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Abstract

The hypothesis - suggested particularly by Deaton - that real income and price 'innovations' affect the savings ratio positively are tested. As a point of reference two models are used, where consumers´ uncertainty on relative prices in a cross-section sense and in an intertemporal sense respectively play a major role. When completing the models, a tight money variable is also introduced as a factor affecting the savings ratio. Evidence from Finnish quarterly data over 1966-1979 gives strong support to this hypothesis. Results are strikingly robust to alternative proxies for real income and price 'innovations' as well as to alternative specifications of the tight money variable.

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1. INTRODUCTION

In most western European countries personal saving has recently attained high levels in relation to personal disposable income and this has been accompanied by equally high inflation rates. Because of their zero degree homogeneity assumptions the standard versions of the life cycle and permanent income hypotheses are not, however, well equipped to analyze changes in the inflation rate.

Typically consumers do not purchase all their goods simultaneously so that they may have immediate knowledge only on the prices of goods they are currently buying. Thus, at least in the first instance, consumers do not have sufficient information to distinguish between relative and general price movements, when both are changing simultaneously. Under these circumstances unanticipated inflation is misinterpreted as the rise in the relative prices of goods economic agents are currently buying, so that real saving increases. Deaton (1977) has developed and tested a formal model of 'disequilibrium' saving along these lines and found some support to it by using the U.K. and U.S. quarterly time series data over the period 1954-1974.

It can be argued, however, that the most obvious form of uncertainty about prices is that relating to the future. Suppose that present and future consumption are complements and future price level has been underestimated. Now consumers save less than they would have, had they correctly foreseen the future price level. Thus they start the next period with smaller assets than they would have liked and increase their saving so that unanticipated future inflation causes saving to rise. This story with uncertainty about relative prices, not over cross-section, but over time, also suggests a positive relationship between saving and unanticipated inflation and has been discussed in Deaton and Muellbauer (1980, ch. 12).

In the presence of imperfect capital markets with 'sticky' interest rates, however, economic agents may be subject to binding borrowing constraints and even the possibility of credit rationing may affect their behaviour. How is the savings behaviour affected by these considerations?

The purpose of this paper is to test for the relationship between saving and inflation by using Finnish quarterly time series data over the period 1966(I) - 1979(IV). We use both a savings function specification where uncertainty about relative prices in a cross-section sense plays a major role and and a specification where uncertainty about relative prices over time is of importance. Moreover, we allow for tightness in the capital market to affect savings behaviour and test for the resulting 'generalized money illusion' savings functions.

Theoretical considerations are presented in section 2, while section 3 is devoted to empirical results.

2. THEORETICAL CONSIDERATIONS

This section outlines briefly theoretical background for the savings function in the presence of uncertainty about the current and future price level.

2.1. Savings function with a cross-section uncertainty

Assume that consumers know only the prices of goods they are currently buying, while the current price level is not known with certainty. If preferences are weakly intertemporally separable and if differences in actual and expected price are entirely due to mistaken expectations about the general price level, then the following expression for the savings ratio (s/y) can be derived as an approximation:

$$(1) \qquad (s/y) = (\hat{s}/\hat{y}) + (\log y - \widehat{\overline{\log y}}) - \phi(\log p - \widehat{\overline{\log p}}),$$

where the variables with hat refer to anticipated values, $y = Y/p$, $\hat{y} = \hat{Y}/\hat{p}$, p is the price level, Y nominal income and $\phi = \sum_k \hat{w}_k e_{kk}$, w_k is the budget share of commodity k and e_{kk} the corresponding own-price elasticity. The value of ϕ should be between minus one and zero (see Deaton (1977) for details).

This first term on the RHS of (1) gives the equilibrium savings ratio when the expectations of real income and prices are fulfilled. According to the second term consumer cannot react to stimuli they do not perceive so that all unanticipated real income is saved. Finally, the third term suggests that unanticipated prices will increase the savings ratio, ceteris paribus.

