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Effects of Unexpected Inflation on Wealth Redistribution and Stock Prices: Test of the Nominal Contracting Hypothesis

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EFFECTS OF UNEXPECTED INFLATION ON
WEALTH REDISTRIBUTION AND STOCK PRICES:
RE-EXAMINATION OF THE NOMINAL CONTRACTING HYPOTHESIS

ABSTRACT

One befuddling empirical result related to rationality of stock price determination is the lack of convincing evidence for the wealth redistribution effect of unexpected inflation between creditors (bondholders) and debtors (shareholders). The principal objective of this paper is to examine how inflation-induced changes in stock prices are related to individual firm characteristics. The empirical findings of this research, using micro firm data, demonstrate the existence of the theoretically anticipated wealth redistribution effect of unexpected inflation. This empirical evidence requires controlling for the effects of uncertain inflation on the firm's operating income and the cost of equity.

I. INTRODUCTION AND MOTIVATION OF THE RESEARCH

Unexpected inflation, *ceteris paribus*, causes wealth redistribution (i) from creditors to debtors because fixed rate debt contracts stipulate fixed amounts of nominal payments; and (ii) from shareholders to the government because the value of tax shield is nominally fixed. The so-called nominal contracting hypothesis or debtor-creditor hypothesis has been repeatedly examined over the last thirty years. Surprisingly, convincing evidence for the wealth redistribution effect of unexpected inflation has yet to be presented.

It may be suggested that earlier studies[1] are inadequate for the test of the nominal contracting hypothesis because they did not distinguish between expected and unexpected inflation. However, even recent studies[2] which carefully distinguished between expected and unexpected inflation could not support the existence of wealth redistribution by unexpected inflation between bondholders and shareholders.

It should be noted that the nominal contracting hypothesis has been examined in a strict "partial" equilibrium framework. None of the previous studies has considered the potentially important effects of *uncertain* inflation on the firm's operating income. Dokko and Edelstein [10], in explaining the observed negative relationships between stock returns and inflation, have shown that the adverse effect of inflation uncertainty on operating income causes an increase in the real required return for common stocks; and suggested that this inflation uncertainty effect is a potentially dominating depressant effect of inflation on stock prices.[3]

This "business" risk of operating income, associated with inflation uncertainty, will be intensified as debt increases because it is "piled" upon the smaller equity base (Modigliani and Miller [32]), resulting in a higher real required return for equity and, ceteris paribus, a decrease in the real value of equity. Therefore, without controlling for the potentially adverse and overwhelming impacts of uncertain inflation on operating income, capital gains on debt may appear spuriously to be unrelated or negatively related to realized stock returns.

In addition, the value of tax shield, which is "nominally" fixed, is related to the firm's asset structure as well as income-reporting method. The firm's optimal capital structure could be closely related with its asset structure. This implies that one may need to control, also, for the effect of "historic cost" tax laws on the firm's value when examining the wealth redistribution effect of inflation.

The principal objective of this research is, in an effort to test the nominal contracting hypothesis, to examine how inflation-induced changes in stock prices are related to the characteristics of individual firms. In brief, the empirical findings of this paper demonstrate the existence of the theoretically anticipated wealth redistribution effect of unexpected inflation. This empirical evidence requires jointly controlling for the effects of uncertain inflation on the firm's operating income, the real required return for equity and the real value of the tax shield.

Section II develops a simple capital asset pricing model to show how inflation-induced changes in stock prices are related to individual firm characteristics. As a part of the analysis, an empirically testable model, based on the theory, will be presented. Section III outlines the data base and testing procedures, and presents empirical findings. Finally, the conclusions and implications of this research will be delineated.

II. THEORY and MODEL

II.1. Theory

The economy is described as following:

A1. Individuals are standard Sharpe-Lintner CAPM investors.

A2. There are "N" firms which issue nominally risk-free short term bonds (denoted by subscript o) and common stocks (denoted by subscript i = 1,..,N). Supply of these assets is fixed; and the net supply of bonds is zero.

The inflation rate[4] over a single period, π, is decomposed into expected and unexpected inflation rates:

$$\pi \equiv E[\pi] + \pi^u \tag{1}$$

where E is the expectation operator at the beginning of the period, t-1 (unless explicitly required, time subscripts are omitted for convenience); π^u is the unexpected inflation rate; π^u is normally distributed with mean zero and variance ξ. The measure of inflation uncertainty[5] is represented by ξ.

It is further assumed that the nominal interest rate before tax, R_o, is known at the beginning of the period. Since taxes are calculated for nominal interest payments, the *ex post* net real interest rate after tax, r_o, is defined as:

$$r_o \equiv (1-\tau)R_o - \pi \tag{2}$$

where τ denotes the ordinary income tax rate which is assumed to be the same for all economic agents.

The real rate of return on firm i's asset, a_i, is also decomposed into expected and unexpected rates:

$$a_i \equiv E[a_i] + a_i^u \tag{3}$$

where the unexpected rate of asset return, a_i^u, is assumed to be generated by a two-factor return generating process:[6]

$$a_i^u = a_i^* + \alpha_i \pi_i^u \tag{4}$$

where a_i^* is the unexpected rate of the asset return which is independent of unexpected inflation; i.e., $E[a_i^* \pi^u] = 0$; and α_i is the measure of the degree of responsiveness of the firm's real asset return with repect to unexpected inflation, i.e., $\alpha_i = COV(a_i, \pi^u)/\xi$.

