Inflation and Common Stock Value Changes

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I. Introduction

Common stocks were viewed as a complete hedge against inflation under classical economic theory and the Fisher effect.[1] Further support to the traditional view was provided by the debtor-creditor hypothesis and the wage and cost lag hypothesis. Recent empirical examinations provide contrary evidence by finding a negative relationship between inflation and common stock returns.[2] The hypothesis of depreciation understatement under inflation (Nichols [22]) provides one possible theoretical justification for the empirical results of an inverse relationship between inflation and common stock returns. Each of the three hypotheses has implications on wealth transfers due to inflation among individual firms as well as among different macroeconomic sectors such as households, business corporations and the government.

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1) The traditional view of common stock valuation may be found in Williams [28]. An excellent summary of this view is contained in Lintner [18].

2) A group of studies (Bodie [5], Jaffe and Mandelker [13], Nelson [21], Reilly et al. [24], and Cagan [8]) simply relates the returns on the stock market to the changes in the general price index. Another group of studies (Keran [14], Oudet [23], Lintner [18], Branch [7], and Modigliani and Cohn [19]) incorporates some other variables in addition to inflation rates to allow for changes in the noninflationary factors. While most of these studies found a negative relationship, a recent study by Ang et al. [2] demonstrates the existence of the Fisher effect in the stock market.

While most studies were concerned with the relation between aggregate stock market levels and inflation rates, the present study attempts to investigate differential returns on individual common stocks resulting from differences in inflation-related variables. Individual firms differ from one another in capital structure, asset composition, and operating characteristics. Share price changes caused by these variations were examined by past studies in efforts to test the hypotheses regarding inflationary effects. Van Horne and Glassmire [27] modeled the effects of unanticipated inflation on stock prices arising from wage-cost lag, monetary position and depreciation. Earlier empirical tests on the debtor-creditor hypothesis include Kessel [15], Bach and Ando [3], and Alchian and Kessel [1]. The wage-cost lag hypothesis was empirically tested by Kessel [15], Kessel and Alchian [16], and Cargill [9].

Joint effects of net monetary and depreciation positions have been tested in a cross-sectional context by Bradford [6] and Hong [12]. Bradford's results indicate that depreciation effects are significantly negative while the impact of monetary position is not significant. Hong further refined a cross-sectional model by considering risk and more adequately defined variables. With control for risk, an effect from net monetary position becomes insignificant while effects of depreciation and inventory cost understatements show up very strongly. The models ignore relative price effects or NOI sensitivity to inflation, which are demonstrated in a hypothetical environment to be a dominant factor in determining stock prices by Van Horne and Glassmire [27].

All the studies noted, other than Hong, fail to control for risk. Without proper risk control, differences in returns between groups or among firms might simply reflect a risk-return tradeoff rather than differences in wealth transfer.[3] Bach and Stephenson [4] and Hong [12] employed a risk control in testing inflationary effects on stock returns. The CAR (cumulative average residuals) methodology adopted by the former tends to

3) All variables considered to be susceptible to inflation — i.e., net monetary position, depreciation position, and wage-lag—are shown to have a significant association with risk later in the paper. The effects of the operating risk and financial risk on the extpected rate of return for equity are analyzed theoretically by Rubinstein [25]. Hamada [11] and Lev [17] empirically test the effects of financial leverage and operating leaverage, respectively, on systematic risk.

reject a null hypothesis by cumulating residuals which have an expected value of zero, as indicated by Hong [12, footnote 14, p. 1040]. Hong's regression equation, on the other hand, contains a potential serious problem of multicollinearity that will be evaluated later.

The primary objective of this paper is to evaluate differential effects of inflation on individual stock returns. For this purpose, a model of common stock valuation under inflation similar to the Van Horne and Glassmire [27] model is derived in the following section. The inflation model continues to identify the three important variables related to the three traditional hypotheses regarding the inflationary effects found by Van Horne and Glassmire. The distinction between anticipated and unanticipated inflation is also maintained. The third section is concerned with the methodology and data. Alternative regression equations are introduced in this section and the role of risk control is discussed. In the fourth section results of the empirical tests are evaluated and compared with Hong's [12] results. The final section provides a summary and implications of the test results.

II. Stock Valuation Under Inflation

The discounted cashflow approach to common stock valuation is used. The stock valuation model is defined:

$$V_0 = \sum_{t=1}^{\infty} \frac{CF_t}{(1+k)^t}$$

$$= \sum_{t=1}^{\infty} \frac{(X_t - \gamma_t B_t)(1-T) + G_t T}{(1+k)^t} \qquad (1)$$

where CF_t is the cash flow in period t; X_t is the expected earnings before interest, taxes, and depreciation for the firm in period t; γ_t is the average interest rate that is expected to be paid in period t for B_t; B_t is the expected net monetary position (NMP) in period t defined as monetary liabilities minus monetary assets; T is the tax rate applicable to the firm, which is constant over time; and G_t denotes the expected depreciation charges in period t.

To examine the consequences of inflation, a simple environment is examined where no inflation occurred in the past and a single discrete increase in prices (inflation) takes place at the beginning of the first period. Furthermore, the anticipated rate of inflation is p^e while the actual realized rate of inflation is p. The nominal NMP at the end of period one (B^p) is assumed to increase proportionally with an actual rate of inflation p. That is,

$$B^p = B\ (1 + p). \tag{2}$$

The firm's depreciation at the end of period one (G_1) has three components:

$$G_1 = G_{c1} + G_{r1} + G_{w1} \tag{3}$$

where G_{c1} is depreciation on the firm's fixed asset component that existed at time zero and has not yet expired at time point one; G_{r1} is depreciation on the fixed asset component that is purchased for replacement of expiring assets during period 1; and G_{w1} is depreciation on the firm's new fixed assets purchased for the purpose of expanding the asset base during the period. Under the historical cost method of depreciation, G_{c1} is fixed in monetary terms regardless of replacement costs. G_{r1} and G_{w1} are assumed to increase proportionally with the rate of inflation. Specific price changes on assets are assumed to be equal to the general inflation level; thus, prices of the fixed assets move together with changes in the general price level. Depreciation charges (G_1^p) become

