# Effects of Nominal Contracting on Stock Returns

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This paper examines 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 there is little 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.

## I. 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 prespecified future date. The parties involved in the contract estimate the present value of the future payment taking into account the inflation that 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 assets and liabilities. For example, cash, accounts receivable, depreciation tax shields, and contracts to sell products at fixed prices are nominal assets. On the other hand, debt, accounts payable, labor contracts, raw materials contracts, and pension commitments may be nominal liabilities. To the extent that these contracts do not have inflation adjustment clauses, unexpected inflation affects their real value. The net effect of unexpected inflation 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 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

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[1] Freeman (1978) 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 redistributional 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 Kessel and Alchian (1962) for an extensive discussion of the effects of expected inflation, unexpected inflation, and changes in expected inflation.

(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 the market is efficient, the effect of expected inflation on the nominal contracts will be impounded in stock prices. Only unexpected inflation (and new information about future inflation) should cause differences between stock returns for net debtors and net creditors. Since, by definition, unexpected inflation is serially uncorrelated with a mean of zero, the periods of high and low inflation used in previous tests probably correspond to periods of high and low expected inflation.

To construct a more powerful test of the nominal contracting hypothesis, we 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 requires a measure of the unexpected part of the inflation rate. Section II examines a variety of time-series models for the quarterly inflation rate. Based on several statistical criteria, we select a model that uses the 3-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 III we form 27 portfolios based on relative rankings of three nominal contracting variables: (i) short-term monetary position, that is, cash + accounts receivable − current liabilities; (ii) long-term monetary position, that is, − 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 Center for Research in Security Prices (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 little evidence that stockholders of firms with high levels of nominal liabilities benefit from unexpected inflation.

Section IV discusses some additional tests that are used to assure that the results in Section III are not sensitive to the definition of the nominal contracting variables. Finally, Section V 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.

## II.  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), Bodie (1976), Nelson (1976$a$), 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) and others suggest using variables such as the growth rates of the money supply and of industrial production in addition to lagged inflation and interest rates to estimate expected inflation. We consider the regression model

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\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,
$$

(1)

where $\rho_t$ 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 industrial production for nondurable consumption goods in quarter $t - j$, and $M_{t-k}$ is the growth rate of the monetary base in quarter $t - k$.[4] 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 an AR(3) univariate model is correct;[5] ($b$) if the lag coefficients on inflation ($\alpha_1$, $\alpha_2$, and $\alpha_3$) and the coefficients on $IP_{t-j}$ and $M_{t-k}$ are all zero, and if the coefficient on $TB_t$ equals 1.0, then Fama's (1975) constant expected real rate of interest model is correct.

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[3] Box and Jenkins (1976) describe the use of autoregressive integrated moving average (ARIMA) models.

[4] 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, $S(u)$.

[5] Analysis of the quarterly inflation rates in table 1 using the techniques of Box and Jenkins (1976) indicates that an AR(3) model is an adequate ARIMA model for the 1947–79 period. However, using past data on $TB$, $IP$, and $M$ significantly improves the fit of the AR(3) model.

Inflation is defined as a simultaneous 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. Because 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 major differences among these indices are due to the weighting schemes used to combine the price data collected by the Bureau of Labor Statistics. Many people have argued that the deflators are less subject to bias due to relative price changes. Also, the deflators do not include mortgage interest rates. Bulletin 1517 of the U.S. Department of Labor (1966) provides a more complete description of the methods used to calculate the CPI.

Part A of table 1 contains estimates of (1) using the three different inflation series for the 1947–79 period. Most of the regressors have coefficients that are more than one standard error away from zero, and both the univariate AR(3) model and Fama's constant expected real rate of interest model are rejected by these data. The coefficients are similar for all three measures of inflation. The last column in part A contains an asymptotic $F$-test of the hypothesis that the model parameters are constant across the 1947–63 and 1964–79 sub-periods. The $F$-statistics are relatively small, especially for the CPI inflation rate and the nondurable consumption deflator inflation rate, DEFN. This is important because we use residuals from (1) to measure unexpected inflation, $u_t$, and the fitted values measure expected inflation, $\rho_t'$. The entire sample period is used to estimate the regression parameters. Given the parameter estimates, the measures of expected inflation rates 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.

