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Are Changes in Inflation Expectations Capitalized into Stock Prices? A Micro-Firm Test for the Nominal Contracting Hypothesis

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ARE CHANGES IN INFLATION EXPECTATIONS CAPITALIZED INTO STOCK PRICES? A MICRO-FIRM TEST OF THE NOMINAL CONTRACTING HYPOTHESIS

ABSTRACT

This paper re-examines the wealth redistribution effect of inflation between bondholders and shareholders (the nominal contracting hypothesis). Theory suggests that changes in subsequent inflation expectations cause a change in the market value of fixed rate debt instruments; which, in turn, should be capitalized into the market price of equity. Earlier studies do not find convincing evidence to support the wealth redistribution between creditors (bondholders) and debtors (shareholders). This study provides new evidence that the theoretically anticipated wealth redistribution effect does exist, and can be isolated empirically if one controls properly for the effects of uncertain inflation on operating income (and, thus, the cost of equity) and capital gains taxation at the micro-firm level.

> Fuller utilization of the concepts and hypotheses of economic theory as a part of the process of observation and measurement promises to be a shorter road, perhaps even the only possible road, to the understanding of ...
>
> Koopmans [1947]

INTRODUCTION

The principal objective of this paper is to re-examine the wealth redistribution effect of inflation from bondholders to shareholders: the nominal contracting hypothesis. Theory suggests that changes in subsequent inflation expectations[1] cause a change in the market value of fixed rate debt instruments, particularly long term debt; which, in turn, should be capitalized into the market price of equity. Over the last thirty years, little, if any, supporting evidence has been found for the theoretically anticipated wealth redistribution effect of inflation from bondholders to shareholders.[2]

In brief, our empirical analysis for the 1961-1985 period provides supporting evidence for the nominal contracting hypothesis. This evidence requires proper model specification controlling for individual firm differences in the effects of inflation on operating income and additional taxes paid for nominal capital gains because these effects are also important determinants of inflation-induced stock price changes.

Among recent studies, Bernard [1986] suggests that evidence for the nominal contracting hypothesis could be presented by controlling for the effects of inflation on operating income. Our paper, while recognizing this fact, should be contrasted with earlier efforts in at least two ways. First, our theoretical development suggests, borrowing knowledge from the studies on the inflation-economic activity relations (e.g., Friedman [1977]), that model misspecification is likely to be a reason why earlier studies have been unable to provide supporting evidence for the nominal contracting hypothesis.

Second, our analysis as well as some recent studies recognize that the nominal contracting hypothesis and the nominal capital gains tax effect hypothesis are jointly tested. In this joint hypotheses test, one must recognize that collinearity among asset and capital structure variables arises because of the balance sheet identity relationship (i.e., total assets ≡ total liabilities plus equity). Quite surprisingly, however, none of earlier studies appear to consciously remedy the collinearity problem.

The remainder of this paper is organized into three sections. Section I, utilizing a conventional capital asset pricing theory, shows how inflation-induced stock price changes are related to individual firm characteristics. The theoretical development in this section suggests an empirically testable model. Section II presents the data base, the statistical testing procedures and the empirical findings; and discusses econometric issues related to some recent studies for the nominal contracting hyphothesis. The last section contains the conclusion.

I. MODEL

I.1. Theory

In the economy where risk-averse individuals hold common stocks and nominally risk-free bonds, the real required rate of return on firm i's equity can be expressed as (see Black [1972])

$$E_t[r_i] = E_t[r_z] + \theta_t COV_t(r_i, r_m) \quad (1)$$

where E and COV are conditional expectation and covariance operators at time t (subscript t will be omitted for convenience unless explicitly required), r_i is the real rate of return on firm i's equity, r_m is the real rate of return on market, r_z is a risky asset's real rate of return uncorrelated with r_m, and θ is the market price of risk.

In order to show how inflation affects the cost of equity, the real stock return generating process is described by a linear factor model, equation (2):

$$r_i = E[r_i] + \beta_i \pi^u + \varepsilon_i; \; COV(\pi^u, \varepsilon_i) \equiv 0 \quad (2)$$

where π^u is the unexpected inflation rate with mean zero and variance σ_π^2, and $\beta_i = COV(r_i, \pi^u)/\sigma_\pi$ such that ε_i (mean zero and variance σ_i^2) is uncorrelated, by construction, with unexpected inflation. Subscript i=m denotes for the market.

Using equation (2), it can be shown that $COV(r_i, r_m) = \beta_i \beta_m \sigma_\pi^2 + \sigma_{im}$; where $\beta_m = COV(r_m, \pi^u)/\sigma_\pi^2$, and $\sigma_{im} = COV(\varepsilon_i, \varepsilon_m)$. By substituting this covariance into equation (1), the real required rate of return on firm i's equity can be alternatively expressed as

$$E[r_i] = E[r_z] + \theta\{\beta_i \beta_m \sigma_\pi^2 + \sigma_{im}\}. \quad (3)$$

Equation (3) illustrates that to the extent the market does not provide effective hedges against unexpected inflation (i.e., β_m is negative as well-documented by previous empirical works[3]), an individual firm's cost of equity which is not protected against unexpected inflation (i.e., $\beta_i < 0$) increases when inflation uncertainty increases; that is, inflation risk becomes non-diversifiable risk (hereafter, referred to as the inflation risk hypothesis). Therefore, when examining how inflation-induced stock price changes are related to individual firm characteristics, the assumption of the constant cost of equity could be potentially misleading because β_i is a function of the firm's characteristics (as will be shown by equation 5).

