Measuring the Usefulness of Consumers' Inflation Expectations in Finland

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Abstract

During the past decade a lot of attention has been paid to consumers' inflation expectations, mainly because they have been found to contain information about future inflation. Since October 1995, in the Finnish Consumer Survey carried out by Statistics Finland, the respondents have been asked monthly to give both their inflation assessments and expectations in straight percentage points. Here we analyse the formation and accuracy of these estimates with respect to the measured inflation e.g. by disaggregating inflation by commodity group. We look at the relationship between consumers' assessments and expectations about inflation with various measures of inflation. We find out e.g. that expectations have predictive power over inflation, but the horizon of this information does not carry exactly 12 months ahead as could be assumed basing on the question.

We find out that inflation expectations have been an unbiased predictor for the median and underlying (core) CPI, but not for the ordinary CPI. For instance, oil prices can affect inflation significantly, but they are largely unpredictable for consumers as well as for professional forecasters. Evidence was found that consumers react excessively to commodity groups that are familiar and close to them, such as food, housing and restaurant services. This phenomenon could also mainly explain the recent divergence between consumers' inflation assessments and expectations after the changeover to euro. We also examined whether the distributional moments calculated from the cross-sectional data sets could be used in forecasting actual inflation. Apart from the clear evidence in favour of the usefulness of the mean of expectations, we find weak evidence that volatility (standard deviation) and skewness could be helpful in making more precise forecasts. Conditioning inflation expectations by selecting into the sample only the "informed consumers" who approximately know the current inflation also appears to produce more accurate estimates about forthcoming inflation.

Keywords: inflation expectations, monetary policy, surveys, forecasting

JEL Classification: D12, D84, E31, E52

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1 Introduction

In this paper we consider the accuracy of consumers' assessments about the actual past inflation and expectations about future inflation. The data from the Finnish Consumer Survey are used as indicators of inflation assessments, i.e. valuations concerning the past inflation, and of inflation expectations. These data are available monthly since October 1995. In the Consumer Survey consumers state the inflation rate as a direct percentage change from the previous year's corresponding month. By analysing the inflation assessments we can first evaluate how precisely consumers know the current inflation situation. The actual inflation is commonly measured by means of Statistics Finland's Consumer Price Index (CPI), so in principle the estimates measure the annual change in consumer prices, which is widely in the public eye, too. However, we also study whether some other measure of inflation, such as the harmonised CPI (HICP), underlying (core) inflation or median CPI would give a closer relationship with the reported inflation estimates.[1]

First we study how well the inflation assessment estimates match the actual inflation. In this context we can also examine the sensitivity of the assessments with respect to the inflation rates of different consumption expenditure groups. Compared with the real consumption weights, consumers may adopt a divergent attitude towards the categorical inflation rates, i.e. familiar or frequently bought consumption items, such as foodstuffs or petrol, may be over-represented in consumers' thoughts. This phenomenon may partly explain why inflation assessments have diverted from the measured inflation in a number of the eurozone countries from the beginning of 2002. The changeover to euro raised the perceived inflation in many eurocountries, including Finland, while at the same time expectations concerning the rate of inflation in twelve months' time declined significantly, which clearly calls for an interpretation and explanation.

As a second step we study whether consumers can forecast the forthcoming inflation with any accuracy. This is not an easy task, since inflation is widely known to be close to a random walk process, i.e. probably containing a unit root, which implies that changes in inflation are unpredictable. If inflation is to any extent predictable, we are interested in how inflation expectations are formed. The accuracy of inflation forecasts is analysed by means of weak rationality regression tests, testing for bias and (linear) efficiency.

Finally, we will also carry out an analysis concerning the distribution moments of inflation expectations by using individual survey interview data. It is interesting to try to find out whether the uncertainty of inflation expectations has somehow changed over time and whether this has had any interesting consequences. We calculated the distribution parameters of the cross-sectional survey data samples and examined their variation and the predictive power of different distributional moments of

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[1] The underlying or the so-called core inflation measures the permanent component of inflation by excluding volatile energy and non-processed fresh food out of the inflation concept, therefore core inflation is usually measured as harmonised inflation (HICP) excluding unprocessed food and energy. Unprocessed food and energy prices are typically out of normal control since the prices of unprocessed food, such as vegetables are subject to climate conditions and lately also animal diseases that may affect price formation in a exogenous way. Energy prices are heavily affected by oil prices, which again are frequently influenced by Middle-East political turmoils and are hard to forecast.

inflation expectations on actual inflation. It is especially interesting to see whether the volatility, skewness or kurtosis of inflation expectations can give us any information about future inflation. A related study using skewness of CPI commodity group data has been conducted by Suvanto and Hukkinen (2001).

During the past decade a lot of attention has been paid to consumers' expectations because they have been noticed to contain important information on people's economic behaviour in the future. The expectations also possess predictive power concerning macro-economic phenomena, e.g. indebtedness, unemployment and inflation (e.g. Berg & Bergström, 1996, and Djerf & Takala, 1997). If inflation expectations carry information about future inflation, then monetary policy authorities should already react to rising inflation expectations to neutralise their self-fulfilling nature. This is quite obvious, because households make plans and decisions to purchase all the time on the commodity market.

2 Data description

2.1 About the consumer survey

Statistics Finland introduced the Consumer (Barometer) Survey in November 1987. From October 1995, the data have been collected monthly in accordance with a harmonised data collection method of the European Union (European Commission, 1997). The Consumer Survey examines Finnish consumers' evaluations and expectations on the general economic situation in Finland and on that of their own households (i.e. consumer sentiment). Furthermore, it also considers consumers' intentions to make purchases, save and raise loans.

Until December 1999, the data for the Consumer Survey were collected together with the data of the Labour Force Survey. Six rotating panels were then used in the Consumer Survey. The same person was asked the same questions three separate times at six-month intervals, and each month a third of the target persons were new. Statistics Finland's field interviewers conducted the telephone interviews around the country.

From January 2000 on, the Consumer Survey has had a totally new individual sample each month. All the interviews are now conducted from Statistics Finland's CATI Centre by about 35 interviewers. The target area is still the whole country, and the respondents represent the 15 to 74-year-old population in Finland, according to age, gender, region and native language. [2] The change in the data collection method has had some effect on the results of the survey (Kangassalo and Heiskanen,

[2] Data collection for the Consumer Survey takes place mainly during the first fortnight of each month, and the results are published on the last working day of the same month. The gross sample size of the Consumer Survey is 2,200 persons monthly. Systematic random sampling (SYS) is used to extract the sample from the updated Central Population Register. The sorting system of the sampling frame is based on geographical population density. Non-response being currently as high as 25 per cent, a little more than 1,600 persons usually respond to the survey each month.

2001), but it looks apparent that no clear change can be seen in the distributional moments of inflation assessments and expectations.

The results of the Consumer Survey are weighted up to the total population by means of sample weights. Weighting improves the accuracy of the data. The weights are established by using the probability of each observation to be included in the sample. Individual weights are computed by CALMAR software, so that the estimated marginal distributions of certain background variables (region, person's age group and gender) correspond to the marginal distributions in the whole population, i.e. the population structure.[3]

2.2 How the questions about inflation are asked in the consumer survey

There are four questions in the Finnish Consumer Survey that deal with price changes in the past and future. The two EU harmonised questions with answer categories precede the two percentage questions, so that the questions dealing with assessment come first and these are then followed by those about expectations. The questions about inflation assessment (past inflation) are:

EUp. *"Compared to 12 months ago, do you think consumer prices:"*

1 have risen a lot
2 have risen moderately
3 have risen slightly
4 have hardly changed
5 have fallen
9 don't know.

SFp. *"By how many per cent do you think consumer prices have changed during the past 12 months? Please give your answer at the accuracy of one decimal."*

Correspondingly, inflation expectations are asked with the following:

EUf. *"Compared to now, do you think that in the next 12 months:"*

1 prices will increase more rapidly
2 prices will increase at the same rate
3 prices will increase at a slower rate
4 prices will stay about the same
5 prices will fall

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[3] Weighting generally has only a minor effect on the actual values of the sentiment scales. There are several reasons for this. First, the sample design (SYS) produces a self-weighting sample. Second, non-response has been relatively constant in different population groups and, therefore, has not caused considerable bias in the material. Third, questions concerning opinions and the extracted indicators have shown only a weak correlation with the variables used in weighting. Opinions tend to vary quite considerably in different population groups.

9 don't know.

SFf. *"By how many per cent do you think consumer prices will change during the next 12 months? Please give your answer at the accuracy of one decimal."*

In respect of both assessments and expectations, if the respondent chooses alternative 4 (no change in prices) in an EU question, the corresponding SF question is not asked and the system automatically records a zero against it. If alternative 6 (don't know) is chosen, the percentage question is skipped.[4] In general, no perfect harmony is required between assessments and expectations, but technically these four questions have worked reasonably well together. However, according to the interviewers' experiences, the questions on price changes, especially those on the per cent change and on the decimal point are among the most difficult ones on the questionnaire. Nevertheless, they very rarely totally interrupt the interviewing even though they are placed at the beginning of the questionnaire just after the opening questions about general economy and unemployment.

In the following we use as measures of inflation assessments and expectations the monthly observations in percentage points from the Finnish Consumer Survey between October 1995 and December 2002. The monthly cross-sectional data sets were available as well. The monthly number of respondents varied between 1,485 and 2,095.

Consequently, the main aim is to measure the same concept of inflation that is published and generally known via media like newspapers, television, etc., so consumers are able to obtain information on this phenomenon almost free of charge. Yet it seems quite clear that only some consumers follow this information closely. However, it should be borne in mind that the actual inflation rate of the current month is not known at the time of the interview and that in practice consumers only observe direct the prices of a limited number of goods.

2.3 About the consumer price index

The consumer price index (CPI) is used below as the main measure for the actual inflation, instead of e.g. the harmonised or underlying inflation, because inflation expectations are probably mostly connected with the consumer price inflation published widely in the media. [5] Technically, we can justify choosing the CPI for this purpose by the fact that categorical price indices are available for the CPI. The 2000-based CPI contains 12 different consumption groups, every one of which gets a weight that corresponds to the value of the goods in the consumer's commodity basket. In fact, at the beginning of

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[4] There are also some consistency checks between the questions, e.g. if a minus signed assessment is given in the future percentage change question even though it has been previously stated that prices will increase, the system always gives a note about this contradiction and the respondents can change their answers although this is not obligatory. Large outliers are also excluded later as influencing the reported results.

[5] It is also possible and problematic that for our purposes consumers may think about the HICP inflation or some other measure of inflation calculated with the EU method. In practice, all consumers have their own comsumption bundles of goods and probably form their inflation assessments basing on these individual bundles.

our sample, the CPI was calculated with weights from base year 1990, and between 1998 and December 2001 the CPI was calculated and reported with 1995 weights. The CPI commodity groups and the weights for base year 2000 are presented in Table 1.

Table 1: CPI commodity groups and weights

CPI commodity groups and weights	Weights, % 2000	Weights, % 1995
01. Food and non-alcoholic beverages	13.83	15.76
02. Alcoholic beverages and tobacco	5.97	6.16
03. Clothing and footwear	4.99	4.60
04. Housing, water, electricity, gas and other fuels	19.48	22.10
05. Furnishing, household equipment and routine maintenance of the house	5.03	4.67
06. Health	4.29	4.12
07. Transport	15.51	13.58
08. Communication	3.48	2.21
09. Recreation and culture	12.41	11.93
10. Education	0.57	0.15
11. Restaurants and hotel	7.58	6.48
12. Miscellaneous goods and services	6.86	8.23

Source: Statistics Finland, Consumer Price Index

3 Basic analysis of inflation assessments and expectations

3.1 Inflation assessments

One starting point is how well consumers' valuations concerning the past inflation match the actual measured inflation. First of all, it should be noted that, on average, consumers seem to be able to assess the current inflation rate with certain accuracy, since the correlation is the highest between current inflation assessments and current inflation and not, for instance, the known inflation rate of the previous month. The inflation assessment figure is published at the end of the month, while the actual inflation rate of the previous month calculated by Statistics Finland is published in the middle of the following month.

Figure 1 shows that from the end of 1995 to June 1996 the consumer assessments of the CPI were negative while the actual CPI had already become positive. This negative period probably occurred partly because real inflation was still slightly negative in the last quarter of 1995. However, the actual reason may be the fast decline in food prices in Finland during 1995 due to increased competition as Finland joined the EU. This 10 per cent fall in food prices may have made consumers believe that the effects could extend to the rest of the economy as well (Figure 2). However, food only accounted for about 16 per cent of expenditure, so it cannot explain the entire bulk of the perceived deflation. No

decline of prices happened in other expenditure except for that on communication (weight 3.5), It was noticed rather soon that the fall in food prices did not continue, so also the assessment estimates became smoother, changed into positive and reached the level of actual inflation. Since then the shape and the level of the assessments corresponded fairly well with the experienced inflation for many years, i.e. consumers were able to assess the measured inflation quite accurately. Towards the end of the year 2000 and at the beginning of 2001 inflation in Finland accelerated to as high as four per cent, mostly due to higher oil (energy) and housing prices, but the assessment only followed this sluggishly. Since the adoption of the euro currency in January 2002, consumers' inflation assessment estimates have clearly exceeded the actual measured inflation rates. One plausible reason for this might be the inflation assessment's sensitivity to inflation in services and other menu-list price changes.

Figure 1 tells us that something very exceptional has happened during the changeover to euro in Finland among the euro countries. Even though consumers have been surely informed by newspapers and the media that inflation was not greatly affected by the changeover, consumers do not seem to believe it or they only pay attention to some particular items of the CPI. According to surveys conducted by the Consumer Research Institute the price awareness of consumers has not deteriorated significantly because of the euro changeover.[6] Thus, this phenomenon seems to be at least partly psychological. Price increases have been accused of having arisen from the changeover to euro, although prices for goods have been clearly marked in both national currencies and euros. The price decreases that have also occurred have been argued to have been caused by other reasons. For instance, the most clearly observed price decreases that have been seen in fast food (mainly hamburgers) have been understood to have happened as a consequence of competition, not because of the changeover.

