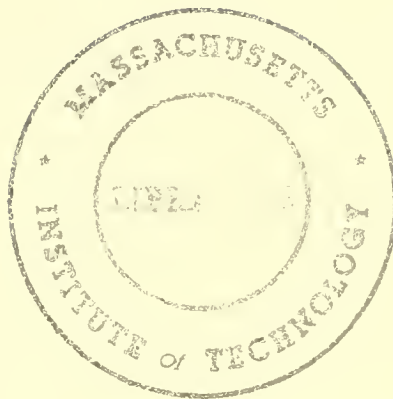


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EFFECTS OF NOMINAL CONTRACTING
ON STOCK RETURNS

by

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Kenneth R. French†
G. William Schwert††

#1231-81

July 1981

Revised October 1981

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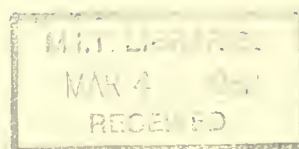
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Abstract

In this paper we estimate the effects of unexpected inflation on the returns to the common stock of companies with different short-term monetary positions, different long-term monetary positions, and different amounts of nominal tax shields. Unlike most previous studies of the effects of nominal contracting, we distinguish between expected and unexpected inflation in our tests. Surprisingly, over the 1947-79 period we find no evidence that stockholders of net debtor firms benefit from unexpected inflation relative to the stockholders of net creditor firms. We conclude that wealth effects caused by unexpected inflation are not an important factor in explaining the behavior of stock prices.

Effects of Nominal Contracting on Stock Returns

1. Introduction

The relation between inflation and the stock market has been the focus of much research in recent years, probably because the returns to common stocks in the United States have been low in the last 15 years while the inflation rate has been high. One reason that stock returns might be related to the inflation rate is that depreciation expenses are based on historical costs, so they cannot rise with inflation. In other words, the U. S. tax laws make the depreciation tax shield a nominal contract between the firm and the government, so that higher inflation reduces the real value of the tax shield to the firm. This argument has been made by a number of authors, including Shoven and Bulow [1975, 1976], Feldstein and Summers [1979], and Feldstein [1980].¹

Nominal contracts stipulate payment of a fixed number of dollars at a pre-specified future date. The parties involved in the contract estimate the present value of the future payment taking into account the inflation which is expected to occur over the course of the contract. The deviations of the actual inflation rate from its expected value redistribute wealth between the parties to the nominal contract. Unexpected inflation increases the wealth of the debtor and decreases the wealth of the creditor, while unexpected deflation (or negative unexpected inflation) has the opposite effect.² Firms generally have a variety of nominal contracts. Besides the depreciation tax shield, firms often have other nominal assets such as cash, accounts receivable, and contracts to sell their products at fixed prices. In addition, firms generally

have debt, accounts payable, labor contracts, raw materials contracts, and pension contracts, which are all nominal liabilities. To the extent that these contracts do not have inflation adjustment clauses, unexpected inflation affects the real value of all of these contracts. The net effect on the value of common stock is an empirical issue. If nominal contracting plays a large role in explaining the behavior of stock prices, the returns for firms with different sets of nominal contracts should be affected differently by unexpected inflation--we shall refer to this as the nominal contracting hypothesis.

The nominal contracting hypothesis has been studied extensively by examining the relation between common stock returns and inflation. Kessel [1956], Bach and Ando [1957], Alchian and Kessel [1959], Kessel and Alchian [1960], Bach and Stephenson [1974], and Hong [1977], among others, compare the common stock returns of net debtor and net creditor companies in periods with different inflation rates. However, there is a problem with all of these tests. If high inflation is anticipated when nominal contracts are written, there should be no difference in the stock returns to net debtors versus net creditors. Since, by definition, unexpected inflation is serially uncorrelated with a mean of zero, the periods of high inflation used in previous tests probably correspond to periods of high expected inflation.

To construct a more powerful test of the nominal contracting hypothesis, it is necessary to measure the comovement of stock returns and unexpected inflation. This comovement is examined in a number of papers, including

Bodie [1976], Jaffe and Mandelker [1976], Nelson [1976a], Fama and Schwert [1977] and Schwert [1981]. However, these papers only use an aggregate portfolio of common stocks; they do not make cross-sectional comparisons among firms with different sets of nominal contracts.

Estimating the comovement of stock returns and unexpected inflation critically depends on measuring the unexpected part of the inflation rate. In section 2 we examine a variety of time series models for the quarterly inflation rate. Based on several statistical criteria, we select a model which uses the three month treasury bill yield, lags of the growth rate of industrial production for nondurable consumption goods, and lags of the growth rate of the monetary base to predict the inflation rate of the Consumer Price Index. The residuals from this model are used as estimates of the quarterly unexpected inflation rate.

In section 3 we form 27 portfolios based on relative rankings of three nominal contracting variables: (i) Short-term Monetary Position, (Cash + Accounts Receivable - Current Liabilities); (ii) Long-term Monetary Position, (- Long-term Debt - Preferred Stock); and (iii) an estimate of the Depreciation Tax Shield. Firms with data available on the COMPUSTAT data tape and the CRSP Monthly Returns File are grouped into one of the 27 portfolios based on the values of these nominal contracting variables. Using a variety of test procedures, we find no evidence that stockholders of firms with more nominal liabilities benefit from unexpected inflation.

Section 4 discusses some additional tests that are used to assure that the results in section 3 are not sensitive to the definition of the

nominal contracting variables. Finally, section 5 discusses some possible reasons why the tests in this paper do not support the nominal contracting hypothesis. We conclude that the wealth redistributions caused by unexpected inflation are not an important factor in explaining the behavior of stock returns.

2. Models for Unexpected Inflation

A number of models for predicting inflation have been suggested in the literature. Univariate ARIMA models are used in several papers, including Hess and Bicksler [1975], Nelson [1976a], Bodie [1976], Nelson and Schwert [1977] and Schwert [1981].³ Fama [1975] and Fama and Schwert [1977], among others, use the short-term interest rate on a default-free discount bond to measure expected inflation under the assumption that the expected real rate of interest is constant over time. Fama [1981], Plosser [1980], and others suggest using variables such as the growth of the money supply and the growth rate of industrial production, in addition to lagged inflation and interest rates to estimate expected inflation. Since our tests depend on estimating comovements of stock returns and unexpected inflation, we consider a variety of measures of unexpected inflation. We use three criteria to choose the "best" measure of unexpected inflation:

- (1) All predictable movements in inflation should be eliminated. This reduces errors-in-variables problems in estimating the comovement of stock returns and unexpected inflation.⁴
- (2) The coefficients of the prediction model should be stable over time so that the fitted residuals can be used as estimates of unexpected inflation.
- (3) The measure of unexpected inflation should be negatively correlated with the returns to corporate debt.

It is important to distinguish between unexpected inflation and (unexpected) changes in expected inflation. If expected inflation is constant over time, and expected real rates of interest are constant, nominal interest rates will be constant. In this case, the nominal discounted value of cash flows is unaffected by unexpected inflation.

For example, the dollar price of a bond with a coupon yield equal to the interest rate would not change as a result of unexpected inflation, although the real value of the bond falls by the amount of the unexpected inflation. If the real value of the firm that issues the bonds is unaffected, the stockholders of the firm get a wealth transfer equal to the amount of the decrease in the real value of the bonds.

In general, expected inflation rates are not constant over time, and unexpected inflation is related to changes in expected inflation. If expected inflation rates rise, and therefore nominal interest rates increase, corporate bond prices will fall. Fama [1975, 1976] argues that movements in the term structure of interest rates are dominated by inflationary expectations. In the extreme case where default risk is unaffected and the expected real interest rate is constant over time, the only reason that long-term corporate bond prices would change is because of changes in expected inflation. This effect of unexpected inflation on bond prices though changes in expected inflation is the motivation for our third criterion in choosing a measure of unexpected inflation.

The effects of a change in expected inflation on the value of a nominal contract are greater the longer the term of the contract. While unexpected inflation affects the current price level, changes in future expected inflation rates have additional effects on the price level in future periods. The value of current liabilities, such as accounts payable, changes by the

amount of the unexpected inflation. The value of long-term debt, however, changes by a multiple of unexpected inflation, because of the additional effects of changes in future expected inflation rates. Thus, it is important to consider the time pattern of payoffs specified in different contracts when measuring the effects of changes in future expected inflation rates.

Inflation is defined as a simultaneous equal proportionate increase in the money prices of all goods. In reality, prices of different goods change at different rates, so it is difficult to measure an overall inflation rate. In recognition of this problem we consider three different price indices to measure the quarterly inflation rate in the United States for the 1947-79 period: (a) the Consumer Price Index (CPI), (b) the deflator for the personal consumption component of Gross National Product (DEF), and (c) the deflator for the nondurable goods component of personal consumption (DEFN). The first eight autocorrelations, means, and standard deviations of these inflation rates are in Table 1.