$$G_1^p = G_{c1} + (G_{r1} + G_{w1})\ (1 + p). \tag{4}$$

Inflation also has an impact on the firm's earnings through relative price effects. The degree of relative price effects can be measured by introducing a concept of the firm's net operating income before depreciation charges (NOI) sensitivity to unanticipated inflation, denoted by λ. The firm's actual nominal NOI (X_1^p) deviates from the previously expected NOI (X_1^e) since:

$$X_1^p = X_1^e \left(1 + \frac{\lambda p^u}{1 + p^e}\right) \quad (5)$$

where p^u is the unexpected inflation component ($p - p^e$) and λ is considered constant throughout periods of time.[4] $\lambda \gtreqless 1$ depending upon how prices of the firm's products respond to unexpected inflation relative to its wages, and other production and operating costs. If the response rate of output prices to unexpected inflation is more rapid than the response rate of costs of factors of production, λ will be greater than one. For example, this expectation would hold in the presence of a wage-lag environment. In perfect markets, prices of both input and output factors would both be expected to fully reflect anticipated inflation. A hypothetical anticipated inflation multiplier, λ^e, would then be expected to be equal to one.

Combining Equations (2), (4), and (5), the expected nominal cash flow during period 1 (CF_1^p) becomes:

$$CF_1^p = [X_1^e \left(1 + \frac{\lambda p^u}{1 + p^e}\right) - \gamma_1 B\,(1 + p)\,]\,(1 - T) +$$

$$[G_{c1} + (G_{r1} + G_{w1})\,(1 + p)]\,T \quad (6)$$

where γ_1 is the period one market required return rate (interest rate) on monetary liabilities. In a world of no inflation, there would be no change in interest rates, i.e., $\gamma_1 = \gamma_2 = \gamma_3 = \ldots = \gamma_\infty = \gamma$ in Equation (1). In Equation (6), however, γ_1 is the weighted average interest rate in period 1. The current single period interest rate on new monetary liabilities increases from γ to γ_p where $\gamma_p = \gamma + p^e$ in accordance with the Fisher effect. The average interest rate will vary depending upon the composition of older debt with an interest rate of γ and new debt with an interest rate of γ_p.

With similar reasoning, the expected nominal cash flow (CF_1^e) when inflation is anticipated

4) The λ is identical to the multiplier, θ, applied by Van Horne and Glassmire to their expected earnings before unanticipated inflation [27, p. 1083, equation 5] when their τ = t.

at p^e during period 1 becomes

$$CF_1^e = [X_1^e - \gamma_1 B(1 + p^e)](1 - T) + [G_{c1} + (G_{r1} + G_{w1})(1 + p^e)]T. \quad (7)$$

From Equations (6) and (7) an unanticipated change in real cash flows (ΔCF_1), or unexpected wealth transfer, resulting from unanticipated inflation is:

$$\Delta CF_1 = \frac{CF_1^p}{1 + p} - \frac{CF_1^e}{1 + p^e} = \frac{X_1^e(p - p^e)(\lambda - 1)(1 - T)}{(1 + p)(1 + p^e)} + G_{c1}T\frac{(p^e - p)}{(1 + p)(1 + p^e)} \quad (8)$$

since $1 + p = (1 + p^u)(1 + p^e)$. In Equation (8), the net monetary position effect $\gamma_1 B$ completely drops out. This indicates that nominal interest cash flow changes are irrelevant to unexpected wealth transfers in periods of unexpected inflation provided that B is expected to, and actually does, increase proportionately with the rate of unanticipated inflation.

Unexpected inflation causes not only a change in real cash flows from the firm's operations as in Equation (8), but also an unexpected wealth transfer between creditors and debtors. A net debtor firm gains from inflation by repaying its debt retirement due in period 1 (b_1) in deflated dollars. The net wealth change in period 1 (ΔW_1) from the firm's NMP again arises from the unanticipated component of inflation and is the difference between the realized wealth transfer and anticipated wealth transfer. That is,

$$W_1 = \left(b_1 - \frac{b_1}{1 + p}\right) - \left(b_1 - \frac{b_1}{1 + p^e}\right) = \frac{b_1(p - p^e)}{(1 + p)(1 + p^e)} \quad (9)$$

The one-period inflation affects the real cash flows and NMP wealth transfers for the remaining future periods in the same way. These variations in real cash flows and wealth transfers caused by unanticipated inflation would change the firm's common stock value. The change in the firm's value (ΔV) is the present value of cash flow and wealth transfer variations, discounted at the firm's cost of capital k. Symbolically,

$$\Delta V = \frac{(p - p^e)(\lambda - 1)(1 - T)}{(1 + p)(1 + p^e)} \sum_{t=1}^{\infty} \frac{X_t^e}{(1 + k)^t} + \frac{p - p^e}{(1 + p)(1 + p^e)} \sum_{t=1}^{\infty} \frac{b_t}{(1 + k)^t} - \frac{(p - p^e)T}{(1 + p)(1 + p^e)} \sum_{t=1}^{\infty} \frac{G_{ct}}{(1 + k)^t} \qquad (10)$$

where b_t is a portion of B that is due and retired in period t and G_{ct} is the depreciation balance to be charged off in period t for the previously purchased and unexpired fixed assets. The ex ante discount rate, k, is assumed unchanged by inflation in real terms. This assumption implies that riskiness in the firm's real cash flows does not change due to inflation. Limitations from ignoring the risk change will be discussed in the final section.

The inflation model of Equation (10) has the following implications.

(a) The NCF sensitivity to unexpected inflation (λ) and unanticipated inflation ($p-p^e$) effect common stock value. If $\lambda > 1$ and inflation is underestimated ($p-p^e > 0$), stock value increases while for $\lambda < 1$ value decreases. When inflation is overestimated ($p-p^e < 0$), the signs of the stock value changes reverse.

