Inflation Expectations Revisited

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Inflation Expectations Revisited

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In 1975 Carlson and Parkin published quantitative estimates of UK consumer inflation expectations, based on qualitative Gallup Poll data. This paper uses a number of additional surveys, and a more general quantification technqiue, to revise and update their figures. The new figures exhibit very different time-series properties from those of Carlson and Parkin.

INTRODUCTION

It is over ten years since the publication of the pioneering attempt by Carlson and Parkin (1975) to obtain quantitative estimates of consumer inflation expectations in the United Kingdom from qualitative survey data, and over five years since their series was last updated, by Smith (1982). Their data have been used to investigate the rationality of expectations (Holden and Peel, 1977; Evans and Gulamani, 1984), and the role of expected inflation in labour and capital markets (Parkin *et al.*, 1976; Demery and Duck, 1978). However, in spite of intense theoretical interest in expectational macro models, such use of the data has been rather limited. This probably reflects the reservations of many researchers, articulated by Foster and Gregory (1977), over the validity of the quantification technique used by Carlson and Parkin.

This paper describes the construction and main features of a new monthly time series for the mean and the standard deviation of consumer inflation expectations in the United Kingdom, covering the years 1961-85. By using information from a richer set of surveys than was available to Carlson and Parkin, we have been able to relax their most restrictive assumptions. The new surveys also allow us to compute consumer perceptions of past inflation in the period 1974-85, and to estimate the rate of inflation that, in each month, consumers regarded as 'moderate'.

The paper is in four sections. The first gives details of the surveys we have used. The second develops a general framework for quantifying the qualitative data obtained from three of these surveys. Section III looks at the accuracy and rationality properties of the new series, and their sensitivity to changes in the assumptions underlying their construction. Section IV compares our mean inflation expectations series with one produced by the Carlson-Parkin technique. We find significant differences in the variability, accuracy, bias and error patterns between the two series.

I. SURVEYS OF CONSUMERS

Direct information on consumer inflation expectations in the United Kingdom has become available in the form of responses to four surveys. All of these are based on random samples of around 1000 individuals. The surveys are as follows.

The Gallup (1961) survey

This was instituted in January 1961 by Social Surveys (Gallup Poll) Ltd and has been run monthly ever since. The question asked concerning inflation expectations is:

Q1 Over the next six months do you think that prices will go up, go down, or stay the same?

We can therefore extract information on the fraction of respondents, excluding 'don't knows', who think prices will fall (A), stay the same (B) or rise (C). This was the raw data used by Carlson and Parkin (1975).

The Gallup (1974) survey

In January 1974, as part of a more comprehensive monthly survey, Gallup Poll introduced two different questions about inflation:

Q2′ Over the past twelve months do you think prices have risen a lot, risen a little, stayed the same or fallen?

Q2 Over the next twelve months do you think that prices will rise a lot, rise a little, stay the same, or fall?

From both questions, we can extract four response proportions A, B, C and D for expectations (A′, B′, C′ and D′ for perceptions) measuring the fractions of the sample answering in the 'fall', 'same', 'rise a little' and 'rise a lot' cateogories, respectively.

The EEC survey

In May 1984, the EEC commissioned the Office of Population Censuses and Surveys to conduct a UK survey as part of its programme of harmonized consumer surveys in member countries. This was run thrice yearly, in January, May and October, until 1979. In January 1980 conduct of the survey was transferred to Gallup Poll, and the survey was run monthly. Two questions about inflation are asked in these surveys:

Q3′ Compared to what they were twelve months ago, do you think that prices in general are now much higher, moderately higher, a little higher, about the same, or a little lower?

Q3 By comparison with what is happening now, do you consider that in the next twelve months prices will increase more rapidly, increase at the same rate, increase at a slower rate, be stable, or fall slightly?

This yields five response proportions A, B, C, D and E for expectations (A′, B′, C′, D′ and E′ for perceptions) measuring the fractions of the sample with successively higher inflation forecasts. These data are described and analysed in Papadia and Basano (1981).

The Gallup (1981) survey

Finally, in October 1981, Gallup Poll piloted a new survey of consumer expectations. This was run intermittently through the first half of 1982, and monthly from January 1983 onwards. In contrast to the earlier surveys, it asks for a quantitative estimate of expected inflation:

Q4 Over the next twelve months, what do you think the rate of inflation will be?

This allows direct calculation of the mean and standard deviation of expectations across individuals. A detailed analysis of the results from this survey is reported in Batchelor and Dua (1987).

II. Quantification of Qualitative Survey Data

A technique for quantifying the results of the three-category Gallup (1961) survey was developed by Carlson and Parkin (1975), building on earlier work by Theil (1958) and others. Here, we generalize their approach and extend it to cover the four- and five-category surveys described above.

A basic premise is that respondent i to a survey taken at time t implicitly forms a subjective probability distribution function (p.d.f.) for future inflation, with mean μ_{it} and standard deviation σ_{it} (μ'_{it} and σ'_{it} for past inflation), and answers the survey questions in the light of this distribution. As discussed in Bathcelor (1986a), three types of empirical assumption are then necessary to infer the parameters of the p.d.f.s from the survey responses. These concern the expectations distribution, the response function and the scaling technique. An added complication in the present study is the need to pool data from the various surveys.

