The Decline of Inflation and the Bull Market of 1982–1999

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Abstract

If stocks were severely undervalued in the late 1970s and early 1980s, then the bull market starting in 1982 was partly just a correction to more normal valuation levels. This paper tests the hypothesis that investors suffer from inflation illusion, resulting in the undervaluation of equities in the presence of inflation, with levered firms being undervalued the most. Using firm level data and a residual income/EVA model, we find evidence that errors in the valuation of levered firms during inflationary times result in depressed stock prices. Our misvaluation measure can be used with expected inflation to make statistically reliable predictions for real returns on the Dow during the subsequent year. Our model suggests that stocks were overvalued at the end of the 1990s.

I. Introduction

Beginning in August 1982, the U.S. stock market experienced one of the longest bull markets in history. From August 1982 to December 1999, the compounded real total return on the Dow Jones Industrial Average was 15% per year, far in excess of the increase in earnings or book value. Explanations that the academic literature has focused on for the rise in price-earnings and market-to-book ratios include improved earnings growth prospects and a decrease in the equity risk premium. While we believe that both of these factors have played a significant role in the bull market, we argue, using the hypothesis originally suggested by Modigliani and Cohn (1979), that the early stages of the market runup were partly attributable to a recovery from inflation-induced valuation errors. Specifically, investors commit two errors in valuing equities: they capitalize real cash flows at nominal rates, and they fail to recognize the capital gain that accrues to

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the equity holders of firms with fixed dollar liabilities in the presence of inflation. We propose that these two errors result in substantial undervaluation of equities when inflation is high, as in the early 1980s. The bull market that we have seen is in part a correction from this previous level of undervaluation.

We develop a measure of intrinsic value using a residual income model that adjusts for inflation-induced distortions in accounting income. When compared to the stock price, this provides a measure of misvaluation. In cross-sectional regressions, we find that the amount of undervaluation is positively correlated with leverage and expected inflation, consistent with our inflation illusion hypothesis. We aggregate this measure to construct a value-to-price ratio for the Dow. By itself, this measure of misvaluation fails to reliably predict real returns on the Dow over the subsequent year. Future real returns are, however, negatively related to expected inflation. When our value-to-price measure and expected inflation are both used in a regression for predicting the next 12 months' real return on the Dow, each variable has reliable predictive power, with the regression having an adjusted R^2 of 27%. Neither variable works well by itself because of omitted variable bias. These two variables are highly correlated with each other, and they have opposite effects on expected future stock returns.

Although we focus on misvaluation as the explanation for the relation between expected inflation and valuation measures, a number of alternative hypotheses have been advanced in the literature. These alternatives include the possibility of analyst earnings forecast errors being correlated with the level of inflation, tax and inflationary distortions in accounting numbers, changes in the equity risk premium, and a correlation of expected inflation and expected real economic growth (the proxy hypothesis). We also discuss the nominal contracting hypothesis, which can partly explain revaluations when inflation unexpectedly changes. After presenting our empirical results, we discuss the ability of these alternatives to explain the evidence. Finally, we find that even if the equity premium has fallen to zero, our valuation model calculates that the Dow was overvalued in the late 1990s.

The remainder of this paper proceeds as follows. Section II describes the inflation illusion hypothesis. Section III describes the methodology and data, and shows how the residual income model of valuation must be corrected to incorporate the distortions caused by inflation. Section IV presents the regression results. Section V discusses alternative explanations for our results. Section VI concludes.

II. The Inflation Illusion Hypothesis

A. The Capitalization Rate Error

The correct value of a firm's stock can be computed by capitalizing nominal cash flows to equity holders at a risk-adjusted nominal rate, or real cash flows at a risk-adjusted real rate. Assuming a constant discount rate, inflation rate, and real growth rate, so that simple growing perpetuity formulas can be used, these two methods are equivalent, i.e.,

(1)
$$V_0 = \frac{\text{Div}_0(1+g)(1+p)}{R-G} = \frac{\text{Div}_0(1+g)}{r-g},$$

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where Div_t = the expected dividends per share for period t,
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 V_0 = the present value of the perpetuity of cash flows beginning with D_1 ,

R = the nominal discount rate,

G = the nominal growth rate,

p = the expected rate of inflation,

r = the real discount rate, i.e., r = ((1+R)/(1+p)) - 1, and

g = the real growth rate of the cash flows, i.e., g = ((1+G)/(1+p)) - 1.

During periods of inflation, the nominal cost of equity is higher by virtue of higher inflation. However, the nominal growth rate of earnings will, ceteris paribus, also be higher—and, consequently, inflation's effect on the real value of the stock will be neutral. Misvaluation will occur if investors use a nominal discount rate but fail to incorporate a higher nominal growth rate into their valuations. Of course, inflation distorts the cost of inventory and taxable income, and these distortions will affect real cash flows. These distortions are discussed in Section V.C. The equilibrium required real return on equity may also covary with inflation, as discussed in Section V.E.

Modigliani and Cohn hypothesize that capitalizing current earnings at the nominal cost of equity is a common practice. This practice implicitly assumes a real earnings growth rate of minus the rate of inflation and a 100% dividend payout rate, or at least that any reinvested earnings will generate zero net present value. Unless earnings are distorted in a manner that exactly compensates for the failure to incorporate nominal earnings growth, this will result in undervaluation when inflation is positive.

B. The Debt Capital Gain Error

Inflation has two completely separate effects on nominal debt instruments. First, an unexpected increase in inflation will result in a wealth transfer from bondholders to the equity holders of levered firms. At any point, these wealth transfers are not forecastable (as the inflation is unexpected). Second, fully expected inflation results in wealth transfers from bondholders to equity holders, as inflation erodes the real value of the bondholder's asset. This wealth transfer is fully forecastable, and indeed is priced in the nominal yield on the bond. In this paper, we focus on the second of these two effects.

The debt capital gain error is more subtle and less obvious to most investors and financial economists than the capitalization rate error. In the valuation of equities, analysts frequently use equity net income or earnings per share (EPS) to derive their valuations. (In this paper, the word earnings always refers to net income. Operating earnings, i.e., earnings before interest and taxes, are explicitly named as such.) The rationale behind this approach comes from the belief that earnings are a proportional proxy for cash flows and future dividends. In the presence of anticipated inflation, this belief is fundamentally wrong for levered firms, and will result in the undervaluation of net debtors. Debt, being a nominal or fixed dollar contract, is reduced in real value terms by inflation, but bondholders are compensated for this by an inflation premium in the nominal interest rate they

charge the firm. This higher nominal borrowing cost results in lower net income for the firm. The decline in net income, however, is offset by the decrease in the real value of nominal liabilities. The cash flow associated with this economic gain occurs when a firm increases its nominal borrowing to keep the real value of its debt constant. The proceeds from the incremental debt are a cash flow that accrues to equity holders. Generally accepted accounting principles do not recognize this gain, but it is a true economic gain to equity holders, whether or not accountants recognize it. Any valuation approach that relies on earnings will be biased downward for levered firms in the presence of inflation unless explicit corrections are made. This misvaluation is not due to an inflation surprise, or a change in unanticipated inflation; rather, this error can occur even if investors have perfect foresight about future inflation.