Part B of table 1 contains estimates of the first eight autocorrelations of the unexpected inflation rates. Most of these estimates are within two standard errors of zero, which indicates that there are no predictable patterns in the unexpected inflation series. The last column of part B contains estimates of the correlation of unexpected inflation rate, $u_t$, with the quarterly holding period return to a portfolio of long-term corporate bonds, $CB_t$, obtained from Ibbotson and Sinquefield (1979). The corporate bond returns are not yet available for 1979. All of these estimates are significant and negative, which

[6] To the extent that these data are revised subsequent to initial publication, this statement is not literally true.

## TABLE 1

### PREDICTION MODELS FOR QUARTERLY INFLATION, 1947–79

#### A. REGRESSION MODELS[a]

$$p_t = \alpha_0 + \sum_{i=1}^{3} \alpha_i p_{t-i} + \beta_1 TB_t + \sum_{j=1}^{2} \beta_{2j} IP_{t-j} + \sum_{k=1}^{2} \beta_{3k} M_{t-k} + u_t$$

| Price Index | $\alpha_0$ | $\alpha_1$ | $\alpha_2$ | $\alpha_3$ | $\beta_1$ | $\beta_{21}$ | $\beta_{22}$ | $\beta_{31}$ | $\beta_{32}$ | $S(u)$ | F-Test for Stability |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 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) | −.096 (.115) | −.096 (.090) | .0067 | .98 |

#### B. SUMMARY STATISTICS FOR UNEXPECTED INFLATION, $u_t$[b]

| Price Index | $r_1$ | $r_2$ | $r_3$ | $r_4$ | $r_5$ | $r_6$ | $r_7$ | $r_8$ | $S(r)$ | $\mathrm{Corr}(u_t, CB_t)$ |
|---|---|---|---|---|---|---|---|---|---|---|
| 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). $p_t$ 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 $k$. $\mathrm{Corr}(u_t, CB_t)$ is the correlation of unexpected inflation with the quarterly return to a portfolio of long-term corporate bonds from 1947 to 1978.

* Significant at the 5 percent level.

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indicates that bond prices fall when unexpected inflation occurs. These results are similar to the findings of Fama and Schwert (1977) using returns to long-term government bonds.

There are two factors that cause differences in the stock returns for net debtors versus net creditors: unexpected inflation and unexpected changes in expected inflation. To see the effect of unexpected inflation, assume that both expected inflation and the expected real rate of interest are constant over time. In this case, the nominal interest rate is also constant and the discounted value of cash flows is not affected by unexpected inflation. For example, the dollar price of a bond with a coupon yield equal to the interest rate will not change as a result of unexpected inflation. However, the *real* value of the bond falls by the amount of the unexpected inflation. If the real value of the firm that issues the bond is unaffected, the stockholders of the firm get a wealth transfer equal to the decrease in the real value of the bond. In general, the expected inflation rate is not constant, and changes in expected inflation affect stock returns by changing the interest rates that are used to discount cash flows.

In our tests, we would like to measure the effect of both unexpected inflation and changes in expected inflation. Fortunately, these variables are closely related. Although corporate bond prices are not affected by unexpected inflation, they will be affected by changes in expected inflation. In fact, 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 change is because of changes in expected inflation. Thus, the negative correlation of $u_t$ with $CB_t$ in table 1 is evidence that our measure of unexpected inflation contains new information about future expected 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 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.

Based on the results in table 1, we use the residuals from the CPI regression to measure the unexpected inflation rate, $u_t$, in our tests. The stability of the coefficients and the magnitude of the correlation

with bond returns indicate that the CPI measure is slightly preferred to either DEF or DEFN. Nevertheless, the models are similar enough that it is unlikely that the choice of price index would substantially affect the test results.[7]

## III. Tests for Nominal Contracting Effects

*The Data*

Tests of the nominal contracting hypothesis require measures of nominal contracts for different firms. 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 for many nonfinancial corporations from 1946 through 1979.

