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SEPARATING SHORT-TERM AND LONG-TERM INFLATION EXPECTATIONS USING OBSERVATIONS FROM FINANCIAL MARKETS*

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Abstract

The study extends the analysis of inflation expectations generating mechanisms by separating short-term and long-term inflation expectations from observations from financial markets. Using the term structure of nominal interest rates obtained from non-indexed bonds and the term structure of real interest rates obtained from indexed bonds we derive the term structure of inflation expectations.

Alternative inflation expectations generating mechanisms are tested with special emphasis on the difference between processes generating the short and the long expectations. In a period characterized by both relatively stable inflation and accelerating inflation the adaptive expectations hypothesis obtains unambiguous support when both short-term and long-term expectations were used. The rate of adaptation is higher for the short expectations. The regressive element of the Frenkel hypothesis was not found significant.

In a small open economy the foreign price level is found out to influence rapidly the short-term inflation expectations, while no such clear evidence is obtained for the long-term expectations.

SEPARATING SHORT-TERM AND LONG-TERM INFLATION EXPECTATIONS USING OBSERVATIONS FROM FINANCIAL MARKETS

Inflation expectations and the process generating them have had a given place in both theoretical and empirical works, and during the seventies their role became more prominent. For the moment the problem is approached in the empirical literature in two distinct, but complementary ways. On one hand, there are studies concentrating on the expectations generating mechanism using different sets of data.[1)] These studies attempt to find an answer to the question whether there is a general inflation expectations generating mechanism and how this process has changed over time. On the other hand, the term structure of inflation expectations has received some attention by economists dealing with empirical test of the Fisher equation. Until now only CARGILL-MEYER /3/ have focused on the term structure of inflation expectations in the context of testing the Fisher equation. MULLINEAUX /12/ and TANZI /15/ have briefly examined the difference between the processes generating short term and long-term inflation expectations, although the term structure of inflation expectations as such is not dealt with. Problems connected with short run and long run inflation expectations are discussed shortly by VAN HORNE /17/. As economists gain more insight into the process generating inflation expectations it is likely that attention will be given to a more detailed analysis of the term structure of inflation expectations due to differences in the influence on economic activity of short-term and long-term inflation expectations.

The aim of this study is to cope with the problem of separating short-term and long-term expectations using direct observations of inflation expectations obtained from financial markets. Thus our work can be seen as a complement to studies based on direct observations, specially to that by PAUNIO and SUVANTO /13/, but also as a complement to studies based on the Livingston data, where both short-term and long-term aspects have been touched upon (LAHIRI /9/, TANZI /15/). By focusing particular attention on the relationship between short-term and long-term inflation expectations, our approach can be summarized as follows: using directly observable monthly data on short-term and long-term inflation expectations obtained from yields on non-indexed and indexed government bonds traded in the bond market in Finland, we study the process generating these expectations, and how expectations influence price development during the period 1969-1973 which is characterized by accelerating inflation.[2)] Several empirical works on saving and consumption decisions have pointed out the importance of examining how the formation of inflation expectations have changed during the period following the sharp rise in the inflation rate that took place during the seventies.

In this study we are not capable of testing the Fisher equation of the relationship between nominal interest rates, real interest rates and inflation expectations as our data is derived assuming the difference between the nominal and the real interest rate is part of the inflation expectation.[3)] If, however, further studies indicate that the data used in our study resembles traditional inflation expectations proxies, this analysis can also be done.

In part II we generate the time series on inflation expectations from yields on indexed and non-indexed bonds. In contrast with the study by PAUNIO and SUVANTO /13/ (below just PS) we take explicitly into account the term to maturity of inflation expectations. Having done this we analyse in part III the term structure of inflation expectations. To some degree the results of this part of the study must be considered as tentative because of lack of observations on real interest rates in the intermediate range. In part IV we consider the expectations generating process underlying our data. Although this has been done in earlier studies we find it necessary even here, in order to explore possible differences in the mechanisms generating the short-term and long-term inflation expectations. Attention is also given to the possible influence of the short-term inflation expectations on the short-term expectations. The last part of the study contains an analysis of the effect on expectations of not only the past history of prices but also of some other variables suggested by economic theory. We consider also, although not in detail, the influence of inflation expectations on the inflation rate; this analysis is not worked out within the framework of a larger model, thus the disadvantages of partial analysis must be kept in mind.

Test of the rationality of the price expectations data are not included in this report.

II DATA GENERATION

The data underlying the empirical work of this study consists of direct observations of inflation expectations derived from the financial markets where the difference between yields on indexed and non-indexed bonds is taken as an indicator for inflation expectations. Apart from the study by PS /13/, on which our method of data generation relies, two other studies using direct observations of inflation expectations can be found in the literature, both studies basing their empirical analysis on data derived from yields on indexed and non-indexed financial assets. CUKIERMAN /6/ uses the Israeli bond market. No non-indexed bond was available in Israel so a commercial paper with 18 months to maturity was substituted for the non-indexed bond. The inflation expectations were derived from the Fisherian generalized relationship $(1+n) = (1+r)(1+q)(1+d)$, where n stands for the nominal rate of return, r for the real rate of return, q for inflation expectations and d for risk aversion. Assuming the risk factor d to be proportional to the real rate of return, Cukierman obtained a time series on short-term inflation expectations q.

Vartia /18/ uses non-indexed and indexed bank deposits, assuming that inflation expectations can be derived from the relative shares of holdings of the two different types of assets.

Following PS we apply a two-asset portfolio analysis assuming that investors hold in their portfolios indexed and/or non-indexed government bonds. The only risk affecting the choice between these two assets is the uncertainty of the future price level. Thus one shortcoming of the derived term structure of inflation expectations is that the capital uncertainty attached to the bonds is not taken into account. When dealing with the term structure of interest rates, this may affect the calculated term structure of inflation expectations.