Now, using a permanent income consumption function, $C = kY^p$, to specify the equilibrium savings ratio and the following adaptive adjustment mechanism for d(s/y)/dt:

$$(2) \qquad d(\hat{s}/\hat{y})/dt = m((1-k) - (s/y))$$

makes it possible to transform (1) into:

$$(3) \qquad d(s/y)/dt = m(1-k) + (d \log y - \widehat{\overline{d \log y}}) - \phi(d \log p - \widehat{\overline{d \log p}}).$$

In order to estimate (3) on discrete data it has to be integrated over some finite interval (t,t-h), where h may vary. Utilizing the calculations by Deaton (1977) makes it possible to express the discrete form of (3) as follows:

$$(4) \qquad \Delta_h (s/y)_t = b_0 + b_1(\Delta_h \log y_t - \Delta_h \widehat{\overline{\log y_t}}) + b_2(\Delta_h \log p_t - \Delta_h \widehat{\overline{\log p_t}}) + b_3(s/y)_{t-h}$$

where b_1 and b_2 should be positive, b_3 negative and all between zero and one. Δ_h is the backwards h^{th} difference operator.

The savings function presented above is based upon the 'dis-equilibrium' story with a cross-section uncertainty. While the information about the current inflation may be quite good with frequent publication of official indices, the same does not hold for future inflation. Therefore, it is interesting to derive saving behaviour from an intertemporal framework with uncertainty about relative prices over time.

2.2. Savings function with an intertemporal uncertainty

Assume that consumers take their labour supply as given and determine their intertemporal consumption conditional on expected future income streams. The intertemporal budget constraint can be written as

$$(5) \qquad W_1 = \sum_{i=1}^{T} R_i p_i c_i$$

where $W_1 = (1 + r_1)A_0 + \sum_{i=1}^{T} R_i Y_i$ = the current wealth position in period 1 (the sum of non-human $((1 + r_1)A_0)$ and human wealth $(\Sigma R_i Y_i)$), c_i = consumption, p_i = the price of consumption, R_i = the discount rate factor, Y_i = the earned income, all in period i. T is the length of the planning horizon, A_0 = the value of assets at the beginning of period 1, and r_1 = the nominal interest rate in period 1. Maximizing the intertemporal utility function $U(c_1, \bar{L}_1, \ldots, c_T, \bar{L}_T)$, where L describes the labour supply, subject to (1) yields the consumption function of the form $c = c(W_1, R_1 p_1, \ldots, R_T p_T, \bar{L}_1,$

$\ldots,\bar{L}_T)$, in which $\bar{L}_1,\ldots,\bar{L}_T$ are the number of hours the consumer expects to work in each period. This consumption function describes behaviour in a certain period and one might expect that as new information becomes available, new plans will be calculated.

In the presence of new information previous consumption levels are not optimal, so that current consumption will be modified by past consumption. With weakly intertemporally separable preferences, however, all past effects go solely via assets. Moreover, if preferences are homothetic, then we obtain $p_t c_t = k_t W_t$, where $W_t = A_{t-1}(1 + r_t) + R_t^{-1} E_t(\sum_t^T R_i Y_i)$, and E = the (mathematical) expectations operator. Utilizing the asset accumulation equation $A_{t-1} = (1 + r_{t-1})A_{t-2} + Y_{t-1} - p_{t-1}c_{t-1}$ makes it possible to transform W_t into the form:

$$(6) \qquad W_t = (1 + r_t)(W_{t-1} - p_{t-1}c_{t-1}) + n_t$$

where n_t denotes the change in expected income prospects from t on between t-1 and t and can be expressed as:

$$(7) \qquad n_t = R_t^{-1}[E_t(\sum_{i=t}^{T} R_i Y_i) - E_{t-1}(\sum_{i=t}^{T} R_i Y_i)]$$

It is to be seen that consumption is associated with its own lagged value and with income "innovations" n_t (Bilson (1980), Hall (1978)).