The analysis in Section II indicates that unexpected inflation is 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, SMP = cash + accounts receivable − current liabilities. Similarly, the *long-term monetary position*, LMP, is the negative of the sum of the long-term debt and the preferred stock, LMP = −(long-term debt + 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.

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[7] One reason that the unexpected CPI inflation rate might have the largest correlation with corporate bond returns is that the deflators are "smoothed" within the years due to the way quarterly GNP is measured. This raises a general issue about the relative timing of the inflation measures and asset returns (see Schwert [1981] for a detailed analysis of the CPI and stock returns). As a check on whether our unexpected inflation measure is contemporaneous with bond returns, we computed correlations of $u_t$ with leads and lags of $CB_t$ and found no evidence of noncontemporaneous correlation.

[8] Some preferred stock is "participating," which means 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 is not 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.

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 reduces the effect of unexpected inflation by reducing the effective maturity of these contracts; however, since COMPUSTAT does not contain enough information to adjust for convertibility we ignore this issue in our tests. Second, although we would rather 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.[9]

Another nominal contract that can be measured using COMPUSTAT data is the tax shield provided by depreciation. Depreciation expenses are based on historical 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 from 1947 through 1954 because firms were required to use straight-line depreciation for tax purposes in this period. Since they typically used the same technique for financial reporting, we estimate the future nominal tax shields in year $t$, $TAX_t$, using the plant and equipment data from COMPUSTAT, $PE_t$. However, starting in 1954 firms were allowed to use accelerated depreciation for tax purposes. Since they were not required to use the same method for financial reporting, $PE_t$ is not a good measure of the tax shield after 1954. Fortunately, the plant and equipment data can be adjusted using the deferred tax account, $DT_t$. Each year the firm credits the difference between its tax liability computed using the financial accounts and its actual taxes paid to $DT_t$. Assuming that this credit is due solely to the different depreciation methods and that the marginal corporate tax rate is 50 percent, we can estimate the tax shields as $TAX_t = PE_t - 2DT_t$.[10]

[9] Freeman also correlates market and book measures of debt with estimates of the sensitivity of stock returns to unexpected inflation similar to the tests in Sec. III. He finds similar correlations using either measure of debt. Two additional problems affect our measure of long-term monetary position. First, since interest payments are tax deductible, our measure of LMP overstates the monetary liability. Second, to the extent that some types of long-term debt have interest rates that are linked to short-term rates (e.g., revolving credit arrangements), our measure of LMP will have a shorter maturity.

[10] For a discussion of accounting rules associated with tax deferrals, see Wheeler and Galliart (1974). The marginal federal tax rate on corporate income varied between 46 percent and 52.8 percent from 1950 to 1979, with excess profits taxes, investment tax credits, etc., ignored.

Since the maturity structure of the nominal tax shields depends on the ages of the underlying assets, the effective maturity of TAX$_t$ varies across firms. In addition, if tax laws are revised in response to expected inflation (e.g., the investment tax credit reduces current taxes for firms that are buying qualifying assets), the effect of unexpected inflation on the value of these nominal contracts is reduced. 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. To be included in the sample for a given quarter a firm must satisfy the following criteria: (*a*) the firm must have 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 must have 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; and (*c*) the firm must have stock return data available in that quarter from the CRSP Monthly Returns File. The number of firms in the sample varies from a low of 328 in 1947 to a high of 1,184 in 1972; 158 firms have data available for every quarter.

*Seemingly Unrelated Regression Tests*

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

$$R_{it} = \gamma_{0i} + \gamma_{1i}\rho'_t + \gamma_{2i}u_t + \epsilon_{it}, t = 1, \ldots, T, \tag{2}$$

where $R_{it}$ is the quarterly return to stock $i$, $\rho'_t$ is the expected CPI inflation rate from the model in table 1, and $u_t$ is the unexpected CPI inflation rate. The coefficient of unexpected inflation in (2), $\gamma_{2i}$, measures the comovement of stock returns from firm $i$ with unexpected inflation. The expected inflation rate is included in (2) to eliminate some of the variation in stock returns that is not related to unexpected inflation. Since $\rho'_t$ and $u_t$ are uncorrelated by construction, including $\rho'_t$ increases the power of the tests without affecting the least-squares estimator of $\gamma_{2i}$.

