

# Consumer confidence and consumption in Sweden


by

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**Abstract:** The role of confidence indices in explaining consumption growth in Sweden during the period 1975-94 is analysed in this paper. We first analysed which variables influence the levels of the confidence indices. Two important such factors are found to be changes in real interest rates and changes in the inflation rate. Of the two forward-looking indices considered, the one regarding the personal financial situation is found to be more closely related to changes in consumption than the index regarding the general economic situation. The latter has no additional information content in the presence of the former. In a crude analysis the personal financial situation index explains about 37 % of the variance in the growth rate of consumption. The index has an important significant effect even in the presence of other variables in the two types of consumption models that are considered, an Euler equation and a solved-out consumption model. In the latter model, the confidence index increases the explained part of the variance in consumption growth from about 0.69 to 0.76. The real after-tax interest rate and the change in the inflation rate are important determinants of consumption. Financial wealth is more important than housing wealth and changes in debt also influence consumption. The solved-out consumption model is able to reflect the Swedish boom-to-bust cycle in consumption remarkably well.

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## 1. Introduction

The consumption growth in recent years has been more difficult to forecast in Sweden than in many other countries. During the last decade private consumption went through a boom-to-bust cycle in Sweden: in both 1986 and 1987 the real per capita growth rate was above 4 per cent while in 1992 and 1993 the growth figures were negative, -1.9 and -4.3 per cent, respectively (see also Figure 1 and 2). A recent study of forecasting accuracy in Sweden indicates that "the consumption boom of the middle 1980s was only anticipated with some delay and the great decrease in 1992 was unexpected" (Bergström 1993). A general pattern of forecasts in Sweden during the late 1980s and early 1990s is that they underestimated GDP growth in the first part of the period and overestimated it in the second part of the period. Unsatisfactory forecasts for consumption was probably one reason for these forecast errors.<sup>1</sup>

The mistakes in predicting consumption have once more started a discussion in some OECD countries whether measures of consumer confidence could be used in monitoring consumption trends.<sup>2</sup> Several studies in Sweden report results of including consumer confidence in consumption functions.<sup>3</sup> When focusing on consumer confidence a forward-looking element is explicitly introduced, something which has not yet been dealt with in any great detail in the Swedish discussion. A forward-looking behaviour appears to be consistent with one of the standard theoretical approaches to consumption modeling, the joint rational expectations and permanent income hypothesis (REPIH). A forward looking behaviour can also be incorporated in a solved-out consumption function of the error-correction type.

In this paper we will discuss primarily two questions:

- a) Whether a forward looking index of consumer confidence influences current consumer spending, and
- b) Whether a forward looking index of consumer confidence contains information about changes in consumer spending in addition to information contained in other variables.

We start by analyzing the relationship between consumption growth and two confidence indices, which measures expectations for the next twelve months, in section 2. Analyses based on both seasonal unadjusted and adjusted quarterly data are performed. The predictive value of the confidence indices is tested by estimation of models based on lagged confidence variables. Formal causality tests are also performed in section 3 including a sys-

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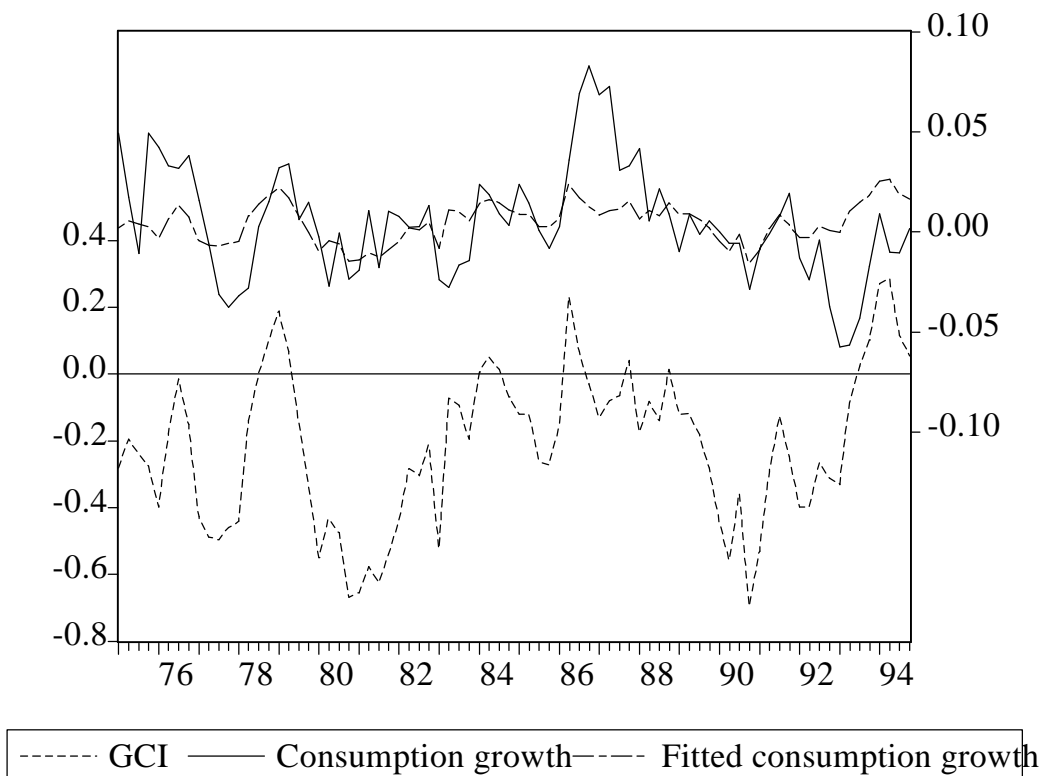
<sup>1</sup> See Aasen & Sundberg (1993).

<sup>2</sup> See e.g. Carroll *et. al.* (1994) for the US case, Acemoglu & Scott (1994) for the UK and Klein (1991) for the EC.

<sup>3</sup> See Holmgren & Warginger (1994) for a survey.

tematic general-to-specific modelling of which factors that influence the confidence variables. sections 4 and 5 examine the information content of the confidence variables using models of the Euler equation type and traditional solved-out consumption function.

**Figure 1** *Real per capita growth in consumption expenditures, actual and fitted, (the two upper curves and right hand scale) and the difference between the proportions "better" and "worse" in the attitude index for the general economic situation, GCI (the lower curve and left hand scale)*



Note: The fitted values are obtained from a direct regression of  $\Delta_4 \ln c$  on  $GCI$  and a constant.

## 2. The Swedish Consumer Confidence index and private consumption - a crude analysis

The measures of consumer confidence we use come from Statistics Sweden and are available since the fourth quarter of 1973. The Swedish surveys (the HIP-surveys) contain questions about the economic situation, the personal financial situation, buying intentions about cars and perceptions about unemployment.<sup>4</sup> Later the survey has also included questions about inflation and savings. The interviews take place at the very beginning of each quarter. The attitudinal questions in the HIP-surveys are based on a three point scale of the form "Better", "The same" and "Worse". A common practice is to calculate an index based on the difference between the proportion of responses to the alternatives "Better" and "Worse". The two attitudinal indices we use are the expectations regarding the general

<sup>4</sup> See Ågren & Jonsson (1991) for more details about the HIP-surveys.

economic situation (*GCI*) and the personal financial situation (*PCI*) for the next 12 months, i.e. forward looking attitudes. Confidence indicators are nowadays available on a monthly basis with a rather short publication lag while preliminary consumption figures are published quarterly with approximately a one-quarter lag.

During the period 1975-94 consumers on average were rather pessimistic about the general economic situation as reflected in the variable *GCI*, see Figure 1. In general more people chose the "Worse" alternative than the "Better" alternative. The average value of the balance variable was -0.21 units (-21 percentage points). There was little sign of any trend-wise change in the variable, while the cyclical variations were marked. The variability was very large, the standard deviation being 0.23 units. Often there were very rapid changes in the index. During the marked recession in the early part of the 1990s, the index fell from +0.01 in 1988:4 to -0.70 in 1990:4. Otherwise there is surprisingly little evidence of this recession. Thus in 1993 when private consumption was uniquely depressed the *GCI* variable was higher than average.

**Figure 2** *Real per capita growth in consumption expenditures, actual and fitted, (the two upper curves and right hand scale) and the difference between the proportions "better" and "worse" in the attitude index for the personal financial situation, PCI (the lower curve and left hand scale)*



Note: The fitted values are obtained from a direct regression of  $\Delta_4 \ln c$  on *PCI* and a constant.

Regarding their own private situation consumers on average were more optimistic, Figure 2. The average *PCI* index figure was -0.02 (-2 percentage points). The variability was much smaller than for *GCI* with a standard deviation of 0.11 units. There is more evidence of the early 1990s recession in the *PCI* index than in the *GCI* index. The minimum value of -0.27 was recorded in 1981:3 and 1992:4, two periods with declining consumption. The correlation between the indices for the general and private economic situation was 0.69.

