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FIRM CHARACTERISTICS, UNANTICIPATED INFLATION, AND STOCK RETURNS

Douglas K. Pearce

V. Vance Roley

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Douglas K. Pearce is Associate Professor of Economics, North Carolina State University. V. Vance Roley is Rainier National Bank Professor of Banking and Finance, University of Washington. The authors are grateful to Michael Gilberto for research assistance and to John Campbell, Heidi Chrisman, Diana Hancock, Paul Malatesta, James Pesando, and Simon Wheatley for helpful comments. The research reported here is part of the NBER's research program in Financial Markets and Monetary Economics. Any opinions expressed are those of the authors and not those of the National Bureau of Economic Research.

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ABSTRACT

This paper re-examines the effects of nominal contracts on the relationship between unanticipated inflation and individual stock's rate of return. This study differs in three main ways from previous research. First, announced inflation data are used to examine the effects of unanticipated inflation. Second, a different specification is used to obtain more efficient estimates. Third, additional nominal contracts are considered. The empirical results indicate that time-varying firm characteristics related to inflation predominately determine the effect of unanticipated inflation on a stock's rate of return. A firm's debt-equity ratio appears to be particularly important in determining the response.

Douglas K. Pearce
Department of Economics and Business
North Carolina State University
Box 8110
Raleigh, NC 27695-8110
(919)737-2885

V. Vance Roley
Department of Finance, DJ-10
University of Washington
Seattle, WA 98195
(206)545-7476

The behavior of the stock market during the high and volatile inflation of the 1970s rekindled interest in the relationship between stock returns and inflation. The subsequent resurgence of stock prices from 1982 to mid-1986, coinciding with a marked reduction in inflation, is consistent with the experience of the 1970s. This casual evidence suggests a negative relationship between stock returns and inflation, contrary to the traditional view that long positions in stocks can be used as hedges against inflation.

A variety of hypotheses have been proposed to explain the observed inflation-stock return relationship. One hypothesis, advanced by Fama (1981), Nelson (1979), and Geske and Roll (1983), argues that the observed effects of either anticipated or unanticipated inflation on stock returns reflect other economic factors. In particular, given the apparent negative correlation between inflation and future economic output in historical data, the observed negative relationship between inflation and stock returns is actually due to a positive relationship between future economic activity and stock returns. Under this hypothesis, then, causality cannot be attributed to the observed inflation-stock return relationship. Moreover, this hypothesis implies that the effects of firm characteristics related to inflation and nominal contracting are not important in determining an individual stock's response to unanticipated inflation.

A second hypothesis is based on investor irrationality during periods of inflation. The principal advocates of this view are Modigliani and Cohn (1979). They argue that investors do not correctly take into account the effects of unanticipated inflation on a firm's outstanding debt. That is, the market does not correctly value the implicit gain in shareholder wealth due to the fall in the real value of a firm's outstanding debt. In addition to this effect, Modigliani and Cohn hypothesize that investors mistakenly compare real rates of return on common stock to the nominal interest rates on debt. These latter rates, of course, tend to reflect any change in expected inflation. As a consequence, the perceived rates of return on equity fall relative to nominal debt yields during periods of increasing inflation, thereby causing investors to bid down share prices. This hypothesis also implies that a firm's leverage does not matter in determining an individual stock's response to unanticipated inflation.

A third main hypothesis about the relationship between inflation and stock returns is based on the effects of a firm's nominal contracts. Several types of nominal contracting effects have been proposed. First, increases in inflation further erode the depreciation tax shield due to historical cost depreciation. Feldstein (1980) and Feldstein and Summers (1979), for example, estimate such effects to be a significant determinant of aggregate equity values. Second, spurious inventory profits due to inflation increase a firm's real tax burden. Moreover, Summers (1981) presents evidence that the effects of inflation on firms using the FIFO accounting method for inventories are much more pronounced than on those using the LIFO method. Third, a firm's nominal debt contracts potentially offset these negative effects when inflation unexpectedly increases. As Kessel (1956) discussed in an early contribution, as long as firms are net debtors unanticipated inflation should benefit stockholders. So, for at least some firms, the effects of unanticipated inflation may be minimal.

Recent empirical studies on the effects of nominal contracts on the response of a firm's share price to unanticipated inflation do not lend much support to the nominal contracting hypothesis.[1] French, Ruback, and Schwert (1983) suggest that their evidence is consistent with the hypothesis of Fama (1981), Nelson (1979), and Geske and Roll (1983). That is, the negative response of individual stock returns to positive unanticipated inflation reflects a downward revision in expected future economic activity. Bernard (1986) finds some support for the nominal contracting hypothesis, but most of the estimated response of stock returns simply depends on a stock's systematic risk. This again is interpreted as providing support for the future economic activity - stock return link. As noted in both of these studies, however, a number of potentially important nominal contracts are excluded in the empirical investigations. These include the nominal contracts associated with labor, materials, and products, as well as the implicit nominal contracts associated with taxable inventory profits and many pension plans.

The purpose of this paper is to re-examine the effects of nominal contracts on the relationship between unanticipated inflation and an individual stock's rate of return. This study differs in three main ways from previous research. First, a different measure of unanticipated inflation is used. Previous research uses empirical proxies to measure unanticipated inflation over a month, quarter, or year. Moreover, the inflation data as currently revised are usually employed. In contrast, unanticipated announced changes in the Consumer Price Index (CPI) are used here. This approach allows news associated with inflation to be isolated, along with any effect on stock returns. Second, the effects of nominal contracts are examined in a somewhat different specification. The specification implies both a more restrictive null hypothesis and more efficient estimates than those used previously. Third, additional nominal contracts are considered in comparison to the studies by French, Ruback, and Schwert (1983) and Bernard (1986). In particular, the differential effects of unanticipated inflation on stock returns due to LIFO and FIFO inventory accounting are considered. In addition, the effects of a firm's pension plan are investigated.