The introduction of the euro as the payment instrument did change the pricing habits of service producers, since 80 per cent of service prices are currently being rounded to even zero cent prices. It should also be noted that Finland was the only country that did not issue the smallest one and two cent euro coins into circulation. Prices were rounded to 5 cent because of this, which also increased the number of roundings in prices. During the Finnish markka period these roundings were used much less. This effect could be interpreted partly as natural menu-cost pricing behaviour if it turns out that the current price level will prevail for a longer time than usual. This is probably also the way consumers see the phenomenon since inflation expectations have declined at the same moment as past inflation assessments have increased.

However, there have to be also other reasons for this kind of "common misperception". A quite natural explanation arises from the fact that the measured consumer price inflation (CPI) has a bundle of goods that represent total aggregate consumer expenditure weights, while consumers typically make inflation assessments from a narrower perspective. For instance, falls in housing costs due to a decline in interest rates might not be regarded as lower inflation, while a rise in petrol prices will surely be registered as rise in inflation. The familiarity of prices is also certain to affect greatly the perceived rate of inflation. At the beginning of 2002, the prices of unprocessed food (fresh vegetables and meat) increased significantly throughout the euroarea, which was probably also related to the introduction of the euro, although the actual connection was weak.

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[6] Kuluttajatutkimuskeskus (Consumer Research Institute)

Table 2 tests for evidence about the consumption items that affect most the inflation assessment. According to the performed regression analysis, inflation assessment is significantly influenced by food and beverages prices, housing costs, health expenditure prices, and restaurant and hotel service prices. Therefore, the results seem to indicate that consumer inflation assessment is clearly influenced by the prices on which consumers receive a lot of information daily. Basing on the regression analysis, the most important commodity group affecting past inflation assessment is food and beverages prices. It is quite probable that consumers follow food prices closely while making their daily shopping. The same applies to restaurant and service prices. The importance of housing costs might also relate to their large share of the total expenditure that is reported.

Another feature already mentioned in connection with the changeover to euro has been the price awareness of consumers. Price increases more often happen at the shift of the year, and it seems likely that at least temporarily price changes were looked at more closely in this special case of change in currency. It is clear that altogether more prices were changed than normally due to the euro changeover. This seems also clear while comparing the CPI with the median inflation that had been close to each other from beginning of 2002 (Figure 3).[7] Therefore, it may be that the few increases were thought to indicate even higher inflation than was actually measured by their consumption expenditure weights.

In close relation to this, we also calculated the correlation of the inflation assessment series with various different measures of inflation. Although the correlation was significant with all the measured inflation concepts, there seems to be some support to the assumption that during the estimation period consumers' inflation assessment could measure the underlying or harmonised inflation more closely than the ordinary CPI inflation. This does not seem to be entirely surprising since, for instance, energy prices and especially oil prices are quite volatile and, therefore, hard to follow and difficult to forecast. The same applies largely to unprocessed food prices. In Finland, the CPI inflation measures the housing costs of owner-occupants from the basis of house prices and housing loan interest rates rather than from rents. Housing costs form a significant part of the services inflation that accounts for over 40 per cent of the HICP.

[7] Median inflation is calculated here as the 50th percentage point of the cumulative distribution of ordered frequency distribution of the price increases of 492 commodities (goods and services).

Figure 1.

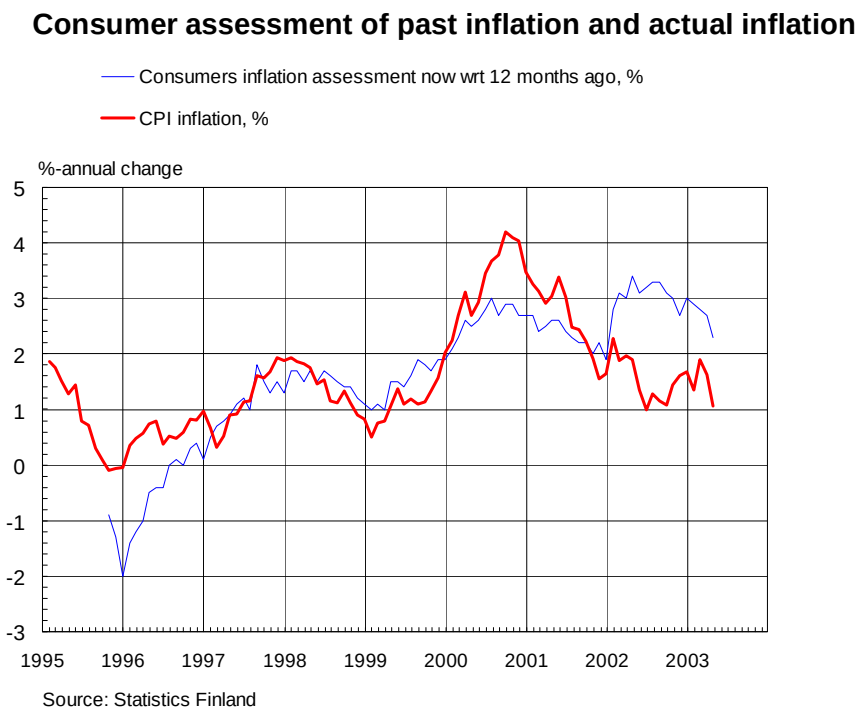

Figure 2.

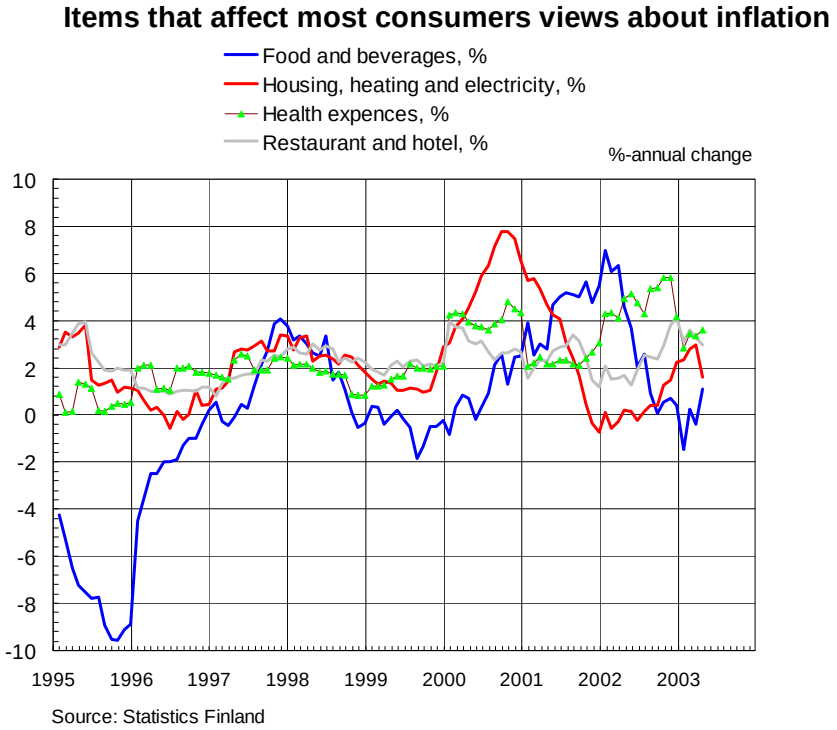

Table 2. Dependence of inflation assessments on commodity group inflation

Consumers inflation assessment regressed wrt CPI commodity groups
Estimation period: 1995/m10 - 2002/m12

Variable	Coefficient	Std.Error	t-value	Partial R^2	Instability test
CPI1g	0.22	0.032	6.85	0.385	0.35
CPI2g	-0.30	0.098	-3.10	0.114	0.77 **
CPI3g	-0.03	0.043	-0.63	0.005	0.55 *
CPI4g	0.10	0.038	2.59	0.082	0.09
CPI5g	0.24	0.108	2.27	0.064	0.38
CPI6g	0.42	0.057	7.44	0.424	0.64 *
CPI7g	0.06	0.063	0.93	0.011	0.64 *
CPI8g	0.03	0.025	1.13	0.017	0.87 **
CPI9g	-0.11	0.120	-0.92	0.011	0.20
CPI10g	-0.07	0.048	-1.40	0.026	0.24
CPI11g	0.29	0.086	3.43	0.135	0.24
CPI12g	-0.02	0.035	-0.68	0.006	0.06

Performance:
R^2 = 0.949 \σ = 0.489 DW = 0.735
Instability tests, variance: 0.284 joint: 5.02203**

Diagnostics:		Statistics	p-value	Significance
AR 1- 6 F(6, 69)	=	10.23	[0.0000]	**
ARCH 6 F(6, 63)	=	2.03	[0.0744]	
Normality $Chi^2(2)$	=	6.48	[0.0391]	*
Xi^2 F(24, 50)	=	3.92	[0.0000]	**
RESET F(1, 74)	=	10.77	[0.0016]	**

Correlations of assessment with various inflation concepts
Marked correlations are significant at p < .01000, T=81

Variable	KB5	CPIg	HICPg	CPIund	CPImed
KB5	1.00	0.72	0.75	0.82	0.75
CPIg	0.72	1.00	0.95	0.78	0.66
HICPg	0.75	0.95	1.00	0.79	0.71
CPIund	0.82	0.78	0.79	1.00	0.94
CPImed	0.75	0.66	0.71	0.94	1.00

Variables:

KB5 = Inflation assessment from past 12 months, %
CPIg = CPI inflation, %
HICPg = Harmonised CPI inflation, %
CPIund = Underlying CPI inflation, %
CPImed = CPI median inflation calculated from 492 goods and services inflation, %

Table 3. Dependence of inflation expectations on current commodity group inflation

Consumers inflation expectations regressed wrt CPI commodity groups
Estimation period: 1995/m10 - 2002/m12

Variable	Coefficient	Std.Error	t-value	Partial R^2	Instability test
CPI1g	0.08	0.018	4.20	0.191	0.1
CPI2g	0.48	0.056	8.50	0.491	0.08
CPI3g	0.01	0.025	0.23	0.001	0.43
CPI4g	0.12	0.022	5.48	0.286	0.10
CPI5g	0.14	0.062	2.23	0.062	0.09
CPI6g	-0.06	0.033	-1.83	0.043	0.05
CPI7g	-0.05	0.036	-1.26	0.021	0.21
CPI8g	-0.01	0.015	-0.57	0.004	0.16
CPI9g	0.06	0.069	0.93	0.012	0.03
CPI10g	-0.06	0.028	-2.17	0.059	0.05
CPI11g	0.37	0.049	7.49	0.428	0.09
CPI12g	0.01	0.020	0.47	0.003	0.12

Performance:
R^2 = 0.983 \σ = 0.282 DW = 1.36
Instability tests, variance: 0.470 joint: 2.919

Diagnostics:		Statistics	p-value	Significance
AR 1- 6 F(6, 69)	=	3.95	[0.0019]	**
ARCH 6 F(6, 63)	=	3.69	[0.0034]	**
Normality $Chi^2(2)$	=	20.51	[0.0000]	**
Xi^2 F(24, 50)	=	1.82	[0.0375]	*
RESET F(1, 74)	=	25.34	[0.0000]	**

Correlations of expectations with various inflation concepts
Marked correlations are significant at p < .01000, T = 81

Variable	KB6	CPIg	HICPg	CPIund	CPImed
KB6	1.00	0.89	0.85	0.74	0.69
CPIg	0.89	1.00	0.95	0.78	0.66
HICPg	0.85	0.95	1.00	0.79	0.71
CPIund	0.74	0.78	0.79	1.00	0.94
CPImed	0.69	0.66	0.71	0.94	1.00

Variables:

KB6 = Inflation expectations 12 months ahead, %
CPIg = CPI inflation, %
HICPg = Harmonised CPI inflation, %
CPIund = Underlying CPI inflation, %
CPImed = CPI median inflation calculated from 492 goods and services inflation, %

3.2 Inflation expectations and the changeover to euro

Forecasting inflation with reasonable precision is already in principle a difficult task, since the statistical process of the inflation percentage is quite close to a random walk process and inflation changes are, therefore, very unpredictable.[8] The intuitive interpretation of a random walk process in this case relates to the function of prices to equate and clear the demand and supply towards market equilibrium. On an efficient market, the price changes around the equilibrium point are also random. It is quite impossible to find any local or global trend from the published inflation rates. In the medium term it is to some extent possible to forecast inflation with some accuracy, for instance by means of money supply, economic activity, interest rates and other types of fundamentals. The inflation target of the ECB sets the upper limit for the HICP inflation to below 2 per cent. If consumers believe this is credible, it certainly should also affect inflation expectations and make them stationary in the long run. In practice, there seems to be some room for inflation forecasts based on the origins of inflation arising from different sources of costs increases and demand pressures affecting prices of commodity groups. These factors include demand indicators, wages and other cost variables that could be regarded as exogenous sources of inflation.

It is important to consider what information inflation expectations are based upon. As we saw from the strong correlation between inflation assessments and expectations, there is good ground to think that the information set behind these two evaluations is very similar (Figure 4). However, inflation expectations are also influenced by other background factors that are only related to forward-looking behaviour, such as interest rates. If inflation target is credible, interest rate changes influence forthcoming inflation. Since the beginning of the euro changeover, inflation expectations have declined drastically, while at the same time perceived inflation has increased and, even more surprisingly, stayed stubbornly high while actual inflation has become lower. This is certainly hard to interpret. During the changeover once-for-all price increases were made, which probably affected perceived inflation due to price raises in food, restaurant and some traffic expenses. As at the same time, inflation expectations declined significantly: these price raises were not expected to continue or be repeated within the forthcoming year. This decline was probably not so much an indication of expectations of a forthcoming slowdown in activity in the next 12 months but should rather be interpreted in terms of the cost factors that occurred in connection with the euro changeover.