The expectations distribution

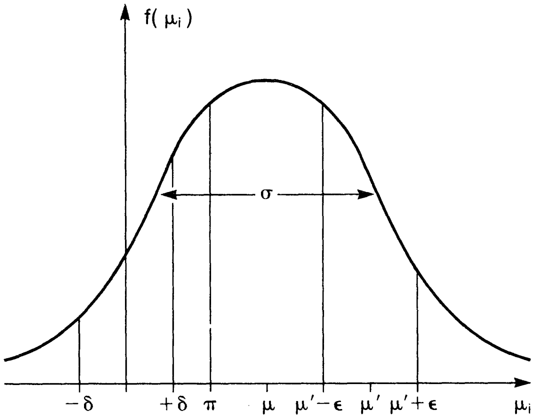
The expectations distribution $f_t(\mu_{it})$ describes how mean expectations are distributed across individuals in the survey. One such distribution is illustrated in Figure 1. Its expected value μ_t is what is generally referred to as 'the expected rate of inflation'. Its standard deviation σ_t measures the dispersion of subjective mean expectations across the population, a commonly used proxy for 'inflation uncertainty'.

Carlson and Parkin (1975) invoke the Central Limit Theorem to justify their assumption that f is normal. However, individual subjective p.d.f.s are unlikely to be the result of independent random sampling of information, so this need not be the case. The empirical evidence is that the expectations distribution is centrally concentrated, but not strictly normal (Carlson, 1975; Batchelor and Dua, 1987); on the other hand, estimates of μ and σ are not sensitive to choices of alternative symmetric unimodal distributions (Agenor, 1982). We have followed Fishe and Lahiri (1981) in assuming, for computational convenience, that f is logistic.

The response function

The response function maps the parameters of individual p.d.f.s for inflation into their responses to the tendency survey questions. We assume the following:

1. In Q1 respondents answer 'down'/'same'/'up' according as $\mu_{it} < -\delta_{it}$, $-\delta_{it} < \mu_{it} < \delta_{it}$ or $\delta_{it} < \mu_{it}$. Here, $\delta_{it} > 0$ is, in psychological parlance, a 'just-noticeable difference' (j.n.d.) in inflation (Green and Swets, 1974).



μi = individual mean expectation of inflation
f(μi) = distribution of mean expectations across individuals
μ = mean expected inflation
σ = s.d. of inflation expectations
π = moderate rate of inflation
μ′ = mean perceived inflation
δ = just noticeable difference in inflation around zero
ε = just noticeable difference in inflation around μ′

FIGURE 1. The distribution of mean inflation expectations.

2. In Q2 respondents answer 'fall'/'same'/'rise a little'/'rise a lot' according as $\mu_{it} < -\delta_{it}$, $-\delta_{it} < \mu_{it} < \delta_{it}$, $\delta_{it} < \mu_{it} < \pi_{it}$ or $\pi_{it} < \mu_{it}$. Here, π_{it} is the rate of inflation which the respondent considers 'moderate'. Answers to the perceptions question Q2′ similarly depend on the relationship of μ'_{it} to j.n.d.s $\pm\delta'_{it}$ around zero, and to the moderate rate π_{it}.
3. In Q3 respondents answer 'fall'/'stable'/'increase more slowly'/'increase at same rate'/'increase more rapidly' according as $\mu_{it} < -\delta_{it}$, $-\delta_{it} < \mu_{it} < \delta_{it}$, $\delta_{it} < \mu_{it} < \mu'_{it} - \varepsilon_{it}$, $\mu'_{it} - \varepsilon_{it} < \mu_{it} < \mu'_{it} + \varepsilon_{it}$ or $\mu'_{it} + \varepsilon_{it} < \mu_{it}$. The parameter ε_{it} is the j.n.d. in inflation around the perceived rate. Answers to the perceptions question 3′ similarly depend on the relationship of μ'_{it} to j.n.d.s $\pm\delta'_{it}$ around zero, and to the j.n.d. band $\pi_{it} \pm \varepsilon'_{it}$ around the moderate rate.

Carlson and Parkin (1975), and most other researchers, assume the j.n.d.s δ_{it} are equal across individuals and constant over time. However, the theory of signal extraction (Green and Swets, 1974, Batchelor, 1986b) suggests that the δ_{it} should be regarded as critical values in a hypothesis test of $\mu_{it} = 0$, and so should depend, among other things, on the noise σ_{it} surrounding the mean expectation μ_{it}. We therefore assume that δ_{it} is distributed logistically across individuals with mean δ_t which varies over time with σ_t, and a variance $(\lambda^2 - 1)\sigma_t^2$ which is proportionate to the degree of inflation uncertainty through the factor $\lambda \geq 1$. For simplicity, the other thresholds π_{it} and $\mu'_{it} \pm \varepsilon_{it}$ for μ_{it} are assumed to have time-varying expected values π_t and $\mu'_t + \varepsilon_t$, but the same variance as δ_{it}. The thresholds $\pm\delta'_{it}$, π_{it} and $\pi_{it} \pm \varepsilon_{it}$ for μ'_{it} are similarly assumed to be logistically distributed across individuals with variance proportionate to $\sigma_t'^2$.

The signal detection interpretation of δ also means that it is liable to be different in different surveys, since each offers a different alternative to the null of $\mu = 0$. Similarly, the j.n.d. in perceptions of past inflation is liable to be different from (smaller than) the j.n.d. in expectations, since uncertainty about the past should be lower.