The utility function is

$$(1) \qquad U = E(R_T) + aS_T^2, \; a < 0$$

where the utility U is a function of the total expected real return from the portfolio, R_T, and the total risk of the portfolio S_T^2. The total real return from the portfolio T is

$$(2) \qquad R_T = (r_0 - p)x + (r_1 + \pi - p)y$$

where r_0 is the nominal yield on the non-indexed bond, $r_1 + \pi$ is the yield on the indexed bond, π is the index linkage increment of the indexed bond and p is the rate of inflation. x and y stand for the relative shares of the non-indexed and indexed bonds in the portfolio. With a 50 per cent index linkage of the indexed bond equation (2) becomes

$$(3) \qquad R_T = (r_0 - p)x + (r_1 - \tfrac{1}{2}p)y$$

The expected real rate of return of the portfolio is

$$(4) \qquad E(R_T) = (r_0 - p^e)x + (r_1 - \tfrac{1}{2}p^e)y$$

and the risk of the portfolio S^2

$$(5) \qquad E[(R_T - E(R_T)]^2 = S^2x^2 + \tfrac{1}{4}S^2y^2 + 2 \cdot \tfrac{1}{2}S^2xy$$

where $S^2 = E(p - p^e)^2$.

The utility function can thus be written as

$$(6) \qquad U = (r_0 - p^e)x + (r_1 - \tfrac{1}{2}p^e)y + aS^2(x^2 + \tfrac{1}{4}y^2 + xy)$$

Assuming utility maximizing investors and the equilibrium condition $\frac{\partial U}{\partial x} = \frac{\partial U}{\partial y}$, equations (1)-(6) imply an expression for the inflation expectations according to equation

$$(7) \qquad \pi = r_0 - r_1 + aS^2(x + \tfrac{1}{2}y)$$

For a 50 per cent index linkage, time series for expected inflation $p^e = 2\pi$ expressed as annual rates were then derived for the period 1969 I - 1973 XII. Although our period coincides with the latter period of the PS study their data was not used in our study because our interest lies in separating short-term and long-term inflation expectations, and in the PS data set bonds are aggregated over maturity without considering the term structure of interest rates. The yield on indexed bonds in the study by CUKIERMAN /6/ is also obtained from bonds that are aggregated over maturity, although Cukierman claims that this can be done because the real yield curve was flat. A careful analysis of the Cukierman data (BEN-SHAHAR-CUKIERMAN /1/) however suggests that the conclusions obtained in the study could have been affected by this aggregation.

Initially our target was to obtain time series on inflation expectations from equation (7) using nominal and real interest rates generated from nominal and real yield curves.[5] The nominal rates of return $R_1, \ldots, R_{10}$ could be obtained, but real yield curves satisfying standard statistical criteria could not be obtained. Partly this was because of lack of data. Therefor two real rates of return were calculated, one short-term rate RS and one long-term rate RL. RS was obtained by averaging yields of indexed bonds having a short-term to maturity ($12 < n \leq 30$, where n is the term to maturity measured in months), while RL was obtained by averaging yields of indexed bonds having a long term to maturity ($n \leq 60$). Thus, even our study may suffer to some degree from aggregation. The procedure for obtaining an estimate for aS^2 in equation (7) corresponds to that of PS. The estimate of aS^2 varied with the term to maturity of the inflation expectations, being approximately -5.1 for the short-term expectations and -5.6 for the long-term expectations.

III THE TERM STRUCTURE OF INFLATION EXPECTATIONS

In this part we study the term structure of inflation expectations resulting from calculations reported in part II. Here it must however be kept in mind the consequences of not having access to the whole term structure of yields on indexed bonds. Table 1 gives the mean and the standard deviations of the time series $E_1, \ldots, E_{10}$, where E_i, $i = 1,2,\ldots,10$, is the inflation expectations derived from bonds having i years to maturity. Thus E_i measures <u>the average rate of inflation expected to prevail during the following i years.</u>

Table 1. Means and standard deviations of the actual annual inflation rate and inflation expectations

	mean	standard deviation
E_1	5.99	4.60
E_2	5.98	4.42
E_3	5.98	4.36
E_4	6.07	3.17
E_5	6.09	3.17
E_6	6.08	3.16
E_7	6.07	3.17
E_8	6.06	3.21
E_9	6.06	3.28
E_{10}	6.10	3.99
QS	6.08	4.44
QL	6.11	3.04
PS	7.94	3.17
P	6.06	3.74

Table 1 shows that the mean of the time series has for the period 1969 I - 1973 XII been almost the same for all the time series on inflation expectations while the standard errors follow a pattern familiar from the literature on the term structure of interest rates, namely starting relatively high, the standard deviation diminishes the longer the term to maturity. The high standard deviation for E_{10} may be a consequence of 10 years being the maximum term to maturity of the government bonds included, and thus the seasoning process may affect the yields on these bonds. Time series QS and QL refer to inflation expectations where the same averaging procedure which was used for indexed bonds above, also was used to obtain short-term and long-term rates of returns on non-indexed bonds. The mean and the standard deviation of the PS data is given also in table 1. The high mean of the time series is not directly comparable to those of our data set, because the procedure for scaling the time series differed following from different time periods being studied.

