Preface

This paper is a progress report on the work with the econometric model KOSMOS. As previous papers on KOSMOS in the Working Paper series, it is intended to constitute part of a future comprehensive report on the whole model, and hence is not completely self-contained.

A very brief discussion of the methodological issues connected with testing of constraints and the estimation method chosen, as well as a description of the way the time-series data were constructed, can be found in an earlier paper published in the Working Paper series, namely A. Markowski and L. Ernsäter, *The Supply Side in the Econometric Model* KOSMOS, Working Paper No. 37, Stockholm: National Institute of Economic Research, January 1994.

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PRIVATE CONSUMPTION EXPENDITURE IN THE ECONOMETRIC MODEL KOSMOS

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by

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INTRODUCTION

Equations for private consumption expenditure were estimated recently[1] by Berg (1990), Berg and Bergström (1991) and Kanis and Barot (1993). They are all based on a similar approach, postulating that consumption in the long run is determined by disposable income and net wealth. The latter is divided into net financial wealth and housing wealth. The long-run elasticities of total consumption derived from the reported regression estimates are shown together with our own results in the concluding section below.

In all three cases, the authors report that the estimated elasticity of consumption with respect to housing wealth is higher than the corresponding elasticity with respect to net financial assets. This is not easy to interpret. First, it indicates that *non-realised* capital gains on houses are readily substituted for financial assets which, generally, are much more liquid. In other words, the sheer fact that the value of my house has increased makes me spend some of my bank savings, since now I have more savings in the form of my house. It should be noted that this behaviour is postulated for house owners who neither have sold the house nor used it as a collateral for a bank loan, since in the latter cases their liquid assets are likely to be affected as well (a bank loan is most often credited to the borrower's account).

Second, and most surprisingly, the estimation results indicate that capital gains on the house actually affect consumption *more* than a corresponding increase in, say, bank deposits (cf. the table in the concluding section below).

In the model estimated by Kanis and Barot (1993), the main effect is due to the increase in the stock of houses rather than in their price. The authors interpret this as a result of the shortage of government-subsidised houses, pointing out that the house stock could represent the supply constraint. Without going into the merits of this interpretation, we can note that this model is likely to show a poor forecasting performance in today's situation of excess supply in the housing market.

The role of the two wealth variables can be better understood upon comparison of Charts U.1 and U.2. As can be seen in the latter, housing wealth and net financial assets tended to be negatively correlated over the period under study, 1970-92. This is intuitively understandable since a larger housing wealth has to be financed by increased

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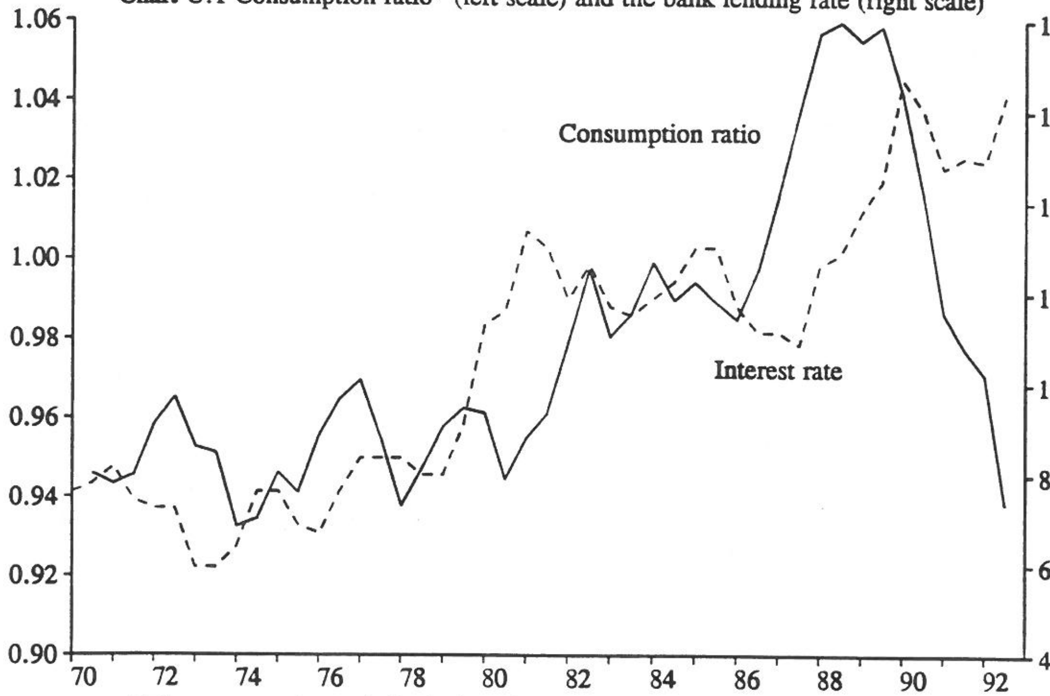
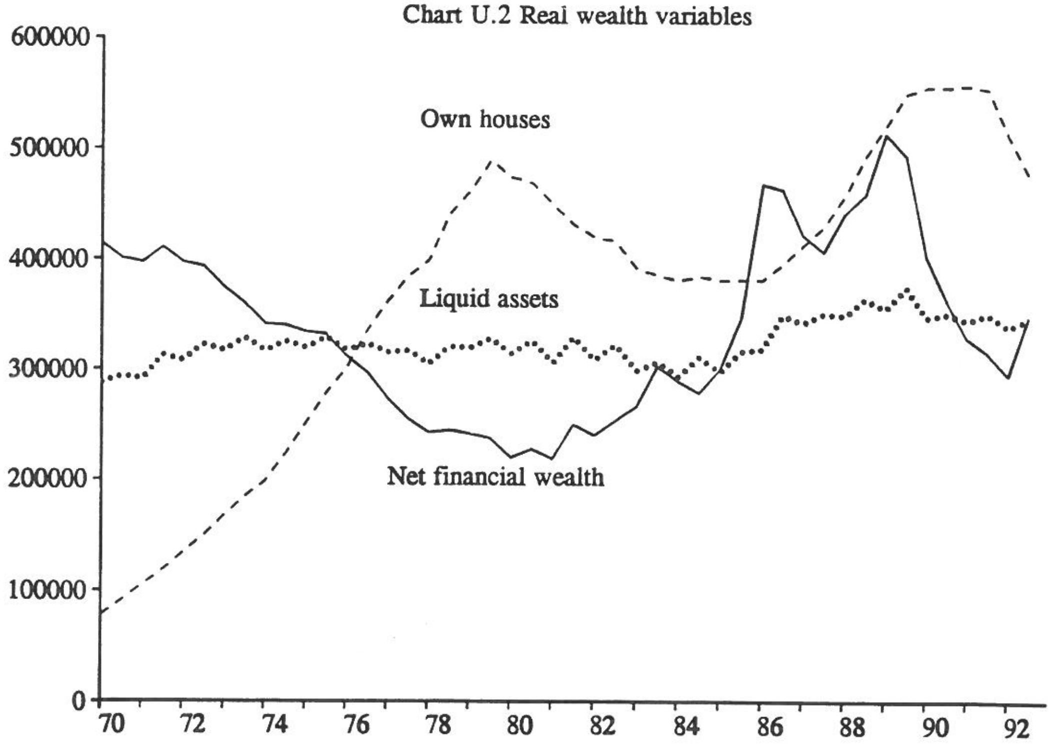
1 See Markowski and Palmer (1977), (1979) and (1981) and Palmer (1981) for earlier work on the consumption function at the National Institute of Economic Research.

Chart U.1 Consumption ratio* (left scale) and the bank lending rate (right scale)



* The consumption ratio is depicted in the form of a two-term moving average

Chart U.2 Real wealth variables



borrowing (cf Kanis, Kottas and Kobba (1993)). The only instance when the two wealth variables covaried, 1987-89, coincided with the period of extremely high consumption/income ratios, which at that time exceeded 100% (cf. Chart U.1).