Under these assumptions, the response fractions from the surveys can be regarded as maximum likelihood estimates of the areas under the expectations distribution bounded by the relevant thresholds. In Figure 1, we show the thresholds relevant to the interpretation of the expectations questions. Proportions A and B from Q1 estimate the area under f_t in the range $(-\infty, -\delta_t)$ and $(-\delta_t, +\delta_t)$. Proportions A, B and C from Q2 estimate areas in the ranges $(-\infty, -\delta_t)$, $(-\delta_t, +\delta_t)$ and (δ_t, π_t). Proportions A, B, C and D from Q3 estimate the areas in the ranges $(-\infty, -\delta_t)$, $(-\delta_t + \delta_t)$, $(\delta_t, \mu'_t - \varepsilon_t)$ and $(\mu'_t - \varepsilon_t, \mu'_t + \varepsilon_t)$. In what follows, we denote by a_t, b_t, c_t and d_t the abscissae of the standard logistic distribution corresponding to cumulative probabilities of A_t, $A_t + B_t$, $A_t + B_t + C_t$ and $A_t + B_t + C_t + D_t$, respectively.

The scaling factor

The survey response proportions are in general not sufficient to identify all of the parameters of interest. For example, the responses to Q1, Q2 and Q3 an all lead to estimators of μ and σ of the form

(1) $\mu_t = \delta_t(a_t + b_t)/(a_t - b_t)$

(2) $\sigma_t = \delta_t(-2k/\lambda)/(a_t - b_t)$

where k is the constant (approximately 1·81) necessary to scale the standard deviation of the standard logistic function to unity. Clearly μ_t can be computed only if the common scaling parameter δ_t is known, and σ_t also requires an estimate of λ.

Carlson aned Parkin implicitly assume $\lambda = 1$ (non-stochastic j.n.d.s) and choose δ_t as that single j.n.d. value that would make mean expectations unbiased over the whole available time series of surveys. Strictly, unbiasedness requires that, in the regression

(3) $p_t = \varphi + \psi\mu_t + u_t, \qquad (\varphi, \psi) = (0, 1).$

However, unbiasedness in mean expectation is not the only prior we might wish to maintain. Indeed, since unbiasedness is a necessary condition for rationality in expectations, it would be preferable if it were not imposed *a priori*. Moreover, δ is not the only possible scaling factor.

It is in particular possible to form estimators of μ and σ (and δ and ε) in which π is the scaling factor. From responses to Q2,

(4) $\mu_t = \pi_t(a_t + b_t)/(a_t + b_t - 2c_t)$

(5) $\sigma_t = \pi_t(-2k/\lambda)/(a_t + b_t - 2c_t)$

(6) $\delta_t = \pi_t(a_t + b_t)/(a_t + b_t - 2c_t)$

with analogous expressions for μ'_t, σ'_t and δ'_t using responses to Q2′. From responses to Q3,

(7) $\mu_t = \mu'_t(a_t + b_t)/(a_t + b_t - c_t - d_t)$

(8) $\sigma_t = \mu'_t(-2k/\lambda)/(a_t + b_t - c_t - d_t)$

(9) $\delta_t = \mu'_t(a_t - b_t)/(a_t + b_t - c_t - d_t)$

(10) $\varepsilon_t = \mu'_t(c_t - d_t)/(a_t + b_t - c_t - d_t).$

Since from Q3′

$$(11) \qquad \mu_t' = \pi_t(a_t' + b_t')/(a_t' + b_t' - c_t' - d_t')$$

with analogous expressions for σ_t', δ_t' and ε_t', (11) can be substituted in (7)-(10) to make π_t the scaling factor for expectations also.

One obvious additional prior relevant to our surveys is that mean perceptions μ_t' satisfy the unbiasedness condition (3). Pesaran (1984), for example, uses the assumption of unbiasedness in perceptions to infer the j.n.d. δ', though not from (1), but from a nonlinear regression of actual inflation on the response proportions A' and $1-B'$. He then scales expectations by assuming $\delta = \delta'$. This strong prior may be reasonable as a description of his data, which relate to businessmen's perceptions of their own past decisions, but it is less compelling as a description of consumers' perceptions of the general price level. The assumption of equal j.n.d.s. in past and future inflation is also at variance with the signal detection interpretation of the j.n.d. discussed above.

With respect to our data, both theory and evidence from the Gallup (1981) surveys suggest further interesting priors for λ, δ and π.

The theory of signal detection implies that δ_t should vary over time with σ_t. It also seems reasonable to suppose that the moderate rate of inflation represents the respondent's best guess at the permanent or trend rate of inflation, in which case π_t should depend on past, current and expected future rates of inflation.

By rearranging (1)-(9) and substituting the known values of μ_t and σ_t from the Gallup (1981) survey, estimates of λ, δ, π and ε can be generated for the years 1983-85. These give more specific guidance as to the likely joint p.d.f.s. of these parameters in earlier years. Implied figures for λ are similar in the two Gallup surveys, averaging around 1·14, but are lower, around 1·02, in the EEC survey. These figures do not appear to vary systematically over time with μ or σ, so they have been fixed at these values in all subsequent calculations. With respect to δ, we find again that Gallup (1961) and Gallup (1974) yield very similar figures for δ_t, averaging 3·5 per cent, but that both are consistently some 30 per cent larger than the δ_t from the EEC survey. All three sets of δ estimates are highly correlated, and after some experimentation their dependence on σ_t proves to be best modelled by the first-order adaptive process

$$(12) \qquad \delta_t = \delta_{t-1} + \beta(\alpha + \gamma\sigma_t - \delta_{t-1}).$$

The estimates of π are obtained from the Gallup (1974) and EEC surveys are encouragingly close, averaging around 10·5 per cent in 1983-85. The moderate rate is, however, highly correlated with the expected rate of inflation, and trials with a general bivariate regression suggest the following adaptive process as the best description of π:

$$(13) \qquad \pi_t = \pi_{t-1} + \beta\{(1-\alpha)\bar{\pi} + \alpha\mu_t - \pi_{t-1}\} + \gamma(\mu_t - \mu_{t-1}).$$

That is, π adapts to a long-run equilibrium $(1-\alpha)\bar{\pi} + \alpha\mu$, where $\bar{\pi}$ is what might be called the 'natural rate of inflation'—that rate which, if consistently expected ($\mu = \bar{\pi}$), will in the long run be regarded as moderate. In the short run, π is subject to shocks due to changes in inflation expectations.

