Stock Prices, Risk Premia, Inflation, and Uncertainty

By

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STOCK PRICES, RISK PREMIA, INFLATION, AND UNCERTAINTY†

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ABSTRACT

Using *ex ante* data, we provide new empirical evidence, previously overlooked or de-emphasized, for explaining observed stock market behavior for the post-1960 period. Our principal findings are: (i) the real required risk premium for common stocks has substantially increased as a response to increased inflation uncertainty, apparently caused by the "adverse" impacts of inflation uncertainty upon real corporate earnings before tax; (ii) observed stock market fluctuations can be explained by real output and inflation uncertainty; and (iii) expected inflation *per se* does not depress real stock prices.
Introduction

The objective of this paper is to investigate the interrelationships among stock market prices, inflation and uncertainty during the post-1960 period. Stock market behavior during the 1960s and 1970s, with steadily rising and volatile changes in the general price level, can be characterized by a steady decline in real stock prices accompanied by wide fluctuations. Despite a large quantum of academic research energy being directed to the stock market, little agreement has emerged about why and how inflation affects stock prices.

Earlier studies indicate that rising inflation is associated with increasing inflation uncertainty. This is associated, in turn, with unpredictable relative price changes (i.e., a less efficient price system) and, consequently, depressed economic activity, a key determinant of real stock prices. Nevertheless, the effects of inflation uncertainty upon real asset prices have been down-played.

In brief, by recognizing the effects of inflation uncertainty on real activity, we find that increasing inflation uncertainty is an important cause for the increase in the required risk premium for common stocks and, thus, the observed decline and fluctuations in stock prices for the post-1960 period; this result occurs apparently because inflation uncertainty adversely affects real corporate earnings before tax.

The presentation is divided into three sections. Section I presents a model for the interrelationship between the required risk premium for common stocks and real and inflation uncertainty. Section
II, the heart of our paper, presents the data base, estimation procedures, empirical findings, and their implications. The last section contains a summary and suggests additional avenues for future research.

I. RISK PREMIA AND UNCERTAINTY

Utilizing the capital asset pricing theory (CAPM), we generate an empirically testable relationship between inflation uncertainty and the required risk premium for common stocks. If risk averse investors hold nominally risk-free bonds and market portfolios of common stocks, the CAPM market equilibrium condition is

\[ E[r_s - r_o] = \lambda \{ \text{COV}(r_o, r_s - r_o) + \alpha_s \text{VAR}(r_s - r_o) \} \]  

(1)

where \( r_s \) and \( r_o \) are real after tax returns on common stocks and bonds, respectively; \( \lambda \) is the market price of risk; and \( \alpha_s \) is the fraction of total wealth invested in common stocks.

In order to distinguish between inflation uncertainty and real uncertainty in equation (1), the unexpected real stock market return, \( r_s - E[r_s] \), is assumed to be generated by a linear factor model, equation (2-a):

\[ r_s - E[r_s] = b_s \pi^u + \varepsilon_s; \text{COV}(\varepsilon_s, \pi^u) = 0 \]  

(2-a)

where \( \pi^u \) is the unexpected inflation rate with mean zero and variance \( \sigma^2_\pi \); \( b_s = \text{COV}(r_s, \pi^u)/\sigma^2_\pi \) such that \( \text{COV}(\varepsilon_s, \pi^u) = 0 \); and \( \varepsilon_s \) has mean zero and variance \( \sigma^2_\varepsilon \). Earlier empirical works show that \( b_s \) is negative.\(^3\) Real uncertainty and inflation uncertainty are represented, respectively, by \( \sigma^2_\varepsilon \) and \( \sigma^2_\pi \).
For a nominally fixed interest rate, the unexpected \textit{ex post} component of the real interest rate, $r_o - E[r_o]$, is defined by

$$r_o - E[r_o] = -\pi^u. \quad (2-b)$$

Using equations (2),

$$\text{COV}(r_o, r_s - r_o) = -(1+b_s)\sigma^2_{\pi} \quad (3-a)$$

$$\text{VAR}(r_s - r_o) = \sigma^2_{\varepsilon} + (1+b_s)^2\sigma^2_{\pi}. \quad (3-b)$$

Hence, equation (1) can be rearranged to be equation (4):

$$E[r_s - r_o] = \lambda((1+b_s)^2\alpha_s - (1+b_s))\sigma^2_{\pi} + \lambda\alpha_s \sigma^2_{\varepsilon}. \quad (4)$$

