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Stock Returns, Inflation, and Economic Activity: The Survey Evidence

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ABSTRACT

The primary purpose of this paper is the use of survey expectations data to study the empirical relationships between stock returns, inflation, and economic activity. In the course of this analysis and as a secondary purpose, the paper discusses general considerations involving the use of expectations proxies and makes recommendations for econometric techniques. The main empirical findings are: (1) Hypothesized relationships between expected economic activity and expected inflation do not in practice appear to be important in explaining the negative relationship between expected inflation and stock returns. (2) Nevertheless, the survey data do lend some support to the hypothesis of a quantity theory relationship between expected inflation and expected economic activity, holding constant monetary growth. (3) The cross-forecaster dispersion of economic activity forecasts, a proxy for real uncertainty, appears to be a significant determinant of stock returns. Inclusion of this variable eliminates the negative impact of expected inflation.

THE EARLY STUDIES IN stock returns and inflation obtained the now-familiar result of a negative relationship using *ex post* data. Additional studies encountered a more troubling result—that stock returns appeared to be negatively related to expected inflation as well, contrary to theoretical presupposition.[1] Such analyses have relied on proxies for expected inflation, however, and the strength of the findings seems at least in part dependent on what proxy is used. With expected inflation measures constructed from time series models or implicit in Treasury bill yields, the negative relationship is invariably significant. Using the Livingston survey measure of expected inflation, Gultekin [14] found a negative but insignificant relationship between actual returns and expected inflation.[2] However, in a critical examination of the properties of alternative inflation forecasts, Fama and Gibbons [9] found the Livingston forecasts dominated by time series projections. Given that the latter seem to provide the best forecasts of inflation, it is troubling that they are significantly negatively related to real realized stock returns. Considering the relatively poor performance of the Livingston expected inflation measure, the finding that it is not significantly negatively correlated with real stock returns cannot be viewed as definitive.

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[1] See Jaffe and Mandelker [16], Nelson [26], Fama and Schwert [10], and Friend and Hasbrouck [12].

[2] See Table IV, Panel B, the CPI specification, p. 671. Gultekin also found a positive relationship between expected forward inflation and stock returns, but the reasonableness of the expected stock return series from the Livingston data has been criticized by Lakonishok [18].

Along another line, Fama [8] attempted to explain the relationship between expected inflation and stock returns as an induced consequence of a negative relationship between inflation and real activity. In Fama's development, this underlying relationship is due to a Fisherian quantity theory mechanism. Geske and Roll [13] attempted to establish a similar link, but hypothesized a mechanism driven by policy reaction. In their view, economic downturn is accompanied by lower tax receipts, monetization of the resulting deficit, and finally inflation.

The common assertion of both theories is a link between expected inflation and expected economic activity. (A relationship between, say, expected inflation and unexpected economic activity would violate rationality.) Also common to both studies is the utilization of actual *ex post* data for inflation and economic activity in the empirical analyses. As acknowledged by Fama, hypothesized relationships among expectations are more properly investigated using expectations data if such data exist. While a number of proxies for expected inflation have long been available, this has not been the case for economic activity measures. The Livingston surveys of economists' predictions do contain such data, however, and these expectations measures have been studied by Brown and Maital [6]. The primary purpose of this paper is the use of this data to illuminate the interrelations among stock returns, expected economic activity, and expected inflation.

In using survey data to address a question of such importance, the validity of the expectations proxies must be critically examined. Tests for unbiasedness and information utilization have been proposed and carried out by other researchers. This study examines in a general fashion the use of proxies for expectations as explanatory data in econometric specifications and proposes a simple test to detect measurement error. With respect to the present purpose, this analysis aims to provide a framework for critically examining the efficacy of the expectations proxies in the stock return estimations.

In addition to the possibility of directly testing for a link between expected inflation and expected economic activity, the survey data may be exploited in another useful fashion. This paper uses the cross-forecaster dispersion of expectations of economic activity as a proxy for expected real uncertainty. In this, we follow Wachtel [30], Levi and Makin [19], and Bomberger and Frazer [5], who used this procedure for expectations of inflation.

The key empirical results of this analysis are the following. First, the inclusion of expected and unexpected economic activity in stock return specifications results in little impact on the (negative) coefficient of expected inflation. Second, the Livingston forecasts of economic activity are somewhat negatively related to expected inflation when monetary growth is held constant in a quantity theory specification. The third principal finding concerns the role of the proxy for real uncertainty in the stock return regressions. The relationship between this proxy and real realized returns is positive, as would be suggested by theory. More significantly, when this variable is included in the return specification along with economic activity and expected inflation, the coefficient of the latter is dramatically affected. The coefficient of expected inflation using the Livingston expected inflation proxy becomes positive (but not significant), while that of the T-bill proxy remains negative but of no statistical significance. Thus, it appears that when economic activity and real risk are included in the set of explanatory variables, the relationship between expected inflation and realized stock returns vanishes.

The remainder of the paper is organized as follows. Section I examines in a general fashion the use of expectations proxies in the estimation of structural models and proposes simple validity tests. Section II describes in detail the data and construction of the expectations series used. Discussion and estimation of stock return specifications using the expectations data are presented in Section III. The relationship between expected inflation and expected economic activity is discussed in Section IV, and a brief summary in Section V concludes the paper.

I. Expectations Data: Errors in Measurement

This section is a critical discussion of the use of proxies for expectations of economic variables as explanatory data in econometric analyses. It often happens that the expected and unexpected components of an economic variable enter a theoretical model in different ways, and it is common practice to reflect this difference in the empirical specification. Many of the stock return and inflation studies cited in the introduction, for example, estimate relationships with proxies for expected and unexpected inflation as separate variables, and the estimated coefficients are supposed to capture the separate effects of the two components. Such proxies are inevitably subject to measurement errors, however, and it is the purpose of the following analysis to clarify the consequences of such errors for estimation.