Based on the autocorrelations in Table 1 and further data analysis, we estimate third-order autoregressive models (AR(3)) for each of the inflation series. Part A of Table 2 contains the parameter estimates and an asymptotic F-test of the hypothesis that the model parameters are constant across the 1947-63 and 1964-79 subperiods. Part B of Table 2 contains the first eight autocorrelations of the unexpected inflation rates from these univariate time series models and the correlation of the unexpected inflation rate with the quarterly holding period return to a portfolio of long-term corporate bonds obtained from Ibbotson and

Table 1

Summary Statistics for Quarterly Inflation Rates, 1947-79*

Price Index	<u>r₁</u>	<u>r₂</u>	<u>r₃</u>	<u>r₄</u>	<u>r₅</u>	<u>r₆</u>	<u>r₇</u>	<u>r₈</u>	<u>S(r)</u>	<u>Mean</u>	<u>Standard Deviation</u>
Consumer Price Index, CPI	.60	.46	.51	.37	.21	.16	.15	.11	.09	.0096	.0101
Personal Consumption Deflator, DEF	.62	.58	.51	.33	.27	.20	.12	.16	.09	.0092	.0078
Nondurable Consumption Deflator, DEFN	.70	.54	.46	.23	.13	.07	-.02	-.03	.09	.0087	.0106

* r_k is the autocorrelation coefficient at lag k , $S(r)$ is the asymptotic standard error of the autocorrelation coefficients under the hypothesis of zero autocorrelation at all lags.

Sinquefield [1979]. The corporate bond returns are not available for 1979.

The results in Table 2 indicate that the AR(3) model satisfies two of our three criteria for a measure of unexpected inflation. The first criterion is met because the residual autocorrelations are small and insignificantly different from zero. The third criterion is satisfied because unexpected inflation rates are negatively correlated with the corporate bond returns, CB_t , with the largest correlation for the unexpected CPI inflation rate. The second criterion is not satisfied, however, since the F-tests indicate that the coefficients are not equal in the 1947-63 and 1964-79 subperiods.

In order to generalize our model for expected and unexpected inflation, we consider the regression model

$$\rho_t = \alpha_0 + \sum_{i=1}^3 \alpha_i \rho_{t-i} + \beta_1 TB_t + \sum_{j=1}^2 \beta_{2j} IP_{t-j} + \sum_{k=1}^2 \beta_{3k} M_{t-k} + u_t, \quad (1)$$

where ρ_t is the quarterly inflation rate, TB_t is the yield to maturity on a three month treasury bill (which is known at the beginning of the quarter), IP_{t-j} is the growth rate of industrial production for nondurable consumption goods in quarter $t-j$, and M_{t-k} is the growth rate of the monetary base in quarter $t-k$.⁵ The regression model (1) contains several models as special cases: (a) if the coefficients on TB_t , IP_{t-j} , and M_{t-k} are all zero, then the AR(3) univariate model is correct; (b) if the lag coefficients on inflation (α_1 , α_2 , and α_3), and the coefficients on IP_{t-j} and M_{t-k} are all zero, and if the coefficient on TB_t equals 1.0,

Univariate Models for Quarterly Inflation, 1947-79

Part A: AR(3) Models ^{a/}

$$\rho_t = \alpha_0 + \alpha_1 \rho_{t-1} + \alpha_2 \rho_{t-2} + \alpha_3 \rho_{t-3} + u_t$$

Price Index	α_0	α_1	α_2	α_3	$S(u)$	F-test for Stability
CPI	.0017 (.0009)	.505 (.076)	-.040 (.084)	.356 (.078)	.0068	4.79**
DEF	.0018 (.0008)	.388 (.088)	.262 (.091)	.158 (.088)	.0056	4.13**
DEFN	.0019 (.0009)	.656 (.088)	.009 (.105)	.116 (.089)	.0073	2.63*

Part B: Summary Statistics for Unexpected Inflation, u_t ^{b/}

	r_1	r_2	r_3	r_4	r_5	r_6	r_7	r_8	$S(r)$	$\text{Corr}(u_t, C8_t)$
CPI	.10	.11	.02	.11	.05	-.18	-.07	-.19	.09	-.27
DEF	.00	.10	.08	-.06	.00	-.11	-.18	-.05	.09	-.21
DEFN	.01	.05	.16	-.13	-.04	-.04	-.13	-.10	.09	-.22

^{a/} Standard errors are in parentheses. $S(u)$ is the estimate of the standard deviation of unexpected inflation. The F-test for stability tests the hypothesis that $\alpha_0, \alpha_1, \alpha_2$, and α_3 are the same in the 1947-63 and 1964-79 subperiods, so the degrees of freedom are (4,121).

^{b/} r_k is the autocorrelation of unexpected inflation (the residual from the time series model) at lag k . $\text{Corr}(u_t, C8_t)$ is the correlation of unexpected inflation with the quarterly return to a portfolio of long-term corporate bonds from 1947-78.

**Significant at 1% level.

*Significant at 5% level.

then Fama's [1975] constant expected real rate of interest model is correct.

Table 3 contains estimates of (1) using the three different inflation series for the 1947-79 period. Most of the additional regressors have coefficients that are more than one standard error away from zero, and the estimates of the standard deviation of unexpected inflation, $S(u)$, are substantially lower than for the AR(3) models in Table 2. It is worth noting that both the univariate AR model and Fama's constant expected real rate of interest model are rejected by these data. In addition, the F-tests for the stability of the regression coefficients between the 1947-63 and 1964-79 subperiods are relatively small, especially for the CPI inflation rate and the nondurable consumption deflator inflation rate, DEFN.

The results in Tables 2 and 3 indicate that the residuals from the multivariate prediction model (1) for the CPI inflation rate provide the best measure of unexpected inflation. The residual variance is relatively low, the parameters of the model seem to be stable over the 1947-79 period, the residual autocorrelations are small, and the correlation of the unexpected CPI inflation rate with the return to the portfolio of corporate bonds is $-.30$. Thus, we use the residuals from (1) for the CPI inflation rate to measure unexpected inflation, u_t , and the fitted values measure expected inflation, ρ_t^e . By using fitted values and residuals from (1) as measures of expected and unexpected inflation we are using the entire sample period to provide estimates of the regression parameters, but given the parameter estimates the estimates of expected inflation rates

Table 3

Multivariate Models for Quarterly Inflation, 1947-79

Price Index	Part A: Regression Models $\frac{a}{b}$										F-test for Stability
	α_0	α_1	α_2	α_3	β_1	β_{21}	β_{22}	β_{31}	β_{32}	S(u)	
	$\rho_t = \alpha_0 + \sum_{i=1}^3 \alpha_i \rho_{t-i} + \beta_1 TB_t + \sum_{j=1}^2 \beta_{2j} IP_{t-j} + \sum_{k=1}^2 \beta_{3k} M_{t-k} + u_t$										
CPI	-.0043 (.0013)	.362 (.073)	-.117 (.079)	.372 (.075)	.580 (.157)	.080 (.045)	.142 (.044)	.075 (.077)	-.075 (.078)	.0058	1.65
DEF	-.0026 (.0011)	.237 (.087)	.226 (.085)	.184 (.086)	.383 (.130)	.125 (.038)	.044 (.037)	.106 (.065)	-.071 (.067)	.0049	2.37*
DEFN	-.0034 (.0015)	.537 (.089)	-.020 (.099)	.115 (.090)	.480 (.177)	.137 (.052)	.035 (.050)	.115 (.089)	-.096 (.090)	.0067	.98

Part B: Summary Statistics for Unexpected Inflation, $\frac{b}{c}$

	r_1	r_2	r_3	r_4	r_5	r_6	r_7	r_8	S(r)	Corr($u_t, C8_t$)
CPI	.01	.08	-.07	.09	.08	-.14	-.08	-.19	.09	-.30
DEF	-.05	.10	.01	-.02	.02	-.08	-.19	-.07	.09	-.20
DEFN	-.02	.05	.11	-.15	-.02	-.03	-.17	-.13	.09	-.22

a/ Standard errors are in parentheses. S(u) is the estimate of the standard deviation of unexpected inflation. The F-test for stability tests the hypothesis that all of the regression parameters are the same in the 1947-63 and 1964-79 subperiods, so the degrees of freedom are (9,111). ρ_t is the quarterly inflation rate, TB_t is the yield to maturity on a 3 month treasury bill which is known at the beginning of the quarter, IP_{t-j} is the growth rate of the index of industrial production for nondurable consumer goods in quarter t-j, and M_{t-k} is the growth rate of the monetary base in quarter t-k.

b/ r_k is the autocorrelation of unexpected inflation at lag k. Corr($u_t, C8_t$) is the correlation of unexpected inflation with the quarterly return to a portfolio of long-term corporate bonds from 1947-78.