The intuition behind the debt capital gain error is analogous to a homeowner who, in a period of high inflation, has a mortgage with a high nominal borrowing cost (and, therefore, less disposable income). Due to the nominal appreciation of the house, however, the homeowner is able to take out a home equity loan and supplement his or her disposable income with the proceeds. Indeed, to keep the loan to value ratio constant, the homeowner must constantly borrow more.

To illustrate the debt capital gain error, assume a zero real growth firm that pays all earnings out as dividends and has accounting depreciation that exactly equals the economic depreciation of assets. (In periods when there has been prior inflation, historical cost depreciation will generally not satisfy this assumption. We address this in Section V.C.) At time zero, the firm has debt per share of D_0 with a real interest rate of r, operating income per share of X_0 , and an income tax rate of T. In a world of no inflation, the expected EPS at time one is

(2)
$$EPS_1 = (1-T)[X_1 - rD_0].$$

To avoid the problem of wealth transfers between debt and equity holders due to inflation surprises, assume that debt is repayable on demand. This way, at the onset of steady inflation p, the old debt is replaced by new debt with the same face value but at an interest rate of R where R = r + p. The EPS at time one of the levered firm in the presence of inflation is

(3)
$$EPS_1 = (1-T)[X_1 - RD_0] = (1-T)[X_1 - rD_0 - pD_0].$$

The difference between equations (2) and (3) is the amount by which the onset of inflation reduces expected EPS, i.e., $(1 - T)pD_0$. The higher is a firm's leverage, the more will EPS be reduced by inflation. If inflation is neutral, the basic earning power of the firm remains unchanged in real terms, and the level of operating income will increase with inflation, i.e., $X_1 = X_0(1 + p)$. Therefore, the firm's assets must also increase at the rate of inflation to support this increase in nominal profitability. At all times, the value of the firm, A, is the sum of the value of equity, V, and debt, D. At t = 0, $A_0 = V_0 + D_0$. At t = 1, prior to any new debt issue but after nominal interest and dividends have been paid, the value of assets has grown by the inflation rate, less the inflationary component of the nominal

¹It is common practice to ignore the cross-product as it is small for inflation rates that have prevailed in the U.S. In our empirical analysis, however, we incorporate the cross-product term.

interest expense pD; i.e., $A_1 = A_0(1+p) - pD_0 = V_0(1+p) + D_0$. To maintain the previous debt to equity ratio, the firm must issue incremental debt in the amount pD_0 .

The cash flow from the nominal debt sale offsets the loss incurred by the equity holders through having to pay higher nominal interest expense. Thus, the inflation premium in nominal interest expense pD is in fact repayment of the debt in real terms. The tax code, in effect, allows firms to deduct this repayment of principal from taxable income, while the gain to equity holders is untaxed. Raising pD via an increase in nominal debt outstanding allows dividends to be maintained, even though EPS falls due to the higher nominal interest expense.

The inflation illusion hypothesis, composed of both the capitalization rate and debt capital gain errors, is graphically illustrated in Figure 1. This shows the theoretical level of undervaluation given increasing leverage and different levels of inflation, assuming that the two cognitive errors are made. Notice that even when leverage is zero, there is still positive undervaluation caused by the capitalization rate error, unless inflation is zero. For any given level of inflation, the undervaluation is greater the higher is the level of debt due to the debt capital gain error. This effect is stronger the higher is the level of inflation.

FIGURE 1

The Effects of the Capitalization Rate and Debt Capital Gain Errors on the Level of Equity Valuation

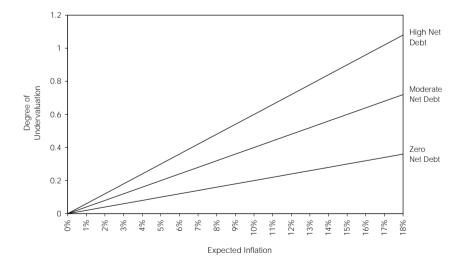


Figure 1 shows the implications of the inflation illusion hypothesis. The vertical axis measures the degree of undervaluation—higher means more undervaluation (note that the numbers are merely for illustration). Net Debt is nominal liabilities less nominal assets all as a fraction of total assets. The zero Net Debt line represents the effect of the capitalization rate error acting alone. The moderate and high Net Debt lines represent the combined effect of the capitalization rate error and the debt capital gain error. The greatest undervaluation occurs for high Net Debt firms when inflation is high.

C. Disintermediation

The inflation illusion hypothesis makes direct predictions about the level of stock prices and inflation. Without adding an auxiliary assumption about how the valuation errors get gradually impounded into stock prices, all of the reaction should occur when expectations of inflation change.

To generate a relation between real returns on stocks and expected inflation, a popular inflation illusion explanation is that with high nominal interest rates, many investors move money out of the stock market into interest earning assets. The effect results in negative returns as long as nominal interest rates remain high. This disintermediation does not occur entirely on the days when inflationary expectations change for several reasons. The most important reason is that individuals do not all act simultaneously. Not all individuals keep track of money market fund and bank interest rates on a daily basis, and banks are typically somewhat sluggish at adjusting rates paid on savings accounts when market interest rates change. Thus, as long as nominal interest rates remain high (relative to some distributed lag of past interest rates), money is pulled out of the stock market. This continued drop in the demand for stocks results in lower returns. Symmetrically, when interest rates have fallen, the disintermediation effect results in a continued flow of money into stocks, boosting returns no matter what the current level of stock prices. These effects are well known among money managers, just as the fact that "money flow" into equity mutual funds is a function of lagged market returns. Even though disintermediation is predictable, no arbitrage opportunity exists because of the high variance of market returns. As explained by Shleifer and Vishny (1997), low frequency misvaluations expose arbitrageurs to risks, so market forces do not necessarily lead to their elimination.²

D. Valuation Errors in the Literature

Is it plausible that the market makes the valuation errors that Modigliani and Cohn allege? A popular model for calculating what the level of the stock market should be is the so-called "Fed model," although this is not necessarily used by the Federal Reserve Board. The Fed model calculates the market's fair value price-earnings ratio by equating the market's earnings yield to the nominal yield on 10-year Treasury bonds (see, e.g., Cooper (2001) in *Business Week*). In using the nominal bond yield, the Fed model makes the capitalization rate error. In using earnings without any further adjustment, the Fed model makes the debt capital gain error. In the academic literature, the residual income model, as implemented by Lee, Myers, and Swaminathan (1999) (hereafter LMS), which computes the intrinsic value of a stock as current book value plus the present value of future economic value added (EVA), also makes both of the mistakes that Modigliani

²Perhaps the most obvious recent example of this is the Internet bubble that peaked in March 2000. Even though financial publications ran numerous articles stating that Internet stocks were dangerously overvalued in 1999, short sellers lost substantial amounts of money as the bubble got bigger. High frequency misvaluations, on the other hand, do provide opportunities for arbitrageurs. By definition, high frequency misvaluations disappear rapidly, whereas low frequency misvaluations disappear unpredictably, perhaps only after long periods. The Japanese stock market and land price bubbles of the 1980s are other examples of low frequency misvaluations where arbitrage fails.

and Cohn mention. It treats earnings as the source of value to equity holders, resulting in undervaluation of levered firms in times of inflation. Additionally, it calculates the terminal value as a non-growing perpetuity discounted at the nominal capitalization rate, implicitly assuming a real growth rate equal to minus the inflation rate.