Typically, as a first step in estimating a relationship calling for expectations data, the econometrician uses the realized value as a proxy for the expected component, and omits the unexpected component. As discussed by McCallum [21], this approach presupposes the rationality of expectations, and interprets the realization as the expectation plus a zero-mean measurement error. Refinement usually takes the form of a proxy series for the expectation (from survey data, time series modeling, etc.), leaving the unexpected component to be computed as a residual. The question then naturally arises as to whether this additional refinement is valid or worthwhile.

At a bare minimum, the proxy must be arrived at in some economically reasonable fashion. Also, at the current state of knowledge, the proxy will be more plausible if it statistically satisfies various rational expectations conditions. Nevertheless, these criteria do not directly address the question. Assuming knowledge of the relevant joint distribution, the actual *ex post* value conveys information about the expected value. Therefore, a more refined proxy for the expectation is useful only to the extent that it conveys more information than does the *ex post* realization. Equivalently, this means that the distribution of the true expected value, conditioned on both the realization and the proxy, is different from that conditioned on the realization alone. Henceforth, proxies that satisfy this condition will be termed incrementally informative.

Specification analysis may be used to formalize various aspects of this situation. In particular, it will be shown that when proxies for expected and unexpected values are used as explanatory variables in a linear regression, a decomposition which is not incrementally informative in the above sense will lead to identical coefficient estimates for the two components. Furthermore, this circumstance may arise even when the proxy series satisfies certain common rationality properties.

Denote by x the actual *ex post* value of an economic variable. Let x^e and x^u denote the true but unobservable decomposition into *ex ante* expected and unexpected components, and let $\tilde{x}^e$ and $\tilde{x}^u$ denote the observable proxy series. The precepts of rational expectations suggest *inter alia* that expectations are unbiased, $E[x^u] = 0$, and also that expected and unexpected components are independent, $\mathrm{Cov}(x^e, x^u) = 0$. Consider first the problem that may arise when the proxy series are used as independent variables in a linear regression. Suppose that the true relationship is given by

$$y = b_1 x^e + b_2 x^u + e \tag{1}$$

where y is the dependent variable, e is the disturbance, and x^e and x^u are assumed strictly exogenous. Since both true and observable decompositions must sum to the same *ex post* value, we have $x^e + x^u = \tilde{x}^e + \tilde{x}^u$, and (1) may be written

$$y = b_e \tilde{x}^e + b_e \tilde{x}^u + (b_e - b_u) x^u + e \tag{2}$$

Lacking knowledge of the true x^u, the econometrician will actually estimate

$$y = c_e \tilde{x}^e + c_u \tilde{x}^u + \epsilon \tag{3}$$

Estimation of (3) when the true relation is (2) is the familiar omitted variable problem. Assume for simplicity that the observed decomposition satisfies the independence requirement, $\mathrm{Cov}(\tilde{x}^e, \tilde{x}^u) = 0$. A straightforward specification analysis (see Johnston [17, p. 168]) shows that

$$\begin{aligned} E[c_e] &= \left[1 - \frac{\mathrm{Cov}(\tilde{x}^e, x^u)}{\mathrm{Var}(\tilde{x}^e)}\right] b_e + \frac{\mathrm{Cov}(\tilde{x}^e, x^u)}{\mathrm{Var}(\tilde{x}^e)} b_u \\ E[c_u] &= \left[1 - \frac{\mathrm{Cov}(\tilde{x}^u, x^u)}{\mathrm{Var}(\tilde{x}^u)}\right] b_e + \frac{\mathrm{Cov}(\tilde{x}^u, x^u)}{\mathrm{Var}(\tilde{x}^u)} b_u \end{aligned} \tag{4}$$

We turn now to a formal characterization of the informativeness of the observable decomposition. An observable decomposition will be considered (incrementally) *noninformative* if it contains no information about the true decomposition beyond that contained in the actual realization. That is,

$$E[x^e, x^u \mid \tilde{x}^e, \tilde{x}^u] = E[x^e, x^u \mid \tilde{x}^e + \tilde{x}^u] = E[x^e, x^u \mid x]$$

Assuming for convenience that all the relevant variables are jointly normally distributed, the conditional expectation, say of x^u, may be written as the linear function

$$E[x^u \mid \tilde{x}^e, \tilde{x}^u] = d_e \tilde{x}^e + d_u \tilde{x}^u \tag{5}$$

If the observed decomposition is noninformative, $d_e = d_u = d$, since $E[x^u \mid \tilde{x}^e, \tilde{x}^u] = dx$. Now, since

$$d_e = \mathrm{Cov}(\tilde{x}^e, x^u)/\mathrm{Var}(\tilde{x}^e) \quad \text{and} \quad d_u = \mathrm{Cov}(\tilde{x}^u, x^u)/\mathrm{Var}(\tilde{x}^u),$$

equality of these coefficients implies in (4) that $E[c_e] = E[c_u]$, i.e., the sample coefficients of expected and unexpected components are expected to be equal. In essence, the measurement error has smeared the coefficients to the point of indistinction. Note too that this situation exists in the presence of the rational expectations independence requirement.

This analysis suggests that when an observable decomposition is employed on the right-hand side of an estimation, both expected and unexpected components should be included, irrespective of any prior exclusion restrictions suggested by the underlying theory. If the estimated coefficients are not found to differ statistically, we may not reject the null hypothesis that the observable decomposition is incrementally noninformative.

The preceding discussion has been conducted from the vantage point of an econometrician engaged in historical analysis and has attempted to ascertain the efficacy of observable proxies for expected and unexpected variates. Before proceeding to the implementation of the suggested tests, however, two final aspects concerning incremental informativeness must be discussed. These are first the relationship between the incremental informativeness and the conventional definition of *ex ante* rationality, and second the sources of measurement error that are likely to lead to incremental noninformativeness.