Let "v" and "d" be the beginning-of-the-period values of the firm's total asset (v) and debt (D), respectively, divided by the beginning-of-the-period value of equity (S). It will be assumed, for the time being, that firms have the simplest asset-capital structure: homogeneous physical asset and no long term debt. This assumption simplifies the model derivation, and will be released later. Under this asset-capital structure, the real rate of return on firm i's equity, r_i, becomes:[7]

$$r_i = (1-\tau)\, a_i\, v_i - r_o\, d_i - g\, \pi\, v_i \tag{5}$$

where πv represents nominal capital gains on the firm's asset (per dollar value of equity); g is the tax rate on nominal capital gains.

By combining (1) through (5):

$$r_i = E[r_i] + r_i^* + \beta_i \pi^u \quad (6)$$

where $E[r_i] = (1-\tau)\, E[a_i]\, v_i - E[r_o]\, d_i - g\, E[\pi]\, v_i;$

$r_i^* = (1-\tau)\, a_i^*\, v_i$, i.e., $COV(r_i^*, \pi^u) = 0$; and

$\beta_i = COV(r_i, \pi^u)/\xi = [(1-\tau)\, \alpha_i\, v_i + d_i - g\, v_i]$

Given these real returns on equity and bonds, investors (denoted by superscript k) are to maximize expected utility of end-of-the-period real wealth, and their individual optimality condition for expected utility maximization is derived to be:[8]

$$E[r_i - r_o] = c^k \left\{ COV(r_o, r_i - r_o) + \sum_{j=1}^{N} \theta_j^k\, COV(r_i - r_o, r_j - r_o) \right\}$$

$$\text{for } i = 1, \ldots, N \quad (7)$$

where c^k is the Pratt-Arrow measure of relative risk aversion and θ_j^k is the fraction of initial wealth invested into jth equity. By aggregation, the market equilibrium condition becomes:

$$E[r_i - r_o] = \lambda \left\{ COV(r_i, r_m) - COV(r_o, r_m) \right\} \quad (8)$$

where r_m is the real return on market portfolio of common stocks; and λ is the market price of risk.

Since there is no real risk-free asset in our model, Black's [5] version of the CAPM is applied to derive the real required return/ risk trade-off for bonds. Since (8) is a market equilibrium condition for any risky asset, the risk premium for the zero-beta portfolio, whose real return is uncorrelated with the real market return, is:

$$E[r_z - r_o] = -\lambda \ COV(r_o, r_m) \tag{9}$$

where r_z is the real return on the zero-beta portfolio.

By substituting $E[r_o]$ in (9) into (8):

$$\begin{aligned} E[r_i] &= E[r_z] + \lambda \ COV(r_i, r_m) \\ &= E[r_z] + \lambda \ \{\sigma^*_{mi} + \beta_m \beta_i \xi\} \end{aligned} \tag{10}$$

where $\sigma^*_{im} = COV(r^*_i, r^*_m)$; and $\beta_m = COV(r_m, \pi^u)/\xi$.

Equation (10), vis-a-vis the standard CAPM, shows that a change in the cost of equity could be induced by inflation uncertainty. Given that β_m is negative as well-documented by the previous empirical works, if an individual firm's equity return is negatively related to unexpected inflation ($\beta_i < 0$), its cost of equity increases when inflation uncertainty increases. In other words, if an individual common stock is not hedged against unexpected inflation, inflation uncertainty becomes "non-diversifiable" risk to the extent the market is not also hedged against unexpected inflation. Therefore, when examining how inflation-induced stock returns are related with the characteristics of individual firms, the assumption of the constant cost of equity[9] could be potentially misleading.

Since the stock price is, in principle, a discounted value of expected cash flow streams to shareholders, it can be expressed as:

$$S_i = \frac{(1-\tau)\ E[a_i]\ V_i - E[r_o]\ D_i - g\ E[\pi]\ V_i}{E[r_z] + \lambda\{\sigma^*_{mi} + \beta_m \beta_i \xi\}} \tag{11}$$

Then, the change in the stock price can be approximated as:[10]

$$\log\{S_{i,t}/S_{i,t-1}\} =$$

$$\log\{E_t[CF_i]/E_{t-1}[CF_i]\} - \log\{\lambda COV_t(r_i, r_m)/\lambda COV_{t-1}(r_i, r_m)\} \tag{12}$$

where E[CF] represents expected cash flow to shareholders, that is, the numerator of the RHS in (11). Since the changes in stock prices are mostly determined by revisions in expectations, a linear approximation of (12), assuming that σ^*_{mi}, λ, β_m, and β_i are stationary over time, shows that the realized stock return can be expressed as:

$$r_i = (1-\tau)\ \Delta E[a_i]\ v_i - \Delta E[r_o]\ d_i - g\ \Delta E[\pi]\ v_i - \lambda\ \beta_m\ \beta_i\ \Delta\xi + \varepsilon_i \tag{13}$$

where ε_i represents the realized dividend yield.