### **Annual or quarterly changes in the modelling?**

Before turning to the actual modelling we have to make a decision if we shall use seasonally adjusted data and first differences or seasonally unadjusted data with either annual changes or with quarterly changes and seasonal dummies. A general discussion of the advantages or disadvantages of the two approaches is beyond the scope of the present paper.<sup>5</sup> We limit ourselves to just a few important points. Annual differences can be considered as moving sums of quarterly differences, which has the obvious advantage of eliminating part of the random errors. A major drawback of using annual differences is the probable introduction of serial correlation. An important aspect is the usefulness of the results in terms of direct applicability and ease of interpretation. Here quarterly differences based on unadjusted data are at a serious disadvantage as the strong seasonal effects make them more or less useless for direct comparisons. Thus we have to use seasonally adjusted data or annual differences if a direct interpretation of results is important.

In models where simultaneity bias can be disregarded the aspects mentioned above should be the most important ones and the most suitable alternative should be selected in each special case. It can be noted that much of the error correction-type modelling where long-run aspects are important is based on annual differences and models estimated by OLS.

In situations where simultaneity bias must be considered the situation is more complicated. An acceptable estimation method in this case is in general instrumental variables estimation. A common choice of instruments is suitable lags of certain of the explanatory variables, lags that are chosen in such a way that they are guaranteed to be uncorrelated with the structural residuals. The use of annual differences causes difficulties in such a case. The reason is that we then implicitly include variables dated "t-4", which means that instruments dated even further back in time must be used if we want to avoid any possibility of correlation between instruments and structural residuals. However, this has the drawback that the instruments in general will be so weak that the efficiency of the estimates must be seriously questioned. As a conclusion it can be said that in situations where instrumental variables estimation is considered essential there are strong arguments for the use of some form of quarterly differences.

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<sup>5</sup> In the context of consumption modelling, we have ourselves discussed the matter in Berg & Bergström(1991), (1993) and (1995). A discussion of seasonal adjustment of Swedish consumption data including the applicability of different statistical measures is given in Assarsson (1991) and Bergström(1985).

### Analyses based on annual differences

Figures 1 and 2 also show the relationships between the annual per capita growth rate in private consumption expenditures,  $\Delta_4\text{Inc}$ , and the two consumer confidence indices. The correlation is much higher between *PCI* and the annual growth in consumption ( $r = 0.61$ ) than between *GCI* and the growth in consumption ( $r = 0.35$ ).<sup>6</sup> Simple regression models with the growth rate in consumption as the dependent variable and *GCI* and *PCI*, respectively, in unlagged form as the only explanatory variable have been estimated. The model with the *PCI* as independent gives the following result for the sample period 1975:1 - 94:4 (the fitted values from the model are shown in the upper part of Figure 2):

$$\Delta_4\text{Inc} = 0.0086 + 0.1622 \text{ PCI} \quad \bar{R}^2 = 0.37 \quad \text{D-W} = 0.70$$

(0.0025)    (0.0236)

This implies that an increase in the *PCI* balance by 0.10 units (10 percentage points) on average is associated with an increase in the annual consumption growth rate of 1.6 percentage points. From a statistical point of view, the model is obviously unsatisfactory. There is strong autocorrelation in the residuals as shown by the Durbin-Watson value, and a direct inspection of Figure 2. The *PCI* variable does not reflect the consumption peak in 1986-87, when annual growth rates of up to 6-8 percent were recorded in certain quarters. Large negative residuals in 1993-94 confirm the earlier mentioned impression that the *PCI* reflects the economic recession at that time very incompletely.

**Table 1** *The relationship between the annual change in consumption expenditures and consumer confidence*

Lags of the confidence variable:	Consumer confidence variable			
	PCI		GCI	
	(1)	(2)	(1)	(2)
0	0.109 (0.041)	0.127 (0.031)	0.012 (0.020)	0.038 (0.014)
1	0.050 (0.051)	-0.036 (0.041)	0.022 (0.027)	-0.011 (0.019)
2	0.036 (0.051)	0.002 (0.039)	0.015 (0.027)	0.001 (0.019)
3	0.039 (0.051)	0.027 (0.039)	0.027 (0.026)	0.014 (0.018)
4	-0.080 (0.041)	-0.068 (0.031)	-0.021 (0.020)	-0.030 (0.014)
$\Delta_4\text{Inc}_{-1}$		0.632 (0.087)		0.739 (0.082)
$\bar{R}^2$	0.384	0.639	0.148	0.590
D-W	0.66	1.91	0.54	2.04
LM $\chi^2(4)$	38.30	7.72	46.03	11.10

Standard errors in parentheses.

<sup>6</sup> In all estimated equations in the following *PCI* and *GCI* are used in the form of proportions (not percentages). Unless otherwise stated variables such as  $\Delta_4\text{Inc}$  are defined as relative changes (not percentage changes).

Models with lagged values of *PCI* as the explanatory variable (one lag at a time) leads to successively smaller parameter estimates and lower  $\bar{R}^2$  as the lag increases, the estimated parameters being 0.15, 0.13, 0.10 and 0.06 for lags 1 to 4 (standard errors 0.024 to 0.029). Irrespective of lag there is strong autocorrelation in the residuals.

Addition of the lagged dependent variable to the explanatory variables eliminates the first order serial correlation in the residual. *PCI* in unlagged form is again found to be the strongest variable, the  $\bar{R}^2$  increasing from 0.524 to 0.615 as a consequence of the introduction of *PCI* into the model. *PCI* is insignificant starting with lag 2. As expected the parameters are smaller than in the series of models without the lagged dependent variable.

Is there any gain in using *PCI* with several lags ? A model with *PCI* in current form and four lags produces an  $\bar{R}^2$  of 0.384, see Table 1, which is a very marginal improvement on the  $\bar{R}^2$  of the simple model with just current *PCI*, which is 0.370. The parameter of the current form of the variable is 0.109 (standard error 0.041). The parameters of lags 1 to 3 are 0.03-0.05, all insignificant. The parameter at lag 4 finally is negative, -0.08 and very close to significant at the 5 % level. The corresponding model with the lagged dependent variable among the explanatory variables produces a similar picture, model (2) of Table 1. Exclusion of the current value of *PCI* reduces the  $\bar{R}^2$  to 0.32 for a model with just  $PCI_{-1}$  and 0.33 with the four variables  $PCI_{-1}$  to  $PCI_{-4}$ .

A corresponding analysis for the variable *GCI*, the confidence variable based on the general economic situation reveals that the explanatory power of this variable is considerably lower. The highest  $\bar{R}^2 = 0.158$  is obtained at lag  $k=1$ . Lags up to  $k=3$  are significant. Introduction of the lagged dependent variable into the model again eliminates the first-order autocorrelation. *GCI* in unlagged form is the preferred form of the variable, increasing the  $\bar{R}^2$  from 0.524 to 0.580. Lags larger than 1 lead to insignificant effects.

If we consider the joint effects of both confidence indices, it is found that, irrespective of model formulation and lags included, *GCI* has no additional explanatory value at all in the presence of *PCI*. The parameter of *GCI* is always very close to 0 or even negative. With the variables in unlagged form (1975:1 - 94:4), we obtain the following basic result

$$\Delta_4 \ln c = 0.0056 + 0.1871 PCI - 0.0165 GCI \quad \bar{R}^2 = 0.37 \quad D-W = 0.72$$

$$(0.0037) \quad (0.0326) \quad (0.0149)$$

It is obvious that use of an aggregated index based on the sum of the two indices should produce inferior results as this implies an assumption of equal effects of the two confidence variables, an assumption clearly rejected by the data. The consumer confidence index has often been used as a leading indicator with lagged values of the index influencing

consumption. However, our results indicate that the strongest relationship is between the current value of the index and changes in consumption.

### Analyses based on quarterly differences

With X-11 seasonally adjusted data, a simple model with just *PCI* in unlagged form gives a parameter estimate of 0.0550 (SE = 0.0126). The effect of *PCI* is clearly significant and the  $\bar{R}^2$  is about half that for the model based on annual growth rates ( $\bar{R}^2 = 0.185$ ). There is no indication of first-order serial correlation (D-W = 2.01). The estimated parameter is smaller than in the model based on annual growth rates (as expected). Models with lagged values of *PCI* (one lag at a time) show smaller and insignificant effects with increasing lags.

A model with *PCI* in current form and four lags increases  $\bar{R}^2$  to 0.270. Only the first two lags are significant with opposite signs. The numerical value of the lagged variable is about two thirds of that of the current variable. This result indicates that the change in *PCI* might be the relevant explanatory variable. However, such a model is clearly inferior to the model allowing for separate effects of the variables and is about equivalent in statistical terms to the baseline model with just *PCI* in unlagged form. Using *GCI* instead of *PCI* produces clearly inferior results.

With seasonally unadjusted data a baseline model with *PCI* unlagged and seasonal dummies produces a parameter estimate that is very similar to that obtained with seasonally adjusted data, but with a markedly larger standard error (0.0161 compared with 0.0126). The  $\bar{R}^2$  is a measure of limited usefulness with such strong seasonal effects. The inclusion of *PCI* leads to an increase from 0.9328 for the seasonal dummies only-model to 0.9386. Lags larger than 1 of *PCI* have no effect on the quarterly growth rate and a model with just the current form of *PCI* and the first lag produces results that are similar to those obtained with seasonally adjusted data. The parameter of the lagged variable is about half that of the current variable.