Turn now to consider how k_t depends on relative prices over time and assume that preferences can be described by the CES utility function:

$$(8) \qquad U = B\left(\sum_{i=1}^{T} a_i c_i^{-v}\right)^{-1/v}, \quad \sum a_i = 1$$

Maximizing (8) subject to (5) for $i = t$ implies that following consumption function $p_t c_t = \{(a_t^q p_t^{1-q})/[E_t(\sum_{i=t}^{T} a_i^q \tilde{p}_i^{1-q})]\}W_t$ where $q = (1+v)^{-1}$ = the intertemporal elasticity of substitution and $\tilde{p}_j = R_j p_j$. Substituting the right-hand side of (6) for W_t implies after some manipulation:

$$(9) \qquad c_t = (a_t/a_{t-1})^q (1 + r_t^*)^q \Theta_t c_{t-1} + k_t n_t / p_t$$

where r_t^* = the real rate of interest, and

$$(10) \qquad \Theta_t = E_{t-1}\left(\sum_{i=t}^{T} a_i^q \tilde{p}_i^{1-q}\right) / E_t\left(\sum_{i=t}^{T} a_i^q \tilde{p}_i^{1-q}\right)$$

describes the change in price expectations from t on between t-1 and t.

It is easy to see the role of future price expectations in (9). If the anticipated rate of inflation will e.g. rise between t-1 and t, then c_t will be smaller than it would have been, had anticipations remained constant. But if we have Cobb-Douglas preferences with the intertemporal elasticity of substitution equal to one, then changes in future price expectations will have no effect on current consumption.

Utilizing the approximation $(s/y) \doteq \log y - \log c$, the expression (9) can be transformed into the form:

$$(11) \qquad \Delta(s/y)_t = 1 - (a_t/a_{t-1})^q(1 + r_t^*)^q\theta_t + \Delta \log y_t - k_t n_t \cdot (1/p_t c_{t-1}) \, ,$$

where Δ = the backwards first difference operator.

Thus far savings functions - both in a cross-section and in an intertemporal framework - have been derived in terms of real income and inflation innovations. In the presence of imperfect capital markets with 'sticky' interest rates, however, economic agents may be subject to binding borrowing constraints and even the possibility of credit rationing may affect behaviour.

Clearly, borrowing constraints can affect consumption and saving behaviour via various channels. First, consumption may be directly (negatively) affected simply because of the direct 'liquidity' effect. Second, a rise in anticipated borrowing constraints can increase precautionary saving (see, Foley and Hellwing (1975)). Summarizingly, these 'liquidity' and 'expectations' effects of borrowing constraints would seem to raise saving ratio. Given the earnings profiles, net asset holdings for borrowing constrained consumers will always be at least as high as those of unconstrained consumers whether or not the constraints are actually binding as that moment.

Theory of demand with quantity rationing suggests that quantity constraints may affect also the role of other explanatory variables (see, Deaton and Muellbauer (1980), 109-114). Testing for these effects would require micro data e.g. on the incidence of borrowing constraints. This does not exist so that in what follows tight money-variable is introduced as an additional explanatory variable into (4) and (11).

Thus, we have the following equations to be estimated[1]:

$$(4') \qquad \Delta(s/y)_t = b_0 + b_1 q_t + b_2 g_t + b_3 (s/y)_{t-1} + b_4 R_t + b_5 r_t^* + u_t$$

$$(11') \qquad \Delta(s/y)_t = b_0' + b_1' \Theta_t + b_2' r_t^* + b_3' \Delta \log y_t + b_4' (n_t / p_t c_{t-1}) + b_5' R_t + b_6' r_t^* + u_t' ,$$

where $q_t = \Delta \log y_t - \overline{\Delta \widehat{\log y_t}}$, $g_t = \Delta \log p_t - \overline{\Delta \widehat{\log p_t}}$, R_t is the proxy for tightness of money and u_t is the error term. (4') corresponds to the case $h = 1$, (11'), in turn, is obtained from (11) by linearizing the $(a_t/a_{t-1})^q (1 + r^*)^q \Theta_t$-term with respect to r_t^* and Θ_t.