Pooling and linking

Equations (3), (12) and (13) all represent relationships that it would be desirable to approximate in scaling the pre-1983 survey data. However, because μ, δ and π are interdependent, all three cannot be simultaneously satisfied, and the optimum scaling method must involve choosing values for the scaling parameter that minimize some loss function based on weighted deviations of the parameter estimates from these prior constraints.

For the years 1974–82, we have conducted a grid search for values of the parameters $(\alpha, \beta, \gamma, \bar{\pi})$ in the moderate rate model (13) which lead to pooled estimates of (μ, σ, π, μ') through (4)–(11) which minimize the loss function

$$L = 0{\cdot}4(0{\cdot}25\varphi' + 0{\cdot}75|\psi' - 1|) + 0{\cdot}2(RMSEM + RMSES + RMSEPI). \tag{14}$$

Here, φ' and ψ' are the constant and slope coefficients in the regression (3) of actual on perceived inflation μ', and *RMSEM*, *RMSES* and *RMSEPI* are root mean square deviations of the values of μ, σ and π which would be estimated for the years 1983–85 from their known values in the Gallup (1981) survey. The loss function is in two parts. The first penalizes deviations from unbiasedness in perceptions past inflation, but imposes no such condition on expectations. The second penalizes failure to link the 1974–82 data closely with the higher-quality 1983–85 data. The weights in the functions are chosen to be roughly proportionate to the inverse of the standard deviations of the variables involved. Even so, the choice of weights is a matter of discretion, and the sensitivity of our results to changes in the weighting scheme is tested below.

The pooled estimates of μ and σ which enter (14) have been prepared as follows. First, we estimate the scaling factor δ for the Gallup (1961) survey as an equally weighted average of the δ from the Gallup (1974) survey and 1·3 times the δ from the EEC survey. A synthetic 12-month-forward forecast is computed for the Gallup (1961) survey as an average of the current mean expectation, and that in six months' time. This figure is then averaged with the μ estimates from the other two surveys. Because the adjustment for the forecast horizon is liable to introduce some measurement error, the Gallup (1961) figures are given only half the weight of the Gallup (1974) and EEC surveys in this pooling.

The loss-minimizing model for π has parameters $(\alpha, \beta, \tau, \bar{\pi}) = (0{\cdot}89, 0{\cdot}08, -1{\cdot}02, 6{\cdot}40)$. This implies that individuals adapt their concept of the moderate rate of inflation rather slowly in response to changes in the expected rate of inflation. The natural rate of inflation is put at 6·4 per cent per annum.

For the years 1961–73, only the Gallup (1961) data are available. We have searched for values of the parameters (α, β, γ) in the j.n.d. model (12) that lead to estimates of (μ, σ) through (1) and (2) which minimize the loss function

$$\begin{aligned} M = {} & 0{\cdot}5(0{\cdot}25\varphi + 0{\cdot}75|\psi - 1|) \\ & + 0{\cdot}5(0{\cdot}5RMSED + 0{\cdot}3RMSEM + 0{\cdot}2RMSES). \end{aligned} \tag{15}$$

Again, φ and ψ are constant and slope coefficients, from a regression (3) of actual six-month inflation on the mean six-month expectations estimated from the Gallup (1961) survey, and *RMSED*, *RMSEM* and *RMSES* are root mean square deviations of the values of δ, μ and σ from their previously estimated levels in 1974. The value of the 12-month expectation μ is, as before, generated as a geometric average of the current and six-month-ahead six-month expectation. The loss function in this case does penalize departures from unbiasedness in (six-month) expectations, and also penalizes any failure of the pre-1974 series to link up with the higher-quality post-1974 data.

The loss-minimizing model for δ has $(\alpha, \beta, \gamma) = (0{\cdot}21, 0{\cdot}73, 0{\cdot}15)$. That is, the j.n.d. in inflation reacts quite rapidly to changes in inflation uncertainty.

III. Properties of Inflation Expectations

The result of these manipulations is a large body of quantitative information on expectations. To summarize these data, we give a brief description of the main features of the series, an analysis of the accuracy and weak-form rationality of mean expectations, and some tests of the sensitivity of our results to changes in the quantification technique.