Our analysis will determine the impact of uncertainty on the required \textit{(ex ante) risk premium} for common stocks (hereafter, referred to as the risk premium). \textsuperscript{4}

\textbf{II. EMPIRICAL ANALYSIS}

\textbf{II.1. Data Base}

Our raw data base for \textit{ex ante} variables is the Livingston expectations surveys from June 1960 through December 1985. \textsuperscript{5} For each semi-annual survey, individual respondents generated six-month forward forecasts for the Consumer Price Index, the Industrial Production Index and the S&P Composite Index. For each survey, we compute the means for the expected inflation rate ($E\pi$), the expected rate of return for the stock market, and the expected rate of change for industrial production ($E\lambda$). \textsuperscript{6} The risk premium (PREM) is obtained by
subtracting the six-month Treasury bill rate (at the beginning of the month in which the corresponding survey was conducted) from the expected stock-market return. Inflation uncertainty and real uncertainty are represented by cross-sectional variances of individual inflation forecasts \(v_\pi\) and production forecasts \(v_\epsilon\), respectively.\(^7\) \(E\pi, E\epsilon\) and PREM are measured in percentage; and the logarithms of \(v_\pi\) and \(v_\epsilon\) are used to control for scale differences.

II.2. **Uncertainty and the Risk Premium: Empirical Findings**

Given our database for the risk premium and the measures for inflation and real uncertainty, the empirical model analog for equation (4) is equation (5):

\[
PREM_t = c_0 + c_1 \log v_{\pi,t} + c_2 \log v_{\epsilon,t}
\]

where \(c\)'s are parameters to be estimated; subscript \(t\) represents the time of the Livingston survey; PREM is the risk premium; and \(v_\pi\) and \(v_\epsilon\) are cross-sectional variances of the Livingston inflation forecasts and production forecasts, respectively.

(Insert Figures I Here)

Figures I-a and I-b show graphically how the risk premium between 1960 and 1985 relates to inflation uncertainty \((\log v_\pi)\) and real uncertainty \((\log v_\epsilon)\), respectively. In both charts, the risk premium tracks uncertainty measures relatively well throughout our sample period. These observations reinforce the hypothesis that uncertainty variables may be important explanations for observed changes in the
risk premium over time. Figure I-c shows the relationship between expected inflation and inflation uncertainty. Since 1965 the level of expected inflation has risen secularly; and similarly our inflation uncertainty measure also has risen secularly, but with more volatility. Collectively, Figures I-a and I-c suggest that it is crucial to sort independently the effects of expected inflation and inflation uncertainty on stock prices.

The regression results for equations (5) are reported in Table I for two different sample periods: (i) the 1966.I through 1980.II sub-period, an era characterized by increasing inflation expectations and uncertainty, and (ii) the entire 1960.I through 1985.II sample period, containing both relatively low inflationary sub-periods (the early 1960s) and "disinflationary" sub-periods (the 1980s). The results confirm that the risk premium increases when uncertainty increases. Also, our findings imply that common stocks are not, even relative to bonds, hedges against uncertain inflation; and contrast with a common claim that bond investment is riskier with respect to uncertain inflation than equity investment.

(Insert Table I Here)

In order to test for the possibility of reverse causality from the risk premium to uncertainty variables, we employ statistical techniques similar to those suggested by Sims [1972]. First, the results reported in Table II indicate that future values of PREM variables are positively significant in explaining the log $v_{t}$ dependent variable (Panel A), but future values of log $v_{t}$ variables are not positively
related to the PREM dependent variable (Panel B). This finding is consistent with a uni-directional causality relationship from increased inflation uncertainty to increased risk premia.

Second, future values of PREM variables are not significant in explaining the log $v_e$ dependent variable; and, also, the future values of log $v_e$ are not significant in explaining the PREM dependent variable. This finding may indicate that even though the current log $v_e$ variable is significantly related to the current PREM variable (the results reported in Table I), the impacts of real output uncertainty upon stock prices may not be persistent.