Let $V_i \equiv$ the value of the firm's assets per dollar value of equity;

$D_i \equiv$ the value of the firm's debt per dollar value of equity;

$r_i^a \equiv$ the after tax real rate of return on the firm's assets;

$R \equiv$ the pre-tax nominal interest rate (assumed to be known);

$\tau \equiv$ the ordinary corporate income tax rate; and

$\tau_g \equiv$ the "effective" nominal capital gain tax rate.

Given these notations, the real rate of return on the firm's equity, holding future expectations constant, is expressed as[4]

$$r_i = r_i^a V_i - [(1-\tau)R - \pi]D_i - \chi_i \pi \qquad (4\text{-a})$$

where χ_i is Feldstein's [1980] linear approximation which assumes that 1 percent inflation rate reduces the firm's real stock return by χ_i percent due to nominal capital gains taxation. Hence, $\chi_i \pi$ can be explicitly expressed by $\tau_g \pi V_i$. Equation (4-a) becomes

$$r_i = r_i^a V_i - [(1-\tau)R - \pi]D_i - \tau_g \pi V_i. \qquad (4\text{-b})$$

By combining equations (2) and (4-b), β_i is expressed as

$$\beta_i = \{COV(r_i^a, \pi^u)/\sigma_\pi^2\}V_i + D_i - \tau_g V_i \qquad (5)$$

where $COV(r_i^a, \pi^u)/\sigma_\pi^2$ is represented, hereafter, by α_i.

Since the stock price is, in principle, a discounted value of expected future cash flow streams to shareholders, the simplest stock valuation equation is presented to be

$$S_i(\equiv 1) = \frac{E[r_i^a]V_i - E[r]D_i - \tau_g E[\pi]V_i}{E[r_z] + \theta COV(r_i, r_m)} \qquad (6)$$

where $E[r] \equiv (1-\tau)R - E[\pi]$, and $COV(r_i, r_m) = \beta_i \beta_m \sigma_\pi^2 + \sigma_{im}$.

After a linear approximation of equation (6) up to the first order, the rate of change for the real stock price (ΔS_i), while assuming that $E[r_z]$, θ, β_i, β_m and σ_{im} are constant parameters over time, can be expressed as

$$\Delta S_i = \lambda\{\Delta E[r_i^a]V_i - \Delta E[r]D_i - \tau_g \Delta E[\pi]V_i\} - \lambda'\theta\beta_m \Delta\sigma_\pi^2 \beta_i \qquad (7)$$

where Δ denotes the first-order difference with respect to time; and λ and λ', positive constants, represent capitalization factors.

For our objective of examining the wealth redistribution effect of inflation through changes in the real interest rate, it is convenient to express $-\Delta E[r]$ as

$$-\Delta E_t[r] = q\Delta E_t[\pi] + q'\Delta\sigma_{\pi,t}^2 + \phi_t \qquad (8)$$

where q and q' are positive constants,[5] and ϕ (error term) represents "real shock" to the interest rate. Also, based upon theoretical and empirical grounds, $\partial\Delta\sigma_\pi^2/\partial\Delta E[\pi]$ is assumed to be a positive constant, $\gamma > 0$;[6] that is,

$$\Delta\sigma^2_{\pi,t} = \delta + \gamma\ \Delta E_t[\pi] + \nu_t \tag{9}$$

where ν_t is error term. By substituting equation (9) into equation (8),

$$-\Delta E[r] = q'\delta + (q+q'\gamma)\Delta E[\pi] + (q'\nu_t+\phi_t) \tag{10}$$

where $q + q'\gamma$ is, hereafter, represented by $q^* > 0$.

After substituting equations (9) and (10) into equation (7), the first derivative of equation (7) with respect to $\Delta E[\pi]D_i$, equation (11), illustrates how inflation-induced stock price changes are related to the firm's debt-equity ratio (N.B., $V_i \equiv D_i + 1$ and equation 5).

$$\partial\Delta S_i/\partial(\Delta E[\pi]D_i) = (\lambda q^*-\lambda'\theta\beta_m\gamma) - \tau_g(\lambda-\lambda'\theta\beta_m\gamma) + \left\{\lambda(\partial\Delta E[r_i^a]/\partial\Delta E[\pi]) - \lambda'\theta\beta_m\gamma\alpha_i\right\}. \tag{11}$$

Equation (11) has several important implications for the empirical test of the nominal contracting hypothesis. First, the wealth redistribution effect of inflation from bondholders to stockholders should be isolated by $(\lambda q^*-\lambda'\theta\beta_m\gamma) > 0$. (Note that β_m is negative.) Second, the effects of inflation, through nominal capital gains taxation, on stock prices is represented by $-\tau_g(\lambda-\lambda'\theta\beta_m\gamma) < 0$. Third, if $\partial\Delta E[r_i^a]/\partial\Delta E[\pi]$ and α_i are, on average, sufficiently negative[7] to offset shareholders' benefits from debt financing, equation (11) is more likely to be negative in spite of a positive wealth redistribution effect. Earlier studies apparently do not recognize the effects of inflation on the firm's operating income and cost of equity, and, consequently, may not be able to isolate the wealth redistribution effect of inflation. In sum, the nominal contracting hypothesis, the tax effect hypothesis, and the inflation risk hypothesis should be tested jointly.