Note that (13) is a rather general expression for the realized return of common stock particularly because the change in expected operating income ($\Delta E[a_i]$) could result from other than inflation (e.g., new growth opportunity). Therefore, the realized return on equity <u>induced by inflation</u>, r^π_i, can be expressed as:

$$r^\pi_i = (1-\tau)\ \Delta^\pi E[a_i]\ v_i - \Delta E[r_o]\ d_i - g\ \Delta E[\pi]\ v_i$$

$$+ \lambda^*\{(1-\tau)\ \alpha_i\ v_i + d_i - g\ v_i\}\ \Delta\xi \tag{14}$$

where $\Delta^{\pi}E[a_i]$ may be expressed as $(\partial E[a_i]/\partial E[\pi])\ \Delta E[\pi] + (\partial E[a_i]/\partial \xi)\ \Delta\xi$, that is, the change in the expected asset return induced by inflation; $\lambda^* = -\lambda\ \beta_m > 0$ (because $\beta_m < 0$); and $(1-\tau)\ \alpha_i\ v_i + d_i - g\ v_i$ was substituted for β_i. The second line of the RHS in (14) illustrates how the real return on equity resulting from the change in the cost of equity is related with the characteristics of individual firms.

Even though (14) is not expressed in terms of unexpected inflation per se, it should be appropriate for explaining the wealth redistribution effect of unexpected inflation because the immediate consequences of unexpected inflation would be the revisions in expected inflation and the changes in perceptions about its uncertainty, and these revisions result in the change of stock prices.

Equation (14) also illustrates how inflation-induced stock returns are related to the firm's capital structure. The first derivative of (14), in which $q\ \Delta E[\pi]$ is substituted for $-\Delta E[r_o]$ (q is a constant[11]), with respect to d_i shows (N.B., $v_i = d_i + 1$):

$$\Delta r_i^{\pi}/\Delta d_i = (1-\tau)\ \Delta^{\pi}E[a_i] + (q-g)\ \Delta E[\pi] + \lambda^*\{(1-\tau)\ \alpha_i + 1 - g\}\ \Delta\xi \quad (15)$$

This relationship has been conventionally thought to be positive when unanticipated inflation occurs. However, (15) demonstrates that (i) the nominal contracting hypothesis cannot be separable from the nominal capital gain tax effect hypothesis to the extent the capital gain tax rate is positive;[12] and (ii) the nominal contracting hypothesis cannot be validly tested <u>without controlling</u> for the potentially overwhelming effects of uncertain inflation on operating income (i.e., $\Delta^{\pi}E[a_i]$ and α_i). If $\Delta^{\pi}E[a_i]$ and α_i are, on average, sufficiently negative to offset the benefits from capital gains on debt,[13] the failure of the previous studies to present empirical evidence for the wealth redistribution effect of unexpected inflation could be attributed to the ignorance of impacts of uncertain inflation on operating income.

II.2. Testing Model

Our theory has been so far developed under an extremely simple asset-capital structure. It is now assumed that firms have monetary assets such as cash and receivables (MA), inventories (INV), and plant and equipment (FA) on the asset side; and short term debt (STD), long term debt (LTD), and equity (S) on the claims side.

It is further assumed that: (i) the maturity of monetary assets is the same as that of short term debt, and the opportunity cost of holding monetary assets is the same as the short term interest rate; (ii) the short term nominal interest rate, R_o, adjusts immediately to the change in the inflation rate with relationships such that $\Delta R_o = c\,\Delta\pi$ (c is a positive constant) and $\Delta r_o = (1-\tau)\,c\,\Delta\pi - \Delta\pi = -q\,\Delta\pi$ (q is a constant); (iii) long term debt is issued in the form of consols, i.e., the nominal long term interest rate, R_L, is fixed ($\Delta r_L = -\Delta\pi$);[14] and (iv) the present value of tax shield (τ FA) is nominally fixed, and is viewed as long term monetary asset.

Under these assumptions, the inflation-induced stock return in (14) can be modified to (where lower-case asset and capital structure variables denote that they are divided by the equity value):

$$r_i^{\pi} = (1-\tau)\ \Delta^{\pi}E[a_i]\ v_i$$
$$- g_I\ \Delta E[\pi]\ inv_i - (\tau + g_K)\ \Delta E[\pi]\ fa_i$$
$$+ q\ \Delta E[\pi]\ (std_i - ma_i) + \Delta E[\pi]\ ltd_i$$
$$+ \lambda^* \Delta\xi \left\{(1-\tau)\ \alpha_i v_i - g_I\ inv_i - (\tau + g_K)\ fa_i \right.$$
$$\left. + q\ (std_i - ma_i) + ltd_i\right\} \qquad (16)$$

where g_I and g_K are tax rates imposed on nominal capital gains on inventory and fixed assets, respectively.

For a testable model, asset and capital structure variables in (16) are factored out. In the "real world," both inflation and real variables may change simultaneously, and, thereby, affect the real return on the asset. Since it is empirically difficult to sort out these two determinants of the asset return, the testing model is modified to be:

$$r_i - (1-\tau)\ \Delta E[a_i]\ v_i = - g_I \{\Delta E[\pi] + \lambda^* \Delta\xi\}\ inv_i$$
$$- (\tau + g_K)\ \{\Delta E[\pi] + \lambda^* \Delta\xi\}\ fa_i$$
$$+ q\{\Delta E[\pi] + \lambda^* \Delta\xi\}\ (std_i - ma_i)$$
$$+ \{\Delta E[\pi] + \lambda^* \Delta\xi\}\ ltd_i$$
$$+ \lambda^* \Delta\xi\ (1-\tau)\ \alpha_i\ v_i \qquad (17)$$

where the dependent variable is the realized real return on equity minus the change in the real rate of expected return on firm's assets adjusted for tax and the capital structure. In this fashion, note that the superscript π is not required for the dependent varaible; but one can still control for the effect of uncertain inflation on the level of operating income.