As neither of the two wealth variables on its own seems to be particularly correlated with the consumption/income ratio, they complement each other in the equation by offsetting each other's movements. It appears, that the estimates of their coefficients are especially sensitive to changes in the definitions of the variables and in the specification of the short-term part of the equation.

Below, we specify and estimate a consumption equation which is similar in the general approach to that of Kanis and Barot (1993). We allow, however, for the effects of variation in bank lending - through its impact on household liquid assets - and introduce more adequate definitions of the house stock and the interest rate. Furthermore, the real rate of interest is employed in the equation instead of the nominal one. As a theoretical hypothesis we postulate, moreover, that the elasticity of consumption with respect to housing wealth is lower than with respect to financial assets.

THE MODEL

We start in a general framework of the life-cycle hypothesis (cf. Appendix III), postulating that in the long run consumption is determined by disposable income and net wealth:

(z.1) $$C = k' \, Y^{\alpha} \, W^{\beta} \, ,$$

where

- C - real private consumption,
- Y - real household disposable income,
- W - real household net wealth,
- k', α, β - parameters.

Assuming

(z.2) $$\alpha = 1 - \beta \, ,$$

we obtain:

$$C/Y = k' (W/Y)^{\beta} . \quad \text{(z.3)}$$

Hendry and von Ungern-Sternberg (1981) show how equation (z.3) can be directly derived from a quadratic loss function. Assumption (z.2) was tested and accepted in our preferred equation (z.11) below.

The proportionality constant, k', in equation (z.3) is postulated to be a function of the after-tax real interest rate, implying that *ceteris paribus* the overall consumption level is a function of the real interest rate:

$$C/Y = k\,[1 + r(1-t) - i]^{a}\,(W/Y)^{\beta} , \quad \text{(z.4)}$$

where

- r - interest rate faced by the households,
- t - marginal tax rate on interest income (the latter being also assumed deductible),
- i - inflation rate,
- k,a - parameters, $k>0$, $a<0$.

The household net wealth, W, includes both financial and real assets, the latter being mainly composed of houses. When financial an real assets are added together, an infinite elasticity of substitution between them is implied (cf. Evans (1969), Appendix to Section 10.1). In accordance with the reasoning in the Introduction above, where full substitutability of the two types of assets was questioned, we replace W with a geometric, weighted average of net financial wealth and housing wealth, implying a finite (unitary) elasticity of substitution (cf also Kanis and Barot (1993)):

$$C/Y = k\,[1 + r(1-t) - i]^{a}\,(NWF/Y)^{b}\,(WH/Y)^{c} , \quad \text{(z.5)}$$

where

- NWF - household real net financial assets,
- WH - real housing wealth,
- b,c - parameters.

An alternative model specification follows from the observation that households borrow money mainly to finance house purchases or - at least - that houses constitute collateral for the major part of the household liability stock. Real financial wealth could then be defined in terms of assets only (no liabilities being subtracted), while the effect of housing wealth would be dependent on the relation[2] of housing assets to liabilities:

$$(z.6) \qquad C/Y = g\,[1 + r(1\text{-}t) - i]^{d}\,(WF/Y)^{e}\,(WHn/LIn)^{f},$$

where

WF - household real financial assets,
WHn - nominal housing wealth (market value),
LIn - nominal financial liabilities of households,
g,d,e,f - parameters.

As in the case of the previous model, the restriction on the coefficient of the disposable income was tested and accepted in our preferred equation (z.11) below.

Equations (z.5) and (z.6) give two models of the determination of the *long-run* consumption level. In the short run, consumption is postulated to be affected by the variation in disposable income and in household liquid assets, defined as currency and bank deposits. Household liquid assets are treated here as a buffer stock which is affected by the income and recurrent spending flows as well as by the real and financial investment decisions. Consumer spending is assumed to be affected on the margin by all those factors - and in particular by the financial portfolio investment - through a *sui generis* short-term budget constraint.

In the model, household liquid assets represent - besides the effect on accumulated savings of the varying consumption-income ratio - the impact of variation in borrowing (bank lending) and households' financial investment. Increased borrowing usually affects both bank deposits and consumer spending; increased financial investment results in lower money balances and thus limits consumer demand.

Real household liquid assets are depicted in Chart U.2. Although they appear to vary little in comparison with the other two real wealth variables shown in the same chart, seasonally adjusted their semiannual rate of growth have fluctuated between -4% and +4% .

Finally, the historical relation between the interest rate and the consumption-income ratio is illustrated in Chart U.1. The effect of the interest rate could have changed in the

2 Net housing wealth cannot be computed analogously to the net financial wealth, i.e. by subtracting liabilities from the gross housing wealth, since the latter variable is known only up to a multiple (the real-estate price being an index). Cf. the next section.

second part of the eighties, after the deregulation of the credit market. However, the chart doesn't seem to give any clear indication in this direction, possibly with the exception of the increased amplitude in the variation of both variables.

THE DATA AND THEIR QUALITY

Private consumption is here defined as the total real private consumer expenditure according to the National Accounts. Real disposable income was obtained by deflating the National Accounts' personal disposable income with the implicit deflator for private consumption. Both variables were constructed using different data sources for the 1970-ies and the rest of the sample period. It appears that there is considerable inconsistency between those sources, in particular in the case of private consumption.

The nominal financial variables, *viz.* household financial assets, liabilities and liquid assets, are based on the Financial Accounts (*Finansräkenskaper*) and described in detail in Appendix I. It should be noted that the quality of these data for the household sector is most probably rather poor. Real wealth variables were obtained upon deflating with the implicit deflator for private consumption.

The interest rate is defined as the average bank lending rate. The variable was constructed by splicing the most common highest interest rate on overdrafts (1970-87), the Riksbank's marginal rate (1988) and the average interest rate on outstanding credits to the households (1989-92). The average bank deposit rate was also tested and found to have only slightly worse explanatory power. We believe that the bank lending rate is a more adequate measure of the interest rate perceived by the households than the rate of interest on five-year government bonds employed (due to lack of data) by Kanis and Barot (1993).

The marginal tax rate on interest income was generously supplied by A. Kanis and B.Barot and is defined in Kanis and Barot (1993). Due to the complicated tax systems in the past, the quality of this series is questionable.

The house stock series employed, pertains to the stock of one & two-family houses and second homes owned by households and is described in detail in Appendix II. The series differs from those used by Berg (1990) and Kanis and Barot (1993). The former used the real estate taxation data (cf Berg (1988)) while the latter based the computation on total investment in the relevant building category rather than on household investment only. The total stock of houses in question (computed by ourselves according to the

Chart U.3 One & two-family houses and second (summer) houses:
total stock (solid line) and the stock owned by households* (dashed)