Figure 1. The term structure of inflation expectations, April and October 1969-1973

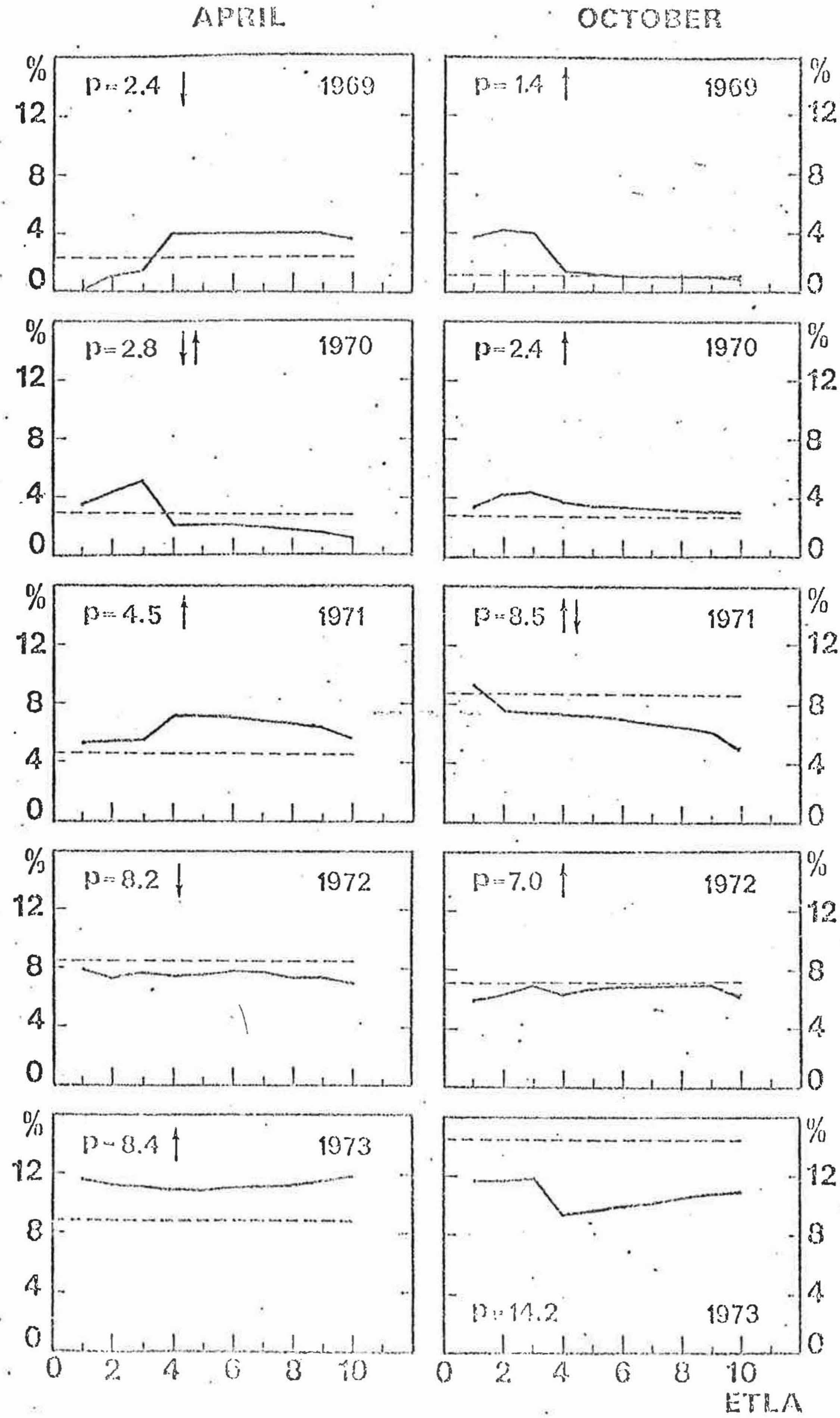
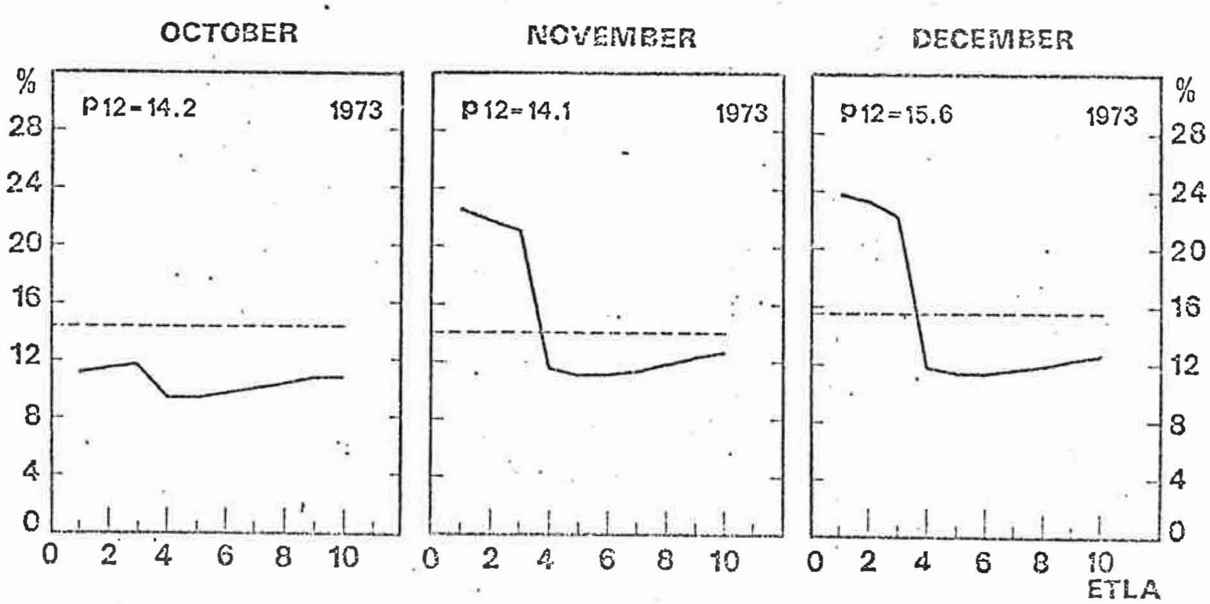


Figure 1 gives the term structure of inflation expectations for April and October each year. Here the consequences of having access to only some segments of the real yield curve can be seen. The sharp jumps that occasionally occur when moving from E_3 to E_4 must be seen at least partly as a result of the method of data generation. On the other hand, one can draw some tentative conclusions from comparing the short end and the long end of the curve. Also the position of the actual level of inflation relative to the term structure of inflation expectations deserves attention. The direction the actual annual rate of inflation is at each point of time indicated by an upward or downward pointing arrow.