Broad patterns

Figures 2 and 3 show quarterly averages of the mean and standard deviation of 12-month-forward inflation expectations. Inflation expectations track the rise and fall of inflation through the 1960s, 1970s and 1980s fairly well. One major bout of unexpected inflation occurred in 1973–74, presumably because the inflationary effects of the oil price rise and its monetary accommodation were not fully appreciated. The deceleration in inflation in 1976, in response to deflation and wage restraint, was also not anticipated, nor was the subsequent acceleration of inflation when these policies broke down in 1978. Consumers also appear to have been surprised by the slowdown in inflation in 1981–82,

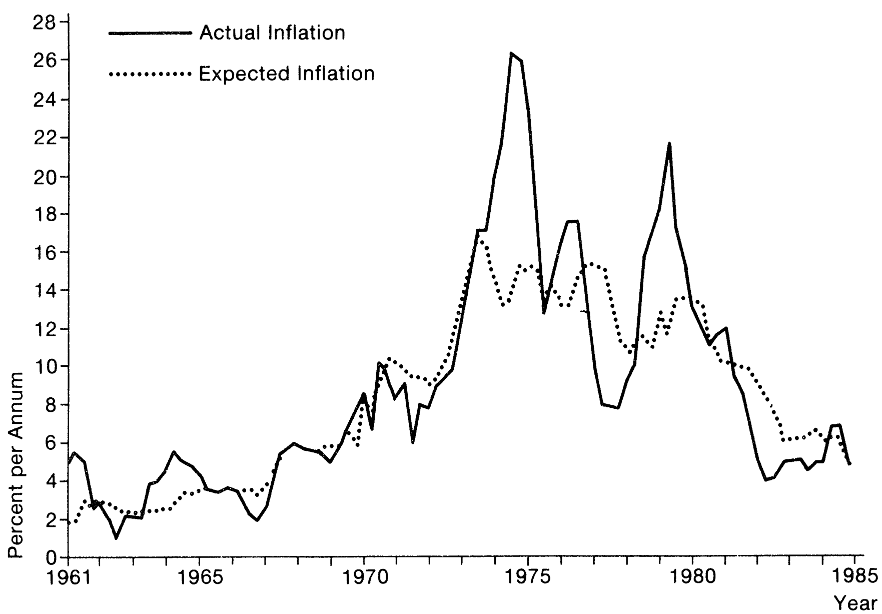


FIGURE 2. Expected inflation, 1961–1985.

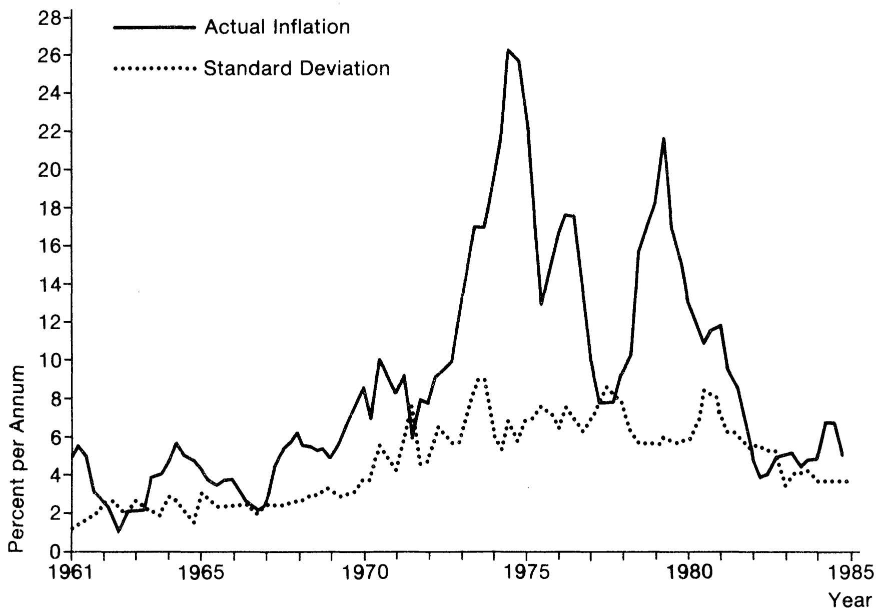


FIGURE 3. Inflation uncertainty, 1961–1985.

in spite of its pre-announcement in the Medium Term Financial Strategy (MTFS).

Inflation uncertainty follows the general profile of inflation itself, but the correlation is by no means perfect. Inflation uncertainty peaked during the 1973–74 oil price crisis. But it rose sharply again in 1977, a time of low inflation, presumably because of well publicized uncertainties about the continuation of the 'Social Contract' incomes policy. And uncertainty rose in 1980, perhaps because of differences of opinion about the credibility of the MTFS.

Figures 4 and 5 track the moderate rate of inflation and the j.n.d. thresholds δ and ε. The behaviour of the moderate rate reflects the adaptive mechanism (13). It fluctuates around 10–14 per cent through the 1970s, but falls steadily from mid-1980 to stabilize around 6 per cent in 1985. The j.n.d. δ rises from around 1 per cent in the early 1960s to peaks of over 5 per cent in the 1970s, falling to 2 per cent by 1985. Our data clearly refute the proposition that δ is constant and point to a potentially important source of error in the Carlson–Parkin data.

Accuracy and rationality

We have examined the relation between actual and expected inflation more formally, by measuing the accuracy of expectations and perceptions, and testing both for unbiasedness and weak-form rationality.

For each month we have computed the root mean square error of a typical individual consumer, *RMSEI*, and the root mean square error of the mean forecast μ of the whole group of consumers, *RMSEG*. As shown in Cukierman and Wachtel (1981), these are related as $RMSEI^2 = RMSEG^2 + \sigma^2$. These statistics have been calculated for perceived inflation and for six- and 12-month expected inflation. The results are reported in Table 1.