Table 2 contains estimates of (2) for the Ibbotson and Sinquefield (1979) portfolio of corporate bonds, $CB_t$, and for the value-weighted portfolio of New York Stock Exchange (NYSE) 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. The 1953–71 subperiod is also included for comparison with earlier results in Fama

TABLE 2

Effects of Expected and Unexpected Inflation on Quarterly
Corporate Bond and Common Stock Returns, 1947–79[a]

$$R_{it} = \gamma_{0i} + \gamma_{1i}\rho_t^r + \gamma_{2i}u_t + \epsilon_{it}, t = 1, \ldots, T$$

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

[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 1 to estimate expected and unexpected inflation, $\rho_t^r$ and $u_t$. $S(\epsilon_i)$ 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 Sinquefield (1979). These data are not available for 1979.

[c] Quarterly return to the value-weighted portfolio of NYSE stocks from the Center for Research in Security Prices (CRSP).

(1975) and Fama and Schwert (1977). The results 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 $\gamma_{1i}$ are not statistically different from zero.[11]

The results for the stock portfolio, $R_{mt}$, in part B of table 2 show the negative effect of expected inflation on expected stock returns, since $\gamma_{1i}$ 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 $\gamma_{2i}$ is

[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 percent significance level for the 1947–78 and 1947–63 periods.

more than two standard errors above zero, which suggests that the NYSE firms as a group benefited from unexpected inflation in this period. However, in the 1964–79 and 1953–71 subperiods the effect of unexpected inflation is negative; in fact, the estimate of $\gamma_{2i}$ 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, 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, $\gamma_{2i}$, should be negatively related to all three nominal variables, LMP, TAX, and SMP. 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, write the coefficient of unexpected inflation for firm $i$ as a function of the monetary position variables,

$$\gamma_{2i,t} = a_{0i} + a_1 \frac{LMP_{i,t-1}}{S_{i,t-1}} + a_2 \frac{TAX_{i,t-1}}{S_{i,t-1}} + a_3 \frac{SMP_{i,t-1}}{S_{i,t-1}}, \quad (3)$$

where $S_{i,t-1}$ is the value of the stock of firm $i$ in period $t-1$. Since $\gamma_{2i}$ represents the effect of unexpected inflation on the stock return of firm $i$, 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

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[12] Equation (3) 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 are proportional to the initial value of the contract, e.g., $\partial LMP_i/\partial u = a_1 LMP_i$, 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 unex-

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 (3) can be substituted into (2) to allow the sensitivity to unexpected inflation to vary as the nominal contract position of firm $i$ changes over time:

$$R_{it} = \gamma_{0i} + \gamma_{1i}\rho_t^e + a_{0i}u_t + a_1 \frac{\text{LMP}_{i,t-1}}{S_{i,t-1}} u_t + a_2 \frac{\text{TAX}_{i,t-1}}{S_{i,t-1}} u_t$$
$$+ a_3 \frac{\text{SMP}_{i,t-1}}{S_{i,t-1}} u_t + \epsilon_{it}, \, t = 1, \ldots, T. \tag{4}$$

According to the nominal contracting hypothesis, the coefficients $a_1$, $a_2$, and $a_3$ should all be negative. If the effects of unexpected inflation on the value of nominal contracts are the same for all firms, the coefficients $a_1$, $a_2$, and $a_3$ will be the same for different firms, and a pooled time-series, cross-sectional approach can be used to estimate (4). This is important because there may not be much variation in the relative monetary position variables ($\text{LMP}_{i,t-1}/S_{i,t-1}$), ($\text{TAX}_{i,t-1}/S_{i,t-1}$), and ($\text{SMP}_{i,t-1}/S_{i,t-1}$) over time for a given firm $i$, but there is substantial variation in these variables across firms.

If the time-series regression equations in (4) 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 $i = 1, \ldots, N$. This technique is a straightforward application of Zellner's (1962) seemingly unrelated regression (SUR) technique.

