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Reexamining loss aversion in aggregate consumption - Swedish and international evidence.

Martin W Johansson*

February 4, 2002

Abstract

Recent empirical and theoretical studies have suggested that consumption growth reacts asymmetrically to positive and negative expected income growth. In this paper we investigate if this behavior is robust to a) assumptions on how the households form their expectations of future earnings and b) sampling frequency. After investigating the case for Swedish consumption using survey data and a panel of annual observations on 15 OECD countries we conclude that previous results can not easily be generalized.

Keywords: Permanent income hypothesis, Prospect theory, Loss aversion, Survey data.

JEL: E21.

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1 Introduction

Research on aggregate consumption has been a central part of macroeconomics since the Keynesian revolution in the 1930s. One might ask why the study of aggregate consumption has stimulated so much research over the years. Perhaps the most compelling reason to study aggregate consumption can be found in the fact that it accounts for such a substantial part of GDP¹ that even minor changes in private consumption can have large effects on other macroeconomic variables. Another reason can be motivated in terms of economic policy as many of the instruments available to policy makers focus on private consumption. Although the 'fine tuning' of the 1970s is by and large out of fashion economic policy is still formulated to stimulate or rein in private consumption. A better understanding of the determinants of private consumption could increase the effectiveness of economic policy.

Much of the empirical and theoretical work on consumption is based on the marriage between Friedman's (1957) permanent income hypothesis and Hall's (1978) quadratic felicity function². Although the permanent income hypothesis (PIH) still forms the backbone of much of the literature it has been the subject of some criticism. On the empirical level the PIH has been challenged by tests based on the linear Euler equation derived by Hall (1978) which has almost invariably shown that changes in consumption can be predicted with some certainty using lagged measures of wealth and income, so called 'excess sensitivity'³. On the theoretical level much of the critique can be categorized into two categories. The first category asserts that the main features of the PIH (quadratic utility and intertemporal expected utility maximization) are correct while the culprits for the apparent mismatch between theory and real world data are found in ancillary assumptions such as liquidity constraints (Deaton, 1991), bequests (Kotlikoff and Summers, 1981), durable goods (Mankiw, 1982) and stochastic real interest rates (Mankiw, 1981). The other category is based on the notion that the underlying assumption of quadratic utility is more or less flawed and most of the research into this area has focused on the proposed existence of a precautionary savings motive among households (see Lyhagen (1997) and Wilson (1998) for evidence on aggregate data). This paper deals with a newfangled approach to non-PIH behavior: loss aversion. Loss aversion is not part of mainstream macroeconomics but has its roots in the literature on prospect theory pioneered by Kahneman and Tversky (1979) and has only recently been applied to macroeconomics by Bowman *et al* (1999; hereafter Bowman *et al*). Apart from giving loss aversion microeconomic foundations Bowman *et al* also provided empirical evidence from five OECD countries. Without going into detail

¹50% of Swedish GDP in 1999, Source: Statistics Sweden.

²Henceforth this synthesis will be denoted the permanent income hypothesis.

³See Deaton (1992) or Mullbauer and Lattimore (1995) for a more extensive overview of the empirical literature on the PIH and the related Euler equation. In the Swedish case this hypothesis has been tested by Assarsson (1991), Berg and Bergström (1993,1996) and Hansson (1997).

here it suffices to say that loss aversion predicts that consumption growth reacts asymmetrically to positive and negative expected income growth. To test this Bowman *et al* followed Shea (1995; hereafter Shea) and allowed for unequal responses in consumption to positive and negative expected income growth and their results were largely in favour of loss aversion.

As prospect theory eschews standard Neumann-Morgenstern expected utility theory its challenge to orthodoxy has not gone unanswered (see Wittman, 1991). Ultimately the question if anything is gained by adopting a more unconventional approach to economic decision making remains an empirical one and this paper makes a contribution to that goal in two ways. First of all, previous papers have modelled the households expectations of future earnings by regressing actual earnings on lagged variables (i.e. an instrumental variables approach to modelling expectations). In the first part of paper we follow Berg and Bergström (1996; hereafter Berg and Bergström) by complementing the traditional Campbell-Mankiw (1991) equation in the Swedish case with survey data on the households expectations. In the second part we test for loss aversion on a larger panel of OECD countries than was done in Bowman *et al* using annual data instead of quarterly data. The paper is organized as follows: Section two and three provides an overview of prospect theory and describe how to test the predictions of Bowman *et al*'s model against the PIH null. Section four and five examine the empirical evidence for Swedish and international data respectively. Section six concludes.

2 Prospect theory

2.1 Introduction

Unlike the theory on precautionary savings which holds that much of the problems with the PIH could be mended if one used a felicity function with non-linear marginal utility, prospect theory goes one (long) step further. Before dwelling into the details it is important to understand the main differences between prospect theory and other economic theories on choice. Prospect theory differs in two ways. First, prospect theory rejects the notion that individuals make their choices according to standard Neumann-Morgenstern expected utility. Since the standard theory on expected utility is well-known and almost universally accepted, deviations from it should be well motivated and founded on empirical evidence. Second, while much of the orthodoxy on choice has been derived from assumptions, propositions and proofs on how individuals *should* behave, prospect theory was generated from research in experimental economics and cognitive psychology. It was noted that the choices made by individuals participating in the experiments generally did not square with existing economic theory. Specifically there seemed to be a persistent asymmetry how individuals evaluated gains versus losses and prospect theory was conceived in an attempt to find a theory that would fit the data.

2.2 Loss aversion

According to Kahneman and Tversky (1979) three assumptions underpin standard expected utility theory:

Assumption 1. Expectation, $U(x_1, p_1; x_2, p_2; \dots; x_n, p_n) = p_1 u(x_1) + p_2 u(x_2) + \dots + p_n u(x_n)$.

Assumption 2. Asset integration, $(x_1, p_1; x_2, p_2; \dots; x_n, p_n)$ is acceptable at asset position w iff $u(x_1 + w, p_1; x_2 + w, p_2; \dots; x_n + w, p_n) > u(w)$.

Assumption 3. Concave utility function, $u'(\cdot) < 0$.

Even if these assumptions are well known they do imply some features that may not be so obvious. Assumption 1 states that expected utility is the sum of the utility of each outcome multiplied by its probability and assumption 3 yields what is known as risk-aversion. We now turn to assumption 2 which perhaps is the most striking difference between prospect theory and standard expected utility. Assumption 2 states, in the words of Kahneman and Tversky (1979) that:

'a prospect⁴ is acceptable if the utility resulting from integrating the prospect with one's assets exceeds the utility of those assets alone.'