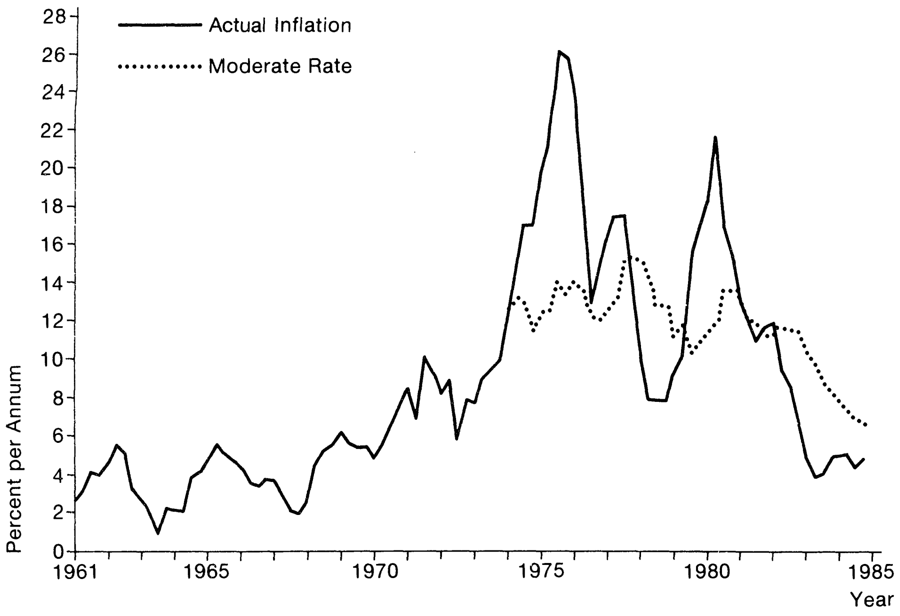


FIGURE 4. The moderate rate of inflation, 1961–1985.

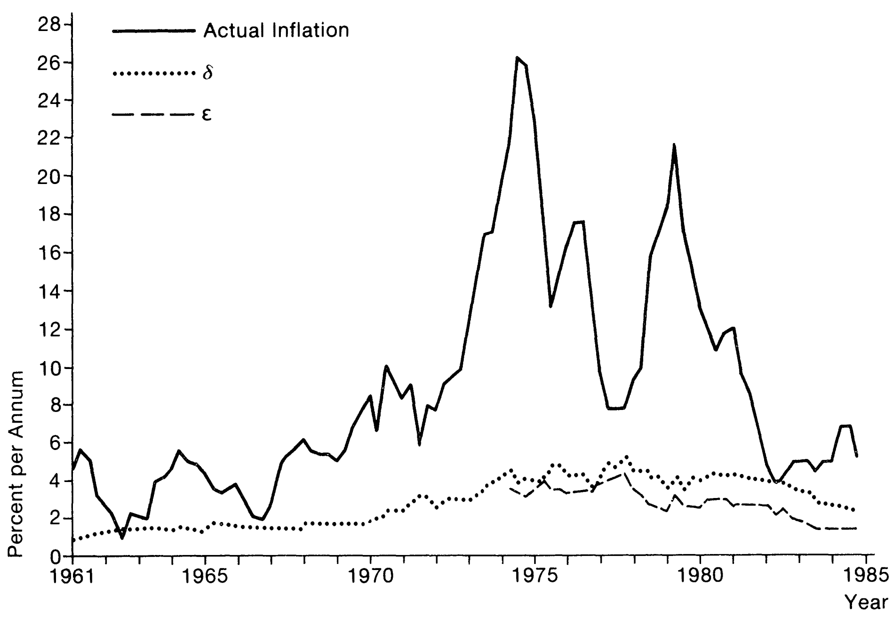


FIGURE 5. 'Just-noticeable' differences in inflation, 1961–1985.

We would expect perceptions of the past to be more accurate than expectations of the future; we would expect forecasts to be better in the stable 1960s than in the volatile 1970s; and we would expect near-term forecasts to be better than long-term forecasts. The first two of these conjectures are borne out by the data. However, although the mean 12-month expectation is quite accurate, with an *RMSEG* of 3·4 per cent, the quality of the individual forecasts

TABLE 1
ACCURACY AND RATIONALITY OF INFLATION EXPECTATIONS

Series		Accuracy		Rationality[a]	
		RMSEI	*RMSEG*	$F(0, 1)$	*BP*
Perceptions	1974–85	6·74	3·59	4·04*	434·0*
Expectations	1961–85	6·21	3·44	0·41	7·42*
(12-month)	1961–73	4·35	1·66	1·53	34·46*
	1974–85	7·89	4·77	0·98	6·67*
Expectations	1961–85	7·22	4·40	3·25*	2·74
(6-month)	1961–73	4·91	2·83	4·16*	16·21*
	1974–85	9·23	5·73	1·35	0·62

[a] $F(0, 1)$ is a (modified) F-statistic testing the unbiasedness restriction (3), and *BP* is a Box–Pierce portmanteau statistic testing for 1–12 order residual error autocorrelation in the case of perceptions, 13–24 order in the case of 12-month expectations, and 7–12 order in the case of 6-month expectations. An asterisk * denotes rejection at the 5 per cent level.

is rather poor—an *RMSEI* of only 6 per cent as against an average inflation rate of 8·8 per cent, with standard deviation 5·9. And the six-month mean forecast actually appears less accurate than the 12-month forecast. This probably reflects the greater volatility of six-month inflation in our seasonally unadjusted data.