I.2. Testing Model

In order to test the model statistically, several more detailed realistic features about the firm's asset and capital structure need to be included. Firms are assumed to have inventories(INV) and plant and equipment(FA) on the asset side; and short term debt net of monetary assets(STD), long term debt(LTD) and equity($S \equiv 1$) on the claims side ($INV + FA \equiv STD + LTD + 1$). Consequently, one needs to distinguish between the effective inventory capital gain tax rate under inventory valuation method j (τ^j_{INV}) and the effective fixed asset capital gain tax rate (τ_{FA});[8] and between the short-term real interest rate after taxes (r_s) and the long-term real interest rate after taxes (r_ℓ).

For the new asset-capital structure, $\tau_g V$ in equation (7) is replaced by $\tau^j_{INV}INV + \tau_{FA}FA$; and $-\Delta E[r]D$ by $\{q_s'\delta + q_s^*\Delta E[\pi] + (q_s'\nu + \phi_s)\}STD + \{q_\ell'\delta + q_\ell^*\Delta E[\pi] + (q_\ell'\nu + \phi_\ell)\}LTD$, resulting in equation (12):

$$\begin{aligned}\Delta S_i &= \lambda\Delta E[r_i^a]V_i - \lambda\tau^j_{INV}\Delta E[\pi]INV_i - \lambda\tau_{FA}\Delta E[\pi]FA_i \\ &+ \lambda\{q_s'\delta + q_s^*\Delta E[\pi] + (q_s'\nu + \phi_s)\}STD_i \\ &+ \lambda\{q_\ell'\delta + q_\ell^*\Delta E[\pi] + (q_\ell'\nu + \phi_\ell)\}LTD_i \\ &- \lambda'\theta\beta_m(\delta + \gamma\Delta E[\pi] + \nu)\beta_i. \qquad (12)\end{aligned}$$

II. EMPIRICAL TEST

II.1. Data Base

Fifty semi-annual cross-sectional samples of non-financial and non-utility corporations were created from the Compustat and CRISP files from 1961.I through 1985.II. Each cross-section meets the following criteria: (i) for a given year, a firm is included if its fiscal year ends in December, and if it has data available on all of the accounting variables required for the estimation of the variables in the testing equation (14); and (ii) the firm's stock return data is available for all months over the previous five years (see footnote 12) from the CRISP file. The number of firms in the sample varies from a low of 168 for the 1961.I sample to a high of 505 for the 1978.II sample (a total of 17,820 firms).

Two alternative measures for the change in expected inflation are employed: (i) the change in the Livingston six-month inflation forecasts,[9] and (ii) the change in the six-month Treasury-bill rates.

II.2. Regression Models and Testing Procedures for Null Hypotheses

The empirical model analog for equation (12) is cross-sectional regression (13) for a given period, t.

$$r_{i,t} = b_{0,t} + \sum_{j=1}^{2} b^{j}_{1,t} (DUM^{j}_{i} INV_{i})_{t-1} + b_{2,t} FA_{i,t-1} + b_{3,t} STD_{i,t-1} + b_{4,t} LTD_{i,t-1} + b_{5,t} \beta_{i,t-1} + b_{6,t} \Delta E_{t}[r^{a}_{i}] V_{i,t-1} + \mu_{i,t} \quad (13)$$

where asset and capital structure variables are divided by the equity value, r_i is the six month real rate of return for firm i's equity,[10] DUM^j is the dummy variable for inventory valuation method ($DUM^1 = 1$ if fifo, $DUM^2 = 1$ if non-fifo),[11] INV denotes inventories, FA denotes net plant and equipment, STD denotes current liability minus monetary assets, LTD denotes long term debt plus preferred stock, β_i is the estimate of $COV(r_i, \pi^u)/\sigma_\pi^2$,[12] $\Delta E[r_i^a]$ denotes the change in the expected after tax real rate of return on the firm's total assets,[13] V denotes total assets, and μ represents error term. b's are regression coefficients; in particular, $b_{0,t}$ (constant term) represents a change in stock prices which is not explained by our model. $b_{0,t}$ is constructed as $b_0 + \xi_t$.