(b) A change in common stock value depends on the firm's net monetary position (B), the maturity schedule (b_t for $t = 1, 2, ..., \infty$) and the error in anticipated inflation ($p-p^e$).[5] The naive debtor-creditor hypothesis which claims that net debtor firms gain from inflation

5) The insight has been made by Sharpe [26] with his statements, "... explicit account should be taken of differences in maturity and the likely effects [of the firm's debt] on future expectations" [p. 236, Chapter 12].

holds true only if inflation is unanticipated. A net debtor firm will suffer loss and a creditor gains from overestimated inflation. There are no gains or losses to either party if inflation is correctly anticipated ($p = p^e$) or if expectations of inflation are on average unbiased over time.

(c) The depreciation variable is negatively related to common stock value only to the extent that inflation is underestimated.

The developed model serves as a basis for the empirical model employed next.

III. Methodology and Data

Regression Models

For notational simplicity, a perpetual growth approximation is employed for the first term of Equation (10). Also summations in the second and third terms are replaced by M and Q, respectively. The equity value change will be equivalent to the derived change in value of Equation (10) divided by the initial equity value (V_0). The inflation model amenable to empirical tests then has the form:

$$\frac{\Delta V}{V_0} = \frac{p - p^e}{(1 + p)(1 + p^e)} \frac{X_1^e (\lambda - 1)(1 - T)}{V_0 (k - g)} + \frac{p - p^e}{(1 + p)(1 + p^e)} \frac{M}{V_0} - \frac{p - p^e}{(1 + p)(1 + p^e)} \frac{QT}{V_0} \qquad (11)$$

where g is the constant growth rate of the firm's NOI variable. The above model will be used to test three main hypotheses concerning the inflationary effects on common stock value. The hypotheses may be stated: *ceteris paribus*, with unexpected inflation stock price appreciation of a firm is higher for

(H1) higher net debtor positions;

(H2) lower depreciation positions; and

(H3) higher NOI sensitivity to inflation.

Overanticipated inflation would reverse the relationships between stock price appreciation and the three inflation effects. In Equation (11), λ, M, and QT are linearly related to stock returns. The corresponding cross-sectional regression equation can be written:

$$R_j = A_0 + A_1\lambda_j + A_2 MV_j + A_3 T_j QV_j + \mu_j \tag{12}$$

where R_j = changes in equity value, represented by the real rate of return on the common stock of firm j over a cross-sectional period;

λ_j = expected NOI sensitivity to inflation for firm j;

MV_j = present value of net debtor position/total assets;

T_j = average tax rate applicable to firm j during the period;

QV_j = present value of depreciation position/total assets;

μ_j = a stochastic disturbance term satisfying the Gauss-Markov conditions of ordinary least squares (OLS) regression.

Equation (12) is designed to examine the effects of inflation-related variables on stock returns before any adjustment for risk. Serviing this purpose, the risk-free rate is used as the present value factor for the two variables M and Q. In order to examine whether any of the inflation-related variables reflects merely risk effects, efforts will be made to segregate the net effects of each variable from risk effects in separate regression equations. Additionally, the firm's total assets were used instead of the market value of its common stock for calculation of MV_j and QV_j.[6)]

The signs of regression coefficients of Equation (12) are determined in accordance with the inflation model of Equation (11). If some inflation is unanticipated, A_1 and A_2 should be positive and A_3 negative. The signs should reverse if expected inflation exceeds actual inflation. This assertion assumes a symmetric effect of the controlling variables from both over- and under-estimation of inflation, a point clearly open to serious question. Thus, based on a finding of expected sign congruence on the set of regression coefficients, the regression

6) This also has been done by Modigliani and Miller [20] and Hong [12] in their attempts to reduce spurious correlation between the dependent variable and the independent variables involved.

results have the ability to reveal the existence of under- or over-anticipated inflation during a given period.

Equation (12) regression coefficients may merely reflect spurious correlations with a risk measure, not wealth transfer effects. Two methods of controlling for risk are employed. One method is to incorporate a measure of systematic risk in the regression as another independent variable, the procedure employed by Hong [12]. With inclusion of β the cross-sectional regression becomes

$$R_j = A_0 + A_1\lambda_j + A_2MV_j + A_3T_jQV_j + A_4\beta_j + v_j \qquad (13)$$

where v_j is the random error term for firm j. Although the linear relationship between β and equity returns is well founded on the CAPM, there is high expected collinearity between β and the other independent variables. MV_j and QV_j represent financial leverage and operating leverage, respectively. Their direct impact in determining β has been demonstrated both theoretically and empirically. λ_j, that is an expected component of the coefficient A_1, is also associated with β in that higher λ firms tend to have lower β in the framework of a capital asset pricing model under inflation (Chen and Boness [10]). In the presence of multicollinearity the relative influences of each of the independent variables in Equation (13) are almost impossible to disentangle, and estimates of coefficients become very sensitive to particular sets of sample data. Although Equation (13) may suffer from some limitations for regression analysis, it is used in this study for comparison with Hong's [12] study.

An alternative risk adjustment approach is adopted in order to avoid the problem of multicollinearity while controlling for risk. A two stage procedure is employed. First, the residual $(\hat{\epsilon}_j)$ is computed from a two-parameter market risk model:

$$\epsilon_j = R_j - \hat{r}_0 - \hat{r}_1\hat{\beta}_j,$$

$\hat{r}_0$ and $\hat{r}_1$ are market determined variables representing the ex post relation between rates of return and systematic risk. R_j is an annual geometric average return calculated over the cross-sectional test period; and ϵ_j is the random error term.[7)] Individual security j beta, β_j, is calculated from the prior 72 months returns correspondence to the CRSP value weighted market index.