Using earnings as a proxy for cash flows ignores the nominal capital gains that equity holders accrue when a firm has debt in the presence of inflation. Net income does not reflect the cash flow available from increasing nominal debt to compensate for inflation. As pointed out by Berens and Cuny (1995) and Modigliani and Cohn (1979), a (nominally) growing firm can maintain zero EPS into perpetuity by having interest expense equal to pretax operating profits and issuing new debt equal to pretax operating profits each year, and then distributing the proceeds of this increase in debt to shareholders as dividends.

The question, which is an empirical one, and the subject of this paper, is whether the marketplace makes the mistakes alleged by the inflation illusion hypothesis. In the 1970s, the real level of the Dow fell, while inflation averaged 8.7% per year. Only in the 1980s with the decline in inflation did the Dow recover and make significant real gains. These patterns are consistent with the hypothesis that the high inflation of the mid and late 1970s and early 1980s led to systematic undervaluation of equities, and this undervaluation was more pronounced for firms with high leverage. With the low inflation of the 1990s, this undervaluation ended

III. Methodology and Data

Finding evidence of misvaluation is by definition a tricky problem. Any valuation model that calculates the "true" value to be different from the price at which the stock trades is either saying that the market has mispriced the stock or that the valuation model itself is incorrect. The latter conclusion is the one more likely to be accepted by most academics unless evidence to the contrary is presented. However, the recent literature has raised the notion that the price of a stock is merely a proxy for the true or intrinsic value of equity.

Lee, Myers, and Swaminathan (1999) and Frankel and Lee (1998) use a residual income model (equation (4) below) as a measure of the intrinsic value of a stock. They test the hypothesis that the stock price is a noisy measure of the intrinsic value. When the price is above this intrinsic value, the stock is overvalued; when the price is below the intrinsic value, the stock is undervalued. LMS use the ratio of the intrinsic value, V, to the price, P, to predict future stock performance. When V/P is high, future performance will be high as the stock adjusts from its undervaluation, and conversely when V/P is low, the future performance will be low as the stock adjusts from its overvaluation.

As a basis for our tests, we modify the residual income model used by LMS to incorporate inflation adjustments, and compare this with the actual level of

³Cagan (1982), Cohn and Lessard (1981), and Summers (1983) also find support for the Modigliani and Cohn hypothesis. Siegel (1998), in his chapter on inflation and the stock market, notes that shareholders of levered firms benefit from the debt capital gain. Sharpe (2002) presents quantitative evidence on the magnitude of the debt capital gain for the S&P 500.

stock prices of the Dow Jones 30 for the period 1978–1997. The model is a powerful stock valuation tool in that it has several important properties. First, it uses forecasts of earnings, thus incorporating a forward-looking element and directly addressing concerns about a correlation of inflation and future profitability. Second, it allows for a time-varying cost of capital. And third, it has strong theoretical underpinnings, unlike many recent asset-pricing models. By comparing the corrected residual income model with the stock price, we are able to test for specific valuation errors by comparing the degree of misvaluation (the difference between the price and the corrected model's valuation) with the level of inflation and leverage. We also use our measure of misvaluation to predict future real returns on the Dow.

A. Residual Income Valuation Model

The basic residual income model (see Feltham and Ohlson (1995) for the theoretical development), as implemented by LMS, is closely related to the EVA concept, which can be expressed as $\text{EVA}_t = \text{NI}_t - (R \times \text{Equity}_{t-1})$. On a per share basis this is $\text{EVAPS}_t = \text{EPS}_t - R \times B_{t-1}$,

where $EVA_t = \text{economic value added at time } t$,

 $EVAPS_t$ = economic value added per share at time t,

Equity $_t$ = book value of equity at time t,

 NI_t = net income for period ending at time t,

 EPS_t = net income per share at time t,

 B_t = book value of equity per share at time t, and

R = nominal cost of equity capital.

On a per share basis, the residual income model computes the value of the firm's equity at time *t* as the book value of the firm's equity plus the present value of all future expected EVA,

(4)
$$V_{t} = B_{t} + \sum_{i=1}^{\infty} \frac{E_{t} \left[\text{EPS}_{t+i} \right] - (R \times B_{t+i-1})}{(1+R)^{i}},$$

where

 V_t = the value per share of the firm's equity at time t, and $E_t[.]$ = expectation based on information available at time t.

To make equation (4) tractable, it is expressed as a finite sum of the present value of EVAs plus a continuing value term. LMS settle upon a three-term model as their preferred specification,

(5)
$$V_{t} = B_{t} + \frac{\text{FEPS}_{t+1} - R \times B_{t}}{(1+R)^{1}} + \frac{\text{FEPS}_{t+2} - R \times B_{t+1}}{(1+R)^{2}} + \frac{\text{FEPS}_{t+3} - R \times B_{t+2}}{(1+R)^{2}R}$$

where $FEPS_{t+i}$ = the t + i earnings per share forecast for the period ending t + i.

If implemented in this specification, the model makes both of the Modigliani and Cohn valuation errors. No debt capital gain adjustment to forecasted earnings

is made, and the continuing value term is capitalized using the nominal cost of equity. Partly offsetting these effects, no adjustment of depreciation expenses is made for the effects of inflation. To correct the model, we make four adjustments to equation (5).

B. Inflation Adjustments

1. Capitalization Rate Errors: Terminal Growth Assumptions

In the third term of equation (5), it is plausible that EVA per share (FEPS $_{t+3}$ – $R \times B_{t+2}$) should tend toward zero through time as competition erodes the ability of a Dow Jones 30 firm to earn returns in excess of the risk-adjusted cost of capital. Recognizing this, LMS treat the EVA after year t + 3 as a flat perpetuity discounted at the cost of equity, i.e., the third term of equation (5) is capitalized at the nominal cost of equity, R. As the equity cost of capital is a nominal rate that includes an inflation premium, LMS are in effect assuming that in real terms, the EVAs decay toward zero each year at the rate of inflation. (In the high inflation years of 1980–1981, they also assume that negative EVA firms will see their EVA position improve more rapidly toward zero.) This assumption is related to the first conceptual error suggested by Modigliani and Cohn, i.e., discounting real cash flows at a nominal rate. A better approach would be to separate out the effects of inflation and the decay rate of EVA. The final term should capitalize EVA at the real cost of equity plus the rate at which EVA is expected to decay each year; i.e., R - p - g, where p is the long-run rate of inflation and g is the real rate of growth of EVA. Thus R - p is the real cost of equity, and in the case of EVA decaying to zero, g should be negative. Since LMS use nominal R, they are implicitly assuming that p = -g; i.e., the rate of inflation equals the real decay rate of EVA, as stated above. This leads to valuations closer to book value the higher is inflation.