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 three 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]

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pected inflation on the value of the stock (e.g., other nominal contracts that 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 that measures the monetary position of the firm.

[14] We use the SAS computer programs for all of the computations in this paper.

## Sequentially Updated Portfolios

To reduce the number of time-series regression equations, $N$, in (4), 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, $\text{LMP}_{i,t-1}/S_{i,t-1}$. 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, $\text{TAX}_{i,t-1}/S_{i,t-1}$. Finally, within each of the previous nine groups, the firms are sorted on the short-term monetary position variable, $\text{SMP}_{i,t-1}/S_{i,t-1}$. 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 $(L, L, L)$, which represents 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 within the sample change; second, new firms are added to and old firms are dropped from the sample. Table 3 contains the sample means and standard deviations of the nominal contracting variables for the 27 portfolios for the 1947–79 period. It is apparent from this table that some of the extreme portfolios have variable levels of the monetary position variables and that there are substantial differences among the 27 portfolios. Table 3 also contains estimates of the coefficient of unexpected inflation, $\gamma_{2i}$, from (2) 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 $\gamma_{2i}$ 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 (nine of these 12 portfolios have negative estimates of $\gamma_{2i}$). Nevertheless, the standard errors for all of the estimates of $\gamma_{2i}$ are large, and the estimates of $\gamma_{2i}$ for different portfolios are highly correlated, so it is inappropriate to view the estimates of $\gamma_{2i}$

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[15] This sequential sorting procedure results in maximum spread for LMP and successively less spread for TAX and SMP. We use this order of sorting since the effect of changes in expected inflation should be greater for contracts with longer maturities.

## TABLE 3

Means and Standard Deviations of Nominal Contracting Variables for 27 Sequentially Updated Portfolios, 1947–79[a]

| Portfolio[b] | $\dfrac{\text{LMP}_{i,t-1}}{S_{i,t-1}}$ Mean | Standard Deviation | $\dfrac{\text{TAX}_{i,t-1}}{S_{i,t-1}}$ Mean | Standard Deviation | $\dfrac{\text{SMP}_{i,t-1}}{S_{i,t-1}}$ Mean | Standard Deviation | Estimate of Sensitivity to Unexpected Inflation[c] $\hat{\gamma}_{2i}$ | $S(\hat{\gamma}_{2i})$ |
|---|---|---|---|---|---|---|---|---|
| (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 $(L, \cdot, \cdot)$ portfolios represent firms with more long-term debt and preferred stock than the $(H, \cdot, \cdot)$ portfolios.

[b] These symbols represent different levels of the nominal contracting variables; e.g., $(H, M, L)$ 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 $R_{it} = \gamma_{0i} + \gamma_{1i}\delta + \gamma_{2i}u_t + \epsilon_{it}$ for the 1947:4–1979:4 period.

in table 3 as evidence in support of the nominal contracting hypothesis.[16]

Table 4 contains estimates of the coefficients $a_1$, $a_2$, and $a_3$ in (4) from the seemingly unrelated regression using the 27 sequentially updated portfolios. This table 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 $i = 1, \ldots, 27$). 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 $a_3$ should be interpreted as 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 4 are inconsistent with 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 $(LMP_{i,t-1}/S_{i,t-1})$, $a_1$ should be negative. Similar analysis indicates that $a_2$ and $a_3$ should also be negative. If we consider all four time periods in table 4, we see that there is only one parameter estimate that 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 that are more than two standard errors *above* zero. Since the estimates in table 4 are generally inconsistent with the nominal contracting hypothesis, 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 4 are surprising because they indicate that data from financial statements do not 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 we accept that conclusion it is worthwhile to consider some alternative tests of the nominal contracting hypothesis to

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[16] The covariance between estimates of $\gamma_{2i}$ 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 3 is about .90, so the estimates of $\gamma_{2i}$ are highly correlated.

[17] In the context of the random parameters regression model, the estimates in table 4 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 large amounts of long-term debt also choose maturity structures of debt that are systematically different from other firms.