A second stage regression is then employed with ϵ_j as the dependent variable

$$\hat{\epsilon}_j = A_0 + A_1\lambda_j + A_2 MV_j + A_3 T_j QV_j + e_j . \qquad (14)$$

Since $\hat{\epsilon}_j$ is purged of systematic risk influences, the regression coefficients of Equation (14) should capture real wealth effects of respective inflation-related variables beyond normal returns that are earned merely as a compensation for higher risk.

Estimation of Variables

The annualized real rate of return, R_j, on the jth firm's common stock is defined as the geometric mean of quarterly estimates of real rates of return.

$$R_j = \left[\prod_{i=1}^{24} \frac{1 + R_{ij}^n}{1 + p_i} \right]^{1/6} \qquad (15)$$

where 24 quarters are used in deriving the annualized geometric mean, R_j, for a given six year cross-sectional period test where R_{ij}^n is the quarterly nominal rate of return for quarter i calculated from the monthly returns that includes all distributions (from CRSP), and p_i is the GNP implicit price deflator during quarter i.

Expected NOI sensitivity is estimated using the relationship between actual and expected inflation. The implicit assumption is that expected NOI ($\widehat{NOI}$) is based on an expectations model and only deviates from actual NOI due to unanticipated inflation. To estimate the expected NOI for a given year, earnings data from the preceding six years are used in a simple

7) Estimates, $\hat{r}_0$ and $\hat{r}_1$, are obtained by: (1) ordering individual company betas in the 72 month pre-test period; (2) forming 24 portfolios based on β rank alone; (3) calculating each portfolio's monthly return from the average return of the securities in the portfolio for each of the 72 months of the test period; (4) each portfolio's $\hat{\beta}_p$ is then calculated over the test period; and (5) the regression over the 24 portfolios is performed, $R_p = \hat{r}_0 + \hat{r}_1\hat{\beta}_p$ for p = 1, 2, ... , 24.

regression model:

$$NOI_t = a + b_t + U_t \qquad (16)$$

where t = 1, 2, ..., 6; and U_t is the error term. The expected NOI in the 7th year (NOI_7) is obtained by substituting t = 7 into the estimated equation.[8]

Once the expected NOI was estimated, the relationship between expected NOI and actual NOI for each year can be written as:

$$NOI = \hat{NOI}\lambda\ (1 + p^u)$$

λ is then estimated for each of the three six-year cross-sectional period tests from the following time-series regression.

$$\frac{NOI_t}{1 + p_t^u} = \lambda \hat{NOI}_t + w_t$$

where t = 1, 2, ..., 6; and where unanticipated inflation $p_t^u = p_t - p_t^e$. p_t is the actual rate of inflation measured by the GNP deflator in year t, p_t^e is the anticipated rate of inflation proxied by the average of 3-month T-bill rates over the year and w_t stands for the standard random error. Unanticipated inflation would be understated to the extent that rates of return on T-bills contained a real positive expected return component.

The monetary variable MV_j for company j is defined as the present value of estimated future retirements of current monetary balances. Monetary position is first disaggregated into monetary current assets, current liabilities and long-term liabilities. Present value of monetary current assets and liabilities is estimated by discounting the end of year balances by the average interest rate of the 3-month T-bills issued during the year.

For the long-term debt component the maturity mix of the outstanding long-term debt is estimated. The Appendix contains detail on the derivation of the estimates of the future retirement schedule.[9] The current annual average T-bill rate is used as the discount

8) An estimating equation that additionally employed the actual GNP growth rate as an independent variable provided poorer explanatory power.

9) The Appendix may be available from the author upon request.

rate employed in deriving an estimate of the present value of future retirements. The use of the current rate adopts a simplifying and clearly questionable assumption of an underlying constant yield curve and no liquidity premiums beyond those incorporated in three month T-bill rates.

The present value estimates of monetary current assets, and current and long-term debt for a given year are then aggregated and divided by the total assets of firm j in that same year. The average of the annual MV_j values for six years of company j data are then used in each of the cross-sectional regression tests.

To smooth out year-to-year variations in tax rates, the tax variable T_j in equations 12 and 13, is estimated as the ratio of the cumulative tax expense to the cumulative before-tax net income over each six-year cross-section period.

The process follows for estimating QV_j, the present value before unanticipated inflation of the depreciation position divided by total assets. The life of fixed assets (N) is estimated by

$$N = \frac{\text{Gross fixed assets in year t } (GA_t)}{\text{Depreciation charges in year t } (G_t)} \tag{17}$$

Since depreciation charges on Compustat are for accounting rather than tax reporting, straight-line depreciation is almost always employed. A fair proxy of estimated accounting plant life for individual firms is, thereby, generated.

To determine the depreciation balance in each of the future years, four simplifying assumptions are adopted: (1) the firm's fixed asset investment was constant in years prior to year t; (2) 1/N of the fixed asset investment with a life of N years was replaced every year; (3) assets do not have any salvage value; and (4) the firm employs the double-declining depreciation method for tax purposes. Assumptions (1) and (2) overstate the future depreciation balance, because for most firms fixed asset investment increases every year both due to inflation and real growth in asset base. On the other hand, assumption (3) understates the future depreciation, since economic life of fixed assets is usually longer than their depreciation life. Assumption (4) also acts to understate the future depreciation balance since the declining double-depreciation method is not allowed on either many assets with a life less than 7 years, or permanent assets (like land). Though the overall effect of the above assumptions on measurement of the future depreciation position can not be assessed *a priori*, their counteracting effects at least decrease the systematic bias in the measurement.

Given the above assumptions, the future depreciation balances can be determined from accounting data. The future depreciation charges decrease every year from the initial position, G_t, according to the double-declining schedule. The future depreciation balances (G_{t+i}) are converted to a present value to get an estimate of Q for each firm as follows:

$$Q_t = \sum_{i=1}^{N} \frac{G_{t+i}}{(1 + r_t)} \tag{18}$$

where i stands for the number of years after year t. Q_t is scaled by its corresponding total assets, TA_t, in each year and the simple arithmetic average of Q_t/TA_t, denoted by QV, is calculated during a six-year period for each cross-sectional test period.