⁴A "prospect" is defined as a set of outcomes and their respective probabilities. For example a lottery ticket that yields 500 USD with the probability 0.05 and nothing with the probability 0.95.

This means that utility is a function of final states only. Thus a personal wealth of 10 000 USD yields the same utility regardless if this wealth was obtained by starting from zero and winning 10 000 USD or starting from 90 000 USD and losing 80 000 USD. This implies that people are indifferent between loosing and winning as long as the final outcomes are the same. There is a respectable amount of evidence from experimental economics suggesting that this is not the case (see Kahneman and Tversky (1979), Tversky and Kahneman (1991), Kahneman D, Knetsch J and Thaler R (1991), Benartzi and Thaler (1995) and the Christmas Special in *The Economist* in 1999). What the results from these experiments do suggest is that individuals seem preoccupied with evaluating prospects in terms of gains and losses around some *reference point*. Usually it is defined as a function of the current state of wealth or consumption but there are several other reference points that can be considered valid under different circumstances.

Now, if utility is derived from outcomes around a reference point what properties/shape does the utility function have around this point? This question can only be answered by studying results from experiments and try to find general rules concerning the behavior of the participants. The results hint at two main themes - loss aversion and diminishing marginal sensitivity. Loss aversion means that a negative deviation from the reference point lowers the utility of an individual more than an equal positive deviation increases it. The term diminishing marginal sensitivity closely resembles that of marginal utility. According to diminishing marginal sensitivity the additional impact on utility of an additional gain or loss becomes smaller the further away we move from the reference point. The main features of prospect theory can be summed up as follows (Tversky and Kahneman, 1991):

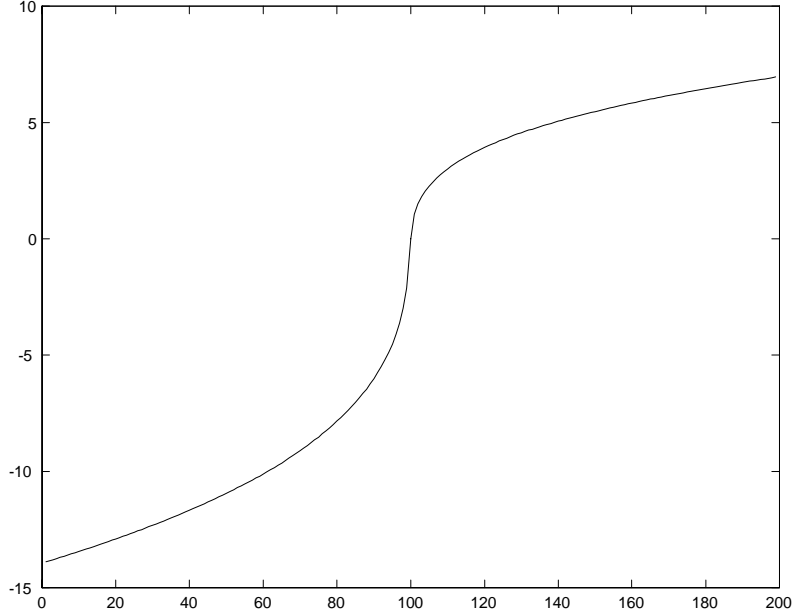
1. Reference dependence, $V(r, c) = w(r) + v(c - r)$, where r and c are the reference point and consumption respectively. Hence utility, $V(r, c)$, is a function of two arguments, the reference point and the deviation from it.
2. Loss aversion, if $y > x > 0$, then $v(y) + v(-y) < v(x) + v(-x)$.
3. Diminishing marginal sensitivity.

A utility function satisfying these three features yields an S-shaped graph around the reference point, see Figure 1 in which r is set to 100. Note that $v(c - r)$ is strictly concave for $(c - r) > 0$ and strictly convex for $(c - r) < 0$ implying that individuals are risk-averse in gains but risk-seeking in losses.

2.2.1 What does loss aversion imply for consumption?

Most papers on prospect theory are concerned with theoretical or experimental issues and until Bowman *et al's* paper there were no attempts to integrate loss aversion with a model for saving and consumption. This latest development makes it possible to theoretically study how the behavior of individuals compare under standard utility vis-à-vis loss

Figure 1: The S-shaped utility function



aversion. We will now give a brief description of the model and its main implications⁵. The two-period model suggested by Bowman *et al* assumes no subjective discount factor or interest rate. Income is given in the first period while uncertain in the second. The household's problem is to maximize the expected utility (1) subject to the budget constraint (2) where c_i is consumption, Y_i is income and r_i is the reference point at time i . The reference point is assumed to be given exogenously in the first period. The second period reference point is set according to $r_2 = (1 - \alpha)r_1 + \alpha c_1$, $\alpha \in [0, 1]$. This means that the reference point in the second period is partly determined by consumption in the first period which translates into a form of habit formation. It is also assumed that if $x \geq 0$, $y < 0$ then $v'(y) > 2v'(x)$. This condition assures that loss aversion holds.

$$U(r_1, c_1; r_2, c_2) = w(r_1) + v(c_1 - r_1) + E\{w(r_2) + v(c_2 - r_2)\} \quad (1)$$

$$c_1 + c_2 = Y_1 + Y_2 \quad (2)$$

There are no solved-out form solutions but the main conclusions can be summed up as follows: Households are more prone to adjust their consumption upward in response to an anticipated future increase in income than they are to lower their consumption in response to an anticipated decrease. When a household learns about a probable increase

⁵The proofs are found in the appendix of Bowman *et al*'s paper.

it immediately raises current consumption thus eliminating all or some future increase. On the other hand, when it learns about a probable decrease it resists lowering the consumption level if there is a credible chance that the prediction will turn out wrong and there will be no decrease in income after all. If, however, the prediction is proven right and income does fall the household will adjust its consumption downward the next period.

2.3 A critique of prospect theory

As mentioned earlier prospect theory is by no means uncontroversial and there is no consensus that loss aversion has a case in economics at all. Wittman (1991, pp. 405) mounts a formidable defense of standard expected utility discarding prospect theory as 'little more than a hodgepodge of contradictory results'. Wittman (1991) observes that nearly all the results from prospect theory have been verified in experimental economics only. This raises the question if the results from these experiments can be generalized to real world situations. A pressing concern is the lack of economic incentives in experimental economics. No one loses his or her job from giving the 'wrong' answer and even in those experiments where there have been monetary gains involved the stakes have generally been too small to make a difference. Furthermore experimental economics give only limited scope for issues like long-run learning and survival. At the theoretical level Wittman (1991) argues that the essential S-shaped utility function would give rise to some real world events that are not observed. Specifically, if individuals indeed are risk-seeking in losses they would be willing to pay a premium for insurance plans and financial instruments that exploited this fact. Yet, such plans are absent from the insurance- and financial markets. As can be seen the relevance of prospect theory as a tool of analysis remains debated and this paper will try to shed some light on the matter.