Since it is untenable to estimate market values of the asset and liability variables in equation (13) firm by firm for each time period, these variables are proxied by their book values as found in the Compustat file. One may criticize the use of historic cost accounting-book values for potential measurement errors in the explanatory variables for equation (13); but, these measurement errors are likely to be positively correlated with the inflation level and, thereby, so is the magnitude of the downward bias (toward zero) in the regression coefficient estimates. Hence, the use of book ratios should pose no serious problem if the empirical results are statistically significant <u>in spite of</u> downward biases in the regression coefficient estimates.[14]

Finally, it is important to note that one of the regressors must be excluded from regression (13) in order to avoid the rank problem (i.e., $INV + FA - STD - LTD - 1 \equiv 0$). By replacing the regressor 1 with INV + FA - STD - LTD (i.e., suppressing the constant term), our cross-sectional regression model becomes

$$r_{i,t} = \sum_{j=1}^{2} c_{1,t}^{j}(DUM_i^j INV_i)_{t-1} + c_{2,t}FA_{i,t-1} + c_{3,t}STD_{i,t-1} + c_{4,t}LTD_{i,t-1} + c_{5,t}\beta_{i,t-1} + c_{6,t}\Delta E_t[r_i^a]V_{i,t-1} + \mu_{i,t} \tag{14}$$

where c's are parameters to be estimated; $c_{k,t} = b_{0,t} + b_{k,t}$ for $k = 1$ and 2, $c_{k,t} = -b_{0,t} + b_{k,t}$ for $k = 3$ and 4, and $c_{k,t} = b_{k,t}$ for $k = 5$ and 6 (b's are as defined in equation 13).

By referring to equation (12), the regression coefficients for equation (14), except for $c_{6,t}$ which equals λ for all t, are expressed by the following <u>time-series</u> relationships:

$$c_{1,t}^{j} = b_0 - \lambda\tau_{INV}^{j}\Delta E_t[\pi] + \xi_t$$

$$c_{2,t} = b_0 - \lambda\tau_{FA}\Delta E_t[\pi] + \xi_t$$

$$c_{3,t} = (-b_0 + \lambda q_s'\delta) + \lambda q_s^{*}\Delta E_t[\pi] + (\lambda q_s'\nu_t + \phi_{s,t} - \xi_t)$$

$$c_{4,t} = (-b_0 + \lambda q_\ell'\delta) + \lambda q_\ell^{*}\Delta E_t[\pi] + (\lambda q_\ell'\nu_t + \phi_{\ell,t} - \xi_t)$$

$$c_{5,t} = -\lambda'\theta\beta_m\delta - \lambda'\theta\beta_m\gamma\Delta E_t[\pi] - \lambda'\theta\beta_m\nu_t \tag{15}$$

where $\lambda\tau_{INV}^{j}$, $\lambda\tau_{FA}$, λq_s^{*}, λq_ℓ^{*}, and $-\lambda'\theta\beta_m\gamma$ are <u>positive</u> constants according to our null hypotheses; and ξ, ν and ϕ are treated as error terms.

Therefore, our research strategy requires a two-step procedure:

Step 1: estimate the cross-sectional regressions for equation (14) for each of the sample periods, 1 to T; and

Step 2: examine the relationships between these regression coefficient estimates and the change in expected inflation over the corresponding period.

The second step in our statistical estimation procedure is the testing of the null hypotheses with time-series regressions (16):

$$c_{k,t} = f_{0,k} + f_{1,k}\Delta E[\pi] + \psi_{k,t} \qquad \text{for } k = 1,\ldots,5 \tag{16}$$

where $c_{k,t}$ is the coefficient of the kth explanatory variable in the cross-sectional regression (14) for sample t, and $\psi_{k,t}$ is error term (e.g., $\psi_{3,t} = \lambda q_s' \nu_t + \phi_{s,t} - \xi_t$). The slope coefficient estimate, $f_{1,k}$, is anticipated to be negative for k = 1 and 2 by the nominal gains tax effect hypothesis; to be positive for k = 3 and 4 by the nominal contracting hypothesis; and to be positive for k = 5 by the inflation risk hypothesis. Because the residuals from regressions (16) are correlated across equations, regressions (16) are estimated as a system of equations, using Zellner's [1962] Seemingly Unrelated Regression (SUR) technique.

II.3. Comparison with Earlier Studies

A. French, Ruback and Schwert (F-R-S) [1983].

The F-R-S model, of which variants are used by others (e.g., Bernard [1986] and Pearce and Roley [1987]), is represented by

$$R_{i,t} = e'_{0,i} + e'_{1,i}E_t[\pi] + e_{1,i}\pi^u_t + e_2\{TAX_{i,t-1}\pi^u_t\} + e_3\{STD_{i,t-1}\pi^u_t\} + e_4\{LTD_{i,t-1}\pi^u_t\} + \mu_{i,t} \tag{17}$$

where the dependent variable is the nominal rate of return for firm i's equity, and TAX represents the value of the tax shield from fixed assets divided by the equity value. The null hypotheses of F-R-S are $e_2 < 0$, $e_3 > 0$, and $e_4 > 0$.