3. EMPIRICAL EVIDENCE

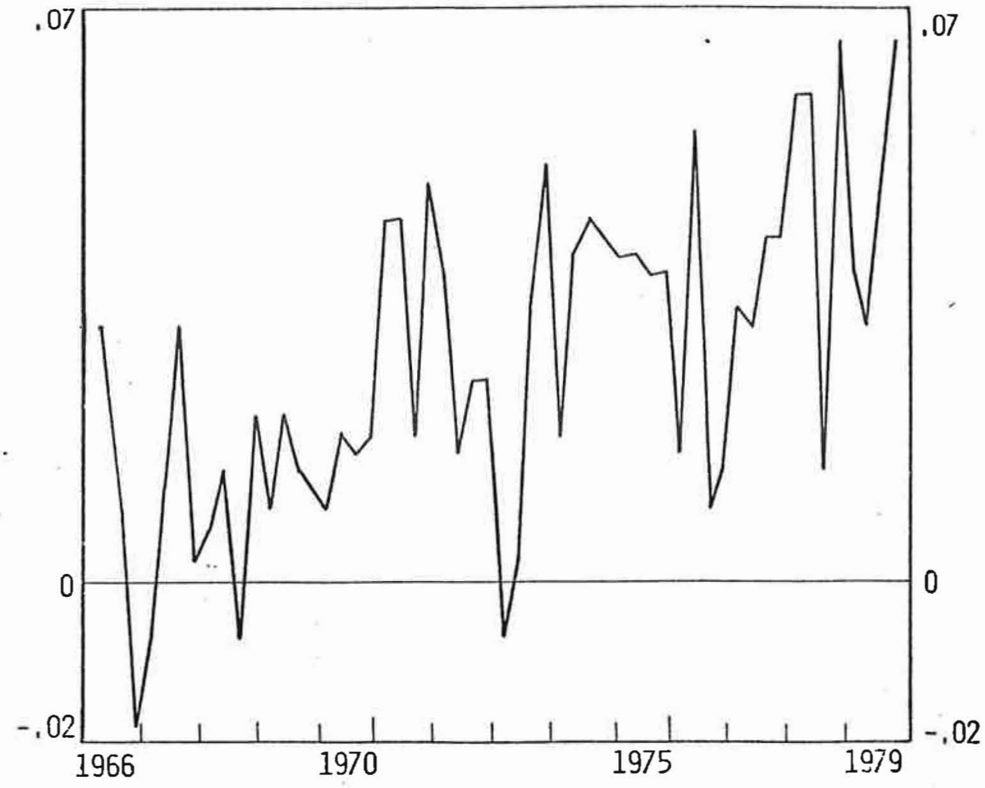
3.1. Data sources and definition of variables

In this section savings function specifications presented above are tested by using Finnish seasonally adjusted quarterly data over the period 1966(I) - 1979(IV)[2].

The concept of income, Y, is personal disposable income and consumption, c, means private consumption expenditures so that it includes expenditures on consumer durables. The corresponding savings ratio, s/y, is illustrated in Figure 1.

In the savings function specifications presented above unobserved variables describing income and price expectations play a major role. In the framework with a cross-section uncertainty unanticipated changes in inflation rate and rate of change in real income are important, while in the framework with an intertemporal uncertainty changes in price level and real income expectations affect savings behaviour. In the lack of survey data on these variables links of expectations to observed variables have to be specified. While there are many ways of doing this we have experimented with some alternative, rather simple, proxies. In the case of cross-section uncertainty specification we have used constant, static and autoregressive inflation and real income rate of change expectations. E.g. in the case of inflation they are respectively $\Delta \log p_t = a_0$, $\Delta \log p_t = \Delta \log p_{t-1}$ and $\Delta \log p_t = a_0 + \Sigma a_i d \log p_{t-i}$. Denoting the expected values by hat the corresponding unanticipated values, $\Delta \log p_t - \Delta \widehat{\overline{\log p_t}}$, are described by q_{it} for inflation rate and by g_{it} for rate of change in real income (see Table 1). In the case of intertemporal uncertainty specification, however, only the AR residuals, i.e. q_3 and g_3, have been used for n_t/p_t and Θ_t, respectively[3].