The model can be further improved if lagged values of the dependent variable are included. With four lags included, we obtain negative estimates of the first three parameters and a positive value for the fourth lag. Only the latter estimate is significant, although the other terms all have t-values that are absolutely larger than 1. Elimination of the first three lags increases the estimate of the lag 4 term further leading to the following estimated model (seasonal dummies not shown)

$$\Delta \ln c = -0.0285 + 0.3418 \Delta \ln c_{-4} + 0.1228 PCI - 0.0862 PCI_{-1} \quad \bar{R}^2 = 0.9517 \quad D-W = 2.14$$

$$(0.0047) \quad (0.0802) \quad (0.0263) \quad (0.0267)$$

Models with *GCI* instead of *PCI* again yield inferior results.



For the US and the UK Carroll *et. al.* (1994) and Acemoglu & Scott (1994) give corresponding results based on seasonally adjusted data and quarterly differences. For the US there is a significant effect of the confidence index, but the explanatory power is very low. Lags 1 to 4 produce an  $\bar{R}^2$  of 0.14 for the period 1955-1992 and an even lower value of 0.05 for the shorter period 1978-1992. The incremental  $\bar{R}^2$  in the presence of a number of lagged macroeconomic variables is as low as 0.03 and -0.03 in the two cases. For the UK the explanatory power of the confidence index is considerably higher. For the period 1974-1990 the  $\bar{R}^2$  obtained in a model with the confidence index lagged one quarter is 0.44, while the corresponding result with the index lagged two quarters is 0.29. This means that our results are much closer to those obtained for the UK than for the US, although a direct comparison is hampered by the different form of data used by us (annual changes in seasonally unadjusted data compared with quarterly changes in seasonally adjusted data).

### 3. Consumer confidence, income and other macroeconomic variables

One explanation for the correlation between consumption and the confidence indices might be that attitudes reflect variables relevant to the consumers' planning problem. According to the REPIH<sup>7</sup> the change in consumption, for a given interest rate is proportional to the current innovation in future income expectations, i.e.

$$\Delta C_t = \frac{r}{1+r} \sum_{k=0}^{\infty} (1+r)^{-k} (E_t - E_{t-1}) Y_{t+k} \quad (1)$$

where  $r$  is a constant real interest rate,  $Y_{t+k}$  and  $C_t$  denote real labour income and consumption, respectively and  $E_t$  and  $E_{t-1}$  is the expectation conditional on all information available in  $t$  and  $t-1$ , respectively. The change in consumption from  $t-1$  to  $t$  which is unpredictable at time  $t-1$ , is directly related to the innovation or "news" about income. The expression on the right hand side of equation (1) thus shows the difference between the realisation and the one period ahead expectation of consumption and as such is independent or orthogonal to any variable that was used in predicting today's consumption. Therefore consumer confidence may be a coincident indicator if it summarises changes in agents' beliefs about future income and thus potentially consistent with the REPIH.

To study whether the two confidence variables used predict income we have performed a Granger causality test regressing the annual change in the logarithm of income on lagged values of itself, each of the confidence variables and the changes in other relevant macroeconomic variables. In all cases four lags were included. Variables included in the model are real growth in net wealth, share prices, consumption expenditures, inflation, the real interest rate and the rate of unemployment. Non-property disposable income is used as in-

<sup>7</sup> See Deaton (1992) or Muellbauer & Lattimore (1994) for a thorough discussion.

come measure for household.<sup>8</sup> The results in the second column of Table 2, reporting exclusion tests on each variable with lags one to four, indicate that neither of the two confidence variables predict the innovation in the growth of non-property disposable income. The same is true for the growth rate in net wealth, the rate of unemployment and the

**Table 2** Granger causality for selected macroeconomic variables, 75:1-94:4

Deletion test on:	Dependent variable								
	$\Delta_4 \ln gdp$	$\Delta_4 \ln y$	$\Delta_4 \ln w$	$\Delta_4 u$	$p$	$r$	$\Delta_4 \ln share$ <i>e</i>	$\Delta_4 \ln c$	$GCI$
$\Delta_4 \ln gdp$	16.8	2.0	7.8	6.9	6.3	3.2	2.4	11.6	11.8
$\Delta_4 \ln y$	8.4	12.9	6.4	8.5	12.1	11.3	4.9	7.3	5.4
$\Delta_4 \ln w$	4.1	8.0	27.1	21.4	9.4	5.3	13.3	6.6	4.8
$\Delta_4 u$	7.9	16.0	16.4	56.4	3.0	0.7	4.2	20.4	2.3
$p$	4.7	13.5	1.0	14.1	5.8	5.6	10.3	11.3	28.2
$r$	4.8	14.8	1.0	15.3	8.5	58.6	7.6	10.9	26.3
$\Delta_4 \ln share$	13.5	9.9	10.5	14.8	7.3	3.6	78.2	15.9	0.9
$\Delta_4 \ln c$	4.2	0.5	0.9	7.9	4.1	3.1	2.4	22.8	8.7
$GCI$	3.0	2.7	1.9	8.0	18.2	10.0	5.2	15.5	-
									<i>PCI</i>
$\Delta_4 \ln gdp$	14.7	2.5	7.5	7.6	4.7	2.2	2.0	7.5	3.2
$\Delta_4 \ln y$	6.9	9.7	10.0	13.4	14.4	14.2	3.9	10.0	1.9
$\Delta_4 \ln w$	7.2	6.1	24.6	17.6	8.1	8.4	12.3	4.7	9.1
$\Delta_4 u$	14.1	14.7	11.5	54.0	7.5	2.8	6.2	13.0	4.7
$p$	6.9	8.9	0.3	13.0	7.1	10.6	10.7	6.6	35.1
$r$	5.9	11.0	0.3	11.3	14.9	69.8	7.7	5.3	36.8
$\Delta_4 \ln share$	13.1	8.9	10.6	14.7	10.4	5.7	78.1	17.6	1.9
$\Delta_4 \ln c$	3.4	1.5	0.6	8.5	7.7	9.8	5.6	18.1	6.3
$PCI$	7.0	7.1	5.3	4.4	25.6	20.0	7.5	8.3	-

Figure quoted is the likelihood ratio (LR) test-statistic for the exclusion of lags one to four of the variable listed in the first column. The dependent variable is listed in the column heading. Lags one to four of all variables listed in the first column were included in each regression. The test statistic is asymptotically distributed as  $\chi^2(4)$  under the null, with 5 per cent critical value 9.49 and 1 per cent level 13.3. Variables:

*gdp* gross domestic product, per capita in constant 1991 years prices,

*y* non property disposable income, per capita in constant 1991 years prices,

*w* household's net wealth, per capita in constant 1991 years prices,

*u* rate of unemployment,

*p* the rate of inflation defined as the relative change in the implicit price deflator for consumer good,

*r* real interest rate (inflation rate, *ex post*, deducted from yield on government bond),

*share* share price index in real terms, *Affärsvärldens* general index adjusted for the inflation rate,

*c* consumption expenditures, per capita in constant 1991 prices,

*GCI* confidence index for the general economic situation, the differences in the proportions of "better" and "worse", and

*PCI* confidence index for personal financial economic situation differences in the proportions of "better" and "worse".

$\Delta_4$  indicates that the variable is expressed in seasonal differences, e.g.  $\Delta_4 \ln y = \ln y - \ln y_{-4}$

growth rate of the stock price index in real terms. The *GCI* index is significant only for the inflation rate, the real interest rate and for the growth rate in consumption. The *PCI* vari-

<sup>8</sup> The variable for non-property disposable income is constructed in such a way that household capital income and operating surplus for unincorporated business and real estate are deducted from the disposable income measure of the National Accounts.

able predicts the inflation rate, the real interest rate but not the growth rate in consumption. It is also of interest to note that inflation and the real interest rate are significant predictors of both *GCI* and *PCI* - see the last column of Table 2.

The Granger causality testing indicates that the "news" in the *GCI* and *PCI* variables does not affect income growth while the *GCI* affects consumption growth. The deletion test also indicates that the confidence variables are heavily influenced by above all inflation and the real interest rate. To further study which factors that influence *GCI* and *PCI*, we have used a systematic testing procedure of "the general to the specific" type. As explanatory variables, all the variables in Table 2 have been considered, in all cases with lags 1 to 4 (the variables in unlagged form are not included). Four lags of the dependent variable are also included. We start with a model that includes all variables and then successively eliminate variables as long as they are insignificant. Each testing step is based on a potential elimination of all four lags of each of the explanatory variables and the test used is a standard F-test.

**Table 3** *GCI and PCI as explained by the inflation rate and the real interest rate*

	Dependent variable			
	GCI		PCI	
	(1)	(2)	(1)	(2)
Const	0.08 (0.12)	0.55 (0.14)	0.03 (0.05)	0.37 (0.07)
$p_{-1}$	-10.20 (2.58)	-11.42 (2.97)	-5.45 (1.04)	-5.98 (1.60)
$p_{-2}$	8.88 (2.43)	7.00 (2.90)	5.19 (1.07)	2.31 (1.59)
$r_{-1}$	-8.83 (2.22)	-16.75 (3.31)	-4.81 (0.93)	-4.39 (1.44)
$r_{-2}$	7.87 (2.15)	9.26 (3.28)	4.43 (0.95)	1.54 (1.40)
$GCI_{-1}$	0.71 (0.09)			
$PCI_{-1}$			0.57 (0.11)	
$PCI_{-2}$			0.29 (0.11)	
$\bar{R}^2$	0.6664	0.3897	0.7427	0.3160
LM- $\chi^2(4)$	0.69	34.39	3.69	50.92

Standard errors in parentheses.