3 Testable implications

3.1 Loss aversion

So far we have reviewed the theoretical implications of loss aversion and we will now turn to the problem of how to empirically test for it. Our workhorse for this purpose will be the standard Campbell-Mankiw (1991) equation. In what follows we let c_t and y_t denote the logarithms of consumption and income. According to the Campbell-Mankiw model the economy consists of two types of households. The first type follows the PIH (3) while the second type in a Keynesian fashion sets consumption equal to current income (4).

$$E_{t-1} \Delta c_t^P = \alpha \quad (3)$$

$$E_{t-1}\Delta c_t^K = E_{t-1}\Delta y_t^K \quad (4)$$

If the Keynesian consumers possess a fixed proportion, λ , of the disposable income in the economy then aggregate consumption may be written as (Agell *et al*, 1995):

$$\Delta c_t = \mu + \lambda E_{t-1}\Delta y_t + \varepsilon_t \quad (5)$$

This model is often augmented with the real interest rate to account for any intertemporal substitution, measured by σ .

$$\Delta c_t = \mu + \lambda E_{t-1}\Delta y_t + \sigma E_{t-1}r_t + \varepsilon_t \quad (6)$$

Under the PIH consumption growth is orthogonal to I_{t-1} (the information set available at $t - 1$) and a λ significantly different from zero means that the null of the PIH can be rejected. The problem with a λ significantly different from zero is that it gives no clues as to *why* the PIH fails. As a solution to this problem Shea (1995) suggests that one should split the series on expected income growth into two series - one with positive and one with negative expected income growth. This can be accomplished by adding two dummy variables to the model, POS_t and NEG_t , which take the values one or zero if expected income growth is positive or negative. More specifically:

$$\Delta c_t = \mu + \lambda_1(POS_t)E_{t-1}\Delta y_t + \lambda_2(NEG_t)E_{t-1}\Delta y_t + \sigma E_{t-1}r_t + \varepsilon_t \quad (7)$$

The idea is then to check for differences with regard to size and significance between the two lambdas. If the data is compatible with the PIH consumption growth should be unpredictable and hence both lambdas should equal zero. But what could be expected if loss aversion is present? Before answering this question we must make a reservation. The results in Bowman *et al* are derived in a two-period model and it is not clear what will happen in an infinite horizon model. However, if the results are robust to such extensions we could expect that only λ_2 should be significant.

3.2 Liquidity constraints

It is important to observe that (7) also nests another theory on consumption, namely liquidity constraints. The PIH assumes that consumers are able to borrow freely in order to smooth consumption in good and bad times. If the households are unable to do so they are said to be liquidity constrained. The for our purposes crucial insight, due to Altonji and Siow (1987), is that liquidity constraints is a one-sided restriction. Assume that a household at time $t - 1$ learns of a future increase in income at time t . Had there been no liquidity constraints present the household would immediately have increased the level of consumption, thus forestalling any future increase. But if the household is liquidity constrained it will not be able to borrow against the radiant future and thus

consumption will not jump until time t when income actually increases. Hence a positive outlook will precede consumption growth. The households are however not constrained to save for a rainy day and consequently a bad outlook will lower the present consumption level thereby eliminating any future change. Under liquidity constraints only λ_1 should be significant as liquidity constraints prevent the households from borrowing against a higher expected future income. Shea originally intended that his model should be used to check for liquidity constraints, but as we have seen it can just as well be used to test for loss aversion. Shea applied his model to US quarterly data from 1956:1 to 1988:4 and found that the size and sign of the parameters were opposite to what could be expected under liquidity constraints, hinting at loss aversion. Bowman *et al* estimated the model for five OECD countries (Canada, France, West Germany, Japan and the UK) and found evidence in support of loss aversion in three cases (Canada, France and West Germany).

3.3 Our extensions

This paper will expand the existing literature by augmenting the standard Campbell-Mankiw model with survey data on the households expectations. The rationale is straight forward: to test the theories we need a proxy for income expectations and survey data provides an easy way to introduce a forward looking element (Acemoglu and Scott, 1994). Survey data is not without its problems (measurement errors and questions related to interpretation being the most cited) but it has been used with varying degree of success on both Swedish data (see Ågren and Jonsson (1991, 1992), Holmgren and Waringer (1994), Berg and Bergström (1996) and Lyhagen (1997)) and international data (Acemoglu and Scott (1994), Carrol *et al* (1994) and Fan and Wong (1998)). Of the many studies using Swedish survey data we will use Berg and Bergström as a benchmark as it deals with some of the specific issues we are interested in. In their paper Berg and Bergström use survey data that focus on the households' perception of their future personal economic situation. To construct an index that measures consumer sentiment they subtract the proportion of pessimists ($worse_t$) from the proportion of optimists ($better_t$) and call this difference $balance_t$. Thus the $balance_t$ measures the net proportion of optimist in the survey.

$$\Delta c_t = \mu + \lambda E_{t-1} \Delta y_t + \sigma E_{t-1} r_t + \xi balance_t + \epsilon_t \quad (8)$$

Equation (8) can be seen as a Campbell-Mankiw equation which has been augmented by the balance of the survey data. The influence of the net optimists on consumption growth is measured by ξ . What is the expected sign of ξ under the PIH? Under the PIH consumption growth should be unpredictable and ξ should not be different from zero. The obvious way to allow for asymmetric effects would be to apply Shea's dummy variable approach to (8).

$$\Delta c_t = \mu + \lambda_1 (POS_t) E_{t-1} \Delta y_t + \lambda_2 (NEG_t) E_{t-1} \Delta y_t + \sigma r_t \quad (9)$$

$$+\xi_1(POS_t)balance_t + \xi_2(NEG_t)balance_t + \epsilon_t$$

This formulation is parallel to (7) in the sense that we split the original sample on expected income growth and net optimists in two and use each sample as a separate series. If the optimists are in majority the effect on consumption growth will be measured by ξ_1 and if the pessimists are in majority the effect will be measured by ξ_2 . The expected sign of these parameters under loss aversion and liquidity constraints are analogous to those of expected income growth.