Therefore, consumers have naturally found it difficult to estimate future inflation. Because of the nature that reminds the random walk process described above, the best inflation forecast in the short run is close to the current observed inflation. Thus, we can ask how accurately consumers' expectations of inflation follow the past assessments of inflation. As Figure 4 shows, these assessments and expectations clearly follow each other, even though there was obvious bias downwards in the inflation assessments from the end of 1995 until 1997 and, correspondingly, some bias upwards since January 2002. At a certain point of time, estimates of past inflation and expectations of future inflation are very similar. Most likely this relates heavily to the same information set behind both of these variables.

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[8] Although the autoregressive coefficient of the consumer price index does not differ significantly from unity, the order of integration with ML estimation is about 0.5 for the index level and for the annual change. A lot of discussion has been raised on whether the CPI inflation has a unit root and, therefore, the CPI index should be an I(2) -variable.

Figure 5 shows the expectations of actual inflation lagged by one year, i.e. to the point of time where inflation expectations are targeted. Actual inflation and inflation expectations followed each other reasonably well until the end of 1997. However, consumers subsequently undervalued the rise in consumer prices and, respectively, from May 1998 on, overestimated the rise in prices. Again, during the year 2000 the expectations proved to be far too low. During that time, measured inflation was greatly influenced by an increase in house prices that was not assumed to raise future housing costs that much.[9] High oil prices also raised the inflation contribution of energy prices to one percentage point during 2000.

When inflation expectations lag by one year to the right point of time they suppose to evaluate, they do not seem to be particularly accurate. However, the performed Granger causality tests indicate that inflation expectations do have certain predictive power over forthcoming inflation as shown below in Chapter 5. However, this leading indicator effect does not last for the entire forecast horizon. According to dynamic regressions the effect is at its best at around 4 to 6 months. Nevertheless, it is undeniably significant. Similar results were also found by Pursiainen (1999) using spectral analysis.

On the other hand we cannot think that there should be any dramatic contradiction between the expectations and the experienced inflation, because the changes in consumer prices are quite small and the forecast error between the expectations and the actual inflation is only about two percentage points at worst. Compared with the general level of inflation the difference is quite big, though. Furthermore, we have to state that the current low level of inflation probably makes the estimating task more difficult for consumers. When inflation is nearly zero, the directions of price changes may be hard to forecast, because there are typically movements to both directions in relative prices.

We can also clearly see from Figure 6 that inflation expectations follow the actual inflation at the time forecasts were made. Thus, inflation expectations are heavily affected by the recently experienced inflation due to the inertia of inflation and the random walk behaviour of the inflation process. In addition, as future contains inherent uncertainty, consumers cannot know the surprises forthcoming in the inflation process. The confidence bounds of the inflation process, i.e. the uncertainty in the forecast, grow very rapidly during just a few months.

From the beginning of the changeover to euro in January 2002, inflation assessments and expectations have diverted greatly. In addition to the other reasons already mentioned, it is likely that the large number of price changes due to the introduction of the euro currency affected this divergence. However, as we saw already when comparing past inflation and inflation assessments, the divergence was apparent.

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[9] In Finland, UK and Sweden house prices affect consumer price inflation direct as capital costs of owner-occupied housing is affected by a capital user cost calculations. Ordinary rents behave more smoothly and do not contribute inflation that much.

Figure 3.

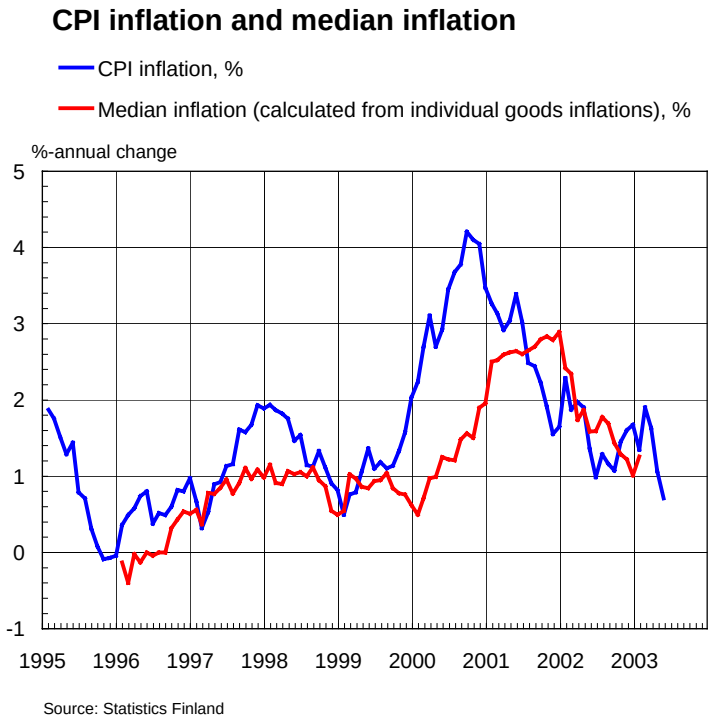


Figure 4.

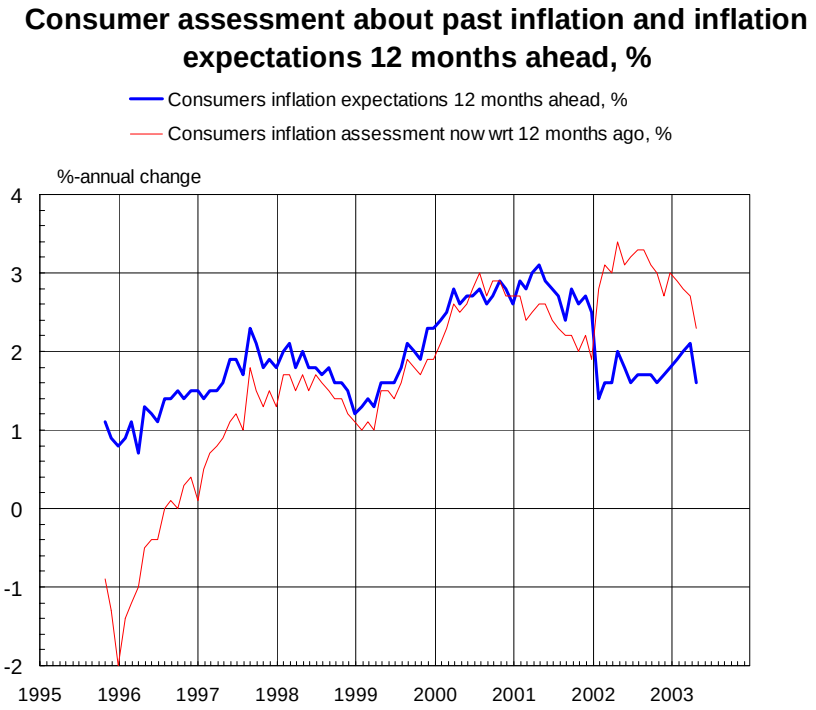


Figure 5.

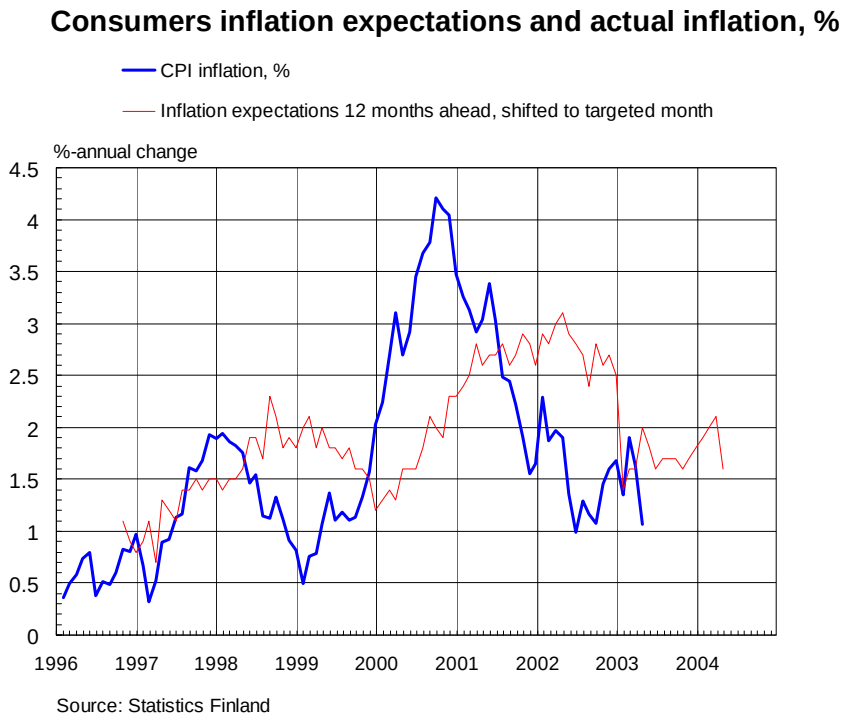
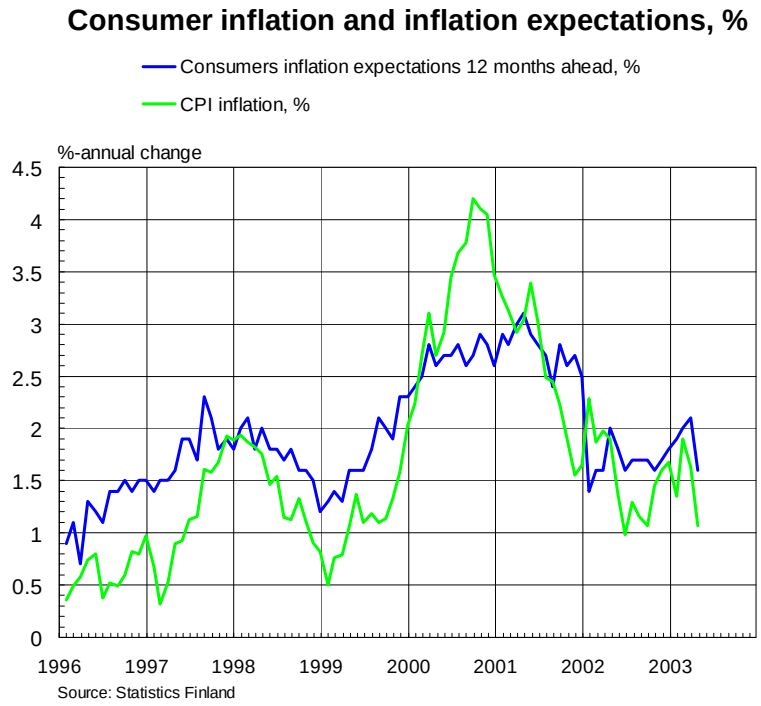


Figure 6.



4 Factors affecting inflation expectations

When we study consumers' expectations of inflation it is also interesting to examine which are the commodity groups, e.g. subgroups in CPI where price changes have the greatest influence on the formation of expectations. On the other hand, we are also interested in discovering the macro-economic variables that are reflected in people's estimates of past development of inflation. It is also possible to identify which macroeconomic variables have not been included in the forecast information set by regressing forecast errors with lags of these macroeconomic variables. However, this sort of reasoning does not exactly say whether it is possible to predict these variables. It simply says that these variables are missing from the information set or have not always been properly taken into account.

We may think that inflation assessments and expectations are largely affected by price changes in expenditure groups such as food and housing, on which a major part of income is consumed. It is also possible that households follow especially price trends in such commodity groups that are purchased almost daily. Consumer durables and dwellings are purchased more infrequently and knowledge about their price changes may not be accurate. Consumers also tend to follow the prices of certain groups of durables only when they are contemplating purchasing those in the near future and not otherwise. Therefore, current knowledge of these goods is not very widespread. One fact supporting this view is that information on the price development of restaurant services seems to receive over-emphasised significance.

It seems quite reasonable to conclude that the same factors that affect inflation assessments are also behind the formation of inflation expectations (table 3). As we have seen, few special commodity groups receive great deal of attention in the formulation of inflation assessments and expectations. From the beginning of the euro changeover in January 2002, inflation assessments and expectations have diverted quite radically.

4.1 Correlation of expectations with different inflation measures

We have seen that although consumers may be informed most by the published overall CPI inflation, they seem to react in an uneven manner to the different components of inflation. To be more specific, this is not necessarily very odd since in practice every consumer has a different expenditure bundle of himself or herself. Consumers also get new information on different consumption groups infrequently. Food and beverages are shopped almost daily, while few other items like durables or most services are bought seldom. Car owners certainly pay attention to petrol prices, while persons driving leased company cars do not necessarily consider them at all. The motives for monitoring prices may, thus, also differ. Therefore, it may be worthwhile to investigate different measures of inflation to see whether any differences can be seen in assessment and expectation reactions to these measures. [10]

[10] The ordinary CPI is the most common and widely used inflation measure supposed to measure inflation weighted with private consumption goods expenditure. In Finland, as well as in the UK and in Sweden, house prices and housing loan interest rates affect the housing costs of owner-occupier dwellers. The harmonised CPI (HICP) is the unified ECB measure of inflation for monetary policy purposes, which excludes owner-occupied housing expenditure (weight 6.8%), consumer credit interest payments

There could also be other reasons for different reactions to different consumption items. The transparency of different services varies, as many public services are calculated as expenditure based on imputed costs. Many public prices are changed only at specific times, like the beginning of the year, and if these services are used rarely they are not remembered so clearly. For instance, fresh food prices may vary due to crops and are, therefore, remembered more clearly. Some consumer goods, such as clothes or durables, are only bought during (seasonal) sales. Therefore, changes in their normal prices are not investigated frequently.

It is also not clear whether different measures of inflation correlate differently with the moment generating function behind inflation expectations. Table 4 shows the correlation between different inflation measures and the moments of inflation expectations. The first observation from these correlations is that the CPI and HICP inflations correlate heavily with each other, while core inflation and median inflation also seem to measure more closely the same inflation components. Second, with the central moments of expectations skewness seems to be quite instantaneously uncorrelated with inflation measures as well as with the other moments of expectation distribution. With distribution moments other than asymmetry (skewness) and with the mean of expectations, standard deviation and kurtosis may contain some information about forthcoming inflation, but this information is not particularly stable. It should also be noted that when inflation is low, kurtosis is high and distribution of expectations very concentrated, and vice versa when inflation is high.