Figure 1. Households' saving ratio



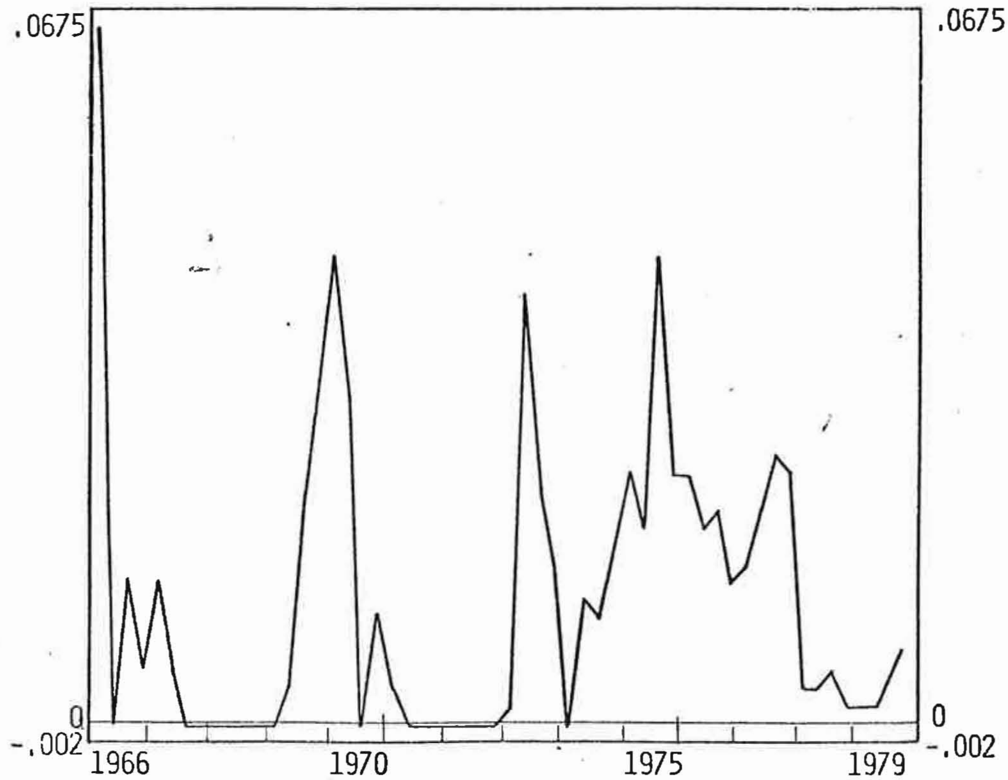


Figure 2. (MC_t - r_t) series

Using constant and static expectations implies that corresponding residuals - unanticipated values - are not white noise; according to Box-Pierce statistics (with 12 lags denoted by Q(12)) only in the case of constant expectations for rate of change in real income the hypothesis of no serial correlation cannot be rejected at the 5 % significance level. Consequently, using these proxies contradicts with a form of rational expectations hypothesis according to which past information about variables are used in forming expectations. It is from this point of view that the AR residuals, being serially uncorrelated, can be justified.

As a proxy for tight money we have used the difference between the banks' marginal cost of borrowing from the central bank, MC, and their weighted average lending rate, r (see Tarkka (1981) for details of constructing this series which is presented in Figure 2)[4]. If tight money affects not via 'liquidity' effect, but via 'expectations' effect, then some anticipated value of tight money, R_t, should be used in place of $RAT_t = MC_t - r_t$, In this connection we have experimented both with static and autoregressive expectations hypotheses. In both cases 'innovation' terms, RR_{1t} and RR_{2t}, turned out to be white noise (see Table 1).

3.2. Estimation results

OLS estimation results for equations (4) and (11) added with tight money-proxies are presented in Table 2. Coefficient