3.3.1 An alternative specification of our model

So far we have modelled asymmetric effects in survey data by Shea's dummy variable approach. Alternatively we could refrain from calculating the balance and instead use both the proportion of optimists and pessimists in the model and let the data determine their respective weights.

$$\Delta c_t = \mu + \lambda_1(POS_t)E_{t-1}\Delta y_t + \lambda_2(NEG_t)E_{t-1}\Delta y_t + \sigma E_{t-1}r_t + \beta_1 better_t + \beta_2 worse_t + \epsilon_t \quad (10)$$

How can we interpret the two beta coefficients? According to standard linear regression theory a coefficient, β_i , measures the impact of a one-unit shock to i :th independent variable on the dependent variable keeping all other variables on the right hand side unaltered. The survey divides the respondents into three camps, the optimists, the pessimists and the status-quo people. Only the two former are included in (10). Had we included all three camps the system would have been unestimatable since the camps sum to one, i.e. perfect multicollinearity. Thus β_1 measures the effect of a one unit increase in $better_t$ on Δc_t keeping all other variables on the right hand side constant, including $worse_t$. Yet, since the three camps sum to one, $better_t$ can only rise by one unit by robbing some of the other two camps on one unit. However since β_1 measures the effect when keeping $worse_t$ constant this rise can only come from decreasing the status-quo camp. Hence β_1 measures the effect when one (net) percentage point of the respondents leaves the status-quo camp for the optimist camp. A similar interpretation can be given for β_2 . We close this section by reporting the expected signs of the parameters under different hypotheses on consumer behavior in Table 1.

4 Empirical estimates of asymmetric Euler equations

4.1 The data set

The data covers the period 1975:1 to 1997:2 and consists of the following variables: non-durable consumption (cmd_t), non-property disposable income (yl_t), the real interest rate

Table 1: The expected signs of the parameters from (7) to (10).

Parameters→ Model↓	λ_1	λ_2	ξ_1	ξ_2	β_1	β_2
PIH	0	0	0	0	0	0
Liq. Constr.	+	0	+	0	+	0
loss aversion	0	+	0	+	0	-

(r_t) and survey data⁶. The data on consumption and income are seasonally adjusted using a standard X-11 filter. For the period 1975-1980 the real interest rate is calculated by subtracting the ex-post inflation rate from the nominal yield of a 3-month t-bill⁷. For the remaining period it is obtained by subtracting the expected inflation⁹ from the nominal rate. The survey variables are obtained from the HIP-survey. Statistics Sweden has since the 4th quarter 1973 polled the households expectations on the economy the coming 12 months and the interviews take place at the beginning of each month. This means that the results from these surveys can be seen as an end-of-period value for the previous quarter (Berg and Bergström). The data is graphically depicted in Figure 2 and Table 2 lists some descriptive statistics. The income and consumption variables will henceforth be used in (first differenced) logs while the attitudinal variables and the real interest rate are used in levels. Surprisingly there is an equal number of instances with positive and negative income growth. This is generally not what can be expected. Judging from previous studies on OECD countries negative income growth is usually outnumbered by a sizeable margin. Consumption growth, income growth and the real interest rate were tested for stationarity, Table 3, were found to be stationary¹⁰.

Since we later are going to use survey variables as proxies for income expectations we are interested in the relationship between the survey data and the other macroeconomic variables. To investigate this we performed tests for Granger causality (4 lags) between them, see Table 4. These sort of tests were extensively carried out in Berg and Bergström and thus we will not probe much further into this matter here. To gain information on the contemporaneous correlation we also calculated the correlation matrix for the included

⁶I am grateful to Jesper Hansson for supplying the data on consumption expenditures and non-property disposable income (expressed per capita in 1991-prices).

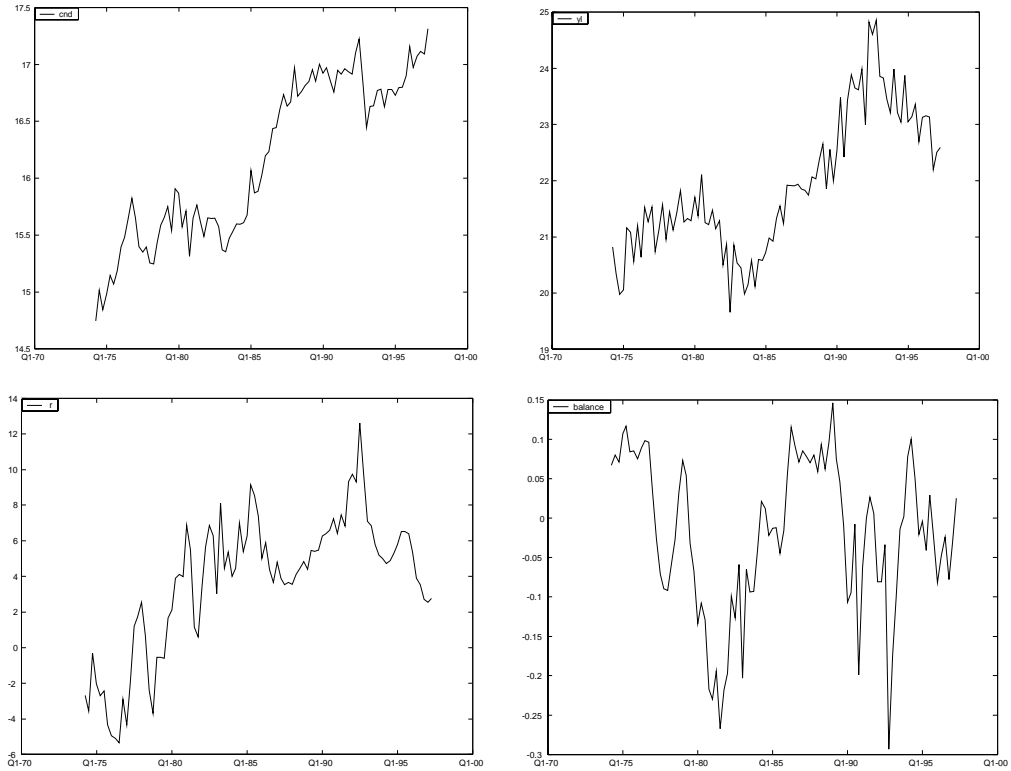
⁷Source: International Financial Statistics (IFS).

⁸Agell *et al* (1995) experiment with different measures of ex-post real interest rate without influencing the main result.

⁹Obtained from Statistics Sweden's HIP-survey.

¹⁰As the attitudinal variables are bounded they are per definition stationary. We did however perform a standard unit-root test on those variables as well and they too were found to be stationary.

Figure 2: Consumption, income, interest rate and survey data, Sweden 1975-1997



Notes: Figure 2 was produced using J.P LeSage's `tsplot` function for MATLAB.

Table 2: Descriptive statistics from fig 2.

