Nominal Interest Rates as Indicators of Inflation Expectations

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Abstract

This paper evaluates the properties of nominal interest rates as indicators of inflation expectations. Are they unbiased? How precise are they? To arrive at robust results, a range of different methods are applied on several US and UK data sets. The results show that the interest rate level is a reasonably good indicator of the level of inflation expectations. However, changes in interest rates are poor indicators of changes in inflation expectations.

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I Introduction

The use of nominal interest rates as indicators of inflation expectations has recently gained wide popularity. For instance, Svensson (1993) uses forward rates to discuss inflation expectations under simple assumptions about the real interest rate. This method is now used by, among others, Bank of England (1994) and Sveriges Riksbank (1995).

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The purpose of this present paper is to evaluate this approach on US and UK data. I compare a simple forecasting rule, which uses the nominal interest rate as a proxy for inflation expectations, with a slightly more complicated rule which uses the nominal interest rate in an optimal way.

The difference between these two rules depends on the relative volatility of inflation expectations and real interest rates (plus risk premia), as well as on their correlation. Since there are no universally accepted measures of inflation expectations and real interest rates, I use several data sets: different surveys, professional forecasts, VAR predictions of inflation, and real interest rates from index linked bonds (UK).

For comparison with previous studies, I also use regressions of (ex post) inflation on nominal interest rates, which is the standard approach for measuring the “Fisher effect.” However, this approach provides only part of the information needed to compare the two rules. It is also likely to suffer from important “peso problems,” where the sample of (ex post) inflation differs systematically from the inflation expectations. The survey data will shed some light on this issue.

The relation between inflation expectations and nominal interest rate may perhaps change over time, for instance, after a shift in policy or in the mix of shocks hitting the economy. I therefore report the results for a large set of different samples, and find some interesting instability related to the early 1980s.

II Extracting Expected Inflation from Nominal Interest Rates

In the standard asset pricing model, the nominal ($i(t, T)$) and real ($q(t, T)$) interest rates on default free discount bonds with trade date t and maturity date T satisfy

$$e^{-i(t,T)(T-t)} = E_t^p e^{-\pi(t,T)(T-t)+m(t,T)} \text{ and} \quad (1)$$

$$e^{-q(t,T)(T-t)} = E_t^p e^{m(t,T)}, \quad (2)$$

where $\pi(t, T)$ is the inflation rate between t and T , $m(t, T)$ the real stochastic discount factor, and E_t^p denotes the conditional expectation of private agents based on information in t . Assume $\pi(t, T)$ and $m(t, T)$ have a joint conditional normal distribution. The nominal interest rate is then

$$\begin{aligned} i(t, T) = & E_t^p \pi(t, T) + q(t, T) + \frac{1}{2} (T - t) \text{Var}_t^p \pi(t, T) \\ & + \text{Cov}_t^p [\pi(t, T), m(t, T) - \pi(t, T)(T - t)], \end{aligned} \quad (3)$$

where Var_t^p and Cov_t^p denote the variance and covariance of the subjective conditional distribution of private agents. This is a “Fisher equation” where the nominal interest rate is the sum of expected inflation, real interest rate, and an inflation risk premium which depends on the second moments of π and m . This expression is approximately correct for any distribution provided the risk premium is a small fraction of the interest rate.¹

There is a corresponding forward rate version of the Fisher equation. Let $f(t, \tau, T)$ be the nominal forward interest rate at trade date t for the investment period from τ to T (with $t \leq \tau < T$). It will turn out to be convenient to merge the forward real interest rate and the risk premium into

¹ This can be shown by using the fact $E_t e^{-\pi+m} = E_t e^{-\pi} E_t e^m + \text{Cov}_t(e^{-\pi}, e^m)$ and using $\ln(1+x) \approx x$ for small x . See Shiller (1990) for an application to the term premium.

a “risk adjusted real forward interest rate,” denoted $r(t, \tau, T)$.² The forward rate version of the Fisher equation is then

$$f(t, \tau, T) = E_t^p \pi(\tau, T) + r(t, \tau, T). \quad (4)$$

Central bankers and others are interested in both accurate predictions of future inflation, and in measuring the inflation expectations of the public. It is not surprising that a whole range of methods are used: from large-scale macro economic models to surveys. The use of nominal interest rates as indicators of inflation expectations has recently gained wide popularity. The main reasons are probably the following. First, interest rates are easily and quickly available. Second, they are market prices. This means that they should react quickly to news and changing circumstances. It also means that they matter for a lot of people, so they are likely to summarize meaningful information.