In the first section, the model of the response of individual stock returns to unanticipated inflation is presented. The data used in estimating the model also are discussed. The estimation and test results are presented in the second section. The tests focus on the effects of firm-specific characteristics. In the third section, the implications of firm characteristics in determining the response of a firm's stock to unanticipated inflation are further analyzed. The main conclusions are summarized in the final section.

SPECIFICATION AND DATA

The specification used to estimate the response of individual stock returns to unanticipated inflation is similar to those of French, Ruback, and Schwert (1983) and Bernard (1986). The model allows the response to depend both on general or economy wide effects and individual firm characteristics. Under the null hypothesis of no firm characteristic effects, however, the specification takes a somewhat different form.

To motivate the specification used here, consider the response of the rate of return on stock i, R_{it}, to unanticipated inflation announced during day t:

$$R_{it} = R_{it}^{e} + (\gamma Z_i + \delta X_{it}) \cdot INF_t^u + e_{it} \qquad (1)$$

where

R_{it}^{e} = expected rate of return on stock i during day t as of time t-1,

Z_i = time-independent firm i characteristic, normalized such that

$$(1/N) \sum_{i=1}^{N} Z_i = 1,$$

N = number of firms in the market portfolio,

X_{it} = time-varying firm i characteristic,

INF_t^u = INF_t - INF_t^e, unanticipated inflation,

INF_t = announced inflation,

INF_t^e = expected value of announced inflation as of time t-1,

e_{it} = random error term,

γ,δ = fixed coefficients.

In this specification, the actual rate of return differs from what was expected by two random errors. The first corresponds to movements due to unanticipated inflation, depending on both fixed and time-varying firm characteristics. The second is the remaining component of the unanticipated movement in the stock's rate of return. The expectation of both of these errors equals zero as of time t-1, when the expectation of the rate of return was formed.

Equation (1) is analogous to the specification presented by French, Ruback, and Schwert (1983). In particular, their specification includes both firm-specific fixed $\gamma_i(=\gamma Z_i)$ and time-varying effects. The constant term in their specification corresponds to R^e_{it} in equation (1). The null hypothesis tested by French, Ruback, and Schwert (1983) is $\delta=0$. Thus, the firm-specific fixed effects γ_i are implicitly associated with the economic activity hypothesis of Fama (1981), Nelson (1979), and Geske and Roll (1983). However, two types of fixed effects may be embedded in γ_i. One is in fact the individual firm's stock response to economy-wide effects. The other is firm-specific fixed effects apart from these economy-wide effects. If these two types of fixed effects exist, the null hypothesis that $\delta=0$ is not restrictive enough to capture only the economic activity hypothesis.

To consider both Bernard's (1986) specification and that estimated here, it is useful to examine the response of the market. Given that the rate of return on an individual stock is described by (1), the response of the market can be represented as

$$R_{mt} = R^e_{mt} + (\gamma + \delta\bar{X}_t) \cdot INF^u_t + e_{mt}, \tag{2}$$

where

$R_{mt} = (1/N)\sum_{i=1}^{N} R_{it}$, market rate of return for an equally weighted portfolio

$R^e_{mt} = (1/N)\sum_{i=1}^{N} R^e_{it}$, expected market rate of return,

$\bar{X}_t = (1/N)\sum_{i=1}^{N} X_{it}$, cross-section average of time-varying firm characteristics

$$e_{mt} = (1/N) \sum_{i=1}^{N} e_{it}, \quad \text{random error term}$$

The estimated aggregate stock responses in previous studies [e.g., Nelson (1976), Fama (1981), and Pearce and Roley (1985)] therefore reflect the averages of the individual firm characteristics.

Now assume that the single-factor market model describes the rates of return on individual stocks:

$$R_{it} = \alpha_i + \beta_i R_{mt} + u_{it} \tag{3}$$

where

α_i, β_i = fixed coefficients,

u_{it} = random error term.

Combining (2) and (3), and using the fact that

$$R_{it}^{e} = \alpha_i + \beta_i R_{mt}^{e}, \tag{3'}$$

implies

$$R_{it} = R_{it}^{e} + \beta_i(\gamma + \delta\bar{X}_t) \cdot INF_t^{u} + \beta_i e_{mt} + u_{it}. \tag{4}$$

Under the null hypothesis, u_{it} in equations (3) and (4) is independent of any firm-specific fixed or time-varying effects, implying $Z_i = \beta_i$ and $\delta=0$ in equation (1). That is, a stock's response is assumed to depend on its beta and the market's response to unanticipated inflation. It seems plausible to associate this effect with the economic activity hypothesis of Fama (1981), Nelson (1979), and Geske and Roll (1983).

To test the null hypothesis that $Z_i = \beta_i$ and $\delta=0$, equation (1) can be rewritten as

$$R_{it} = R_{it}^{e} + \beta_i(\gamma + \delta\bar{X}_t) \cdot INF_t^{u} + [\gamma(Z_i - \beta_i) + \delta(X_{it} - \beta_i\bar{X}_t)] \cdot INF_t^{u} + e_{it}, \tag{5}$$

which is obtained by adding and subtracting $\beta_i(\gamma + \delta\bar{X}_t) \cdot INF_t^{u}$ on the right-hand side of equation (1). Equation (5) is analogous to Bernard's (1986) specification, where R_{it}^{e} is again replaced by a time-invariant intercept and firm-specific fixed effects are represented by $\gamma_i[= \gamma(Z_i - \beta_i)]$. Bernard's preferred specification, however, includes the constraint that γ_i equals the same constant across firms. It is difficult to motivate this constraint from the model. Bernard further estimates β_i from an auxiliary sample, implying that the estimated coefficient on $\beta_i \cdot INF_t^u$ is γ in his specification.[2]

The variance of the error term in equation (5) can be reduced with one further substitution. In particular, using equations (2), (3), and (3′), equation (5) can be expressed as

$$R_{it} = \alpha_i + \beta_i R_{mt} + [\gamma(Z_i - \beta_i) + \delta(X_{it} - \beta_i \bar{X}_t)] \cdot INF_t^u + e_{it} - \beta_i e_{mt}. \quad (5')$$

Under the null hypothesis, the error term $(e_{it} - \beta_i e_{mt})$ reduces to u_{it}. In contrast, the error term in equation (5) under the null hypothesis is $\beta_i e_{mt} + u_{it}$, which has an unambiguously larger variance than u_{it} since u_{it} and e_{mt} are uncorrelated. For the same reasons, the variance of the error term in equation (5') also is smaller than that in equation (1). As before, the null hypothesis is $Z_i = \beta_i$ and $\delta=0$.