In the case of *GCI*, this procedure leads to a model that includes the inflation rate, the real interest rate and lags of the dependent variable. It is also obvious that all four lags are not necessary for the included variables. A further elimination of the longest lags lead to the models shown in Table 3. There are strongly significant effects of the first two lags of the inflation rate and the real interest rate. One lag of the dependent variable should also be included. This leads to a model without signs of serial correlation in the residuals. If we

drop the lagged dependent variable, the parameter estimates of the remaining variables are not greatly changed. However, strong autocorrelation in the residuals is introduced.

The parameters are rather similar in size and of opposite sign when we compare lags one and two of the basic explanatory variables. This implies that we should consider the change in the inflation rate and the change in the real interest rate as the our explanatory variables. This leads to the following model

$$GCI = 0.04 - 9.19\Delta p_{-1} - 8.21\Delta r_{-1} + 0.77GCI_{-1} \quad \bar{R}^2 = 0.6701$$

(0.02) (2.39) (2.11) (0.07)

The model obviously is compatible with the data to the same degree as model (1) of Table 3, which is shown by the even higher  $\bar{R}^2$  compared with this model. An interpretation of the estimated parameters is that an increase in the inflation rate by one percentage points reduces the *GCI* index by 9.2 percentage points (the impact effect), while an increase in the real interest rate has a slightly smaller effect, a reduction of 8.2 percentage points.

The definition of the variables and the similarity of the estimated parameters makes one further interpretation of the estimated equation natural. If the estimated parameters of the inflation rate and the real interest were exactly the same, we could simplify the model to include only the nominal interest rate, *nr*. Such a model yields the following estimates

$$GCI = 0.04 - 8.71nr_{-1} + 7.98nr_{-2} + 0.77GCI_{-1} \quad \bar{R}^2 = 0.6695$$

(0.10) (2.20) (2.13) (0.07)

Obviously this model reflects the data as well as the model shown in Table 3, which means that the basic explanatory variable could be described as the change in the nominal (long-term) interest rate.

The corresponding modelling with *PCI* as the dependent variable produces very similar results. Although there is a somewhat higher explanatory content in certain of the variables, the model finally selected is basically the same as for *GCI*, the only difference being that two lags of the dependent variable are included. The first three steps of the testing-down procedure eliminate the change in the unemployment rate, the change in the share price index and the change in GDP. The p-values for deletion of the change in disposable income, wealth and private consumption at this stage are 0.21, 0.08 and 0.04 respectively, indicating some explanatory value. However, the further formal stepwise reduction in the model does not lead to inclusion of any of the variables. Nor is the pattern in the estimated parameters such that inclusion of a variable on these grounds seems warranted.

The model finally selected has very acceptable statistical properties, with little sign of autocorrelation in the residuals. Exclusion of the lags of the dependent variable introduces a lot of autocorrelation in the residuals. Interpretations of the estimated parameters similar to those given above for *GCI* are possible. Thus the effect on *PCI* can either be described as due to changes in the inflation rate and the real interest rate or as due to changes in the nominal interest rate.

#### 4. The Campbell-Mankiw model and consumer confidence

Tables 1 and 2 suggest that our two measures of consumer confidence are leading indicators for the growth in consumption expenditures although the effects of the variables in current form are stronger. Irrespective of whether the *PCI* or *GCI* variables are lagged one, two or even three periods we find that the variables have some relationship with consumption. This result seems to contradict the REPIH outlined in equation (1) which says that confidence indicators (or any other variable) should not contain any information with predictive ability for consumption growth. Many previous studies on Swedish data, have already rejected the REPIH or the "Euler equation" because consumption shows excess sensitivity with respect to lagged income.<sup>9</sup>

To perform yet another test of the REPIH we use the standard Campbell-Mankiw (1991) model for the Euler equation. Campbell-Mankiw assume that there are two types of consumers. The first type obeys the rules of REPIH and the second consists of rule-of-thumb consumers who simply consume their current income. For the second group of consumers, who can be thought of as being liquidity constrained, the rate of growth of consumption is equal to the rate of growth of income.<sup>10</sup> Given this assumption, aggregated consumption is given by

$$\Delta C_t = \lambda \Delta Y_t + \mathbf{e}_t \quad (2)$$

In equation (2) the parameter  $\lambda$  denotes the fraction of consumption that accrues to consumers who are liquidity constrained. Hence, an estimate of  $\lambda$  close to zero shows evidence in favour of the REPIH model, while an estimate significantly different from zero indicates that some fraction of consumers are liquidity constrained.

A problem with equation (2), when it comes to empirical estimation, is that  $\Delta Y_t$  will be correlated with  $\mathbf{e}_t$ , but a consistent estimate of  $\lambda$  can be obtained using instrumental variables. Another related problem is that consumption decisions are made continuously while the data are measured as time-aggregates. As a result the observed series on spending will follow an IMA(1,1) process even if consumer behaviour conforms to the life-cycle model and

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<sup>9</sup> See Agell & Berg (1995), Agell *et. al.* (1995), Assarsson (1991) and Campbell & Mankiw (1991).

<sup>10</sup> We follow Campbell & Mankiw (1991) and use log changes in consumption and income rather than arithmetic changes.

the consumption good is completely nondurable.<sup>11</sup> To avoid this problem Campbell & Mankiw exclusively use instruments lagged more than once, i.e. variables dated at  $t-2$  or earlier. Carroll *et. al.* argue that this strategy throws away the most up-to-date predictors of the change in income namely observations from period  $t-1$ . If equation (2) is specified with a moving average term in the residuals, observations from period  $t-1$  can be used as instruments.

$$\Delta C_t = \lambda \Delta Y_t + \mathbf{n}_t - \mathbf{q}\mathbf{n}_{t-1} \quad (3)$$

In equation (3) the moving average parameter  $\mathbf{q}$  is estimated explicitly and as a result any variable dated at  $t-1$  or earlier should be independent of  $\mathbf{n}_t$ . Using a one period moving average for the error term in the model thus means that we minimise the loss of information for the instrumental variables but still satisfy the theoretical considerations.

In the econometric model the standard Campbell-Mankiw model, equation (3) is augmented with a constant term, the real after-tax interest rate<sup>12</sup> and the confidence index *PCI* as additional explanatory variables. Before discussing the result for the Campbell-Mankiw model, it should be noted that the interviews for the confidence index take place in the very beginning of each quarter. This means that the values of the confidence variables can be looked upon as the ultimo value of previous quarter, i.e. belonging to the information set "t-1", information available at the start of time-period "t". the lagged value of the variable. As a consequence of this, ordinary excess sensitivity test with unlagged confidence variables are reported in Table 4. Experiments with one and two lags for the *PCI* variable in the Campbell-Mankiw model resulted in insignificant effects and much poorer  $\bar{R}^2$ s.

Experiments with the other confidence index, *GCI*, never showed any satisfactory results. As income variable we use non-property disposable income. We estimate the models with and without MA terms and appropriate lags for the variables in the instrument set are used according to this. The model is tested with both seasonally adjusted data models (5) - (8) and unadjusted data models (1)- (4) of Table 4.

The estimated parameters for the Campbell-Mankiw model are given in columns 2-6 of Table 4. The dependent variable is the annual and quarterly differences of the logarithm of consumer expenditures, per capita in constant 1991 prices. All equations are estimated by the instrumental variables method. We have experimented with different instrument sets. They are described below Table 4 and columns 10-12 give the  $\bar{R}^2$  when each right hand side variable is regressed on the relevant instrument set. Columns 7 and 8 give the  $\bar{R}^2$  of

<sup>11</sup> See Carroll *et. al.* for a discussion.

<sup>12</sup> Under a certain set of assumptions, estimating equation (3) with a variable interest rate as an independent variable makes it possible to obtain an estimate of the intertemporal elasticity of substitution. See e.g. Hall (1988) and Campbell & Mankiw (1991).

the estimated model and the p-value for the null that all coefficients are zero when the residual of the IV equations is regressed on the instrument set. A p-value greater than 0.05 indicates that the instrument set is independent of the structural error term of the model. This is Sargan's test for instrument validity, see i.e. Cuthbertson *et. al.* (1992). Finally, in column 9 the p-value for the Breusch-Godfrey test for serial correlation up to fourth order are shown.