*Significant at the 5% level.

use only prior data.⁶ As long as the parameters of the regression model are stable over time, there should be no problem in using the entire sample period to estimate the parameters.

There is one additional issue that must be resolved before proceeding with the tests of the nominal contracting hypothesis. Unlike stock and bond prices that are measured on the last trading day of each measurement period, the prices of consumption goods that are used to measure inflation are not sampled frequently and they are not reported quickly. For example, the monthly CPI inflation rate contains price changes that occur over many previous months because some items are not sampled every month. Even the items that are sampled every month measure price changes from the middle of the previous month to the middle of this month, and to make things even more confusing, the CPI for January (for example) is not made public until the third week in February. Schwert [1981] uses daily returns to the Standard and Poor's Composite portfolio for the 1953-78 period to determine when the stock market reacts to the unexpected CPI inflation rate. His evidence suggests that most of the effect occurs around the date when the CPI is announced, which is after the month when the prices are sampled.

One of the reasons we use quarterly unexpected inflation rates in this paper is to mitigate some of the dating problems associated with price indices. Nevertheless, as a check on the dating of our inflation measures we compute the regression of quarterly corporate bond returns on one lead, one lag, and the current unexpected CPI inflation rate for the 1947-78 period,

$$CB_t = \begin{matrix} .0078 \\ (.0026) \end{matrix} \begin{matrix} -.280 \\ (.437) \end{matrix} u_{t-1} \begin{matrix} -1.535 \\ (.435) \end{matrix} u_t \begin{matrix} +.315 \\ (.438) \end{matrix} u_{t+1} + \epsilon_t, \quad (2)$$

where standard errors are in parentheses. The contemporaneous coefficient is more than 3.5 standard errors below zero, but both the lead and lag coefficients are less than one standard error from zero. Given Schwert's [1981] results discussed above, we also consider an alternative measure of the quarterly return to corporate bonds that encompasses the announcement periods for the CPI. For example, the return to corporate bonds for the first quarter would include the returns for February, March, and April, instead of the usual January to March interval. Using this alternative measure of corporate bond returns, CB_t^* , to estimate the effects of current, one lead, and one lag of unexpected CPI inflation yields the following results,

$$CB_t^* = \begin{matrix} .0078 \\ (.0025) \end{matrix} \begin{matrix} -.183 \\ (.432) \end{matrix} u_{t-1} \begin{matrix} -.529 \\ (.430) \end{matrix} u_t \begin{matrix} -.714 \\ (.432) \end{matrix} u_{t+1} + \epsilon_t. \quad (3)$$

Staggering the measurement interval for the corporate bond returns seems to spread the effect of unexpected inflation out over the current quarter and next quarter. In fact, the coefficient of next quarter's unexpected inflation rate, u_{t+1} , indicates that the current corporate bond return could be used to help forecast next period's inflation.⁷ Based on the results in (2) and (3) it seems appropriate to assume that there are no dating problems in using the quarterly CPI unexpected inflation rate u_t .

3. Tests for Nominal Contracting Effects

A. The Data

To test the nominal contracting hypothesis, we want measures of nominal contracts for the firms in our sample. Ideally, we would like data on all of the nominal commitments for each firm, such as labor contracts, supply contracts, debt contracts, and pension commitments. Unfortunately, only a subset of these contracts is easily observable for most firms. We use the COMPUSTAT Annual Industrial file to obtain data on some of the major nominal contracts, including debt contracts and depreciation tax shields. This computer tape contains yearly financial statement data from 1946 through 1979.

The analysis in section 2 indicates that unexpected inflation is generally related to changes in future expected inflation. Hence, the value of long-term contracts will be more sensitive to unexpected inflation than the value of short-term contracts. Accordingly, we segregate nominal contracts into groups by maturity. The short-term monetary position of the firm, SMP, includes all accounts that will be settled within the next year,

$$\text{SMP} = \text{Cash} + \text{Accounts Receivable} - \text{Current Liabilities}.$$

Similarly, the long-term monetary position, LMP, is the negative of the sum of the long-term debt and the preferred stock,

$$\text{LMP} = - (\text{Long-term Debt} + \text{Preferred Stock}).$$

Long-term debt includes all debt contracts with maturities of more than one year. Preferred stock is a perpetuity unless the firm liquidates.⁸ Note that SMP and LMP are defined in terms of nominal assets, so LMP is always negative.

Our measure of LMP has at least two problems. First, many debt and preferred stock contracts are convertible into common stock, which means that part of the value of these contracts is not related to the promised future nominal payouts. This will reduce the effective maturity of these contracts in terms of the effects of unexpected inflation; however, since COMPUSTAT does not contain enough information to adjust for the effect of convertibility we ignore this issue in our tests. Second, although we would prefer to use market values, we measure both debt and preferred stock by their book values. This reflects a second limitation imposed by the data available from COMPUSTAT. Fortunately, Freeman [1978] compares book and market value measures of debt for a reasonably large set of firms and finds that they are highly correlated.

Another nominal contract that can be measured using COMPUSTAT data is the tax shield provided by depreciation. Depreciation expenses are based on historical costs, rather than replacement costs. Since these expenses reduce the firm's tax payments, the claim to these depreciation tax shields is a nominal contract with the government. Unexpected inflation reduces the real value of the tax shields and redistributes wealth from the firm to the government.

The depreciation tax shield is easy to measure for years from 1947 through 1954 because firms were required to use straight-line depreciation for tax purposes and they typically used the same technique for financial reporting. However, starting in 1954 firms were allowed to use accelerated

depreciation for tax purposes, but they were not required to use the same technique for financial reporting. Since COMPUSTAT contains financial statement data, the nominal tax shields cannot be measured directly using the depreciation data alone. Nevertheless, it is possible to estimate the depreciation tax shields after 1955 using the following algorithm:⁹

- (1) if a firm uses different depreciation methods for tax and book purposes, it generally reports the difference between the tax liability which is implied by the book method (the tax expense, TE) and the actual tax payments which result from using the tax depreciation method (taxes paid, TP) as a credit to the deferred tax account, DT.
- (2) assuming that the change in the deferred tax account arises solely because of the different depreciation methods, we can infer the firm's depreciation for tax purposes

$$\begin{aligned}
 DT_t - DT_{t-1} &= TE_t - TP_t \\
 &= (NI_t - d_B)\tau - (NI_t - d_T)\tau \\
 &= \tau(d_T - d_B) ,
 \end{aligned}
 \tag{4}$$

where NI is net income before depreciation and taxes, d_B is book depreciation, d_T is tax depreciation, and τ is the marginal corporate tax rate. Rearranging (4) yields

$$d_T = d_B + \frac{DT_t - DT_{t-1}}{\tau} .
 \tag{5}$$

The future nominal tax shields in year t , TAX_t , are found by adjusting the plant and equipment account, PE_t , for the accumulated difference between book and tax depreciation since 1954,

$$\begin{aligned} \text{TAX}_t &= \text{PE}_t + \sum_{i=1955}^t (d_{B_i} - d_{T_i}) \\ &= \text{PE}_t - \sum_{i=1955}^t \frac{(DT_i - DT_{i-1})}{\tau} . \end{aligned} \quad (6)$$

Assuming that the marginal tax rate equals 50% over the sample period, equation (6) simplifies to

$$\text{TAX}_t = \text{PE}_t - 2DT_t , \quad (7)$$

where DT_t is the level of the deferred tax account in year t .¹⁰ Thus, the tax shield variable, TAX_t , represents the total amount of depreciation that can be used to reduce future tax liabilities. The maturity structure of the nominal tax shields depends on the ages of the underlying assets. In addition, if tax laws are revised in response to unexpected inflation, Freeman [1978], Fama [1981] and Gonedes [1981] suggest this will reduce the effect of unexpected inflation on the value of the depreciation tax shield. Nevertheless, we expect the tax shields, TAX , to have a maturity between the long-term monetary position, LMP , and the short-term monetary position, SMP , for most firms.

A sample of firms from the COMPUSTAT tape is constructed for each quarter from 1947 through 1979 subject to the following criteria:

- (a) a firm is included in a given quarter if it has the data available on all of the accounting variables used to measure the monetary position for the previous fiscal year (Cash, Accounts Receivable, Current Liabilities, Long-term Debt, Preferred Stock, Plant and Equipment, and Deferred Taxes);

- (b) the firm has data available on the number of shares of common stock outstanding and the year-end market price so that the value of the equity at the beginning of the quarter, S_{t-1} , can be computed;
- (c) the firm has stock return data available in that quarter from the CRSP Monthly File (from the Center for Research in Security Prices, University of Chicago).