In sum, several advantages are apparent in specification (5'). First, the null hypothesis involves a test of both firm-specific fixed (apart from β_i) and time-varying responses of individual stocks to unanticipated inflation. Second, the variance of the error term is smaller than those in previous specifications. Third, the intercept corresponds to α_i instead of R_{it}^e, where the latter may be expected to vary over time.

Firm Characteristics and Inflation

In the specification examined empirically, several different time-varying firm characteristic variables corresponding to X_{it} in (5') are included. The specific model estimated is

$$R_{it} = \alpha_i + \beta_i R_{mt} + \theta_i INF_t^e + [\gamma_i + \delta_1(INV_{it} - \beta_i \overline{INV}_t)$$

$$+ \delta_2(L_{it} \cdot INV_{it} - \beta_i L_{it} \cdot \overline{INV}_t) + \delta_3(DEBT_{it} - \beta_i \overline{DEBT}_t)$$

$$+ \delta_4(DEPR_{it} - \beta_i \overline{DEPR}_t) + \delta_5(PENS_{it} - \beta_i \overline{PENS}_t)]\cdot INF^u_t + u_{it}. \quad (6)$$

As before, R_{it} is the daily rate of return on stock i during inflation announcement day t, R_{mt} is the daily rate of return on the market portfolio, and u_{it} is the random error term. The daily rate of return data are taken from the Center for Research in Security Prices (CRSP), and R_{mt} is the rate of return on the value-weighted CRSP index. The coefficients to be estimated are α_i, β_i, θ_i, γ_i, and δ_j (j=1,2,...,5). The firm-specific fixed response coefficient γ_i corresponds to $\gamma(Z_i - \beta_i)$ in equation (5'). As a result, the testable constraint that $Z_i = \beta_i$ translates to $\gamma_i = 0$.

The inflation variables represent anticipated inflation, INF^e_t, and unanticipated inflation, INF^u_t. In both cases, the variables pertain to announcements of the previous month's inflation as measured by the Consumer Price Index (CPI). For the portion of the sample before March 1982, CPI announcements were made at 9:00 a.m., eastern time. For the latter portion of the sample, these announcements were made at 8:30 a.m., eastern time.

The anticipated value of the CPI announcement, INF^e_t, is from the survey conducted by Money Market Services, Inc. In all cases, the survey was taken less than two weeks before each month's CPI announcement. Previous research indicates that the median of this survey generally has desirable characteristics in that it is an unbiased forecast of the announcement, it fully reflects past information on inflation, and it outperforms simple forecasting models [Pearce and Roley (1985) and Pearce (1987)]. When this variable is included in the estimation, its effects are allowed to vary across firms, as indicated by the coefficient θ_i. Under the efficient markets hypothesis, however, this information already should be reflected in share prices. This estimated coefficient is therefore expected to be insignificantly different from zero.

Unanticipated inflation, INF^u_t is calculated by subtracting the survey measure of expected inflation from the actual announced percentage change in the CPI. This measure of unanticipated inflation corresponds to the error in predicting the previous month's inflation. This error is nevertheless a statistically significant determinant of the survey measure of expected announced inflation in the subsequent month. In particular, a one percentage point increase in unanticipated announced inflation causes an upward revision in the subsequent month's expectation of announced inflation of 0.3 percentage points [Pearce (1987)]. This evidence indicates that the new information provided by an inflation announcement has value in predicting current and future inflation.

The remaining terms in equation (6), with coefficients $\delta_i (i=1,2,...,5)$, represent time-varying firm characteristics X_{it} adjusted by a firm's β_i and the average characteristics of the market $\bar{X}_t$. The firm characteristic variables are taken from COMPUSTAT, and the previous year's values are used. Moreover, all of these variables are deflated by the market value of the firm's outstanding equity as of the end of the previous year. The average characteristics of the market are calculated using about 500 COMPUSTAT firms which are comparable to those used to estimate equation (6).[3]

The first firm characteristic variable, INV_{it}, is the value of a firm's inventories. This same variable multiplied by L_{it} takes different inventory accounting methods into account. L_{it} is a dummy variable with value of unity if firm i predominately uses LIFO and zero if it predominately uses FIFO. The next variable, $DEBT_{it}$, is the book value of firm i's long-term debt.[4] The variable measuring a firm's depreciation tax shield, $DEPR_{it}$, is defined following French, Ruback, and Schwert (1983).[5]

Finally, the effects of a firm's pension plan is represented by $PENS_{it}$. This variable is defined as pension expense, and it reflects the average annual future pension expense of a firm. This variable is included to measure the size of a firm's pension plan. While other variables may seem as relevant in evaluating the effects of inflation, especially a firm's unfunded pension liability [e.g., Feldstein and Seligman (1981)], this measure appears to be more closely related to share prices.[6] In examining the effects of pensions fully, a number of additional characteristics also should be considered. Of particular importance is whether a pension is a defined benefit plan or a defined contribution plan. If a pension is a defined benefit plan, it may be potentially important to consider the composition of the pension firm's assets, as well as the value of the unfunded pension liability. Based on the data reported by Kotlikoff and Smith (1983), it appears that asset composition is related to the size of a pension plan.[7] As a result, the $PENS_{it}$ variable may capture some asset composition effects. Additional factors include the wage policy of the firm and the degree to which pension benefits are indexed [e.g., Pesando (1987)]. For an unanticipated increase in inflation, the value of the pension's assets most likely falls, but the real value of the firm's liability also may fall [e.g., Bulow (1982) and Bodie, Marcus and Merton (1985)]. Thus, the net effect is uncertain. The pension expense variable is included as a preliminary attempt to examine the net effect.