2. Debt Capital Gain Error

Equations (4) and (5) incorrectly assume that the only gains to stockholders are through net income (which is either distributed as dividends or retained for investment). In the presence of fully anticipated inflation, bondholders demand a higher interest payment to compensate them for the depreciation in real terms of their asset, the firm's debt. This higher interest payment will reduce the EPS measure in equations (4) and (5). As we discussed earlier, this reduction in earnings is offset by the capital gain that equity holders enjoy because of the reduction in the real value of the firm's debt. Any earnings-based valuation measure should reflect this gain, for otherwise these models will undervalue equity during times of anticipated inflation. To correct for the debt capital gain error, the expected inflation rate times the market value of debt per share, pD, should be added to the forecasted earnings per share. Note that for this adjustment to be nonzero, there must be both inflation and firm debt. The debt in the pD adjustment reflects

⁴LMS also present results assuming that EVA decays toward an industry median over 12- and 18-year horizons, before applying a flat perpetuity formula. Because with longer horizons the terminal value is a smaller part of the present value, their long horizon results are less sensitive to the capitalization rate error.

the market value of net liabilities of the firm, i.e., nominal liabilities less nominal assets. The pD adjustment is unaffected by taxes.

Real vs. Nominal Required Returns for Calculating EVA

Because they use nominal required returns for calculating economic value added, EVA and residual income models as commonly implemented underestimate residual income in the presence of inflation. In *The Quest for Value* (Stewart (1990)), Bennett Stewart of Stern Stewart & Co., the firm behind EVA, does not appear to recommend any explicit adjustments for inflation in the EVA metric (which is calculated using nominal variables).

Consider the following example of an all equity firm. To simplify things a little, we will just examine the valuation of next year's residual income. Next year's EVA can be expressed as EVA=EPS₁- $R \times B_0$, where EPS₁=EPS₀(1+p+g) and is the forecasted earnings per share for t=1. As the nominal rate R is the sum of the real cost of equity r and the expected inflation rate p, we can express EVA as EVA = EPS₀(1+p+g) – $(r+p)B_0$. Taking the first derivative to examine the effect of inflation, p, on EVA, we obtain ∂ EVA/ ∂p = EPS₀ – B_0 . This derivative is negative, as long as the return on equity is less than 100%. The use of nominal rates in the calculation of EVA will result in undervaluation when inflation is positive. A straightforward way of avoiding this is to use real costs of equity throughout the valuation and deflate all nominal values (such as EPS, debt, and book equity) by the inflation rate.

4. Depreciation and Book Value Adjustments

In the presence of prior inflation, a firm's historical depreciation expense will understate the true replacement cost and, therefore, will lead to overstated accounting income. To overcome this, the depreciation adjustment, DA, which is the difference between the inflation-adjusted depreciation expense and actual depreciation expense, must be subtracted from reported earnings. A failure to incorporate the depreciation adjustment will tend to offset the effects of the two cognitive errors (see Figure 4 of Sharpe (2002) and Modigliani and Cohn (1979)).

Inflation, through its effect on depreciation, will also lead to book equity being understated relative to replacement cost. As book equity represents the capital base on which the required return is computed, this will lead to overstatement of EVA following a period of inflation. This will also serve to offset the debt capital gain and capitalization rate errors. We explicitly compute replacement book equity by adjusting for the effect of historical inflation on accumulated depreciation.

5. The Corrected Residual Income Model

Reflecting all these changes (the terminal growth rate g, the real cost of equity r, the debt capital gain pD, the depreciation adjustment DA, and the replacement cost book equity, ReB), the theoretically correct residual income model is

(6)
$$V_t = ReB_t + \frac{\frac{\text{FEPS}_{t+1}}{(1+p_t)} + p_t D_t - \text{DA}_t - r \times ReB_t}{(1+r)^1}$$

$$+\frac{\frac{\text{FEPS}_{t+2}}{(1+p_{t+1})(1+p_t)} + \frac{p_{t+1}D_{t+1}}{(1+p_t)} - \text{DA}_t - \frac{r \times ReB_{t+1}}{(1+p_t)}}{(1+r)^2} \\ + \frac{\frac{\text{FEPS}_{t+3}}{(1+p_{t+2})(1+p_{t+1})(1+p_t)} + \frac{p_{t+2}D_{t+2}}{(1+p_{t+1})(1+p_t)} - \text{DA}_t - \frac{r \times ReB_{t+2}}{(1+p_{t+1})(1+p_t)}}{(1+r)^2(r-g)}.$$

C. Outline of the Testing Method

To test the inflation illusion hypothesis, we perform two types of tests. One group of tests uses aggregate time-series data and focuses on the ability of our measure of misvaluation to forecast future real returns. The other group of tests uses firm level pooled time-series cross-sectional data and focuses on the relation between the level of misvaluation and both leverage and expected inflation.

Both groups of tests use the value-to-price ratio, V/P. In general, for V/P greater than one, the stock is undervalued; for V/P less than one, the stock is overvalued. More importantly, however, we are concerned with relative changes in the V/P ratio cross-sectionally and across time. Because the ratio V/P is skewed at the individual firm level (it has a minimum value of zero, and no upper limit), it is transformed by taking logs to make it more well behaved in the cross-sectional analysis. $\ln(V/P)$ can, therefore, be thought of as the proportional misvaluation. $\ln(V/P)$ is used for the firm level analysis, while the raw V/P ratio is used for the aggregate analysis, in line with LMS.

The two residual income models that we use in our analysis are as follows.

Vnom: The unadjusted nominal rate residual income model (equation (5)), which is identical to the model used by LMS and forms the benchmark for the other tests. Comparison of the results of the regressions using this model and the modified models will enable us to determine the size of any valuation errors that are occurring.

Vreal: The debt capital gain and EVA decay-adjusted, real rate residual income model (equation (6)). Inflation-adjusted book values and depreciation expense are also used. This is the theoretically correct model that corrects for both types of cognitive valuation errors.

D. Practical Computation of the Residual Income Model

LMS use their model to compute the intrinsic value of the Dow 30 stocks. We also value the Dow Jones 30 companies, which are highly visible stocks. If we find evidence of misvaluation among the largest, most well-known stocks in the market, then it seems very reasonable that this misvaluation may exist for smaller stocks, but the opposite might not be true. The following discussion of how V is computed for each firm is an overview of the method described in more detail in LMS and in Frankel and Lee (1998). Although other variations of the model are possible, LMS find that this specification provides the best predictability of future returns.

The nominal cost of equity, R, is computed as a time-varying riskless rate plus the historical market risk premium. This is the method used by LMS. The riskless rate used is the annualized monthly Treasury bill rate. The equity risk premium used is the geometric average excess return over the one-month T-bill rate for the NYSE/AMEX value-weighted market portfolio from January 1945 to month t-1.5 The use of the historical equity risk premium, while recommended by major finance textbooks, is not without controversy (see, e.g., Fama and French (2002)). In Section V.E, we address how much the equity risk premium would have to vary to keep price equal to value at all points in time.