Both issues will be addressed in the following framework. Let $\tilde{x}^e = x^e + v$ and $\tilde{x}^u = x^u - v$, where v is the measurement error with properties which are yet to be specified. Suppose first that v is a random term spuriously added to the true expectation x^e to arrive at the observed expectation. In the context of the survey data, this might hypothetically arise from a tendency to report round numbers, or perhaps a systematic behavioral tendency by all forecasters to shade their "public" forecasts to one side of their private expectations. (The effect of individual uncorrelated random errors would be largely eliminated in the averaging.) Since this error would be uncorrelated with the true unexpected disturbance, x^u, however, the value of d_e in (5) would be zero, leading to $d_e \neq d_u$; such a source of error would lead to a decomposition that would be at least partially incrementally informative.

It might be reasonably conjectured that the measurement error stems from different information sets underlying the two forecasts. The properties of the Livingston data, for example, do not permit the identification of a precise time when expectations were formed. Accordingly, it is quite possible that the Livingston respondents had access to more (or less) information than did the stock market participants. Let I and $\tilde{I}$ be the information sets underlying the true and observed expectations measures, that is, $x^e = E[x \mid I]$ and $\tilde{x}^e = E[x \mid \tilde{I}]$. Suppose that the information set underlying the true expectation expands on that underlying the observed, that is, $\tilde{I} \subset I$. Then e will be the innovation in expectations based on the additional information. However, since this innovation will be uncorrelated with x^u, we have again that $d_e = 0$ in (5), ruling out incremental noninformativeness. A similar argument may be made concerning the reverse case, $I \subset \tilde{I}$.

The conclusion that must be drawn is that we are likely to observe incrementally noninformative decompositions if the two underlying information sets are unequal and neither one is contained in the other. Unfortunately, such a situation is indeed likely to arise when we attempt to measure the expectation at a point in time with survey data collected over an interval bridging that point. The mean prediction will reflect information not available at the point of interest, and the true expectation at that point will reflect information not available to the early respondents.

II. Data Description and Preliminary Analysis

The following is a list of the principal variables used in this study:

- $\dot{p}_t$ Inflation measured by the continuously compounded annualized rate of change in the CPI from the end of period $t-1$ to the end of period t.
- x_t Economic activity: the continuously compounded annualized rate of change in the Federal Reserve Board total industrial production index.
- r_t The real realized rate of return on the CRSP value-weighted stock portfolio, equal to the nominal return less inflation over the period.
- GMB_t Continuously compounded annualized rate of change in the monetary base (St. Louis Federal Reserve Bank, seasonally adjusted).

In addition, a number of proxies for expectations of two of the above variables were employed. For one of the two inflation expectations proxies, the sole expected economic activity expectations measure, and the proxy for expected risk, this study relies on the Livingston survey data. Each June and December since 1946, Joseph Livingston, an economic and business writer with the Philadelphia Inquirer, has conducted a poll of economists concerning their predictions of certain key economic variables over horizons ranging from six months to several years. This valuable source of data has been tapped by numerous researchers, and the inflation forecasts in particular have been extensively studied.[3] Of particular importance for this study are expectations of inflation and the rate of economic growth. It should be noted that the Livingston questionnaires actually solicit predictions of the *levels* of the key variables: the consumer price index and the Federal Reserve Board total industrial production index. Computation of a rate of change requires determination of a base level. In this study, the base level was taken as the most recent value supplied on the actual questionnaire, and an annualized rate of change was computed using the six-month forecast, usually resulting in an eight-month forecasting horizon.[4] The average predicted level was computed from the raw survey responses to avoid the adjustments Livingston made to the data prior to reporting the summary statistics (see Carlson [7]). Actual rates of change were computed over the same horizon as the forecast, but using the latest revised series.

[3] The Livingston inflation forecasts have been analyzed by Carlson [7], Wachtel [30], Mullineaux [24, 25], Figlewski and Wachtel [11], and Bomberger and Frazer [5]. Perhaps the most comprehensive examination of the Livingston expectation series has been conducted by Brown and Maital [6], who critically examined the unbiasedness and rationality characteristics.

[4] It has been suggested that the respondents might actually have had access to figures more timely than those on the questionnaire. Alternative analyses were made on the assumption that May and November values were available, but the key results were not materially affected.

It was noted in the introduction that the strength of the negative relationship between stock returns and inflation has been found to depend on the expected inflation proxy employed. An alternative proxy suggested by Fama and Gibbons (and termed by them the "naive interest rate model") arises as a consequence of the Fisher relationship. This familiar equation expresses the current observable nominal interest rate as the sum of the expected inflation rate and the expected real rate. The expected inflation rate is obtained by subtracting from the nominal rate a proxy for the expected real rate computed as a recent average of realized real rates. Fama and Gibbons note that this proxy exhibits statistical and predictive characteristics highly similar to those of a more elaborate time series model in which the expected real rate is assumed to evolve as a random walk.[5] Furthermore, they show that the forecasting performance of this proxy is relatively good over the 1953–1977 sample period. In a preliminary analysis, this finding was duplicated for the series in this study over the same period, but, subsequent to October 1979, the performance deteriorated markedly and fell quite short of that of the Livingston proxy. This is undoubtedly a consequence of the shift in Federal Reserve policy occurring at that time. For this reason, use of this proxy was limited to the period before October 1979 and, to ensure comparability, analyses involving the Livingston proxy will also be presented using samples prior to this period. (The results are not significantly affected in the Livingston case when the estimations were extended to 1981.[6])

To serve as a proxy for expected uncertainty in the Livingston forecasts, cross-forecaster dispersion was used. Specifically, the proxy was computed as the standard deviation across forecasters of their log forecasts for the six-month horizon, denoted $s(E_{t-1}x_t)$. The cross-forecaster dispersion of the inflation forecasts similarly defined has been examined by Wachtel [30], Levi and Makin [19], and Bomberger and Frazer [5]. A plot of $s(E_{t-1}x_t)$ is presented in Figure 1. The highest levels of forecast dispersion are evident in the post-WW II period; economists were torn between predictions of growth or dire post-war depression. The series falls off sharply, however, and the average level seems to rise only

[5] More precisely, the procedure for constructing the T-bill proxy was as follows. Denote by R_t the (annualized) nominal interest rate on three-month T-bills at the beginning of month t. Departing slightly from the notation in the text, let $\dot{p}_t$ be the (annualized) three-month inflation rate in months t to $t+2$. Then the real return on a three-month T-bill purchased at the beginning of month t is $RR_t = R_t - \dot{p}_t$, and this is observable at the beginning of month $t+3$. The average of the nine most recently observed RR_t's is used to proxy for the expected real return: $\overline{RR}_t = [RR_{t-11} + RR_{t-10} + \cdots + RR_{t-3}]/9$. The expected inflation rate is then $R_t - \overline{RR}_t$.