Portfolio Tests

Estimating each variable for individual common stocks involves measurement errors. Because the direct use of these estimates in a cross-sectional regression causes an errors-in-variables bias in OLS estimators, a second set of portfolio tests on both Euations (12) and (13) are performed using the following grouping procedure:

(a) Individual company common stocks are estimated by employing monthly data during six years before a cross-sectional test period.

(b) Each stock is ranked by β and three portfolios are formed by allocating each stock to either the high, middle, or low protfolio. Each of the three portfolios is subdivided by income sensitivity to inflation (λ) into two subgroups. This ranking and grouping procedure is performed successively at two levels by net debtor position (MV) and depreciation position (QV). The number of final portfolios thus formed is 24 (3 x 2 x 2 x 2) with each portfolio including L firms, where L = N/24.[10)]

10) In order to form portfolios of equal size, some of the initial eligible firms are randomly selected and eliminated from the final sample.

(c) For each of the 24 portfolios, monthly portfolio returns are computed during the cross-sectional period. The portfolio return (R_{pt}) in each month is calculated as the simple arithmetic average of monthly rates of return on individual securities included in the portfolio.

(d) Portfolio betas ($\hat{\beta}_p$) are obtained by running a time-series regression between portfolio returns calculated above and the CRSP value-weighted market index.

(e) The values of all portfolio independent variables, except β_p, are obtained by taking the average value of the variable calculated over all firms in the portfolio.

(f) Regression model equations (12) and (13) are then calculated with the data from the set of 24 portfolios.

The portfolio tests are expected to provide better explanatory power than the individual firm results from the first set of tests.

Data

The primary data for this study are from the Compustat Industrial file and CRSP file. Accounting data from Compustat were drawn from 1956 through 1979. Monthly returns data for New York Stock Exchange firms over the same period were also employed. Three periods were chosen for cross-sectional regression tests: 1962-67, 1968-73, 1974-79. For admission into the sample in a given six-year test, a firm had to be included in both Compustat and CRSP files with complete data on NOI and monthly holding period returns on common stocks for the six-year pre-test period as well as for the six-year test period. The data for the pre-test period were required for both beta and expected NOI estimation. During the following six-year test period additional data on net monetary position, depreciation, and total assets were necessary for the series of cross-sectional regression tests of Equations (12) and (13). The final sample size and average inflation rate for each subperiod are as follows:

Period	Number of Firms in the Sample	Average Actual Inflation Rate
1962-67	312	2.22%
1968-73	432	4.98%
1974-79	504	7.74%

IV. Empirical Results

Means and Correlations

To examine the reliability of the estimated variables, the sample means and simple correlations between variables for individual firms are reported for each period in Tables 1 through 3. Two different measures are shown for the monetary and depreciation variables, respectively. SNMP is a measure of the monetary variable that conforms with the inflation model of this study while HNMP represents the firm's net monetary position (total debt minus monetary assets) divided by its total assets. Likewise, SDEP is a measure of the depreciation variable in conformity with the inflation model, while HDEP represents the firm's gross plant divided by its total assets as a proxy for the firm's depreciation position. HNMP and HDEP are the equivalent to the measures used by Hong [12] and were calculated for comparison with Hong's results.

The sample means of the NOI sensitivity coefficients are around 1, which may be interpreted as an indication that the underlying expectations model fairly performs for prediction of actual earnings. As argued in the methodology section, a measure of systematic risk is significantly correlated with both the monetary and depreciation variables in all three periods. The relationships of the real stock return with the monetary or depreciation variables are indeterminate since their simple correlations have different signs in different periods.

Individual Firm Regression Tests

Risking an errors-in-variables bais, a cross-sectional regression was still conducted for individual firms. The regression results are shown in Table 4 for different model specifications in each period. The first equations in each period indicate that both the monetary and depreciation variables exert only minor effects on stock returns as shown in low coefficients of determination. The regression results in Table 4 may be interpreted in view of the inflation model of this study. First, despite different model specifications, positive monetary coefficients were combined with negative depreciation coefficients in all the equations of period 1. The same combinations are observed for period 3 except for the third equation where the

Table 1. Correlation Matrices and Sample Means for Individual Firms: 1962-67 (Period 1)

Variables	Real Return (R)	Risk (β)	NOI Sensitivity to Inflation (λ)	NMP Measures		Depreciation Measures		Sample Mean	Standard Deviation
				SNMP	HNMP	SDEP	HDEP		
R	1.000							0.091	0.100
β	0.167[a]	1.000						1.008	0.345
λ	0.431[a]	0.102[b]	1.000					1.083	0.161
SNMP	0.061	–0.108[b]	0.043	1.000				0.027	0.155
HNMP	–0.006	–0.002	0.050	0.722[a]	1.000			0.070	0.156
SDEP	–0.080	0.156[a]	–0.161[a]	0.176[a]	0.144[a]	1.000		0.115	0.046
HDEP	–0.044	0.159[a]	–0.089	0.161[a]	0.153[a]	0.818[a]	1.000	0.747	0.324

[a]Indicates significance at the 5 percent level on a one-tail t-test.

[b]Indicates significance at the 10 percent level on a one-tail t-test.

Table 2. Correlation Matrices and Sample Means for Individual Firms: 1968-73 (Period 2)

Variables	Real Return (R)	Risk (β)	NOI Sensitivity to Inflation (λ)	NMP Measures		Depreciation Measurs		Sample Mean	Standard Deviation
				SNMP	HNMP	SDEP	HDEP		
R	1.000							-0.040	0.101
β	-0.127[a]	1.000						1.058	0.346
λ	0.411[a]	0.070	1.000					1.039	0.094
SNMP	-0.152[a]	-0.208[a]	0.015	1.000				0.130	0.191
HNMP	-0.154[a]	-0.271[a]	0.040	0.738[a]	1.000			0.217	0.220
SDEP	0.191[b]	-0.028	0.176[a]	0.055	0.011	1.000		0.104	0.041
HDEP	0.115[a]	0.358[a]	0.182[a]	0.397[a]	0.500[a]	0.599[a]	1.000	0.797	0.324

[a]Indicates significance at the 5 percent level on a one-tail t-test.