I/B/E/S provides forecasts of one- and two-year(s) ahead earnings per share, as well as of the long-term growth rate. We use the one-year ahead forecast (FEPS_{t+1}) and the two-years ahead forecast (FEPS_{t+2}), and compute the three-years ahead forecast (FEPS_{t+3}) using the two-years forecast multiplied by the long-term growth rate: FEPS_{t+3} = FEPS_{t+2} × LTG, (where a 15% growth rate is expressed as 1.15). When the long-term growth rate is not available, as is the case in the earlier years of I/B/E/S data, the growth rate from the one- to two-year(s) forecast is used, i.e., FEPS_{t+3} = (FEPS_{t+2})²/FEPS_{t+1}. Where earnings forecasts are not for a full year ahead, e.g., when a forecast is made for the December yearend in June, we discount these forecasts by the remaining fraction of the year to the actual earnings date. We differ here from LMS who always use full years when discounting.⁶

Future book values per share are computed using the clean surplus relation, $B_{t+1} = B_t + \text{EPS}_{t+1} - \text{Div}_{t+1}$, where $\text{Div}_{t+1} = \text{dividend}$ per share at t+1. Future dividends per share are estimated as follows. If $\text{EPS}_{t+1} < \text{or} = \text{EPS}_t$, then $\text{Div}_{t+1} = \text{Div}_t$, and if $\text{EPS}_{t+1} > \text{EPS}_t$ then $\text{Div}_{t+1} = \text{Div}_t (1 + \text{expected inflation} + 0.03)$. This method ensures a steady upward growth in dividends for firms that are seeing earnings growth. We use this instead of a dividend payout ratio (as favored by LMS), as a fixed payout ratio when combined with variable earnings will lead to unrealistic fluctuations in dividends. The results, however, are not sensitive to these alternative assumptions regarding the dividend payout ratio.

Stock price and share data are obtained from the CRSP monthly tapes. Company accounting data are from the 1997 and 1998 annual Compustat tapes (including the historic and research tapes for delisted firms). Monthly data are collected for each firm in the Dow Jones Industrial Average from January 1978 through December 1997, giving a potential of 7,200 firm-month observations.

E. Data for Adjustments to the Benchmark Model

We now modify the benchmark model to measure the degree of misvaluation that may occur at a point in time by making the adjustments discussed in Section III.B. Several new data items are required to make these adjustments.

⁵We also compute the Fama and French (1997) industry risk premiums and perform an unreported sensitivity analysis. The Fama-French estimates tend to be much noisier than the market risk premiums and as a result, add more variation to the overall V/P measures. However, they do not produce results significantly different from those using the NYSE/AMEX historical risk premium.

⁶LMS use earnings forecasts from 1979, as they were unable to obtain earnings forecast data prior to 1979. We have I/B/E/S data back to 1978, so our sample includes these years. From 1965–1978, LMS use a time-series model to forecast earnings.

Nominal Liabilities

The pD term in equation (6) requires a measure of debt, D. We use the Net Debt position (Net Debt) of the firm. We compute Net Debt as the sum of nominal liabilities less the sum of nominal assets, as in French, Ruback, and Schwert (1983). Theoretically, this is the correct method, for the capital gain that accrues to equity from having nominal liabilities in the face of anticipated inflation is unrelated to the maturity of the liabilities or the interest rate charged. Several firms in the Dow have significant nominal assets—for example, Sears has substantial credit card receivables.

Book values of debt explicitly assume that the firm's debt is trading at par. For short-term debt and recently issued debt, this is a reasonable approach. However, if interest rates have changed significantly since the debt was issued, then the debt may trade at levels far away from par. As the debt capital gain adjustment is based upon the market value of debt, the use of book values in these cases could lead to an incorrect adjustment. This problem is especially severe in the early 1980s when inflation was high and long-term debt sold at a substantial discount to par value. Ideally one would want to know the market value of debt for each firm in the sample at each month. However, because not all of the debt is publicly traded, we employ an approximation. From the Warga Fixed Income Data Base we compute the ratio of the market value to book value of debt for each firm for each month based on the firm's publicly traded bonds. We then multiply the level of long-term debt (Compustat item 9) by this ratio to approximate the market value of debt. In doing this, we assume that all debt under one year trades at par and that all of the firm's long-term debt, both public and private, trades at the same average discount as the public debt. The month with the largest discount is September 1981, when the average discount was 34% of par value. Our results are not materially affected by the inclusion of this adjustment, rather than just using the par value.

2. Depreciation and Book Value Adjustments

Estimating the depreciation adjustment requires several assumptions to simplify the process: i) asset depreciable life is equal to asset economic life, ii) replacement of assets happens steadily through time, and iii) inflation has been steady over the life of the assets. The depreciation adjustment, DA, is computed by estimating the average age of the assets and then using this to gross up the depreciation expense by the amount of inflation that occurred over the life of the assets, i.e.,

$$\mathrm{DA}_t = \mathrm{Depreciation} \ \mathrm{Expense}_t imes \left[rac{\mathrm{GDP}_t}{\mathrm{GDP}_{t-(n/2)}} - 1
ight],$$

⁷The Compustat items are: debt in current liabilities (34) (current portion of debt and debt under one year), accounts payable (70), income taxes payable (71), current liabilities-other (72), long-term debt-total (9), liabilities-other (75), deferred taxes (35), minority interest (38), preferred stock (130), minus nominal assets of cash and short-term investments (1), receivables-total (2), current assets-other (68), investments and advances-other (32). Nominal assets such as credit card receivables are generally classified under Compustat item 32. We also use just long-term debt (9) in place of Net Debt, and find no significant changes in the qualitative results.

where Depreciation Expense = the annual depreciation and amortization expense reported in Compustat item 14, GDP $_t$ = the level of the GDP deflator at time t, n/2 = [Accumulated Depreciation/Depreciation Expense], representing an estimate of half the depreciable life of the assets. ReB, replacement book equity, is book equity adjusted for the effects of inflation on historical cost depreciation. Using the simplifying assumptions above, ReB is computed as

$$ReB = \sum_{i=1}^{n} \left[\frac{(i/n)X(1+\pi)^{n-i}}{(1+G)^{n-i}} \right],$$

where
$$X = \frac{\text{Book}}{\sum\limits_{i=1}^{n} \left[\frac{(i/n)}{(1+G)^{n-i}} \right]},$$

Book = reported book equity,

 $\pi = (GDP_t/GDP_{t-n})^{1/n} - 1,$

 $G = ROE \times (1 - dpr)$, and dpr is the dividend payout ratio,

 $n = 2 \times (\text{accumulated depreciation/depreciation expense}), an estimate of the depreciable life of the assets.$

X can be thought of as the annual investment in assets needed to replace depleted assets and grow the assets at the nominal rate G. G is estimated using the return on equity and the retention rate. For firms with negative ROE, G is set to equal zero. π is the average rate of inflation over the estimated life of the assets.

Expected Inflation

Expected inflation is needed for both deflating terms and in the computation of the debt capital gain, pD. Several methods of estimating expected inflation exist. They include simple time-series models where monthly inflation is modeled as an MA(1,1) series, interest rate models that derive inflation from the estimated real rate and the expected return on risk-free bonds, and complex macroeconomic forecasting models. Alternatively, various inflation surveys are available such as the Livingston forecast of the CPI and the Survey of Professional Forecasters' (formerly the NBER/ASA) forecast of the GDP deflator. Hafer and Hein (1985) compare several methods and find that, overall, inflation forecasts of the Survey of Professional Forecasters provide the most accurate forecasts.