The number of firms in the sample varies from a low of 328 in 1947 to a high of 1184 in 1972, and 158 firms have data available for every quarter.

B. Seemingly Unrelated Regression Tests

To measure the comovements of stock returns with unexpected inflation we use the time series regression model

$$R_{it} = \gamma_{0i} + \gamma_{1i}\rho_t^e + \gamma_{2i}u_t + \varepsilon_{it}, \quad t=1, \dots, T, \quad (8)$$

where R_{it} is the quarterly return to stock i , ρ_t^e is the expected CPI inflation rate from the model in Table 3, and u_t is the unexpected CPI inflation rate. The coefficient of unexpected inflation in (8), γ_{2i} , measures the comovement of stock returns from firm i with unexpected inflation. The expected inflation rate is included in (8) because Fama and Schwert [1977] have documented a negative relation between stock returns and expected inflation over the 1953-75 period. The inclusion of expected inflation in (8), therefore, increases the power of the tests by controlling for variation in stock returns that is not related to unexpected inflation. In terms of the model in (8), the effect of expected inflation reflects movement of expected stock returns through time, while

the effect of unexpected inflation reflects the ex post revaluation of stocks due to the new information about inflation. Note that ρ_t^e and u_t are uncorrelated by construction, so the least squares estimator of γ_{2i} is unaffected by the inclusion of ρ_t^e in (8).

Table 4 contains estimates of (8) for the Ibbotson-Sinquefield [1979] portfolio of corporate bonds, CB_t , and for the value-weighted portfolio of New York Stock Exchange (N.Y.S.E.) common stocks, R_{mt} , for several time periods. The overall 1947-79 time period is split into two roughly equal subperiods, 1947-63 and 1964-79, and the 1953 - 1971 subperiod is included for comparison with earlier results in Fama [1975] and Fama and Schwert [1977]. The results for corporate bond returns in Part A show that unexpected inflation has a negative effect on corporate bond returns over the 1947-78 period, with the strongest effect occurring in the 1964-78 subperiod (where $\hat{\gamma}_{2i} = -3.2$ with a t-statistic of -3.7). It seems that the expected returns to corporate bonds are not substantially affected by expected inflation since the estimates of γ_{1i} are not statistically different from zero.¹¹

The results for the stock portfolio R_{mt} in Part B of Table 4 show the negative effect of expected inflation on expected stock returns, since γ_{1i} is negative in all of the periods reported, and the estimates are more than two standard errors below zero in all periods except 1964-79. The effect of unexpected inflation on the aggregate portfolio of stocks is less regular. For the 1947-63 subperiod, the estimate of γ_{2i} is more than two standard errors above zero, suggesting that the N.Y.S.E. firms as a group benefited from unexpected inflation in this

Table 4

Effects of Expected and Unexpected Inflation on
Quarterly Corporate Bond and Common Stock Returns, 1947-1979^{a/}

$$R_{it} = \gamma_{0i} + \gamma_{1i}\rho_t^e + \gamma_{2i}u_t + \varepsilon_{it}, \quad t=1, \dots, T$$

Period	Sample Size, T	γ_{0i}	γ_{1i}	γ_{2i}	$S(\varepsilon_i)$	R^2
Part A. Corporate Bond Returns, $R_{it} = CB_t^{b/}$						
1947:4 - 1978:4	125	.0069 (.0040)	.067 (.327)	-1.521 (.433)	.0286	.090
1947:4 - 1963:4	65	.0089 (.0036)	-.645 (.523)	-.730 (.408)	.0221	.069
1964:1 - 1978:4	60	.0018 (.0102)	.461 (.646)	-3.168 (.867)	.0330	.181
1953:1 - 1971:2	74	.0060 (.0057)	-.359 (.737)	-2.515 (.893)	.0295	.103
Part B. Common Stock Returns, $R_{it} = R_{mt}^{c/}$						
1947:4 - 1979:4	129	.0446 (.0104)	-2.299 (.854)	-.121 (1.132)	.0749	.054
1947:4 - 1963:4	65	.0499 (.0098)	-4.109 (1.440)	2.576 (1.123)	.0607	.181
1964:1 - 1979:4	64	.0284 (.0252)	-1.113 (1.597)	-5.711 (2.143)	.0814	.116
1953:1 - 1971:2	74	.0571 (.0134)	-5.377 (1.732)	-3.132 (2.099)	.0694	.122

^{a/} Standard errors in parentheses. The data start in the fourth quarter of 1947 (1947:4) because three lags of inflation are used in Table 3 to estimate expected and unexpected inflation, ρ_t^e and u_t . $S(\varepsilon_i)$ is the standard deviation of the residuals and R^2 is the coefficient of determination.

^{b/} Quarterly rate of return to a portfolio of long-term corporate bonds from Ibbotson and Sinquefeld [1979]. These data are not available for 1979.

^{c/} Quarterly return to the value-weighted portfolio of New York Stock Exchange stocks from the Center for Research in Security Prices (CRSP).

period. However, in the 1964-79 and 1953-71 subperiods the effect of unexpected inflation is negative and the estimate of γ_{2i} is more than two standard errors below zero in the 1964-79 period. For the overall 1947-79 period the estimate of the coefficient of unexpected inflation, $\hat{\gamma}_{2i}$, is small and not significantly different from zero. Thus, while unexpected inflation was generally bad for bondholders throughout the 1947-78 period, there is some evidence that unexpected inflation had a changing effect on stockholders within the 1947-79 period. One possible explanation for the changing effect of unexpected inflation on aggregate stock returns is that firms changed their nominal contracting positions over time. The tests below provide a detailed look at this issue.

The nominal contracting hypothesis says that ceteris paribus the sensitivity of stock returns to unexpected inflation, γ_{2i} , should be more negative: (a) the larger the long-term monetary position, LMP_i , (b) the larger the nominal tax shields, TAX_i , and (c) the larger the short-term monetary position, SMP_i . Since these variables are defined as nominal assets, with nominal liabilities expressed as negative values, unexpected inflation reduces the real value of these nominal contracts. To represent this hypothesis, we write the coefficient of unexpected inflation for firm i as a function of the monetary position variables,

$$\gamma_{2i,t} = a_{0i} + a_1 \left(\frac{LMP_{i,t-1}}{S_{i,t-1}} \right) + a_2 \left(\frac{TAX_{i,t-1}}{S_{i,t-1}} \right) + a_3 \left(\frac{SMP_{i,t-1}}{S_{i,t-1}} \right), \quad (9)$$

where $S_{i,t-1}$ is the value of the stock of firm i in period $t-1$. Since γ_{2i} represents the effect of unexpected inflation on the return to the stock of firm i (i.e., the change in the stock price divided by $S_{i,t-1}$), dividing the monetary position variables by $S_{i,t-1}$ puts all of the variables in the same units of measurement. The coefficient of the long-term monetary position, a_1 , measures the effect of unexpected inflation on the value of these long-term contracts. Likewise, a_2 and a_3 measure the effects of unexpected inflation on the value of the nominal tax shields and the short-term monetary position, respectively.¹² Estimating a_1 , a_2 , and a_3 avoids the problem of combining these categories into a single measure of the monetary position of the firm and lets the data determine the effect of using contracts with different maturities.¹³

Equation (9) can be substituted into (8) to allow the sensitivity to unexpected inflation to vary as the nominal contract position of firm i changes over time

$$\begin{aligned}
 R_{it} &= \gamma_{0i} + \gamma_{1i}\rho_t^e + \left[a_{0i} + a_1 \left(\frac{LMP_{i,t-1}}{S_{i,t-1}} \right) + a_2 \left(\frac{TAX_{i,t-1}}{S_{i,t-1}} \right) + a_3 \left(\frac{SMP_{i,t-1}}{S_{i,t-1}} \right) \right] u_t + \epsilon_{it} \\
 &= \gamma_{0i} + \gamma_{1i}\rho_t^e + a_{0i}u_t + a_1 \left(\frac{LMP_{i,t-1}}{S_{i,t-1}} \right) u_t + a_2 \left(\frac{TAX_{i,t-1}}{S_{i,t-1}} \right) u_t \\
 &\quad + a_3 \left(\frac{SMP_{i,t-1}}{S_{i,t-1}} \right) u_t + \epsilon_{it}, \quad t=1, \dots, T.
 \end{aligned} \tag{10}$$

The coefficients a_1 , a_2 , and a_3 should all be negative according to the nominal contracting hypothesis. Assuming that the effects of unexpected inflation on the value of nominal contracts are the same for all firms, the coefficients a_1 , a_2 , and a_3 should be the same for different firms, and a pooled time series-cross sectional approach can be used to estimate (10). This is important because there may not be much variation in the relative monetary position variables $(LMP_{i,t-1}/S_{i,t-1})$, $(TAX_{i,t-1}/S_{i,t-1})$, and $(SMP_{i,t-1}/S_{i,t-1})$ over time for a given firm i , but there is substantial variation in these variables across firms.