**Table 4** *Testing for excess sensitivity, 1975:1 - 94:4 on unadjusted and seasonally adjusted data. Dependent variable: annual and quarterly growth rate in consumption expenditures*

	1	2	3	4	5	6	7	8	9	10	11	12
		<i>Const</i>	$\Delta \ln y$	<i>r</i>	<i>PCI</i>	MA(1)	$\bar{R}^2$	Test 1	Test 2	$\Delta \ln y$	<i>r</i>	<i>PCI</i>
(1) -6, -7		0.003 (0.005)	0.258 (0.304)	0.018 (0.120)	0.021 (0.109)		0.1081	0.67	0.00	0.0583	0.5987	0.1237
(2) -6, -7, -8		0.004 (0.004)	0.219 (0.178)	-0.004 (0.093)	0.050 (0.071)		0.2248	0.70	0.00	0.0819	0.6588	0.0965
(3) -5, -6, -7		0.006 (0.005)	-0.002 (0.147)	-0.082 (0.095)	0.132 (0.067)	0.660 (0.090)	0.5982	0.34	-	0.1074	0.6310	0.1130
(4) -5, -6, -7, -8		0.004 (0.005)	0.180 (0.098)	-0.026 (0.092)	0.078 (0.055)	0.850 (0.068)	0.6039	0.08	-	0.1211	0.6996	0.0811
(5) -2, -3		0.001 (0.002)	-0.285 (0.337)	-0.077 (0.057)	0.059 (0.030)		- 0.6034	0.69	1.00	- 0.0525	0.7574	0.5723
(6) -2, -3, -4		0.001 (0.002)	-0.105 (0.168)	-0.063 (0.042)	0.046 (0.019)		- 0.0107	0.75	1.00	- 0.0697	0.7621	0.6268
(7) -1, -2, -3		0.001 (0.002)	0.065 (0.071)	-0.039 (0.033)	0.039 (0.014)	-0.063 (0.117)	0.1864	0.42	-	0.2534	0.8900	0.7442
(8) -1, -2, -3, -4		0.001 (0.002)	0.042 (0.067)	-0.039 (0.033)	0.042 (0.014)	-0.053 (0.116)	0.1826	0.09	-	0.2478	0.8907	0.7643

In model (1) - (4) seasonally unadjusted data are used. Consumption and income growth are here expressed in seasonal differences, e.g.  $\Delta_4 \ln y = \ln y - \ln y_{-4}$  and  $\Delta_4 \ln c = \ln c - \ln c_{-4}$ . In model (5) - (8) seasonally adjusted data are used. Consumption and income growth are here expressed in first differences, i.e.  $\Delta \ln y = \ln y - \ln y_{-1}$  and  $\Delta \ln c = \ln c - \ln c_{-1}$ .

The first column shows the lags in the instrument set. The instrument set consists of the constant, lagged values of the dependent variable and the independent variables in the model. Columns 2 - 6 show the IV estimates of coefficients with standard errors in brackets for different specifications of the Euler equation. Columns 7 and 8 give  $\bar{R}^2$  for the IV estimates and show p-values for the Sargan test for instrument validity (Test 1). Test 2, in column 9, gives the p-value for the Breusch-Godfrey test for serial correlation up to fourth order. The final three columns show  $\bar{R}^2$  from regressing income growth, real interest rate and confidence index for personal financial situation on the instrument set with different lag length.

Variables:

- y* non property disposable income, per capita in constant 1991 years prices,
- c* consumer expenditures, per capita in constant 1991 years prices,
- r* real after-tax interest rate (inflation rate, *ex post*, deducted from after-tax yield on government bond), and
- PCI* confidence index for personal financial economic situation.

It is clear from Table 4 that using unadjusted data in the model gives poor results. In models (1) - (4) non-property disposable income growth is never significant at the 5 percent

level and the smallest p-value (0.07) for this variable is obtained in model (4). The is also true for the *PCI* variable for these models. The smallest p-value (0.053) for this variable is obtained in model (3). Only for models (3) and (4) where an MA(1) term is included do we get an acceptable  $\bar{R}^2$ . The estimated MA coefficient is thus the driving parameter in these two models. Models (1) - (4) are also examples of the drawback of the constraint set by the theoretical model that the instrument have to be dated back as far as "t-5" and "t-6". From columns 10 and 11 we see that the instruments are very weak so the efficiency of the estimates must be seriously questioned.

For the models where seasonally adjusted data and quarterly growth rates are used the efficiency of the instruments improves. The *PCI* variable is significant in all the models (5) - (8) while the growth rate of income is insignificant and the lowest p-value for these variable is as large as 0.36. Even when the MA(1) term is included, as in model (7) and (8), the  $\bar{R}^2$  is low; only about 18 per cent of the variance in the left hand variable is explained by the model. The Sargan test is not significant and thus the instrument set is valid for these models. A really striking finding is that when the *PCI* variable is included the income growth variable has no effect on consumption expenditures.

The expected sign of the real interest rate in the model is positive. Reported results show negative but insignificant estimates for this variable. Our results are in accordance with those reported by Agell *et. al.* (1995) who with one exception never managed to identify a positive and significant coefficient for the interest variable.

We have also examined the recursive coefficient for the *PCI* variable which can be of interest when borrowing constraints for the consumer are discussed. If the predictive role of the confidence indicator is due to liquidity constraints, the hypotheses is that its coefficient should be lower when liquidity constraints are less binding.<sup>13</sup> We should thus expect a fall in the coefficient after the mid-1980s when the deregulation of the credit market occurred, but the recursive estimates do not confirm this hypotheses, see Figure 3.

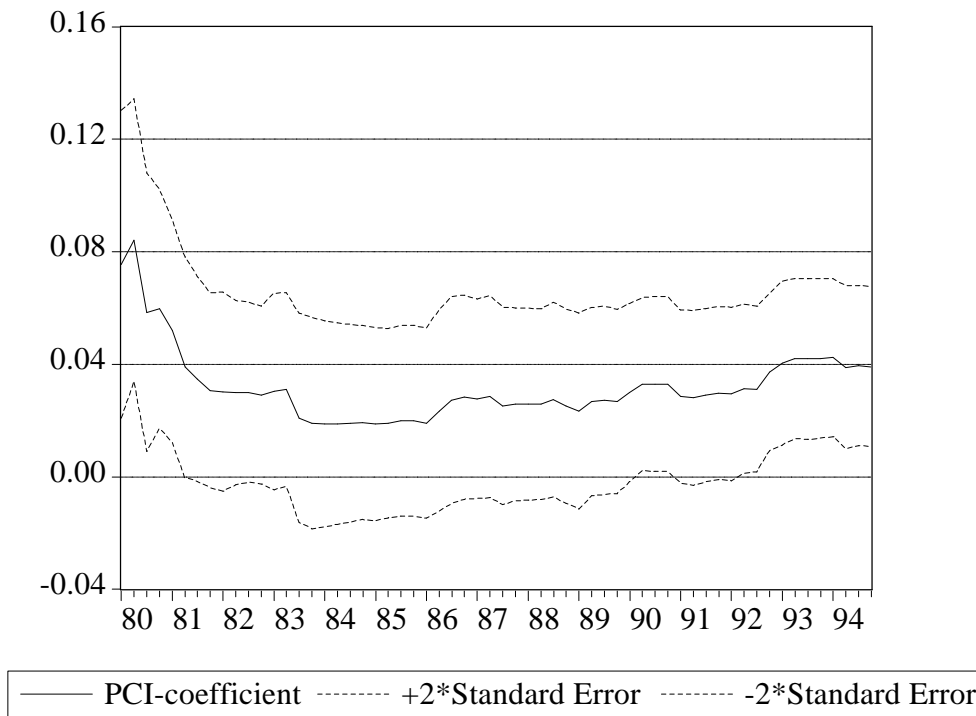
The coefficient is rather stable 1983-92 but hardly significant - the lower confidence limit is below zero for most of that period. After 1992 the coefficient increases with a small amount. Agell & Berg (1995) report a sudden jump in the recursive coefficient of non-property disposable income for different consumption measures after 1991, based on estimates for annual data. They explain this finding by the fact that Swedish banks were beset by heavy loan losses, necessitating direct government support for a number of banks and as a result the credit constraints became tighter during the deep recession. Our result indicates no such dramatic effects but the *PCI* coefficient shows a small increase and is significant for 1993-94.

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<sup>13</sup> For a detailed survey of the financial deregulation in Sweden, see Englund (1990).



**Figure 3** Recursive coefficients of the confidence index for the personal financial situation, *PCI*, for model (7) in Table 4



One objection to our empirical results is that it might be misleading to use consumer expenditures as the basic dependent variable in the model. Consumer expenditures comprise both expenditures for non-durables, durables and semi-durables which also introduces problems of durability in the consumption function. However, as has been pointed out by Mankiw (1982) consumption spending will follow an MA(1) process if the consumption good is durable. Thus, the specification of the consumption function with an MA(1) process for the error term may be a remedy to this problem of durability in our models.

Our results indicate that when we add a certain forward looking consumer confidence indicator to the Campbell-Mankiw model we find no evidence of excess sensitivity with respect to income. Instead, the *PCI* variable predicts growth for consumption expenditures and thus rejects the REPIH. However, a repetition of the analysis of Table 4 using non-durable consumption expenditures as the basic dependent variable alters our conclusions in particularly for model (7) and (8). In model (7) income growth becomes significant at less than the 1 per cent level and the *PCI* variable on 8.5 per cent. In model (8) both variables are significant at less than the 5 per cent level. Thus in one of these two models the confidence index is insignificant and income growth is the decisive variable. In the other both variables are significant. However, in the test for credit constrained consumers we believe that consumer expenditures is the best consumption measure. The estimated lambda value gives an indication of the proportion of consumption expenditures for constrained consu m-

ers. If non-durables consumer expenditures are used the interpretation of the meaning of  $\lambda$  is not entirely clear. A remedy out of this problem can be to assume that utility is separable between durables and non-durables and that the non-durables share is constant for constrained consumers. However, resort to this assumption is not so appealing.