Because the value of tax shield from fixed assets is, in principle, the book value of fixed assets,[15] regression (17) can be replaced by

$$r_{i,t} = e_{0,i} + e_{1,i}\pi^u_t + e_2\{FA_{i,t-1}\pi^u_t\} + e_3\{STD_{i,t-1}\pi^u_t\}$$
$$+ e_4\{LTD_{i,t-1}\pi^u_t\} + \mu_{i,t}. \tag{18}$$

There are two problems associated with regressions (17) or (18). First, our model development (see equation 11) suggests that the change in the firm's anticipated operating income is potentially an important missing variable from the F-R-S model. Note that this missing variable affects the stock price and is likely to be correlated with unexpected inflation. Because regression (18) pools cross-section and time-series data, the error term from regression (18) will be correlated with unexpected inflation and, consequently, with the explanatory variables. To the extent the F-R-S model is misspecified, the use of OLS, GLS, or, as they use, SUR will not engender statistically consistent coefficient estimates.

Second, inventory is apparently another missing variable from regression (18). If one does not need to consider inventory, regression (18) may suffer from perfect collinearity among the regressors (i.e., $1 + STD + LTD - FA \equiv 0$). If INV is replaced with $1 + STD + LTD - FA$

to avoid perfect collinearity among the regressors, the null hypotheses of F-R-S ($e_2 < 0$, $e_3 > 0$, and $e_4 > 0$) are not consistent with what they intend to examine. Indeed, the "correct" null hypotheses are $e_1 < 0$, $e_2 + e_1 < 0$, $e_3 - e_1 > 0$, and $e_4 - e_1 > 0$ (F-R-S do not report their statistical findings about e_1). This can be easily shown by replacing $E[\pi]$ and INV in our equation (12) with π^u and 1 + STD + LTD - FA, respectively (ignoring potential model misspecification due to missing $\Delta E[r_i^a]$ and β_i), equation (19):

$$\begin{aligned} r_i = & -\lambda\tau^j_{INV}\pi^u + \lambda(-\tau_{FA} + \tau^j_{INV})\pi^u FA_i \\ & + \lambda\{q_s'\delta + (q_s^* - \tau^j_{INV})\pi^u + (q_s'\nu + \phi_s)\}STD_i \\ & + \lambda\{q_\ell'\delta + (q_\ell^* - \tau^j_{INV})\pi^u + (q_\ell'\nu + \phi_\ell)\}LTD_i. \end{aligned} \tag{19}$$

In order to re-examine the F-R-S model within the context of our analysis, cross-sectional regressions (20) are estimated for each t.

$$\begin{aligned} r_{i,t} = & e_{1,t} + e_{2,t}FA_{i,t-1} + e_{3,t}STD_{i,t-1} + e_{4,t}LTD_{i,t-1} \\ & + e_{5,t}\beta_{i,t-1} + e_{6,t}\Delta E_t[r_i^a]V_{i,t-1} + \mu_{i,t}. \end{aligned} \tag{20}$$

Testing of our null hypotheses, if one must avoid the rank problem, is represented by

$$\left\{ \begin{array}{c} e_{1,t} \\ e_{2,t} - e_{1,t} \\ e_{3,t} + e_{1,t} \\ e_{4,t} + e_{1,t} \\ e_{5,t} \end{array} \right\} = h_{0,k} + h_{1,k}\Delta E_t[\pi] \tag{21}$$

where $h_{1,k}$ is anticipated to be negative for k = 1 and 2; and to be positive for k = 3, 4 and 5.

Testing of the null hypotheses, which is parallel with that provided by F-R-S, would be represented by

$$e_{k,t} = h'_{0,k} + h'_{1,k}\Delta E_t[\pi] \qquad (22)$$

where $h'_{1,k}$ is anticipated to be negative for k = 2; and to be positive for k = 3 and 4.

B. Summers [1981].

Using our notations, Summers' model can be represented by

$$r_{i,t} = d'_0 + \left\{ \frac{d_0 \Delta E_t[\pi]}{-} \right. + d_1\{INV_{i,t-1}\Delta E_t[\pi]\} + d_2\{FA_{i,t-1}\Delta E_t[\pi]\}$$

$$+ d_3\{STD_{i,t-1}\Delta E_t[\pi]\} + d_4\{LTD_{i,t-1}\Delta E_t[\pi]\} + \mu_{i,t} \qquad (23)$$

where $\Delta E_t[\pi]$ is either included or suppressed as an independent variable.

Summers recognizes incisively that missing variables from regression (23) will cause the error term to be correlated with the explanatory variables. In this situation, an appropriate model is the error-components model;[16] the error term is decomposed into cross-section, time-series, and combined error terms. Summers attributes the cross-section error component to firm-specific effects jointly caused by inflation and missing variables from his regression. By controlling for these firm-specific errors, Summers could avoid potential misspecification biases, even though he does not explicitly incorporate the firm-specific effects of inflation on operating income and the cost of equity into his model. Summers' findings (his Table 7) contain "mixed" results about the wealth redistribution effect from long-term bondholders to shareholders. As would be anticipated by our discussion about the F-R-S model, his supporting evidence ($d_4 > 0$) is found generally when he both controls for firm-specific errors and suppresses $\Delta E_t[\pi]$ as an independent regressor (i.e., avoids perfect collinearity among the explanatory variables).