[b]Indicates significance at the 10 percent level on a one-tail t-test.

Table 3. Correlation Matrices and Sample Means for Individual Firms: 1974-78 (Period 3)

Variables	Real Return (R)	Risk (β)	NOI Sensitivity to Inflation (λ)	NMP Measures		Depreciation Measures		Sample Mean	Standard Deviation
				SNMP	HNMP	SDEP	HDEP		
R	1.000							0.050	0.102
β	0.333[a]	1.000						1.134	0.431
λ	0.283[a]	0.061	1.000					1.038	0.131
SNMP	0.035	-0.216[a]	0.162[a]	1.000				0.128	0.140
HNMP	-0.018	-0.271[a]	0.020	0.898[a]	1.000			0.225	0.199
SDEP	-0.057	-0.085[b]	-0.093[a]	0.083[b]	0.102	1.000		0.095	0.041
HDEP	-0.172[a]	-0.387[a]	-0.161[a]	0.429[a]	0.514[a]	0.617[a]	1.000	0.757	0.298

[a]Indicates significance at the 5 percent level on a one-tail t-tetst.

[b]Indicates significance at the 10 percent level on a one-tail t-test.

Table 4. Cross-sectional Regression Results for Individual Firms

Test Period	Intercept	Systematic Risk (β)	NOI Sensitivity (λ)	Monetary Effect (SNMP)	Depreciation Understatement (SDEP)	Coefficient of Determination (r^2)
1962-67	0.113			0.050	-0.205	0.01
	(7.37)			(1.38)	(-1.83)[b]	
	0.063	0.058		0.068	-0.283	0.05
	(3.04)	(3.50)[a]		(1.86)[b]	(-2.26)[a]	
	-0.192		0.265	0.030	-0.043	0.19
	(-4.82)		(8.61)[a]	(0.89)	(-0.38)	
	-0.213	0.041	0.253	0.044	-0.106	0.21
	(-5.30)	(2.68)[a]	(7.77)[a]	(1.29)	(-0.91)	
1968-73	-0.055			-0.083	0.247	0.03
	(-4.23)			(-3.40)[a]	(2.16)[a]	
	-0.002	-0.048		-0.101	0.240	0.06
	(-0.08)	(-3.52)[a]		(-4.10)[a]	(2.12)[a]	
	-0.488		0.435	-0.084	0.070	0.19
	(-10.39)		(9.52)[a]	(-3.77)[a]	(0.65)	
	-0.434	-0.040	0 425	-0.099	0.068	0.21
	(-8.76)	(-3.21)[a]	(9.39)[a]	(-4.40)[a]	(0.65)	
1974-79	0.061			0.029	-0.152	0.01
	(5.05)			(0.89)	(-1.35)	
	-0.047	0.084		0.083	-0.091	0.12
	(-2.73)	(8.24)[a]		(2.66)[a]	(-0.86)	
	-0.171		0.221	-0.007	-0.075	0.08
	(-4.56)		(6.50)[a]	(-0.20)	(-0.69)	
	-0.247	0.078	0.197	0.048	-0.027	0.19
	(-5.74)	(7.93)[a]	(6.13)[a]	(1.56)	(-0.26)	

[a] Indicates significance at the 5 percent level on a one-tail t-test.

[b] Indicates significance at the 10 percent level on a one-tail t-test.

monetary coefficient sign is reversed. According to the inflation model, the empirical results in both periods 1 and 3 evidence the existence of an unanticipated increase in inflation. The unanticipated rates of inflation over each of the two periods may be negligible, and thereby produce statistically insignificant coefficients for both the monetary and depreciation variables.

Second, the negative monetary coefficients were combined with the positive depreciation coefficients in period 2. The statistical significance of both the monetary and depreciation coefficients in period 2 provide evidence consistent with a debtor-creditor and depreciation hypothesis when inflation is over-anticipated.

Third, Hong's [12] finding that the net monetary effect is "spuriously" correlated with stock returns is not supported in the present study. The equations that incorporate systematic risk show that none of the monetary coefficients turn from significant to insignificant in the presence of the risk variable. Rather, the monetary coefficients in periods 1 and 3 become statistically significant while they are insignificant with no control for risk.

Fourth and finally, the NOI sensitivity variable is a greater contributor to returns than the monetary or depreciation variables. The coefficients of Table 4 and sample means of the independent variables of Tables 1 through 3 can be multiplied to confirm the greater average contribution of NOI sensitivity to returns. This conforms to Van Horne and Glassmire's modeling and hypothetical simulations. The NOI sensitivity to inflation is positively associated with stock returns in all three periods. Firms whose earnings increase more rapidly relative to expected NOI in the face of inflation, on average, perform better than firms whose earnings increase less. One would expect a positive coefficient with NOI sensitivity when unexpected inflation is encountered and a negative coefficient from overanticipated inflation. The test results for the 1968-73 period, thereby, appear inconsistent with coefficients from the monetary and depreciation regression coefficients. An NOI sensitivity variable that is not equally effected by unanticipated or overanticipated inflation might explain the observed phenomenon. A firm with high NOI sensitivity to inflation may be able to rapidly pass on price increases in the presence of unanticipated inflation increases while not being required, or motivated, to reduce prices in light of previously overanticipated inflation levels. The significantly positive NOI coefficients in the second test period may then indicate the relationship to actual inflation rather than the impact of the unanticipated component of inflation.