If the time series regression equations in (10) for N different firms are estimated as a system of equations, the parameters a_1 , a_2 , and a_3 can be estimated directly by imposing the linear restriction that these parameters are constant across firms for $i=1, \dots, N$. This technique is a straight-forward application of Zellner's [1962] seemingly unrelated regression (SUR) technique. Recent applications of this methodology to financial models include Gibbons [1981], Hess [1981], and Stambaugh [1981].

A limitation of the SUR model is that the number of firms (time series regression equations) must be less than the number of time series observations, $N < T$. There are at most 129 quarterly observations since 3 observations are lost by using lagged inflation rates to model expected inflation. Therefore, the number of stocks that can be analyzed at one time is less than 129. In fact, since the SUR estimation technique requires inverting the $N \times N$ covariance matrix of time series regression disturbances, the practical limit on the number of equations is much smaller.¹⁴

1. Sequentially Updated Portfolios

To reduce the number of time series regression equations, N , in (10), we form portfolios of stocks with similar sets of nominal contracts. In forming these portfolios we would like to create dispersion in the values of the nominal contracting variables so that the estimates of a_1 , a_2 , and a_3 are as precise as possible. Accordingly, the firms with data available for the first quarter of 1947 are sorted into one of three equal-size groups (high (H), medium (M), or low (L)) depending on the level of the long-term monetary position variable, $(LMP_{i,t-1}/S_{i,t-1})$. Next, within each of the long-term monetary position groups, the firms are sorted into three equal-size groups based on the nominal tax shield variable $(TAX_{i,t-1}/S_{i,t-1})$. Finally, within each of the previous nine groups, the firms are sorted into three equal-size groups based on the short-term monetary position variable, $(SMP_{i,t-1}/S_{i,t-1})$. This sequential sorting procedure yields 27 portfolios with different levels of the three nominal contracting variables ranging from (H,H,H) which represents high levels of all three variables through (L,L,L) representing low levels of all three variables.¹⁵

The sorting is updated every quarter based on data available for the most recent fiscal year. As a result of this updating process the composition of the 27 portfolios changes over time for two reasons: first, the relative rankings of firms change as new data become available; second, new firms are added to the sample as they meet the data requirements and old firms drop from the sample if they fail to meet data requirements. Table 5 contains the sample means and standard

Table 5

Means and Standard Deviations of Nominal Contracting Variables
for 27 Sequentially Updated Portfolios, 1947-79 ^{a/}

Portfolio ^{b/}	$\left(\frac{LMP_{i,t-1}}{S_{i,t-1}} \right)$		$\left(\frac{TAX_{i,t-1}}{S_{i,t-1}} \right)$		$\left(\frac{SMP_{i,t-1}}{S_{i,t-1}} \right)$		Estimate of Sensitivity ^{c/} of Stock Returns to Unexpected Inflation	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	$\hat{\gamma}_{2i}$	$S(\hat{\gamma}_{2i})$
(H,H,H)	-.048	.045	.599	.163	.305	.104	-.366	1.651
(H,H,M)	-.062	.054	.549	.130	.092	.053	-.876	1.475
(H,H,L)	-.062	.053	.557	.130	-.133	.138	-.581	1.589
(H,M,H)	-.043	.037	.244	.073	.254	.089	-.839	1.584
(H,M,M)	-.052	.041	.241	.075	.081	.041	.168	1.430
(H,M,L)	-.055	.043	.242	.074	-.057	.057	-.496	1.468
(H,L,H)	-.028	.023	.094	.033	.273	.109	.231	1.452
(H,L,M)	-.027	.012	.101	.036	.075	.038	-.177	1.348
(H,L,L)	-.032	.018	.099	.039	-.044	.060	.806	1.517
(M,H,H)	-.333	.180	.875	.246	.257	.079	-1.654	1.643
(M,H,M)	-.330	.187	.864	.260	.069	.057	-1.087	1.781
(M,H,L)	-.345	.193	.930	.282	-.174	.153	-1.015	1.816
(M,M,H)	-.309	.167	.481	.165	.298	.116	-.609	1.540
(M,M,M)	-.283	.140	.490	.169	.086	.057	.328	1.482
(M,M,L)	-.292	.159	.484	.167	-.123	.127	.126	1.632
(M,L,H)	-.282	.133	.240	.091	.325	.122	-.413	1.431
(M,L,M)	-.242	.117	.255	.108	.087	.040	.709	1.420
(M,L,L)	-.263	.136	.250	.088	-.259	.463	.277	1.460
(L,H,H)	-1.842	1.275	2.142	.881	.435	.280	-1.335	1.968
(L,H,M)	-1.389	.888	2.055	.950	.044	.154	-.532	1.816
(L,H,L)	-2.036	1.383	2.491	1.048	-.525	.605	-.479	1.782
(L,M,H)	-1.091	.627	.988	.398	.442	.152	.469	1.824
(L,M,M)	-.837	.451	.997	.419	.114	.095	.302	1.666
(L,M,L)	-1.005	.638	1.007	.422	-.260	.273	.220	1.830
(L,L,H)	-1.411	.771	.307	.177	1.421	.542	1.426	2.044
(L,L,M)	-.762	.401	.503	.218	.196	.105	.311	1.673
(L,L,L)	-1.022	.775	.454	.193	-.372	.614	1.064	1.990

^{a/} All of the nominal contracting variables are defined as assets, so that nominal liabilities are expressed as negative values. Thus, the (L,.,.) portfolios represent firms with more long-term debt and preferred stock than the (H,.,.) portfolios.

^{b/} These symbols represent different levels of the nominal contracting variables, for example (H,M,L) represents high levels of long-term monetary position, medium levels of tax shields, and low levels of short-term monetary position.

^{c/} Estimate of the coefficient of unexpected inflation, $\hat{\gamma}_{2i}$, and the standard error of the estimate, $S(\hat{\gamma}_{2i})$, from the regression $R_{it} = \gamma_{0i} + \gamma_{1i}p_t^e + \gamma_{2i}u_t + \epsilon_{it}$ for the 1947:4 - 1979:4 period, where R_{it} is the return to the equally-weighted portfolio of stocks with similar nominal contracting positions.

deviations of the nominal contracting variables for the 27 portfolios for the 1947-79 period. It is apparent from Table 5 that some of the extreme portfolios have very volatile levels of the monetary position variables, and that there is substantial variation across these 27 portfolios. Table 5 also contains estimates of the coefficient of unexpected inflation, γ_{2i} , from (8) for each of the 27 portfolios for the 1947-79 sample period. Casual inspection of these estimates suggests that the nominal contracting hypothesis may be valid, since the largest positive estimates of γ_{2i} occur for the portfolios with low levels of nominal assets (or high levels of nominal liabilities). Similarly, portfolios with high or medium levels of long-term monetary position and tax shields seem to be hurt by unexpected inflation (for these 12 portfolios, 9 have negative estimates of γ_{2i}). Nevertheless, the standard errors for all of the estimates of γ_{2i} are large, and the estimates of γ_{2i} for different portfolios are highly correlated, so it is inappropriate to view the estimates of γ_{2i} in Table 5 as evidence in support of the nominal contracting hypothesis.¹⁶

Table 6 contains estimates of the coefficients a_1 , a_2 , and a_3 in (10) from the seemingly unrelated regression using the 27 sequentially updated portfolios. Table 6 also contains F-tests of the cross-sectional restrictions that the monetary position coefficients are constant across portfolios (e.g., $a_{1i} = a_1$ for $i = 1, \dots, 27$). Since almost all of these F-tests reject the hypothesis of constant coefficients for all of the time periods reported, the estimates of a_1 , a_2 , and a_3 can only be interpreted as

Table 6

Seemingly Unrelated Regression Tests of the Nominal Contracting Hypothesis

Using Sequentially Updated Portfolios^{a/}

$$R_{it} = \gamma_{0i} + \gamma_{1i} \rho^e + a_{0i} u_t + a_1 \left(\frac{LMP_{i,t-1}}{S_{i,t-1}} \right) u_t + a_2 \left(\frac{TAX_{i,t-1}}{S_{i,t-1}} \right) u_t + a_3 \left(\frac{SMP_{i,t-1}}{S_{i,t-1}} \right) u_t + \varepsilon_{it}$$