(Insert Table II Here)

II.3. The Impact of Inflation Uncertainty Autocorrelation Upon Stock Prices

We now turn our analysis to the persistence of the impacts of changing uncertainty upon the risk premium and, thus, stock prices. Ceteris paribus, increasing uncertainty over time tends to depress stock prices ex post, and thereby leads to lower ex post realized returns for common stocks. The observed positive ex ante relationship of the risk premium with real output uncertainty and inflation uncertainty would imply a negative ex post relationship between stock prices and uncertainty. However, Poterba and Summers [1986], in a critique of Pindyck [1985], claim that because stock return volatility is not highly autocorrelated, the impacts of increased stock return volatility upon stock prices would be neither substantial nor persistent.
In contrast with the analysis of Poterba and Summers, when we decompose stock return volatility into inflation uncertainty and production uncertainty (see equations 3), our analysis shows that an increase in inflation uncertainty will change stock prices. In order to understand the relationships among stock prices, inflation uncertainty and real output uncertainty, we examine the following GLS (Cochrane-Orcutt) regressions for the 1960.I-1985.II period:

\[
\log SP_t = \text{const} - 0.076 \log \pi_{w,t} - 0.030 \log \epsilon_{t} - 0.035 \log \epsilon_{t} + 0.990 \log \text{DIV}_t \\
\text{(-2.699) (-1.133) (-2.333)} \\
\hat{R}^2 = 0.83; \text{DW} = 2.26
\]  

\[\text{(6-a)}\]

\[
\log SP_t = \text{const} - 0.087 \log \pi_{w,t} - 0.035 \log \epsilon_{t} + 0.606 \text{TIME}_t + 2.551 \\
\text{(-2.957) (-1.189)} \\
\hat{R}^2 = 0.83; \text{DW} = 2.00
\]  

\[\text{(6-b)}\]

where SP is the S&P Composite Index (price level adjusted) at the end of June or December in each year, DIV is the real dividend paid (semi-annual), and TIME is the time trend variable.

In equations (6), the coefficient estimate for inflation uncertainty is statistically significant, while that for real output uncertainty is not. Because equations (6) are log-linear, the coefficients for log \( \pi_{w} \) are estimates for the real stock price elasticity with respect to inflation uncertainty. Using this apparently "small" (i.e., about 0.08) elasticity, the expected change in real stock prices, caused by a change in inflation uncertainty, can be estimated.

The average level of inflation uncertainty during the late 1970s (1975.I-1979.II) is approximately 7.6 times higher than that during
the early 1960s (1960.06-1964.12). This implies that the decline in real stock prices from the early 1960s through the late 1970s attributed to increased inflation uncertainty would be about 53 percent. Indeed, the S&P Composite Index (price level adjusted) declined by 48 percent from December 1964 to December 1979. The average six-month change in inflation uncertainty ($\Delta v_{\pi}/v_{\pi}$) for the surveys from June 1960 through December 1979 is 19 percent. Hence, the average six-month decline in real stock prices resulting from an increase in inflation uncertainty is 1.5 percent; and, consequently, real stock prices would be expected to decline by 45 percent from 1960 through 1979. The S&P Composite Index (price-level adjusted) declined by 27 (41) percent from June 1960 (December 1961) to December 1979.

Around the oil shock period, inflation uncertainty for December 1974 is 8.6 times higher than that for December 1972. The expected decline in real stock prices during the two year span attributed to increased inflation uncertainty would be 60 percent. During this period, the actual decline in the S&P Composite Index (price-level adjusted) was 52 percent. Finally, inflation uncertainty for December 1979 is 6.5 times higher than that for December 1985. The implied expected increase in real stock prices during this "disinflationary" period would be 44 percent. The S&P Composite Index (price-level adjusted) has risen by 37 percent from December 1979 through December 1985. In brief, the observed fluctuations in real stock market prices from the early 1960s to the mid-1980s appear to be influenced strongly by changes in inflation uncertainty.
II.4. Real Output Changes, Inflation Uncertainty, and Stock Market Fluctuations

Using a variant of Fama's [1981] model, equation (7), we explain the observed stock market fluctuations during the post-1960 period as a function of changes in real output and inflation uncertainty.

\[
\log SP_t = \gamma_1 E_t \Delta x - \gamma_2 \log \pi_{t,t} - \gamma_3 \log \varepsilon_{t,t} \tag{7}
\]

where \(E_t\) represents anticipated real output; \(\gamma\)'s are positive constants. By taking the first-order difference of equation (7) with respect to time, we create equation (8) to be estimated.

\[
\Delta \log SP_t = c_0 + c_1 \Delta E_t \Delta x + c_2 \Delta \log \pi_{t,t} + c_3 \Delta \log \varepsilon_{t,t} \tag{8}
\]

where \(c\)'s are parameters to be estimated, and \(\Delta E_t\) is measured by the change in the Livingston forecasted rate of change in the Industrial Production Index.