In sum, a variety of variables are included to capture the response of individual stocks to unanticipated inflation. For a set of representative stocks as a group, previous research indicates that the effect of positive unanticipated inflation by itself should be negative. The effect of the FIFO inventory accounting δ_1 should contribute to this negative impact. LIFO inventory accounting should substantially offset the negative effect associated with δ_1, implying an anticipated positive sign for δ_2. The coefficient δ_3 is expected to be positive, reflecting the gains to shareholders due to an unanticipated decline in the real value of a firm's outstanding debt. The larger a firm's depreciation expenses, the more it is adversely affected by positive inflation surprises. So, δ_4 is expected to be negative. Finally, the net effect of a firm's pension expense depends on a variety of factors, implying that the sign of δ_5 is unknown a priori.

The sample period used in estimating equation (6) begins in November 1977 and ends in December 1982. The starting point coincides with the availability of the survey data for inflation announcements. This sample has a total of 62 observations, corresponding to one inflation announcement day during each month of the sample.

A total of 84 firms are considered over this sample period. This limited number of firms is considered because of the estimation techniques used, which are discussed in the next section. To limit the size of the sample, and to ensure an adequate representation of firms to test the null hypothesis that all inflation effects are incorporated in the single-factor market model, the sample was initially selected according to the values of Value Line betas. Firms were selected that had betas of exactly 0.8, 1.0 and 1.2 as of the end of the sample period. Further firms were deleted depending on the availability of data from COMPUSTAT, and whether the firm used the same inventory accounting procedure over the 1977-1982 period. The sample used by Bernard (1986) consists of 136 firms. French, Ruback, and Schwert (1983) examine 158 firms with data in each quarter of their sample. In each of these studies, portfolios of stocks are considered, thereby eliminating some of the advantages of larger cross-sectional samples.

Because of the relatively small size of this sample, at least in comparison to the universe of stocks available on the CRSP tapes, it is important to determine whether the sample is representative of the stock market as a whole. In this respect, two equations were estimated to compare the aggregate response of the sample with that of the CRSP index:

$$R_{mt} = b_0 + b_1 INF_t^e + b_2 INF_t^u + e_t, \quad (7)$$

$$R_{it} = b_{i0} + b_1 INF_t^e + b_2 INF_t^u + u_t, \quad (8)$$

where the b's are coefficients, e_t and u_t are random error terms, and the other variables are as defined previously.

The estimation results of equations (7) and (8) are reported in Table 1. The equations are estimated using ordinary least squares over the entire sample period. For the rate of return on the CRSP market index on inflation announcement days, a positive one percentage point inflation surprise is associated with an average decline of 0.87 percent in this rate of return.[8] The effect of anticipated inflation is estimated to be insignificantly different from zero at the 10 percent level.[9] For the rates of return on the sample of 84 stocks, the estimation results are comparable. For these stocks, the estimated negative effect of a positive inflation surprise is somewhat larger, but the effect of anticipated inflation again is insignificantly different from zero. As a whole, the results suggest that the sample stocks selected are representative of the much broader CRSP market index.

ESTIMATION RESULTS

The response of the 84 stocks to unanticipated inflation is estimated using the seemingly unrelated regression technique (SUR). Because the number of stocks exceeds the number of inflation announcements, it was not possible to consider the entire set of 84 stocks together. As a consequence, two subsamples of 42 stocks were formed. These two subsamples were arbitrarily selected except that roughly equal numbers of firms using LIFO and FIFO inventory accounting were placed in each sample. As is apparent in the reported estimation results, no effort was made to make the results of the two subsamples the same. Moreover, the first subsample has somewhat more desirable characteristics in that the explanatory variables exhibit more variability.

Two different versions of equation (6) are estimated for each of the subsamples of stocks. The most general version corresponds exactly to equation

(6). The other version excludes the pension variable because of its uncertain theoretical effect. Equation (1), corresponding to the specification adopted by French, Ruback, and Schwert (1983), also is estimated. In this case, firm-specific intercepts replace R_{it}^{e} in equation (1), and expected inflation is included in a manner analogous to equation (6).[10] This specification is considered to determine the relative importance of using unanticipated announced inflation versus the usual empirical proxies.

The estimation results for both subsamples of stocks estimated over the November 1977 - December 1982 period are reported in Table 2. For the first subsample of stocks, the results for the most general model are reported in the first row. Again, this specification includes four firm-specific coefficients, α_i, β_i, γ_i, and θ_i, not reported in the table. Also, each of the time-varying firm characteristic variables are adjusted by $\beta_i \bar{X}_t$ as indicated in equation (6). The results indicate that four coefficients on time-varying firm characteristics are statistically significant at the 10 percent level. The coefficient on the inventory variable is negative, as expected. The coefficient on the LIFO term, however, is insignificantly different from zero. The coefficient on the debt variable is positive, reflecting the gains to shareholders due to a decrease in the real value of a firm's outstanding debt in the presence of a positive inflation shock. For a ratio of long-term debt to equity of one half, for example, a one percentage point inflation shock increases a stock's rate of return by about 4.6 percentage points. The depreciation variable has the anticipated negative coefficient and is statistically significant at the 10 percent level, reflecting a reduction in the tax shield due to an increase in unanticipated inflation. The final variable, pension expense, has a positive and statistically significant coefficient in this particular specification.