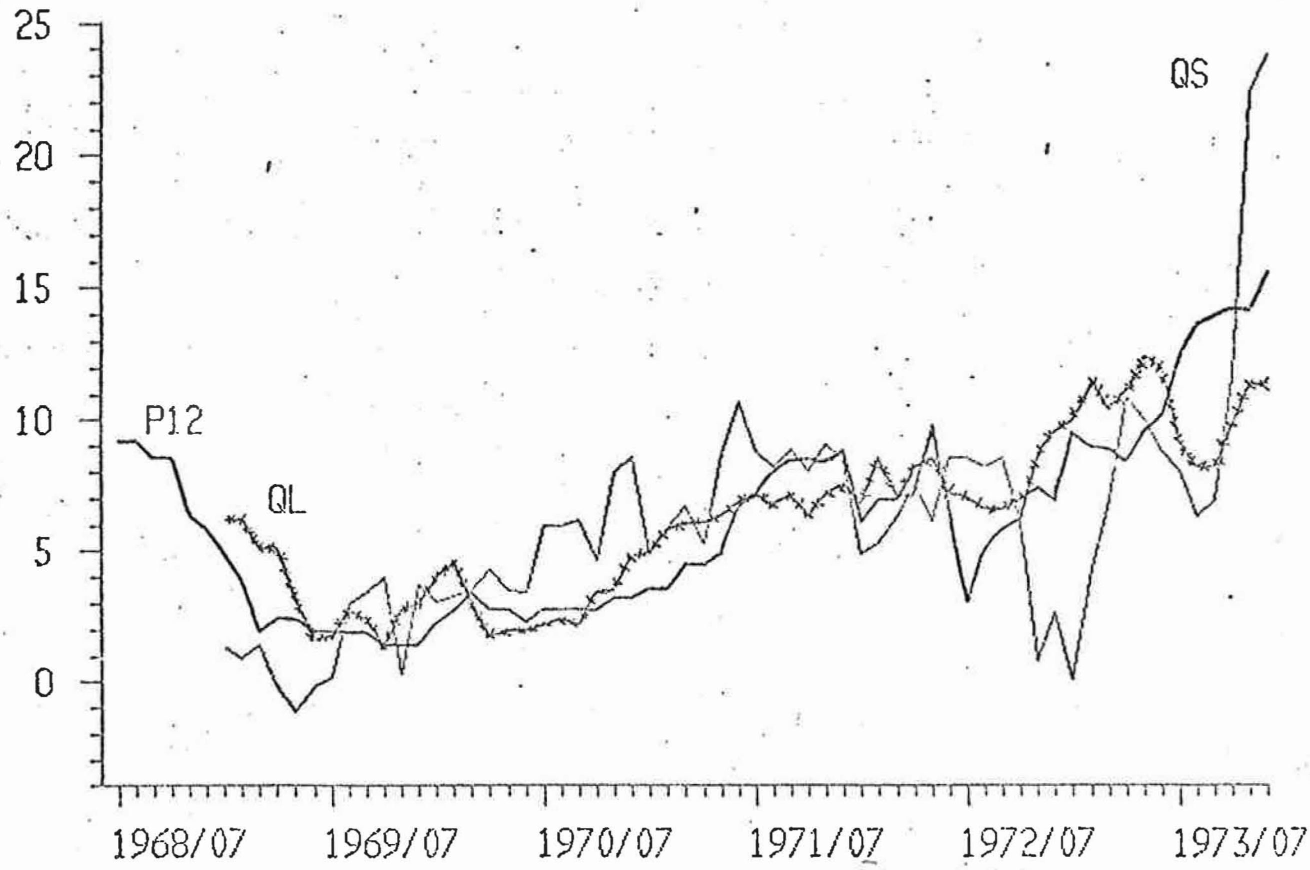
Our period 1969 I - 1973 XII coincides with the increase in the price of oil and the formation of oil cartels. A comparison of the term structure of inflation expectations for October, November and December 1973 reveals that the oil price increase had an immediate effect on short-term inflation expectations, while the changes in the long-term inflation expectations are not as evident. Because our data does not extend beyond December 1973 this latter result is not surprising. If we had had access to data for the period following the oil crisis we would have been capable of seeing whether and when the oil price increases had a significant impact also on the long-term inflation expectations, or whether the price increases following the formation of oil cartels was in the beginning seen just as a short run phenomenon, which our results seem to indicate. A comparison of the term structure of inflation expectations for October, November and December 1973 reveals that some changes in the long-term inflation expectations took place. Figure 2 shows that market participants have taken into account the changes in the oil prices already in November when forming their short-term inflation expectations, while only a small change, about 1 per cent, can be seen for the long-term inflation expectations. The short-term inflation expectations, using E_2, increased from 12 % to 24 % from October to December, while the long-term inflation expectations increased only from 10.8 % to 12.2 %. The PS aggregated inflation expectations data indicates a rise in inflation expectations not until the middle of 1974.

Figure 2. The term structure of inflation expectations 1973 X-XII



The short-term inflation expectations QS and the long-term inflation expectations QL are shown in figure 3 as time series together with the actual annual rate of inflation. The actual inflation rate is here shown for 1968-1974. Thus the decline of he long-term inflation expectations during 1969 seems be a result of the declining development of the actual inflation rate during the latter part of 1968.