Table 4. Correlations between inflation measures and moments of expectations

Variable	Correlations between inflation measures and expectation moments Marked correlations are significant at p < .01000, N=81							
	CPIg	HICPg	CPIund	CPImed	Mean	Stdev	Skewness	Kurtosis
CPIg	1.00	0.95	0.78	0.66	0.91	0.77	-0.18	-0.71
HICPg	0.95	1.00	0.79	0.71	0.87	0.82	-0.24	-0.69
CPIund	0.78	0.79	1.00	0.94	0.77	0.67	-0.15	-0.58
CPImed	0.66	0.71	0.94	1.00	0.73	0.64	-0.15	-0.56
Mean	0.91	0.87	0.77	0.73	1.00	0.80	-0.07	-0.81
Stdev	0.77	0.82	0.67	0.64	0.80	1.00	-0.44	-0.65
Skewness	-0.18	-0.24	-0.15	-0.15	-0.07	-0.44	1.00	0.09
Kurtosis	-0.71	-0.69	-0.58	-0.56	-0.81	-0.65	0.09	1.00

(weight 0.53%) and lottery games (weight 2.1%) and a few items of social and health expenditure. Core inflation is further reduced from the HICP excluding energy and unprocessed food prices.

4.2 Dynamic correlation between inflation and expectations

After a static correlation analysis, we must turn to dynamic correlations to investigate the forecasting properties of expectations. Dynamic relationship between inflation and inflation expectations can be analysed by investigating cross-correlation functions. Plotting the cross-correlation function between the CPI inflation and inflation expectations at the time they are published reveals that the highest correlation is attained at lag zero. Therefore, inflation expectations are heavily dependent upon the time the expectations are formed (Figure 7). Of course, it would be nice to have expectations that correlate strongly with exactly the one-year ahead inflation, but for various reasons, such as the autoregressive nature of the inflation process and cumulative innovations (or even white noise errors), this is in practice impossible. The relevant question therefore, is whether inflation expectations made this month contain any relevant information about future inflation, not necessarily for exactly 12 months, but for a shorter horizon. Therefore, we have to ask whether consumers' inflation expectations as a process tell anything important about the future inflation process.

The estimated cross-correlation function is clearly asymmetric and expectations are significantly correlated up to the 12th month as they were supposed to do. On the other hand, actual inflation only correlated with lagged expectations up to 9th lag. The same observation can be made from the different presentations in Figure 8.

The ordinary CPI inflation includes a few inflation components that are difficult to forecast, such as owner-occupied housing costs including house price effects and effects from interest rates, in addition to energy (oil) prices, so it is no wonder that consumers cannot predict these items. Qualitatively the same interpretation can be made even more clearly from the cross-correlation functions between inflation expectations and core inflation and also median inflation (Figures 9-10). Basing on these measures of inflation, inflation expectations correlate mostly with forthcoming inflation 4 to 5 months ahead. The trouble with cross-correlation function analysis is that the series under investigation have similar time series processes. Therefore, the series could either be pre-filtered and the cross-correlations of the resulting innovations could be studied, or a bivariate VAR system could be specified to study the predictive content of inflation expectations.

A bivariate VAR(4) model estimated for the CPI inflation and inflation expectations showed clearly the predicting power of expectations for the next few months (Table 5). A Wald test imposed on the lagged (lags 1- 4) expectation coefficients turns out to be very significant in indicating the explanatory power of expectations.

Figure 7. Cross-correlation function of CPI inflation and inflation expectations

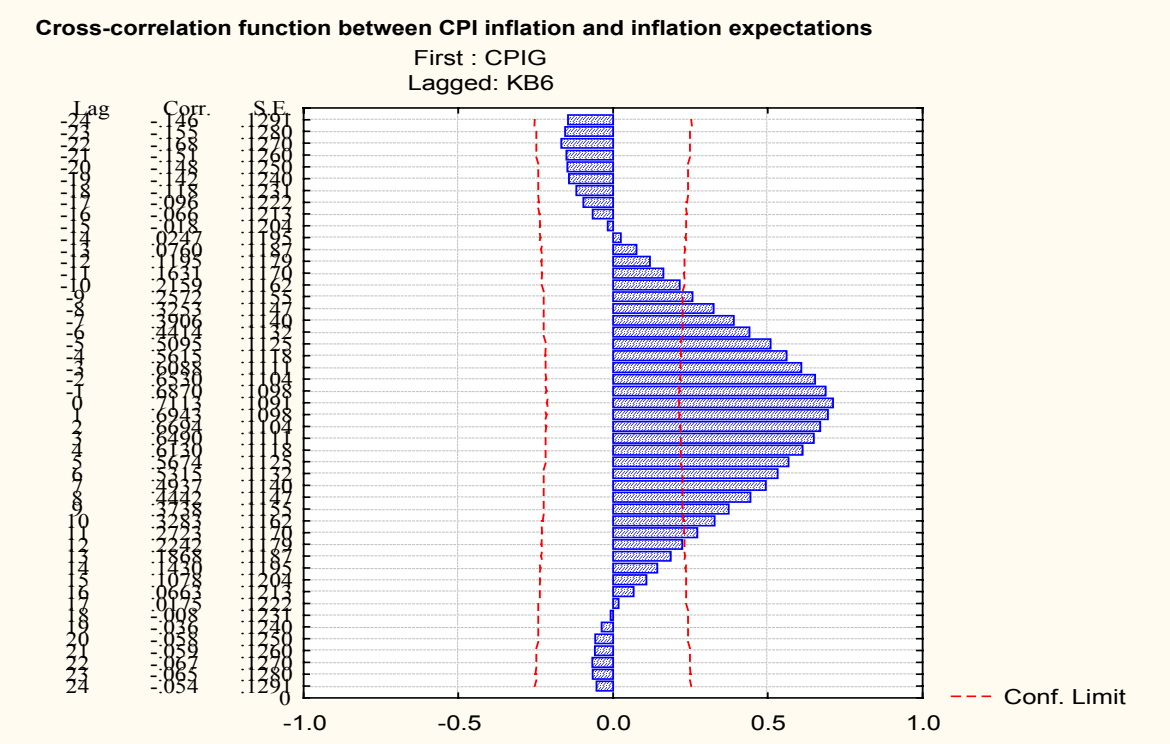


Figure 8. Cross-correlation function of CPI inflation and lagged inflation expectations

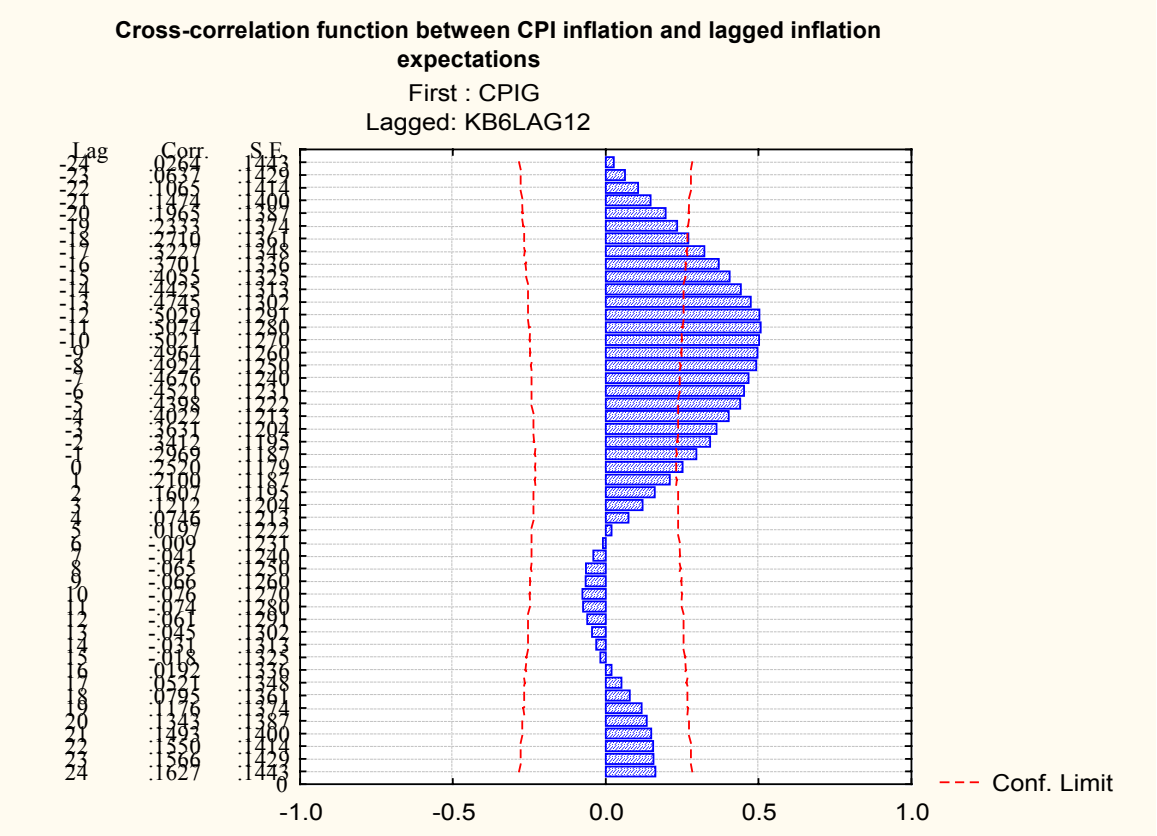


Figure 9. Cross-correlation function of core inflation and inflation expectations

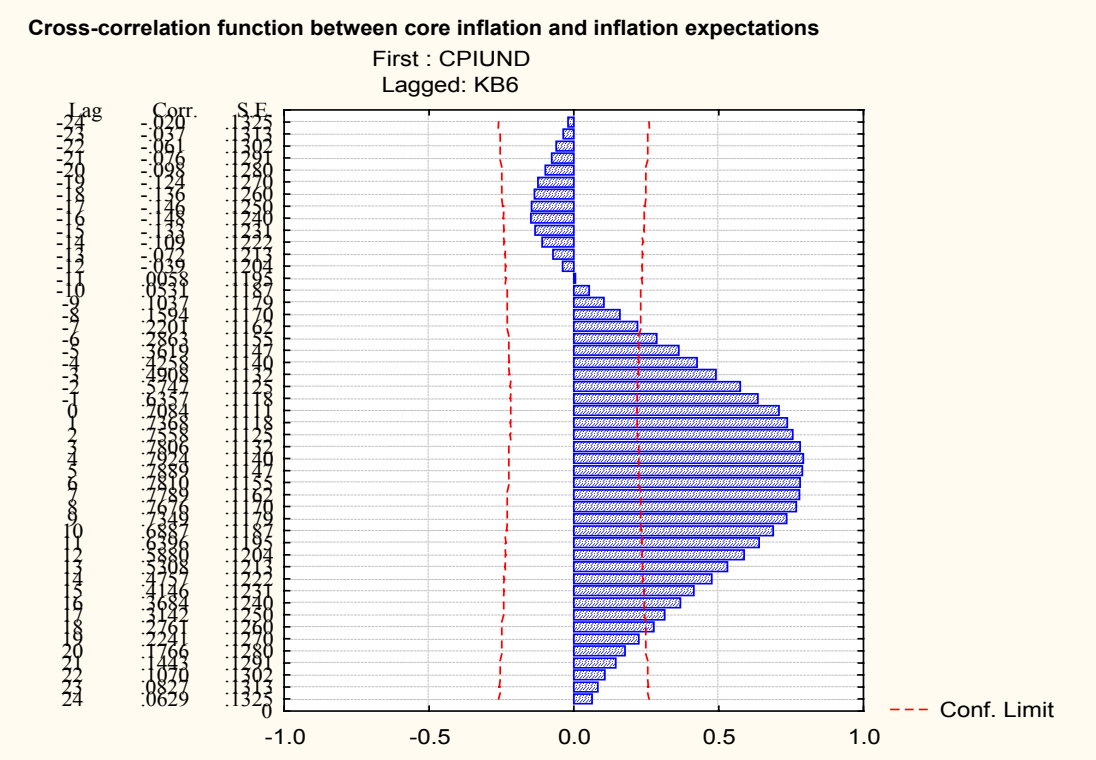


Figure 10. Cross-correlation function of median inflation and inflation expectations

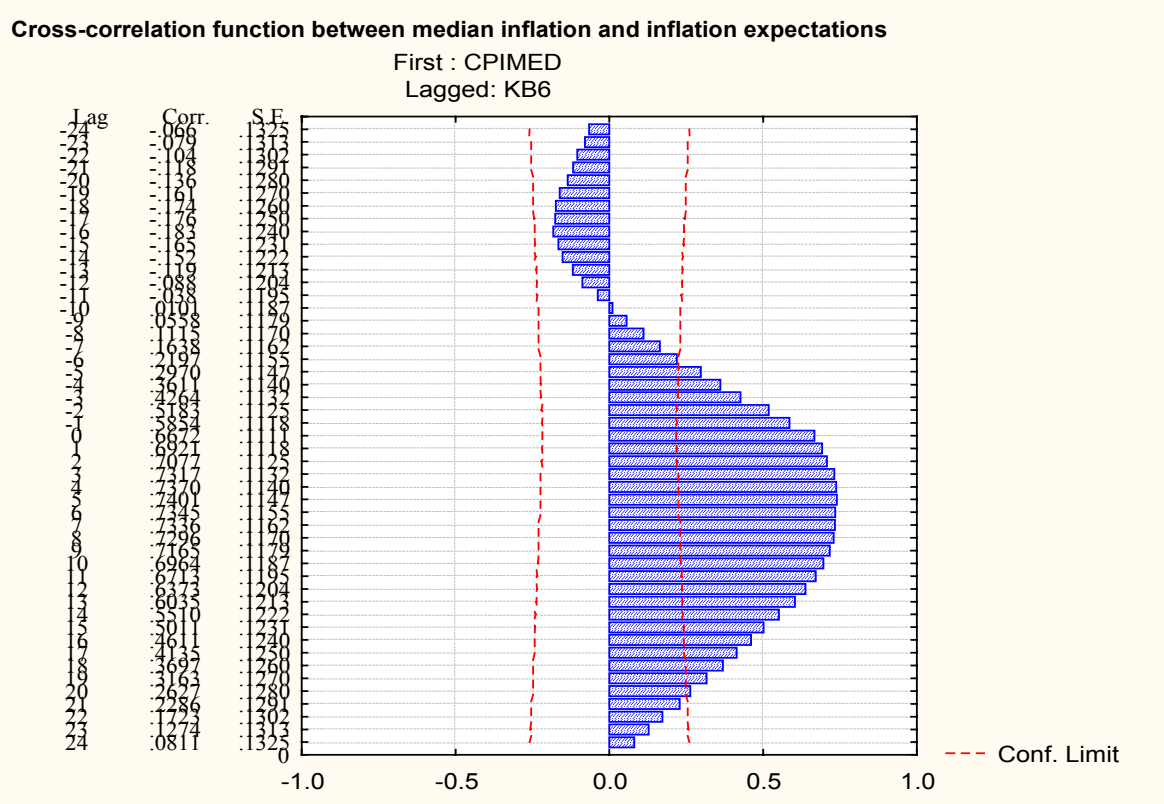


Table 5. Bivariate VAR(4) estimation for inflation and inflation expectations

Estimating the unrestricted reduced form by OLS
Estimation period: 1996/m2 - 2002/m12