Our results using growth of consumer expenditures as dependent variable differ from those reported by Carroll *et. al.* (1994) for the US, but are rather similar to those reported by Acemoglu & Scott (1994) for the UK. The explanatory power of consumer confidence in the context of an Euler equation is considerably lower in the US than in the UK. The UK study arrives at the same conclusion as we do i.e. that the confidence variable is useful in predicting growth of consumer expenditures and the REPIH is rejected due to consumer confidence and not income.

The Euler model has been used as a vehicle among economists for testing the REPIH. From a policy point of view it is of course of interest to know whether consumption is unpredictable or not. If excess sensitivity of consumption to income is caused by the fact that some households face liquidity constraints, it will have strong implications for fiscal policy. Changing transitory taxes and transfers will affect current consumption to a larger extent than predicted by the REPIH model, thus giving a larger scope for anticyclical fiscal policy. Our result that the *PCI* predicts consumption also gives a larger scope for fiscal policy: if policy makers can influence consumer perceptions regarding the personal financial situation for the next 12 months the growth rate in the economy will be affected. We have already learned that the consumer confidence index is heavily influenced by at least two other central macroeconomic variables, namely the change in the rate of inflation and the real after-tax interest rate, see Tables 2 and 3, or changes in the nominal interest rate. Fiscal and monetary action to curb inflation and lower the nominal interest rate will thus affect consumption expenditures through the consumers perceptions of the state of the economy.

One assumption underlying the REPIH model is that no income uncertainty is present. If this assumption is relaxed income uncertainty will result in precautionary saving. From theoretical models with income uncertainty we learn that the factor used to discount future income includes a part which reflects uncertainty.<sup>14</sup> This extra discount factor is larger for consumers with debts than for those with assets. If future income is more heavily discounted because of uncertainty, current income must be more important in determining current consumption. This must be particularly true for young people without assets. Uncertainty and precautionary saving helps to explain why consumption follows income more closely over the life cycle than the REPIH suggests. One possibility is thus that the *PCI* variable reflects income uncertainty among households. In the next section a solved-out

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<sup>14</sup> See Muellbauer & Lattimore (1994) for a discussion.

consumption function is estimated equipped with proxy variables for uncertainty and/or income expectations and the confidence index.

## 5. The solved-out consumption function

Muellbauer & Lattimore (1994) point out that a solved-out consumption function complements the Campbell & Mankiw model or the Euler approach in at least two ways. First, the differencing of the data underlying the Euler approach eliminates important information on the long-run levels of consumption, income and assets. Second, if the Euler equation were to be used to analyse the effects of a tax cut or an increase in asset prices on consumption for the next few years it would be necessary to obtain a solution of the first order condition (the Euler equation) with an intertemporal budget constraint. This requires certain expectational assumptions or in other words: the explicit solution for consumption of just that type that the solved-out consumption function is designed to give.

The solved-out consumption function we use is developed in detail by Muellbauer & Murphy (1993) and has previously been applied to Australia, Japan, the UK and the US.<sup>15</sup> Recently Agell *et. al.* (1995) used the model to estimate a consumption function for Sweden using annual data for the period 1953-93. An advantage of the model is that it allows us to explain secular and cyclical elements in consumption by a number of different factors, such as income expectations, assets, uncertainty and financial deregulation. Muellbauer & Murphy's benchmark model when the dependent variable is expressed in seasonal differences, can be written as:

$$\Delta_4 \ln c = \alpha_0 + \beta(\ln y - \ln c_{-4}) + (1-\beta)\lambda \Delta_4 \ln y + (1-\lambda)\beta \gamma A_{-4}/y + (1-\lambda)\beta \alpha_3 r + \text{other variables} + \varepsilon \quad (4)$$

The variables included in equation (4) are consumption,  $c$ , non-property disposable income,  $y$ , the assets to income ratio,  $A_{-4}/y$ , the real after-tax interest rate,  $r$ , and an error term. The equation has an error-correction term, and the  $\beta$  parameter is the adjustment parameter originating from the hypothesis of habit formation or adjustment costs in consumption.

The  $\lambda$  parameter has the same interpretation as in equation (2). It is a measure of the fraction of non-property disposable income accruing to consumers who are liquidity constrained. The assumption of two groups of consumers also introduces a moving average component in the error term.<sup>16</sup> In our empirical work we will consider this fact and consider models with and without such a moving average component. The inclusion of the

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<sup>15</sup> For details see Muellbauer & Murphy (1993a) and Muellbauer & Lattimore (1994). For a short derivation see the Appendix.

<sup>16</sup> The error term from equation (4) can be written as  $\varepsilon = (1-\lambda)\varepsilon^u + \lambda(\varepsilon^c - (1-\beta)\varepsilon^c_{-1})$ , where  $\varepsilon^u$  and  $\varepsilon^c$  is the error term for the unconstrained and constrained consumers consumption function, respectively. A small  $\lambda$ -parameter and a high  $\beta$ -value can be an indication that the negative autocorrelation in the error term can be ignored.

MA term can also be motivated by the problem of durability in consumption as already mentioned.

In the Muellbauer & Murphy model, equation (4), both the constant  $\alpha_0$  and the parameter  $\gamma$  are diminishing functions of the real interest rate and uncertainty of income (precautionary savings). In our implementation we follow Muellbauer & Murphy (1993 a,b) and assume that both parameters are constants. Instead we include the real after-tax interest rate as a separate variable. To control for the effects of uncertainty and/or income expectations we experiment with the change in the rate of unemployment and inflation and the relative real changes in debt. We have also experimented with the ratio of changes in general government net lending to income to capture the effects of the uncertainty of future taxes or that fiscal consolidation may stimulate consumption (see Giavazzi & Pagano 1990,1996). This variable never turned out to be significant. To avoid the problem of reversed causation, instrumental variables will be used for the proxy variables for uncertainty effects and/or income expectations.

The change in the rate of unemployment is often used as a measure of uncertainty and income expectations in empirical studies. There are also several reasons why inflation may influence consumption. It may influence the value of and return on assets, it can make the recorded real income deviate from that perceived by households, and it may capture the effect of income uncertainty - for a discussion, see e.g. Koskela & Virén (1985).

The real growth rate of debt can be used as a proxy for income expectations or income uncertainty in an unregulated credit market. According to the life cycle theory debt is a function of the consumers time preferences, intertemporal rate of substitution, expected income and the interest rate. Any changes in the mentioned factors will thus affect debt. Note also that the variable can be used as a proxy for rationing in the credit market. In a regulated credit market (before 1986 in Sweden) all consumers could save (postpone consumption) but not all could dissave (anticipate consumption). The availability of credit thus is important to anticipate consumption and the debt variable can be used as a proxy for rationing.<sup>17</sup>

Like Muellbauer & Murphy, we use per capita data on consumption expenditures and non-property disposable income to represent consumption and income variables.<sup>18</sup> We have

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<sup>17</sup> The availability of credit has been reported as an important determinant of household savings and consumption in Sweden during the 1970s and the first half of the 1980s, see e.g. Bentzel & Berg (1983) and Berg (1990). Furthermore, Berg & Bergström (1995) found in their study that the change in household debt was an important determinant of short-run consumer behaviour indicating that households have been credit constrained.

<sup>18</sup> Berg & Bergström (1995) contains a detailed analysis of the integration and cointegration properties of consumption, income and wealth for a period that is quite similar to the one considered here. Such results are therefore not shown here.

also experimented with splitting net wealth into net financial wealth and housing wealth.<sup>19</sup> In general we find that the estimated effect is greater for net financial wealth than for housing wealth indicating that the latter variable is less liquid than the former. We have also tested for seasonal effects with dummy variables. Only the variable for the third quarter  $D_3$  have a significant effect.

In all model specifications two dummy variables (equal to one for each quarter of 1986 and 1987, respectively, else zero) are included. We use these variables to capture effects of omitted factors. One of these effects is the deregulation of the credit market for households. Financial deregulation took place in the mid-1980s, which may have caused a temporary increase or overshooting in household indebtedness and thus a drop in savings. Once households have adapted to the deregulation, savings should revert to its more long term-level. Another of these effects is the possibility of revaluation of future income which have an impact on today's consumption.

We have experimented with different specifications of Muellbauer & Murphy's benchmark model, equation (4), and included other right-hand variables in the model. For all models we use instrumental variables estimation - see below Table 5 for a description of the instrument set. We have chosen to instrument only the real after-tax interest rate and the proxies for expectations or uncertainty in the consumption function and not the more traditional variables and income growth.<sup>20</sup> Results for our four models are displayed in Table 5 - each model estimated with and without a moving average component in the error term. A general feature of our results is that the inclusion of the MA term, although significant in all models, does not change the estimated parameters very much compared with the corresponding model without MA-term.

We have also experimented with both the *GCI* and the *PCI* variable in the models and we found that the latter variable outperformed the former. The *PCI* variable is always strongly significant. The parameter estimates are stable across different models, varying between 0.09 and 0.14. We have also reestimated all models in Table 5 without the *PCI* variable and the last row of the table reports the incremental  $\bar{R}^2$  from this experiment. The adjusted coefficient of determination increases between 0.06 and 0.15 units when the *PCI* variable is included in the model.