Figure 3. Short-term and long-term inflation expectations



Both the short-term and the long-term inflation expectations show a larger variance than the actual inflation, the variance of the long-term inflation expectations being smaller than that of the short-term expectations. Figure 3 also shows that the inflation expectations time series follow the actual inflation rate fairly well and partly according to the adaptive expectations hypothesis, the actual inflation rate leading the expected. However, inflation expectations cannot solely be explained by considering the past inflation rate (see for instance 1970-1971). The larger variation of the short-term inflation expectation compared to that of the long-term expectations suggests that the short-term and the long-term expectations relate in different ways to the actual inflation rate, thus suggesting different expectations generating mechanisms. This problem is dealt with next.

IV EXPECTATIONS GENERATING PROCESSES

Although empirical work on expectations generating mechanisms has been done to some extent using different sets of data, we find it necessary to consider also this stage of the empirical work on inflation expectations because our data has one aspect almost lacking in earlier works on inflation expectations, namely the term to maturity aspect. The earliest works on inflation expectations did not consider the term to maturity aspect at all. These earlier studies gave support both to the adaptive expectations hypothesis (/4/, /13/, /18/) and the regressive-extrapolative expectations hypothesis (/16/). Some efforts have been made to incorporate the term to maturity aspect into the expectations generating mechanism. A disadvantage here has been the lack of data on long-term inflation expectations. Either the Livingston data has been used as indicators for the long-term (12 months) inflation expectations, or the long-term expectations have been proxied by some long run average of past inflation rates.

The hypothesis developed by FRENKEL /7/ has received some support by the studies which using the Livingston data try to incorporate the term to maturity aspect (TANZI /15/, LAHIRI /9/). The Frenkel hypothesis distinguishes between an adaptive element and a regressive element in the expectations generating process. As Tanzi /15/ points out it is, however, difficult to use the Livingston data to test the Frenkel hypothesis because of lack of data on inflation expectations longer than 12 months.

Summarizing the work on inflation expectations Chan-Lee /5/ notices a diminishing influence of the regressive element in the expectations generation process and a shortening of the learning lag in the adaptive element.

Using the monthly data QS, E_2, E_3, QL, E_7, E_9, where QS, E_2, and E_3 are time series on short-term inflation expectations and QL, E_7, and E_9 are time series on long-term inflation expectations, we estimated for the period 1969 I - 1973 XII the first-order adaptive expectations hypothesis as in equation (H1),

(H1) $$p_t^e = a_0 + a_1 p_{t-1} + a_2 p_{t-1}^e$$ adaptive expectations.

The OLS estimates for equation (H1) are given in table 2. Models constraining $a_0 = 0$ gave better results in terms of the value of R^2, the t-ratios and the Durbin-Watson test statistics. The value of the constant is influenced by the scaling of the time series when calculating the risk aversion coefficient aS^2.

Table 2. First-order adaptive expectations*

$$p_t^e = a_1 p_{t-1} + a_2 p_{t-1}^e$$

	a_1	a_2	a_1+a_2	R^2	d
QS	.280 (2.9)	.789 (8.2)	1.069	.910	1.63
E_2	.316 (3.2)	.749 (7.7)	1.065	.910	1.60
E_3	.348 (3.6)	.714 (7.5)	1.062	.916	1.57
QL	.171 (2.1)	.832 (10.1)	1.003	.969	1.79
E_7	.202 (2.4)	.808 (9.2)	1.010	.968	1.85
E_9	.214 (2.4)	.791 (8.6)	1.005	.965	1.82

*) t-ratios in parenthesis

critical test values:

$d_{L,.05,60,2} = 1.51$, $d_{U,.05,60,2} = 1.65$

$t_{.05,60} = 1.67$

The rate of adaptation in our study differs from all the studies mentioned above, which we find to be a consequence of taking into account the time period over which expectations are made. In interpreting the results one must also keep in mind whether the data underlying the analysis is monthly (/13/, /18/ and our study), quarterly or semiannual (all studies relying on the Livingston data) data, because the rate of adaptation refers to changes in the inflation expectations within the base period used.

The interpretation of our results proceeds in the following way. First we compare our estimates for the short-term expectations with the estimates for the long-term inflation expectations. Note that the results obtained using time series QS and QL are not directly comparable with the results obtained using the time series E_i, i=1,...,10, because these two sets of data are constructed in different ways. In comparing our results with earlier studies, we start by comparing our results of the adaptive expectations hypothesis with other studies using monthly data, but where the term to maturity aspect is not taken into account. Thereafter we consider how our results differ from studies where the term to maturity aspect in some way is taken into account (/7/, /9/, /12/, /15/).

The results support the general conclusions from earlier studies on inflation expectations, namely that the data fits the adaptive expectations hypothesis well. They are also in line with other results using Finnish data (/13/, /18/). Table 2 shows that the monthly rate of adaptation differs significantly between short-term and long-term inflation expectation. Comparing QS and QL the rate of adaptation is .28 respectively .17. Comparing the results from using the data obtained from yield curves i.e. E_2, E_3, E_7 and E_9 the rate of adaptation for E_2 and E_3 are higher than for E_7 and E_9. The learning lag is shorter for short-term expectations and longer for long-term expectations. On the other hand, when the E_i time series are considered more closely we find one result that is inconsistent with this aspect: the rate of adaptation for E_2 is lower than that for E_3, and the rate of adaptation for E_9 is higher than that for E_7. This result must be analysed more closely, specially the question whether it is a result of the method of data generation, and the lack of access to a real yield curve. This aspect is however not considered in this paper. For the short-term and long-term expectations the sum of coefficients, $a_1 + a_2$, is close to unity, implying that no trends is taken into account.