This differs from the Fama and Gibbons procedure in that they used price (rather than yield) quotes on T-bills one month from maturity to compute an implied one-month interest rate and a one-month expected inflation rate. To obtain comparability with the Livingston forecasts, they then extrapolated the one-month forecasts over eight months. In a similar fashion, this study extrapolates the three-month expected inflation rate computed above. Statistical properties of this proxy were quite close to those reported for the Fama and Gibbons proxy, especially in regard to predictive accuracy (their Table 5).

[6] The question may be raised as to why a time series forecast of economic activity was not attempted as an alternative to the Livingston forecast. As noted by Fama [8], rates of growth in real output measures strongly resemble white noise. Although a high-order ARIMA forecasting model could undoubtedly be developed, it would not possess much plausibility as an expectations-formation mechanism.

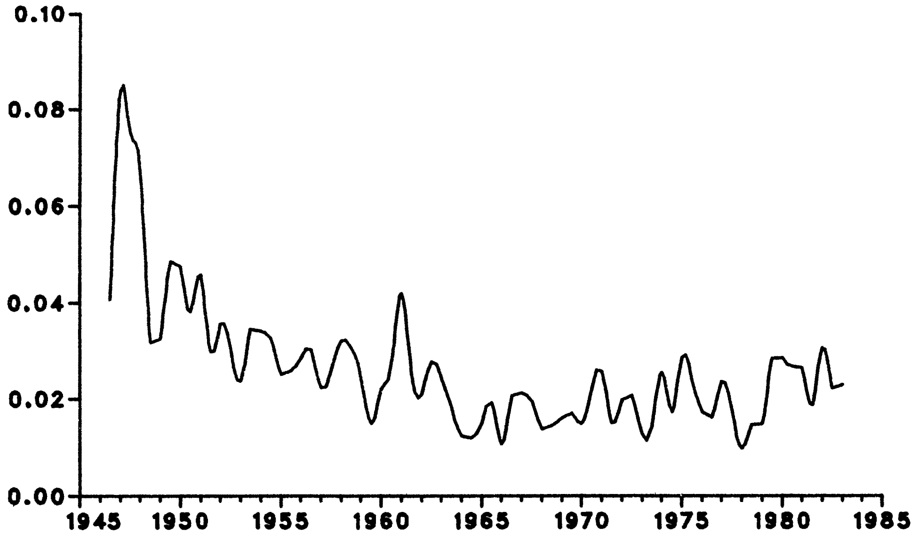

Figure 1. Standard Deviation (Across Forecasters) of the Logarithm of Predictions of the Industrial Production Index (Eight Months Ahead), ($s(E_{t-1}x_t)$)

modestly in the 1970s, contrary to anecdotal evidence in support of a large increase in real uncertainty.

As $s[E_{t-1}x_t]$ will subsequently play an important role in the data analysis, it is necessary to examine its suitability as an uncertainty proxy. In the case of the dispersion of CPI predictions, Bomberger and Frazer looked at the correlation between this variable and a lagged average of actual forecast errors. This procedure was not applied to the industrial production forecasts for several reasons. First, rates of change in industrial production are not characterized by serial correlations of the sort evident in inflation series. Second, the dispersion series itself appears to exhibit no substantial autocorrelation. Finally, casual observation suggests that real uncertainty may indeed vary considerably from period to period, being somewhat higher at times considered to be "turning points."

As an alternative procedure, this study examined the relationship between the *ex ante* dispersion, $s[E_{t-1}x_t]$, and the size (absolute value) of the *ex post* unanticipated rate of change. Over the 1946–1981 period, the simple correlation between these variables was found to be 0.553 (with an associated t-statistic of 5.55). An alternative nonparametric test, the Kendall rank correlation, concluded that the null hypothesis of no relationship could be rejected with a probability in excess of 0.999. It should be noted that these significance levels may be overstated since the observations are slightly overlapping.

Table I reports the bivariate correlations between the explanatory variables used in this study. (Those involving GMB relate to the discussion in Section IV). Ignoring the problem of overlapping observations, correlations greater in magnitude than approximately 0.27 would be significant at the 0.05 level (two-tailed). Not surprisingly, the two expected inflation measures are highly correlated with each other, as are their corresponding unexpected components.

Table I

Bivariate Correlation Matrix of Variables

	$E\dot{p}_t$ (Liv.)	$\dot{p}_t - E\dot{p}_t$ (Liv.)	$E\dot{p}_t$ (T-bill)	$\dot{p}_t - E\dot{p}_t$ (T-bill)	Ex_t (Liv.)	$x_t - Ex_t$ (Liv.)	$s(Ex_t)$	GMB_t
$E\dot{p}_t$ (Liv.)	1.000							
$\dot{p}_t - E\dot{p}_t$ (Liv.)	0.425	1.000						
$E\dot{p}_t$ (T-bill)	0.916	0.568	1.000					
$\dot{p}_t - E\dot{p}_t$ (T-bill)	0.015	0.512	−0.154	1.000				
Ex_t (Liv.)	0.105	−0.348	−0.109	0.118	1.000			
$x_t - Ex_t$ (Liv.)	−0.233	−0.188	−0.312	0.174	0.256	1.000		
$s(Ex_t)$	−0.368	−0.155	−0.294	−0.200	−0.452	−0.025	1.000	
GMB_t	0.814	0.306	0.674	0.183	0.253	−0.079	−0.573	1.000

Notes: 53 semiannual observations using forecasts dated May 1953 to May 1979. Expectations are formed in the prior period and hence $(*)_t - E(*)_t$ refers to the unexpected component. Terms in parentheses refer to the source of expectations data (Livingston or Treasury bill proxies). Variable definitions: x, rate of change in industrial production index; $\dot{p}$, inflation in CPI; $s(Ex_t)$, cross-forecaster dispersion in log industrial production forecasts (see text); GMB, growth in the monetary base.