It is therefore interesting to study if interest rates are useful indicators of inflation expectations. Are they unbiased? How precise are they? A simple way of doing that is to compare the *simple forward rate rule*

$$\text{estimate of } E_t^p \pi(\tau, T) = \alpha + f(t, \tau, T), \quad (5)$$

with the slightly more complicated *projection rule*

$$\text{estimate of } E_t^p \pi(\tau, T) = a + bf(t, \tau, T), \quad (6)$$

where b is the coefficient we would obtain from running a (large sample) regression of the form (6). Let $\text{Var}(\cdot)$ and $\text{Corr}(\cdot)$ denote population vari-

² The risk adjusted real forward interest rate is the sum of the forward real interest rate, the inflation risk premium, and the difference between the nominal and the real forward term premia (see Söderlind and Svensson (1997)).

ances.³ The b coefficient can then be shown to be

$$b = \frac{1 + \rho\sigma}{1 + \sigma^2 + 2\rho\sigma}, \text{ where} \quad (7)$$

$$\sigma^2 = \text{Var} [r(t, \tau, T)] / \text{Var} [E_t^p \pi(\tau, T)] \text{ and} \quad (8)$$

$$\rho = \text{Corr} [E_t^p \pi(\tau, T), r(t, \tau, T)]. \quad (9)$$

The projection rule, (6)-(9), has some nice optimality properties within the class of rules of the type $\gamma + \beta f$, that is, those that use only the interest rate (in a linear way) to predict $E_t^p \pi$. This is a very small class indeed, but it is a natural benchmark for the simple forward rate rule. First, the projection rule minimizes the mean squared error. Second, if $E_t^p \pi$ and f are normally distributed, then it is the rational (mathematical) expectation, and also the optimal prediction rule for any loss function which is symmetric in terms of the prediction error.⁴

From the perspective of extracting inflation expectations from the nominal interest rate, the Fisher equation splits up into inflation expectations and “noise.” This explains why the real interest rate and the risk premium do not show up individually in (7)-(9); only the sum (r) does.

Figure 1.a shows how the projection coefficient b changes as the ratio of the standard deviations of the risk adjusted real interest rate and inflation expectations, denoted σ , increases. The three curves correspond to three different values of the correlation of $E_t^p \pi$ and r , denoted ρ . The relative efficiency gain from using the projection rule instead of the simple forward rate rule is illustrated in *Figure 1.b* by the relative mean squared error (MSE). However, even if the projection rule is better than the simple rule, it can

³ They should not to be confused with the moments of the subjective distributions of private agents which carry a superscript p , or with conditional distribution which carry a subscript t .

⁴ See Granger (1969). He also shows that symmetric linear or linear plus exponential loss functions also give (7), but require adjustments of the constant in (6).

still be very poor so the need for bringing in more information is especially great. *Figure 1.c* gives some guidance to this by showing how the R^2 for the projection rule depends on σ and ρ .⁵

There are four basic cases to consider. *First*, the simple forward rate rule is a perfect predictor when the risk adjusted real interest rate is constant ($\sigma = 0$). *Second*, the simple forward rate rule is a noisy and biased predictor when the risk adjusted real interest rate is fluctuating ($\sigma > 0$) independently of inflation expectations ($\rho = 0$). The projection rule would then set $0 \leq b < 1$ (some of the movements in the forward rate are rationally ascribed to the risk adjusted real interest rate). The relative MSE and R^2 are both equal to b in this case. *Third*, a positive correlation means that the forward rate tends to be a magnified version of the inflation expectations. It is then natural that $0 \leq b < 1$, and that the forward rate becomes very informative. *Fourth*, for negative correlations, the forward rate is a dampened version of inflation expectations when σ is low: the projection rule sets $b > 1$. The projection coefficient will eventually decrease as σ increases, and at $\sigma = -\rho$ it is one so the simple and projection rules coincide.⁶

III Evaluating the Prediction Rules

We do not know b , but we could estimate it in different ways. The two main approaches are to run a regression on ex post data on inflation⁷

$$\pi(\tau, T) = a + b_{\text{ex post}} f(t, \tau, T) + \epsilon(T), \quad (10)$$

⁵ It can be shown that $\text{MSE}(a + bf)/\text{MSE}(a + f) = (1 - \rho^2)/(1 + \sigma^2 + 2\rho\sigma)$ and that $R^2 = (1 + \rho\sigma)^2/(1 + \sigma^2 + 2\rho\sigma)$.