URF Equation 1 for CPIg

Variable	Coefficient	t-value	t-prob	
CPIg_1	0.893	8.01	0.000	**
CPIg_2	-0.255	-1.76	0.082	
CPIg_3	0.287	1.97	0.053	
CPIg_4	-0.307	-2.87	0.005	**
KB6_1	0.238	1.84	0.070	
KB6_2	0.052	0.35	0.727	
KB6_3	0.312	2.11	0.038	*
KB6_4	-0.072	-0.54	0.592	
Constant	-0.394	-2.48	0.015	*

\sigma = 0.242855 RSS = 4.364428662

URF Equation 2 for KB6

Variable	Coefficient	t-value	t-prob	
CPIg_1	0.180	1.78	0.079	
CPIg_2	0.015	0.12	0.909	
CPIg_3	-0.009	-0.07	0.946	
CPIg_4	0.010	0.10	0.920	
KB6_1	0.562	4.78	0.000	**
KB6_2	0.114	0.85	0.396	
KB6_3	0.134	1.00	0.323	
KB6_4	-0.188	-1.55	0.126	
Constant	0.426	2.96	0.004	**

\sigma = 0.220636 RSS = 3.602349767

Diagnostics summary:

CPIg	:Portmanteau 9 lags=	10.42		
KB6	:Portmanteau 9 lags=	5.72		
CPIg	:AR 1- 5 F(5, 69) =	0.69	[0.6333]	
KB6	:AR 1- 5 F(5, 69) =	0.83	[0.5316]	
CPIg	:Normality Chi^2(2)=	1.06	[0.5889]	
KB6	:Normality Chi^2(2)=	22.64	[0.0000]	**
CPIg	:ARCH 5 F(5, 64) =	0.13	[0.9846]	
KB6	:ARCH 5 F(5, 64) =	0.41	[0.8381]	
CPIg	:Xi^2 F(16, 57) =	0.89	[0.5880]	
KB6	:Xi^2 F(16, 57) =	1.09	[0.3889]	
CPIg	:Xi*Xj F(44, 29) =	0.72	[0.8445]	
KB6	:Xi*Xj F(44, 29) =	3.30	[0.0006]	**

Testing for inflation expectations coefficients sum to zero in the CPI inflation equation:
Wald test for general restrictions
GenRes Chi^2(1) = 11.496 [0.0007] **

5 Can we forecast inflation with inflation expectations?

During the past couple of decades, inflation expectations have been taken increasingly into consideration in examinations of inflation processes in many countries. Furthermore, a lot of interest has been paid to the influence of different economic policy decisions, particularly interest rate policy, on the formation of inflation expectations. Several studies have proved that consumers' expectations on inflation do have predictive power over the inflation process, and there is an obvious connection between interest rate formation and the development of inflation expectations. Next, we will examine whether actual inflation is predictable with inflation expectations. In addition, we will try to find out the forecast horizon of the expectations and the strength of their predictive power in respect of inflation.

5.1 Granger causality tests on the time series

Although we have already analysed the cross-correlation functions between the Consumer Survey variables, it must be remembered that correlation in itself does not necessarily imply causation in any useful sense. Granger causality tests can be helpful in establishing the degree of usefulness of expectations in forecasting models. Granger causality tests pose the question of causation from the point of predictive ability. The question of whether expectations "Granger-cause" inflation is approached by looking at how much of the current inflation can be explained by past values of inflation and then seeing whether the addition of lagged values of inflation expectations can improve this predictive explanation.[11]

By using Granger causality tests we can also examine whether few other related variables are exogenous or endogenous with respect to some other variable, i.e. can variable y be explained by the history of variable x. Granger causality can also be two-sided, in which case past inflation will also predict future expectations. In this case we mainly aim to find out whether actual inflation can be forecast by the history of inflation expectations. If not, at least for this purpose inflation expectations would be useless to the forecasting of inflation.

Table 6 reveals few interesting findings about estimated Granger causality tests. First of all, as it is clear that recently observed inflation affects inflation expectations, it also turns out that even if consumers knew exactly the past inflation process, their inflation expectations include additional predictive contents over forthcoming inflation up to 12 months ahead at 5 per cent significance level.

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[11] Granger causality tests are performed by two linear regressions where an autoregressive model for inflation is complemented with the lagged values of the consumer barometer variable in the equation. Granger causality test is then based on an F-test for the lagged barometer response variables as a group. If this F-test is significant, we can conclude that the expectation variable reduces the forecast error of the inflation and is, therefore, useful at least in an autoregressive model. It should be borne in mind that Granger causality does not mean any strict philosophical relation between cause and effect, but merely that one variable can be helpful in predicting another. In some sense forecasting ability is a stronger property than pure explanatory coincidence, since it requires controllable predictability between variables if all the "third variable" links are eliminated from the framework. Granger non-causality, i.e. absence of feedback from the dependent variable back to the independent variable, has, therefore, an important role in econometric model building (see e.g. Hamilton, 1994).

Quite surprisingly this result holds true with the CPI inflation, but not with the median inflation. However, the kurtosis of expectations is useful for median inflation. Basing on performed tests, median inflation also appears to affect inflation expectations strongly. Another interesting observation is that the skewness of consumers' inflation expectations can predict actual inflation within 3 to 6 months. This is in accordance with the idea that arising inflationary pressures may show out in the right hand side tail of expectations even before it spreads more widely to the overall inflation.

The causality tests showed that actual inflation could be effectively foreseen from the history of inflation expectations. The test results depend on the number of lags used, but between the lags of 2 to 12 months inflation expectations are, on average, significant in predicting the CPI inflation. Although the accuracy of consumers' point estimates for inflation expectations does not always seem to be convincing, the expectations have predictive power for actual inflation according to the performed Granger causality tests. This emphasises the role of the expectations as a process.

One of the basic ideas we had in mind was that the kurtosis of inflation expectations may have some power in predicting inflation, as concentration of expectations might indicate reduced variation and uncertainty, and then slowing down of inflation pressures. The kurtosis seemed to have predicting power over the median inflation in the very near future, but evidence of this with the ordinary CPI inflation was rather weak.

Table 6 also presents a couple of test results related to short-term market interest rates and inflation variables. Short-term rates affect Finnish inflationary pressures very clearly before 1999, but the eurosystem interest rates have not been influenced by the Finnish inflation history. This finding is quite understandable, especially during the euro period after 1999. However, it is more difficult to interpret why consumers' inflation expectations are not affected by interest rates at all after 1999.

Producer prices seem to affect inflation expectations strongly according to these Granger causality tests. Of course, inflation expectations do not predict producer prices. According to the performed tests the relationship between the growth of GDP and inflation expectations is not particularly strong. There is only weak evidence that expectations may have some power in predicting GDP one year ahead.

We may also be interested in Granger causality between interest rates and inflation expectations as well as inflation assessments to see whether monetary policy reacts on inflation and whether monetary policy affects the forthcoming inflation rate. In particular, we may ask whether the interest policy of the ECB has affected inflation in Finland since the establishment of the monetary union at the beginning of 1999. Of course, interest policy is not activated for Finnish inflation purposes (only), but we could expect that interest rates might also affect domestic inflation pressures. Table 7 presents additional evidence that the interest rate effect of the short-term rate (3 month Helibor/Euribor rate) on inflation expectations may be different before and after the fixing of the exchange rate to euro and during the changeover from national monetary policy to ECB interest rate policy. Using the period 1995/m10 to 1998/m12 it is the case that higher interest rate reduces inflation expectations during the next 6 months, while from beginning of 1999 this relationship turns to positive. Even though the estimation period is very short, it may refer to change in the effectiveness of monetary policy to affect inflation expectations during the euro period.

Table 6. Granger causality tests for inflation and inflation expectations

Granger causality tests between inflation and inflation expectations
Estimation period: 1995/m10 - 2002/m9

		Granger causality test p-values				
Causation		Lag lenght				
From	To	1	2	3	6	12
KB6	CPIg	0.296	0.010	0.010	0.020	0.048
CPIg	KB6	0.001	0.056	0.204	0.297	0.069
KB6	CPImedian	0.690	0.438	0.096	0.124	0.636
CPImedian	KB6	0.004	0.007	0.014	0.161	0.124
SKEWNESS	CPIg	0.723	0.856	0.005	0.016	0.350
CPIg	SKEWNESS	0.220	0.572	0.522	0.162	0.542
KURTOSIS	CPIg	0.296	0.279	0.059	0.183	0.227
CPIg	KURTOSIS	0.001	0.009	0.022	0.146	0.443
KURTOSIS	CPImedian	0.003	0.002	0.023	0.151	0.112
CPImedian	KURTOSIS	0.112	0.615	0.637	0.590	0.291
EHEL3	CPIg	0.563	0.035	0.017	0.034	0.019
CPIg	EHEL3	0.439	0.141	0.522	0.508	0.163
EHEL3	KB6	0.941	0.681	0.240	0.399	0.605
KB6	EHEL3	0.000	0.033	0.065	0.154	0.510
PRODPRI	KB6	0.006	0.015	0.017	0.016	0.056
KB6	PRODPRI	0.631	0.466	0.569	0.078	0.115
GDP	KB6	0.244	0.294	0.313	0.801	0.574
KB6	GDP	0.369	0.197	0.108	0.120	0.049

Variables:

KB6 = Consumers inflation expectations for 12 months ahead, %
CPIg = Consumer price inflation (CPI), %
SKEWNESS = Skewness (3. moment) of the individual inflation expectations
KURTOSIS = Kurtosis (4. distribution moment - 3) of the individual inflation expectations
CPImedian = Median of CPI commodities inflation rates from individual goods (492 items) data, %
EHEL3 = Short-term (3 month) euribor market interest rates, %
GDP = GDP monthly indicator (Statistics Finland), %-annual growth
PRODPRI = Producer prices in industry, %-annual change

Table 7. Interest effect on inflation expectations before euro and during euro

Before euro connection

```
Modelling KB6 by OLS
Estimation period: 1995/m10 - 1998/m12

Variable     Coefficient    Std.Error  t-value       JHCSE PartR^2 Instab
Constant          2.2055      0.23273    9.477     0.19273  0.7434   0.11
EHEL3M           0.87002      0.27970    3.111     0.27318  0.2379   0.10
EHEL3M_1         -1.0881      0.44152   -2.465     0.65897  0.1638   0.10
EHEL3M_2         0.67651      0.47541    1.423      1.0492  0.0613   0.10
EHEL3M_3        -0.24829      0.47457   -0.523     0.83000  0.0088   0.10
EHEL3M_4        0.050414      0.47921    0.105     0.84968  0.0004   0.10
EHEL3M_5       -0.058663      0.44186   -0.133     0.92261  0.0006   0.09
EHEL3M_6        -0.34037      0.22055   -1.543     0.46193  0.0713   0.09

R^2 = 0.824  F(7,31) = 20.742 [0.0000]  \σ = 0.176908  DW = 1.68

Residual diagnostics:
AR 1- 3 F( 3, 28) =     0.526 [0.6681]
ARCH 3  F( 3, 25) =     0.204 [0.8930]
Normality Chi^2(2)=     3.329 [0.1892]
Xi^2    F(14, 16) =     0.331 [0.9781]
RESET   F( 1, 30) =     4.248 [0.0480] *

Solved Static Long Run equation
         KB6 =    +2.206              -0.1385 EHEL3M
(SE)              (0.233)             (0.0666)

Test for restricting the interest rate coefficient to zero:
WALD test Chi^2(1) = 4.3284 [0.0375] *
```

During euro period

```
Modelling KB6 by OLS
Estimation period: 1999/m1 - 2002/m12

Variable     Coefficient    Std.Error  t-value       JHCSE PartR^2 Instab
Constant         0.12657      0.31528    0.401     0.36138  0.0040   0.47
EHEL3M           0.48284      0.34608    1.395     0.31381  0.0464   0.41
EHEL3M_1      -0.0094226      0.59242   -0.016     0.58233  0.0000   0.38
EHEL3M_2        0.065941      0.59848    0.110     0.69404  0.0003   0.35
EHEL3M_3        0.028747      0.60081    0.048     0.83478  0.0001   0.33
EHEL3M_4       -0.016536      0.59938   -0.028     0.96617  0.0000   0.32
EHEL3M_5         0.36340      0.58056    0.626     0.91417  0.0097   0.32
EHEL3M_6        -0.35372      0.34312   -1.031     0.48220  0.0259   0.32

R^2 = 0.656  F(7,40) = 10.915 [0.0000]  \σ = 0.350555  DW = 0.624

Residual diagnostics:
AR 1- 3 F( 3, 37) =    12.031 [0.0000] **
ARCH 3  F( 3, 34) =     4.163 [0.0129] *
Normality Chi^2(2)=     1.860 [0.3944]
Xi^2    F(14, 25) =     0.808 [0.6542]
Xi*Xj   F(35,  4) =     0.267 [0.9878]
RESET   F( 1, 39) =     0.103 [0.7496]

Solved Static Long Run equation (std. errors in parenthesis)
         KB6 =   +0.1266           + 0.5613 EHEL3M
(SE)             (0.315)            (0.083)

Test for restricting the interest rate coefficient to zero:
WALD test Chi^2(1) = 45.826 [0.0000] **
```