III. TEST AND EMPIRICAL RESULTS

III.1. Data Base

A sample of non-financial and non-utility corporations from the COMPUSTAT ANNUAL INDUSTRIAL DATA is obtained for each year from 1964 through 1980 subject to 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 (18); and (ii) in a given year, the firm's stock return data is available for all months over the previous five years (for a reason to be explained later) and the subsequent year from the CRISP file.

The number of firms in the sample varies from a low of 266 in 1964 to a high of 420 in 1980; and a total 5,887 year-firms is obtained. This sample may be criticized as an inadequate non-random sample to represent the overall market. However, our sample appears to be similar to the general market as represented by the S&P 500; the correlation between the real monthly portfolio return (equally weighted) on the sample firms and the real monthly market return (S&P 500) is 0.93 for the sample period, 1965 through 1981.

Information about expected inflation, unexpected inflation and inflation uncertainty is obtained from the Livingston expectations data.[15]

III.2. Testing Procedures

Our model (17) suggests running the cross-sectional regression for a given period, t:

$$
\begin{aligned}
r_{i,t} - (1-\tau)\, E_t[a_i]\, (TA_i/S_i)_{t-1} \\
= c_{0,t} + \sum_{j=1}^{3} c_{1,t}^{j}\, DUM_j\, (INV_i/S_i)_{t-1} \\
+ c_{2,t}\, (FA_i/S_i)_{t-1} \\
+ c_{3,t}\, (\{STD_i - MA_i\}/S_i)_{t-1} \\
+ c_{4,t}\, (LTD_i/S_i)_{t-1} \\
+ c_{5,t}\, (1-\tau)\, (\alpha_i\, \{TA_i/S_i\})_{t-1} \qquad (18)
\end{aligned}
$$

where r_i is the realized real return on firm i's equity; τ is the corporate income tax rate assumed to be 0.5 for all firms in the sample; $\Delta E[a]$ denotes the change in the expected real return on the firm's total assets;[16] TA denotes total assets; S denotes common equity; DUM is the dummy variable for inventory valuation method (DUM_1 = 1 if FIFO, DUM_2 = 1 if LIFO, and DUM_3 = 1 if weighted average method (AVG));[17] INV denotes inventories; FA denotes net plant and equipment; STD denotes current liability; MA denotes cash and receivables; LTD denotes long term debt and preferred stock; and α denotes the degree of responsiveness of the real return on total assets with respect to unexpected inflation.[18] Since it would be an enormous task to obtain market values of asset and liability variables, book values which are easily available from the COMPUSTAT data are used.[19]

The magnitudes of the regression coefficients of (18) are principally determined by the changes in expected inflation and inflation uncertainty over the period for which the regression is run. That is, by referring to (17):

$$c^j_{1,t} = - g^j_I \{\Delta E_t[\pi] + \lambda^* \Delta\xi_t\}; \qquad j = 1, 2 \text{ and } 3.$$

$$c_{2,t} = - (\tau + g_K) \{\Delta E_t[\pi] + \lambda^* \Delta\xi_t\}$$

$$c_{3,t} = q \{\Delta E_t[\pi] + \lambda^* \Delta\xi_t\}$$

$$c_{4,t} = \{\Delta E_t[\pi] + \lambda^* \Delta\xi_t\}$$

$$c_{5,t} = \lambda^* \Delta\xi_t \qquad (19)$$

where g^j_I and g_K are tax rates on nominal capital gains on inventory (using valuation method j) and fixed assets, respectively; $\lambda^* = -\lambda\ b_m$; where λ is the market price of risk and $\beta_m = COV(r_m,\pi^u)/\xi$; and q is such that $\Delta E[r_o] = (1-\tau)\Delta R_o - \Delta E[\pi] = (1-\tau)\ c\ \Delta E[\pi] - E[\pi] = -q\ \Delta E[\pi]$.

The research strategy, therefore, is to (i) estimate the cross-sectional regressions for equation (18) for each of the sample period, 1 to T; and, then, (ii) examine the relationships of the coefficient estimates of these regressions with the changes in expected inflation and inflation uncertainty for the corresponding period.

The cross-sectional regression coefficient estimate, $c_{i,t}$ may not be stable over time, perhaps due to omitted variables for a particular period or sample variations over time. One way to reduce this problem is to scale coefficient estimates, for the sake of comparability over time, by the standard errors.

In addition, since the explanatory variables (18) are measured in book values, the measurement errors in these explanatory variables are likely to be correlated with the inflation level.[20] These measurement errors may cause the absolute values of the coefficient estimates from (18) to have a "regression tendency" toward zero over time since both the sample size for the cross-sectional regression (18) and the inflation level increase over time.[21] In fact, the coefficient estimates of fixed asset and long term debt have a moderate regression tendency over time; because of this, the two regression coefficient estimates were adjusted.[22]

In a strict sense such as suggested by the theoretical development for equations (14) and (16), the relationship of a cross-sectional regression coefficient with the change in expected inflation indicates how inflation-induced changes in expected cash flows to shareholders are related to the firm's asset or financial structure, while the relationship of a coefficient with the change in inflation uncertainty indicates how inflation-induced changes in the cost of equity are related to the firm's asset or financial structure, assuming that these inflation-induced changes in expected cash flows and the cost of equity are reflected in the change of stock prices.