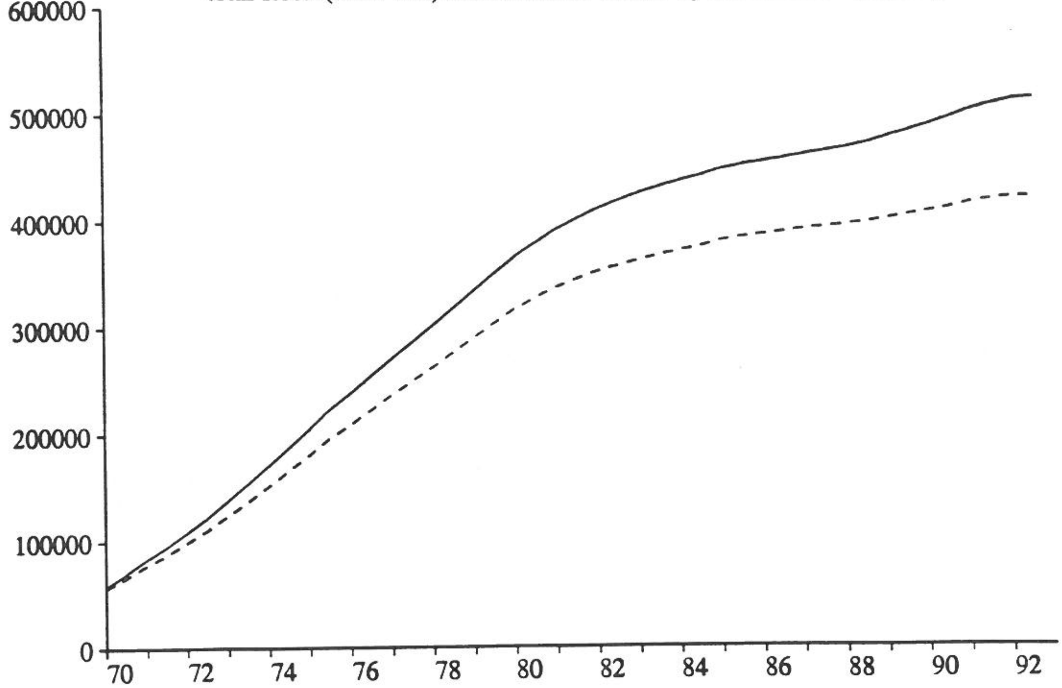
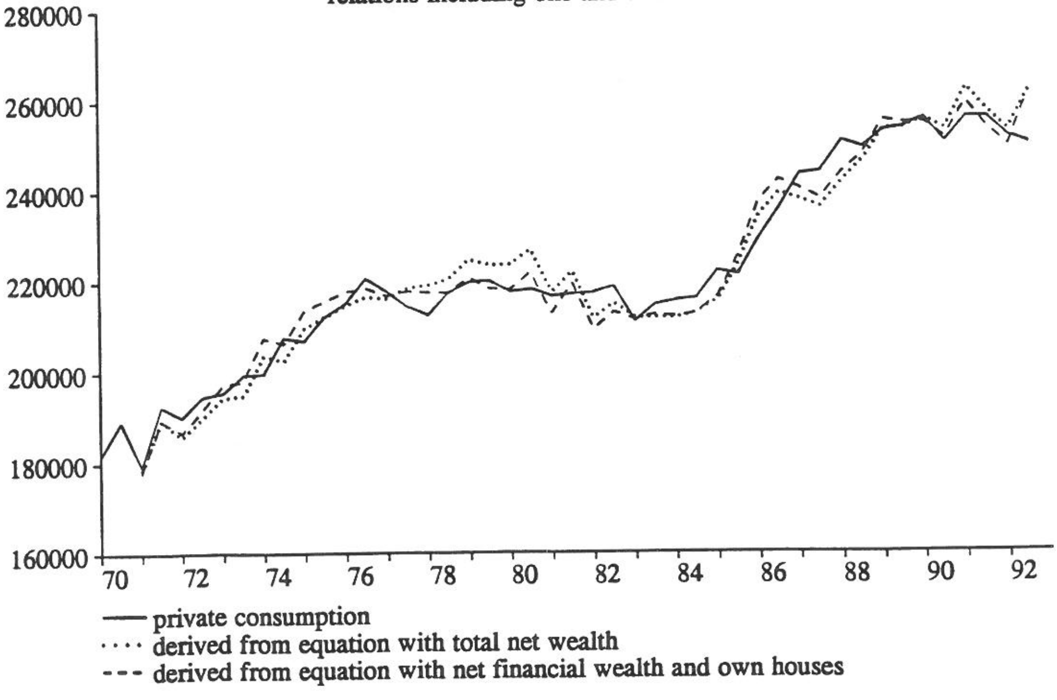


Chart U.4 Actual private consumption and fitted values derived from long-run relations including one and two wealth terms



methodology in Appendix II) is depicted in Chart U.3 together with the stock of houses owned by the households. It appears that the difference between the two series was increasing over time, probably due to the expansion of the market for letting of houses (usually by construction companies).

Real housing wealth was obtained by deflating the market value of the house stock by the implicit deflator for private consumption. The market value of the house stock was computed by multiplying the house stock by the real-estate price index (*Fastighetsprisindex*) obtained as a weighted average of the corresponding indices for one & two family houses (*egna hem*, weight 90%) and second homes (*fritidshus*, weight 10%). The two price series were generously supplied by A. Kanis and B.Barot.

Regression results

As can be seen in Chart U.1, the consumption-income ratio exhibited a peculiar development during the period under study, 1970-92. The ratio increased rather abruptly on two occasions, 1980-82 and 1986-88 and was in 1989, at 106% (seasonally adjusted), more than 10 percentage points higher than in 1980. Subsequently, in 1990-92 the ratio plummeted below the 1980 level.

This rather unusual development that characterised the sample period, in combination with the significant data problems described above and in the appendices, makes statistical analysis difficult. In particular, the Dickey-Pantula test (cf Dickey and Pantula (1987)) indicates that the consumption-income ratio is integrated of order 1. Since we would rather expect the consumption-income ratio to be stationary in equilibrium, we are inclined to believe that this result is period-specific. All the other variables involved in the analysis also appear in the tests to be I(1). However, real housing wealth is close to be accepted as I(0) at the 10% level. This is not surprising, in view of the particular development of the variable during the sample period, illustrated in Chart U.2. We can note that Kanis and Barot found their definition of real housing wealth to be I(0).

Static long-run regressions gave the following results:

(z.7)

```
log(pk/ypd)

  =     0.25409 * log((fwn+hw)/ypd)
       (9.09214
```

$$- 0.12311 * rblr - 0.24760 \quad - 0.13804 * SEAS2$$
$$(1.32283) \quad (6.88992) \quad (17.1811)$$

Sum Sq	0.0178	Std Err	0.0211	LHS Mean	-0.0270
R Sq	0.9584	R Bar Sq	0.9553	F 3, 40	307.384
D.W.(1)	1.0959	D.W.(2)	1.3330	Est. per	1971:1-92:2

where

pk - real private consumption expenditure (1985 prices),

ypd - real personal disposable income (1985 prices),

fwn - real net financial wealth of the households (i.e. the market value of equity shares and the nominal value of other financial assets net of financial liabilities deflated by the implicit deflator for private consumption expenditure),

hw - real housing wealth of the households (i.e. the market value of the stock of one & two-family houses and summer houses owned by the households, deflated by the implicit deflator for private consumption expenditure),

rblr - annual, real after-tax rate of interest on bank lending to the households, fraction,

$$rblr = (1 - taxir)*rbl - inf,$$

rbl - annual rate of interest on bank lending to the households, fraction,

taxir - marginal tax rate on personal interest income, fraction,

inf - year-on-year inflation rate, computed using the implicit deflator for consumer expenditure,

SEAS2 - seasonal dummy, equal to 1 in the second half-year, otherwise 0.

(z.8)

$$\log(pk/ypd)$$
$$= 0.14821 * \log(fwn/ypd) + 0.09719 * \log(hw/ypd)$$
$$(8.83796) \quad (9.30164)$$
$$- 0.13844 * rblr - 0.05602 \quad - 0.14018 * SEAS2$$
$$(1.58579) \quad (3.98162) \quad (19.0659)$$

Sum Sq	0.0152	Std Err	0.0198	LHS Mean	-0.0270
R Sq	0.9645	R Bar Sq	0.9609	F 4, 39	264.580
D.W.(1)	1.4680	D.W.(2)	1.7596	Est. per	1971:1-92:2

(z.9)

```
log(pk/ypd)

  =     0.29039 * log(fwg/ypd) + 0.06360 * log(nhw/nfl)
       (11.6709)                 (6.11025)

      - 0.23112 * rblr  - 0.30751     - 0.13349 * SEAS2
       (2.80970)          (8.94753     (19.5110)

Sum Sq      0.0122   Std Err     0.0177   LHS Mean  -0.0270
R Sq        0.9717   R Bar Sq    0.9688   F  4, 39  334.351
D.W.( 1)    1.6491   D.W.( 2)    2.0183   Est. per 1971:1-92:2
```

where

nhw - nominal housing wealth, defined as above,
fwg - real gross financial wealth (i.e. nfw plus the real value of nfl),
nfl - nominal value of financial liabilities of the households,

The fit of equations (z.7) and (z.8) is illustrated in Chart U.4, where consumption figures derived from the equations are depicted rather than the strongly seasonal (logarithm of the) consumption-income ratio, being the actual dependent variable. The fitted values for equation (z.9) are very close to those of equation (z.8).