Rationality has been tested in two standard ways, by means of an unbiasedness test and by means of a test for the orthogonality of forecast errors with respect to known past errors. The unbiasedness test is an F-test of the coefficient restriction in the regression (3) above. The orthogonality test is based on the fact that, subject to the coefficient constraints, the regression residuals u_t are forecast errors, and weak form rationality requires that such errors be uncorrelated with known past errors. Hence the orthogonality condition is

$$(16) \qquad \operatorname{cov}(u_t, u_{t-r-s}) = 0 \qquad s = 1, 2, 3, \ldots$$

where r is the forecast horizon. That is, $r = 0$ for perceptions of the past, 6 for the six-month-forward expectations and 12 for the 12-month expectations. The fact that low-order autocorrelations in the residuals from (3) will be non-zero in the expectations regressions means that the coefficient variance-covariance matrix cannot be estimated by ordinary least squares. We have instead based our unbiasedness test on the modified F-statistic described in Hansen and Hodrick (1980) and used in the context of rationality testing by Brown and Maital (1981). The orthogonality test is based on the modified Box–Pierce statistic described in Batchelor (1986a).

These statistics are shown in the final two columns of Table 1. Unbiasedness is rejected for perceptions and six-month expectations, but not for 12-month expectations, a paradoxical result which may only reflect the low power of the Hansen–Hodrick test. Looking at the data period as a whole, neither perceptions nor expectations fail the orthogonality test. Because unbiasedness in expectations is to some extent imposed on the 1961–73 data through the loss function (15), we have conducted the rationality tests on pre- and post-1974 data separately. Paradoxically, there are some signs of irrationality in the pre-1974 data, but not in the post-1974 figures. Before 1974 the six-month forecasts are biased and the 12-month errors serially correlated. After 1974, when unbiasedness in expectations does not enter as a factor in our scaling procedure, neither test for rationality is failed. It should be noted, however, that these are only weak-form tests and that, as reported in Batchelor and Dua (1987), the Gallup (1981) data taken on their own do fail semi-strong rationality tests.

Sensitivity analysis

We have conducted a number of experiments to test the sensitivity of our data to changes in the assumptions of the quantification procedure.

The first set involves changing the weights in the loss functions (14) and (15). Both functions consist of two parts, an unbiasedness requirement and a linking requirement. The effect of choosing parameters that satisfy only the linking condition in (14) is to make perceptions of past inflation biased and inaccurate. As shown in Table 2, the loss function rises from 0·54 to 0·65, and the *RMSEG* of perceptions rises from 3·59 to 4·65. Perceptions are in fact persistently 2–3 per cent above outturns in the years 1983–85, a highly implausible situation. On the other hand, imposing only unbiasedness on perceptions has the equally undesirable consequence that mean expectations in 1983–85 are driven 2–3 per cent above their values in the Gallup (1981) survey. A similar though less dramatic trade off between the linking and unbiasedness conditions holds for the loss function (15). For example, imposing unbiasedness on six-month expectations would imply values for mean expectations in 1974 that are some 3–4 per cent above those indicated by the Gallup (1974) and EEC surveys.

TABLE 2

SENSITIVITY TESTS

Period	Experiment	Loss function	Accuracy (RMSEG)	
			Perceptions	Expectations
1961–73	Base run	0·67		1·66
	Linking	0·76		1·67
	Unbiasedness	0·76		2·64
	Constant δ	1·28		3·21
1974–85	Base run	0·54	3·59	4·77
	Linking	0·65	4·65	4·58
	Unbiasedness	0·59	3·73	4·91
	No natural rate	0·68	4·45	5·51
	No SR dynamics	0·58	3·24	4·94
	Constant π	1·83	3·96	5·53

The second set of experiments involves imposing restrictions on the functional forms of the models (12) and (13) for δ and π. The results are again set out in Table 2. With respect to π, removing the 'natural rate' concept ($\alpha = 1$) reduces the accuracy of both perceptions and expectations significantly. Removing the short-term dynamics by setting $\gamma = 0$ has a smaller effect on L and increases the accuracy of perceptions at the expense of expectations.

Holding π constant ($\alpha = 0$, $\beta = 1$, $\gamma = 0$) raises the loss function very substantially, and cannot be entertained. With respect to δ, we have investigated only one variant, in which it is held constant, as in Carlson and Parkin (1975). If this is imposed on the 1961–73 period, the loss function M rises sharply. Six-month expectations become much more biased than suggested by our figures, implied values of μ in 1974 are implausibly low relative to those indicated by the later surveys, and the synthetic 12-month forecasts are much less accurate than under our variable-δ model.

IV. New v. Old Series

It seems appropriate to conclude with a more comprehensive comparison of our new mean inflation expectations series with the series that would be produced by exactly replicating the Carlson–Parkin method. We have therefore constructed an expectations series for the years 1961–85, on the basis of the Gallup (1961) data alone, interpreting these as 12-month forecasts, and assuming a constant δ. The value for δ that ensures unbiasedness is exactly 3 per cent, considerably above Carlson and Parkin's figure of 1·764.

The updated Carlson–Parkin (C–P) inflation expectations series is set against our own series in Figure 6. The C–P series is more volatile than ours, and lies consistently above our figures in the 1960s, but below our figures, and below actual inflation, in the 1970s. The C–P series imputes less accuracy to consumers, with a *RMSEI* of 7·01 and *RMSEG* of 4·81, as against our 6·21 and 3·44. The upward bias of the C–P series in the 1960s and its downward bias in the 1970s also means that it fails the error orthogonality test for weak-form rationality, the χ^2 statistic testing for 13–24 order error correlation being 26·35, well in excess of the 5 per cent critical level.