$t=1, \dots, T; \quad i=1, \dots, 27$

Period	Sample Size, T	a_1	F-statistic ^{c/} $a_{1i}=a_1$	a_2	F-statistic ^{d/} $a_{2i}=a_2$	a_3	F-statistic ^{e/} $a_{3i}=a_3$	F-statistic ^{f/} $a_{1i}=a_1, a_{2i}=a_2, a_{3i}=a_3$
1947:4 - 1979:4	129	.601 (.550)	2.39	.328 (.711)	2.80	-.224 (.396)	2.54	2.44
1947:4 - 1963:4	65	-.027 (.929)	2.26	.897 (.978)	3.09	2.845* (1.048)	2.38	2.26
1964:1 - 1979:4	64	1.552* (.775)	3.87	-.831 (1.118)	3.84	-1.084* (.487)	5.87	3.79
1953:1 - 1971:2	74	6.509* (1.742)	2.40	2.942 (2.029)	2.31	7.357* (1.983)	1.52	2.35

^{a/} Asymptotic standard errors in parentheses. The coefficient of unexpected inflation is assumed to take the form

$$\gamma_{2i} = a_{0i} + a_1 \left(\frac{LMP_{i,t-1}}{S_{i,t-1}} \right) + a_2 \left(\frac{TAX_{i,t-1}}{S_{i,t-1}} \right) + a_3 \left(\frac{SMP_{i,t-1}}{S_{i,t-1}} \right)$$

where a_{0i} represents effects which are allowed to differ across the 27 portfolios, a_1 measures the effect of Long-term Monetary Position, a_2 measures the effect of Tax shields, and a_3 measures the effect of Short-term Monetary Position. The 27 portfolios are created by allocating all firms with data for a given quarter to a portfolio based on rankings of LMP, TAX, and SMP.

^{b/} The data start in the fourth quarter of 1947 (1947:4) because three lags of inflation are used in Table 3 to estimate the expected and unexpected inflation, ρ_t^e and u_t .

^{c/} This statistic tests the hypothesis that $a_{1i}=a_1$ for $i=1, \dots, 27$. Note that a_1 is the point estimate under the constraint that this coefficient is the same for all 27 portfolios.

^{d/} This statistic tests the hypothesis that $a_{2i}=a_2$ for $i=1, \dots, 27$.

^{e/} This statistic tests the hypothesis that $a_{3i}=a_3$ for $i=1, \dots, 27$.

^{f/} This statistic tests the hypothesis that $a_{1i}=a_1$, $a_{2i}=a_2$, and $a_{3i}=a_3$ for $i=1, \dots, 27$. This and the test statistics described in footnotes c to e have asymptotic F-distributions. For testing the constancy of one coefficient across equations, the test has 26 and 27·(T-6) degrees of freedom. The test of all three constraints has 78 and 27·(T-6) degrees of freedom.

*More than two standard errors from zero.

measuring the average effect of the nominal contracting variables on the sensitivity of stock returns to unexpected inflation.¹⁷

The estimates of a_1 , a_2 , and a_3 in Table 6 are contrary to the predictions of the nominal contracting hypothesis. Stockholders of firms with nominal liabilities should benefit from unexpected inflation. Since the long-term monetary position variable is defined so that firms with a lot of debt have substantially negative values for $(LMP_{i,t-1}/S_{i,t-1})$, this implies that a_1 should be negative. Similar analysis indicates that a_2 and a_3 should also be negative. Considering all four time periods in Table 6, there is only one parameter estimate which is more than two standard errors below zero - the coefficient of short-term monetary position, a_3 , for the 1964-79 subperiod. On the other hand, there are four estimates which are more than two standard errors above zero. Since the estimates in Table 6 are generally inconsistent with the nominal contracting hypothesis (e.g., the estimate of $a_1 = 6.5$ for the 1953-71 subperiod implies that stockholders of firms with more long-term debt actually suffer substantially greater losses as a result of unexpected inflation than stockholders of firms with less debt), it is not worth considering some of the more refined hypotheses about the effects of maturity discussed earlier (e.g., the maturity effect ought to cause $-a_1 > -a_2 > -a_3$).

The results in Table 6 are surprising because they seem to indicate that data from financial statements cannot be used to identify firms whose stockholders benefit from unexpected inflation. If anything,

the wealth effects seem to go in the opposite direction from the theoretical predictions. However, before accepting that conclusion it is worthwhile to consider some alternative strategies for testing the nominal contracting hypothesis to ensure that the results in Table 6 are not due to faulty statistical analysis.

2. Using Corporate Bond Returns to Estimate Wealth Transfers

As discussed earlier, tests of wealth redistributions due to unexpected inflation are only as good as the measure of unexpected inflation. Section 2 considers a variety of measures of unexpected inflation and one of the criteria used to select the best measure was the correlation of unexpected inflation with the return to the Ibbotson-Sinquefeld [1979] corporate bond portfolio, CB_t . The premise of that criterion is that the primary cause of changes in bond prices is changes in future expected inflation, which also affect the value of all other nominal contracts. Following that logic, we replicate the tests in Table 6 using CB_t instead of the unexpected inflation rate u_t in (10).

Table 7 contains estimates of the coefficients of the nominal contracting variables using the sequentially updated portfolios. The coefficients a_1 , a_2 , and a_3 are multiplied by -1 in Table 7 to make them comparable to the results in Table 6, since unexpected inflation, $u_t > 0$, should be associated with negative bond returns, $CB_t < 0$.

In general the results in Table 7 are less consistent with the nominal contracting hypothesis than the results in Table 6, since all but one of the coefficient estimates are positive, and three of the estimates are

Table 7

Seemingly Unrelated Regression Tests of the Nominal Contracting Hypothesis

Analyzing the Effect of Corporate Bond Returns^{a/}

$$R_{it} = \gamma_{0i} + \gamma_{1i} \rho_t^e + a_{0i} CB_t + a_1 \left(\frac{LMP_{i,t-1}}{S_{i,t-1}} \right) CB_t + a_2 \left(\frac{TAX_{i,t-1}}{S_{i,t-1}} \right) CB_t + a_3 \left(\frac{SMP_{i,t-1}}{S_{i,t-1}} \right) CB_t + \varepsilon_{it}$$

$$t = 1, \dots, T; \quad i = 1, \dots, 27$$

Period <u>b/</u>	Sample Size, T	Sequentially Updated Portfolios		
		<u>-a₁</u>	<u>-a₂</u>	<u>-a₃</u>
1947:4-1979:4	129	.168* (.077)	.175 (.110)	.145* (.062)
1947:4-1963:4	65	.113 (.372)	.667 (.394)	.494 (.377)
1964:1-1979:4	64	.043 (.077)	.103 (.109)	.103 (.057)
1953:1-1971:2	74	.646* (.199)	.487 (.248)	-.019 (.228)

^{a/} Asymptotic standard errors in parentheses. These regressions are similar to the estimates in Table 6, except the rate of return to a portfolio of long-term corporate bonds, CB_t , is used instead of the unexpected inflation rate, u_t , to measure the wealth redistribution effects. In order to make these results comparable to the results in Table 6, the estimates of a_1 , a_2 , and a_3 are multiplied by -1, since a positive unexpected inflation rate should correspond to a negative corporate bond return.

^{b/} The data start in the fourth quarter of 1947 (1947:4) because three lags of inflation are used in Table 3 to estimate expected inflation, ρ_t^e .

*More than two standard errors from zero.

more than two standard errors above zero. For example, a literal interpretation of the estimate of the coefficient of long-term monetary position, a_1 , for the 1947-79 period would be that a 1% loss to bondholders would be associated with a .17% loss to stockholders if the LMP/S ratio is 1.

Instead of a wealth transfer, it seems that there is some phenomenon which affects both bond and stock returns in the same direction which dominates the wealth transfer. Note that the phenomenon has to be stronger for firms with large amounts of debt, since a_1 is multiplied by $(LMP_{i,t-1}/S_{i,t-1})$.

Thus, using corporate bond returns as a proxy for changes in future expected inflation rates does not seem to change the results of the seemingly unrelated regression tests of the nominal contracting hypothesis.

C. Paired Comparison Tests for Nominal Contracting Effects

The seemingly unrelated regression tests presume that the effect of unexpected inflation on stock returns, γ_{2i} , is linearly related to the size of the contract relative to the value of the stock. While this presumption is reasonable, the relation may not be the same for all firms. For example, firms with different maturity structures for the long-term monetary position variable should have different coefficients for $(LMP_{i,t-1}/S_{i,t-1})$ in (9). This does not cause a problem as long as the differences in coefficients across portfolios are not related to the magnitudes of the nominal contracting variables.