⁶ An estimated value of b close to unity is therefore not sufficient for proving that the risk adjusted real interest rate is constant. See the discussion between Fama (1975) and Schwert and Nelson (1977).

⁷ This is the same type of ex post regression as often used for studying the expectations hypothesis of interest rates or uncovered interest rate parity. In those cases, time-varying risk premia may give $b \neq 1$. Here, it is time-varying real interest rates and/or risk premia.

or on some measure of inflation expectations

$$E_t^p \pi(\tau, T) = a + b_{E\pi} f(t, \tau, T) + \varepsilon(t, T). \quad (11)$$

The least squares estimate, $\hat{b}_{E\pi}$, from (11) can be calculated as b in (7), using sample estimates of σ and ρ . The difference between the least squares estimates of $b_{\text{ex post}}$ in (10) and $b_{E\pi}$ is

$$\hat{b}_{\text{ex post}} - \hat{b}_{E\pi} = \frac{\widehat{\text{Cov}}[\pi - E_t \pi, f]}{\widehat{\text{Var}}(f)} + \frac{\widehat{\text{Cov}}[E_t \pi - E_t^p \pi, f]}{\widehat{\text{Var}}(f)}, \quad (12)$$

where E_t denotes the rational expectations, and a “hat” marks a sample estimate.⁸ The first term on the right hand side of (12) captures the sample covariance between the interest rate and the innovation in inflation, which should go to zero as the sample size increases. The second term is the systematic expectation error of private agents in this sample. This term is zero if private agents make completely rational (unbiased and efficient) forecasts, and it would go to zero as the sample size increases if private agents make at least unbiased forecasts.

The major advantage of the ex post regression (10) is that it does not use data on inflation expectations (which we may want to predict by using the estimated b coefficient). There are also several disadvantages. First, $\hat{b}_{\text{ex post}}$ may be heavily biased by systematic expectation errors (non-rational expectations or “peso” problems). Second, ex post data does not allow us to estimate σ and ρ , and the value of b does not tell us anything about the relative MSE of the projection rule or the fit (R^2). For instance, Figures 1.a-c show that $b = 0.5$ can be associated with a relative MSE and an R^2 of anything between 0.15 and 0.85 if we allow ρ to be between -0.7 and 0.7.

Survey data gets around these problems, but at a price: there is usually little to stop people from giving nonsense answers (or worse). We can par-

⁸ See Froot (1989) for a related decomposition.

tially control for this by comparing different surveys, and by comparing with other types of forecasts.

But, why should we be interested in any prediction rules if we believe that existing surveys provide accurate measures of inflation expectations? There are several reasons. First, financial prices provide much quicker information than surveys. This may be important for policy decisions, but also in other cases where we need a proxy for inflation expectations (for instance, in macroeconomic simulation models). Second, surveys are typically available for much fewer forecasting horizons than interest rates. The idea is therefore to evaluate the simple forward rate rule and the projection rule for the frequencies/horizons for which we have reliable survey data. If a regular pattern is found, then it might be reasonable extrapolate the results to other frequencies/horizons.

IV Empirical Assessment of the Simple Forward Rate Rule on US Data

IV.1 Main Results from Ex Post and Survey Data

This section reports results for the sample 1953 (when the CPI was redefined) to 1995. The data, shown in *Figures 2.a-b*, consists of semi-annual (June and November) observations of the Livingston survey of inflation expectations over the next twelve months, twelve month inflation, and a twelve month interest rate.⁹

The results from running the regressions (10) and (11) are shown in *Table*

⁹ The CPI is for urban consumers, all items. The zero coupon interest rates are estimated by McCulloch and Kwon (1993) (-1990:IV) and Bliss (1994) (1991:I-). The Livingston survey of inflation expectations is taken from Carlson (1977) (-1965) and the Federal Reserve Bank of Philadelphia (1966-).