Table III contains alternative regression results for equation (8) for two sample periods, (i) 1966.I-1980.II, and (ii) 1960.I-1985.II. First, as suggested by Fama, stock prices are determined by expectations about future real activity; the coefficients for changes in anticipated output are positive and statistically significant irrespective of the presence of uncertainty variables.

Second, the coefficients for changes in production uncertainty are not statistically significant when controlling for real output and/or inflation uncertainty (equations 8-4 and 8-6). This finding is internally consistent with the statistically insignificant coefficient for real production uncertainty in equations (6).
Third, the coefficients for changes in inflation uncertainty are negative and statistically significant, even when controlling for real output (equations 8-5 and 8-6). Our findings are similar to that of Fama; he reports a non-spurious negative relationship between ex post stock market returns and unexpected inflation, controlling for real activity. 

Fourth, equations (8-5), controlling for both real output and inflation uncertainty, show the best fit among the regressions in Table III. This reinforces our claim that stock price changes, in spite of wide fluctuations during the post-1960 period, are "economically" determined by changes in anticipated real output and inflation uncertainty.

(Insert Table III Here)


If, as is assumed in some quarters, expected inflation is neutral, the risk premium (and, thus, real stock prices) should not be affected by expected inflation. However, a simple positive correlation between the risk premium and expected inflation might occur because of the high correlation between expected inflation and inflation uncertainty. This is shown by GLS (Cochrane-Orcutt) regressions, equations (9):

\[
\text{PREM}_t = \text{const} + 0.753 \ \text{E}_t \epsilon \quad (6.1-80; \text{II}) \quad (1.634) \quad ^\text{t} \quad (R^2 = 0.20; \ D.W = 1.75) \tag{9-a}
\]

\[
\text{PREM}_t = \text{const} + 0.609 \ \text{E}_t \epsilon \quad (60.1-85; \text{II}) \quad (1.422) \quad ^\text{t} \quad (R^2 = 0.26; \ D.W = 1.88) \tag{9-b}
\]
In order to obtain a true statistical relationship between the risk premium and expected inflation, we estimate equations (10), which are also GLS-regressions, by adding uncertainty variables.

\[
\begin{align*}
\text{PREM} &= \text{const} - 1.219 \, E \, \pi_t + 2.870 \, \log v_{\pi,t} + 2.357 \, \log v_{\varepsilon,t} \quad \text{(10-a)} \\
&\quad (66.1-80.II) \quad (-2.265) \quad (3.168) \quad (5.50) \\
\text{\(R^2\)} &= 0.49, \quad \text{DW} = 1.78
\end{align*}
\]

\[
\begin{align*}
\text{PREM} &= \text{const} - 0.505 \, E \, \pi_t + 1.528 \, \log v_{\pi,t} + 1.571 \, \log v_{\varepsilon,t} \quad \text{(10-b)} \\
&\quad (60.1-85.II) \quad (-0.921) \quad (2.454) \quad (2.935) \\
\text{\(R^2\)} &= 0.46; \quad \text{DW} = 1.99
\end{align*}
\]

In equations (10), the coefficients for expected inflation are not positive. The overall fit of equations (10) is superior to that of equations (9). This might be interpreted to mean that the observed positive relationship between the risk premium and expected inflation in equations (9) is spurious. Equations (10) suggest that expected inflation per se does not depress real stock prices.\(^{14}\)

II.6. Uncertain Inflation and Corporate Earnings Before Tax: Tax Effects and Money Illusion Hypotheses

We believe that increased inflation uncertainty reduces the real gross marginal return on capital, i.e., real corporate earnings before tax.\(^{15}\) To the extent this were true, of course, stock prices would be affected by inflation uncertainty. Our belief at least in part contrasts with the positions of Feldstein [1980] and Summers [1981] that inflation depresses real stock prices because nominal capital gains taxation with historic cost methods of depreciation causes a decline in expected real earnings after tax. Summers, regressing real stock
returns on changes in expected inflation, allegedly proves his position by finding that the coefficient for the change in expected inflation is statistically significantly negative. However, to the extent changes in inflation uncertainty affect real corporate earnings before tax, the appropriate reduced form model, which would be parallel with that provided by Summers, should **jointly** test the tax effect hypothesis and the inflation uncertainty effect hypothesis.