Nevertheless, as a check on the validity of the tests in Tables 6 and 7, we compare the coefficients of unexpected inflation in (8) for portfolios with different levels of the nominal contracting variables in Table 8. For example, in Part B of Table 8 the coefficient of unexpected inflation, γ_{2i} ,

is constrained to be the same for all portfolios with high levels of the long-term monetary position variable (H,.,.) and for all portfolios with low levels of that variable (L,.,.). Under the nominal contracting hypothesis γ_{2i} is more negative for the high LMP portfolios than the low LMP portfolios. We compute the t-statistic for the difference between the estimates of γ_{2i} by regressing the difference in the portfolio returns, $R_H - R_L$, against expected and unexpected inflation

$$(R_H - R_L) = \gamma_{0i} + \gamma_{1i}\rho_t^e + \gamma_{2i}u_t + \epsilon_{it}, \quad t=1, \dots, T. \quad (11)$$

Panel A of Table 8 contains estimates for the two extreme portfolios with high levels of all three nominal contracting variables (H,H,H) and low levels of all three variables (L,L,L). Panels B, C, and D contain combinations of all portfolios with high and with low levels of LMP, TAX, and SMP, respectively.

Although the estimates of the coefficient of unexpected inflation jump around between subperiods, most of the t-statistics for the paired comparison tests have the predicted negative sign for the overall 1947-79 period and for the 1947-63 and 1964-79 subperiods. In particular, Part C of Table 8 shows that the firms with high levels of depreciation tax shields are hurt more by unexpected inflation than firms with lower levels of tax shields in these time periods since all of the t-statistics are less than -1.87.

The most puzzling results in Table 8 occur for the 1953-71 subperiod which was studied previously by Fama [1975] and Fama and Schwert [1977],

Table 8

Effects of Unexpected Inflation on Stock Returns for
Portfolios with Different Nominal Contracting Positions^{a/}

A. All Nominal Contracts

Period ^{b/}	Sample Size, T	High Assets (H,H,H)	Low Assets (L,L,L)	t-statistic, (H,H,H) - (L,L,L)
1947 4 - 1979 4	129	-.366 (1.651)	1.064 (1.990)	-1.20
1947 4 - 1963 4	65	2.911 (1.511)	4.753 (1.533)	-1.61
1964 1 - 1979 4	64	-7.186 (3.318)	-6.408 (4.270)	-.31
1953 1 - 1971 2	74	-3.227 (2.966)	-7.490 (3.239)	2.17

B. Long-Term Monetary Position

Period ^{b/}	Sample Size, T	High LMF (H,.,.)	Low LMF (L,.,.)	t-statistic, (H,.,.) - (L,.,.)
1947 4 - 1979 4	129	-.237 (1.440)	.161 (1.787)	-.61
1947 4 - 1963 4	65	2.842 (1.229)	3.295 (1.378)	-.99
1964 1 - 1979 4	64	-6.510 (2.952)	-6.271 (3.846)	-.23
1953 1 - 1971 2	74	-4.567 (2.524)	-7.261 (2.980)	3.03

C. Tax Shields

Period ^{b/}	Sample Size, T	High TAX (.,H,.)	Low TAX (.,L,.)	t-statistic, (.,H,.) - (.,L,.)
1947 4 - 1979 4	129	-.881 (1.653)	.471 (1.537)	-2.91
1947 4 - 1963 4	65	2.183 (1.287)	3.240 (1.331)	-1.87
1964 1 - 1979 4	64	-7.123 (3.540)	-5.182 (3.174)	-2.34
1953 1 - 1971 2	74	-6.155 (2.880)	-6.229 (2.617)	.08

D. Short-Term Monetary Position

Period ^{b/}	Sample Size, T	High SMO (.,.,H)	Low SMO (.,.,L)	t-statistic, (.,.,H) - (.,.,L)
1947 4 - 1979 4	129	-.343 (1.612)	-.009 (1.620)	-1.40
1947 4 - 1963 4	65	2.527 (1.248)	3.124 (1.291)	-2.07
1964 1 - 1979 4	64	-6.166 (3.463)	-6.344 (3.432)	.42
1953 1 - 1971 2	74	-6.179 (2.738)	-6.214 (2.737)	.07

^{a/} Standard errors in parentheses. Estimates of the coefficient of unexpected inflation γ_{2i} from the regression

$$R_{it} = \gamma_{0i} + \gamma_{1i} p_t^e + \gamma_{2i} u_t + \epsilon_{it} \quad i=1, \dots, T$$

using different sets of portfolios, R_{it} , from Table 5. For example, the (H,H,H) portfolio contains firms which have high levels of all three nominal contracting variables. The t-statistic for testing the hypothesis that the coefficient of unexpected inflation is equal for the high and low portfolios comes from regressing the difference in the returns to the (H,H,H) and (L,L,L) portfolios against expected and unexpected inflation. For the three categories of nominal contracts equal-weighted portfolios are formed using the nine portfolios with high LMF (H,.,.) and the nine portfolios with low LMF (L,.,.), for example. If unexpected inflation hurts firms with relatively more nominal assets, the t-statistics should be negative.

^{b/} The data start in the fourth quarter of 1947 (1947:4) because three lags of inflation are used in Table 3 to estimate expected and unexpected inflation, p_t^e and u_t .

among others. In particular, in Panel B it seems that firms with large amounts of long-term nominal liabilities (L,*,*) are hurt by unexpected inflation more than firms with small amounts (H,*,*), and this difference has a t-statistic of 3.03. In addition, in Panel A the portfolio with low levels of nominal assets (L,L,L) is hurt more by unexpected inflation than the high portfolio (H,H,H), for the 1953-71 subperiod with a t-statistic of 2.17.

Thus, even though the paired comparison results in Table 8 seem more consistent with the nominal contracting hypothesis for some time periods, there are still a number of results which are inconsistent with the nominal contracting hypothesis.

4. Alternative Tests for Nominal Contracting Effects

In addition to the tests reported in Tables 6, 7, and 8, we have performed a number of additional tests to see whether the financial contract data available on COMPUSTAT can be used to detect effects of nominal contracting on stock returns. Since the additional tests yield results which are similar to the results reported above, we omit detailed reporting of these tests. Nevertheless, it is useful to know that a variety of different test specifications are equally unable to detect a strong effect of nominal contracting on stock returns.

Most firms are involved in a wide range of nominal contracts besides those we examine in the tests above. For example, firms subject to price regulation have an implicit contract with the consumers of their products. Because of this nominal contract, these firms are hurt by unexpected inflation, especially if "regulatory lag" causes regulated prices to adjust slowly to inflation.¹⁸

Omitting the nominal regulatory contracts will not necessarily cause problems in the tests above. However, if these contracts are correlated with the included contracts, the results will be biased. For example, public utilities appear to have relatively large proportions of long-term debt and preferred stock in their capital structures. If this is true, omitting their regulatory contracts will tend to bias the coefficients in our tests against the nominal contracting hypothesis.

To check this possibility, we replicate the tests in Tables 6, 7, and 8, excluding firms in the railroad, trucking, airline, telephone,

and natural gas industries.¹⁹ This excludes a total of 93 firms, but none of the results change in a substantive way. In addition, estimates of the effects of unexpected inflation on portfolios involving only regulated firms do not support the nominal contracting hypothesis. In short, it does not seem that exclusion of product price nominal contracts from the previous tests explains the failure to support the nominal contracting hypothesis.

There is a potential problem with using the seemingly unrelated regression technique on a set of portfolios that change composition over time. The SUR technique assumes that the $N \times N$ contemporaneous covariance matrix of regression disturbance terms, Σ , is constant over time and, since a given firm will not generally stay in the same portfolio in all time periods, it seems unlikely that Σ is actually constant through time.²⁰ One way to solve this problem is to construct portfolios that do not change over time. There are 158 firms that have data for the entire 1947-79 period, so these firms are sorted into 27 portfolios based on their nominal contracting variables, LMP, TAX, and SMP, as measured at the middle of the time period, the second quarter of 1963. Of course, there is less dispersion in the nominal contracting variables across portfolios, especially in the time periods distant from the period when the sorting occurs. Also, since firms must have data for the entire 1947-79 period, this sample has a disproportionate number of large firms.²¹ Nevertheless, if the covariance matrix of regression disturbances from

(10) is stationary for individual stocks, these fixed composition portfolios will also have a stationary covariance matrix, and it is legitimate to use the SUR technique to estimate the effects of nominal contracting.

We replicate the tests in Tables 6 and 7 using the fixed composition portfolios. There are a few differences between these results and the results in Tables 6 and 7 but the major conclusion is the same: there is no consistent evidence that the wealth effects due to unexpected inflation explain much of the variation in stock returns.

5. Conclusions

This paper analyzes the effects of unexpected inflation on the stock returns of firms with different nominal contracting positions. A major improvement over most previous work along these lines is that we distinguish between the effects of expected and unexpected inflation in our tests. The main conclusion is that there is no strong support for the nominal contracting hypothesis. Firms that have relatively large net monetary liabilities did not benefit from unexpected inflation relative to firms with net monetary assets during the 1947-79 period. This result is surprising, to say the least, since the purported distributive effects of unexpected inflation are so well-known that they have been the source of numerous journal articles (see for example Bradford [1974], Budd and Seiders [1971], Kaplan [1977], Nelson [1976b], and Van Horne and Glassmire [1972], in addition to the papers previously mentioned).