Estimating the first-order adaptive expectations hypothesis Paunio and Suvanto obtained an estimate of the monthly rate of adaptation of .120. This is significantly smaller than our estimate of the monthly rate of adaptation for the short-term expectations, a result which could have been anticipated as PS included in their data for the period 1968-1974 bonds having a term to maturity longer than 72 months. Our estimate of the monthly rate of adaptation for the long-term expectations is even higher than that of Paunio and Suvanto, although the maturity of the bonds included in our long-term inflation expectations exceeds that of the bonds included in the PS data.

Also VARTIA /18/ makes use of monthly data on inflation expectations. The term to maturity aspect cannot be dealt with within his method of data generation. His results can be compared to expectations data such as our E_1 and the Livingston 12 month data, as the minimum deposit time was one year for the Finnish index linked bank deposits. Vartia did not obtain significant estimates of the monthly rate of adaptation when the annual rate of inflation was used as explanatory variable.

Using the 6 months time series on inflation expectations from the semiannual Livingston data when testing the first-order adaptive expectations hypothesis LAHIRI /9/ obtained an estimate of .426 for the rate of adaptation and TANZI /15/, also using the Livingston data obtained an estimate of .417. These results seem to conform to our short-term results. The results of the test of the first-order adaptive expectations hypothesis by Lahiri and Tanzi are reproduced in equations (8) and (9).

$$(8) \qquad \dot{p}^e_t = \underset{(1.2)}{.1776} + \underset{(9.8)}{.417}\dot{p}_t + \underset{(5.1)}{.371}\dot{p}^e_{t-2} \qquad \text{Tanzi /12/}$$

$$(9) \qquad \dot{p}^e_t = \underset{(2.9)}{.426}\dot{p}_t + \underset{(3.2)}{.534}\dot{p}^e_{t-2} \qquad \text{Lahiri /8/}$$

As our period of investigation coincides with accelerating inflation the stability of the rate of adaptation becomes relevant. The change in the inflation pattern can also change the learning lag, which can be measured by the rate of adaptations. In order to test this aspect, some tentative experiments were made by splitting up the period into two parts, one period characterized by a relatively stable inflation rate, 1969-1970, and one period in which the inflation rate accelerated, 1971 I - 1973 XII. The rate of adaptation for the periods, obtained from OLS estimation of the first-order adaptive expectations hypothesis was then compared to the rate of adaptation obtained for the whole period. No other tests of the stability of the rate of adaptation were made at this stage. The results for QS and QL are given in table 3.

Table 3. Stability of parameters

Period	time series used	rate of adaptation	R^2	d
1969-1973	QL	.171 (2.1)	.969	1.79
1971-1973	QL	.152 (1.5)	.973	1.85
1969-1973	QS	.280 (2.9)	.910	1.63
1971-1973	QS	.305 (2.4)	.918	1.40

Critical test-values: 1971-1973 $t_{.05,60} = 1.67$

As the latter segmented period is relatively short our main focus is on the possible change in the value of the rate of adaptation of the short-term inflation expectations as a consequence of the acceleration of the actual inflation rate. The rate of adaptation is slightly higher for the period of accelerating inflation (.305) compared to the whole period (.280). The low value of the Durbin-Watson test statistic makes these conclusions however ambiquous. For the first period (1969-1970) with relatively stable inflation the rate of adaptation was lower than for the whole period, but parameter estimate was not significant at 5 per cent level. For the long-term inflation expectations the rate of adaptations became insignificant for both the segmented periods. The lower values of R^2 in some periods, the low value of d and the insignificant values of some parameter estimates point to the possibility of other factors influencing the expectations generating process. This analysis is done in part V.

Returning back to the estimation results for the whole period in table 2 our data thus suggest that both for the short-term and the long-term inflation expectations the first-order adaptive expectations hypothesis explains the variation in the expectations, and that the rate of adaptation for the process generating the short-term expectations is higher than that of the process generating the long-term expectations.

In a period of accelerating inflation a priori one would assume that the extrapolative hypothesis would gain support. Paunio and Suvanto concluded that when moving from the 1960's to the 1970's the extrapolative element in the expectations formation seems to have strengthened. Their test of the extrapolative hypothesis as in equation (H2)

(H2) $\dot{p}_t^e = b_1\dot{p}_{t-1} + b_2(\dot{p}_{t-1} - \dot{p}_{t-2})$

does not however clearly support such a conclusion, because when moving to their latter period, which coincides with our period, the estimated value of b_2 becomes insignificant at the same time as the Durbin-Watson statistics indicates misspecification of the equation, although the low value of the Durbin-Watson test statistic partly can be seen as a consequence of overlapping periods.

Also our test of the first-order extrapolative expectations hypothesis (H2) gave insignificant coefficients for the variable indicating a change in the inflation rate. A low R^2 and an unsatisfactory value of the Durbin-Watson test statistic were obtained.[6)]

The support obtained for the adaptive expectations hypothesis and the a priori assumption about the strengthening of the extrapolative forces in the periods of accelerating inflation led us to test a combined adaptive-extrapolative hypothesis according to equation (H3)

(H3) $\dot{p}_t^e = a\dot{p}_{t-1}^e + b\dot{p}_{t-1} + c\dot{p}_{t-2}$.

Also in this case the coefficients of determination R^2 were lower than those of the pure adaptive expectations model and significant parameter estimates were obtained only for the lagged expectations variable. The extrapolative element could thus not contribute to the explanation of the variations in the expectations.

The adaptive expectations model implies a geometrically falling lag structure. The relatively small value of the rate of adaptation suggests a relatively short lag structure. Both Carlson and Parkin /4/, Paunio and Suvanto /13/ and Vartia /18/ tested a more general lag structure concluding that such a model could not be superior to the adaptive expectations model.