Our position is supported statistically by OLS regressions (equations 11) for the pre-tax reform period (1960.I-1980.II).

\[
\begin{align*}
r_t &= \text{const} - 11.482 \Delta \pi_t \\ &\quad (-2.342) \quad R^2 = 0.10; DW = 1.93 \\
(11-a)
\end{align*}
\]

\[
\begin{align*}
r_t &= \text{const} - 5.699 \Delta \pi_t - 8.033 \Delta \log v_{t} \\ &\quad (-1.052) \quad (-2.143) \quad R^2 = 0.17; DW = 2.04 \\
(11-b)
\end{align*}
\]

where \( r \) is the **ex post** six-month real rate of return for the S&P Composite Index (in percentage).

The results in equations (11-a) and (11-b) represent **ex post** consequences of our **ex ante** findings for equations (9) and (10), respectively. The statistically insignificant coefficient for the change in expected inflation in equation (11-b) does not support the tax effect hypothesis. In brief, earlier analyses, without taking into account the effects of changing inflation uncertainty, may have overstated the importance of the tax system for determining real stock values.
Another implication of the effects of inflation uncertainty on real corporate earnings before taxes relates to the empirical test of the nominal contracting hypothesis: unexpected inflation, through changes in subsequent expectations, will redistribute wealth from bondholders to shareholders. Our analysis indicates that unexpected inflation, a concomitant of increased inflation uncertainty, may affect the firm's value (equity plus debt) through two interrelated channels: (i) real corporate earnings before taxes decline, and (ii) the real required rate of return for equity increases. Although inflation will cause the real value of corporate debt to decline, the decrease in real corporate earnings before tax and/or the increase in the real required rate of return for common stocks may offset the net wealth redistribution effect.

Earlier studies\textsuperscript{17} do not provide supporting evidence for the nominal contracting hypothesis. Modigliani and Cohn [1979] attribute this to irrational investor behavior. Our analysis suggests that earlier studies, by neglecting the effects of uncertain inflation on the firm's operating income, may not test adequately the nominal contracting hypothesis.\textsuperscript{18}

III. SUMMARY

The key finding of this paper is that the required risk premium for common stocks has increased during the post-1960 period because of increased inflation uncertainty, resulting in relatively depressed real stock prices. The increase in the risk premium occurred because increased inflation uncertainty has apparently increased the riskiness of real corporate earnings before tax.
Based upon this principal finding, we further suggest that (i) observed stock market fluctuations are economic, i.e., can be explained by changes in anticipated real output and inflation uncertainty; (ii) the expected inflation level per se, controlling for inflation uncertainty, does not depress real stock prices; and (iii) prior claims about the importance of nominal capital gains taxation for determining stock values may be overstated.

Our research leaves open several important questions. First, our analysis does not identify the sources of changes in perceived uncertainty about future inflation. Second, there is a clear area for future research: the study of the relationship among economic policy variables, real economic variables and their uncertainty, inflation uncertainty, and stock prices.
FOOTNOTES

1. The adverse effects of inflation uncertainty on real economic activity are well-recognized. For example, Friedman [1977] in his Nobel Laureate Lecture argues that inflation uncertainty, by making it harder to extract the signal about relative prices from absolute prices, reduces the efficiency of the price system and thus lowers the growth rate of real output (Levi and Makin [1979, 1980] and Mullineaux [1980] provide empirical evidence which supports Friedman's position).

Vining and Elwertowski [1976] and Parks [1978] find empirically that increased, unstable inflation tends to be associated with increased dispersions for mean relative price changes. Cukierman [1982] demonstrates that the variances of general inflation rates and relative price changes are closely related to each other. Also, while the underlying cause is a subject of continued debate, the positive statistical relationship between the level of actual/expected inflation and the volatility of inflation (both in the U.S. and other countries) has been verified independently by many studies. See, for example, Okun [1971], Logue and Willet [1976], Cukierman and Wachtel [1979], Fischer [1981], Taylor [1981], Hafer and Heyne-Hafer [1981], Pegan, Hall and Trivedi [1983], and Zarnowitz and Lambros [1987], among others.

2. See, for example, Friend and Blume [1975].

3. This finding has been well documented by a number of studies since Lintner [1975]. See, for example, Fama [1981] and Friend and Hasbrouck [1982] and the references therein.

4. Equation (4) can be used to derive the "generalized" Fisher equation which has the expected pre-tax nominal return on common stocks as the dependent variable. Empirically, it is difficult to estimate the generalized Fisher equation because real interest rates may not be constant over time (for example, see Mishkin [1981]) or may be correlated with inflation (for example, see Mundell [1963], Tobin [1965] and Startz [1981]). See, also, Dokko and Edelstein [1987a].