## TABLE 4

SEEMINGLY UNRELATED REGRESSION TESTS OF THE NOMINAL CONTRACTING HYPOTHESIS USING SEQUENTIALLY UPDATED PORTFOLIOS[a]

$$R_{it} = \gamma_{0t} + \gamma_{1t}\rho_t^e + a_{0i}u_t + a_1 \frac{LMP_{i,t-1}}{S_{i,t-1}} u_t + a_2 \frac{TAX_{i,t-1}}{S_{i,t-1}} u_t + a_3 \frac{SMP_{i,t-1}}{S_{i,t-1}} u_t + \epsilon_{it},$$

$$t = 1,\ldots,T; i = 1,\ldots,27$$

| Period[b] | 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

$$\gamma_{2t} = a_0 + a_1 \frac{LMP_{i,t-1}}{S_{i,t-1}} + a_2 \frac{TAX_{i,t-1}}{S_{i,t-1}} + a_3 \frac{SMP_{i,t-1}}{S_{i,t-1}},$$

where $a_0$ represents effects that 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 1 to estimate the expected and unexpected inflation, $\rho_t^e$ and $u_t$.

[c] This statistic tests the hypothesis that $a_{1i} = a_1$ for $i = 1,\ldots,27$. 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 $i = 1,\ldots,27$.

[e] This statistic tests the hypothesis that $a_{3i} = a_3$ for $i = 1,\ldots,27$.

[f] This statistic tests the hypothesis that $a_{1i} = a_1, a_{2i} = a_2$, and $a_{3i} = a_3$ for $i = 1,\ldots,27$. This and the test statistics described in nn. c–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 · $(T - 6)$ df.

* More than two standard errors from zero.

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assure that the results in table 4 are not due to faulty statistical analysis.

## 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 II 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 and Sinquefield (1979) corporate bond portfolio, $CB_t$. The premise is that the primary cause of changes in bond prices is changes in future expected inflation. Following that logic, we replicate the tests in table 4 using $CB_t$ instead of the unexpected inflation rate, $u_t$, in (4).

Table 5 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 5 to make them comparable to the results in table 4, since unexpected inflation, $u_t > 0$, is associated with negative bond returns, $CB_t < 0$.

TABLE 5

SEEMINGLY UNRELATED REGRESSION TESTS OF THE NOMINAL CONTRACTING
HYPOTHESIS ANALYZING THE EFFECT OF CORPORATE BOND RETURNS[a]

$$R_{it} = \gamma_{0i} + \gamma_{1i}\rho_t^e + a_{0i}CB_t + a_1 \frac{\text{LMP}_{i,t-1}}{S_{i,t-1}} CB_t$$

$$+ a_2 \frac{\text{TAX}_{i,t-1}}{S_{i,t-1}} CB_t + a_3 \frac{\text{SMP}_{i,t-1}}{S_{i,t-1}} CB_t + \epsilon_{it},$$

$$t = 1, \ldots, T; \ i = 1, \ldots, 27$$

| Period[b] | Sample Size ($T$) | $-a_1$ | $-a_2$ | $-a_3$ |
|---|---|---|---|---|
| 1947:4–1978:4 | 125 | .168* | .175 | .145* |
|  |  | (.077) | (.110) | (.062) |
| 1947:4–1963:4 | 65 | .113 | .667 | .494 |
|  |  | (.372) | (.394) | (.377) |
| 1964:1–1978:4 | 60 | .043 | .103 | .103 |
|  |  | (.077) | (.109) | (.057) |
| 1953:1–1971:2 | 74 | .646* | .487 | −.019 |
|  |  | (.199) | (.248) | (.228) |

[a] Asymptotic standard errors in parentheses. These regressions are similar to the estimates in table 4, 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. To make these results comparable to the results in table 4, 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 1 to estimate expected inflation, $\rho_t^e$.

* More than two standard errors from zero.

In general, the results in table 5 are less consistent with the nominal contracting hypothesis than the results in table 4, since all but one of the coefficient estimates are positive and three of the estimates are more than two standard errors above zero. For example, the estimate of the coefficient of long-term monetary position, $a_1$, for the 1947–79 period implies that a 1 percent loss to bondholders is associated with a 0.17 percent *loss* to stockholders if the LMP/S ratio is 1. Instead of a wealth transfer, it seems that there is some phenomenon that affects both bond and stock returns in the same direction that dominates the wealth transfer.[18] Note that the phenomenon has to be stronger for firms with large amounts of debt, since $a_1$ is multiplied by ($\text{LMP}_{i,t-1}/S_{i,t-1}$).