Of more interest for this study is the correlation between expected inflation and expected economic activity—positive for the Livingston proxy, negative for the T-bill proxy, but insignificant in both cases. This suggests in a preliminary fashion that the survey data will not support the Fama or Geske and Roll hypotheses. However, unexpected economic activity appears to be negatively correlated with expected inflation and the relationship is significant for the T-bill proxy. This is an apparent violation of rational expectations and may be indicative of measurement problems in the expected economic activity series.

Other interesting features of the matrix are those correlations involving $s(E_{t-1}x_t)$, the proxy for real uncertainty. Bomberger and Frazer noted a positive relationship between expected inflation and uncertainty about inflation; and a positive link between expected inflation and uncertainty in *real* variables is part of contemporary lore as well. The experience of the 1970s, for example, is felt to reflect relatively high uncertainty and inflation. The correlations between $s(E_{t-1}x_t)$ and both expected inflation measures in Table I suggest, however, that the hypothesized positive relationship does not exist; the correlations are significantly negative. Furthermore, a significant negative correlation exists between $s(E_{t-1}x_t)$ and the expected growth in economic activity. Although the reasons for this are unclear, it may reasonably be conjectured that times of economic downturn are accompanied by large policy uncertainty. In any event, this negative relationship will have important ramifications for the stock return regressions to follow.

III. Stock Return Analysis

This section presents empirical results on the relationship between real realized stock returns, the expected and unexpected components of inflation and economic activity, and the risk measure discussed above. The empirical specification employed here for real realized stock returns is very similar to that of Fama:

$$r_t = a_0 + a_1 E_{t-1}x_t + a_2(x_t - E_{t-1}x_t) + a_3 E_t x_{t+1} + a_4(x_{t+1} - E_t x_{t+1}) + a_5 E_{t-1}\dot{p}_t + a_6(\dot{p}_t - E_{t-1}\dot{p}_t) + a_7 s(E_{t-1}x_t) + e_t \quad (6)$$

The real stock return, r_t, is assumed to be from the beginning of period t (= end of period $t - 1$) to the end of period t. With the exception of certain minor timing considerations, all notation for the variables is identical to that of the previous section. In particular, expectations are assumed to be formed at the end of the period, and thus E_{t-1} refers to expectations held at the beginning of the return period and E_t refers to expectations held at the end.

The first four terms after the intercept involve in some fashion the rate of change in industrial production. Use of this variable was justified by Fama on the grounds of an accelerator model for investment. In this mechanism, growth in output leads to increased returns on existing capital, and then to greater capital expenditures, which is then shown to be positively related to stock returns. It is also plausible, however, that a relationship exists between the rate of expansion and the required return on investment, in effect a cyclical dependence of the real interest rate. An econometric analysis which differentiates between expected and unexpected components of this variable may be useful in separating out these two effects.

The first term, $E_{t-1}x_t$, reflects expectations formed at the beginning of the return period, and so can affect only the expected component of the realized return. Any impact of expectations on future profits (the accelerator argument) should be reflected in the beginning-of-period stock price, and should not therefore affect the expected return. A relationship between expected growth and, say, the real required return, however, may lead to a contribution from this term.

The second term, $(x_t - E_{t-1}x_t)$, reflects the unexpected component of the growth rate contemporaneous with the return period, relative to beginning-of-period expectations. A positive value here is likely, ceteris paribus, to indicate higher contemporaneous earnings, and should therefore lead to a positive contribution to the realized return.

The third term, $E_t x_{t+1}$, involves end-of-period expectations of future growth. To the extent that a high value here reflects increased expected future earnings, there will be a positive impact of end-of-period stock price, and therefore on the realized return over the period. If, however, there is a positive relationship between the required rate of return and expected growth, a negative component may be introduced. The net effect may therefore be ambiguous.

The fourth term, $(x_{t+1} - E_t x_{t+1})$, is the unexpected component of growth occurring subsequent to the return period, relative to expectations held at the end of the return period. It is in principle unknown to market participants at the end of the return period, and its impact should therefore be nil. It is included, however, for reasons of assessing the extent of measurement errors in the expectations data as discussed in the previous section.

Terms in expected and unexpected inflation are included in the fashion conventional in these analyses. If expected inflation is unrelated to the expected real rate of return, the coefficient of $E_{t-1}\dot{p}_t$ should be zero. The sign of the coefficient of unexpected inflation should in theory be determined by an interaction of opposing factors such as taxation and transfers to creditors, but the net effect is unpredictable.

The final term, $s(E_{t-1}x_t)$, is the cross-forecaster dispersion of log predictions discussed in the previous section. It is intended to measure the level of risk as assessed at the beginning of the return period, and as such should be positively related to the expected return over the period. The exact nature of the risk measure theoretically relevant in this situation is a matter of debate, contingent on the degree of sophistication of the underlying investment-under-uncertainty model and on the empirical definition of a suitable market portfolio. This issue lies beyond the scope of the present paper; $s(E_{t-1}x_t)$ is proffered as a proxy for the unknown theoretically correct risk measure without further justification.

A strong theoretical case may be made for the inclusion of other expectational variables in (6). The Livingston surveys solicit predictions over 12- and 18-month horizons as well as six, and it might be conjectured that these variables would possess great additional explanatory power. The empirical correlation between the six-month forecasts and the more distant predictions is very high, however, leading to multicollinearity when the latter are included in the specification. It might also be supposed that revisions in expectations would be important, i.e., that a key determinant of the stock price change between $t - 1$ and t would be the revision (between $t - 1$ and t) of expectations of post-t economic activity. Again, however, the correlation between the revisions constructed from the Livingston data and end-of-period expectations was quite high. Furthermore, inclusion of the revision series usually yielded no marginal explanatory power.