II.4. Empirical Findings

For each of the cross-sectional samples from 1961.I through 1985.II, regression coefficients for equation (14) are estimated. The results from the testing of our null hypotheses, regressions (16), are reported in Table I for two sample periods: (i) 1961.I through 1985.II; and (ii) 1965.I through 1979.II. The first sample period includes both relatively low inflationary perids (the early 1960s) and "disinflationary" periods (the 1980s), while the second sample period can be characterized by "worsening" inflation.

Our findings are robust with respect to different inflationary regimes, and consistent across different expected inflation measures. Specifically, we find:[17]

(i) statistically significant wealth redistribution effects of inflation from long-term bondholders to shareholders;

(ii) statistically significant wealth redistribution effects of inflation from short-term bondholders to shareholders during the worsening inflationary period;[18]

(iii) statistically significant effects of nominal capital gains taxation for inventories on stock prices during the worsening inflationary period;[19]

(iv) statistically significant effects of nominal capital gains taxation for fixed assets on stock prices during the worsening inflationary period;[20] and

(v) statistically significant effects of the non-diversifiable inflation risk on stock prices.

Using the same samples,[21] cross-sectional regressions (20) are also estimated. The results from the testing of two different sets of null hypotheses, regressions (21) and (22), are reported in Table II.[22] The results for regressions (21), which recognize the potential rank problem, are consistent with (or stronger than) those in Table I. However, the results for regressions (22), which parallel those of French, Ruback and Schwert, perform poorly, providing spuriously no visible evidence for the wealth redistribution effect and the tax effect of inflation.[23]

III. CONCLUSION

This paper provides supporting evidence for the nominal contracting hypothesis, and suggests an alternate view to the "money illusion" hypothesis of Modigliani and Cohn [1979].

FOOTNOTES

[1]Our theoretical development recognizes that inflation-induced stock price changes are caused by revisions in expectations and uncertainty about future inflation, not necessarily by current unexpected inflation.

[2]Among earlier studies are Kessel [1956], Bach and Ando [1957], Alchian and Kessel [1959], Kessel and Alchian [1960], Bach and Stephenson [1974], and Hong [1977]. Among more recent studies are Summers [1981], and French, Ruback and Schwert [1983], Bernard [1986], and Pearce and Roley [1987].

[3]The negative stock market return-inflation relationship has been well documented since the mid-1970s. See, for example, Friend and Hasbrouck [1982] and the references therein.

[4]For analytical convenience, a 100% dividend payout ratio is implicitly assumed. Consideration of retained earnings (and thus "real" capital gains) would not be required in order to focus on the effect of "pseudo" profit taxes on the stock price. Also, personal equity income tax is not considered. This must be inconsequential to this paper's results because most of inflationary distortions on shareholders' cash flows arise before personal taxes are paid.

[5]If the long term nominal interest rate is fixed, $q = 1$. If the short term nominal interest rate at most one-to-one responds to expected inflation (as is empirically observed), q must be positive but less than 1. For the empirical estimate of $q' > 0$, see Levi and Makin [1979], Hartman and Makin [1982], and Zarnowitz and Lambros [1987], among others.

[6]While the underlying cause is a subject of continued debate, the positive statistical relationship between the level of actual/expected inflation and inflation uncertainty (both in the U.S. and other countries) has been empirically documented. See, for example, Okun [1971], Logue and Willet [1976], Friedman [1977], and Zarnowitz and Lambros [1987], among others.

[7]Increasing inflation uncertinaty, a concomitant of rising inflation, appears to adversely impact real corporate earnings before tax. Friedman [1977] in his Nobel Laureate Lecture contends that increased inflation uncertainty, by making it harder to extract the signal about relative prices from absolute prices, reduces the efficiency of the price system and thus lowers the growth rate of real output. Levi and Makin [1980] and Mullineaux [1980] provide empirical support for Friedman. Malkiel [1979] attributes observed depressed corporate fixed capital expenditures during the 1970s to increased economic uncertainty, a concomitant of increased inflation uncertainty. A survey of non-financial corporations listed on the New York Stock

Exchange, conducted by Blume, Friend and Westerfield [1981], finds that corporate managers consider inflation uncertainty to be one of the key factors depressing real plant and equipment expenditures. Friend and Hasbrouck [1982] find that a one percent increase in the sustained inflation rate is associated with more than a ten percent decrease in real economic earnings per share; and Friend [1982] attributes this finding to the adverse effects of increased inflation uncertainty upon the firm's operating income. Dokko and Edelstein [1987a] observe that increased inflation uncertainty is an important cause for the increase in the real required market return for common stocks for the post-1960 period; and they [1987b] attribute this finding to the adverse impacts of inflation uncertainty upon real corporate earnings before tax.

[8]The U.S. tax laws do not allow the use of different inventory valuation methods for financial and tax purposes. It is a reasonable assumption that firms use the accelerated depreciation method for tax purposes (see Parker's [1977] survey evidence).