We use the Survey of Professional Forecasters quarterly prediction of the next year's GDP deflator. These forecast data are the most frequent data because they are quarterly; the Livingston data are only available semiannually. Because the forecast data are quarterly, we assume that the level of expected inflation remains unchanged for three months until the next forecast is published. The GDP

⁸As a robustness check, we also estimated expected inflation by an MA(1,1) process. Several other authors including Ferson and Harvey (1991) use this methodology. This method involves estimating a first difference moving average model on monthly inflation data, and then using the model each month to predict inflation for the next month. Annual rates of inflation are computed by annualizing the monthly forecasts. Our results are not materially affected by the choice of method.

deflator is also a better measure of the overall price level in the economy than the CPI, which just measures a basket of consumer goods. The CPI is also likely to overstate inflation in the early 1980s because nominal mortgage interest rates were included in the basket of goods and services. As inflation accelerates, the CPI increases too rapidly. This problem has since been corrected, but other criticisms of the CPI still exist.

The EVA decay rate *g* is assumed to be 10% per year. Estimating the rationally expected decay rate is almost impossible without knowing the market's long-term expectations of the profitability of each company. Additionally, the decay rate will vary across firms and industries, and across time. The use of various other real decay rates has little effect on the results. Fama and French (2000) estimate an average decay rate of 38% per year, but emphasize that the rate is higher for firms with extreme earnings or unusually low earnings. The higher is the decay rate, the closer to book value will the valuation be.

Real Rate Computation

The expected real rate of interest is needed to compute the real required return on equity and the real rate residual income model. We compute the expected real rate using the Survey of Professional Forecasters' forecast of the change in the GDP deflator, i.e.,

$$E(\text{Real rate}) = \left(\frac{1+1 \text{ year T-bill rate}}{1+\text{forecasted growth rate of GDP deflator}}\right) - 1.$$

For a given month, this real rate is used for all three years of earnings forecasts for all firms. The real cost of equity is computed by adding the estimated real rate to the equity risk premium, computed earlier as the historical average excess return on the NYSE/AMEX value-weighted portfolio. Figure 2 presents the discount rate series that we use and shows that the nominal cost of equity is much more variable than the real cost of equity.

F. Summary Statistics

Table 1 shows the summary statistics and descriptions of the variables. The sample size is 6,946 firm months out of a possible 7,200. Seventy-four observations are lost due to missing items from Compustat and I/B/E/S. Another 180 observations are missing as either Vnom or Vreal is negative. In the aggregate regressions these are recoded to zero, but in the cross-sectional regressions they are omitted as $\ln(0)/\text{Price}$ is undefined. The bulk of these observations are from Navistar and Bethlehem Steel during the early 1980s. The basic measures of misvaluation that will be used in the analysis are the two residual income values, Vnom and Vreal, each expressed as a proportion of price.

The mean levels of the two V/P ratios are not very informative, because the V/P ratios are very dependent upon the magnitude of the equity risk premium. Furthermore, it is well known that analyst earnings forecasts are systematically upward biased. As LMS point out, the V/P ratio could be scaled to have a mean of one, but this would not improve its predictive ability. Therefore, no conclusions about market efficiency can be drawn from the mean levels of the V/P ratios. What

FIGURE 2

Expected Inflation, Expected Real T-Bill Rate, Nominal Cost of Equity, and Real Cost of Equity, 1978–1997

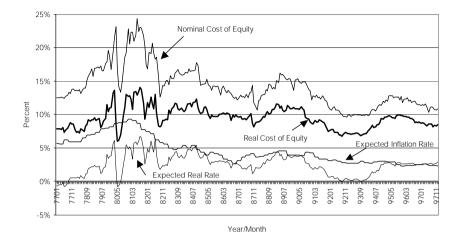


Figure 2 shows the time series of key discount rates used in the paper. The expected inflation rate is the expected change in the GDP deflator over the next year from the Survey of Professional forecasters. The expected real rate is the difference between the expected inflation rate and the yield on a one-year T-bill. The real cost of equity is the annualized average monthly excess return on the NYSE/AMEX from 1945 to month t-1 plus the expected real rate. The nominal cost of equity is the same average excess return but added to the one-month T-bill rate and then annualized.

is more important is the cross-sectional and time-series variation in the V/P ratios and whether this variation is correlated with the level of expected inflation and firm leverage.

For some firms with negative Net Debt, the debt capital gain adjustment actually has a value-reducing effect. The overall impact of these observations is small, as there are only 177 total firm-months with negative pD. At all times, expected inflation is positive.

The correlation between DA, the depreciation adjustment, and pD, the debt capital gain adjustment, is 0.48. This is consistent with the conventional wisdom that firms with substantial tangible (depreciable) assets tend to use debt financing.

IV. Regression Results

A. The Time Series of the Value/Price Measures

Figure 3 shows a time series of the aggregate Price/Vnom, Price/Vreal, and Price/Book equity ratios for the 30 stocks comprising the Dow Jones industrials. The figure shows P/V rather than V/P, which is used in the analysis that follows to allow comparison with LMS. The aggregate Price/Book ratio is computed in the

	,,,,,	niolo value	Mododio			
Variable	N	Mean	Median	Standard Deviation	Min	Max
Individual Firm/Month Variables						
Vnom/Price	6946	0.74	0.70	0.27	0.004	4.44
Vreal/Price	6946	0.97	0.85	0.56	0.04	10.12
Net Debt/TA	6946	0.30	0.31	0.17	-0.12	0.96
Market Value/Par Value of bonds	6946	0.93	0.98	0.14	0.42	1.43
Expected inflation × Net Debt/share	6946	1.18	0.91	1.15	-0.53	8.74
DA per share	6946	1.58	1.18	1.51	0	11.28
Replacement Book/Book Equity	6946	1.22	1.21	0.12	1	1.70
Monthly Variables, Annual Rates						
E(Real rate)	240	2.65%	2.61%	1.48%	-0.73%	6.70%
E(Inflation)	240	4.58%	3.98%	1.98%	2.30%	9.37%
Nominal cost of equity	240	14.13%	13.61%	3.13%	9.66%	24.43%
Real cost of equity	240	9.57%	9.61%	1.51%	5.99%	14.10%
Monthly Aggregated Variables						
Vnom/Price (Vnom/P)	240	0.74	0.73	0.13	0.50	1.31
Vreal/Price (Vreal/P)	240	0.97	0.88	0.29	0.52	1.91

TABLE 1
Summary Statistics for Firms with Data Available for Computation of Various Residual Income Intrinsic Value Measures