In integrating the Livingston data into the above stock return analysis, a problem arises in synchronization related to the overlapping horizons of the data. One aspect of this problem noted in the last section involves forecaster ignorance of the most recent figures. This means that we will be using eight-month rates of change rather than six-month rates. Another problem occurs in that, in (6), expectations are used from both the beginning and the end of the return period. This suggests that the return should be measured over the interval between survey dates, and in practice this was approximated by computing the return from November 30 to May 31 and from May 31 to November 30. Following these procedures means, however, that the expectations horizons are no longer exactly synchronized with the return period. We must therefore rely on the crude assumption that the expected eight-month rates of change are homogeneous, i.e., expected to hold over the six-month horizon as well. Additionally, the unexpected component ($x_t - E_{t-1}x_t$, for example) must be ascertained by market participants on the basis of available preliminary data.

Estimation Results

A large number of estimations using (6) and various subsets were performed, and a set of representative results is given in Table II. Since an important aspect of the analysis is the possibility that return risk (and hence regression residual variance) is not homogeneous over the sample, reported standard errors are computed using the correction suggested by White [31] for general heteroscedas-

Table II

Stock Returns and Expectations

$$r_t = a_0 + a_1Ex_t + a_2(x_t - Ex_t) + a_3Ex_{t+1} + a_4(x_{t+1} - Ex_{t+1}) + a_5E\dot{p}_t + a_6(\dot{p}_t - E\dot{p}_t) + a_7s(Ex_t) + e_t$$

Period	Proxy	a_0	a_1	a_2	a_3	a_4	a_5	a_6	a_7	R^2	D.W.	$\lvert a_1 - a_2 \rvert$	$\lvert a_3 - a_4 \rvert$	$\lvert a_5 - a_6 \rvert$
1. 1946:1–1981:1		0.005	−1.377	0.196	2.637	1.003				0.392	1.91	1.573	1.634	
		(0.027)	(0.713)	(0.271)	(0.654)	(0.393)						(0.768)	(0.876)	
2. 1953:1–1978:2		0.001	−1.652	0.644	2.665	1.652				0.409	2.08	2.296	1.013	
		(0.034)	(0.704)	(0.377)	(0.555)	(0.415)						(0.882)	(0.732)	
3. 1953:1–1978:2		−0.268	−0.441	0.462	2.153	1.660			11.559	0.505	2.25	0.903	0.493	
		(0.085)	(0.797)	(0.370)	(0.541)	(0.393)			(3.215)			(0.969)	(0.723)	
4. 1953:1–1978:2	Liv.	0.188					−1.407	−8.313		0.362	2.05			6.906
		(0.039)					(1.425)	(1.778)						(2.803)
5. 1953:1–1978:2	T-bill	0.183					−3.226	−8.051		0.376	1.95			4.825
		(0.036)					(0.901)	(1.603)						(1.950)
6. 1953:1–1978:2	Liv.	−0.099	−1.632	0.474	1.541	1.087	0.991	−7.185	9.426	0.617	2.21	2.107	0.454	7.185
		(0.104)	(0.790)	(0.272)	(0.518)	(0.307)	(0.888)	(1.310)	(3.346)			(0.936)	(0.606)	(1.713)
7. 1953:1–1978:2	T-bill	−0.138	−0.560	0.541	1.919	1.326	−0.999	−5.291	8.194	0.607	2.05	1.101	0.593	4.291
		(0.109)	(0.751)	(0.294)	(0.475)	(0.343)	(0.751)	(1.029)	(3.456)			(0.923)	(0.580)	(1.081)

Notes: Estimations are semiannual. Standard errors are computed using the White [31] correction for heteroscedasticity and are reported in parentheses. R^2 is corrected for degrees of freedom. D.W. is the Durbin-Watson statistic. Variables: r_t, real return on CRSP value-weighted portfolio; Ex_t, beginning-of-period expectation of rate of change in industrial production index, from survey data; $(x_t - Ex_t)$, unexpected rate of change in industrial production; Ex_{t+1}, end-of-period expectation of rate of change in industrial production over following period; $(x_{t+1} - Ex_{t+1})$, unexpected rate of change in industrial production in following period; $E\dot{p}_t$, expected inflation over period, beginning-of-period expected rate of change in CPI; $(\dot{p}_t - E\dot{p}_t)$, unexpected inflation; $s(Ex_t)$, proxy variable for uncertainty in expectations of economic activity, constructed as the standard deviation of the log of respondents' industrial production forecasts. See Section III of the text for a precise discussion of timing relationships.

ticity. The first two estimations employ a specification involving only expected and unexpected economic activity, estimated over different samples. Although the results are for the most part reasonable, there are some noteworthy differences. Perhaps most striking is the pattern of coefficients for the expected activity series (a_1 and a_3). The coefficient of $E_{t-1}x_t$ is significantly negative, while the coefficient of $E_t x_{t+1}$ is significantly positive. Taken at face value, this would suggest a negative relationship between expected growth and expected real returns, although we will shortly have reason to modify this conclusion.

The coefficient of contemporaneous unexpected economic activity, $(x_t - E_{t-1}x_t)$, is positive and significantly so in the 1953:1–1978:2 subperiod. More troubling is the significant positive contribution from unexpected activity occurring subsequent to the return period, $(x_{t+1} - E_t x_{t+1})$. That the coefficient here is nonzero is certainly indicative of at least some measurement error in the expectations decomposition. We investigate this further using the coefficient tests discussed in the previous section. Table II reports the difference in coefficients for expected and unexpected components along with their standard errors. With respect to the first set of coefficients (a_1 and a_2), these differences depart from zero to a statistically significant degree. The second pair of coefficients (a_3 and a_4) is found to have a difference close to zero for the 1953:1–1978:2 estimation and only marginally different from zero for 1946:1–1981:1.