Empirically, however, this kind of strict distinction may not be plausible because of a structural relationship between inflation uncertainty and the inflation level.[23] As discussed in the previous section, the revisions in expected inflation and perception about inflation uncertainty are likely to be the immediate consequences of unexpected inflation. Thus unexpected inflation can be used as a "composite" variable reflecting the changes in the level of expected inflation and the degree of inflation uncertainty. Then, our null hypotheses can be tested by examining how the regression coefficients from equation (18) are related to unexpected inflation for the corresponding period, that is, by running a time-series regression for each of the regression coefficients in (18):

$$c^*_{j,t} = f_{o,j} + f_{1,j}\hat{\pi}^u_t \qquad t = 1,\ldots,T \text{ and } j = 1,\ldots,5. \tag{20}$$

where $c^*_{j,t}$ is the scaled coefficient estimate of the jth explanatory variable in the cross-sectional regression (18) for period t; and $\hat{\pi}^u_t$ is the fitted value of the regression of unexpected inflation on the changes in expected inflation and inflation uncertainty over the period for which the regression is run. Since measurement errors are expected from both the measurement of unexpected inflation and the estimates of cross-sectional regression coefficient, a two-stage regression procedure is adopted to estimate $f_{1,j}$ in (20): the changes in expected inflation and inflation uncertainty are used as instrumental variables (note a hat over unexpected inflation in (20)).

The time-series regression coefficient, $f_{1,j}$, is expected to be negative for $j = 1$ and 2 by the nominal capital gain tax effect hypothesis, to be positive for $j = 3$ and 4 by the nominal contracting hypothesis, and to be positive for $j = 5$ if a change in the business risk of operating income due to inflation uncertainty (and, consequently, a change in the cost of equity) explains cross-sectional variations in inflation-induced stock returns.

In addition to the time-series regression analysis, the correlations of the cross-sectional regression coefficient estimates with the change in expected inflation, the change in inflation uncertainty and unexpected inflation (Hereafter, these three variables are referred to as "inflation variables.") will be examined:

$$\text{CORR}(c^*_{j,t}, \Delta E_t[\pi])$$

$$\text{CORR}(c^*_{j,t}, \Delta\xi_t)$$

$$\text{CORR}(c^*_{j,t}, \pi^u_t)$$

$$\text{CORR}(c^*_{j,t}, \hat{\pi}^u_t) \qquad (21)$$

where c^*_j is as defined in (19); and these correlations are expected to be negative for j = 1 and 2, and to be positive for j = 3, 4, and 5.

In contrast with this paper's testing model (18), the nominal contracting hypothesis generally has been examined without considering nominal capital gain taxes (previous exceptions in the literature include Hong [25] and Summers [34]) and effects of uncertain inflation on operating income. The conventional models may be represented by setting g, $\Delta^\pi E[a_i]$ and α_i in our equation (16) equal to zero:

$$r_{i,t} = c_{0,t} + c_{2,t}\,(FA_i/S_i)_{t-1} + c_{3,t}\,(\{STD_i - MA_i\}/S_i)_{t-1} + c_{4,t}\,(LTD_i/S_i)_{t-1} \quad (22)$$

The relationships between the regression coefficients of this conventional model[24] and the inflation variables will also be examined.

Insert TABLES I and II

III.3. Empirical Results

Thirty four semi-annual cross-sectional regressions[25] for equation (18) were run for each of the sample period from the first half of 1965 through the second half of 1981; and, then, the relationships between the coefficient estimates from these regressions and the inflation variables were examined.

The results for the time-series regression (20) and the correlation analysis (21) are reported, respectively, in Tables I and II for two separate sample periods: (i) 1965.I through 1981.II; and (ii) 1970.I through 1981.II. The main findings suggest:

(i) there is a negative effect of nominal capital gain taxes on stock prices when the firm uses FIFO inventory valuation method, with the 90 percent statistical significance level (for the 1965.I - 81.II period) or the 95 percent statistical significance level (for the 1970.I - 81.II period);

(ii) there is a positive wealth redistribution effect of unexpected inflation from long-term bondholders to shareholders, with the 95 percent statistical significance level when the scaled coefficient estimate of "ltd" from cross-sectional regression (18) is adjusted for the "regression" tendency over time and the 90 percent statistical significance level when it is unadjusted for the regression tendency; and

(iii) the change in the cost of equity resulting from the change in the "business" risk of operating income due to inflation uncertainty is likely to be an important factor (as indicated by the highest t statistic) in explaining cross-sectional variations of inflation-induced stock returns.

Statistically insignificant results' for LIFO and AVG inventory indicate that the negative effects of "historic cost" tax laws may not be substantial and, in part, may be offset when firms use counter-inflation tax accounting methods.

The results for fixed asset coefficients are not statistically significant as might be anticipated by the use of accelerated depreciation methods for tax reports and the provision of investment tax credits. However, it should be noted that (i) the current research has not explicitly considered different fixed asset structures and, thus, different effective tax rates calculated for the use of fixed assets across firms, and (ii) the measurement error caused by a discrepancy between market value and book value in the fixed asset variable might be substantial.

Our findings also show that both the magnitude and the statistical significance of the wealth redistribution effect of unexpected inflation are related to the maturity of corporate debt or monetary position.