1. Survey data gives a regression coefficient of 0.71, and the projection rule can explain 74% of the fluctuations in inflation expectations. The risk adjusted real interest rate is relatively stable and almost uncorrelated with inflation expectations.¹⁰ The mean squared error (MSE) of the projection rule is clearly lower than from the simple forward rate rule; the ratio is 0.67.

	$\hat{b}$	σ	ρ	$\frac{\text{MSE}(a+bf)}{\text{MSE}(\alpha+f)}$	R^2 of $a + bf$
Ex post	0.62				
Survey	0.71	0.62	0.07	0.67	0.74

Table 1: Regression results for one year inflation expectations. Semi-annual sample 1953:6-1995:6: $\pi(1995:6, 1996:6)$ is the last observation of ex post inflation.

The coefficient from ex post data is lower than from survey data. We see from the decomposition in (12) that this means that the survey has, on average, overestimated inflation when interest rates were high (et vice versa). The most clear cut episode of this type is the early 1980s (see Figures 2.a-b), at the end of the Volcker deflation. This observation prompts the question of how robust the results are to changes in the sample period.

One way of studying that is illustrated in *Figure 3.a*, which shows estimates from “rolling” subsamples of fifteen years. The coefficient for ex post data is very unstable with estimates as high as 1.5 for samples centered on the late 1960s/early 1970s, and as low as 0 for the sample centered on 1980. The coefficient for survey data is more stable (peaks at 1 in early 1970s and gets down to 0.4 in 1980).

Figure 3.b takes another approach by using all the data for 1953-1995,

¹⁰ This interpretation relies on an assumption of a zero marginal tax rate. With a tax rate of 30%, the risk adjusted real interest rate is less variable (the relative standard deviation is 0.51) and negatively correlated with inflation expectations (-0.53). The correct projection coefficient is, however, unaffected by the assumptions about the tax rate.

except a rolling window of five years. These curves are essentially flat, except when 1983-1985 are excluded from the estimation. A tentative conclusion is that results for the whole sample (Table 1) are mostly a product of the turbulent events during the early 1980s. If we exclude the early 1980s (perhaps because we think it represents a very rare event), then survey data gives a coefficient slightly below one and an R^2 is around 0.75, while ex post data gives a coefficient slightly above one. This means that the simple forward rate rule is close to the projection rule and that it should perform quite well.

IV.2 Other Surveys and Forecasts

The results above rely on the Livingston survey, which asks some fifty economists from business, academia, government, and trade unions about their expectations. The main advantage of this, apart from the long sample, is that the respondents are fairly close to the financial markets and “...deemed to be knowledgeable observers of the economy...” (Carlson (1977)). The main weaknesses are the fairly small number of respondents, and the fact that the survey has changed from asking about expected price level to expected inflation.¹¹

It is therefore interesting to compare the Livingston survey with the surveys and other forecasts in *Figure 4*. The Michigan survey (approximately 500 randomly chosen persons, available 1966-) has higher and more volatile inflation expectations, at least before 1980, but the overall pattern is similar to the Livingston survey. The estimated coefficient from the Michigan survey is 0.39, while the Livingston survey gives 0.49 for the same period.

The ASA/NBER survey (approximately 40 professional forecasters, avail-

¹¹ There also seems to have been an inconsistent handling of base levels and strange roundings of index numbers, especially in the early years. See Carlson (1977) for a discussion.

able 1981-) and the DRI forecasts (available 1970-) are very similar to the Livingston survey, and give almost the same coefficient estimates (controlling for the sample period). The VAR forecasts are out-of-sample forecasts from a from a second order vector autoregression of GDP growth and inflation, estimated on rolling eight year samples. They are more volatile than the Livingston survey, but give a very similar coefficient estimate.

It seems as if the Livingston survey is similar enough to other surveys and forecasts to be considered as a reasonable representation of the inflation expectations.¹²

IV.3 Levels or Differences?