In the various specifications estimated for the first subsample of firms, two robust firm-specific effects are evident. In particular, in all cases the FIFO inventory and debt variables have statistically significant effects, with the anticipated signs.[11] In some specifications, the remaining firm characteristic variables also have statistically significant effects. Moreover, the hypothesis that both firm-specific fixed and time-varying characteristics have no effect on the response to unanticipated inflation ($\gamma_i = \delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = 0$) can be rejected in both versions of equation (6). In this case, all effects are assumed to operate through a stock's beta under the null hypothesis. The weaker hypothesis that only time-varying firm characteristics have no effect ($\delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = 0$) also can be rejected. Finally, the results also suggest that the use of unanticipated announced inflation is largely responsible for the significant effects, and not the lower variance of the error term implied by equations (5') and (6). In particular, the results for equation (1) are comparable to those of equation (6). In turn, the main difference in equation (1) from the specification estimated by French, Ruback, and Schwert (1983) is the use of unanticipated announced inflation.

The results for the second subsample of firms, reported in the last three rows of Table 2, are similar to those of the first with one exception. The exception is the coefficient on the pension variable, which is negative and statistically significant. The effects of FIFO inventories and debt are qualitatively the same. Also, the hypothesis that both fixed and time-varying firm characteristics have no effect on the response again can be rejected.

As a whole, the results indicate that a stock's response to unanticipated inflation depends on the characteristics of the firm. Moreover, each of the firm-characteristic variables is significant in at least some specifications. The variable with the most robust effects across subsamples and specifications is the long-term debt variable. The results related to this variable suggest that firms with high debt-equity ratios are less susceptible to any adverse effects from positive unanticipated inflation. This provides evidence against the Modigliani-Cohn hypothesis. The economic implications of firm characteristics are further examined in the next section.

IMPLICATIONS OF FIRM CHARACTERISTICS

The presence of statistically significant firm-characteristic effects suggests that different stocks' responses to unanticipated inflation may vary considerably across firms. To consider this possibility initially, the responses of the individual stocks are summarized in Chart 1. The chart represents the average responses of all 84 firms to a 1 percentage point inflation surprise, using the average values of each firm's characteristics over the estimation period and the estimated coefficients of equation (6). These estimated coefficients are reported in the first and fourth rows of Table 2. The response due to the market factor is calculated using a stock's estimated beta in equation (6) and the estimated response of the market rate of return as reported in Table 1.

The chart indicates that the majority of the stocks register an average response to a 1 percentage point increase in unanticipated inflation between -2.5 and -.5 percent.[12] As is apparent, however, some stocks are affected both much more and much less than this amount. Indeed, some of the stocks record a positive response.

To investigate the determinants of the individual responses further, summary measures of the time-varying firm characteristic variables and betas are reported in Table 3. These measures correspond to averages of the highest third, middle third, and lowest third of the values for the first subsample of firms. The average characteristics of the sample of about 500 COMPUSTAT firms used to construct the $\overline{X}_t$ variables in equation (6) also are included. As indicated in the table, both betas and time-varying firm characteristics exhibited considerable cross-sectional variation.[13]

In Table 4, the values of betas and two time-varying firm-characteristic variables in Table 3 -- FIFO inventories and debt -- are formally combined with the estimated coefficients from the first row of Table 2 to consider the relative importance of these factors. In this table, high, medium, and low values of these variables are combined in all possible combinations. Other time-varying firm-characteristics are assumed to take their market values in the fourth row of Table 3. Across the top of the table, different combinations of debt and FIFO inventories are considered. Each row similarly examines different values of beta. The reported figure in the first row and first column, for example, indicates that a firm with a low beta, low debt, and low inventories with FIFO (L, L, L), has an average rate of return of
-0.59 percent on its stock in response to a 1 percentage point inflation surprise.

The individual figures reported in the table suggest economically important differences in rates of return in response to unanticipated inflation. The lowest rate of return is -10.09 percent. In this case, a firm has a high beta, low debt, and high inventories. In contrast, the other extremes of all of these firm characteristics yield a rate of return of 6.67 percent. That is, a low beta, high debt, and low inventories actually imply a positive rate of return larger than the 1 percentage point increase in unanticipated inflation. In general, the debt and inventory variables are particularly important in determining a stock's response. In contrast, variation over the range of a stock's beta considered here does not account for as much of the differences across the responses.

Some of the values in Table 4 exceed the range of responses illustrated in Chart 1. As a consequence, it is useful to consider an alternative approach of evaluating the relative importance of a firm's beta versus its other characteristics. In this respect, the estimated responses of all 84 firms are plotted against their estimated betas in Chart 2. Each point on the horizontal axis represents the response of an individual firm's stock to a one percent inflation surprise, using sample averages of the firm's characteristic variables. Using these average values, the responses are calculated using the first and fourth rows in Table 2, along with estimates of firm-specific fixed effects γ_i. If the estimated betas account for all of the responses of the individual stocks, the points in Chart 2 should lie on a line with a slope equal to -0.87, the response of the market to a 1 percent inflation surprise from Table 1. The chart instead indicates considerable dispersion in the responses. Indeed, the simple correlation between the estimated betas and the estimated responses is only 0.18. Thus, most of the variation across the estimated responses is due to factors other than beta.

As a whole, the results indicate that time-varying firm characteristics related to inflation play a major role in determining a stock's response to unanticipated inflation. Fixed economywide effects, which are assumed to operate through a stock's beta, play much less of a role. As a consequence, these results support the nominal contracting hypothesis, contrary to the results presented by French, Ruback, and Schwert (1983) and Bernard (1986).