A joint contributor to the observed phenomenon of positive NOI sensitivity coefficients in the second test period is quite likely coming from the empirical proxy employed for the NOI sensitivity measure. The NOI sensitivity variable, λ, is directly related to the rate of change of NOI growth. Examinations of the equations deriving λ in the Estimation of Variables section will confirm that λ is expected to be greater than 1.0 if the derivated $d^2NOI/dt^2 > 0$ and less than 1.0 if $d^2NOI/dt^2 < 0$. If unexpected NOI increases coming from non-inflation factors are positively related to the second derivative, factors unrelated to inflation could be leading to real return windfalls and the observed positive NOIs ensitivity coefficient in all test periods. In this setting the securities with higher observed NOI sensitivity would be afforded additional protection from actual inflation. Firms with $\lambda < 1$ would suffer windfall losses from downward revised expectations on future NOI position resulting from non-inflation factors while inflation could further erode the value of the still remaining expected NOI stream.

Portfolio Tests

In order to avoid the errors-in-variables bias in cross-sectional regressions, analysis was also conducted for protfolios. Both real and nominal returns on common stocks were used as dependent variables and reported separately in the Table 5 regression results. The former results are discussed here while the latter results will be compared later with regression results obtained by employing Hong's methodology.

The exaplanatory power, measured by the coefficient of determination in the last column, is substantially increased in Table 5 over Table 4 when portfolios are employed. The coefficient signs of the monetary and depreciation variables are reversed in the first equations of period 1 and 3 compared to the corresponding equations in Table 4. The regression coefficients of the two variables remain statistically insignificant at the 10 percent level. The conflicting results between Table 5 and Table 4 may be interpreted as an indication that unanticipated rates of inflation were negligible in periods 1 and 3. With negligible unanticipated inflation, the coefficient signs could be easily changed by different grouping procedures.

Table 5 Cross-Sectional Regression Results for Portfolios

Test Period	Intercept	Systematic Risk (β)	NOI Sensitivity (λ)	Monetary Effect (SNMP)	Depreciation Understatement (SDEP)	Coefficient of Determination (r^2)
			Real Returns			
1962-67	-0.329 (-5.20)		0.382 (7.16)[a]	-0.074 (-1.62)	0.063 (0.47)	0.73
	-0.391 (-6.68)	0.083 (2.84)[a]	0.356 (7.61)[a]	-0.067 (1.71)[b]	0.048 (0.42)	0.81
1968-73	-0.589 (-8.47)		0.527 (7.68)[a]	-0.106 (-3.03)[a]	0.137 (0.91)	0.79
	-0.457 (-8.59)	-0.072 (-5.09)[a]	0.488 (10.50)[a]	-0.162 (6.28)[a]	0.113 (1.12)	0.91
1974-79	-0.281 (-2.70)		0.323 (3.45)[a]	-0.055 (-0.77)	0.031 (0.12)	0.38
	-0.442 (-4.73)	0.152 (3.63)[a]	0.289 (3.89)[a]	0.065 (1.00)	0.284 (1.30)	0.63
			Nominal Returns			
1962-67	4.360		3.719 (3.07)[a]	-0.629 (-0.61)	-1.830 (-0.60)	0.36
	4.020 (2.55)	0.453 (0.58)	3.575 (2.84)[a]	-0.593 (-0.56)	-1.911 (-0.62)	0.37
1968-73	1.926 (1.52)		5.223 (4.17)[a]	-0.414 (-0.65)	2.230 (0.81)	0.52
	3.740 (3.07)	-0.994 (-3.05)[a]	4.684 (4.39)[a]	-1.184 (-1.99)[b]	1.891 (0.82)	0.67
1974-79	6.027 (4.46)		2.347 (1.93)[b]	0.108 (0.12)	-0.339 (-0.10)	0.17
	5.169 (3.39)	0.813 (1.19)	2.169 (1.79)[b]	0.745 (0.70)	1.011 (0.28)	0.23

[a]Indicates significance at the 5 percent level on a one-tail t-test.

[b]Indicates significance at the 10 percent level on a one-tail t-test.

Regression results in period 2 are consistent between Tables 4 and 5. The negative monetary coefficient was combined with the positive depreciation coefficient.

Further examinations of potential spurious correlation between risk and other independent variables are warranted; the risk variable may incorporate effects of other variables, as Hong has argued with respct to the monetary variable. Although the empirical results of the current study so far do not provide any credence to a finding of "spurious" correlation, similar results may occur by more closely replicating Hong's methods. Table 6 reports the regression results when portfolios are based on β, monetary and depreciation variables as defined by Hong. Hong's monetary variable, denoted by HNMP, is defined as the firm's financial liabilities minus financial assets. Hong's depreciation variable, denoted by HDEP, is proxied by the firm's gross plant. Hong also used the nominal rate of return on stocks as a dependent variable.

There are no significant shifts in the signs of regression coefficients between Table 5 and Table 6. This implies that the risk adjustment phenomenon found by Hong is not observed whichever measures are used for net monetary and depreciation position. Our additional use of the NOI sensitivity variable, a failure to employ Hong's inventory variable and testing of different time frames can all be contributing to findings inconsistent with tests by Hong.

The outcome of employing the nominal rate of return as a dependent variable is the appreciable lowering of the coefficient of determination, r^2, as can be noticed by comparing the upper and lower half in Tables 5 and 6. The results indicate that the inflationary effects of each variable are captured better by regressing against the real rate of return rather than against the nominal rate. The monetary and depreciation effects are more likely to be significant contributors to explanatory power when real returns are employed. Also, the more elaborate definitions of both the monetary and depreciation effects employed in this study do not improve on the simple, and thereby fairly robust, definitions used by Hong.