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.

### Paired Comparison Tests for Nominal Contracting Effects

The seemingly unrelated regression tests assume that the effect of unexpected inflation on stock returns, $\gamma_{2i}$, is linearly related to the size of the contract relative to the stock value. While this assumption 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 ($\text{LMP}_{i,t-1}/S_{i,t-1}$) in (3). This does not cause a problem as long as the differences in coefficients across portfolios are not related to the magnitudes of the nominal contract variables.

Nevertheless, as a check on the tests in tables 4 and 5, we compare the coefficients of unexpected inflation in (2) for portfolios with different levels of the nominal contracting variables in table 6. For ex-

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[18] The relation that should exist between stock returns and bond returns if the value of the firm is unaffected can be illustrated with a simple example. Consider a firm with bonds, $B$, and stocks, $S$, so that the return to the firm is just a weighted average of the returns to the stocks and the bonds:

$$R_V = \left(\frac{S}{B+S}\right)R_S + \left(\frac{B}{B+S}\right)R_B.$$

The return to the stock is

$$R_S = \left(\frac{B+S}{S}\right)R_V - \left(\frac{B}{S}\right)R_B,$$

so if the value of the firm is unaffected ($R_V = 0$), $R_S = -(B/S)R_B$. In terms of the regressions in table 5, LMP $= -B$ and $R_B = CB$, so that $a_1$ should equal 1.0 in this example.

ample, in part B of table 6 the coefficient of unexpected inflation, $\gamma_{2i}$, is constrained to be the same for all portfolios with high levels of the long-term monetary position variable $(H, \cdot, \cdot)$ and for all portfolios with low levels of that variable $(L, \cdot, \cdot)$. Under the nominal contracting hypothesis $\gamma_{2i}$ 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 $\gamma_{2i}$ by regressing the difference in the portfolio returns, $R_H - R_L$, against expected and unexpected inflation:

$$(R_H - R_L) = \gamma_{0i} + \gamma_{1i}\rho_t^c + \gamma_{2i}u_t + \epsilon_{it}, t = 1, \ldots, T. \quad (5)$$

Part A of table 6 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 $(L, L, L)$. Parts 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 6 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 $-1.87$.

Although the results for the other periods provide some support for the nominal contracting hypothesis, the estimates for the 1953–71 subperiod are puzzling. In part B it seems that firms with large amounts of long-term nominal liabilities $(L, \cdot, \cdot)$ are *hurt* by unexpected inflation more than firms with small amounts $(H, \cdot, \cdot)$, and this difference has a $t$-statistic of 3.03. In addition, in part 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 6 seem more consistent with the nominal contracting hypothesis for some time periods, there are still a number of results that are inconsistent with this hypothesis.

## IV. Alternative Tests for Nominal Contracting Effects

In addition to the tests reported in tables 4, 5, and 6, 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

## TABLE 6

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 LMP $(H, \cdot, \cdot)$ | Low LMP $(L, \cdot, \cdot)$ | $t$-Statistic $(H, \cdot, \cdot) - (L, \cdot, \cdot)$ |
|---|---|---|---|---|
| 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) | −6.171 (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 $(\cdot, H, \cdot)$ | Low Tax $(\cdot, L, \cdot)$ | $t$-Statistic $(\cdot, H, \cdot) - (\cdot, L, \cdot)$ |
|---|---|---|---|---|
| 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 SMP $(\cdot, \cdot, H)$ | Low SMP $(\cdot, \cdot, L)$ | $t$-Statistic $(\cdot, \cdot, H) - (\cdot, \cdot, L)$ |
|---|---|---|---|---|
| 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 |