Equations (z.8) and (z.9) passed the Dickey-Fuller cointegration test at the 5% level. Equation (z.7) passed the test at the 10% level, but not at the 5% level. Johansen analysis (cf Johansen (1988)) of the variable set included in equation (z.8) clearly indicates the existence of one cointegrating vector.

As can be seen, the coefficient of real housing wealth in equation (z.8) is much smaller than that of real net financial assets (0.097 as compared to 0.148). Furthermore, comparison of the results of the Dickey-Fuller test for equations (z.7) and (z.8) gives some evidence in favour of two wealth terms instead of one total, as in equation (z.7). We can note that the coefficient of the interest rate is much larger in equation (z.9) than in the other two.

In estimation of the adjustment equation, a dummy variable was introduced, to account for the effects of the pre-announced increase of the value added tax in the beginning of 1983 . The hypothesis is that VAT increases give rise to a shift in the timing of purchases, such that an increase in period t is matched by an equal decrease in period t+1.

The VAT changes are listed in Table z.1, with the tax rates given there as a percentage of the price excluding tax. As can be seen from the table, only two general VAT changes took place in the first or the last month of a half-year during our estimation period 1971-92, such that the effects can be expected to be observed in two consecutive semiannual periods. The general change in 1990 and the selective changes in 1991 and 1992 were too limited to have any significant effect. A dummy for 1977:1 and 1977:2 (allowing for the VAT change on the 1/6 1977) was also tested, but without success.

Estimation of the adjustment equation according to the Engle-Granger two-step method (cf Engle and Granger (1987)) gave the following results:

(z.10)

$$
\begin{aligned}
&\mathrm{dlog(pk)} \\
&= -\underset{(4.14902)}{0.42428} * \mathrm{dlog(pk)}_{-1} + \underset{(5.88436)}{0.76879} * \mathrm{dlog(ypd)} \\
&\quad + \underset{(5.21386)}{0.67177} * [0.5*(\mathrm{dlog(hla)}+\mathrm{dlog(hla)}_{-1}) - \mathrm{dlog(ypd)}] \\
&-\underset{(3.08)}{0.352}*\log[(\mathrm{pk/ypd})/(\mathrm{pk/ypd})*]_{-1} + \underset{(2.09)}{0.019}*\mathrm{D822} + \underset{(1.63)}{0.026} - \underset{(1.10)}{0.036}*\mathrm{SEAS2}
\end{aligned}
$$

Sum Sq	0.0053	Std Err	0.0122	LHS Mean	0.0078
R Sq	0.6615	R Bar Sq	0.6051	F 6, 36	11.7254
D.W.(1)	1.2497	D.W.(2)	1.7499	Est. per	1971:2-92:2
H	2.9778				

where

hla - real liquid assets of the households (i.e. currency and bank deposits deflated by the implicit deflator for private consumption expenditure),

(pk/ypd)* - estimated (from eq. (z.8)) long-run value for pk/ypd,

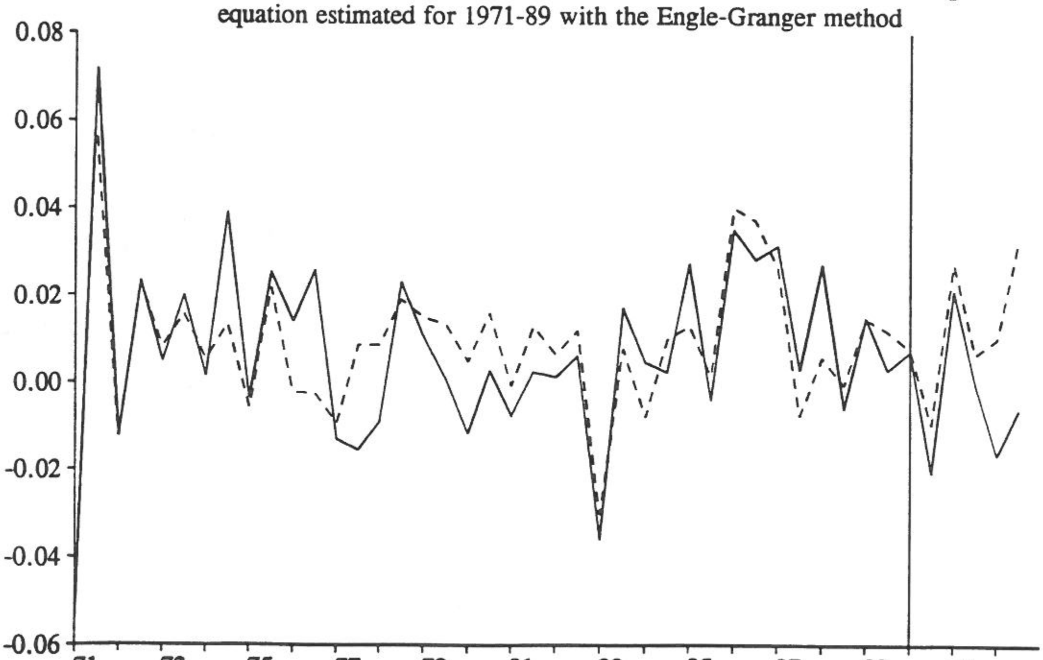
log[(pk/ypd)/(pk/ypd)*] - residual from equation (z.8),

D822 - dummy variable for the announcement of increased VAT rate on Jan 1, 1983, equal to 1 in 1982:2, -1 1983:1, otherwise 0.

The fit of equation (z.10) and a test of its predictive power are illustrated in Charts U.5 and U.6. The outside-sample forecasts are based on regressions with both steps estimated up to 1989:2. Employment of equation (z.9) in the first step gave very much the same results as equation (z.10). We may note that the Durbin-Watson and Durbin's H statistics improve considerably when the VAT dummy is excluded.

Chart U.5 Actual (solid line) and fitted (dashed line) values for the consumption equation estimated for 1971-92 with the Engle-Granger method

Chart U.6 Actual (solid line) and fitted* (dashed line) values for the consumption equation estimated for 1971-89 with the Engle-Granger method



* The last six fitted values are outside-sample forecasts.

Table z.1 Changes in the value added tax rate expressed as a percentage of the price excluding tax

Date	Previous rate	New rate	Coverage of selective change
1/1 1969	0	10	
9/2 1970	10	14	cars, boats, TV sets[1]
1/11 1970	14	15	cars, boats, TV sets[1]
1/1 1971	10	15	other liable goods
1/4 1974	15	12	
16/9 1974	12	15	
1/6 1977	15	17.1	
8/9 1980	17.1	19	
16/11 1981	19	17.7	
1/1 1983	17.7	19	
1/1 1990	0	19	hotels, rest., water[2]
1/3 1990	0	19	energy
1/7 1990	19	20	
1/1 1991	0	20	construction, transp.[3]
1/1 1992	20	15.25	food, hotels, rest.[4]
1/1 1993	15.25	17.36	food, hotels, rest.[4]
1/7 1993	17.36	10.71	hotels, rest., transp.[5]

Notes:

[1] Automobiles, motorbikes, sailing boats, speed boats, TV-sets, etc.