These results should probably be assigned the following interpretation. Pursuant to the discussion of the previous section, a statistically insignificant difference in the coefficients of expected and unexpected measures is consistent with a null hypothesis that states that either the true coefficients do not differ, or the decomposition is not informative. In these estimations, the decomposition is used twice: expected and unexpected (relative to beginning-of-period), and expected and unexpected (relative to end-of-period). They are the same series, however, merely offset by one period. Therefore, if the coefficients of expected and unexpected (beginning-of-period), i.e., a_1 and a_2, differ, but those of expected and unexpected (end-of-period), i.e., a_3 and a_4, do not, this is consistent with the assertion that the decomposition is informative, but this is not evident in all aspects of the estimation. The similarity of expected and unexpected (end-of-period) coefficients may be due to equality in the true population values, but this is unlikely. It is more plausible that statistical noise prevents a discrimination of the difference.

Estimation 3 reflects inclusion of the real uncertainty measure $s(E_{t-1}x_t)$. The coefficient of this variable is positive and significant, reflecting the expected relationship between risk and required return. Interestingly, the coefficients of expected and unexpected economic activity at the beginning of the return period (a_1 and a_2) are now reduced in size and statistically indistinguishable.

Estimations 4 and 5 relate real realized stock returns to expected and unexpected inflation using the two expectations measures. As in the Gultekin study, the coefficient of expected inflation using the Livingston proxy is negative, but not significant. Using the T-bill expected inflation proxy, the coefficient is negative and significant, a finding in conformance with Fama and Fama/Schwert. In both cases, the coefficient of unexpected inflation is significantly negative. Also presented in the last column of Table II are the absolute values of the differences in the expected and unexpected inflation coefficients. In both cases, these are about two standard errors removed from zero, confirming that these decompositions of inflation are informative in the context of the stock return specification.

Finally, estimations 6 and 7 reflect the comprehensive variable set and differ only in the expected inflation proxies used. The most striking feature of these regressions is that in both cases the coefficients of expected inflation are depressed well below the point of statistical significance. In estimation 6, the coefficient of the Livingston expected inflation proxy is actually positive, although insignificant. Other coefficients are little altered from prior estimations; those of $s(E_{t-1}x_t)$ are significantly positive while those of unexpected inflation are significantly negative. Also note that the tests on expected and unexpected coefficients indicate equality (noninformativeness) for economic activity, but inequality (informativeness) for inflation.

In view of the nature of the findings, the robustness of the results was investigated with a wide range of alternative specifications. These are not reported for the sake of brevity, but the main results are as follows. Given that the null hypothesis of equal coefficients for expected and unexpected economic activity cannot be rejected in 6 and 7, alternative estimations were performed using realizations for economic activity. Minor variations in the coefficients were noted, and in particular those of expected inflation were not significantly changed. In estimations in which economic activity was omitted (but $s(E_{t-1}x_t)$ retained), the coefficients of expected inflation were similar to those in estimations 4 and 5 (negative, and significantly so for the T-bill proxy).

A related question concerns the relative importance of uncertainty in real economic activity and uncertainty in inflation. A recent analysis by Pindyck [27] suggests that the former dominates, and the present analysis supports this. A measure of inflation uncertainty, $s(E\dot{p}_t)$, was computed in the same manner as $s(Ex_t)$, as the cross-forecaster dispersion of expectations. When $s(E\dot{p}_t)$ was included in the stock return specifications of the form 5 or 6 in Table II, its coefficient was generally close to zero and invariably dominated by that of $s(Ex_t)$.

Finally, given the correlation between $s(Ex_t)$ and $E\dot{p}_t$ evident in Table I, the possibility must be considered that the negative impact of expected inflation is being submerged in the coefficient of $s(Ex_t)$. At the referee's suggestion, the expected inflation measures were regressed against $s(Ex_t)$. The residuals from these regressions were then used as expected inflation proxies orthogonal to $s(Ex_t)$. When used in specifications similar to 6 and 7 in Table II, the coefficients of $E\dot{p}_t$ and $s(Ex_t)$ were little changed from the original estimations.[7]

IV. The Determinants of Inflationary Expectations

Even allowing that the inclusion of expected economic activity in the stock return regressions did not seem to materially affect the expected inflation coefficient,

[7] In these alternative estimations, unexpected inflation was omitted from the specification. Since unexpected inflation is computed as a residual, purging the dependence of $s(Ex_t)$ from expected inflation will place this dependence in unexpected inflation.

the relationship between expected inflation and expected economic activity is nevertheless of considerable interest. This section investigates this relationship in the framework of Fama's proposed mechanism. To begin with, Fama suggested a link between expected inflation and expected economic activity as a consequence of the quantity theory of money in first-difference logged form; $\dot{p}_t = a_0 - a_1 x_t + a_2 \mathrm{GMB}_t$, where GMB is the rate of growth of the monetary base. Fama then established the empirical validity of this relationship using *ex post* data in lieu of expectations data which he admitted would be preferred.

Before considering estimations of this relationship utilizing the expectations data, note the correlations between GMB and the other variables in Table I. (GMB is computed as an annualized eight-month growth rate to be compatible with the other variables in the study.) Not surprisingly, the correlations with the expected and unexpected inflation measures are quite positive. More problematic is the marginally significant positive correlation with expected economic activity. Since realized monetary growth is the sum of expected and unexpected components, this finding is subject to two interpretations. If it arises as a consequence of a correlation between expected economic activity and unexpected monetary growth, the principle of rational expectations is violated. On the other hand, a correlation between expected economic activity and expected monetary growth is incompatible with certain macroeconomic models and some empirical evidence that actual economic activity is neutral with respect to expected monetary growth.[8]

The estimation using the Livingston proxy for expected inflation is:

$$\underset{\text{(Liv.)}}{E\dot{p}_t} = \underset{(0.058)}{-0.078}\ Ex_t + \underset{(0.059)}{0.634}\ \mathrm{GMB}_t \tag{7}$$

$$R^2 = 0.658; \qquad \text{Autocorrelation coefficient} = 0.602$$

(All variables are defined in the first part of Section II. Estimation is semiannual from t = second half of 1953 to second half of 1979. Standard errors are given in parentheses, corrected for overlapping expectations using the Hansen-Hodrick [15] procedure.)