SUMMARY AND CONCLUSIONS

This paper re-examined the effects of unanticipated inflation on the rates of return on individual stocks. This empirical research differed in several ways from previous studies. First, a different measure of unanticipated inflation was employed. The measure corresponded to the unanticipated component of the monthly CPI announcement. Second, a larger set of firm-specific characteristics was considered, including different inventory accounting methods and pensions. Finally, the effects of firm characteristics were tested against a plausible null hypothesis involving the single-factor market model.

The empirical results indicated that time-varying firm characteristics related to inflation predominately determine the effect of unanticipated inflation on a stock's rate of return. Moreover, the net effect could be either positive or negative. A firm's debt-equity ratio and its inventories, when FIFO inventory accounting is used, appear to be particularly important in determining the response. A firm's market beta also is a significant factor, but the associated effect is smaller in comparison. These results therefore offer support to the nominal contracting hypothesis, in contrast to those of French, Ruback, and Schwert (1983) and Bernard (1986). Given the significant role of debt-equity ratios in determining a stock's response, the results also contradict the investor irrationality hypothesis presented by Modigliani and Cohn (1979).

The results also suggest several promising areas of future research. First, to ensure the robustness of the results, additional sets of stocks could be considered. Second, the estimation period could be extended beyond that covered by the inflation announcement survey data. In this case, simple time-series models of inflation might be appropriate. Finally, given the results concerning the effects of a firm's pension plan on the response to unanticipated inflation, it seems worthwhile to isolate the various effects associated with pensions.

FOOTNOTES

1. Hong (1977) investigated the nominal contracting hypothesis but did not distinguish between expected and unexpected inflation.

2. Equation (5) differs from Bernard's (1986) specification in that the two $\beta_i\ \delta\bar{X}_t$ terms are excluded. Thus, the coefficient on $\beta_i\ INF_t^u$ is γ, and time-varying firm characteristic effects are represented by $\delta X_{it} \cdot INF_t^u$.

3. The firms are comparable in that all the characteristics considered here are reported and the same fiscal years are used.

4. Following French, Ruback, and Schwert (1983), this variable is defined as the sum of bonds and preferred stock. A short-term debt variable is not included because its effects are likely to be small in comparison.

5. This variable is calculated using plant and equipment (PE) data and deferred tax account (DT) data from COMPUSTAT. The tax shield is defined as PE-2·DT, assuming a marginal tax rate of 50 percent.

6. Daley (1984) compares a variety of different pension measures in terms of their empirical relationship with stock prices. Based on his research, the pension expense measure appears to be the most relevant.

7. In Tables 5.6.3 and 5.6.4, Kotlikoff and Smith (1983) report the portfolio composition of private pension plans by size of the pension fund. The data suggest that the fraction of assets invested in equities increases with the

size of the fund. Also, the fraction held in cash and deposits declines with size.

8. This result is similar to that reported by Schwert (1981) except that he finds that the market return (measured by the S&P composite index) falls by .99 percent the day prior to the announcement and about .52 percent on the day of the announcement for the period 1971-78. His measure of unexpected inflation is actual inflation minus the beginning of the month one-month Treasury bill rate plus the mean real rate over the period. Also, the response on inflation announcement days is only considered here, both for the market and individual stocks. Using inflation announcement and survey data, Pearce and Roley (1985) do not find any significant effects other than on the announcement day.

9. Both of these results are comparable to those obtained by Pearce and Roley (1985) for the Standard and Poors 500 index except that the response was not significantly different from zero when the period was split into two subperiods. Also note that intercepts are not reported in Table 1, but they were included in estimating equations (7) and (8). As indicated in equation (8), the intercepts were allowed to vary over individual stocks. Finally, none of the percentage changes or rates of return are annualized.

10. All specifications also were estimated excluding anticipated inflation. Because anticipated and unanticipated inflation are very close to being orthogonal, the estimates are virtually unchanged. In contrast to the results in Table 1, however, the hypothesis that the coefficients on expected inflation (θ_1) equal zero can be rejected in all specifications at the 5 percent significance level.

11. Recent studies on the SUR estimation procedure suggests that the asymptotic standard errors used in forming t-ratios in Table 2 may be downward biased. See, for example, Marais (1986). However, doubling the standard errors for the first subsample of firms still implies statistically significant effects from the FIFO inventory and debt variables. Three-fold increases in the standard errors maintains the significance of the debt variable. The importance of these firm characteristic variables in determining a stock's response to unanticipated inflation is considered further in the next section.

12. A one percent CPI surprise is very large since these are monthly inflation rates. The average absolute error for the survey median predictions was .17 percent or about 2 percentage points when annualized. There were, however, several times when the error was .5 percent or higher (above 6 percentage points when annualized).

13. Betas were allowed to take their estimated values, not the Value Line values used to form the sample. Also, in comparison to the medium values in Table 3, the sample means -- equal to the average of the high, medium, and low values -- are closer to the market values.

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TABLE 1

Response of Aggregate Stock Returns to Unanticipated Inflation.

Rate of Return	Coefficient Estimates		Summary Statistics	
	INF^e	INF^u	$\bar{R}^2$	SE
R_{mt}	.0002 (0.05)	-.0087** (-1.88)	.057	.008
R_{it}	.0007 (0.66)	-.0108* (-7.77)	.027	.022

Notes: The specifications correspond to equations (7) and (8). In estimating equation (8) for the selected sample of stocks, the constant term is allowed to vary over individual stocks. The estimation period begins in November, 1977, and ends in December, 1982. Numbers in parentheses are t-statistics.

* Significant at the 5 percent level.

** Significant at the 10 percent level.

R_{mt} = rate of return during inflation announcement days on the value-weighted CRSP index.

R_{it} = rate of return during inflation announcement days on a selected sample of stocks.

INF_t^e = expected value of the inflation announcement, represented by the survey conducted by Money Market Services, Inc.