Variables→	$\Delta y_l_t > 0$	$\Delta y_l_t < 0$	$balance_t > 0$	$balance_t < 0$
Number of obs.	47	47	42	52
Mean	2.11	1.84	0.07	0.09
Median	1.89	1.53	0.07	0.07
St.dev.	1.61	1.55	0.03	0.07

Table 3: Phillips-Perron (PP) test for stationarity

Variable→	Δcnd_t	Δy_l_t	r_t
PP statistic	-11.0**	-18.6**	-2.79*

Notes: All PP equations include an intercept. '**' and '*' denotes rejection at the 5- and 10 percent level. This notation is used consistently throughout the paper.

Table 4: Granger causality

Variable→	Δcnd	Δyl	r
p[<i>better</i> _t does not Granger cause]:	0.11	0.16	0.71
p[<i>better</i> _t is not Granger caused by]:	0.50	0.41	0.01
p[<i>worse</i> _t does not Granger cause]:	0.04	0.15	0.69
p[<i>worse</i> _t is not Granger caused]:	0.48	0.72	0.01

Table 5: Contemporaneous correlation

	Δcnd_t	Δyl_t	r_t	<i>better</i> _t	<i>worse</i> _t
Δcnd_t	1.00	0.20	-0.09	0.20	-0.30
Δyl_t		1.00	-0.01	0.09	-0.05
r_t			1.00	0.02	0.50
<i>better</i> _t				1.00	-0.60
<i>worse</i> _t					1.00

variables, Table 5.

It is important to recall that Granger causality is a measurement of correlation over time and does not necessarily imply causality in any structural sense and one should not take the results too far. Yet, there are a few interesting results in Table 4 and 5. First of all there does not seem to be any Granger causality between the attitudinal variables and income, or vice versa. This is important since it hints that the two variables capture different 'dimensions' of the data and that the attitudinal variables should not be seen as 12-month extrapolations of changes in quarterly income growth. Further, the only variable that Granger causes the attitudinal variables is the real interest rate but the reverse causation does not seem to apply. Last but not least in Table 4 we note that *worse* (but not *better*) Granger causes consumption growth. Table 5 reports the correlation matrix for our variables and echoes the results from Table 4 - there does not appear to be much correlation between the income and survey data. This is surprising since you might expect that households took account of recent changes in income when forming their expectations on the future state of their economy. There are two factors that potentially could explain this behavior. First of all we may note from Table 5 the strong correlation between the survey data and the real interest rate. This suggests that the survey data could be more related to capital income than to labor income. Second there is also the issue of time horizon where the survey variables cover the next four quarters while income growth is calculated between two adjacent quarters.

4.2 Modelling income expectations

Our immediate concern is to find a good proxy for the expected income growth, $E_{t-1}\Delta y_t$. One way that has grown popular (see Agell *et al*, 1995) is to simply assume Muth-rational agents and replace $E_{t-1}\Delta y_t$ with the outcome, Δy_t . To ensure that the estimated relationships are not biased by any feed-back between income and aggregate consumption the use of two-stage least squares (TSLS) is recommended. However, replacing $E_{t-1}\Delta y_t$ with Δy_t is only valid if the agents actually are Muthian. If one finds this assumption too restrictive an alternative approach would be to use extrapolative predictors as right hand side (RHS) regressors. The extrapolative predictors are calculated as the fitted values from a regression of the RHS variables on lagged values. This may seem a bit confusing but is nothing else than TSLS where we use the predictions from the first stage regression as regressors in the second stage regression. The rationale for the extrapolative predictors is that since the full information set used by the households, Ω_t , is unavailable to us as econometricians we can use a subset, Λ_t , containing the past values of our variables. Certainly the information set Λ_t will be too small but at least we err on the side of caution. In our equations this would entail running a regression of Δy_t on our instrument set, obtaining the fitted values, Δy_t^{pred} , and replacing $E_{t-1}\Delta y_t$ by Δy_t^{pred} and then estimate by OLS. Cuthbertson (1992, p.167) reviews both alternatives (TSLS and explorative predictors) and is critical of the latter for two reasons. First of all the fitted values are calculated using regression coefficients obtained using the whole sample, hence in fact overstating the information set. Secondly the use of extrapolative predictors does not guarantee consistent estimates in the second stage regression. Romer (1996, p. 323) briefly mentions the use of extrapolative predictors in a study by Shea and comments:

'An alternative would be to follow Campbell and Mankiw's approach and regress consumption growth on actual income growth'...'Given the almost one-for-one relationship between actual and constructed earnings growth this approach would be likely to produce similar results.'

As the discussion above shows there exists no clear consensus in the literature how to model expected income growth. Most applied work has invoked Muthian households but Shea and Bowman *et al*, which are the main sources of inspiration, use extrapolative predictors (the reasons for doing so are not explicitly stated in their paper). We estimated (7) under both assumptions but the results did not differ in any substantial way. In order to save space we present only estimates assuming Muthian households. Due to problems with time-averaging (decisions on consumption are made continuously while the data is discrete), it is common practice to use instruments lagged twice to ensure that the variables on the RHS are non-correlated with the disturbances (Deaton, 1992, p. 97-98). Unfortunately instruments lagged twice or more have small or no explanatory power. Carrol *et al* (1994) argue that the problem with time-averaging can be mended

Table 6: Shea’s model, eq 7

instr. → Variable ↓	Inst.set 1	Inst.set 2	Inst.set 3	Inst.set 4
constant	0.006	0.006	0.010**	0.009**
$\Delta y_l_t > 0$	0.086	0.069	-0.102	-0.175
$\Delta y_l_t < 0$	0.566*	0.597**	0.645**	0.438**
r_t			-0.000	-0.000
MA(1)	-0.501**	-0.499**	-0.421**	-0.327**
Test				
p[F _{BG}]	0.38	0.52	0.43	0.27
p[F _{ARCH}]	0.97	0.94	0.23	0.11
p[JB]	0.51	0.51	0.57	0.43
p[F _{SARGAN}]	0.87	0.78	0.65	0.45

Notes: Inst. set 1: $\Delta c_t, \Delta y_l_t > 0, \Delta y_l_t < 0$, all lagged 1,2,3 times.

Inst. set 2: $\Delta c_t, \Delta y_l_t > 0, \Delta y_l_t < 0$, all lagged 1,2,3,4 times.

Inst. set 3: $\Delta c_t, \Delta y_l_t > 0, \Delta y_l_t < 0, r_t$, all lagged 1,2,3 times.

Inst. set 4: $\Delta c_t, \Delta y_l_t > 0, \Delta y_l_t < 0, r_t$, all lagged 1,2,3,4 times.