Table 1. Definition of variables

1.	q_{1t}	$= \Delta \log y_t$	$Q(12) = 13.91$
2.	q_{2t}	$= \Delta\Delta \log y_t$	$Q(12) = 34.66$
3.	q_{3t}	$= \Delta \log y_t - \Delta \widehat{\overline{\log y_t}}$	$Q(12) = 5.99$
	$\Delta \widehat{\overline{\log y_t}}$	$= \underset{(.0028)}{.0139} - \underset{(.1109)}{.3398}\, \Delta \log y_{t-1}$	$R^2 = .1113$
4.	g_{1t}	$= \Delta \log p_t$	$Q(12) = 114.90$
5.	g_{2t}	$= \Delta\Delta \log p_t$	$Q(12) = 77.99$
6.	g_{3t}	$= \Delta \log p_t - \Delta \widehat{\overline{\log p_t}}$	$Q(12) = 8.77$
	$\Delta \widehat{\overline{\log p_t}}$	$= \underset{(.0024)}{.0042} + \underset{(.1020)}{.1957}\, \Delta \log p_{t-1} + \underset{(.1111)}{.1997}\, \Delta \log p_{t-2} + \underset{(.1062)}{.4092}\, \Delta \log p_{t-4}$	$R^2 = .4298$
7.	RAT_t	$= MC_t - r_t$	
8.	R_{1t}	$= RAT_{t-1}$	
9.	RR_{1t}	$= RAT_t - R_{1t}$	$Q(12) = 10.45$
10.	R_{2t}	$= \underset{(.2088)}{.6404} + \underset{(.0902)}{.6050}\, RAT_{t-1}$	$R^2 = .3689$
11.	RR_{2t}	$= RAT_t - R_{2t}$	$Q(12) = 6.68$
12.	r^*	$= r_t - \Delta \log p_t$	

y_t indicates households' disposable income at 1975 prices, p_t the implicit deflator of private consumer expenditure, MC_t the (commercial) banks' marginal cost of Central Bank borrowing, and r_t the average lending rate of commercial banks. The AR equations are estimated by OLS, those presented above represent the most parsimonious ones.

Table 2. OLS estimates of equations (4) and (11) with different proxies of q, g and R.

	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)
	$[q_1, g_1, R_2]$	$[q_2, g_2, R_2]$	$[q_3, g_3, R_2]$	$[q_3, g_3, R_1]$	$[q_3, g_3, R_2]$	$[q_3, g_3, R_2]$	$[q_3, g_3, R_2]$
Constant	-.0126	-.0015	.0019	.0101	.0040	-.0198	-.0197
	(.0058)	(.0060)	(.0057)	(.0034)	(.0057)	(.0057)	(.0057)
q_j	.6040	.3598	.5676	.5676	.5950		
	(.0728)	(.0563)	(.0860)	(.0860)	(.0851)		
g_j	.3545	.2500	.3748	.3748	-.1073	.3717	.2683
	(.1220)	(.1287)	(.1816)	(.1816)	(.3072)	(.1783)	(.2983)
R_j	.0073	.0064	.0079	.0029	.0076	.0068	.0066
	(.0031)	(.0035)	(.0035)	(.0013)	(.0034)	(.0035)	(.0035)
r^*					-.5033		-.1171
					(.2622)		(.2548)
$(s/y)_{t-1}$	-.4698	-.2793	-.4698	-.4698	-.5281		
	(.1006)	(.1127)	(.1006)	(.1006)	(.1027)		
q_j/c_{t-1}						-5.7627	-5.7241
						(2.5439)	(2.5652)
$\Delta \log y_t$						1.0927	1.0977
						(.1937)	(.1955)
R^2	.7052	.6108	.6225	.6225	.6486	.6325	.6340
m/DW*)	-.1093	-.4655	.7233	.7234	.8661	2.4675*	2.4532*

Figures inside parentheses are standard errors, * indicates the DW statistic for equations (VI) and (VII). The number of observations is 56. The definition of q_j, g_j and R_j is presented in Table 1.

estimates, their standard errors, goodness-of-fit statistics R^2, DW statistics and Durbin's m-statistics (see Spencer (1975)) for equation (4) are recorded over the the period 1966(I) - 1979(IV).