[2] Hotel & restaurant services, water, sewage treatment, garbage collection.

[3] Construction, telecommunication, entertainment, domestic passenger transportation, beauty care.

[4] Foodstuffs, hotel & restaurant services, domestic passenger transportation.

[5] Hotel & restaurant services, domestic passenger transportation.

The change in the logarithm of real household liquid assets in equation (z.10) has the moving average form since the coefficients of the current and lagged changes were close to each other. The transformation can be seen as a simple form of seasonal adjustment.

It was expected that changes in personal disposable income would be immediately reflected in liquid assets, as income in the first place is credited to the bank account of its recipient. In order to expose the full effect of changes in disposable income (as a coefficient of this variable), the latter was subtracted from the change in liquid assets. The effect of income changes over and above their effect on liquid assets can be computed as the difference between the coefficients of the change in income and of the change in liquid assets.

ADL estimation of consumption equations based on models (z.5) and (z.6) (i.e. with the long-run relations substituted into the adjustment equations) gave the following results:

(z.11)

$$
\begin{aligned}
\text{dlogpk} = & - \underset{(5.43858)}{0.49104} * \text{dlog(pk)}_{-1} + \underset{(5.45258)}{0.64645} * \text{dlog(ypd)} \\
& + \underset{(4.56518)}{0.56000} * [0.5*(\text{dlog(hla)}+\text{dlog(hla)}_{-1}) - \text{dlog(ypd)}] \\
& - \underset{(2.63486)}{0.26691} * \text{log(pk/ypd)}_{-1} + \underset{(4.22067)}{0.06896} * \text{log(fwn/ypd)}_{-1} \\
& + \underset{(2.41382)}{0.02594} * \text{log(hw/ypd)}_{-1} - \underset{(2.80343)}{0.16404} * \text{rblr}_{-1} \\
& + \underset{(2.37246)}{0.01832} * \text{D822} - \underset{(2.97660)}{0.03994}
\end{aligned}
$$

Sum Sq	0.0038	Std Err	0.0106	LHS Mean	0.0078
R Sq	0.7590	R Bar Sq	0.7023	F 8, 34	13.3866
D.W.(1)	1.6021	D.W.(2)	2.1266	Est. per	1971:2-92:2

(z.12)

$$
\begin{aligned}
\text{dlogpk} = & - \underset{(4.74192)}{0.42832} * \text{dlog(pk)} + \underset{(5.83205)}{0.66832} * \text{dlog(ypd)} \\
& + \underset{(4.67811)}{0.56107} * [0.5*(\text{dlog(hla)}+\text{dlog(hla)}_{-1}) - \text{dlog(ypd)}]
\end{aligned}
$$

$$- 0.33549 * \log(pk/ypd)_{-1} + 0.13299 * \log(fwg/ypd)_{-1}$$
(3.06615) (4.04205)

$$+ 0.00792 * \log(nhw/nfl)_{-1} - 0.23040 * rblr_{-1}$$
(0.82109) (3.60453)

$$+ 0.01776 * D822 - 0.16928$$
(2.33615) (3.98005)

Sum Sq	0.0037	Std Err	0.0104	LHS Mean	0.0078
R Sq	0.7663	R Bar Sq	0.7113	F 8, 34	13.9337
D.W.(1)	1.5518	D.W.(2)	1.9461	Est. per	1971:2-92:2

The fit of equation (z.11) and a test of its predictive power are illustrated in Charts U.7 and U.8. The corresponding charts for equation (z.12) are very similar and they are not reproduced here.

Recursive regression, with the end period of estimation moving forward, indicated a possibility of a shift in parameters in 1986. This is illustrated for the housing wealth by the solid line of Chart U.11, where we also can note the remarkable stability of the coefficient after 1986. As already mentioned, a parameter shift in 1986 is a possible result of the deregulation of the credit market. When shifts in the coefficients of the wealth variables and of the interest rate were allowed for, a downward shift in the coefficient of the financial wealth and an upward shift (in absolute terms) in the coefficient of the interest rate were obtained. However, the overall fit of the equations did not improve and the shift variables were therefore not retained.

Equations (z.11) and (z.12) imply the following long-run solutions:

$$\text{(z.11')} \quad \log(pk/ypd) = 0.258 \log(fwn/ypd) + 0.097 \log(hw/ypd) - 0.615\, rblr - 0.179 ,$$

$$\text{(z.12')} \quad \log(pk/ypd) = 0.396 \log(fwg/ypd) + 0.024 \log(nhw/nfl) - 0.687\, rblr - 0.526 .$$

We can note that the interest rate coefficients in the above equations are much larger than in the corresponding static long-run regressions (z.8) and (z.9). As for the differences in the coefficients of the wealth terms, they are much smaller (in relative terms) between equations (z.11') and (z.8) than between equations (z.12') and (z.9).

Generally, from equations (z.8)-(z.9) and (z.11')-(z.12') it appears that the estimated elasticity increases when a wealth variable is defined in gross rather than net terms. Still,

Chart U.7 Actual (solid line) and fitted (dashed line) values for the preferred consumption equation estimated for 1971-92

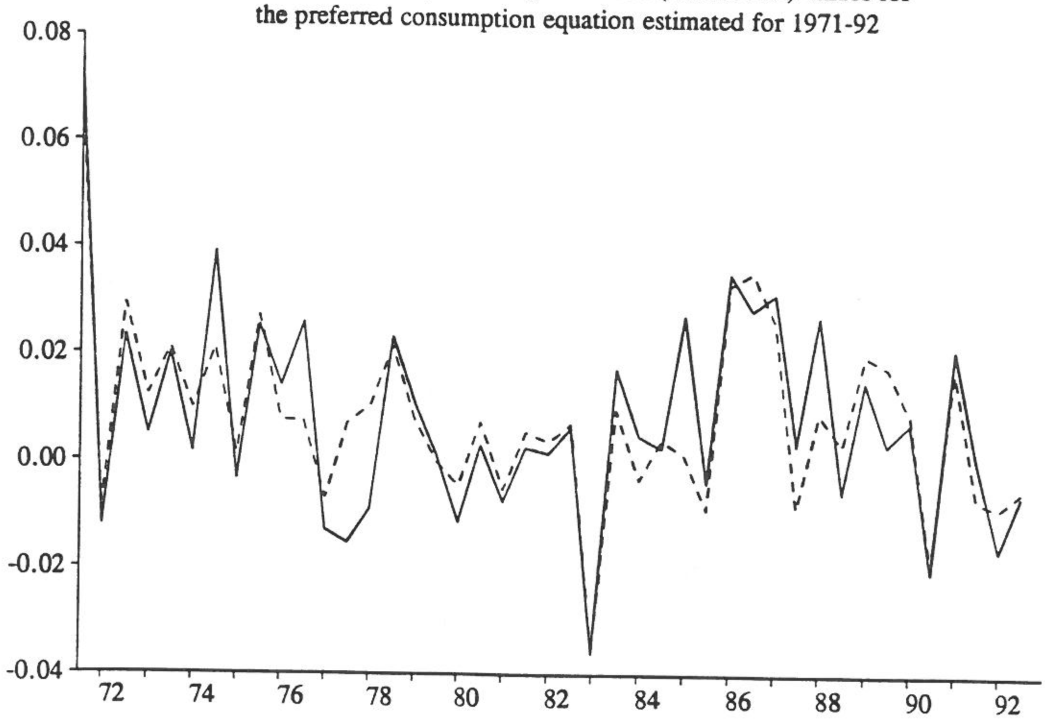
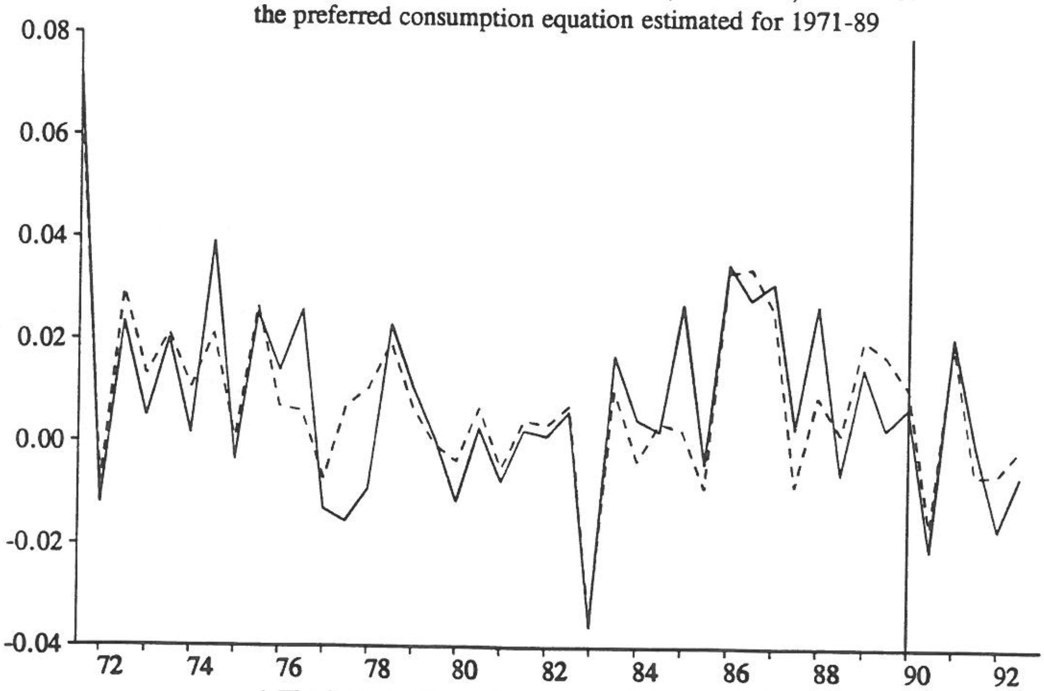


