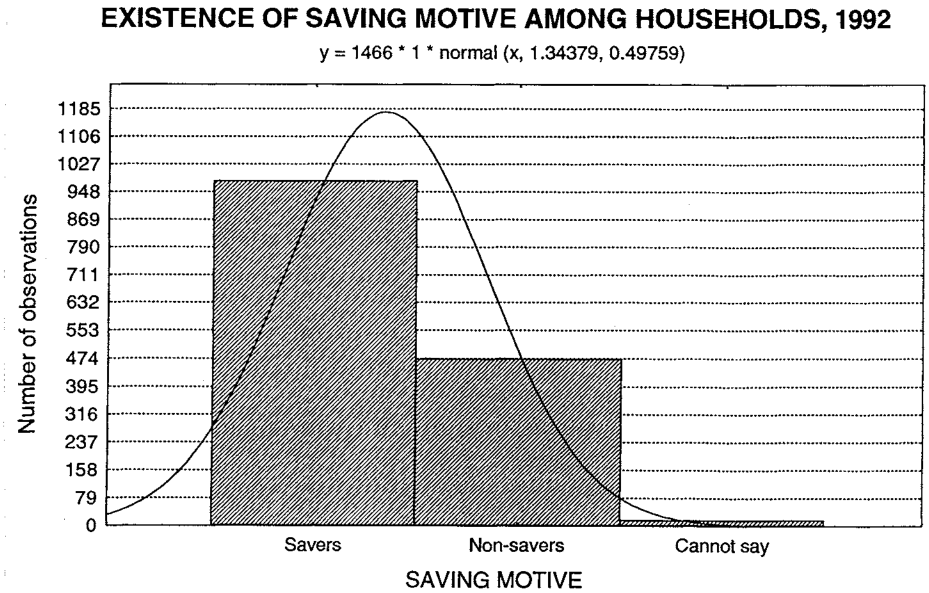


Figure 21

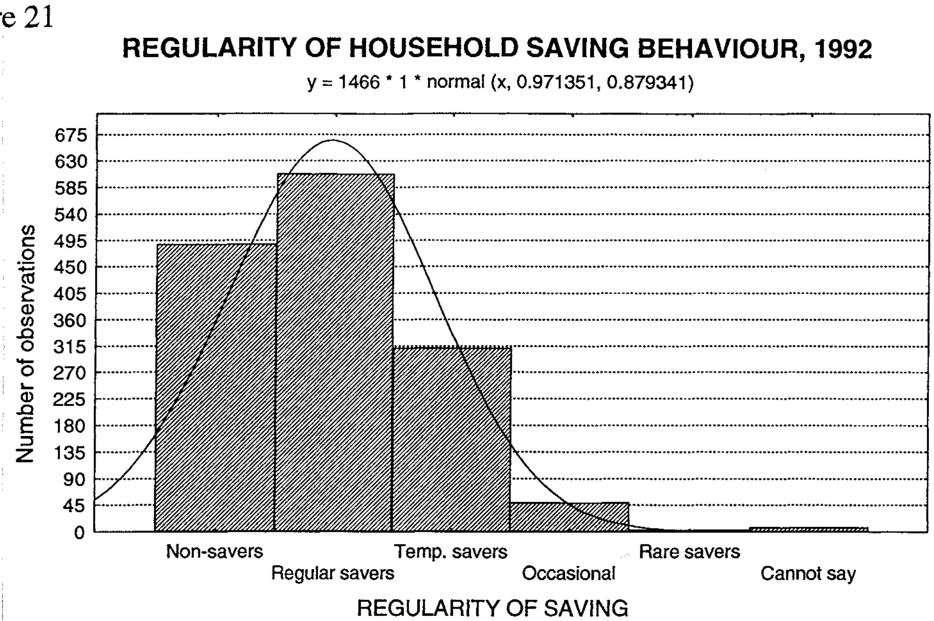


Figure 22 **SAVING MOTIVE AND PLANNING HORIZON**

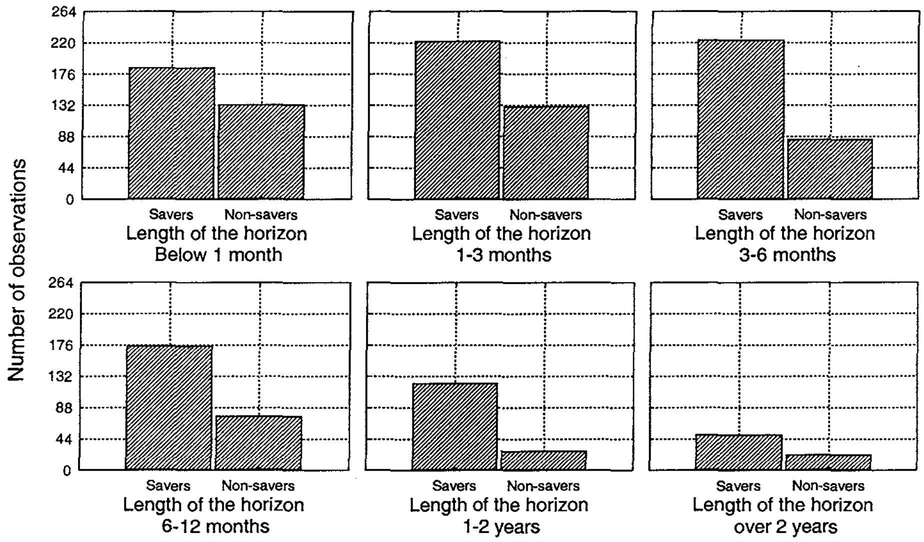


Figure 23 **REGULARITY OF SAVING AND PLANNING HORIZON**

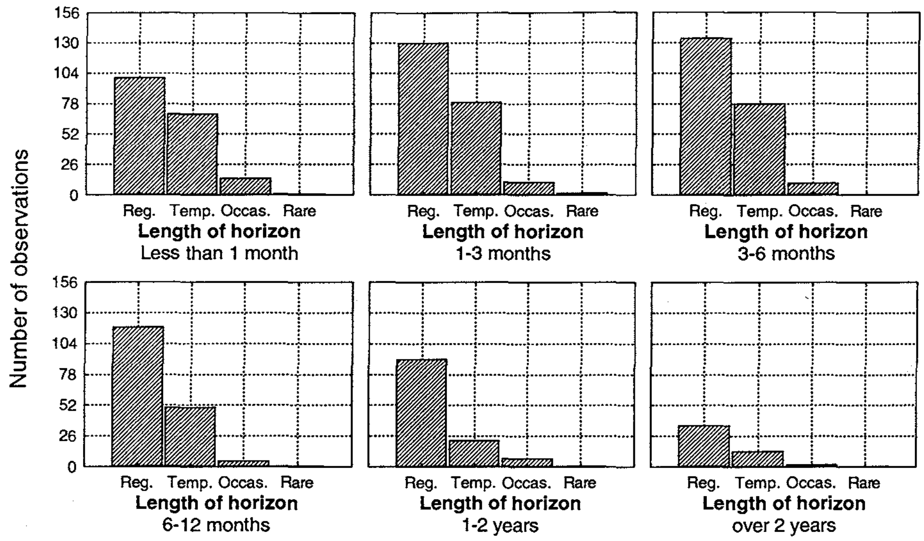


Figure 24

REGULARITY OF SAVING AND UNEMPLOYMENT EXPECTATIONS

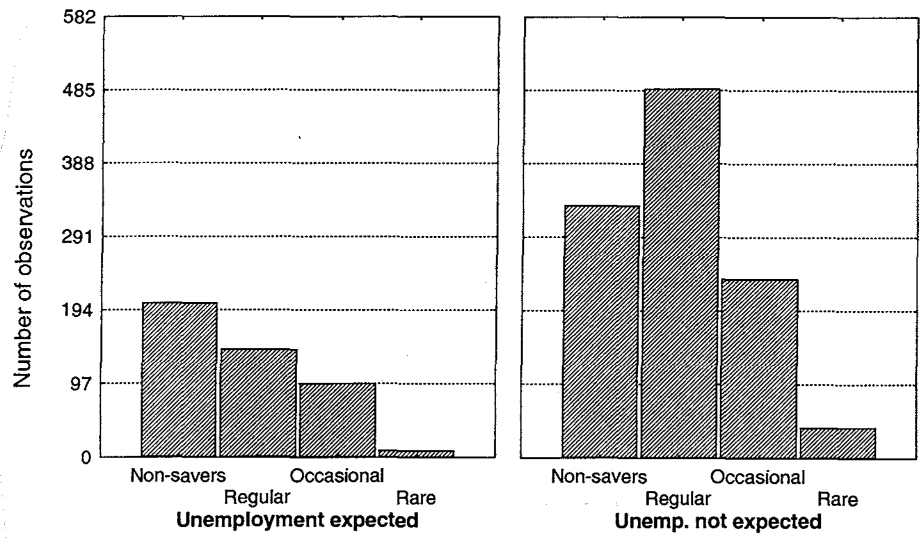
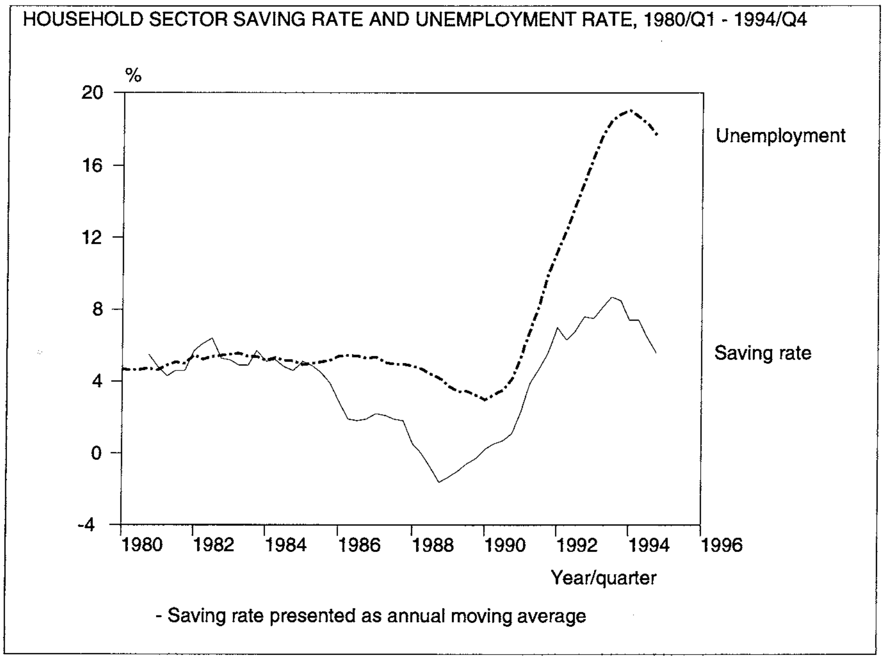


Figure 25


HOUSEHOLD SECTOR SAVING RATE AND UNEMPLOYMENT RATE, 1980/Q1 - 1994/Q4
%
20
16
12
8
4
0
-4
1980
1982
1984
1986
1988
1990
1992
1994
1996
Year/quarter
Unemployment
Saving rate
- Saving rate presented as annual moving average

4 Conclusions

The permanent income hypothesis has been widely accepted as the major theory of consumption. Empirical models based on PIH have also been among the most analysed and well behaved empirical relationships in macroeconomics. However, the appearance of the Muthian "rational" expectations hypothesis together with statistical tools for analysing non-stationary series have revealed some inconsistencies with the data and have lead to rejections of REPIH. It could be argued that some of these rejections are due more to the assumption of rational expectations than to the permanent income hypothesis itself. In any case, through these tests of the REPIH, many old perceptions concerning consumption and savings have changed (Deaton 1992).

The stochastic nature of consumption and income differ to some extent. While the income process could be modelled – at least most of the time – as a trend-stationary series in most samples, non-durable consumption undoubtly has a stochastic trend (difference stationary) and is quite close to a pure random walk process. Both the series were tested to be integrated of order one.

As a ratio between these logged variables, the saving rate is stationary. The saving rate correlates strongly with the error-correction term of a cointegration system including consumption, income and net wealth. As an implication of this relationship Campbell (1987) derived the saving-for-a-rainy-day equation, which gives an important insight to saving as an offset to declining labour income. Households are also affected by the precautionary savings motive, which is caused by increased uncertainty in earnings.