Using the T-bill proxy for expected inflation,

$$\underset{\text{(T-bill)}}{E\dot{p}_t} = \underset{(0.086)}{-0.231}\ Ex_t + \underset{(0.087)}{0.920}\ \mathrm{GMB}_t \tag{8}$$

$$R^2 = 0.534; \qquad \text{Autocorrelation coefficient} = 0.422$$

(same sample and estimation technique as (7)).

The constant term in these equations was found to be insignificant and was therefore suppressed. If the actual rate of monetary growth is a good proxy for the corresponding expectation, theory would predict a coefficient of unity, and in this respect the Livingston estimation is somewhat deficient. This is consistent

[8] The modern theoretical basis for predicting neutrality of anticipated monetary policy was proposed by Lucas [20] and Sargent and Wallace [28]. The empirical results supporting this view are not unanimous. The analyses of Barro [1, 2, 3] and Barro and Rush [4] fail to reject the neutrality hypothesis. Small [29], Mishkin [23], and Merrick [22], on the other hand, find this conclusion sensitive to econometric specification.

with the finding of Fama and Gibbons that the Livingston proxy underpredicts actual inflation, while the T-bill proxy overpredicts (see their Table 5, regressions 2 and 4).

The coefficient of expected economic activity is negative in both cases and significantly so for the T-bill expected inflation proxy. This suggests that the quantity theory relationship that exists in the *ex post* data may also be present in expectations as well. These estimations are not, however, completely free from reliance on *ex post* data, as the actual rate of monetary growth is used. An alternative analysis employed an autoregressive time series model to proxy expected monetary growth. When this proxy series was used in place of the actual rate in the above specifications, the results changed in that the coefficients of expected monetary growth were closer to unity and the coefficients of expected economic activity became much closer to zero. The overall effect of economic activity in these estimations is much lower than that found in Fama's *ex post* analyses. Statistically, this may be a consequence of the positive correlation between GMB and expected economic activity, the economic interpretation of which was noted above.

Additional indirect evidence bearing on the problem may be found in the relationship between expected inflation and expected economic activity across forecasters. The correlation coefficient (between respondents' forecasts of inflation and the rate of change in industrial production, one for each survey date) is plotted in Figure 2, along with 0.95 confidence bands. A positive value indicates that respondents who predicted above the mean response on inflation were also likely to predict above the mean on economic activity. In the early years of the survey, the coefficients are significantly positive, but with the passage of time, the strength of the relationship diminishes. In the 1970s, when the negative relationship between inflation and stock returns is strongest, the cross-forecaster

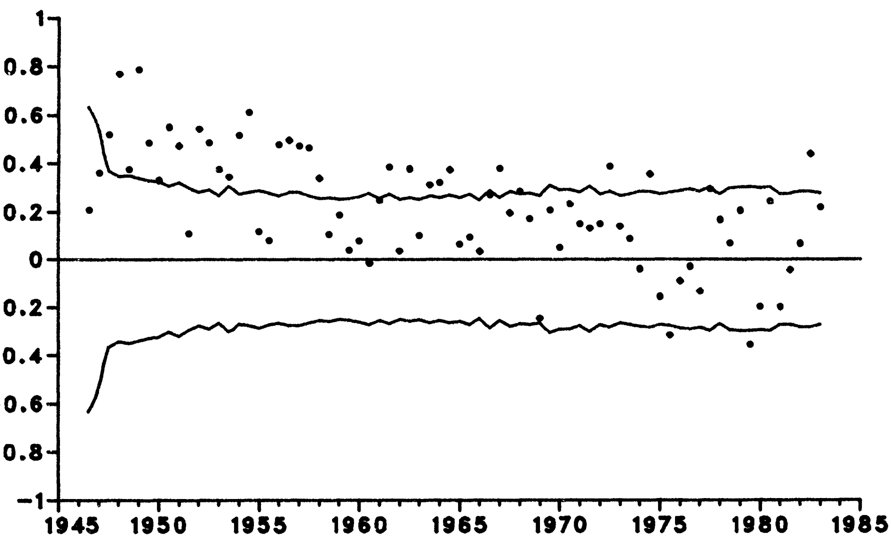

Figure 2. Correlation Coefficient (Across Forecasters) Between Predictions of Inflation and the Rate of Growth in the Industrial Production Index (Solid Lines are 95% Confidence Bands)

correlations exhibit no particular pattern, being roughly evenly dispersed about zero. As in the regressions reported above, lack of a relationship between expected economic activity and expected inflation is consistent with a quantity theory relationship only if the repondents believe in an endogenous relationship between monetary growth and economic activity.

V. Conclusions

Based on a critical examination of expectational data from the Livingston surveys and other sources, this study has reached the following conclusions. Although the survey data do exhibit a slight negative relationship between expected economic activity and expected inflation in a quantity theory estimation, there is no significant simple bivariate relationship between the two. Thus, the relationship hypothesized in earlier studies does not appear to be useful in explaining the negative impact of the former on real realized stock returns found in numerous empirical studies.

A final significant finding concerns the role of expected risk as assessed by the cross-forecaster dispersion of expectations. In the stock return estimations, the coefficient of this variable possessed the expected positive sign. Furthermore, inclusion of this variable depressed to the point of statistical insignificance the coefficient of expected inflation as measured by survey and T-bill proxies.[9] This finding is perhaps the most striking, as it suggests an explanation for the resolution of the stock return and expected inflation dilemma.[10]

[9] The negative relationship between stock returns and unexpected inflation, however, persists in this analysis, perhaps as a consequence of inflation-related tax effects.

[10] The relationship between uncertainty and the required rate of return will have a direct bearing on stock valuation. The econometric analysis conducted by Friend and Hasbrouck [12] suggests that the impact of inflation on true economic profits is of sufficient magnitude to explain the decline in stock prices, but that increased uncertainty is a likely contributing factor.

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