Chart U.8 Actual (solid line) and fitted* (dashed line) values for the preferred consumption equation estimated for 1971-89



* The last six fitted values are outside-sample forecasts.

in all the instances, the elasticity with respect to housing assets is considerably smaller than that pertaining to financial assets.

Equations (z.11') and (z.12') did not pass the Dickey-Fuller cointegration test.

Judging from the outside-sample forecasts in Charts U.6 and U.8 equations (z.11) and (z.12) should be preferred to equation (z.10). Equation (z.11) appears, moreover, to be preferable to equation (z.12) on theoretical grounds. In the latter equation, the coefficient of the ratio of housing wealth to debt is practically zero, leaving us with *gross* financial wealth as the long-run determinant of consumption. While this might well reflect the borrowing-and-spending spree of the two decades preceding the 1990-ies (i.e. most of the sample period), we can hardly accept it as a long-run condition for the consumption function. Attempts to include household debt separately in equation (z.12) were not successful. Equation (z.11), on the other hand, includes *net* financial assets as a long-run determinant of consumption, besides housing wealth.

As already mentioned, both equations show signs of coefficient instability, probably due to the data problems discussed above. Moreover, when the sample period starts later than 1972 the importance of the housing wealth term in both equations decreases rapidly, as is illustrated by the dashed line in Chart U.11. At the same time, the predictive power of the equation deteriorates, as can be illustrated by comparison of Charts U.8 and U.10.

Estimation of equation (z.11) without the housing wealth gave the following results:

(z.13)

$$
\begin{aligned}
\mathrm{dlogpk} \\
= & - \underset{(3.10398)}{0.41929} * \mathrm{dlog}(pk)_{-1} + \underset{(4.78881)}{0.61032} * \mathrm{dlog}(ypd) \\
& + \underset{(4.01181)}{0.54389} * [0.5*(\mathrm{dlog}(hla)+\mathrm{dlog}(hla)_{-1}) - \mathrm{dlog}(ypd)] \\
& - \underset{(2.24066)}{0.20278} * \log(pk/ypd)_{-1} + \underset{(3.85773)}{0.05563} * \log(fwn/ypd)_{-1} \\
& - \underset{(1.81384)}{0.10265} * rblr_{-1} + \underset{(2.63413)}{0.02033} * D822 - \underset{(2.76660)}{0.01708}
\end{aligned}
$$

Sum Sq	0.0028	Std Err	0.0105	LHS Mean	0.0048
R Sq	0.6883	R Bar Sq	0.6044	F 7, 26	8.2018
D.W.(1)	1.7036	D.W.(2)	2.1664	Est. per	1976:1-92:2

The fit of the equation is illustrated in Chart U.9. A test of its predictive power is, as already mentioned, shown in Chart U.10. The equation was estimated for the period 1976-92. The shorter estimation period gave better results since, as can be seen in Chart U.11, the importance of housing wealth for this period is negligible.

Conclusion

Our estimates of the long-run elasticities of total consumption with respect to real housing wealth and real net financial assets are compared in Table z.2 below with the corresponding elasticities derived from the regression estimates reported by Berg (1990), Berg and Bergström (1991) and Kanis and Barot (1993). The underlying regressions are quarterly, if not otherwise stated.

As can be seen, the estimates vary a lot, most probably due to the differences in data definitions (cf. the section on data above) and the length of the sample period. We can also note the differences between static long-run regressions and autoregressive, distributed lag models.

It appears that the only systematic difference between our results and those reported by the other authors is the fact that according to the present paper the effect of housing wealth is considerably smaller than that of net financial assets. This relation between two coefficients in a cointegrating vector can hardly be formally tested in the traditional framework. Johansen analysis (cf. Johansen (1988)), which employs a general VAR approach, makes it possible to test whether the two coefficients are equal, the latter hypothesis being rejected. The limited number of observations at our disposal makes, however, Johansen analysis hardly meaningful. For this reason, the results of this analysis were not reproduced here, although they were mentioned above.

Our results - and probably also those of the other authors - are severely affected by data problems. It appears that the most serious problem is the inconsistency with the rest of the sample of the data for the 1970-ies. It manifests itself in the instability of the coefficients in regressions with the starting period moving forward.

Since the predictive accuracy of our equations seems to deteriorate when the sample period is shortened and the starting period is moved forward, we retain equation (z.11), estimated over the full available sample, as our consumption equation.

Table z.2 Estimates of consumption elasticities with respect to real wealth variables

	Estim. per.	Housing wealth	Net financial assets
Berg	1970:4-89:4	0.283	0.190
	1970:4-85:4	0.300	0.167
Berg and Bergs-tröm	1970:4-89:4*)	0.104	0.066
	1970:4-85:4*)	0.123	0.110
	1970:1-85:4**)	0.244	0.127
Kanis & Barot	1970:4-92:4	0.29***)	0.10
semiannual:	1970:2-92:2	0.36***)	0.10
Present paper			
semiannual:	1971:1-92:2**)	0.097	0.148
semiannual:	1971:2-92:2	0.097	0.258

Notes:
*) Equation (5.1) on p. 22 indicates that the two variable names in Table 9 have been interchanged.
The estimates above are given in accordance with equation (5.1).
**) Static long-run regression.
***) Elasticity with respect to the real house stock, the elasticity with respect to the relative house market price is much lower (0.08 for the quarterly equation and 0.05 for the semiannual one).

Sources:
Berg (1990), Table 3,
Berg & Bergström (1991), Table 9*), 70:4-89:4 eq. (3),
70:4-85:4 eq. (3),
Table 3, 70:1-85:4 eq. (6),
Kanis & Barot (1993), Exhibit 11.