We perform a variety of tests to verify that the statistical analysis is not sensitive to the specification of the variables or the sample period. Several measures of quarterly unexpected inflation are used, different types of nominal contracts are used, and different sample periods are used. The seemingly unrelated regression technique is used to produce pooled time series-cross sectional tests of the nominal contracting hypothesis. Given the variety of tests used in this paper, it is difficult to believe that there is a simple statistical explanation for our failure to support the nominal contracting hypothesis.

There is at least one explanation that is consistent with the results in this paper: Modigliani and Cohn [1979] claim that stockholders do not understand the effect of inflation on the value of nominal debt contracts. We are reluctant to accept the hypothesis that stockholders and bondholders (who may be the same people) have differential ability to understand the effects of inflation. Nevertheless, the results in this paper certainly do not contradict the Modigliani-Cohn hypothesis.

We believe there are two more likely explanations for our results. First, published financial statements only contain a subset of nominal contracts, so our tests do not include data on nominal contracts for raw materials, labor, pensions, final products, and so forth. If stockholders desire to hedge against unexpected inflation, firms could construct a set of contracts for inputs and outputs that would leave the value of the stock unaffected by unexpected inflation. For example, even though the stockholders would benefit because the value of the debt falls, they would lose if the firm has a contract to sell its product at a fixed price in the future. If there was a general tendency for firms to hedge in this way, tests such as ours would not support the nominal contracting hypothesis because there would be no relationship between a subset of contracts and the sensitivity of stock returns to unexpected inflation. While this explanation sounds plausible, there are at least two reasons to doubt that omitted contracts explain our results. First, it is unclear why firms would want to hedge inflation risk for stockholders, since stockholders could presumably diversify this risk on personal account if they wanted

to do so. Second, it is hard to imagine what kinds of omitted nominal contracts would have maturities of sufficient length to off-set the effects of changes in expected inflation on long-term debt contracts. It would have to be a contract where the firm is receiving cash inflows (such as a contract to sell final products), and most of these contracts are of relatively short maturity compared with corporate debt.

The second possible explanation for our results is that the wealth effects caused by revaluation of nominal contracts due to unexpected inflation are small compared with other factors that affect stock values. Under this interpretation, the earlier results which show a negative relation between aggregate stock returns and unexpected inflation are not attributable to wealth transfers between debtors and creditors (where the real value of the firm is implicitly held fixed). Instead, there is some other unspecified reason why unexpected inflation is associated with a fall in the value of corporate capital, since both stockholders and bondholders lose from unexpected inflation. This is essentially the argument put forward by Nelson [1979] and Fama [1981] based on the observation that unexpected inflation and real activity are negatively correlated over the last 30 years.

Using this interpretation of our results, it is inappropriate to attribute a causal relation between inflation and the behavior of stock prices. Instead, there are apparently other factors affecting stock values that happen to be correlated with inflation in the recent past.

Footnotes

1. Freeman [1978], Fama [1981] and Gonedes [1981] argue that changes in the tax law have reduced tax rates in periods of high inflation. Nevertheless, the tax code is adjusted at most once a year, so these changes in tax laws could not eliminate redistributive effects of unexpected inflation over shorter time intervals. Also see Joines [1981] for a variety of estimates of tax rates on corporate capital over time.
2. See Alchian and Kessel [1962] for an extensive discussion of the effects of expected inflation, unexpected inflation, and changes in expected inflation.
3. Box and Jenkins [1976] describe the use of autoregressive-integrated-moving average (ARIMA) models.
4. If relevant variables are omitted from the model for unexpected inflation, the least squares estimator of the regression coefficient of stock returns on unexpected inflation will be biased toward zero. This problem would reduce the likelihood that data on nominal contracting variables can be used to explain differences in the sensitivity of stock returns to unexpected inflation.
5. The data on the deflators, DEF and DEFN, and on IP and M are seasonally adjusted. All of the variables in (1) are obtained from the Citibank Database. Specifications of (1) that included more lags of inflation, IP and M were estimated, but the additional parameters generally resulted in a higher estimate of the standard deviation of unexpected inflation, $S(u)$.

6. To the extent that these data are revised subsequent to initial publication, this statement is not literally true.
7. It might seem that the coefficients of (3) are too different from those in (2) to be consistent with the simple dating story described here. However, if the true contemporaneous coefficient in (2) is -1.5, and each month in the quarter has equal influence, the coefficient of u_t in (3) should be -1.0 and the coefficient of u_{t+1} should be -0.5 (assuming that the lead and lag coefficients in (2) are zero). The F-test based on (3) does not reject the hypothesis that the coefficients of u_t and u_{t+1} are -1.0 and -0.5, respectively.
8. Some preferred stock is "participating", meaning that the dividend on the preferred stock must be increased if the dividend on common stock is increased by a prespecified amount. This means that the payoffs to preferred stock are not completely fixed in nominal terms. However, it seems unlikely that many firms reach the point where the preferred dividend is actually changed, so this isn't a problem for our tests. As a check on this, we ran some of our tests omitting preferred stock from LMP and there were no substantial changes in our results.
9. For discussion of accounting rules associated with tax deferrals see James E. Wheeler and Willard H. Galliard, An Appraisal of Interperiod Income Tax Allocation, Financial Executive Research Foundation, New York, 1974.

10. The marginal federal tax rate on corporate income varied between 46% and 52.8% from 1950-79, ignoring excess profits taxes, investment tax credits, etc.
11. Note that the hypothesis that expected real corporate bond returns are unrelated to expected inflation is equivalent to testing $\gamma_{1i} = 1.0$, and this hypothesis is rejected at the 5% significance level for the 1947-78 and 1947-63 periods.
12. Equation (9) can be thought of as a decomposition of the derivative of the stock return with respect to unexpected inflation

$$\gamma_{2i} = \frac{dR_i}{du} = \frac{dS_i}{du} \frac{1}{S_i} = \left[\frac{\partial LMP_i}{\partial u} + \frac{\partial TAX_i}{\partial u} + \frac{\partial SMP_i}{\partial u} \right] \frac{1}{S_i} .$$

If the effects of unexpected inflation on the value of the nominal contracts is proportional to the initial value of the contract, for example,

$$\frac{\partial LMP_i}{\partial u} = a_1 LMP_i ,$$

then

$$\gamma_{2i} = a_1 \frac{LMP_i}{S_i} + a_2 \frac{TAX_i}{S_i} + a_3 \frac{SMP_i}{S_i} .$$

Adding the intercept a_{0i} which varies across firms allows for other

effects of unexpected inflation on the value of the stock
(e.g., other nominal contracts which are not included in the test).

13. Gonzalez-Gaviria [1973] and Freeman [1978] attempt to measure the monetary position of the firm using similar data, except that they predetermine the effect of the maturity of contracts by making a_1 a fixed proportion of a_3 (Freeman sets $a_1 = 2a_3$ and Gonzalez-Gaviria uses several different weights) to derive a single number which measures the monetary position of the firm.
14. We use the SAS computer programs for all of the computations in this paper.
15. This sequential sorting procedure results in maximum spread for LMP, and successively less spread for TAX and SMP. We chose this order of sorting since the effect of changes in expected inflation should be greater for contracts with longer maturities.
16. The covariance between estimates of γ_{2i} for different equations is proportional to the covariance of the errors from the respective equations. For the 1947-79 period, a typical correlation coefficient for the errors across equations in Table 6 is about .90, so the estimates of γ_{2i} are highly correlated.
17. In the context of the random parameters regression model, the estimates in Table 6 are consistent and unbiased for the average effect of the nominal contracting variables as long as the variation in the parameters across equations is independent of the

variation in the regressors. One example where this condition would be violated occurs if firms with lots of long-term debt also choose maturity structures of debt that are systematically different from other firms.

18. Keran [1976] argues that utility stock prices behave like bond prices because of the implicit nominal contract that results from regulation.
19. Specifically, all firms with SIC codes 4011, 4210, 4400, 4511, 4811, 4922, and 4925 were excluded from the 27 sorted portfolios and analyzed separately. The COMPUSTAT Industrial File does not contain data for electric utilities.
20. For example, if the covariance matrix of regression disturbances for individual firms is stationary, the covariance matrix of the 27 portfolio disturbances will vary with the changing portfolio compositions.
21. For example, firms that were not listed on the N.Y.S.E. in 1947, or not followed by COMPUSTAT in 1946, or firms that were taken over or that went bankrupt during the 1947-79 period are excluded. Since COMPUSTAT creates tapes that cover 20 year time intervals, there is a survival bias whereby firms that don't exist in 1965 are unlikely to have data for 1946. Similarly, firms that grew fast over the period are more likely to be included in the sample. It seems unlikely that this survival bias affects the results of our tests.

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