INF_t^u = unanticipated inflation, calculated as $INF_t^a - INF_t^e$, where the INF_t^a is the announced value of inflation as represented by the Consumer Price Index (CPI).

$\bar{R}^2$ = multiple correlation coefficient adjusted for degrees of freedom.

SE = estimated standard error.

TABLE 2

Estimated Responses of Stock Rates of Return to Unanticipated Inflation

Results for Sample 1

Specification	Firm Characteristics: INV	L·INV	DEBT	DEPR	PENS	Test Statistics: $\gamma_i=\delta_1=\ldots=\delta_5=0$	$\delta_1=\ldots=\delta_5=0$
Equation (6)	-.0739* (-4.60)	-.0266 (-1.46)	.0919* (6.58)	-.0155** (-1.71)	.3753* (3.58)	$\chi^2(47)=199.21^*$	$\chi^2(5)=72.79^*$
Equation (6)	-.0650* (-4.04)	-.0130 (-0.74)	.0916* (6.50)	-.0046 (-0.53)	--	$\chi^2(46)=181.67^*$	$\chi^2(4)=55.55^*$
Equation (1)	-.0824* (-3.09)	-.0339** (-1.77)	.1115* (7.89)	-.0085 (-0.94)	.3370* (3.12)	--	--

Results for Sample 2

Specification	INV	L·INV	DEBT	DEPR	PENS	$\gamma_i=\delta_1=\ldots=\delta_5=0$	$\delta_1=\ldots=\delta_5=0$
Equation (6)	-.0142* (-2.18)	.0018 (0.18)	.0327* (4.32)	.0053 (0.62)	-.2429* (-5.34)	$\chi^2(47)=257.96^*$	$\chi^2(5)=104.95^*$
Equation (6)	-.0188* (-2.98)	-.0254* (-2.80)	.0489* (6.81)	-.0234* (-3.41)	--	$\chi^2(46)=233.59^*$	$\chi^2(4)=84.31^*$
Equation (1)	-.0167 (-1.10)	-.0109 (-1.01)	.0386* (4.77)	-.0042 (-0.46)	-.1617* (-3.30)	--	--

Notes: Constant terms, α_i, coefficients on the market rate of return, β_i, and expected inflation, θ_i, are allowed to vary for each stock. Equation (1) also is estimated with expected inflation. All estimates were done using the SYSNLIN procedure of SAS, version 5. Variables are defined in the text and in Table 1.

$\chi^2(n) = \chi^2$ statistic with n degrees of freedom. This test statistic, analogous to a likelihood ratio test, is discussed in Gallant and Jorgenson (1979).

* Significant at the 5 percent level.

** Significant at the 10 percent level.

TABLE 3

Summary of Firm Characteristic Variables
(Sample 1)

	beta	INV	DEBT	DEPR	PENS
High (H)	1.494	0.984	0.866	1.124	0.091
Medium (M)	0.761	0.393	0.263	0.371	0.025
Low (L)	0.408	0.113	0.076	0.111	0.005
Market	1.000	0.631	0.644	0.760	0.050

Notes: High corresponds to the average of the highest one-third of the firms, Medium corresponds to the average of the middle one-third of the firms, and Low corresponds to the average of the lowest one-third of the firms for each characteristic separately. Market represents the average of about 500 COMPUSTAT firms, corresponding to the $\bar{X}_t$ variables in equation (6). Also consistent with equation (6), the INV, DEBT, DEPR, and PENS variables are deflated by the market value of a firm's outstanding equity as of the end of the previous year.

TABLE 4

Effects of Selected Firm Characteristics on the Response of Stocks to a One Percentage Point Inflation Surprise (Sample 1)

	Debt and Inventories (with FIFO)								
Beta	(L,L)	(L,M)	(L,H)	(M,L)	(M,M)	(M,H)	(H,L)	(H,M)	(H,H)
L	-0.59%	-2.66%	-7.03%	1.13%	-0.94%	-5.31%	6.67%	4.60%	0.23%
M	-1.59	-3.66	-8.02	0.13	-1.94	-6.31	5.67	3.60	-0.76
H	-3.66	-5.73	-10.09	-1.94	-4.01	-8.38	3.60	1.53	-2.83

Notes: High (H), Medium (M), and Low (L) values are taken from Table 3. The DEPR and PENS variables take their market values in Table 3 for all calculations. In calculating the effects of different betas, the estimated response of the market portfolio, R_m, in Table 1 is used. Other estimated coefficients used in the calculations are taken from the first row of Table 2.

CHART 1

Distribution of Daily Stock Return Responses
to a One Percent CPI Surprise (All Firms)