There are a possible 30 firms per month and 240 months (January 1978-December 1997) giving a total of 7,200 potential firm months. Price, Vnom, and Vreal are in dollars per share of stock. Price is the CRSP stock price for the month end. Observations are only included where each of the intrinsic value measures is positive. Vnom is the residual income intrinsic value measure of the stock for the month end computed using nominal rates. Vreal is the residual income model adjusted for the debt capital gain and the EVA decay rate and using real rather than nominal rates. Net Debt/TA is the firm's net debt(Annual Compustat items: (34 + 70 + 71 + 72 + 9 + 75 + 35 + 38 + 130) - (1 + 2 + 68 + 32)) divided by total assets. Item #9 (Long-term debt-total) is adjusted by the ratio of market value of bonds over par value of bonds as reported in the Warga database. For firms without publicly traded debt reported by Warga, this ratio was set equal to unity. Net Debt per share is Net Debt divided by number of shares. DA per share is the depreciation adjustment to correct for the effect of inflation on historical depreciation charges divided by shares. Replacement book equity per share is book equity corrected for effect of inflation. E(Inflation) is the expected change in the GDP deflator from the Survey of Professional Forecasters. E(Real rate) is the expected riskless real rate computed as the difference between the one-year T-bill rate and the inflation forecast. The nominal cost of equity is the capitalization rate computed using the equity risk premium (the average return on the NYSE/AMEX value-weighted portfolio minus the average T-bill rate, from 1945 to month t-1) plus the current T-bill rate. The real cost of equity is computed as the sum of the equity risk premium and the expected real rate.

same manner as the price-to-value ratios. Aggregate V/P measures are computed as

$$V/P_t = \sum_{i=1}^{30} V_{it} / \sum_{i=1}^{30} P_{it},$$

where V/P_t = the aggregate V/P for month t,

 V_{it} = one of the two V measures for firm i in month t, and

 P_{it} = the stock price for firm i in month t.

Figure 3 merits two comments. First, the LMS valuation model (Price/Vnom) has noticeably more short-term variation than the corrected valuation model (Price/Vreal). This is due to Vnom's sensitivity to changes in nominal interest rates. Second, unlike price-to-book and Price/Vreal, Price/Vnom shows very little trend because the use of nominal discount rates leads to a low valuation when inflation is high and stock prices are depressed.

FIGURE 3

Price-to-Value Measures and Price-to-Book Equity Ratio, 1978–1997

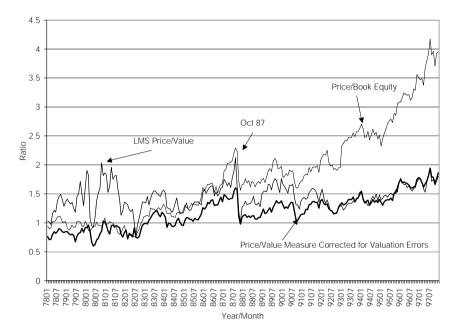


Figure 3 shows the time series of the aggregate price-to-value ratio (the inverse of the aggregate V/P ratios shown in Table 1) using the Lee, Myers, and Swaminathan (1999) methodology and the aggregate price-to-value measure corrected for both of the Modigliani and Cohn (1979) valuation errors, as well as for inflation's effect on depreciation changes and the use of a real cost of equity in calculating economic value added. The ratios are the sum of the prices of each stock in the Dow for the month divided by the sum of the intrinsic value measures for each stock. The price-to-book equity ratio is provided for comparison and is computed as the ratio of the sum of the stock prices over the sum of the book values per share.

B. Predictive Performance of the Nominal Model

The acid test of any model of misvaluation is the ability to predict future returns over some horizon. The length of the horizon depends upon how fast misvaluations are corrected. As a check of our residual income model against that of LMS, we attempt to replicate their basic tests in which the residual income model is used to predict future performance of the Dow Jones Industrial Average (DJIA). The purpose of doing this is to ensure that our residual income computations are broadly in line with the previous work in the area. The basic format of the test is to regress the total real return on the Dow 30 over the next 12 months on an aggregate V/P measure. Specifically,

$$DJIAr_{t+12} = \beta_0 + \beta_1 (V/P)_t + \varepsilon_t.$$

DJIA r_{t+12} is the continuously compounded total real return (dividends and capital gains) for the period t through t + 12 for the Dow 30 firms, i.e., DJIA $r_{t+12} \equiv \ln(1 + r_{mt})$.

The major prediction of the model is that the future real return of the Dow, DJIAr, should be positively related to the aggregate V/P ratio. When V/P is high, the future returns on the Dow stocks will be high as the market corrects from this previous undervaluation. Table 2, column 1 reports the performance of the nominal intrinsic value measure. The aggregate Vnom/P measure, as in LMS, explains around 11% of the annual variation in the Dow, with a slope coefficient of 42. The coefficient of 42 implies that the expected real logged return on the Dow during the next year is 4.2% higher when V/P is 1.1 rather than 1.0. 9

TABLE 2
Predictive Ability of the Nominal and Corrected Residual Income Models

Aggregate V/P measure	Vnom/P (1)	Vreal/P (2)	(3)	Vreal/P (4)	Regression 4 bias based on null of no predictability (5)
Constant	-13.94 (-1.05)	20.55 (2.24)	26.78 (5.41)	6.25 (0.64)	10.81 (4.55)
Value/price	42.00 (2.37)	-5.45 (-0.53)	_	47.94 (2.91)	12.87 (3.09)
Expected inflation	_	_	-2.42 (-2.33)	-7.25 (-4.94)	-1.41 (-2.28)
Adjusted R ²	11.2%	0.004%	11.2%	27.1%	5.3%
N	240	240	240	240	240

The time-series regression is: $DJIAr_{I+12} = \beta_0 + \beta_1 [V/P]_I + \beta_2 E(Inflation) + \varepsilon_I$. The dependent variable is the continuously compounded real percentage return on the Dow Jones Industrial Average (including dividends) for the next 12 months. The first independent variable is the aggregate value-to-price ratio (V/P). $V/P = \sum_{i=1}^{30} V_i / \sum_{i=1}^{30} P_i$ where V_i is the intrinsic value of the ith firm in the Dow Jones Average, and P_i is the price of the ith firm in the Dow Jones Average. $DJIAr_{I+12}$ uses all 30 stocks in the Dow each month, but the value-to-price ratio is calculated using only those firms where V is positive. The two V/P measures are Vnom/P without any debt/inflation adjustment, and Vreal/P with adjustments for the debt capital gain and inflation-induced distortions to depreciation. In the last two columns, expected inflation is the forecasted rate of change of the GDP deflator over the next 12 months, expressed as a percentage. The regressions use Generalized Method of Moments run on 240 monthly observations from January 1978–December 1997, with returns extending to December 1998. t-statistics, corrected for autocorrelation using a Newey-West correction (with 12 lags), are in parentheses. The final column presents the mean coefficients, t-statistics, and R^2 from a Monte Carlo simulation (5000 trials) where a first order vector autoregression data-generating process is used to create an empirical data set based on the null hypothesis of no predictability.

C. Predictive Performance of the Corrected Residual Income Model

Table 2 also includes the results for the real rate residual income model: Vreal/Price. Vreal/P uses the theoretically correct valuation equation, adjusting for the capitalization rate error, the debt capital gain error, the EVA cost of equity

 $^{^9}$ In Panel B of Table III of LMS (1999), a slope coefficient of 0.030 ($R^2 = 19.3\%$) is reported for their sample period of 1963–1996. LMS use monthly returns, rather than annual percentage returns, so 0.030 corresponds to a slope coefficient of 36 in our regressions. Our results differ from theirs because we use a different sample period, we use a more realistic dividend forecasting model, and we use fractional years for discounting the future EVAs. In our sample period, the LMS model explains about 11% of the future variation in the one-year real total returns of the Dow 30 stocks. The fact that the results are broadly in line is important because the nominal model represents our base case for our other regressions.

error, and the depreciation and book value adjustments. In column 2, we present a single variable regression using Vreal/P as the explanatory variable. The striking result is how poorly this adjusted measure does in predicting the one-year ahead return on the Dow.