Chart U.9 Actual (solid line) and fitted (dashed line) values for the ADL equation without housing wealth estimated for 1976-92

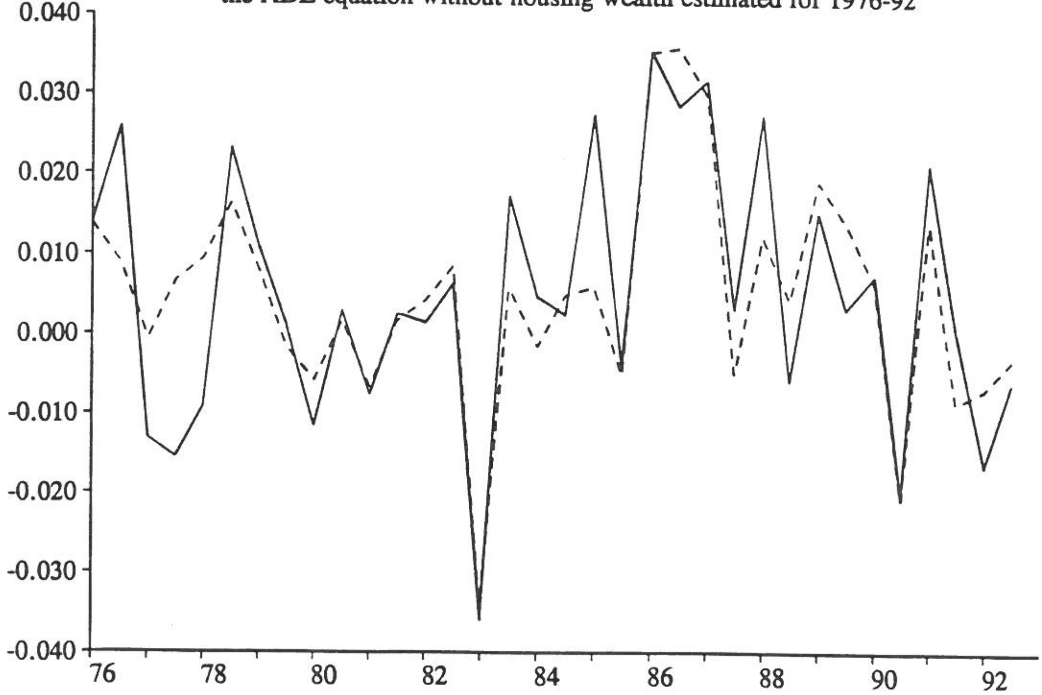
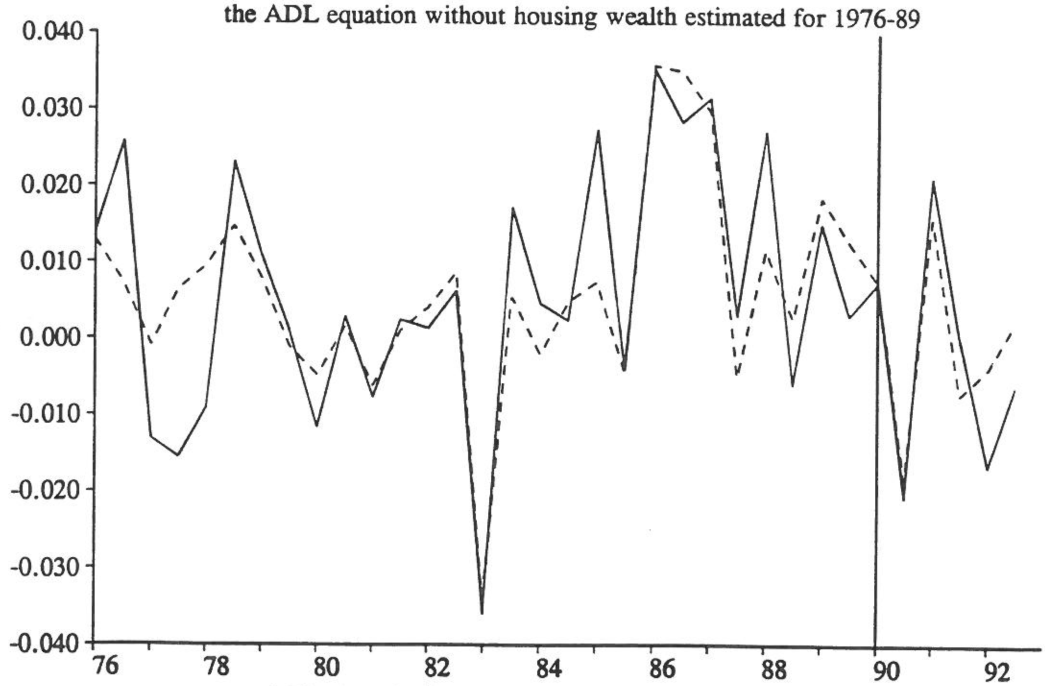
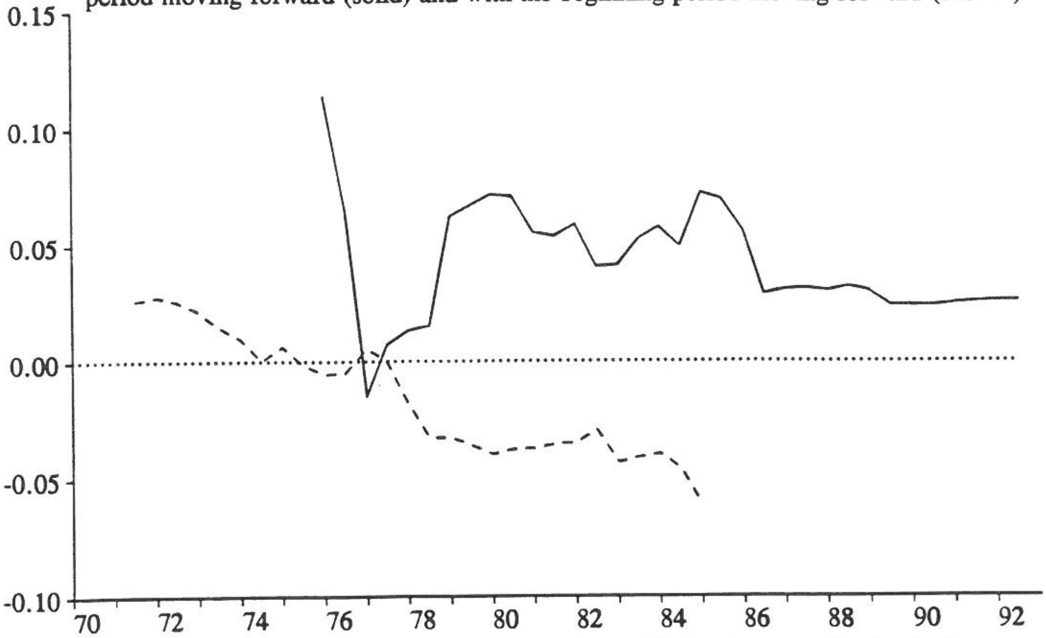


Chart U.10 Actual (solid line) and fitted* (dashed line) values for the ADL equation without housing wealth estimated for 1976-89



* The last six fitted values are outside-sample forecasts.

Chart U.11 Coefficient for housing wealth in equation (z.11) estimated with the end period moving forward (solid) and with the beginning period moving forward (dashed)



The curve value for period t represents the coefficient in regression beginning 71:2 and ending in t (solid) or beginning in t and ending 92:2 (dashed).

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Appendix I. Household financial wealth

Annual stock figures for household financial assets and liabilities were taken from the Financial Statistics (*Finansräkenskaperna).* It should be noted that the quality of the data is rather poor; other financial assets - which actually are a statistical discrepancy between assets and liabilities - amount to 8-15% of total assets. The stock figures were adjusted for the definition change in 1976 by adding the difference between the new and the old measurement for 1976 to the pre-1976 data.