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<sup>19</sup> The asset variable as well as the measure of pure consumption is developed from the Berg (1990) data set. Net financial wealth consists of deposits, shares (at market value), bonds, assets in pension funds (voluntary life insurance savings), other financial assets and loans (deducted). Real assets consist of the market value of owner-occupied homes and holiday homes.

<sup>20</sup> We have also experimented with lags for the instruments that guarantee that they are uncorrelated with the structural residuals of the model, e.g. for models based on annual differences the lags need to be five quarters. However, this led to only marginal changes in the results.

**Table 5** *Modelling Swedish consumption growth. Sample period 1975:1-94:4*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Constant</i>	-0.148 (0.030)	-0.138 (0.033)	-0.097 (0.033)	-0.113 (0.033)	-0.086 (0.036)	-0.100 (0.035)	-0.147 (0.029)	-0.141 (0.031)
<i>D3</i>	-0.018 (0.005)	-0.019 (0.006)	-0.019 (0.006)	-0.020 (0.006)	-0.016 (0.007)	-0.017 (0.006)	-0.021 (0.005)	-0.022 (0.005)
<i>lny-inc<sub>-4</sub></i>	0.259 (0.051)	0.252 (0.059)	0.242 (0.059)	0.258 (0.064)	0.203 (0.064)	0.218 (0.070)	0.291 (0.051)	0.284 (0.057)
<i>D<sub>4</sub>lny</i>	-0.003 (0.047)	-0.011 (0.047)	-0.008 (0.053)	-0.004 (0.046)	-0.007 (0.059)	-0.012 (0.048)	-0.021 (0.045)	-0.023 (0.044)
<i>Wf<sub>-4</sub>/y</i>	0.047 (0.007)	0.043 (0.008)	0.023 (0.007)	0.025 (0.007)	0.015 (0.008)	0.021 (0.007)	0.043 (0.007)	0.039 (0.007)
<i>Wh<sub>-4</sub>/y</i>	0.012 (0.004)	0.011 (0.004)	0.013 (0.004)	0.015 (0.005)	0.013 (0.005)	0.014 (0.005)	0.014 (0.004)	0.015 (0.004)
<i>r</i>	-0.683 (0.084)	-0.647 (0.096)	-0.223 (0.074)	-0.227 (0.083)	-0.151 (0.092)	-0.197 (0.099)	-0.556 (0.089)	-0.502 (0.102)
<i>Δ<sub>4</sub>p</i>	-0.652 (0.090)	-0.654 (0.104)					-0.499 (0.091)	-0.475 (0.108)
<i>D<sub>4</sub>Debt</i>			0.273 (0.057)	0.270 (0.068)			0.168 (0.052)	0.183 (0.065)
<i>D<sub>4</sub>u</i>					-1.194 (0.370)	-0.930 (0.415)		
<i>PCI</i>	0.099 (0.023)	0.112 (0.026)	0.113 (0.026)	0.120 (0.026)	0.135 (0.028)	0.137 (0.027)	0.093 (0.022)	0.107 (0.025)
<i>D86</i>	0.041 (0.008)	0.037 (0.010)	0.021 (0.010)	0.019 (0.011)	0.037 (0.010)	0.035 (0.012)	0.030 (0.008)	0.025 (0.010)
<i>D87</i>	0.039 (0.008)	0.035 (0.010)	0.016 (0.010)	0.010 (0.011)	0.036 (0.010)	0.021 (0.012)	0.026 (0.009)	0.021 (0.010)
<i>MA(1)</i>		0.320 (0.120)		0.542 (0.108)		0.615 (0.104)		0.356 (0.118)
$\bar{R}^2$	0.7212	0.7337	0.6568	0.7324	0.5872	0.6898	0.7559	0.7680
SER	0.0148	0.0145	0.0164	0.0145	0.0180	0.0156	0.0138	0.0135
LM $\chi^2(4)$	0.23		0.00		0.00		0.15	
Chow 90-94	0.14	0.37	0.26	0.60	0.02	0.52	0.47	0.61
Chow 91-94	0.21	0.45	0.20	0.77	0.11	0.70	0.63	0.72
Chow 92-94	0.24	0.29	0.15	0.81	0.06	0.45	0.57	0.66
Incremental $\bar{R}^2$	0.0787	0.0790	0.0915	0.0754	0.1502	0.1132	0.0649	0.0656

Standard errors in parentheses. Variables (consumption, income, wealth and debt are all expressed in per capita terms and 1991 prices): *y* and *c* non property disposable income and consumption expenditures, *Wf* financial net wealth, *Wh* housing wealth, *u* the rate of unemployment, *p* the rate of inflation, *r* the real after-tax interest rate (inflation rate, *ex post*, deducted from after-tax yield on government bond), *D<sub>4</sub>Debt* and *D86* and *D87* dummy variables equal to 1 for each quarter of the indicated year, otherwise zero. *D3* is a dummy variable equal to 1 for every third quarter, otherwise zero.

LM  $\chi^2(4)$  gives the p-value for the Breusch-Godfrey test for serial correlation to the fourth order. For Chow's forecast test the given values are the p-value for the  $\chi^2$ -statistics. For all three tests a p-values greater than 0.05 indicate that we can not reject the null at the 5 per cent level. Incremental  $\bar{R}^2$  records the difference between  $\bar{R}^2$  when the model is estimated with and without the *PCI* variable. In all models the variables *r*, *D<sub>4</sub>u*, *D<sub>4</sub>p* and *D<sub>4</sub>Debt* are instrumented. The instrument set used consists of the lagged value of the variable itself and the actual and lagged value of *lny-inc<sub>-4</sub>*, *D<sub>4</sub>lny*, *Wf<sub>-4</sub>/y*, *Wh<sub>-4</sub>/y* and the constant term, *D3*, *D86* and *D87*.

The models in Table 5 have also been estimated with lagged values for the *PCI* variable. Using the first or second lag of the variable results in lower but still significant parameter

estimates and a poorer  $\bar{R}^2$ . Using the third lag or higher lags results in insignificant parameter estimate for the *PCI* variable. Thus for all models forward-looking expectations, represented by the unlagged value of the *PCI* variable, seem to have a role in explaining today's growth of consumer expenditures.

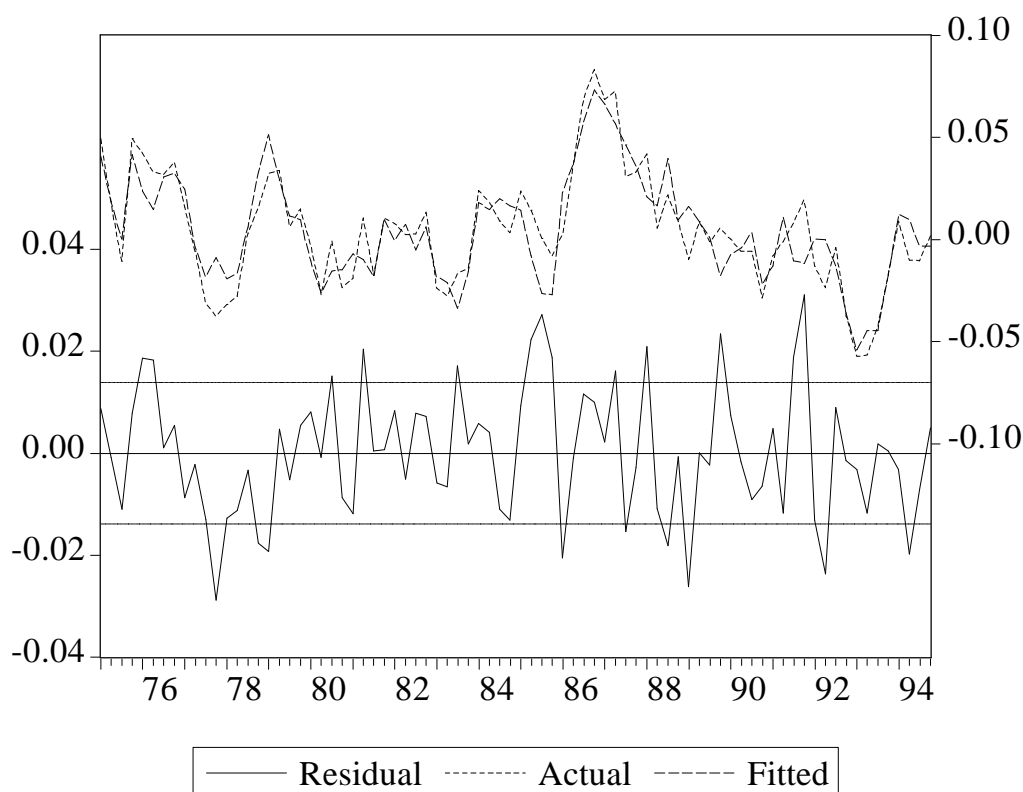
The speed of adjustment in consumption, i.e. the parameter  $\beta$  in equation (4), is estimated in the interval 0.20 to 0.30. The interpretation of this figure is that between one-quarter and one-third of the gap between desired and actual consumption growth for unconstrained consumers is adjusted within the period. Model (8) yields the highest value of the adjustment parameter. The reported  $\beta$  estimates in Agell *et. al.* (1995) are of the same size.