The implications of these empirical findings indicate a strong wealth redistribution effect of unexpected inflation. Earlier analyses missed this effect because of model misspecification. This is demonstrated by comparing the results for the conventional model (22) (reported in Tables I and II also, using exactly the same sample as with our model (18)). Also, the signs of the time-series regression coefficients and their correlations with the inflation variables are, without exception, as anticipated by their null hypothesis; and these findings, particularly relative to those from the conventional model (22), indicate the relative robustness of our model (18).

CONCLUSION

This research has examined how inflation-induced changes in stock prices are related to the characteristics of individual firms, and demonstrated the theoretically anticipated wealth redistribution effect of unexpected inflation. In spite of a limited set of data for this study, the results confirm the nominal contracting hypothesis. It should be noted that these results require jointly controlling for the effect of inflation uncertainty on operating income and the effect of historic cost tax laws on after-tax cash flows. The findings from our model are in contrast with those from the conventional model. The difference in the statistical results between the new model presented here and the conventional model is anticipated by the theoretical analysis for the relationship between inflation-induced stock returns and individual firm characteristics.

Besides providing support for the nominal contracting hypothesis, this research has shown that the "business risk" for operating income associated with inflation uncertainty is important for explaining cross-sectional variations in inflation-induced changes in stock prices. This finding suggests that the adverse effect of inflation uncertainty on before tax profits is likely to be an important cause for the observed depressant effect of inflation on real stock prices during the recent inflationary period.[26]

As a concluding remark, our findings are not consistent with the irrational behavior hypothesis suggested by Modigliani and Cohn [31].[27]

FOOTNOTES

[1]For example, Kessel [27], Bach and Ando [2], Alchian and Kessel [1], Kessel and Alchian [28], Bach and Stephenson [3], and Hong [25], among others.

[2]For example, Mandelker and Rhee [30], Summers [34], and French, Ruback and Schwert [15], among others.

[3]See also Friend [16] and Pindyck [33]. Pindyck's findings also show that the observed negative correlation between stock returns and inflation is attributed to an increase in uncertainty of the "gross" marginal return on capital (i.e., before tax profits).

[4]Inflation is assumed to be neutral to avoid the intricacy of relative price changes in deriving the model.

[5]Inflation uncertainty is viewed as a dispersion measure of the distribution from which a point forecast (expected inflation) is drawn.

[6]Uncertain inflation would cause a change in the firm's production function or a shift in demand for its outputs. Uncertainty about the future, induced by uncertain price changes, is likely to change the firm's investment decision. For example, if a nominally fixed contract (whose duration is affected by uncertainty in price changes) is involved in the firm's production process, its production function will be of a different form. Consumers may have different consumption-saving decisions upon the perception of uncertain price changes. Because the asset return generating function should be viewed as a reduced form of production and demand functions, a change in the asset return is likely to be induced by uncertain price changes. In this spirit, a two-factor return

generating function for the real return on the firm's asset such as equation (4) is assumed.

[7] By constructing the firm's income statement: $(1+\pi)$ a V is the nominal replacement cost operating oncome; R_o D is nominal interest payment; π V is nominal capital gains on assets; and, thereby, after tax nominal income to shareholders becomes $(1-\tau)\{(1+\pi)\, a\, V - R_o\, D\} - g\, \pi\, V$; where g is the tax rate on nominal capital gains. Hence, the real rate of return on equity becomes equation (5). No personal equity income tax is assumed in (5). This assumption should be inconsequential to our objective because most inflationary distortions on real cash flows to shareholders arise before personal taxes are paid.

[8] After obtaining the first-order condition for $\max_{\theta_i^k} E[U(W_t^k)]$ subject to $W_t^k = W_{t-1}^k(1+r_p^k)$ and $\theta_o^k + \sum_{i=1}^{N} \theta_i^k = 1$ (where r_p^k is the real return on individual k's portfolio and θ_i^k is the fraction of initial wealth invested in asset i), the marginal utility of the end-of-the-period wealth, W_t^k, is expanded in a Taylor series expansion about $E[W_t^k]$.

[9] For example, Summers [34].

[10] A change in $E[r_z]$ may be an important consideration for the change in stock prices. However, since we are mainly concerned with cross-sectional variations in inflation-induced stock price changes, the change in $E[r_z]$ is not considered in (12).

[11] q = 1 if debt is consol, and q = 0 if the Darby hypothesis [8] were true. Strictly speaking, a clear distinction should be made between "inflation-induced" and "real factor-induced" changes in the real interest rate. This paper is concerned only with the inflation-induced change in the real interest rate, and assumes no real-factor

induced change in the real interest rate. This assumption must be inconsequential to the results of the current research since the objective of this study is to examine the nominal contracting hypothesis.

[12] Summers [34] also pointed out, for a somewhat different reason, that the tax effect hypothesis and the nominal contracting hypothesis should be jointly tested because negative effects of nominal capital gain taxes will not be recognized by the investors who cannot recognize capital gains on debt.

[13] Friend and Hasbrouck [18] have examined how economic earnings adjusted for replacement cost of resources and capital gains on debt are related to inflation. They found that a one percent increase in the rate of sustained inflation is associated with more than a ten percent decrease in real economic earnings per share. Although they did not explicitly examine the extent how this inflation-induced decline in economic earnings is attributed to inflation-induced decline in operating income, their finding would not have been possible without adverse effects of inflation on operating income because capital gains on debt and taxes on nominal capital gains tend to offset each other. Friend [16] also attributed this decline in economic earnings during the inflationary period to the depressant effect of inflation on real plant and equipment expenditures and increased uncertainty in sales, prices, wages, and the cost of financing as a consequence of uncertain inflation.