Estimation of a general distributed lag structure implies considering the long run in a more explicit way than the extrapolative expectations model. Because the adaptive expectations model receives support from our data, implying a geometrically falling lag structure, some information could be obtained from explicitly testing a hypothesis relying simultaneously on the information contained in both the short-term and the long-term expectations data. In order to obtain information of both short-term and long-term movements in the expectations generating mechanism the following models were estimated:

(H4) $$p_t^e = ap_{t-1} + b(P_{t-1}^e - p_{t-1})$$ regressive expectations

(H5) $$p_t^e = aP_{t-1}^e + bp_{t-1} + cp_{t-1}^e$$ adaptive-regressive expectations

where p_{t-1}^e refers to the long-term expectations, and p_t^e here refers to short-term expectations. The results obtained from using all the three time series on the short-term inflation expectations QS, E_2 and E_3 as dependent variables are reported in table 4.

Table 4. Long-run and short-run movements in the inflation expectations

Regressive expectations (H4):

	a	b	R^2	d
QS	.986 (14.8)	-.06 (-.3)	.805	.59
E_2	.994 (15.7)	.151 (.7)	.817	.60
E_3	1.001 (16.8)	.190 (.9)	.835	.63

Adaptive-regressive expectations (H5):

	a	b	c	R^2	d
QS	-.139 (-.9)	.406 (2.4)	.794 (8.2)	.912	1.69
E_2	-.134 (-.8)	.426 (2.6)	.767 (7.7)	.911	1.68
E_3	-.126 (-.8)	.448 (2.8)	.734 (7.4)	.917	1.63

The regressive expectations hypothesis is based on the assumption of return to normality and in our case a setting of the short-term inflation expectations consistent with the long-term expectations. No indicator of the long-term inflation expectations gave significant estimates for the regressive element in the expectations formation process.

A combination of the regressive and adaptive elements in a process generating inflation expectations has been used by Frenkel /7/, Tanzi /15/ and Cukierman /6/. All studies showed that this model was superior to the pure adaptive expectations model, by including both long run and short run elements in the model. The poor results from our estimation of the regressive model above did not a priori give support for the Frenkel hypothesis. The estimation results using all three time series on short-term inflation expectations as dependent variable supported these suspicions. The regressive element did not obtain a significant estimate, while the rate of adaptation remained almost on the same level as in the pure adaptive expectations hypothesis. The results of the estimation of the Frenkel hypothesis (H5) reported in table 4 imply that we can still stick to our conclusion drawn above that the first-order adaptive expectations hypothesis fits best the data on both short-term and long-term inflation expectations.

V OTHER SOURCES OF INFORMATION AFFECTING INFLATION EXPECTATIONS

The adaptive expectations hypothesis has been critizised because of its limitations. According to it the error learning mechanism is the only source of information on which investors revise and form their expectations. Only the past influences expectations, while the current state of the economy plays no significant role. The rational expectations literature has paid attention to this and to the ad hoc specification of the process generating expectations. The rationality of the Livingston price expectation data has been analysed, and Carlson and Parkin /4/ among others conclude that an augmented second-order adaptive expectations hypothesis which takes into account the devaluation fits their data best. An augmented version of the first-order adaptive expectations hypothesis where the effect of the devaluation is allowed for was by PS found to be the best model for their earlier period of investigation. For their latter period (1969-1974) the influence of other sources of information was not considered at all.

In this last part of our study we allow for other sources of information than past inflation rates to influence the formation of expectations. For a small open economy the inflation rate abroad is usually taken to affect the price expectations and the actual inflation rate. LAIDLER and O'SHEA /10/ have recently tangled this question in the context of an estimation of a six-equation macroeconomic model for an open economy under fixed exchange rates. Their findings suggest that inflation expectations and hence also the behaviour of domestic prices are dominated by world prices. Economic theory also suggests that the level of economic activity in the country affect expectations of the future price level. These two variables were used to determine whether other sources of the current state of the economy were considered relevant for the formation of expectations.

Let us first consider the economic activity, which we measure by the rate of unemployment UN. Extending the adaptive expectations hypothesis with the information contained in the rate of unemployment did not improve our results obtained earlier. This result may partly be explained by taking into account the fact that our period of investigation revers to the time when the inverse relationship between prices and unemployment which existed during the sixties was changing.

Contrary to the rate of unemployment the foreign price level seem to affect the formation of expectations. In order to avoid multicollinearity the adaptive expectations hypothesis (H1) was estimated using the foreign price level as regressor instead of the domestic price level. For the short-term inflation expectations during the latter period 1971-1973 the evidence is clear. The change in the import price index explained a larger part of the variations in the short-term inflation expectations than did the change in the domestic price index. The change in the import price index at time t had the largest and the most significant influence on short-term inflation expectations generated at time t+3. The results for the short-term inflation expectations are given in table 5.[7)]

Table 5. Inflation expectations and import prices

$$p_t^e = \alpha IMP_{t-3} + \beta p_{t-1}^e$$

Time series	Time period	α*	R^2	d
QS	1969-73	.193 (3.5)	.915	1.78
E2	1969-73	.199 (3.5)	.912	1.76
E3	1969-73	.200 (3.6)	.915	1.73
QS	1971-73	.254 (3.2)	.926	1.61
E2	1971-73	.261 (3.3)	.928	1.66
E3	1971-73	.255 (3.3)	.933	1.67

* t-ratios in parenthesis

Critical test values: $t_{.05,60} = 1.67$, $t_{.05,30} = 1.70$

$d_{L,.05,60,2} = 1.51$, $d_{U,.05,60,2} = 1.65$

$d_{L,.05,36,2} = 1.35$, $d_{U,.05,36,2} = 1.59$

For the long-term inflation expectations the influence of the foreign price movement was weak and insignificant. Because preliminary tests indicate that the domestic rate of inflation respond to long-term inflation expectations and not to short term expectations, the impact of changes in the foreign price level on the domestic price level is indirect, and works through inflation expectations. Equations (11)-(13) grasp the main thread of this argument, although it suffers from being a partial analysis.