No model yields a significant estimate of the  $\lambda$  parameter. As the estimated growth rate in non-property disposable income is insignificant in all models we thus reach the same result using the solved-out consumption function as we did with the Euler equation. Our results are in sharp contrast to those reported by Agell *et. al.* (1995). They obtain an estimate of  $\lambda$  in the range .3 to .4 using the Muellbauer & Murphy model on yearly Swedish data for the period 1953-93. Another difference than the data frequency between the Agell study and ours is that the former study uses disposable income and a measure of pure consumption while we use non-property disposal income and consumption expenditures.

Both wealth ratios are estimated with a high degree of precision and a pervading characteristic is that the effect of net financial wealth is greater than that of housing wealth in all models. This result indicates a lower degree of liquidity in the later form of wealth. In models without *PCI* housing wealth is always insignificant.

In the first two models the change in the rate of inflation is used as a proxy for income uncertainty or expectations. These two models give a higher  $\bar{R}^2$  than models (3) - (6) where growth in debt and change in the rate of unemployment are used as proxy variables. The growth in debt is significant in models (3) and (4) as well as the change in the rate of unemployment in models (5) and (6). Models (7) and (8), where both changes in the rate of inflation and growth in debt are included, shows the highest  $\bar{R}^2$  and the lowest standard error of regression.

**Figure 4** Actual and fitted values (right hand scale) and residuals (left hand scale) of the dependent variable  $\Delta_4 \ln c$  for model (7) of Table 5



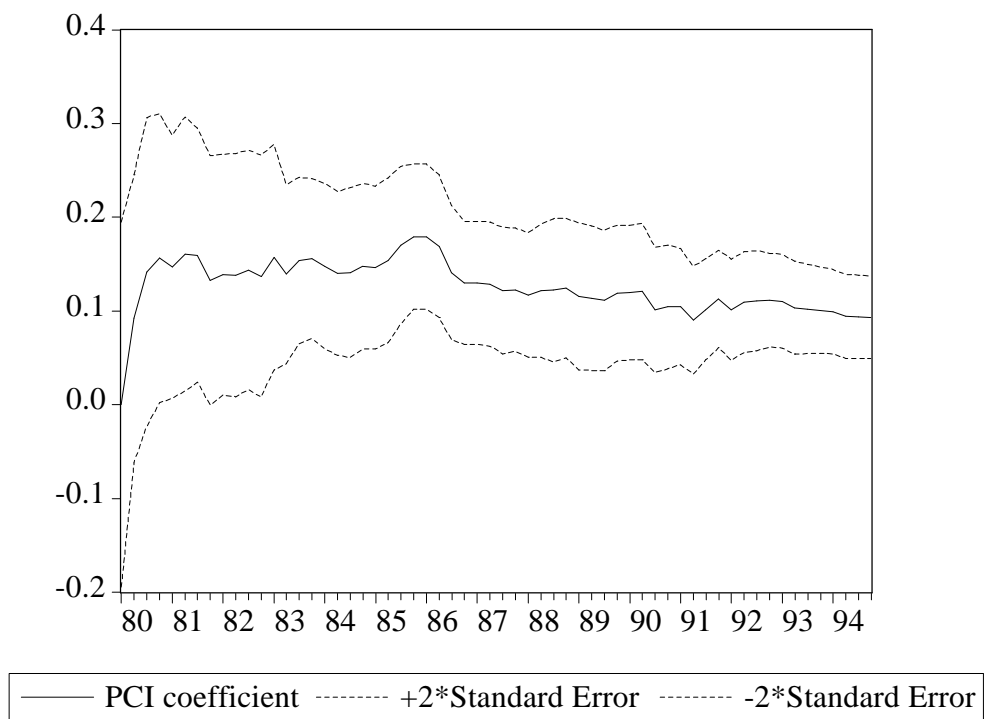
In all models, except (5) and (6), the real after-tax interest rate is significant at least at the 5 per cent level. Crucial for the size of the estimate of this variable seems to be whether the change in the rate of inflation is included or not. In models (3) and (4), where the growth rate in debt is the proxy for income expectations, the effect of the interest rate is reduced in size by as much as two thirds. The estimated parameter for the real after-tax interest rate varies between  $-.68$  to  $-.15$  and even the highest estimate of the effect is not unreasonably large as the impact effect on consumption growth of a change in the real after-tax interest rate by one percentage point is a decrease in consumption growth by between  $0.68$  and  $0.15$  percentage points. Note also that an increase in the real after-tax interest rate by one percentage point in 1994 is equivalent to a rise in the rate by nearly 30 per cent! The corresponding long-run elasticities are  $-0.05$  and  $-0.015$ .

The dummy variables for 1986 and 1987 are significant in all models, except for model (4) and the dummy variable for 1987 for model (3) and (6). The importance of these variables supports the overshooting hypothesis meaning that financial deregulation and/or revaluation of future income increased the growth in consumer expenditures considerably during these two years. Inclusion of the debt variable into the model reduces the size and significance of the parameters for the dummy variables and in model (4) both are insignificant. One interpretation of model (4) is that the consumption boom in the second half of the



1980s is explained entirely by the arguments in the consumption function. The model does not unveil any credit constrained consumers. Habit formation and the predetermined asset to income ratio are of importance for consumption. Using growth rate in debt and the *PCI* variable for income expectations and/or income uncertainty gives a model that excludes the dummy for omitted factors.

**Figure 5** *Recursive coefficients of the confidence index for the personal financial situation, PCI, for model (7) in Table 5*



As has been extensively discussed earlier, consumption growth has been quite volatile during the 1980s and the beginning of the 1990s. Despite this, the Muellbauer & Murphy model fits the data surprisingly well. Model (7) of Table 5 is displayed in Figure 4. The figure shows that the covariation between fitted and actual consumption growth is high, and that the model tracks the boom-to-bust cycle of consumption growth remarkably well. Further, there is no indication of serial correlation in the disturbances. The residuals tend not to be larger in the 1990s but, at conventional significance levels, we cannot reject the null hypothesis for Chow's forecast test for different time periods between 1990-94.

We have also examined whether the effect of the *PCI* variable is stable or not by computing recursive estimate, see Figure 5. Contrary to the Euler equation case, see Figure 3, the effect of the *PCI* variable is quite stable for the solved-out consumption function. In this model we include traditional "long-run" variables and proxy variables to capture uncertainty effects and/or income expectations. It is obvious that the inclusion of these variables lead to more stable estimates of the effect of the *PCI* variable.

## 6. Concluding remarks

The role of confidence indices in explaining consumption growth in Sweden during the period 1975-94 is analysed. We first analysed which variables influence the levels of the confidence indices. Two important such factors are found to be changes in real interest rates and changes in the inflation rate. Of the two forward-looking indices considered, the one regarding the personal financial situation is found to be more closely related to changes in consumption than the index regarding the general economic situation. The latter has no additional information content in the presence of the former. In a crude analysis the personal financial situation index explains about 37 % of the variance in the growth rate of consumption. The index has an important significant effect even in the presence of other variables in the two types of consumption models that are considered, an Euler equation and a solved-out consumption model. In the latter model, the confidence index increases the explained part of the variance in consumption growth from about 0.69 to 0.76. The real after-tax interest rate and the change in the inflation rate are important determinants of consumption. Financial wealth is more important than housing wealth and changes in debt also influence consumption. The solved-out consumption model is able to reflect the Swedish boom-to-bust cycle in consumption remarkably well.

## Appendix: The solved-out consumption function

It should be noted that the asset to income ratio in equation (4) is not expressed in log arithmetic terms. One advantage of this approach is that assets now can be disaggregated in an easy way after the degree of liquidity. To illustrate this point Muellbauer & Murphy (1993a,b) use a simplified consumption function where consumption is a linear function of income and assets with a multiplicative error term,  $1 + \omega$ .

$$c = (\alpha_1 y + \alpha_2 A_{-4})(1 + \omega) \rightarrow c = \alpha_1 y (1 + (\alpha_2/\alpha_1) A_{-4}/y)(1 + \omega) \quad (\text{A1})$$

In the second part of equation (A1) the expression is rewritten and we can now take logs on both side of the equation and if  $(\alpha_2/\alpha_1) A_{-4}/y$  and  $\omega$  are small then  $\ln(1 + (\alpha_2/\alpha_1) A_{-4}/y)$  and  $\ln(1 + \omega)$  can be approximated by  $(\alpha_2/\alpha_1) A_{-4}/y$  and  $\omega$ . The asset to income ratio (measured as net financial wealth and housing stock) on a yearly basis is around 2, the weighted mpc out of these two assets is 0.04 (using the reported mpc from Berg & Bergström (1991)) and the mpc out of income is around 0.95. Thus the term  $(\alpha_2/\alpha_1) A_{-4}/y$  is small and  $\ln(1 + (\alpha_2/\alpha_1) A_{-4}/y)$  can be approximated by  $\gamma A_{-4}/y$ , where  $\gamma = \alpha_2/\alpha_1$ . After taking logs and making the approximations the consumption function can be written as:

$$\ln c \approx \text{constant} + \ln y + \gamma A_{-4}/y + \omega \quad (\text{A2})$$

Note that the mpc out of income,  $\alpha_1$ , now is the exponential of the constant term and the mpc out of assets,  $\alpha_2$ , is deflated by the mpc out of income. After assuming habit formation or adjustment cost in consumption and a fraction of income accruing to consumers who are liquidity constrained the consumption function can be written as equation (4).

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