Variables: KB6 = inflation expectations (%), EHEL3M = Helibor/euribor 3 month market interest rate (%)

5.2 Testing for weak rationality of inflation expectations

Lagged values of inflation form the benchmark information set for both expectations and the actual inflation data generating process. From forecast errors between lagged (12 months) expectations and actual inflation we may analyse whether expectations are inefficient and insufficient with respect to what actually happened. This weak rationality of inflation expectations can be tested by means of a simple regression model as suggested originally by Mincer and Zarnowitz (1969) and recently applied by Forsells and Kenny (2002). This regression uses actual inflation as the dependent variable which is regressed with the expectation series lagged 12 months to the period it intends to forecast

$$\pi_t = \alpha + \beta\pi^e_{t|t-12} + u_t,$$

where π_t is the observed inflation measure in month t and $\pi^e_{t|t-12}$ is the inflation expectation made 12 months ago for that month. The joint null hypothesis for weak rationality is H_o: (α, β) = (0,1). If the null hypothesis is rejected, expectations are not linearly unbiased or weakly rational. The constant measures the unbiasedness in the mean of expectations and β measures the linear efficiency of expectations to forecast variation in inflation. Since the constant and the regression coefficient are in this case negatively correlated, the null hypothesis must be tested as a joint hypothesis e.g. with a F-test. [12]

Table 8 shows the results of the weak rationality tests. It can be seen that inflation expectations have been biased downwards for forecasting the CPI or HICP one year ahead, mostly due to unexpected rises in energy and housing prices in Finland during 2000. As parameter β is well below unity, we conclude that expectations are somewhat inefficient in measuring variance in the actual measured inflation, the CPI and HICP. However, it should be remembered that the variance of inflation expectations should always be smaller than the variance of actual inflation, since the error variance is always non-negative and the following identity would hold true:

$$Var(\pi_t) = Var(\pi^e_{t|t-12}) + Var(u_t), \text{ where } Var(u_t) \geq 0.$$

Consumers' inflation expectations have followed more closely the path of underlying and median inflations, which can be seen also from the regression results. The F-test does not reject the weak rationality of expectations with respect to these measures of inflation. The same can also be seen clearly from the graphs comparing expectations with these measures (Figures 11 and 12). We also tested the efficiency of inflation expectations by means of the following equation:

$$\pi_t - \pi^e_{t|t-12} = \delta + \gamma\Omega_{t-12} + u_t,$$

---

[12] The correlation between the regression coefficients is in this case negative as the covariance can be represented as $Cov\ (\alpha, \beta) = -\bar{\pi}^e_t * Var\ (\beta)$ where $\bar{\pi}$ is the mean of the forecast. The standard deviation of the expectations was .62, while the standard deviation of the actual inflation was .85 between 1996/m10 and 2002/m9, so in this sense the expectations were more conservative than the variance of the actual inflation.

where Ω_{t-12} indicates the macroeconomic information available at the time (t-12) the expectations were formed (see Forsells and Kenny, 2002). Therefore, we cannot use any information that has appeared after the time expectations were formed.[13] As already discussed, it would be partly misplaced to test the point-estimate forecast properties of inflation expectations exactly 12 months ahead if we think of expectations as a process. In fact, we are more interested in testing whether a dynamic model specified to forecast inflation would be helped by using inflation expectations in addition to other leading indicators. It is not very surprising that the mean of inflation expectations is rather close to the mean of actual inflation. What seems to be a more prominent feature in expectations is their small variance in comparison to the volatility of actual inflation. This conservatism would be rational if inflation process were to be stationary and the forecast horizon long.

The results from this type of efficiency test can be seen from Table 9, which shows that, basically, consumers' inflation expectations do not use sufficiently all the information contained in the few macroeconomic variables affecting inflation, such as lagged values of earnings or producer and import prices. In the tests we used lags of between 12 and 17 months to account for the available information. With respect to GDP or unemployment rate, the efficiency of inflation expectations seems to hold true according to this test. However, consumers' inflation expectations seem to account for all the information related to the real economy, since output gap was not efficiently utilised in the expectations.

[13] Of course; we have started to use the lags from 12 although in practice this has not been readily available direct for the current month from statistics on e.g. GDP. With many indicators, publishing takes a few months although the economic activity has been observable to the consumers.

Figure11.

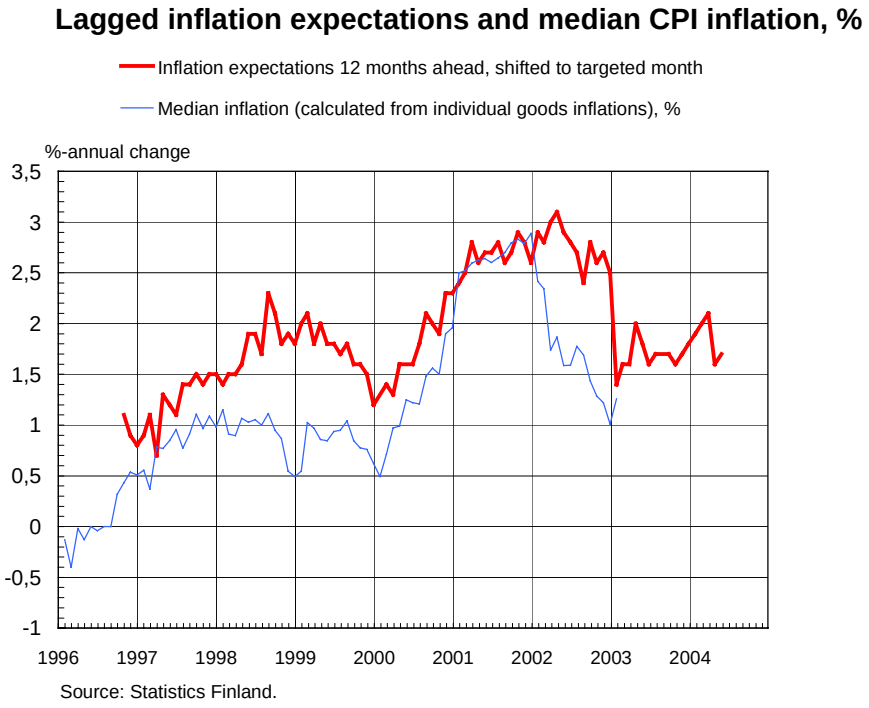

Figure 12.

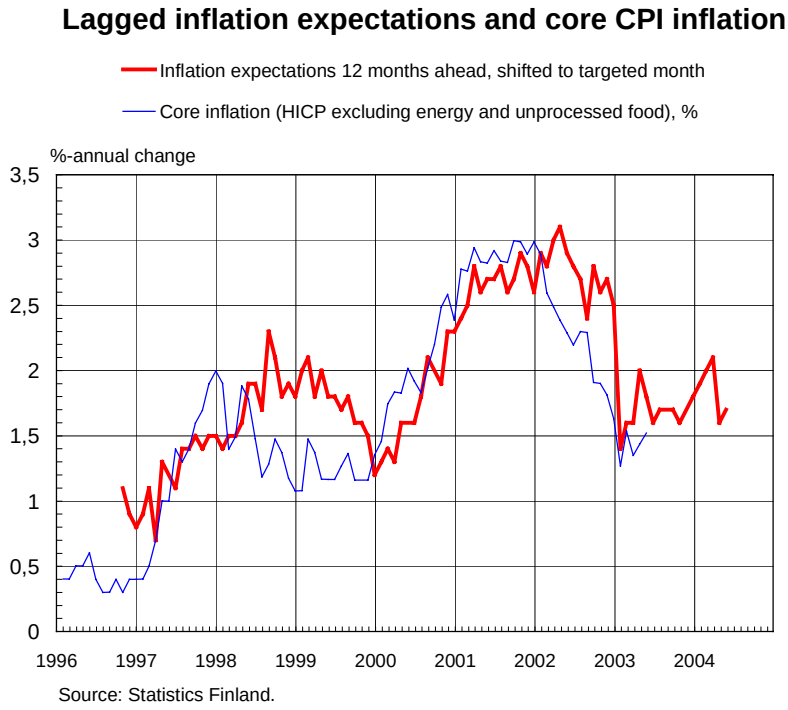

Table 8. Weak rationality tests for inflation expectations

Weak rationality regression tests for consumers inflation expectations (lagged 12 months)
with different measures of inflation, estimation period: 1996/m1 - 2002/m9

$$\pi_t = \alpha + \beta \pi^e_{t|t-12} + u_t$$

Null hypothesis: $\alpha = 0$ & $\beta = 1$ (t-values apart from null in parenthesis)

			F-test for null		P-values for diagnostic tests		
Inflation measure	α	β	p-value	R^2	DW	AR(5)	Normality
CPIg	0.86	0.48	0.0013**	0.12	0.14	.0000**	0.0029 **
	(2.75)	(3.36)					
HICPg	0.80	0.57	0.0027**	0.20	0.23	.0000**	0.2034
	(2.89)	(3.11)					
CPIund	-0.09	0.97	0.7262	0.67	0.39	.0000**	0.0139 *
	(-0.53)	(0.35)					
CPImed	-0.55	0.99	0.8634	0.70	0.46	.0000**	0.7605
	(-3.51)	(0.17)					

Variables:
CPIg = CPI inflation, %
HICPg = Harmonised CPI inflation, %
CPIund = Underlying (core) inflation, %
CPImed = Median CPI inflation, %

Table 9. The forecast-error regressed with lagged macroeconomic indicators

Expectations efficiency regressions wrt different explanatory variables
Dependent variable: Inflation forecast error = inflation - infl. expectation (made 12 months ago)
Estimation period: 1996/m10 - 2002/m8

Independent variable (lags 12 - 17 months)	F(1, 63) -test p-values
GDP, %	0.1655
Earnings, %	0.0184 *
Producer prices, %	0.0000 **
Output gap, %	0.0024 **
Import prices of consumer goods, %	0.0003 **
Industrial production, %	0.1275
Unemployment rate, %	0.7133

Wald test for linear restriction: $\beta_i = 0$, i = 1, ...,6

6 Error-correction model for inflation

Like Forsells and Kenny (2002), we also tested for cointegration between actual inflation and inflation expectations and checked the cointegration properties of these variables. If forecasts are unbiased and linearly efficient estimators for inflation, it is quite natural to think that they would also be cointegrated. Basing on linear efficiency, the cointegration relationship should be homogenous to degree zero, i.e. the cointegration vector should fulfil restriction $[\beta_1, \beta_2] = [1, -1]$ (see Table 10). In addition in this case, the cointegrated variables should have identical means (unbiasedness), so the cointegration relationship should not even include an unrestricted constant. As we have seen in the performed causality tests, current inflation expectations "Granger cause" future observed inflation, which indicates that the causality runs at least in this direction and future changes in inflation can be seen beforehand in expectations.[14] If cointegration is confirmed, then the estimated error-correction term can also be used to forecast inflation. Here we have used core inflation as the measure of inflation, as it does not contain oil prices and unprocessed food prices, which are hard to forecast and sensitive to disturbances.

As a preliminary stage for testing cointegration, the order of cointegration must be tested for the variables included, as cointegration might hold true only between integrated variables. Cointegration in this case implies that inflation should be integrated of order one. This would also imply that the CPI is a I(2)-variable. Appendix 2 shows that although our sample is relatively short we cannot reject the null hypothesis of a unit root in any of the inflation measures or in the inflation expectations and assessments. However, there are also grounds for arguing that the annual inflation rate should be already stationary as it is the target for the ECB monetary policy and should be kept below 2 per cent within the euro area. Of course, Finnish inflation can divert for a while from the overall target, but not permanently without loss of price competitiveness, for example.

Table 10 shows the estimated cointegration tests for the bivariate VAR(4) system. The optimal lag order was tested to be sufficient with 4 lags, and residuals were quite close to white noise.[15] The Johansen cointegration tests performed do not reject the possibility of having a cointegration relationship between core inflation and consumers' inflation expectations. Cointegration can be found basing on both maximum eigenvalue and trace tests at the 5 % significance level. In addition, the restriction of homogeneity in the long run coefficients ($\beta_1 + \beta_2 = 0$) cannot be rejected and can, therefore, be imposed on the error-correction model specification. The error-correction term calculated from the restricted cointegration relationship was then used in the EC-model for core inflation with a month's lag, which also

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[14] It should be emphasised that expectations are not assumed to "cause" inflation in the philosophical sense, but just indicate inflationary pressures. The self-fulfilling nature of expectations is not considered in Granger causality tests. Cointegration was studied using the expectations at the time they were asked about.

[15] Only minor autocorrelation was left in the longer lags, e.g. around 12 months, hinting at minor overdifferencing. The autocorrelation and partial autocorrelation functions were also quite similar for the CPI inflation and for inflation expectations. The diagnostics of the system equations is satisfactory apart from the outliers indicating a level shift in the normality test due to the collapse in inflation expectations after the euro changeover in January 2002.

showed to be significant. The estimated model implies that few lagged inflation expectations can be useful in forecasting the core inflation. It should also be noted that the simultaneous inflation expectation, which is published about two weeks before actual inflation, can already be used in forecasting. The same applies to the error-correction terms, i.e. here the simple difference between inflation expectations and core inflation can be used successfully in forecasting core inflation.[16] Similarly, it should be noted that the diagnostics of the estimated error-correction model do not show any deficiencies apart from the outliers arising from the level shift downwards in inflation expectations starting from January 2002. The results differ considerably from those of Kenny and Forsells (2002), who found that actual inflation is not strongly influenced by expectations. Our finding is quite the opposite, indicating that inflation may even adjust to expectations. To make further interpretations we should also have a mechanism that makes actual inflation adjust towards expectations. However, this result may also be due to the fact that expectations are conservative and closer to the 2 per cent mean, which is the ECB target for inflation. The error-correction coefficient (-0.08) does not show very clear convergence to equilibrium.