Diagnostic tests employed are Breusch-Godfrey’s LM-test for autocorrelation, Engel’s LM-test for ARCH effects, Jarque-Berra’s test for normality and Sargan’s test for instrumental validity.

by including a MA(1)-parameter on the RHS and this would enable us to use instruments lagged only once. This is also the approach chosen by Berg and Bergström.

4.3 Estimating Shea’s model for Swedish data

This section contains the empirical estimates of Shea’s equation applied to our data set. Table 6 contains the empirical estimates of (7) where the top row indicates the instrument sets used. Sargan’s test investigates if the overidentifying instruments are orthogonal to the structural residuals¹¹. The test is performed by regressing the instrument set on the structural residuals and calculating the R^2 . If the null of instrumental validity is true the R^2 can be expected to be low and this can be tested using the F- or χ^2 -distribution.

In the equations estimated in Table 6 positive income growth and the interest rate sometimes have the wrong sign but are never significant¹². Negative income growth on

¹¹The test is sometimes overoptimistically labeled a test for ”instrumental validity”. More correctly it tests if the extra instruments (above those needed to achieve identification) are valid. However we will for convenience use the somewhat misleading label ”instrumental validity”.

¹²The negative but non-significant parameter for the real interest rate is echoed in Berg & Bergström (1996) and Agell *et al.* (1995).

the other hand is always significant on the 10 percent level and three times on the 5 percent level. It is also worth noticing that the point estimate for negative income growth is much higher than that for positive income growth. These results are not consistent with liquidity constraints but are compatible with theories on loss aversion. Unlike Bowman *et al* and Shea we are never able to establish a significant parameter for positive income growth. This could possibly be related to the relatively small number of instances with positive income growth in our data set.

4.4 Asymmetric responses in survey data?

As noted above the idea of proxying income expectations by using fitted values from a regression on actual earnings is common, but not without problems and survey data can be considered a complement. We are interested if there are any asymmetric effects on consumption growth under good and bad outlooks and to investigate this we first estimated (8) which includes the balance undivided, and then (9) and (10) which allows for asymmetric responses. The results from estimating (8) and (9) are reported in Table 7 while the results from (10) are contained in Table 8. All variables on the RHS in both tables have been instrumented. Model 1 in Table 7 corresponds to the 'final' model in the Campbell-Mankiw sense estimated by Berg and Bergström. Although we are using a slightly longer sample period and a different data set the results are in line with each other. For non-durable consumption Berg and Bergström found that both the attitudinal balance and the income variable were significant at the 5 percent level. In our model the attitudinal variable is significant at the 5 percent level and the income variable at 10 percent which means that we reject the permanent income hypothesis. Model 2 shows the result when we split the income variable into positive and negative income growth but otherwise use the same specification as in model 1. The parameter on the attitudinal balance in model 2 is not significant, p-value 0.11. Turning to the income variables in model 2 in Table 7 we see that only negative income growth has any significant effect. Positive income growth has the wrong sign and is not even close to significance, p-values 0.54 and 0.51. Model 3 mimics model 1 with the exception of splitting the attitudinal balance in two. Using this specification we find that undivided income and negative balance are significant at the 10 percent level, but positive balance is not. Model 4 replicates model 1 but splits both the income growth and balance with only negative income growth being significant. According to the diagnostic tests we have no problems with non-normality, instrumental validity or heteroscedasticity. The tests for autocorrelation are sometimes uncomfortably low, especially for model 1 in Table 7¹³. How can we sum up the results reported in Table 7? First of all there does seem to be a point in splitting the income variable since positive income growth never is close to significance. Concerning the attitudinal balance we find,

¹³Other tests for autocorrelation (χ^2_{BG} and Ljung-Box) failed to find any evidence of autocorrelation in model 1.

Table 7: Estimation of (8) and (9) using TSLS

Model→ Variable↓	Mod.1	Mod.2	Mod.3	Mod.4
constant	0.002**	0.007**	0.004*	0.009**
Δy_t	0.103*		0.116*	
$\Delta y_t > 0$		-0.110		-0.096
$\Delta y_t < 0$		0.427**		0.439**
r_t	-0.000	-0.000	-0.000	-0.000
$balance_t$	0.022**	0.018		
$balance_t > 0$			-0.003	-0.008
$balance_t < 0$			0.034*	0.026
$MA(1)$	-0.355**	-0.242**	-0.360**	-0.257**
Test				
p[F _{BG}]	0.05	0.42	0.15	0.41
p[F _{ARCH}]	0.45	0.68	0.20	0.72
p[JB]	0.90	0.57	0.99	0.64
p[F _{SARGAN}]	0.15	0.64	0.29	0.82

Notes: Instruments include RHS variables lagged 1,2,3,4 times. Diagnostic tests employed are Breusch-Godfrey's LM-test for autocorrelation, Engel's LM-test for ARCH effects, Jarque-Berra's test for normality and Sargan's test for instrumental validity.

apart from model 3, no evidence of asymmetric response in consumption growth to survey data.

We now turn to Table 8 which contains our alternative specification as defined in (10). Model 5 and 6 report the results when the undivided and divided income variable are used respectively. Model 7 and 8 repeat the two preceding models but add the real interest rate on the RHS. According to Table 8 the undivided income variable is never significant and when the split series is used only the negative part is significant. Turning to our attitudinal variables we find that $worse_t$ is significant in model 5 and 6 at the 5 percent level whereas $better_t$ never is close to significance with p-values 0.81 and 0.97. However when the real interest rate is added on the right hand side (model 7 and 8) $worse_t$ promptly turns insignificant with p-values 0.20 and 0.27. This is surprising since none of our previous results hinted that the inclusion of the real interest rate could have such an overturning effect. An important factor could be the high correlation between $worse_t$ and the real interest rate. The correlation between these two variables is 0.50, see Table 5, and their correlation from the first stage regression is even higher, 0.61. Although the inclusion of the real interest rate drains $worse_t$ of its significance it does not change the parameter value up to the third decimal. Turning to the diagnostic tests the F_{BG} test

Table 8: Estimation of (10) using TSLS

Model→ variable↓	Mod.5	Mod.6	Mod.7	Mod.8
constant	0.008	0.011	0.007	0.011
Δy_t	0.091		0.091	
$\Delta y_t > 0$		-0.050		-0.049
$\Delta y_t < 0$		0.321*		0.328*
$better_t$	0.006	0.000	0.008	0.000
$worse_t$	-0.039**	-0.030**	-0.036	-0.030
r_t			0.000	0.000
$MA(1)$	-0.361**	-0.401**	-0.364**	-0.407**
Test				
p[F _{BG}]	0.05	0.39	0.08	0.35
p[F _{ARCH}]	0.44	0.60	0.46	0.60
p[JB]	0.88	0.49	0.88	0.49
p[F _{SARGAN}]	0.07	0.77	0.70	0.59

Notes: See Table 7.

for autocorrelation is significant on the 5 percent level in model 1 and on the 8 percent level in model 3. As before the other tests for autocorrelation (χ^2_{BG} and Ljung-Box) were not significant.