[9]Caskey [1985] shows optimal forecasting behavior (a Bayesian learning model) from the Livingston inflation forecasts. Forecasted inflation rates by individual respondents are estimated following Carlson's [1977] suggestion.

[10]We assume that the end-of-period stock price includes dividends. Friend and Hasbrouck [1982] show that inflation has depressant impacts upon dividends. The real price relative was replaced for the real investment relative; and did not alter our conclusions for the null hypotheses.

[11]Inventory valuation method is chosen from the most prevailing method. If a firm uses the most prevailing valuation method other than FIFO, LIFO or Average, the firm is excluded from the sample.

[12]β_i is estimated from quarterly realized real stock returns and quarterly unexpected inflation rates over a five-year period prior to each of the sample periods.

[13]Because of an insufficient number of observations for pre-tax earnings available from the Compustat tape for each of the sample firms, time-series extrapolation to estimate $E[r_i^a]$ is not appropriate. The change in the expected real return on total assets is estimated, assuming perfect foresight, to be:

$$\Delta E_t[r_i^a] = \frac{0.48\ EBIT_{t+1}/(1+\pi_{t+1})}{V_t} - \frac{0.48\ EBIT_t/(1+\pi_t)}{V_{t-1}}$$

where EBIT denotes earnings before interest and tax; V denotes total assets; and π is the inflation rate. The corporate income tax rate is assumed to be 0.48. We attempted to estimate "effective" corporate income tax rates for individual firms. Unfortunately, Compustat data is not sufficient to generate this data. To the extent that $\Delta E_t[r_i^a]V_{i,t-1}$ is introduced as a control variable, potential measurement errors due to the constant tax rate assumption should be innocuous to the testing of our null hypotheses.

Also, note that without a need to empirically estimate "inflation-induced" changes in stock prices and anticipated operating income, we can still control for the impacts of inflation upon anticipated operating income.

[14] In addition, the information content in the discrepancy between accounting-book values and market replacement cost values appears to be negligible (see Watts and Zimmerman [1980] and Beaver and Landsman [1983], among others).

[15] Because most firms use the straight line depreciation method for financial reporting and the accelerated depreciation method for tax reporting, there is a slight discrepancy between the book value of fixed assets and the value of the shield. See French, Ruback and Schwert [1983, p. 78].

[16] See Wallace and Hussain [1969], among others.

[17] Appendix A contains the correlation matrices among residuals from regressions (16). The signs and magnitudes of correlation coefficients across equations are consistent with a priori expectations (see equations 15).

[18] A statistically insignificant (though positive) wealth redistribution effect of inflation from short-term bondholders to shareholders might be consistent with that short-term nominal interest rates respond to changes in inflation expectations.

[19] The slope coefficient differential between fifo and non-fifo is statistically insignificant for both sample periods and for both expected inflation measures with t-statistics from -1.20 to -0.39.

[20] The statistically insignificant capital gains tax effect (for both inventory and fixed assets) during the 1961-1985 sample period might be attributed to changes in tax laws in the 1980s.

[21] Because different inventory valuation methods do not engender statistically different results in Table I (see, also, footnote 19), we do not differentiate inventory valuation methods for regressions (20).

[22]The results using the change in T-bill rates for $\Delta E[\pi]$ are not reported to save space.

[23]The wrong signs or statistical insignificance of the results for regressions (22) are consistent with those from F-R-S. This reinforces the importance of recognizing the rank problem.

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TABLE I†

Testing of Null Hypotheses: Results for $c_{k,t} = f_{0,k} + f_{1,k}\Delta E_t[\pi]$; k=1,...,5 (16)

where $c_{k,t}$ is the coefficient estimate for kth explantory variable in cross-sectional regression (14).

Panel A. (1961.I-1985.II: NOB=50)

		Data Source for $\Delta E[\pi]$: Livingston Forecasts in %				Data Source for $\Delta E[\pi]$: Treasury Bill Rates in %			
		f_0	f_1	R^2	DW	f_0	f_1	R^2	DW
c_k for	INV:fifo	0.045 (2.33)	-0.080 (-1.60)	0.05	2.26	0.045 (1.82)	-0.028 (-0.93)	0.02	2.27
	INV:non-fifo	0.045 (1.86)	-0.072 (-1.20)	0.03	2.22	0.044 (2.12)	-0.023 (-0.86)	0.01	2.29
	FA	0.038 (2.40)	-0.064 (-1.71)	0.06	2.14	0.038 (2.48)	-0.028 (-1.49)	0.04	2.26
	STD	-0.054 (-2.82)	0.053 (1.11)	0.02	2.34	-0.053 (-2.74)	0.008 (0.36)	0.01	2.43
	LTD	-0.033 (-2.40)	0.069 (2.07)	0.08	2.21	-0.032 (-2.36)	0.031 (1.81)	0.06	2.10
	β	-0.001 (-1.71)	0.006 (3.52)	0.20	2.02	-0.001 (-1.48)	0.002 (1.82)	0.06	1.96

TABLE I† (continued)

Panel B. (1965.I-1979.II: NOB=30)