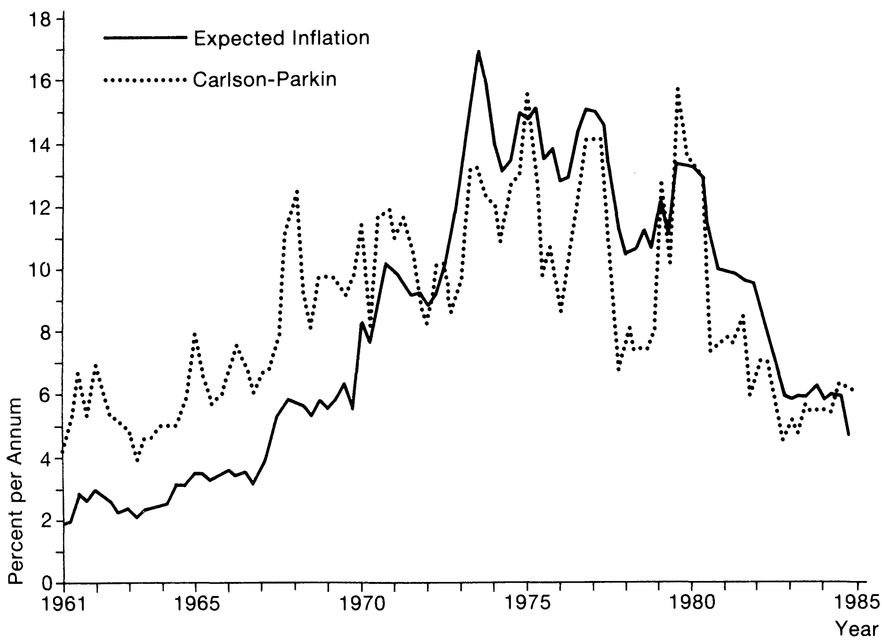


FIGURE 6. New series *v.* Carlson–Parkin, 1961–1985.

Given the intrinsic problems of transforming qualitative data into quantitative data, our new series can hardly be regarded as a definitive picture of UK consumer inflation expectations over the past 25 years. However, in two respects we would claim that it represents an advance over previous work. We have utilized more, and more informative, survey data. And our quantification technique is based on assumptions that are both weaker in content and better grounded in theory and empirical evidence. These innovations clearly change the estimated profile of consumer inflation expectations over time, and suggest that they are at least weakly rational.

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The new inflation perceptions and expectations data described in this paper are available on diskette on application to the first-named author.

REFERENCES

AGENOR, P. R. (1982). Le traitement des anticipations en économétrie. Unpublished doctoral thesis, Université de Paris I, Panthéon-Sorbonne.

BATCHELOR, R. A. (1986a). Qualitative *v.* quantitative measures of inflation expectations. *Oxford Bulletin of Economics and Statistics*, **48**, 99-120.

—— (1986b). The psychophysics of inflation. *Journal of Economic Psychology* **7**, 269-90.

—— and DUA, P. (1987). The accuracy and rationality of UK inflation expectations: some quantitative evidence. *Applied Economics.* **19**, 819-28.

BROWN B. W. and MAITAL, S. (1981). What do economists know? An empirical investigation of experts expectations. *Econometrica*, **49**, 491-504.

CARLSON, J. A. (1975). Are price expectations normally distributed? *Journal of the American Statistical Association*, **70**, 749-754.

—— and PARKIN, M. (1975). Inflation expectations. *Economica.* **42**, 123-38.

CUKIERMAN, A. and WACHTEL, P. Inflationary Expectations: reply and further thoughts on inflation uncertainty. *American Economic Review*, **72**, 508-12.

DEMERY, D. and DUCK, N. W. (1978). The behaviour of nominal interest rates in the United Kingdom, 1961-73. *Economica*, **45**, 23-37.

EVANS, G. and GULAMANI, R. (1984). Tests of the rationality of the Carlson-Parkin expectations data. *Oxford Bulletin of Economics and Statistics*, **46**, 1-20.

FISHER, P. H. and LAHIRI, K. (1981). On the estimation of inflationary expectations from qualitative responses. *Journal of Econometrics*, **16**, 89-102.

FOSTER, J. and GREGORY, M. (1977). Inflation expectations: the use of qualitative survey data. *Applied Economics*, **9**, 319-29.

GREEN, D. M. and SWETS, J. A. (1974). *Signal Detection Theory and Psychophysics.* Huntington, NY: Krieger.

HANSEN, L.-P. and HODRICK, R. J. (1980). Forward exchange rates as optimal predictors of future spot rates: an econometric analysis. *Journal of Political Economy*, **88**, 829-53.

HOLDEN, K. and PEEL D. A. (1977). An empirical investigation of inflationary expectations. *Oxford Bulletin of Economics and Statistics.* **39**, 291-9.

PAPADIA, F. and BASANO, V. (1981). EEC-DGII inflationary expectations: survey-based inflationary expectations for the EEC countries. Commission of the European Communities, *Economic Papers.* no. 1.

PARKIN, M. M., SUMNER, T. and WARD, R. (1976). The effects of excess demand, generalised expectations and wage-price controls on wage inflation in the UK. In K. Brunner and A. H. Meltzer (eds), *The Economics of Price and Wage Controls.* Amsterdam: North-Holland.

PESARAN, M. H. (1984). Expectations formation and macroeconomic modelling. In P. Malgrange and P. A. Muet (eds), *Contemporary Macroeconomic Modelling.* Oxford: Basil Blackwell.

SMITH, G. W. (1982). Inflation expectations: direct observations and their determinants. In M. Artis *et al.* (eds), *Demand Management, Supply Constraints and Inflation.* Manchester: University Press.

THEIL, H. (1958). *Economic Forecasts and Policy*, ch. 4. Amsterdam: North-Holland.