The previous results are for levels of inflation expectations. In some cases a longer perspective is of interest (for instance, for analyzing medium-term growth and inflation cycles), but in other cases we are more interested in short-run changes (for instance, during episodes with rapid policy shifts).

I have therefore re-estimated (11) in terms of averages of survey data and interest rates

$$\frac{1}{k} \sum_{s=0}^{k-1} E_{t+s}^p \pi(t+s, T+s) = a + b_{E\pi} \left[\frac{1}{k} \sum_{s=0}^{k-1} f(t+s, t+s, T+s) \right], \quad (13)$$

and also in differences

$$E_t^p \pi(t, T) - E_{t-k}^p \pi(t-k, T-k) = a + b_{E\pi} [f(t, t, T) - f(t-k, t-k, T-k)]. \quad (14)$$

The results, for the longest possible common sample, are shown in *Table 2*. The coefficient estimate is 0.79 for five year averages, but only 0.17 for semi-annual differences. The main explanation is that inflation expectations

¹² A similar conclusion is reached by Darin and Hetzel (1995).

	$\hat{b}_{E\pi}$	σ	ρ
5 year average	0.79	0.47	0.11
2 year average	0.72	0.60	0.08
Level	0.65	0.71	0.06
5-year difference	0.42	1.17	0.00
2 year difference	0.35	1.36	-0.03
Semi-annual difference	0.17	2.01	-0.09

Table 2: Regression on various averaging and differencing of data. Semi-annual sample 1958:6-1995:6.

has higher autocorrelation than the risk adjusted real interest rate (the first autocorrelation coefficients for the semi-annual 1953-1995 sample are 0.94 and 0.72 respectively). Taking differences will therefore reduce the volatility of inflation expectations relatively more, which decreases the regression coefficient (see Figure 1.a, let $\rho \approx 0$ and increase σ).

The high autocorrelation hints at a possible problem with non-stationarity. Unfortunately, tests of (non-) stationarity is of little help, since the power is usually low. In this case, Park's (1990) J-test cannot reject the hypothesis that both the nominal interest rate and inflation expectations are non-stationary. At the same time, Park's G-test cannot reject the hypothesis that they are both stationary. In any case, the problem with spurious regressions should be taken seriously, especially since Mishkin (1992) argues that strong Fisher effects (in ex post data) are found only in subsamples with trends in inflation and interest rates.¹³

I therefore take a closer look at the estimates from the Livingston survey on the "rolling" fifteen year samples previously shown in Figure 3.a. In *Figure 5.a*, these estimates are shown together with the local trends in inflation

¹³ Evans and Lewis (1995) explore the consequences of non-stationarity and switching inflation regimes for the small sample properties of estimated cointegrating vectors of ex post inflation and interest rates.

expectations and interest rates (calculated as the mean growth rates over the fifteen year sample). Data is consistent with Mishkin's argument up to the early 1980s, even if there is a tendency for the coefficient to increase before the trends do (in the late 1960s). However, the negative trend at the end of the sample is as strong as the positive trend during the 1970s, but the regression coefficient is less than half the size.¹⁴ This would not have been evident in Mishkin's sample, which ended in 1990. It can also be shown that regressions on changes in inflation expectations, which should be unaffected by (linear) trends, show a similar time pattern. Both these pieces of evidence suggest that there is more to the relation between inflation expectations and interest rates than just common trends.

Figure 5.b shows the estimated coefficient together with the estimated relative volatility (σ) and correlation (ρ). It hints at an alternative explanation. The coefficient is high for samples centered on the early 1970s and low ten years later. At the same time, the relative volatility of the risk adjusted real interest rate increases dramatically, probably due to the very active monetary policy after 1979.

IV.4 Other Forecasting Horizons

All results above have been for twelve month inflation. It can be shown that we get very similar results for inflation over six months, and also for the six months starting six months ahead.

For longer horizons, both the ex post data and VAR predictions give very low coefficient estimates on the full sample 1953 to 1986 (the last available observation of ex post ten year inflation is 1986 to 1996). Unfortunately,

¹⁴ The decrease in inflation after 1980 was no more rapid than the increase in inflation after 1972 (see Figure 2.a), so the dynamics of the increase/decrease is probably not an issue.

there are not many surveys to compare with, and none of them goes very far back in time. One of the few long horizon surveys is the “Combined Survey,” which Philadelphia Fed have put together from various sources to get a reasonably long sample (the Blue Chip survey, the Livingston long-horizon survey, and the ASA/NBER survey). It contains expectations of (approximately) ten year inflation and is available from 1979.