Two Stage Risk Adjusted Analysis

In order to avoid the multicollinearity problem while controlling for risk, a two stage regression is performed. Since the residual return calculated in stage one is purged of risk

Table 6 Cross-Sectional Regession Results for Portfolios Based on HNMP and HDEP

Test Period	Intercept	Systematic Risk (β)	NOI Sensitivity (λ)	Debt (HNMP)	Plant (HDEP)	Coefficient of Determination (r^2)
			Real Returns			
1962-67	-0.334		0.389	-0.060	0.010	0.77
	(-6.16)		(8.13)[a]	(-1.06)	(0.58)	
	-0.405	0.076	0.372	-0.069	0.018	0.85
	(-8.01)	(3.13)[a]	(9.25)[a]	(-2.28)[a]	(1.22)	
1968-73	-0.585		0.509	-0.116	0.051	0.78
	(-8.08)		(7.03)[a]	(-3.43)[a]	(2.14)[a]	
	-0.451	-0.079	0.504	-0.135	0.014	0.89
	(-7.50)	(-4.27)[a]	(9.49)[a]	(-5.35)[a]	(0.79)	
1974-79	-0.176		0.260	0.044	-0.071	0.47
	(-1.69)		(2.86)[a]	(0.76)	(-1.81)[b]	
	-0.442	0.165	0.286	0.062	0.015	0.64
	(-3.61)	(3.09)[a]	(3.74)[a]	(1.27)	(0.35)	
			Nominal Returns			
1962-67	3.576		4.265	-0.893	0.039	0.44
	(2.88)		(3.90)[a]	(-1.09)	(0.10)	
	3.529	0.050	4.253	-0.899	0.044	0.44
	(2.48)	(0.07)	(3.76)[a]	(-1.06)	(0.11)	
1968-73	1.864		5.098	-0.600	0.625	0.50
	(1.34)		(3.67)[a]	(-0.92)	(1.37)	
	3.453	-0.978	5.033	-0.832	0.163	0.60
	(2.37)	(-2.22)[a]	(3.96)[a]	(-1.38)	(0.35)	
1974-79	6.688		1.985	0.503	-0.550	0.23
	(4.99)		(1.70)[b]	(0.67)	(-2.09)[b]	
	5.266	0.885	2.124	0.600	-0.089	0.29
	(2.81)	(1.88)[b]	(1.81)[b]	(0.80)	(-0.13)	

[a]Indicates significance at the 5 percent level on a one-tail t-test.

[b]Indicates significance at the 10 percent level on a one-tail t-test.

efffects, the Equation (14) regression coefficients should reflect net effects of each variable after adjustment for risk.[11)]

Cross-sectional regression results using residual nominal returns for individual firms from Equation (14) are reported in Table 7. When compared with Equations (12) and (13) results with nominal returns in the lower half of Table 5, there is further evidence that regression coefficients on the monetary and depreciation variables are not significantly affected by con-

Table 7. Cross-sectional Regression Results Using Nominal Residual Returns

Test Period	Intercept	NOI Sensitivity (λ)	Monteary Effect (SNMP)	Depreciation Understatement (SDEP)	Coefficient of Determination (r^2)
1962-67	0.464		-0.089	-4.029	0.07
	(1.14)		(-0.08)	(-1.18)	
	-3.467	3.425	-0.555	-1.995	0.33
	(-2.41)	(2.82)[a]	(-0.53)	(-0.66)	
1968-73	7.061		-0.384	5.032	0.09
	(17.77)		(-0.45)	(1.42)	
	1.926	5.223	-0.414	2.229	0.52
	(1.52)	(4.17)[a]	(-0.65)	(0.81)	
1974-79	-0.251		1.425	0.718	0.11
	(-0.72)		(1.53)	(0.21)	
	-2.459	2.053	1.160	1.890	0.22
	(-1.85)	(1.72)[b]	(1.29)	(0.57)	

[a]Indicates significance at the 5 percent level on a one-tail t-test.

[b]Indicates significance at the 10 percent level on a one-tail t-test.

trolling for risk with the two stage procedure. In all three periods the regression coefficients remain insignificant with or without control for risk. This is consistent with the results in the

11) The market-determined variables representing the ex post relation between rates of return and risk were estimated for each of the cross-sectional periods as follows:
$\hat{r}_{01} = 7.134$, $\hat{r}_{11} = 0.922$; $\hat{r}_{02} = 8.792$, $\hat{r}_{12} = -1.119$; and
$\hat{r}_{03} = 7.069$, $\hat{r}_{13} = 1.342$.

nominal returns section of Table 5. The coefficient signs in Table 7 are the same as Table 5 in period 2, but vary from Table 5 in periods 1 and 3. Evidence of an unanticipated decrease in inflation during the second period and indeterminant levels of unanticipated inflation in periods 1 and 3 persist under different regression models. The strong relative NOI sensitivity effects are again observed in every period in Table 7.

One plausible explanation for an unanticipated decrease in inflation during period 2 (1968-73) comes from price controls which were imposed on August 15, 1971 and were not completely removed until 1974. Since actual inflation was suppressed by price controls, previously anticipated inflation might have exceeded actual recorded inflation. Supporting evidence to the above argument is provided by the decrease in annual yields on Moody's Aaa corporate bonds during the same period.

V. Summary

The cash-flow and wealth transfer approach to common stock valuation was employed to investigate the effects of each variable on equity value under inflation. The derived inflation model demonstrates that the firm's net operating income sensitivity to inflation, net monetary position and depreciation position may have positive or negative effects on stock returns, depending upon whether an unanticipated decrease or increase in inflation has occurred. Empirical results provide evidence consistent with the theoretical inflation model for monetary position and depreciation position. Unreliability with the NOI empirical measure preclude a conclusion that the theoretical model on expected NOI sensitivity impact from unanticipated inflation is either denied or confirmed.

The role of risk control was closely examined by using alternative regression models. Spurious correlations between a risk variable and inflation-related variables are not supported by this study.

The developed model and empirical test results have implications both to investors and financial managers. Unless investors have a superior ability over the market to correctly forecast the future inflation rates, they can not expect excess returns from information on the firm's monetary or depreciation characteristics. The inflation consequences of a firm's financing and investment decisions appear to be fully reflected in stock prices at the time decisions are undertaken. Since further stock price changes occur in response to unanticipated inflation only, financial managers should not expect to increase common stock value over the long run from decision strategies on monetary and depreciation position aimed at obtaining windfall inflationary gains.

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