A growing number of countries have anchored their monetary policy to a strict inflation target. This nominal anchor policy has clearly stabilised monetary conditions and also affected consumers' inflation expectations. Monetary policy cannot control forthcoming inflation precision, therefore, inflation will vary around the targeted level. If a central bank does not succeed in anchoring inflation expectations, it is forced to pursue a more restrictive monetary policy to nail down the accelerating inflation that is linked to self-fulfilling expectations.

Forecasts are usually conditional expectations based on a set of information on the economic mechanism that is thought to generate the observed phenomenon. The future is rarely exactly similar to the past, which leads to forecast errors as we try to imitate the future with the observed past. Surprises will always happen, but the past and economic reasoning about motivations behind observations is the only basis for forecasting.

Hendry and Clements (2001) note that since unpredictable events happen in the future, the future will inherently be more uncertain than the past. However, our knowledge about the past is not perfect even though it has already happened. This argument applies to inflation as well. We do not know all the economic sources behind inflation even when we have detailed information about the prices of goods and services. We cannot separate the exact demand and supply factors that affect inflation or identify accurately the economic background variables, such as labour costs, raw material or import price effects, demand pressure or other influential factors. There is natural asymmetry when we are considering inflation expectations and inflation assessments.

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[16] The same testing procedure was also applied to the ordinary CPI and inflation expectations, where qualitatively similar conclusions could be made.

Table 10. Cointegration tests between core inflation and inflation expectations

Estimation period: 1996/m5 - 2002/m10, VAR(4) -model

```
                      Max eigenvalue test             Trace test
Ho:rank=p  Eigenvalue   -Tlog(1-\mu)  T-nm      95%   -T\Sum log(.)    T-nm     95%
 p =  0       0.156       13.23*     11.87*    11.4      14.39*       12.92*   12.5
 p ≤  1       0.014        1.16       1.05      3.8       1.16         1.05     3.8

standardized \beta' eigenvectors [β1, β2]
       CPIund         KB6
       1.0000     -0.9468
      -6.6610      1.0000

LR-test for homogeneity restriction [β1, β2] = [1, -1]
LR-test, rank=1: χ2(1) = 0.50528 [0.4772]

standardized \alpha coefficients
 CPIund    -0.13795   -0.00057
 KB6       -0.08940    0.00230
```

System diagnostics:

```
CPIund  :Portmanteau  9 lags=   6.5334
KB6     :Portmanteau  9 lags=   5.7787
CPIund  :AR 1- 5 F( 5, 65) =    1.7262  [0.1411]
KB6     :AR 1- 5 F( 5, 65) =    0.8551  [0.5160]
CPIund  :Normality Chi^2(2)=    2.1329  [0.3442]
KB6     :Normality Chi^2(2)=   40.7150  [0.0000] ** (level change in January 2002)
CPIund  :ARCH 5  F( 5, 60) =    0.6669  [0.6500]
KB6     :ARCH 5  F( 5, 60) =    0.7925  [0.5592]
CPIund  :Xi^2    F(16, 53) =    0.6661  [0.8130]
KB6     :Xi^2    F(16, 53) =    1.4428  [0.1582]
CPIund  :Xi*Xj   F(44, 25) =    0.5777  [0.9452]
KB6     :Xi*Xj   F(44, 25) =    0.6354  [0.9074]
```

The estimated error-correction model for core inflation using inflation expectations and the error-correction term as explanatory variables:

```
Modelling dCPIund by OLS
Estimation period: 1996/m7 - 2002/m10

Variable        Coefficient    Std.Error  t-value      JHCSE  PartR^2 Instab
dKB6                0.13938     0.07887    1.767      0.06416  0.042   0.07
dKB6_4              0.15064     0.07723    1.950      0.06985  0.050   0.22
CRCPIundvec1_1     -0.07687     0.02936   -2.618      0.02761  0.086   0.09  ECT-term
dKB6_8              0.20412     0.07746    2.635      0.07506  0.088   0.22

R2 = 0.273  \σ = 0.155289  DW = 1.98
Instability tests, variance: 0.431 joint: 0.858
```

Regression diagnostics: **Test interpretation**

```
AR 1- 5 F( 5, 67) =     2.2826   [0.0561]    Autocorrelation
ARCH 5  F( 5, 62) =     0.7808   [0.5673]    ARCH-heteroscedasticity
Normality χ2(2)   =     2.5843   [0.2747]    Outliers
Xi2      F( 8,63)  =     0.6310   [0.7486]
Xi*Xj   F(14, 57) =     0.5774   [0.8714]    Functional form
RESET   F( 1, 71) =     1.7972   [0.1843]    Functional form
```

7 Using distribution moments in forecasting inflation

Before we carry out a statistical analysis of the cross-sectional data we will pay attention to the so-called outliers, as otherwise the results with respect to the mean and other distribution moments would be misleading. A significant amount of individual responses were clearly out of any reasonable range. For the Consumer Survey statistics all observations that are below -15 or exceed +15 are removed at Statistics Finland. This corresponds to about 3 times standard deviation, where the standard deviation is determined from monthly deviations without a significant amount of outliers. These outliers are removed from the data along with the “Don’t know” answers.

Examining the monthly distribution parameters reveals that the monthly distributions are commonly clearly asymmetric and gradually changing over time. Skewness and, in particular, kurtosis differ significantly from those of a normal distribution and are time-varying (Figure 13). Thus, the null-hypothesis of normal distribution is rejected in formal tests. It would be interesting to know whether the changes in the distribution moments calculated from the monthly surveys tell us something about future inflation. For instance, it would be plausible to assume that the skewness or kurtosis of inflation expectations could carry information concerning future inflation, e.g. if the kurtosis of inflation expectations increases then inflation expectations are more concentrated to the mean and actual inflation would be slowing down. On the other hand, if skewness increases this is usually related to thicker right hand tail in the distribution of expectations and to a greater number of observed accelerating commodity prices, therefore this may indicate increasing inflation expectations and inflation risk. A related idea was utilised by Suvanto and Hukkinen (2001) in using the skewness measure of the commodity price change distribution for indicating inflation pressures.

The monthly distributional parameters clearly show that the distributions of inflation expectations are asymmetric. The monthly distributions are clearly skewed to the right and are more concentrated than normal distributions. Kurtosis is also the most volatile of the distribution moments.

Table 11 shows the results from static regressions, where different measures of inflation are regressed on moments of inflation expectations. Naturally, the mean of expectations is always significant and skewness is also significant for the CPI and HICP, but higher skewness seems to indicate lower inflation, which is not what one would have expected (Figure 14). The standard deviation and the kurtosis of expectations do not indicate any strong relationship with the current inflation.

In Table 12, we test the dynamic relationship between inflation and expectations. The expectations have been shifted backwards to the point when they were made and 6 dynamic lags were then used to calculate the results. We first notice that the mean is significant for the CPI and HICP as well as for the core and median inflation. Furthermore, for the core inflation, skewness got significant coefficient, which did not appear for the other inflation measures. The volatility (standard deviation) nor kurtosis did not seem to be helpful for the forecasting of inflation measures. Extending the lag structure to 12 lags does not make the other distribution moments significant either, so the conclusion is that distribution moments apart from the mean (and the skewness weakly) do not seem to be powerful in forecasting inflation.

Establishment of the monetary union and the subsequent convergence in inflation rates must have also influenced the Finnish consumers’ expectations on inflation and interest rates. As we noticed above, the diminishing uncertainty concerning inflation should have reduced the variance of past inflation

estimates and partly of inflation expectations as well. This development may also reflect growing credibility of the inflation target.

An interesting feature in inflation assessments and expectations is their slight “asymmetry”. Already at the beginning until August 1996 consumers estimated that consumer prices had fallen from the previous year but, on the other hand, believed the prices would rise in the future (remember Figure 4). However, the assessments and expectations converge toward the end of 1997. Consumers’ valuations of the decline in prices were probably caused by the slight deflation at the end of 1995 and by the fall in food prices that followed EU membership. Thus, we can think that joining the EU distorted the consumers’ views on the decline of prices. When people realised that the prices had not fallen by as much as the media told them, for example, they changed their assessments of past price changes to the positive. However, the membership did not affect the expectations as strongly as it did with the assessments, because the expectations are forward looking. When the inflation assessments changed to the positive, the standard deviations of the expectations and assessments also converged.

Another interesting feature in the euro changeover was that assessments and expectations diverted so clearly from January 2002 onwards and no convergence has appeared so far since. One thing that happened in connection with the euro changeover was a large increase in the kurtosis of inflation expectations, although at the same time the mean of expectations collapsed. In fact, if the rise in the assessments were supposed to be based on a one-off upward change in prices due to the change of currency then according to expectations one year before the assessments should have collapsed in January 2003. However, this did not happen. Therefore, we have a problem in interpreting these responses. Since the changeover consumers have been told widely by the press on at least a couple of occasions that inflation did not accelerate significantly during the changeover. There has also not been any major revision in inflation expectations. Thus, we seem to face some sort of a puzzle in connecting survey results to the measured inflation.

Crevits et al. (2002) identified two main sources from the euro changeover that affect inflation, namely the costs and benefits related direct to the change of currency, such as cash handling costs, coin automat costs and the like. The other sources were more psychological, influencing through rounding effects, usually upwards, and through delayed price increases that had been waiting for the right moment.

The bias observed in the discrepancy between actual inflation and inflation assessments would suggest that consumers might persist making systematic forecasting errors while observing inflation. This would be quite difficult to interpret. The idea of an adaptive expectations mechanism would impose that consumers learn from their previous forecast errors. Of course, consumers do have serious problems in gathering price information about goods and services, but it would be interesting to see whether a systematic bias could persist for a long time.

Figure 13.

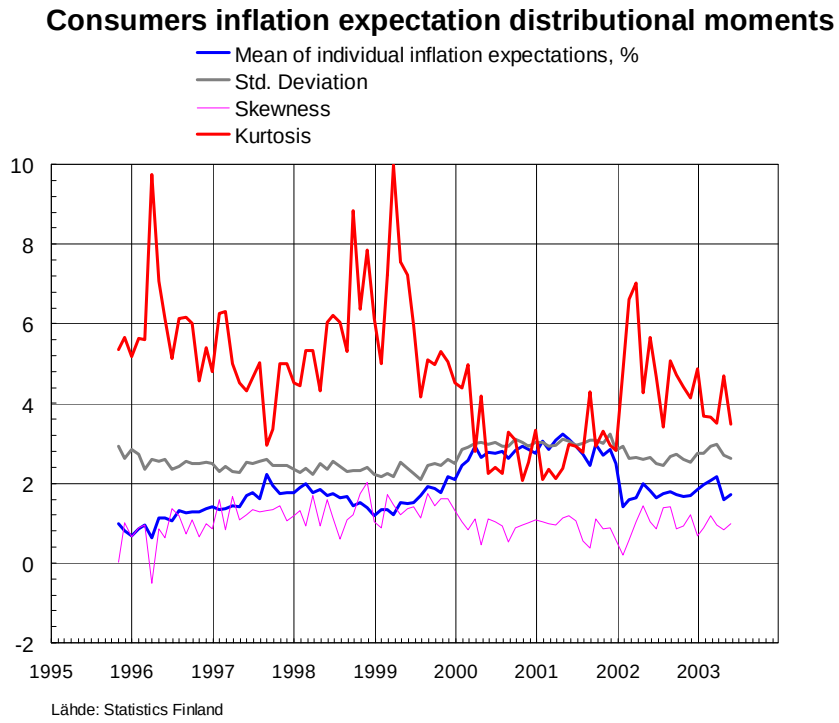

Figure 14.

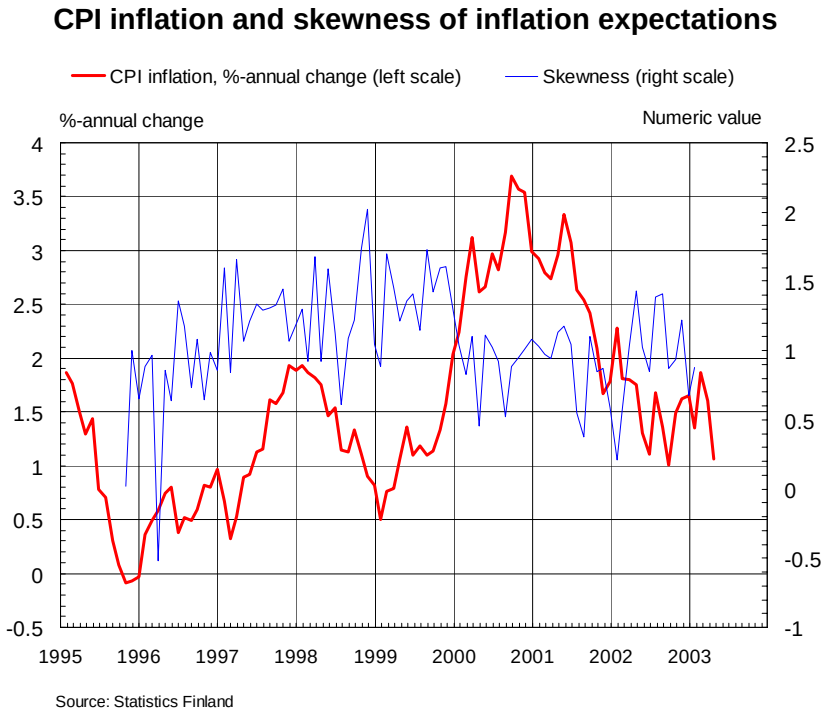

Table 11. Predictive power of inflation expectation moments

Predictive power of consumers inflation expectation moments
Estimation period: 1996/m1 - 2002/m12

Static regressions wrt each expectation moment
(t-values in parenthesis)