(11) $QS_t = \alpha_0 QS_{t-1} + \alpha_1 IMP_{t-3}$

(12) $QL_t = \beta QS_t$

(13) $p_t = \gamma_1 p_{t-1} + \gamma_2 QL_t$

Estimating each equation separately for the period 1971-1973 using monthly data gives significant parameter estimates (t-ratios in parenthesis)

$\alpha_0 = .745$ (7.1) $\quad \alpha_1 = .254$ (3.2)

$\beta = .800$ (10.9)

$\gamma_1 = .922$ (13.9) $\quad \gamma_2 = .123$ (1.8)

Equations (11)-(13) reduce to

(14) $p_t = ap_{t-1} + bQS_{t-1} + cIMP_{t-3}$

where $a = \gamma_1$

$b = \alpha_0 \cdot \beta \cdot \gamma_2$

$c = \alpha_1 \cdot \beta \cdot \gamma_2$

Preliminary estimates from estimating equations (11)-(13) separately yields a = .929 b = .073 c = .025

OLS estimation of equation (14) gives

$$p_t = \underset{(11.7)}{.892p_{t-1}} + \underset{(1.4)}{.065QS_{t-1}} + \underset{(1.4)}{.071IMP_{t-3}}$$

$$R^2 = .989 \qquad d = 2.01$$

The parameter estimates are significant at 10 per cent level.

CONCLUSIONS

This study has extended the analysis of inflation expectations generating mechanisms by separating short-term and long-term expectations from direct observations of inflation expectations obtained from financial markets. The term structure of inflation expectations was also considered, although the results must at this stage be seen as tentative.

Results from testing alternative expectations generating mechanisms suggest that the first-order adaptive expectations hypothesis fits both the short-term and the long-term data best, with a monthly rate of adaptation of .28 for the short-term expectations and .17 for the long-term expectations. The regressive element in the Frenkel hypothesis was not found significant.

Our data suggests that the impact of the oil price increase in the end of 1973 was incorporated in the short-term inflation expectation very rapidly, but not as clearly in the long-term expectations. This feature was considered partly to be an outcome of the period of investigation, which ended in December 1973. The rate of unemployment was not found to influence the expectations.

Our estimation results indicate that the import prices influence expectations, particularly the short-term expectations. Thus our results give some support to the argument for the use of exchange rate policy to stabilize the domestic inflation, if a stable price level as a goal for economic policy is given highest priority.

Economists will seldom have access to direct observations on inflation expectations. Some proxy variable will in all empirical studies be used, and the expectations generating mechanism will always have to be assumed. We are, however, apt to claim that with our data, which is almost the closest one can get to in economists' efforts to obtain data on inflation expectations determined by the market mechanism, we have shown which one of the expectations generating mechanisms based on past inflation rates is the most relevant. In a period characterized both by relatively stable inflation and accelerating inflation the first-order adaptive expectations hypothesis obtains unambiguously the largets support when time series on both short-term and long-term expectations were used. Thus although our conclusions are country-specific they can be of more general interest.

FOOTNOTES:

1) Studies using survey data are those by CARLSON and PARKIN /4/, TURNOVSKY /16/, LAHIRI /9/, and TANZI /15/; direct observations on inflation expectations obtained from financial markets are used in studies by PAUNIO and SUVANTO /13/, VARTIA /18/, and CUKIERMAN /6/.

2) The choice of period is determined by the availability of indexed bonds in Finland. Before 1969 these bonds were regularly traded in the Stock Exchange, but nonindexed bonds with a fixed coupon were not traded and thus we cannot before 1969 obtain data for both indexed and nonindexed bonds. As the index linkage system existed only until 1969 III, there were not observations available over the whole maturity range after December 1973.

3) For a discussion of this aspect see PAUNIO-SUVANTO /13/.

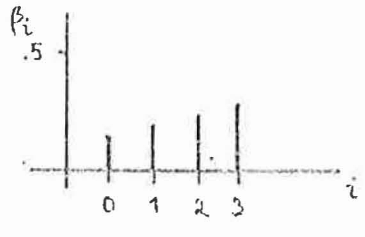
4) A comparison of the inflation expectations derived in our study with traditional proxy variables must take into account the effect of bonds not being considered as taxable income or wealth in Finland.

5) The nominal yield curve was obtained from regressing yields of non-indexed bonds on the term to maturity; the real yield curve was obtained from regressing yields on indexed bonds on the term to maturity. Only bonds issued by the Finnish government were used. In calculating the yields on indexed bond data on accrued index increements were, obtained from FBF Börsnyckeln /19/.

6) Extrapolative expectations: $p_t^e = b_1 p_{t-1} + b_2(p_{t-1} - p_{t-2})$

	b_1	b_2	$\bar{R}^2$	DW
QS	1.008 (15.0)	-.494 (-.92)	.807	.54
E2	1.004 (15.6)	-.526 (-1.02)	.819	.59
E3	1.009 (16.6)	-.547 (-1.12)	.836	.62
QL	.961 (24.0)	-.342 (-.107)	.916	.51
E7	.970 (24.87)	-.210 (-.67)	.921	.58
E9	.972 (24.80)	-.212 (-.67)	.921	.59

7) The value of the coefficient of the change in the import price index lagged i periods was roughly of the same size for all short-term inflation expectations. The parameter values β_i are shown in figure (i).



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