We therefore have both ex post and survey data for the very short sample 1979 to 1986. For this sample, ex post data gives an estimate of -0.01, and the Combined Survey 0.33. This suggests that the ex post results for long horizons may be heavily affected by systematic expectations errors. Even so, 0.33 is far from one, but we should perhaps recall that this particular subsample, which is centered on the Volcker deflation, gave very low estimates also for the one year horizon (see Figure 3.a).

IV.5 Should We Believe in the Assumptions?

This section reviews and discusses some of the main assumptions in the analysis above.

There is no need for *rational expectations* when we use survey data. Strictly speaking, it is not necessary for the VAR forecasts or the ex post data either, but not far from it. What is required is that the expectations errors of private agents are uncorrelated with the interest rates. This is implied by rational expectations, but the converse implication holds only under special circumstances (for instance, with a normal distribution).

The Fisher equation (3) holds if the inflation rate and the real discount factor have a joint *conditional normal distribution*. Otherwise, it is only approximately correct for any distribution with finite second moments, and the approximation error is small if the risk premium is a small fraction of the

interest rate (see footnote 1).

We can get a picture of the conditional distributions by using survey data. The ASA/NBER survey asks for probabilities of different intervals of growth of the GDP deflator (available 1968:IV-) and real GDP (available 1981:III-) during the current calendar year. The number of intervals has changed over time: it is between six and fourteen for the deflator, and between six and ten for real GDP. I use the data for the first quarter as an approximation to the subjective distributions of twelve month inflation and real stochastic discount factor.¹⁵ Pearson’s chi-square test (see, for instance, DeGroot (1986)) rejects the hypothesis of normality at the 5% level in fifteen out of twenty-eight years for the GDP deflator, and in five out of fifteen years for real GDP. The difference between actual probabilities and probabilities implied by estimated normal distributions is usually very small. It is usually no more than one or two percentage points, and, with one exception, it is always less than five percentage points. The exception is in 1986:I when the distribution of real GDP growth has a pronounced bimodal pattern.

The theoretical Fisher equation (3) contains the *continuously compounded inflation rate*. However, most inflation surveys are best thought of as expected “simple” inflation rates. Under the assumption of conditional normality, this means that the survey includes a “Jensen’s inequality” term. However, the time series of estimated standard deviations from the ASA/NBER survey (see above) show that the Jensen’s inequality term, $(T - t)\text{Var}_t^p(\pi)/2$, is very stable compared to the mean (the ratio of standard deviations is less than 1/13). It is therefore unlikely to have any significant effect on the results.

¹⁵ In many macro models the log real discount factor is a linear function of the growth in consumption, and the model solutions often imply that the innovations in consumption is approximately proportional to the innovation in income (and therefore have the same shape of the conditional distribution).

It was noted in Section II that the projection rule uses the interest rate in an optimal way (for any loss function which is symmetric in the prediction error) if inflation expectations and nominal interest rates are *asymptotically normally distributed*. I therefore test the hypothesis of normality of the Livingston survey and the twelve month interest rate (previously shown in Figures 2.a-b), with a standard chi-square test (see, for instance, Harvey (1989)). The critical values are generated by a Monte Carlo experiment to account for the exact sample length and the autocorrelation in data. Normality of the Livingston survey cannot be rejected at any reasonable significance level, but the interest rate is a border line case (rejection at the 9.7% level). The projection rule is, of course, still optimal for quadratic loss functions.

V Empirical Assessment of the Simple Forward Rate Rule on UK Data

This section reports some results on a short UK sample (quarterly data for 1986:III to 1994:II). *Table 3* shows results for inflation over the next year and the year after next. Once again, ex post data gives low regression coefficients, VAR forecasts similar or somewhat higher coefficients, and survey data significantly higher coefficients.