Dependent variable	Mean	Std. dev.	Skewness	Kurtosis	R^2	DW	Autocorr. test p-values AR(5)	
CPIg	1.42	-0.32	-0.37	0.03	0.96	1.09	0.0004	**
	(9.63)	(-2.03)	(-3.64)	(0.89)				
HICPg	0.98	0.15	-0.37	-0.01	0.97	0.96	0.0000	**
	(6.45)	(0.92)	(-3.43)	(-0.38)				
CPIund	1.08	-0.13	-0.25	0.04	0.92	0.26	0.0000	**
	(5.17)	(-0.59)	(-1.72)	(0.71)				
CPImed	0.98	-0.16	-0.28	0.01	0.85	0.20	0.0000	**
	(4.32)	(-0.68)	(-1.78)	(0.17)				

Variables:

CPIg = CPI inflation, %
HICPg = Harmonised CPI inflation, %
CPIund = Underlying (core) inflation, %
CPImed = Median CPI inflation, %

Mean = 1. moment of consumers' inflation expectations
Stdev = 2. moment of consumers' inflation expectations
Skewness = 3. moment of consumers' inflation expectations
Kurtosis = 4. moment of consumers' inflation expectations

Table 12. Dynamic regression on inflation expectations moments

Testing predictive power of consumers inflation expectation moments
Estimation period: 1996/m4 - 2002/m12

Dynamic regressions with 6 lags of each expectation moment
Solved static long-run equations (t-values in parenthesis)

Dependent variable	Mean	Std. dev.	Skewness	Kurtosis	R^2	DW	Autocorr. test p-values AR(5)
CPIg	1.38	-0.29	-0.02	-0.05	0.978	0.615	.0000**
	(5.28)	(1.13)	(0.07)	(0.59)			
HICPg	0.96	0.25	-0.53	-0.02	0.979	0.687	.0000**
	(3.51)	(0.93)	(1.85)	(0.27)			
CPIund	0.88	0.04	0.59	-0.15	0.981	0.604	.0000**
	(3.65)	(0.15)	(2.35)	(2.05)			
CPImed	0.89	-0.03	0.17	-0.11	0.959	0.494	.0000**
	(3.04)	(-0.10)	(0.56)	(1.27)			

8 Conditioning expectations

Last, we will consider ways for improving or, in fact, distilling the information contained in inflation expectations. Simply by looking at the individual responses to the direct questions concerning inflation percentages, it becomes rapidly clear that a significant number of the responses are either erroneous or nonsense.[17] While recording these obviously erroneous responses as outliers, we could also combine separate answers to improve the quality of the inflation expectations responses. First, inflation expectations below -15 per cent or observations above 15 per cent have been eliminated from the analysis. In addition, it would be useful to filter the answers concerning inflation expectations somehow.

It is probably useful to think that consumers can be separated into two groups basing their inflation expectations on different facts. A significant share of consumers may be backward-looking, basing their expectations purely on the recently observed inflation. The other group may have some rational arguments about how forthcoming inflation may evolve. The only problem is how to estimate the sizes of these groups. Without further assumptions we cannot gain any estimate of the sizes, so we may try to approach this question with a few specific assumptions about expectation formation.

The idea was to choose the inflation expectations of those individuals who knew at least approximately the current level of inflation. Basing on the individual questionnaire we selected only those individuals into our sample who knew the current inflation rate correctly within the $\pm$ 2 per cent range (assessed inflation not deviating from the CPI inflation more than 2 percent). Inflation expectations were calculated within this group of "informed" consumers. The measures of the unconditional and this "conditional" inflation expectations are compared in Figure 15. At first glance, the time series properties of these two inflation expectation measures seem quite similar apart from the mean of expectations, which is clearly lower for those having known the current level of inflation. In fact, it turned out that during the sample period the mean of "conditional" inflation expectations was closer to actual inflation than was the mean of the unconditional inflation expectations. The mean of the CPI inflation during 1995/m10 to 2002/m8 was 1.6%, which was exactly the same for "conditional" inflation expectations, but 1.97% for the unconditional expectations.[18] The difference in the frequency distribution can be seen more clearly from the histograms plotted in Figure 16.

This result also held true when lagged inflation expectations were compared with the actual CPI inflation. Even though information is limited because of our short sample, it seems that the quality of inflation expectations can be improved by selecting the answers of "informed consumers". However, other time series analyses, such as accuracy regressions and cross-correlation functions, did not reveal major differences with the earlier results. It should be also noted that the euro changeover was quite similar to all consumers and to the informed consumers, as the drop in inflation expectations was proportional for both groups in January 2002.

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[17] Even allowing for the fact that all persons have separate, individual commodity baskets, responses putting the inflation rate at 50 or 100 per cent seem quite absurd.

[18] The standard deviations were smaller for both unconditional and conditional inflation expectations than the actual CPI inflation.

Figure 15.

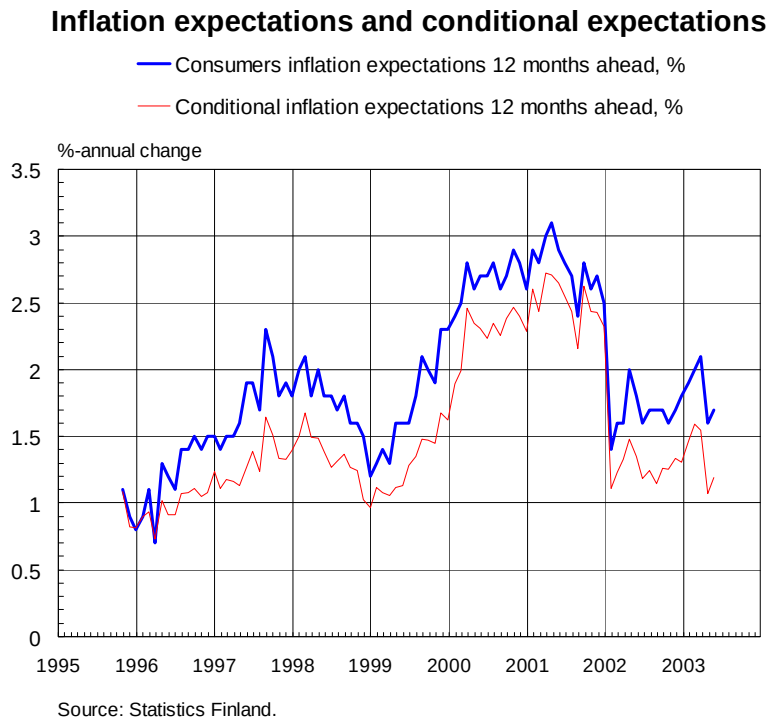
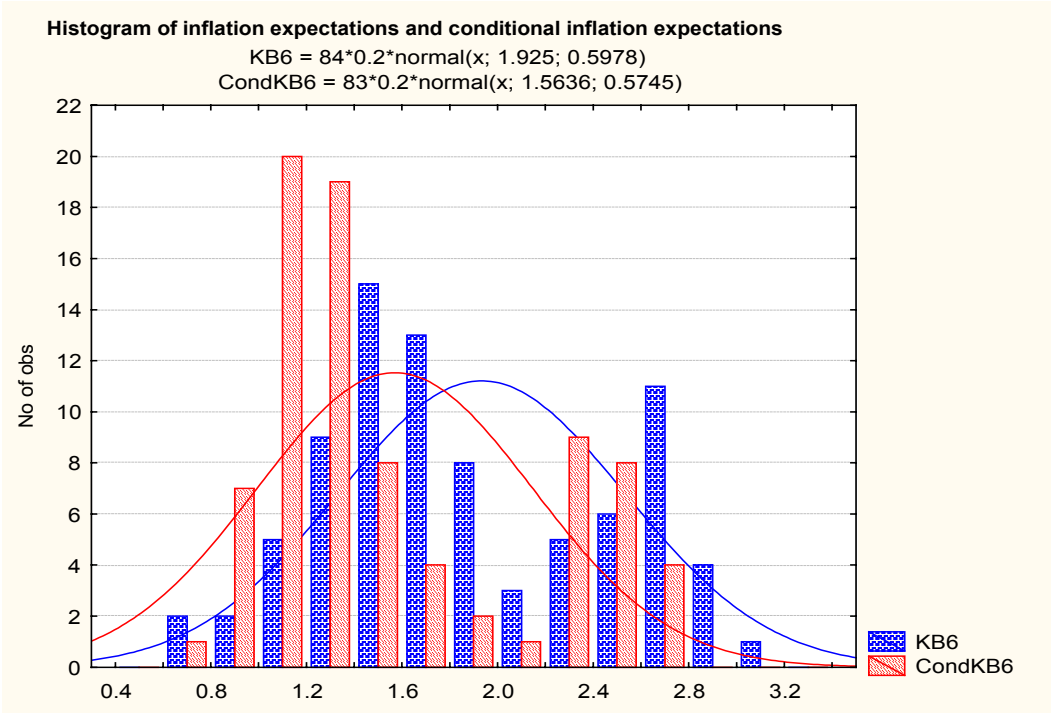


Figure 16.



9 Conclusions

Statistics Finland has asked direct questions about past and future inflation in its Consumer Barometer Survey since October 1995. Basing on the statistical analysis it seems clear that inflation forecasting can be aided by using consumers' per cent inflation expectations, not as direct point estimates but to rather give indication about the overall inflation tendency one year or so ahead. The analysis also showed that assessments about current inflation and inflation expectations cannot be regarded as simple linear combinations of the commodity group prices as used in the CPI weights. We found that certain commodity groups, such as food, health care, housing and restaurant services received over-weighted importance in the formulation of inflation assessments and expectations. Inflation expectations usually measure more closely such inflation measures as core and median inflation that do not contain volatile and difficult components like prices of oil or unprocessed food. Although inflation assessments and expectations are based on very similar background information, there is clear asymmetry between them and inflation expectations have predictive power over inflation as a process.

Causality tests and VAR models also prove the usefulness of inflation expectations in forecasting forthcoming inflation within a one-year horizon, but it was equally clear that inflation expectations are not sufficient for producing accurate forecasts.

One very interesting episode has been the euro changeover. It had a quite dramatic effect on both consumers' inflation assessments and expectations. In Finland, and many other euro countries, inflation assessments rose rapidly in January 2002 and at the same time inflation expectations collapsed. Logically, this means that prices were perceived to rise, but this rise was felt to be a once-for-all rise, which would not be repeated within the forthcoming 12 months. There is evidence that services and menu-list prices were raised markedly, but the overall effect from the euro changeover estimated by Statistics Finland was 0.2 percentage points instead of the close on 1 percentage point estimated by consumers. The sensitivity of consumers to certain goods prices may partly explain the reaction, but something also seems to remain unexplained because the high level has prevailed in the assessments although low inflation figures have since then been published for almost a year. However, if consumers had been rational in their assessments and expectations, inflation assessments would have collapsed at the latest in January 2003 after 12 months from the euro changeover. This did not happen, however, and assessments have continued to stay at around the 3 per cent level, while inflation expectations have remained close to the actual inflation of below 2 per cent.

One novelty in this paper was to look at the predictive power of the distribution moments of inflation expectations. Other studies have shown that e.g. skewness in the CPI commodity distribution could help forecasting inflation. However, the results here were not conclusive for any other distribution moments than the mean so as to be of any systematic use for inflation forecasting. There was slight evidence that the skewness of expectations could predict the CPI inflation, but the sign of this coefficient was negative and, therefore, not as expected.

Another way for improving the information content of inflation expectations we considered was to condition expectations so that only the expectations of those consumers who knew approximately the current level of inflation would be registered. This fine tuning of inflation expectations brought at least the mean of expectations closer to the levels of the current and forthcoming inflation rates (ex post). Otherwise, there was not much difference in the linear efficiency and unbiasedness tests performed for

the “conditional expectations”. Restricting inflation expectations to those of “informed consumers” only did not help to resolve the mystery of the euro changeover, either.

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Appendix 1.

Variable	Descriptive Statistics, 1996/m1 - 2002/m9								
	Valid N	Mean	Confidence -95.000%	Confidence +95.000%	Median	Minimum	Maximum	Std.Dev.	Standard Error
CPIg	81	1.65	1.45	1.85	1.54	0.3	3.69	0.899	0.100
KB6	81	1.96	1.83	2.09	1.80	0.7	3.10	0.899	0.064
KB5	81	1.65	1.41	1.90	1.70	-1.4	3.40	1.103	0.123
HICPg	81	1.80	1.62	1.98	1.60	0.4	3.44	0.817	0.091
CPIund	81	1.64	1.45	1.82	1.48	0.3	3.00	0.818	0.091
CPImed	81	1.19	1.01	1.38	0.98	-0.4	2.89	0.823	0.091

Appendix 2.

Unit root tests for inflation and inflation expectations
Estimation period: 1996/m1 - 2002/m9
Null hypothesis: Variable has a unit root

Variable	ADF	P-value	Phillips-Perron	P-value
CPIg	-2.79	0.0616	-1.86	0.3516
HICPg	-2.12	0.2379	-2.07	0.2552
CPImed	-1.65	0.4541	-1.66	0.4456
CPIund	-1.54	0.5067	-1.55	0.5059
KB5	-2.12	0.2363	-1.66	0.4464
KB6	-2.06	0.2614	-1.83	0.3639

Critical values and McKinnon one-sided p-values

5 %	-2.88	-2.89
1 %	-3.48	-3.50

Appendix 3.

Weak rationality regression tests for consumers inflation assessments
with different measures of inflation, estimation period: 1996/m1 - 2002/m9

Null hypothesis: $\alpha = 0$ & $\beta = 1$ (t-values apart from null in parenthesis)

			F-test for null			P-values for diagnostic tests	
Inflation measure	α	β	p-value	R^2	DW	AR(5)	Normality
CPIg	0.68	0.59	.0000 **	0.52	0.17	.0000**	0.9138
	(5.39)	(6.49)					
HICPg	0.88	0.56	.0000**	0.57	0.26	.0000**	0.1940
	(8.06)	(8.07)					
CPIund	0.63	0.61	.0000**	0.68	0.24	.0000**	.0000**
	(6.66)	(8.24)					
CPImed	0.266	0.56	.0000**	0.56	0.18	.0000**	.0000**
	(2.42)	(7.93)					

Variables:
CPIg = CPI inflation, %
HICPg = Harmonised CPI inflation, %
CPIund = Underlying (core) inflation, %
CPImed = Median CPI inflation, %