A reasonable empirical model for the saving rate was found as a result of three separate effects. The saving rate is first affected by the **ability to save**, which is shown in the strong correlation of the saving rate with current (and lagged) disposable income. Secondly the precautionary motive for saving could be labeled as the **willingness or need to save**, which takes into account the dependence between saving and expected labour income. Expected income could be proxied by real asset prices (house prices) or indebtedness. The uncertainty of expected income is reflected in the unemployment and change in unemployment. The third effect that should not be forgotten is the nominal **interest rate effect** on the saving rate. The nominal interest rate has two components: the real interest rate and expected inflation. The real interest rate measures the intertemporal price of future consumption with respect to current consumption. According to portfolio theory financial saving is positively correlated with relative return on savings. The role of inflation in affecting the saving rate has been explained eg. by deficiencies in national income accounting and household inability to separate overall inflation from changes in relative prices.

Saving behaviour cannot be understood fully in a representative consumer framework since consumers have different abilities and propensities to save and borrow. For some groups, like the unemployed, saving may not be possible at all, and these consumers are likely to be liquidity constrained. A more proper assumption for them is to assume that they consume their disposable income. On the other hand, there are wealthy high income households that save most of the aggregate savings. These forward-looking consumers are able to smooth consumption by saving and borrowing. Therefore it is likely that their consumption-saving decisions depend on real interest rates. The estimated income share of liquidity constrained households was 30—50 percent. Financial deregulation has likely decreased — at least temporarily — the proportion of liquidity constrained households in the economy and allowed consumers to react more to changes in their permanent income. At the height of the lending boom the cost of financial intermediation also declined. Collateral requirements and the collateral ratio declined effectively.

In addition to excess smoothness, the relationship between interest rates and savings is an important implication of REPIH models. The interest elasticity of saving is positive in life-cycle models under standard assumptions. However empirical studies have rarely found any significant interest elasticity. The buffer-stock model on the other hand, produces almost zero elasticity, which coincides better with empirical evidence.

Savings behaviour is motivated by income expectations and therefore unemployment expectations are important. If the outlook for future labour income become more pessimistic, it increases the target buffer-stock savings. Consumer expectations about unemployment have certainly had some effect on the recent high savings rates in many countries. By holding assets through saving, consumers can insure consumption against fluctuations in earnings. There is a drastic difference between investing in liquid assets or illiquid real estate wealth, since liquid assets are easily available for consumption, whereas real estate wealth is not tangible as such. Usually savings in the form of real estate wealth (eg. amortizations) requires borrowing and makes financial balance more vulnerable to income variation. Borrowing also ties up future spending through debt servicing costs. Therefore we clearly expect that the portfolio share of liquid assets increases during recession, while unemployment expectations increase (Guiso, Jappelli and Terlizzese 1994).

In addition, the inclusion of real estate wealth in savings and consumptions functions becomes necessary for carrying information about income expectations. House prices and therefore housing wealth reflect income expectations through their role as the discounted present value of imputed rental income, which correlates with affordability of these durables. The nice thing here is that as econometricians we do not have make the present value calculations with respect to earnings, earnings uncertainty affecting the discount factor, because households have done this already and we can observe them direcly from house market prices. The nominal interest rate and the return on financial assets are more limited indicators of income expectations.

This paper has evaluated the implications of the REPIH for Finnish quarterly data covering 1970—1993. Although the most stringent assumptions of the REPIH where clearly rejected, there is also evidence in favour of the PIH, eg. Campbell's insight that saving is motivated by saving for a rainy day. It is certainly true also that saving behaviour cannot be adequately analysed in a representative consumer framework with rational expectations. A significant portion of the population cannot plan their consumption as the forward-looking PIH assumes. Instead they are limited to consuming their current income. In a serious unemployment crisis as in the 1990s in Finland, it seems clear that uncertainty about future income forces some households to save. However, on this question there seems to be some discrepancy in the time series and cross-section evidence. Saving is observed to be affected not only by the first moment of expected income. The second moment of expected income (uncertainty proxied by unemployment) also affects saving.

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