Several features of Table 2 merit note. First, the overall performance of both cross-section uncertainty specification and intertemporal uncertainty specification is strikingly good; taking account of the rather erratic nature of the savings ratio the goodness-of-fit statistics are high and residuals are - as far as the first-order autocorrelation is concerned - almost white noise[5)]. Second, all coefficient estimates are of expected sign and magnitude (notice e.g. that the coefficient estimate of $\Delta \log y_t$ in (VI) and (VII) is clearly inside $1 \pm 2\sigma$). The corresponding t-ratios are also rather high; with few exceptions the 5 % level of significance (when testing whether b_i, $b_j' = 0$) is exceeded. The real rate of interest does not, however, show up very well, which is obviously due to its high correlation with the inflation 'innovation' terms (that is because r_t has been constant over long periods, see footnote 4), as the following coefficients of correlation, computed for the estimation period, indicate: $r(r_t^*, g_{1t}) = -.989$ and $r(r_t^*, g_{3t}) = -.810$. Third, using various unrestricted distributed lags involving $\log y_t$, $\log p_t$ and $(s/y)_{t-i}$ did not outperform - in the sense of fit - the specifications presented in Table 2 (i.e. equations (I) and (VI)). To give an example, we report the following F-statistics for the model involving $\Delta \log y_t$,

$\Delta \log y_{t-1}$, $\Delta \log y_{t-2}$, $\Delta \log p_t$, $\Delta \log p_{t-1}$, $\Delta \log p_{t-2}$, $(s/y)_{t-1}$, $(s/y)_{t-2}$ and $(s/y)_{t-3}$ against equation (I): $F_{6,45} = 1.96 < F_{.05,6,45} = 2.32$. Finally, when the equations were estimated by instrumental variable technique in order to avoid the simultaneity bias with respect to $\Delta \log y_t$ and $\Delta \log p_t$, results turned out to be practically unaffected[6].

After these general comments the main findings can be briefly summarized as follows: First, estimation results lie in all cases in conformity with the notion that real income and inflation 'innovations' affect the savings ratio positively (for an international evidence, see Koskela and Virén (1981)). Second, estimation results lie in all cases in conformity with the view - consistent both with 'liquidity' and 'expectations' channel of borrowing constraints - that tight money affects the savings ratio positively.

4. CONCLUDING REMARKS

We have tested the hypothesis - suggested particularly by Deaton - that real income and price 'innovations' affect the savings ratio positively. As a point of reference we have used two models, where consumers' uncertainty on relative prices in a cross-section sense and in an intertemporal sense, respectively, play a major role. When completing the models, a tight money variable was also introduced as a factor affecting the savings ratio. Evidence from Finnish quarterly data over 1966-1979 gives strong support to this hypothesis. Results are strikingly robust to alternative proxies for real income and price 'innovations' as well as to alternative specifications of the tight money variable.

FOOTNOTES

1. Note that the real rate of interest occurs in (11) in constrast to (4). This omission of the real rate of interest in a cross-section story is due to the assumed constancy of the 'equilibrium' savings ratio. In empirical experiments, however, the real rate of interest was introduced as an additional variable into (4).

2. This data has been kindly provided by the Bank of Finland where it has been constructed in the context of a quarterly model. Unfortunately, the data is not available in an unadjusted form.

3. In the intertemporal uncertainty specification the differenced terms q_1, q_2, g_1 and g_2 do not show up very well as proxies for 'innovations'. The presence of $\Delta \log y_t$ as an explanatory variable makes it practically impossible to distinguish between the effects of rates of changes and 'innovations' in real income. We have also experimented with some ARMA residuals for $\Delta \log y_t$ and $\Delta \log p_t$, but the results were not qualitative dissimilar from those obtained by using AR residuals. This is not surprising since AR residuals were already white noise.

4. In Finland, the nominal interest rates have been controlled by authorities; they have been unchanged over long period, even nine years in the sixties. Moreover, the banks' borrowing from the central bank is both the major way of absorbing temporary liquidity changes and a permanent source to finance lending to the non-bank public. As a precondition for access to this borrowing facility the banks' weighted average lending rate, however, must not exceed a certain limit, which is slightly above the basic borrowing rate from the central bank and changes with the latter one. Under these circumstances the difference between the cost and return on lending at the margin can be regarded as an indicator of the banks' liquidity situation (see also Tarkka (1981)).

5. There were some signs of higher order autocorrelation: some Box-Pierce statistics, Q(12), exceeded the 5 % critical value, while this did not happen at the 1 % significance level. This might indicate omitted variables or inappropriate seasonal adjustment. The sample size, however, is so small (N = 56) that e.g. the Box-Pierce statistic is not very accurate (see, Harvey (1981), p. 211).

6. A complete set of results is available from the authors upon request.

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