5. Caskey [1985] demonstrates optimal forecasting behavior (a Bayesian learning model) from the Livingston inflation forecasts. Dokko and Edelstein [1987c] show that Livingston stock market forecasts are unbiased, informationally efficient, and adaptive. Our OLS regression analysis supports the unbiasedness of the Livingston stock market forecasts (from the June 1960 survey through the December 1985 survey):

\[ R_t = \beta_0 + \beta_1 R_{t-1} + \epsilon_t \]

\( R^2 = 0.04 \quad (F5) \)

\( \beta = -0.06 \)
where standard errors are in parentheses below coefficient estimates, the explanatory variable is the Livingston stock market forecast, the dependent variable is the corresponding ex post stock market return, and ρ is the first-order autocorrelation of the residual.

The Livingston surveys seem to be appropriate to represent the overall market; according to Ahlers [1977], the institutions with which the respondents were affiliated have accounted for more than sixty percent of all stock market exchange trading during the late 1960's and through the early 1970's.

6 The procedures for computing forecasted rates are described in Carlson [1977] and Dokko and Edelstein [1987c].

7 Although the cross-sectional variance of inflation forecasts is a measure of the "lack of consensus" among forecasters, at least three prior studies justify this measure as a proxy for uncertainty. See (i) Cukierman and Wachtel [1979] for theoretical analysis; see (ii) Bomberger and Frazier [1981] for empirical evidence that the Livingston cross-sectional variance is internally consistent with inflation uncertainty; and see (iii) Zarnowitz and Lambros [1987] for empirical evidence that the Livingston cross-sectional variance is closely correlated with the dispersion measure of predicted distributions of inflation in the ASA-NBER surveys (the latter being a true measure of inflation uncertainty).

8 In order to control for the possibility of temporal trends in equations (5), a time trend variable (TIME: 1960-I = 1, etc.) has been introduced into the regressions. The regression results, after controlling for the possible time effect, are virtually unchanged.

9 Shiller [1981] argues that the observed stock market volatilities, larger than those jointly implied by rational valuation and a constant discount rate, are attributed to investor irrational behavior. LeRoy and LaCivita [1981] and Michener [1982] show that Shiller's variance bound may not exist when the discount rate is not a constant. Also, Kleidon [1986] suggests that even though investors know the parameters which determine the distribution of future dividends, there is sufficient uncertainty which causes a large divergence between the stock market price and the ex post perfect foresight price. Our findings suggest that the risk premium and, thus, the stock price are sensitive to uncertainty about the future, which would support the results of these studies.

10 For example, an earlier work by Gordon and Halpern [1976] claims that "an increase in the uncertainty of the inflation will result in a reduction of the expected risk premium (p. 563)." However, they assume that real returns on non-monetary assets are independent of inflation, and consider the effect of inflation uncertainty only on the required rate of return for bonds. Pindyck [1984] also claims that volatility of inflation "makes bonds relatively riskier, and should
therefore increase share values (p. 336)." But Pindyck's suggestion is also derived from the assumption that the real productivity risk is independent of the inflation risk (see Dokko and Edelstein [1987b]).

Because the assumption of serially uncorrelated residuals is important in the Sims test of the direction of causality, all variables are prefiltered assuming an AR(1) process which appears to be an appropriate description of the data series. The OLS regression results are:

\[
\text{PREM}_t = 0.0005 + 0.438 \text{PREM}_{t-1} \quad (\bar{R}^2 = 0.20) \quad (F11-a)
\]

\[
\log v_{\pi,t} = -1.915 + 0.815 \log v_{\pi,t-1} \quad (\bar{R}^2 = 0.66) \quad (F11-b)
\]

\[
\log v_{\varepsilon,t} = -5.393 + 0.362 \log v_{\varepsilon,t-1} \quad (\bar{R}^2 = 0.15) \quad (F11-c)
\]

where t-statistics are in parentheses below coefficient estimates, and \(\rho\) is the first-order autocorrelation of the residual. For the use of separate prefilters, see Pierce and Haugh [1977].

The average levels of \(v_{\pi}\) for the first 10 surveys (1960.I-1964.II) and the last 10 surveys (1975.I-1979.II) are, respectively, \(8.98 \times 10^{-6}\) and \(6.86 \times 10^{-5}\).

Fama appears to be uncomfortable with this result because it contradicts his proxy effect hypothesis: the observed negative relationships between stock returns and inflation are "spurious" because increased inflation alters real variables such that the real return on capital is reduced; and, therefore, the observed negative relationships are generated by the real income "proxy effect" of inflation. Fama suggests that the contradiction is caused by possible measurement errors in real activity variables; and suggests using \textit{ex ante} survey activity variables.