Taken together the results from Table 6 to 8 are: Negative income growth together with the MA-parameter appear to be the driving force in most of the different specifications considered. This result is stronger than those reached in Shea and Bowman *et al* who found that positive income growth also influenced consumption growth, albeit to a significantly lesser extent. Using survey data we find only weak evidence that bad outlooks have a more powerful impact on consumption as compared to good outlooks. In summation the results are consistent with the predictions from Bowman *et al*'s model with regard to instrumented income growth but not in general with regard to survey data. The flip side of the coin is that we find no support for liquidity constrained households at all.

5 International evidence

5.1 Introduction

In this section we will examine the case for loss aversion in aggregate consumption on a panel of OECD countries. The only previous study into this matter (to our knowledge)

was conducted by Bowman *et al.* Their data set consisted of observations on quarterly income and consumption growth per capita for Canada, France, West Germany, Japan and the United Kingdom yielding a total of 471 observations. We will extend their study in two aspects.

1. Wider panel.
2. Data frequency. Annual data has both advantages and disadvantages compared to quarterly data. An obvious drawback is the limited number of observations available, although this can be partly offset by the use of panel data. On the other hand annual data can be expected to enjoy a better signal to noise ratio. Furthermore the use of annual data eliminates the problem of how to seasonally adjust the data. This is of no small importance since a recent study (Elwood, 1998) have suggested that the X-11 filter may itself be the cause of some of the non-PIH behavior reported in the literature. At a more general level it is dubious to use seasonally adjusted data in expectations based tests since the seasonal smoothing uses the whole sample which clearly is not available to the agents in the model.

The remaining part of this paper is organized as follows. First we will discuss the data set and some of the problems encountered when testing for asymmetric consumption functions. The following section contains the empirical part where we test for the most appropriate model specification, perform diagnostic tests and check for asymmetries. The last section discusses the results.

5.2 A first look at the data

The data consists of annual observations on real household disposable income¹⁴ (RHD_{it}) and total consumption expenditures¹⁵ (C_{it}) adjusted by working age population¹⁶ and real (ex-post) short term interest rates¹⁷ (r_{it}) for 15 OECD countries¹⁸ observed 1973-1997, yielding a total of 375 observations. Following standard operating procedures small letters denote logarithms, r_{it} being the exception.

It is always a good idea to view some descriptive statistics of the data set before getting down to business and especially so in our case. Previous literature using quarterly data found evidence that consumption growth is more sensitive to negative changes in income than positive. Nonetheless there are a few factors that could cast doubt on the

¹⁴Source: OECD "Economic outlook".

¹⁵I am grateful to Göran Hjelm for supplying data on consumption expenditures.

¹⁶Source: OECD "Economic outlook".

¹⁷Calculated by subtracting the annual rate of inflation from the nominal yield, source: IFS.

¹⁸Austria, Australia, Belgium, Can, Finland, France, Germany, Italy, Japan, Netherlands, Portugal, Spain, Sweden, U.K and U.S.

universality of those results. First of all negative growth rates in income are generally rare events¹⁹ implying that our tests for asymmetry are rather low-powered from the start. In the case of West Germany Bowman *et al* found only 5(!) quarters with negative expected income growth out of a total of 114. West Germany is the 'worst' example but not really atypical - in the entire the sample negative quarters are outnumbered by 52 to 419. Yet they find a statistically significant difference how positive and negative income expectations affect consumption growth. This fact could be used to argue the validity of the results - 'Our tests have low power and yet we reject the null. This means that our theory has firm backing in real world data'²⁰. Another explanation not discussed in the literature could be that the few negative observations picked up by the extrapolative predictors represent some near catastrophic events to disposable income or consumption. Such outlier driven results may produce statistical significance but carry little economic meaning. By using annual data we hope to eliminate or mute the effects from a few single quarters and concentrate our analysis on the slower low frequency movements of the variables. We calculated some descriptive statistics, Table 9, for our data set and compared the mean, median and standard deviation for positive and negative income and consumption growth. As can be seen from Table 9 negative cases of income growth are not that infrequent and hence it is hard to argue that our results, whatever they may be, are driven by outliers.

5.3 Model specification issues

Estimation is carried out by running a standard Campbell-Mankiw regression on our data set with different assumptions on the error-component (i.e. panel model). Our task is to find which of the following models that is to prefer²¹:

$$\Delta c_{it} = \lambda \Delta rhd_{it} + \sigma r_{it} + \alpha + \varepsilon_{it} \quad (11)$$

$$\Delta c_{it} = \lambda \Delta rhd_{it} + \sigma r_{it} + \sum_{i=1}^{15} D_i + \varepsilon_{it} \quad (12)$$

$$\Delta c_{it} = \lambda \Delta rhd_{it} + \sigma r_{it} + \sum_{t=1973}^{1997} Y_t + \varepsilon_{it} \quad (13)$$

$$\Delta c_{it} = \lambda \Delta rhd_{it} + \sigma r_{it} + \sum_{i=1}^{15} D_i + \sum_{t=1973}^{1997} Y_t + \varepsilon_{it} \quad (14)$$

D_i is a dummy variable that equals one for the i th country and zero otherwise. In the same manner Y_t is a dummy variable that equals one for the t th year and zero otherwise.

¹⁹This was not the case for the Swedish data previously reviewed.

²⁰This is NOT an actual quote.

²¹This "least-squares dummy variable" approach is numerically identical to fixed effects panel models. Thus (11), (12), (13) and (14) will be denoted "pooled", "FE(i)", "FE(t)" and "FE(it)".

Table 9: Descriptive statistics

Variables→	$\Delta rh_{it}>0$	$\Delta rh_{it}<0$	Test for equality,
Number of obs.	295	95	p-values ↓
Mean	2.74	1.56	<0.01
Median	2.48	1.21	<0.01
St.dev	1.97	1.38	<0.01
Variables→	$\Delta c_{it}>0$	$\Delta c_{it}<0$	Test for equality,
Number of obs.	313	77	p-values ↓
Mean	2.61	1.63	<0.01
Median	2.34	1.25	<0.01
St.dev.	1.66	1.53	0.34

Notes: We employ an ANOVA F-test for equality of means, Levene's test for equality of variances and the Kruskal-Wallis test for the equality of medians.