TABLE 6 (*Continued*)

| Period[b] | Sample Size ($T$) | High SMP $(\cdot, \cdot, H)$ | Low SMP $(\cdot, \cdot, L)$ | t-Statistic $(\cdot, \cdot, H) - (\cdot, \cdot, L)$ |
|---|---|---|---|---|
| 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 $\gamma_{2i}$ from the regression

$$R_{it} = \gamma_{0i} + \gamma_{1i}p_t^r + \gamma_{2i}u_t + \epsilon_{it}, t = 1, \ldots, T$$

using different sets of portfolios. $R_{it}$ from table 3. For example, the $(H, H, H)$ portfolio contains firms that have high levels of all three nominal contracting variables. The t-statistic for testing the hypothesis that the coefficients of unexpected inflation are 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 LMP $(H, \cdot, \cdot)$ and the nine portfolios with low LMP $(L, \cdot, \cdot)$, e.g. 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 1 to estimate expected and unexpected inflation, $p_t^r$ and $u_t$.

yield results that 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.[19]

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 4, 5, and 6, excluding firms in the railroad, trucking, airline, telephone, and natural gas industries.[20] This excludes a total of 93 firms, but none of the results change in a substantive way. In addition, estimates of the ef-

[19] Keran (1976) argues that utility stock prices behave like bond prices because of the implicit nominal contract that results from regulation.

[20] Specifically, all firms with SIC codes 4011, 4210, 4400, 4511, 4811, 4922, and 4925 are excluded from the 27 sorted portfolios and analyzed separately. The COMPU-STAT Industrial File does not contain data for electric utilities, banks, or other financial institutions.

fects 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, $\Sigma$, is constant over time. However, since a given firm will not generally stay in the same portfolio in all time periods, it seems unlikely that $\Sigma$ is actually constant through time.[21] One way to solve this problem is to construct portfolios that do not change composition over time. There are 158 firms that have data for the entire 1947–79 period. 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 contract 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.[22] Nevertheless, if the covariance matrix of regression disturbances from (4) 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 4 and 5 using the fixed composition portfolios. There are a few differences between these results and the results in tables 4 and 5, 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.

## V.    Conclusions

This paper analyzes the effects of unexpected inflation on the stock returns of firms with different nominal contracting positions. A ma-

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[21] 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.

[22] For example, firms that were not listed on the NYSE 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 do not 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.

jor 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. We find little evidence that stockholders of firms with relatively large net monetary liabilities benefited from unexpected inflation relative to the stockholders of firms with net monetary assets during the 1947–79 period. This result is surprising, since the distributive effects of unexpected inflation are so well known that they have been the source of numerous journal articles (see, e.g., Budd and Seiders [1971], Van Horne and Glassmire [1972], Bradford [1974], Nelson [1976b], and Kaplan [1977], 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. These tests involve the use of several measures of quarterly unexpected inflation, different types of nominal contracts, and different sample periods. 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 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.

In our minds there are two more likely explanations of 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 were 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 relation 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 offset the effects of changes in expected inflation on long-term debt contracts. It would have to be a contract where the firm was 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.[23]

The second possible interpretation of 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 that 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).[24] 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), Fama (1981), and Geske and Roll (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.

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[23] As an additional check on the results in this paper, we examine the net monetary position variable used by Alchian and Kessel (1959) for approximately 450 NYSE firms from 1946 to 1952. Their data include additional monetary assets and liabilities that are available from balance sheets, such as pension liabilities. The dispersion in these estimates is similar to the dispersion in the monetary position variables in table 3. Thus, it seems unlikely that non-balance-sheet contracts could totally offset the nominal contracting positions we measure. We thank Armen Alchian for providing these data.

[24] Of course, there can be some firms whose assets and liabilities are all nominal contracts (e.g., savings and loans) where unexpected inflation will be an important determinant of stock returns. For example, for the 1964–79 period a portfolio of eight NYSE-listed savings and loans has an estimate of $\hat{\gamma}_{2i} = -11.0$ with a $t$-statistic of $-2.17$. When the corporate bond return, $CB_t$, is included in the regression instead of unexpected inflation, $u_t$, the coefficient estimate is 3.53 with a $t$-statistic of 6.5. Thus, the returns to the portfolio of savings and loan stocks are affected by unexpected inflation just as long-term corporate bonds are.

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