	$\hat{b}$ for year 1	$\hat{b}$ for year 2
Ex post	0.19	-0.38
Barclay's survey	0.44	0.30
Resursive VAR	0.33	-0.40
Index-linked bonds (Bank of England)	0.86	0.82
Index-linked bonds (Evans)	0.53	0.60

Table 3: Regression results for quarterly UK sample 1986:III-1994:II.

The most interesting results, however, are for the inflation expectations

calculated from combining nominal and index linked bonds. Table 3 shows results based on two different estimates of the real interest rate: by Bank of England (see Deacon and Derry (1994)), and Evans (1996). These estimates differ in terms of how the inflation over the indexation lag is treated, and in how the forward rate curve is estimated from available maturities.

The data from Bank of England gives coefficients slightly above 0.8, and the data from Evans gives coefficients between 0.5 and 0.6. The difference is explained by the relatively high volatility of Evans' data. There are, however, few index-linked bonds with short maturities so the estimates of the short real interest rates are fundamentally uncertain.

In spite of these differences, both set of results from the index-linked bonds give higher coefficients than the survey. This is probably due to sampling errors, especially since the sample is so short (limited by available surveys). Another, and perhaps more intriguing, explanation is that UK nominal interest rates might predict the inflation risk premia better than inflation expectations. The motivation for this argument is that the regressions using data from index-linked do not have inflation expectations as the left hand variable, but the nominal minus the real interest rate, that is, inflation expectations plus the inflation risk premium.

VI Conclusions

Nominal interest rates are increasingly used as indicators of inflation expectations, probably because they are easily and quickly available for many different forecasting horizons. The main purpose of this paper is to study if interest rates would have been good indicators of inflation expectations in the US over the postwar period. I also take a brief look at the UK.

I compare a simple forecasting rule which postulates that inflation expectations are equal to the nominal interest rate (plus a constant), with a rule which uses the nominal interest rate in an optimal way. I study the average squared prediction error (MSE) from these rules, and also how much we can learn about inflation expectations by using the nominal interest rate only.

My main data set consists of the semi-annual Livingston survey of expectations of twelve month inflation, together with the corresponding ex post inflation, and nominal interest rate, for the period 1953 (when the US CPI was redefined) to 1995. This data show that the simple forecasting rule would have worked fairly well for predicting the level of inflation expectations for most of the post war period. The early 1980s is a notable exception, since the very volatile real interest rates during this period weakens the link between nominal interest rates and inflation expectations.

The results from ex post data are, on average, less favorable to the simple rule, than the survey data. They are also less reliable since they vary a lot between subsamples. The idea behind the ex post regression is that, under rational expectations, the difference between expected and actual inflation should be uncorrelated with the interest rates. However, this may easily fail in a small sample if, for instance, the economy is hit by a series of unprecedented inflation shocks (as in the 1970s). The difference between the results for the ex post data and for the survey data suggest that this is an important factor behind many of the traditional results on the Fisher effect.

Nominal interest rates seems be able to predict much of the variations in the level of inflation expectations, perhaps as much as three quarters. This fraction is may even be somewhat larger if we consider average inflation over a few years, but it is clearly smaller for changes in inflation. The reason seems to be that real interest rates and risk premia have relatively more short-run

movements than inflation expectations.

There are several other possible proxies for inflation expectations, but usually for shorter samples. I compare my main measure, the Livingston survey, with the Michigan and ASA/NBER surveys, the DRI forecasts, and out-of-sample forecasts from a simple vector autoregression of inflation-out. They all give results which are similar to those from the Livingston survey (controlling for the sample period).

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Figure 1: Properties of the projection rule $E_t^p \pi(t, \tau, T) = a + bf(t, \tau, T)$ as a function of relative standard deviation (σ) of the risk adjusted real interest rates and inflation expectations and their correlation (ρ) .

Figure 2: Livingston survey of one year inflation expectations, actual inflation, and one-year interest rate.

Figure 3: Regression coefficient ($\hat{b}$) for a moving sample of ± 7.5 years around t (a); for the whole 1953–1995 sample except ± 2.5 years around t (b).

Figure 4: Inflation expectations according to different surveys and forecasts.

Figure 5: $\hat{b}$ (survey data) for a moving sample of ± 7.5 years around t together with absolute value of trend growth (a) and estimated σ and ρ (b).