The negative coefficient for expected inflation in equation (10) is consistent with the Mundell-Tobin wealth effect hypothesis. That is, when expected inflation increases, the opportunity cost of holding near-money financial assets (bonds) increases relative to that of more distant-money financial assets (common stocks). This leads to an increase in the demand for common stocks relative to that for bonds. For more empirical evidence, see Dokko and Edelstein [1987a].

See Dokko and Edelstein's [1987b] critique on Pindyck [1985]. See, also, footnote 1.

See Friend and Hasbrouck [1982b] for another critique of the tax effect hypothesis. Note that we do not reject the effects of nominal
capital gains taxation on stock prices at the micro-firm level (see Dokko [1987]).

See, for example, French, Ruback and Schwert [1983] and the references therein.

See Dokko [1987] for the discussion of recent empirical tests of the nominal contracting hypothesis.
REFERENCES


Figure 1-a
Time-series of the Risk Premium and Inflation uncertainty
corr = 0.435 (1960.1 - 1985.11)
0.537 (1966.1 - 1980.11)
PRM: 
$\log W$: +....+
### TABLE II

Regression Results for Equation (5)

\[ \text{PREM}_t = c_0 + c_1 \log v_{\pi,t} + c_2 \log v_{\varepsilon,t} + c_3 \text{TIME}_t \]  


<table>
<thead>
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<th>Eq. No.</th>
<th>( c_1 )</th>
<th>( c_2 )</th>
<th>( c_3 )</th>
<th>( R^2 )</th>
<th>DW</th>
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<td>--</td>
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</tr>
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<td></td>
<td>(3.537)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>5-a-3</td>
<td>1.201</td>
<td>1.943</td>
<td>--</td>
<td>0.441</td>
<td>1.73</td>
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<tr>
<td></td>
<td>(2.098)</td>
<td>(2.779)</td>
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<tr>
<td>5-a-4</td>
<td>2.072</td>
<td>1.985</td>
<td>-0.105</td>
<td>0.482</td>
<td>1.69</td>
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<tr>
<td></td>
<td>(3.043)</td>
<td>(2.957)</td>
<td>(-1.998)</td>
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</tr>
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</table>

Panel B: (1960.I through 1985.II: NOB = 52)

<table>
<thead>
<tr>
<th>Eq. No.</th>
<th>( c_1 )</th>
<th>( c_2 )</th>
<th>( c_3 )</th>
<th>( R^2 )</th>
<th>DW</th>
</tr>
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<tbody>
<tr>
<td>5-b-1</td>
<td>1.524</td>
<td>--</td>
<td>--</td>
<td>0.372</td>
<td>1.91</td>
</tr>
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<td></td>
<td>(3.296)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>5-b-2</td>
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<td>2.015</td>
<td>--</td>
<td>0.405</td>
<td>1.98</td>
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<tr>
<td></td>
<td></td>
<td>(3.781)</td>
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<tr>
<td>5-b-3</td>
<td>1.144</td>
<td>1.630</td>
<td>--</td>
<td>0.463</td>
<td>2.01</td>
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<tr>
<td></td>
<td>(2.521)</td>
<td>(3.082)</td>
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<td>5-b-4</td>
<td>2.179</td>
<td>1.294</td>
<td>-0.120</td>
<td>0.546</td>
<td>1.89</td>
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<td></td>
<td>(5.148)</td>
<td>(2.630)</td>
<td>(-4.345)</td>
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</tr>
</tbody>
</table>

\(^\dagger\): All regressions are adjusted for the first-order autocorrelation of residuals using the Cochrane-Orcutt method. t-statistics are in parentheses below coefficient estimates.
TABLE III†

Tests of the Direction of Causality Between the Risk
Premium and Uncertainty
June 1960 through December 1985

Panel A

<table>
<thead>
<tr>
<th>Dep Var</th>
<th>Indep Future Var</th>
<th>No of Future Indep Vars</th>
<th>Sum of Coef Estimates (t-statistic)</th>
<th>F for Indep Vars</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\log \nu_\pi$</td>
<td>PREM</td>
<td>2</td>
<td>0.068 (1.661)</td>
<td>1.491</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>0.112 (2.109)</td>
<td>1.561</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>0.089 (1.499)</td>
<td>1.364</td>
</tr>
<tr>
<td>$\log \nu_\epsilon$</td>
<td>PREM</td>
<td>2</td>
<td>-0.001 (-0.170)</td>
<td>0.629</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>-0.017 (-0.267)</td>
<td>0.465</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>-0.054 (-0.763)</td>
<td>0.705</td>
</tr>
</tbody>
</table>