The annual stock figures were converted into quarters using the quarterly transactions data from the same source. This was done by distributing the annual transactions in accordance with the corresponding quarterly figures and then cumulating them beginning with an annual stock figure. The reason for not using the quarterly figures directly was that their coverage (and reliability) is more limited than that of the annual figures. In a few instances, the annual sum of quarterly transactions actually had a different sign than the corresponding annual number. Since no quarterly figures exist for the 1970-ies, the relative quarterly patterns were set arbitrarily on the basis of those for the early 1980-ies.

Annual capital gains for listed and non-listed equity shares were distributed by quarter using the General Share Price Index and then cumulated together with transactions for these two variables. Capital gains were computed for the two equity-share variables as the difference between the change in annual stocks and annual transactions. For all the other assets and liabilities, transactions were defined as changes in the annual stocks. Thus, the minor discrepancy between transactions and changes in capital stocks - mainly due to definitional problems - was treated as part of the transactions.

Quarterly distribution in accordance with the above description was performed for six assets[3] and one liability (total borrowing). Other financial assets including net trade credit, for which no quarterly transactions are available, were distributed by quarter using the (net) sum of the assets and liabilities for which quarterly distribution could be performed.

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[3] a) Notes, coins, bank deposit and National Savings Scheme (Allemanssparande), b) bonds and treasury discount notes (statsskuldväxlar), c) private insurance savings, d) total direct lending, e) listed equity shares, f) non-listed equity shares.

Appendix II. Stock of owner-occupied houses

Owner-occupied houses are here defined as the one-family houses, two-family houses and second homes owned by the household sector. The house stock was computed using the permanent-inventory method, which means that the investments are assumed to depreciate forever at a constant rate (scrapping not being allowed for). Each period's stock equals to the previous period's one, net of depreciation and plus the new investment which is ready to be used. The latter was defined to be lagged by one half-year, assuming a six-months gestation period. The stock was defined as the mid-period stock rather than the end-period one.

The benchmark stock value for (the end of) 1985 was taken from the National Accounts' National Wealth statistics (the depreciated stock for the SNR-Rev 8311 sector). Since the stock included all the existing houses of the above mentioned category, and not only those owned by the households, 85% of the 1985 stock value was assumed to constitute the stock of the owner-occupied houses. This was largely the relation between the corresponding investment figures for 1980, the first year for which data pertaining specifically to the household sector are available. For stock computation prior to 1980, 85% of the total investment in the relevant building category were employed.

Stock computation for the period beginning in 1980 employed investment in one & two-family houses (*småhus*) and second homes (*fritidshus*) by the household sector. Nominal, annual figures for the two categories (being the only available on the investing-sector basis) were distributed by half-years using the corresponding series for all sectors (fixed investment by capital category) and then deflated with the implicit deflators for the latter series.

The semi-annual depreciation rate was set to 1.1%, assuming that 19% of the initial value is left after 75 years (144 half-years), postulated to be the life time of a house of this kind. The 19% scrap value was chosen such that the resulting house stock would show similar development as the National Wealth figures for the category in question. (It should be, however, reiterated that scrapping was not allowed for in the stock computation.)

Appendix III. A long-run consumption relation

Standard references for the life-cycle hypothesis are Modigliani and Brumberg (1979) and Ando and Modigliani (1963). A brief account of the approach is given below, following Lehmussaari (1989).

The life-cycle hypothesis is based on the postulate that consumers maximize life-time utility by allocating life-time earnings to consumption. In particular, they save during working years in order to consume during retirement. In this way, they attain a time pattern of consumption which is smoother than that of income. As a result, the ratio of consumption to income and the ratio of wealth to income would remain constant in steady-state (but would depend on the actual growth rate).

We assume that consumer decisions are taken in a sequential manner, such that labour supply is determined in advance of any spending decisions. Furthermore, we assume that the utility of consumption decreases if it is to take place in a more distant future. Under standard assumptions, life-time utility in period k (U_k) can then be defined as a function of the real consumption in that period (C_k) and of the discounted value of future consumption:

$$U_k = \Sigma\, u(C_t)^* d^t$$

where summation over t goes from k to T, the consumer's horizon, and

$$d^t = 1/(1 + b)^t ,$$

is a discounting factor, based on the time preference component b, b=0 or b>0.

A consumer's budget constraint can be defined as the sum of his/her real net wealth (W_k) and the present value of future real income:

$$B_k = W_k + \Sigma\, Y_t^* s^t ,$$

where the summation is over t, as above, and

$$s^t = 1/(1 + r)^t ,$$

is a discounting factor, based on the real after-tax interest rate r.

The present value of future income is represented by expected income. Assuming that there is (in steady state) an average expected income, Y^e_k, which divides the present value of income into T periods:

$$Y^e_k = (1/T)\, \Sigma Y_t{}^* s^t ,$$

we get

$$\Sigma\, Y_t{}^* s^t = T * Y^e_k .$$

Assuming a homogeneous utility function, the consumer's life-time utility can be maximized, subject to the budget constraint. Aggregating over all the consumers, a macro consumption function is obtained:

$$C_k = a_1\, Y_k + a_2\, Y^e_k + a_3\, W_k .$$

Assuming, furthermore, that the average expected income is (again, in steady state) a multiple of the present income

$$Y^e_k = a * Y_k , \quad a>0,$$

the long-run consumption function can be written as

$$C_k = v_1\, Y_k + v_2\, W_k ,$$

$$v1 = a_1 + a_2{}^* T^* a , \quad v_2 = a_3 ,$$

or

(A3.1) $$C_k/Y_k = v_1 + v_2\, W_k/Y_k .$$

Relation (A3.1) defines the long-run consumption ratio as a function of the ratio of real net wealth to real income.

Accounting for the fact that in steady state

(A3.2) $$Y_k - C_k = g\, W_k ,$$

where $h = g/(1 - g)$ is a constant rate of growth (i.e. $h\ W_{k-1} = g\ W_k$), we obtain the expressions for the (constant) long-run consumption ratio (C/Y) and wealth ratio (W/Y):

$$W/Y = (1 - v_1)/(g + v_2) \quad \text{and} \quad C/Y = 1 - g^*(W/Y)\ .$$

Relation (A3.1), expressed in logarithmic form, constitutes the long-run condition for our consumption function:

$$\log(C_k/Y_k) = z_1 + z_2 \log(W_k/Y_k)\ . \tag{A3.3}$$

In this way, the general relationship implied by the life-cycle hypothesis is introduced in the context of the logarithmic error-correction approach. As pointed out above, the same logarithmic relation was derived under the assumption of optimising behaviour from a specific loss function by Hendry and von Ungern-Sternberg (1981) (cf. also Nickell (1985)).

If the steady-state condition (A3.2) is complemented by

$$C_k = (1 + l)\ C_{k-1} \quad \text{and} \quad Y_k = (1 + l)\ Y_{k-1}\ ,$$

where l is a (constant) growth rate, it can be seen from (A3.3) that the consumption ratio and the wealth ratio are constant when $l = h$.

KONSUMTIONSFUNKTION

SVENSK SAMMANFATTNING

Långsiktsvillkoret för konsumtionsfunktionen i den ekonometriska modellen KOSMOS postulerar att konsumtionskvoten är en fuktion av kvoten mellan hushållens finansiella nettoförmögenhet och disponibel inkomst, kvoten mellan värdet av egna hem och disponibel inkomst samt av realräntan. På kort sikt beror konsumtionen på variationer i disponibla inkomsten samt i hushållens likvida tillgångar (d.v.s. banktillgodohavande och sedlar). Regressionsresultat tyder på att konsumtionens elasticitet med avseende på värde av egna hem är betydligt lägre än motsvarande elasticitet med avseende på finansiell nettoförmögenhet. Detta motsäger de resultat som har publicerats de senaste åren men överensstämmer med författarens förväntningar.