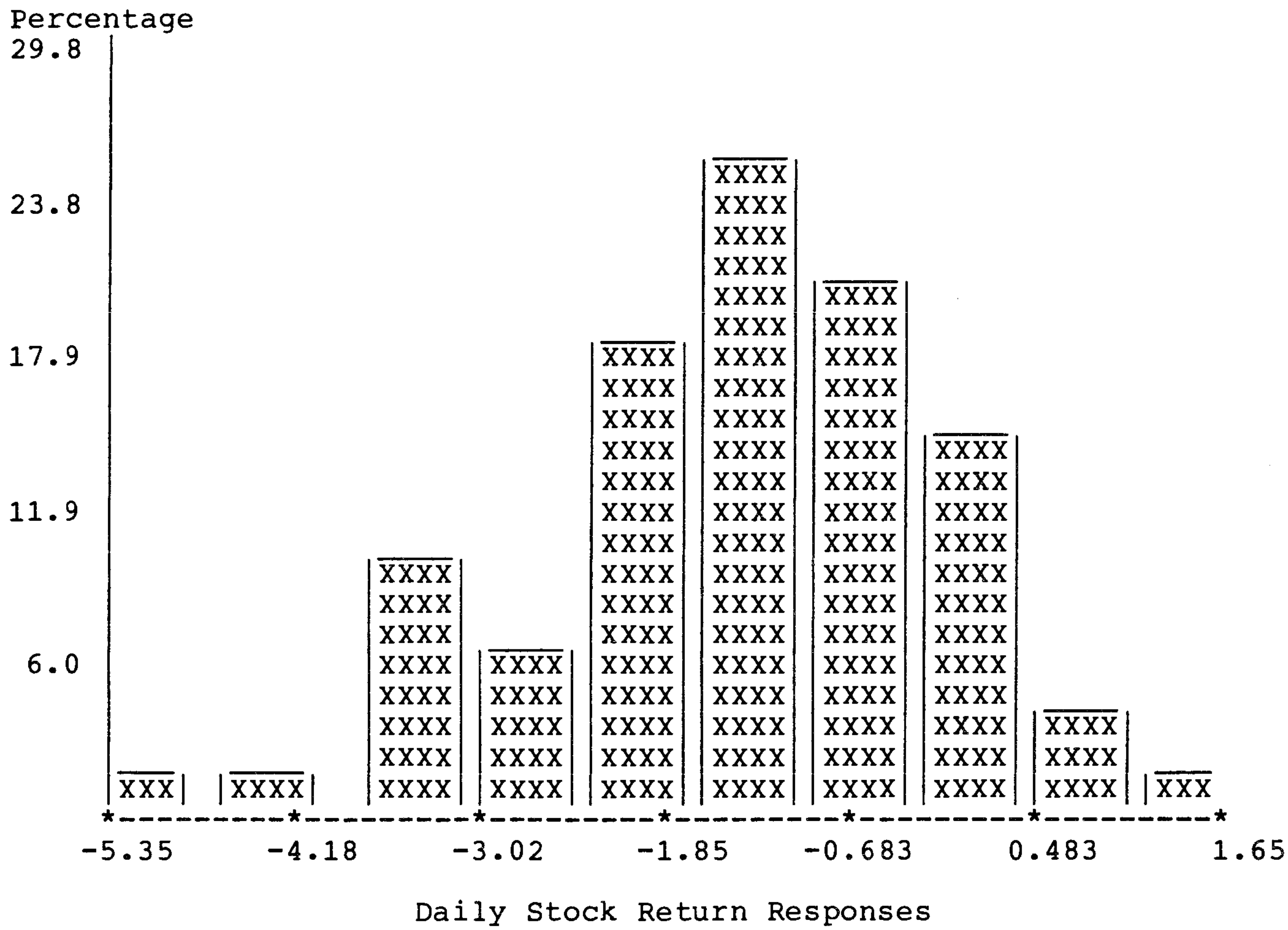
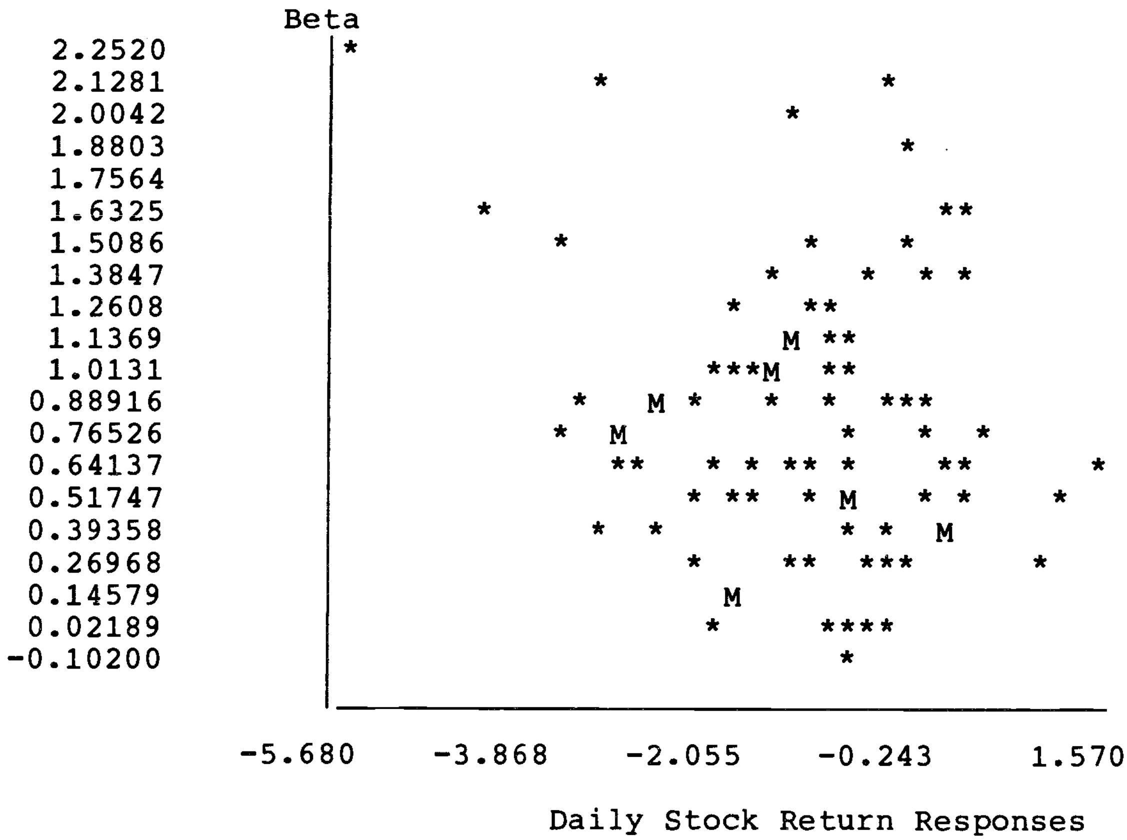


CHART 2

Relationship Between Beta and Daily Stock Return Responses (One Percent CPI Surprise, All Firms)



M = Multiple Point