The one-way country model (12) assumes that the unexplained differences in growth rates in the sample can be attributed to country specific factors. That is, all other things equal we can expect some countries to systematically enjoy higher growth rates in private consumption. The one-way time model (13) assumes that unexplained differences in growth rates over time can be attributed to time specific factors as all countries are symmetrically hit by identical shocks. One can of course combine the two models to obtain the two-way model (14) that includes both country- and time specific effects. On the other side of the spectrum we find (11) which assumes that there is no heterogeneity in either the time- or country domain.

5.4 Estimation

5.4.1 Campbell-Mankiw

To avoid bias from time-averaging we initially estimate using TSLS with instruments lagged twice²², Table 10. The diagnostic tests indicate that the residuals are both auto-correlated and heteroscedastic and thus the standard errors are corrected using Arrelano's method (see Baltagi, 1995, p.13). In all equations in Table 10 income growth is significant while the real interest rate never turns significant. Column 4 reports the p-values for a Chow test for the excludability of the dummy variables. According to these tests we are able to reject the null hypotheses of the pooled model, the FE(i) model and the FE(t) model. Hence we decided to go with the FE(it) model.

²²Instruments included lagged income, interest rate, consumption, the model specific dummies and model specific dummies interacted with lagged income.

Table 10: Panel estimates of (11) to (14)

Model ↓	λ	σ	p[Chow]	p[Bartlett]	p[Z]
Pooled	0.69**	0.05	<0.01	<0.01	<0.01
FE(i)	0.42**	-0.12	<0.01	<0.01	<0.01
FE(t)	0.63**	0.05	<0.01	<0.01	<0.01
FE(i,t)	0.62**	-0.10	n.a	<0.01	<0.01

Notes: The two last columns report p-values for Bartlett's (Edgerton, 2000, p. 47) and Fisher's Z-test (Edgerton, 2000, p. 48) for the null of homoscedasticity and no autocorrelation.

Table 11: Panel estimates of (15)

Model ↓	λ_1	λ_2	σ	p[Sargan]	p[Bartlett]	p[Z]	p[$\lambda_1=\lambda_2$]
FE(it) - 2 lags	0.63**	0.56	-0.10	0.07	<0.01	<0.01	0.86
FE(it) - MA(1)	0.50**	1.21**	0.07	0.02	<0.01	0.90	0.13

Notes: Standard errors corrected using Arrelano's and White's method respectively. p[Sargan] is the p-value from the test for instrumental validity.

5.5 Shea's test

We applied Shea's model, reprinted below for convenience, to our chosen model FE(i,t).

$$\Delta c_{it} = \lambda_1(POS_{it})\Delta rhd_{it} + \lambda_2(NEG_{it})\Delta rhd_{it} + \sigma r_{it} + \sum_{i=1}^{15} D_i + \sum_{t=1973}^{1997} Y_t + \varepsilon_{it} \quad (15)$$

Trying to circumvent the problem of having to use instruments lagged twice we also estimated (15) augmented by a MA(1)-term and instruments lagged once as was done in the sections with Swedish quarterly data.

The result from Table 11 stands in contrast to previous findings using quarterly data. In the equation using instruments lagged twice the parameter estimate for positive income growth is larger than that for negative income growth which is not even significant. The MA(1)-augmented equation bears more resemblance to Bowman *et al's* panel estimate on quarterly data - both parameters are significant and the parameter for negative income growth is the larger of the two - but the difference is not statistically significant.

The obvious question at this stage is why the results supporting loss averting behavior in quarterly data are absent in annual data? We will here suggest two factors that might help to answer that question.

1. Instruments are low-powered. Table 11 does lend support to this idea. Instruments

lagged once can be expected to be more powerful than instruments lagged twice and when we use instruments lagged once the relative size of our parameters are consistent with the predictions from Bowman *et al*'s model. However, as Table 11, shows the MA(1)-augmented equation is not a panacea as the structural residuals fail Sargan's test for instrumental validity. It is not unambiguous if the cure (using instruments lagged twice) is better than the disease (possibly inconsistent parameter estimates). Nelson and Startz (1990) provide Monte Carlo evidence that the performance of the TSLS-estimator can be inferior to that of the OLS-estimator under quite ordinary conditions even if the right hand regressors are correlated with the structural errors. Moreover, the p-value for Sargan's test is not very impressive for the equation using instruments lagged twice either. At the end of the day however the null of equal lambdas can not be rejected for either equation.

2. A more speculative suggestion is that the effects on consumption of expected quarterly growth rates in income are different from annual growth rates if households can distinguish between permanent and transitory innovations to income. Intuitively a lower sampling frequency suggests that a larger proportion of the innovations can be attributed to permanent shocks²³ and since the asymmetric response only was present in quarterly data there is a possibility that measured consumption only reacts asymmetrically to expected changes transitory income. Some of our results from quarterly Swedish data was not unsupportive of such behavior since we only found very weak evidence that quarterly consumption reacted asymmetrically to good and bad outlooks in survey data, which covers the next twelve months. Instrumented income, which only covers the next quarter, however appeared to give rise to asymmetric effects. This is of course pure speculation (so far) but it could be of interest to decompose quarterly income growth into permanent and transitory components (using for example a Kalman filtering technique) and investigate if the asymmetric response in consumption growth can be inferred to changes in transitory income. If this approach is fruitful will be left for future research to decide.

6 Conclusions

Two studies (Shea, 1995 and Bowman *et al*, 1999) have documented that consumption growth appears to be more sensitive to negative expected income growth than to positive. This asymmetric behavior is not consistent with either the PIH or liquidity constraints. It may however be consistent with some recently developed theories on loss aversion (Bowman *et al*, 1999). This paper have extended the evidence on this matter in two directions. First, by examining Swedish quarterly data 1975-1997 we found that consumption only

²³As an extreme example comparing the average wage between two periods spanning 10 years will probably reveal more of the evolution of permanent income than comparing two adjacent months.

responds (in a statistically significant way) to negative income expectations. This result is stronger than those reached by Shea and Bowman *et al* who sometimes found that positive income expectations also influenced consumption growth, albeit to a lesser extent. Nonetheless our result broadly confirms previous findings on other OECD countries. More importantly however we tested if this asymmetric response could be found in survey data but only found weak evidence that such generalizations were possible. We then investigated the case for loss aversion on a panel of OECD countries during 1973-1997 using annual data and found no evidence supportive of loss averting households. If this discrepancy with the results from quarterly data is due to low-powered instruments or something more profound calls for further research.

Summing up the results in this paper we conclude that the asymmetric response in consumption to income expectations reported in Bowman *et al* and Shea are confined to *a)* quarterly data and *b)* proxying income expectations by instrumenting income growth.

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