Panel B

<table>
<thead>
<tr>
<th>Dep Var</th>
<th>Indep Future Var</th>
<th>No of Future Indep Vars</th>
<th>Sum of Coef Estimates (t-statistic)</th>
<th>F for Indep Vars</th>
</tr>
</thead>
<tbody>
<tr>
<td>PREM</td>
<td>$\log \nu_\pi$</td>
<td>2</td>
<td>-1.916 (-1.979)</td>
<td>3.094</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>-1.705 (-1.478)</td>
<td>2.061</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>-1.969 (-1.500)</td>
<td>1.564</td>
</tr>
<tr>
<td>PREM</td>
<td>$\log \nu_\epsilon$</td>
<td>2</td>
<td>-0.362 (-0.392)</td>
<td>0.646</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>0.340 (0.299)</td>
<td>0.803</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>1.008 (0.775)</td>
<td>0.879</td>
</tr>
</tbody>
</table>

†All variables are prefiltered (see footnote 11).
## TABLE III
Regression Results for Equation (8)

\[ \Delta \log S_{Pt} = c_0 + c_1 \Delta E_t X + c_2 \Delta \log \nu_{\pi,t} + c_3 \Delta \log \nu_{\varepsilon,t} \tag{8} \]


<table>
<thead>
<tr>
<th>Eq.No.</th>
<th>(c_1)</th>
<th>(c_2)</th>
<th>(c_3)</th>
<th>(R^2)</th>
<th>DW</th>
</tr>
</thead>
<tbody>
<tr>
<td>8-a-1</td>
<td>3.200</td>
<td>--</td>
<td>--</td>
<td>0.280</td>
<td>2.00</td>
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<tr>
<td></td>
<td>(3.502)</td>
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<td>8-a-2*</td>
<td>--</td>
<td>-12.611</td>
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<td>0.230</td>
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<td>(-3.151)</td>
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<td>8-a-3*</td>
<td>--</td>
<td>--</td>
<td>-4.432</td>
<td>0.033</td>
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<td></td>
<td>(-1.294)</td>
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<td>8-a-4*</td>
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<td>-11.840</td>
<td>-2.136</td>
<td>0.214</td>
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<td></td>
<td></td>
<td>(-2.791)</td>
<td>(-0.651)</td>
<td></td>
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</tr>
<tr>
<td>8-a-5</td>
<td>2.673</td>
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<td>0.362</td>
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</tr>
<tr>
<td></td>
<td>(2.989)</td>
<td>(-2.143)</td>
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<tr>
<td>8-a-6</td>
<td>2.646</td>
<td>-7.559</td>
<td>-1.031</td>
<td>0.341</td>
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<td></td>
<td>(2.902)</td>
<td>(-1.967)</td>
<td>(-0.364)</td>
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</tbody>
</table>

### Panel B: (1960.I through 1985.II: NOB = 52)

<table>
<thead>
<tr>
<th>Eq.No.</th>
<th>(c_1)</th>
<th>(c_2)</th>
<th>(c_3)</th>
<th>(R^2)</th>
<th>DW</th>
</tr>
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<tbody>
<tr>
<td>8-b-1</td>
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<td>0.170</td>
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<td>8-b-2*</td>
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<td>-9.919</td>
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<td>8-b-3*</td>
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<td>--</td>
<td>-6.315</td>
<td>0.076</td>
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<td>8-b-4*</td>
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<td>-8.752</td>
<td>-4.391</td>
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<td>(-2.981)</td>
<td>(-1.599)</td>
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<td>8-b-5*</td>
<td>2.111</td>
<td>-7.458</td>
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<td>0.269</td>
<td>1.98</td>
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<tr>
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<td>(2.838)</td>
<td>(-2.802)</td>
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<td>8-b-6</td>
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<td>(2.462)</td>
<td>(-2.514)</td>
<td>(-0.823)</td>
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<td></td>
</tr>
</tbody>
</table>

†: \(\Delta \log S_{Pt}\) is scaled by multiplying by 100. Equation number followed by * indicates that the regression is adjusted for the first-order autocorrelation of residuals using the Cochrane-Orcutt method. T-statistics are in parentheses below coefficient estimates.