		Data Source for $\Delta E[\pi]$: Livingston Forecasts in %				Data Source for $\Delta E[\pi]$: Treasury Bill Rates in %			
		f_0	f_1	R^2	DW	f_0	f_1	R^2	DW
c_k for	INV:fifo	0.078 (2.14)	-0.176 (-1.98)	0.12	2.49	0.077 (2.39)	-0.181 (-3.18)	0.25	2.27
	INV:non-fifo	0.061 (2.14)	-0.152 (-2.18)	0.14	2.66	0.058 (2.24)	-0.140 (-3.08)	0.24	2.46
	FA	0.057 (2.75)	-0.140 (-2.77)	0.20	2.32	0.053 (2.82)	-0.118 (-3.58)	0.30	2.29
	STD	-0.067 (-2.40)	0.129 (1.91)	0.11	2.48	-0.060 (-2.27)	0.093 (1.98)	0.12	2.49
	LTD	-0.051 (-2.59)	0.144 (3.00)	0.23	2.44	-0.045 (-2.48)	0.113 (3.49)	0.29	2.42
	β	-0.004 (-0.67)	0.005 (2.83)	0.21	2.51	-0.001 (-0.15)	0.003 (1.94)	0.11	2.47

†: Regressions are estimated as a system of equations using Seemingly Unrelated Regression technique. t-statistics are in parentheses below coefficient estimates.

$$\begin{Bmatrix} e_{1,t} \\ e_{2,t} + e_{1,t} \\ e_{3,t} - e_{1,t} \\ e_{4,t} - e_{1,t} \\ e_{5,t} \end{Bmatrix} = h_{0,k} + h_{1,k} \Delta E[\pi] \quad (21)$$

$$e_{k,t} = h'_{0,k} + h'_{1,k} \Delta E_t[\pi]; \; k = 2, 3 \text{ and } 4 \quad (22)$$

where $e_{k,t}$ is the coefficient estimate for the kth explanatory variable in cross-sectional regression (21).

Panel A. (1961.I-1985.II: NOB=50)

		Results for Regressions (21)				Results for Regressions (22)			
		h_0	h_1	R^2	DW	h'_0	h'_1	R^2	DW
Dep. Var. for	INV	0.052 (2.35)	-0.109 (-2.00)	0.07	2.22	--	--	--	--
	FA	0.054 (2.70)	-0.093 (-1.92)	0.07	2.08	0.001 (0.16)	0.0004 (0.70)	0.01	1.83
	STD	-0.076 (-3.48)	0.072 (1.35)	0.04	2.32	-0.024 (-2.36)	-0.037 (-1.49)	0.04	1.83
	LTD	-0.054 (-2.71)	0.109 (2.26)	0.09	2.18	-0.002 (-0.20)	0.0001 (0.01)	0.00	1.67
	β	-0.0001 (-0.28)	0.003 (3.18)	0.17	2.20	--	--	--	--

TABLE II† (Continued)

Panel B. (1965.I–1979.II: NOB=30)

		Results for Regressions (21)				Results for Regressions (22)			
		h_0	h_1	R^2	DW	h_0'	h_1'	R^2	DW
Dep. Var. for	INV	0.068 (2.21)	-0.192 (-2.56)	0.18	2.56	--	--	--	--
	FA	0.070 (2.62)	-0.177 (-2.72)	0.20	2.33	0.002 (0.14)	0.015 (0.46)	0.01	2.08
	STD	-0.083 (-2.74)	0.135 (1.83)	0.10	2.52	-0.015 (-1.17)	-0.056 (-1.79)	0.10	2.21
	LTD	-0.069 (-2.56)	0.193 (2.92)	0.22	2.49	-0.001 (-0.12)	0.001 (0.05)	0.00	1.74
	β	-0.0001 (-0.22)	0.003 (2.08)	0.13	2.24	--	--	--	--

†: The data source for $\Delta E_t[\pi]$ is Livingston forecasts in %. Regressions (21) and (22) are, respectively, estimated as a system of equations using Seemingly Unrelated Regression technique. t-statistics are in parentheses below coefficient estimates.

APPENDIX A†

CROSS-EQUATION (16) CORRELATION MATRICES

Panel A: 1961.I - 1985.II.

	INV:fifo	INV:non-fifo	FA	STD	LTD	β
INV:fifo	1.000					
INV:non-fifo	0.922	1.000				
FA	0.834	0.847	1.000			
STD	-0.800	-0.769	-0.832	1.000		
LTD	-0.834	-0.852	-0.958	0.782	1.000	
β	-0.288	-0.309	-0.151	0.213	0.161	1.000

Panel B: 1965.I - 1979.II.

	INV:fifo	INV:non-fifo	FA	STD	LTD	β
INV:fifo	1.000					
INV:non-fifo	0.924	1.000				
FA	0.814	0.860	1.000			
STD	-0.816	-0.809	-0.863	1.000		
LTD	-0.830	-0.895	-0.955	0.825	1.000	
β	-0.489	-0.412	-0.289	0.481	0.276	1.000

†: Equations (16) are estimated using Livingston forecasts for $\Delta E[\pi]$.