[14] One period model is assumed in the current research. But, in the multi-period model, the change in the long-term expected real interest rate depends on the dynamics of changes in inflation expectations.

[15]Forecasted inflation rates by individual respondents were estimated following Carlson's [7] suggestion. The measure of inflation uncertainty is estimated by the cross-sectional variance of the forecasted inflation rate. The details of the estimation procedure will be available upon request.

[16]The change in the expected real return on total assets is estimated, assuming perfect foresight, to be:

$$\Delta E_t[a] = \frac{EBIT_{t+1}/(1 + \bar{\pi}_{t+1})}{(TA_t + TA_{t+1})/2} - \frac{EBIT_t}{(TA_{t-1} + TA_t)/2}$$

where EBIT denotes earnings before interest and tax for a given year; TA denotes total assets; and $\bar{\pi}$ is the average annual inflation rate.

[17]Inventory valuation method is chosen from the most prevailing method which is represented by the first digit number of "variable 59" in the COMPUSTAT data. If a firm uses the most prevailing valuation method other than FIFO, LIFO or AVG, the firm is excluded from the sample.

[18]Since the asset return data from the annual COMPUSTAT data is not sufficient to estimate α_i, $(1-\tau)\ \alpha_i$ is indirectly estimated as:

$$(1-\tau)\ \alpha_{i,t-1} = \beta_{i,t-1}\ (S_i/TA_i)_{t-1} - 0.5\ (STD_i/TA_i)_{t-1} - (LTD_i/TA_i)_{t-1}$$

where $\beta_{i,t-1}$ ($= COV(r_i, \pi^u)/\xi$) is estimated from the quarterly realized real stock returns and quarterly unexpected inflation rates over a five-year period prior to each year of the sample period.

[19]But these book values are expected to be highly correlated with market values (see Freeman [14]). Moreover, the information content in the discrepancy between historic cost and replacement cost accounting

reports to the stock market seems to be negligible (see Beaver and Landsman [4]).

[20]Unfortunately, adjustments for these measurement errors could not be made through a grouping technique because of the insufficient number of firms in the sample relative to the number of explanatory variables.

[21]For an expository note, let $y = b \cdot x = b \cdot (x^* + e)$ where x is the observed variable, x^* is the true variable, and e is the measurement error. Then, the coefficient estimator, b, is $(y \cdot x^* + y \cdot e)/(x^* \cdot x^* + 2\, x^* \cdot e + e \cdot e)$. Even though the measurement error is uncorrelated with y and x^*, the downward bias in b increases as the sample size or the inflation level increases. See Johnston ([26, Ch. 9]).

[22]Because the measurement error in the explanatory variables of (18) is caused mainly by a discrepancy between book values and market values, the regression coefficient estimates may be adjusted for the regression tendency with respect to the inflation level. But, since the nominal contracting hypothesis is tested by examining how the regression coefficients of (18) are related to the inflation variables, this adjustment procedure may cause a bias in the results in favor of the null hypothesis. Therefore, the regression tendency of the coefficient estimates from equation (18) was examined with respect to the time trend variable.

[23]See Logue and Willet [29] and Holland [24], among others.

[24]This model is essentially identical to that of French, Ruback and Schwert [15].

[25]Because only the annual COMPUSTAT data are available for this research, the explanatory variables of regression (18) for the second half of a calendar year are assumed to be the same as those for the

first half. Since the explanatory variables are ratios which are probably stable over a short period of time, this assumption should be inconsequential to the results of the research.

[26] See Friend [16], Pindyck [33], and Dokko and Edelstein [10].

[27] Modigliani and Cohn [31] have suggested that equity investors do not realize the fact that capital gains on stock are accrued as a result of the devaluation effect of inflation on the value of debt; and this "inflation illusion" of equity investors is the principal cause for the decline in real stock prices during the recent inflationary period.

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TABLE I

RESULTS FROM TWO STAGE TIME-SERIES REGRESSION

$$c^*_{j,t} = f_{0,j} + f_{1,j}\,\hat{\pi}^u_t$$

where the dependent variable, $c^*_{j,t}$, is the regression coefficient estimate, scaled by its standard error, for the jth explanatory variable in the regression equations (18) and (22) for each semi-annual period from 1965.I through 1981.II; and $\hat{\pi}^u$ is the fitted value of the regression of unexpected inflation on the change in expected inflation and the change in inflation uncertainty.[3]

Panel A [1965.I - 1981.II: NOB = 34]

		c^*_j from Equation (18)				c^*_j from Equation (22)			
		f_1	Adj R^2	F	DW	f_1	Adj R^2	F	DW
c^*_j of	constant	-10.865 (-0.170)[1]	-0.030	0.029	1.995	-252.607 (-1.741)	0.058	3.033	2.195
	inv: FIFO	-53.018 (-1.527)	0.039	2.332	1.975	*		*	
	inv: LIFO	-24.899 (-0.846)	-0.009	0.716	1.890	*		*	
	inv: AVG	-13.485 (-0.409)	-0.026	0.167	1.867	*		*	
	fa	-30.632 (-0.902)	-0.006	0.813	1.977	36.331 (0.673)	-0.017	0.453	1.871
	fa + [2]	-85.442 (-1.123)	0.008	1.262	2.066	88.832 (0.772)	-0.012	0.595	1.955
	std - ma	27.643 (0.807)	-0.010	0.651	1.760	4.755 (0.014)	-0.031	0.021	1.615
	ltd	57.123 (1.570)	0.071	2.463	1.913	-36.119 (-0.638)	-0.018	0.407	1.792
	ltd +	134.886 (1.710)	0.055	2.923	1.979	-98.776 (-0.794)	-0.011	0.631	1.885
	α ta	121.905 (2.618)	0.151	6.856	1.826	*		*	

TABLE I (continued)

Panel B [1970.I - 1981.II: NOB = 24]

		c_j^* from Equation (18)				c_j^* from Equation (22)			
		f_1	Adj R^2	F	DW	f_1	Adj R^2	F	DW
c_j^* of	constant	-11.994 (-0.176)	-0.044	0.031	2.146	-251.562 (-1.656)	0.070	2.744	2.366
	inv: FIFO	-57.199 (-1.890)	0.101	3.571	2.285	*		*	
	inv: LIFO	-22.018 (-0.775)	-0.018	0.601	2.247	*		*	
	inv: AVG	-14.936 (-0.510)	-0.033	0.260	2.013	*		*	
	fa	-27.866 (-0.930)	-0.006	0.865	2.543	46.888 (0.926)	-0.006	0.858	2.542
	fa +	-79.437 (-1.114)	0.010	1.240	2.606	110.326 (0.989)	-0.001	0.978	2.580
	std - ma	60.808 (1.066)	0.006	1.136	1.657	7.336 (0.223)	-0.043	0.050	1.711
	ltd	54.512 (1.609)	0.065	2.589	2.307	-45.479 (-0.837)	-0.013	0.700	2.394
	ltd +	130.070 (1.712)	0.077	2.928	2.361	-119.385 (-0.965)	-0.003	0.930	2.456
	α ta	120.135 (2.362)	0.166	5.577	1.791	*		*	

Footnotes:

1. t statistics are in parentheses. 2. Explanatory variable followed by + denotes that the coefficient estimate for this variable in the cross-sectional regression (18) and (22) is adjusted for the regression tendency over time. 3. expected inflation is estimated from the Livingston surveys, and the measure of inflation uncertainty is estimated from the cross-sectional variance of the Livingston forecasted inflation rate.

TABLE II

CORRELATIONS OF c_j^* WITH UNEXPECTED INFLATION

AND THE CHANGES IN EXPECTED INFLATION

where c_j^* is the regression coefficient estimate, scaled by its standard error, for the jth explanatory variable in the regression equations (18) and (22) for each semi-annual period from 1965.I through 1981.II.

Notes: [i] variable followed by "+" denotes that the coefficient estimate for this variable in the cross-sectional regressions (18) and (22) is adjusted for the regression tendency; and [ii] $\Delta E[\pi]$ is the change in expected inflation, $\Delta\xi$ is the change in inflation uncertainty, π^u is the unexpected inflation rate, and $\hat{\pi}^u$ is the fitted value of the regression of unexpected inflation on the change in expected inflation and the change in inflation uncertainty.

Panel A [1965.I - 1981.II: NOB = 34]

		c_j^* from Equation (18)				c_j^* from Equation (22)			
CORR. between c_j^* and		$\Delta E[\pi]$	$\Delta\xi$	π^u	$\hat{\pi}^u$	$\Delta E[\pi]$	$\Delta\xi$	π^u	$\hat{\pi}^u$
c_j^* of	inv: FIFO	-0.252	-0.276	-0.189	-0.260	*		*	
	inv: LIFO	-0.149	-0.061	-0.049	-0.148	*		*	
	inv: AVG	-0.066	-0.145	-0.031	-0.072	*		*	
	fa	-0.154	-0.136	-0.063	-0.157	0.116	0.095	0.149	0.118
	fa +	-0.192	-0.143	-0.118	-0.195	0.133	0.097	0.149	0.135
	std - ma	0.141	0.078	0.130	0.141	0.027	-0.020	0.052	0.026
	ltd	0.265	0.164	0.180	0.267	-0.109	-0.107	-0.101	-0.112
	ltd +	0.287	0.180	0.216	0.289	-0.137	-0.103	-0.101	-0.139
	α ta	0.418	0.244	0.371	0.420	*		*	

Panel B [1970.I - 1981.II: NOB = 24]

CORR. between c_j^* and		$\Delta E[\pi]$	$\Delta\xi$	π^u	$\hat{\pi}^u$	$\Delta E[\pi]$	$\Delta\xi$	π^u	$\hat{\pi}^u$
c_j^* of	constant	-0.032	-0.134	-0.171	-0.038	-0.330	-0.237	-0.382	-0.333
	inv: FIFO	-0.367	-0.317	-0.222	-0.374	*		*	
	inv: LIFO	-0.169	0.042	-0.087	-0.163	*		*	
	inv: AVG	-0.105	-0.108	-0.037	-0.108	*		*	
	fa	-0.189	-0.204	-0.185	-0.194	0.195	0.075	0.070	0.194
	fa +	-0.227	-0.194	-0.237	-0.231	0.208	0.075	0.073	0.206
	std - ma	0.225	0.046	0.264	0.221	0.047	0.026	0.172	0.048
	ltd	0.322	0.214	0.339	0.324	-0.175	-0.109	0.011	-0.190
	ltd +	0.340	0.232	0.369	0.343	-0.201	-0.105	0.001	-0.201
	α ta	0.451	0.211	0.360	0.450	*		*	