In column 3, Table 2, we report the results of return regressions with expected inflation as the sole explanatory variable. By itself, expected inflation has significant explanatory power, with a 100 basis point increase in expected inflation over the next year associated with real returns over the next year that are 242 basis points lower. The adjusted R^2 from this regression is 11%. This result shows that the negative relation between stock returns and expected inflation has continued from the late 1970s through the late 1990s. In column 4, where both Vreal/P and expected inflation are used, both variables become much more significant than when used independently.

In the Table 2 regressions, we deal with overlapping return intervals by using Hansen's (1982) GMM estimator with the Newey-West (1987) correction for autocorrelation. Because the V/P ratio used as the dependent variable is a lagged stochastic regressor that is highly autocorrelated, there is a finite sample bias (Stambaugh (1999)). This, coupled with the fact that we have a high degree of overlap in our observations (i.e., adjacent observations of DJIA r_{t+12} contain 11 out of 12 of the same monthly returns) relative to our sample size, means that the null hypothesis of no predictability tends to be rejected too often. To measure the magnitude of this problem, we use a Monte Carlo simulation based on a vector autoregression to generate regression statistics based upon the null of no predictability of returns. The method we use is that of Hodrick (1992), Swaminathan (1996), and Lee, Myers, and Swaminathan (1999). The magnitude of this bias for the two-variable regression is shown in Table 2, column 5. The numbers suggest that the slope coefficients are biased by about 20%.

After adjusting for bias, the two-variable regression model states that expected inflation's effect more than doubles to a 584 basis point (7.25-1.41=5.84) fall in next year's real returns for every 100 basis point increase in expected inflation. More importantly, Vreal/P goes from indistinguishably different from zero to a point estimate of 35.07 (47.94-12.87), implying that as Vreal/P decreases from 1.1 to 1.0, the expected real return over the next year is 351 basis points lower. Roughly speaking, a 10% undervaluation (Vreal/P = 1.1) is associated with a 3.5% higher real return over the following year. This coefficient suggests that approximately one-third of any misvaluation is corrected over a one-year period. The adjusted R^2 is 27%.

Why are expected real returns so strongly associated with expected inflation, once Vreal/P has been controlled for? Because we have controlled for time-varying real rates of interest, expected earnings growth, and distortions in accounting income associated with inflation, business cycle effects cannot easily account for this. Instead, the most plausible reason is disintermediation. Investors, who are confused about nominal vs. real returns, pull money out of equities when nominal interest rates are high. This flow of funds exerts continued downward pressure on stock prices, resulting in negative real returns on equities when nominal interest rates are high. Counterbalancing this is the tendency for stock prices to revert toward fundamental value, as captured by Vreal/P. When both ex-

pected inflation and Vreal/P are included in the same regression, both effects are picked up.

The two-variable regression with both Vreal/P and expected inflation gives dramatically improved predictive power than when either variable is used by itself. Because there is a strong correlation between these two variables ($\rho = 0.86$), which have opposite effects, omitted variable bias is present when just one variable is used. ¹⁰ Lastly, we should note that part of our valuation model's success at predicting returns is attributable to misvaluations that are not related to inflation. For example, as Figure 3 shows, our model predicts low returns in the year after August 1987 (prior to the market crash) and high returns after October 1987.

D. Pooled Cross-Sectional Time-Series Regressions

An important prediction of the Modigliani and Cohn thesis is that for the debt capital gain error to have any impact, both leverage and high expected inflation must be present. To examine the direct effects of expected inflation and leverage on misvaluation, pooled cross-sectional time-series regressions are run on the entire data set. $\ln(V/P)$ is regressed on dummy variables indicating various levels of E(Inflation) and Net Debt/TA interacted with Net Debt/TA or E(Inflation), respectively. Running an OLS regression on a panel data set such as this in which there is likely to be significant time-series autocorrelation and cross-sectional heteroskedasticity will produce unbiased coefficients but standard errors that are biased downward. Therefore, the regressions are estimated using a Generalized Method of Moments estimator (see Hansen (1982)), which allows for the correction of autocorrelation and heteroskedasticity.

Table 3 examines the differential effect of inflation on misvaluation for different degrees of leverage. Regression (1) uses $\ln(\text{Vnom/P})$ as the dependent variable. There is relatively little difference between the effect of inflation on low debt firms relative to high debt firms. For low leverage firms, the inflation coefficient is -1.65 (t=-3.22), which has a sign opposite to that predicted by the inflation illusion hypothesis. This is not too surprising, given that the calculation of Vnom is subject to the two cognitive errors that we have discussed. For high leverage firms, the effects of inflation are calculated by adding the coefficients on expected inflation and the interaction term (-1.65+2.27) to get a statistically insignificant effect of 0.62. The interaction coefficient of 2.27 is significant (t=3.61), assuming independence. While there is some evidence here of high-levered firms being

 $^{^{10}}$ The high correlation between Vreal/P and expected inflation may also indicate a multicollinearity problem when both variables are used in the same regression. The dramatic improvement in R^2 in the two variable regression in comparison to the one variable regressions suggests that multicollinearity is not a problem. As a robustness check, however, we rerun regression (4) on subsets of the data and find that the broad magnitudes of the coefficients remain unchanged. Additionally, we reestimate the model after orthogonalizing the variables and find that both expected inflation and Vreal/P are still significant.

¹¹Panel dataset regressions such as those that we report in Tables 3 and 4 do not take into account the correlations of contemporaneous residuals, leading to overstated *t*-statistics. When we repeat the regressions using a feasible generalized least squares approach, adjusted for contemporaneous correlation of the residuals and a first-order autoregressive process for the time series of the residuals, the standard errors increase only slightly.

	In(Vnor	m/Price)	In(Vreal/Price)		
	1	2	3	4	
Constant	-0.32 (-11.47)	-0.36 (-13.18)	-0.67 (-21.39)	-0.72 (-22.95)	
E(Inflation)	-1.65 (-3.22)	-1.68 (-3.58)	7.31 (19.30)	6.46 (17.20)	
E(Inflation) * nd2 (low/modest Net Debt)	2.06 (4.09)	_	3.67 (9.46)	_	
E(Inflation) * nd3 (modest/high Net Debt)	3.91 (6.07)	_	7.28 (15.98)	_	
E(Inflation) * nd4 (high Net Debt)	2.27 (3.61)	_	7.60 (16.04)	_	
E(Inflation) * Net Debt/TA	_	9.22 (6.86)	_	21.86 (20.71)	
Firm Fixed Effects	Yes	Yes	Yes	Yes	
Adjusted R ²	32%	32%	64%	64%	
N	6,946	6,946	6,946	6,946	

TABLE 3

Regressions of In(V/P) on Expected Inflation Interacted with Dummy Variables for Increasing Levels of Net Debt/TA and Firm Fixed Effects

The regression is

$$\ln\left(\frac{\mathsf{V}}{\mathsf{P}}\right)_{it} = \beta_0 + \beta_1 \mathsf{E}(\mathsf{Inflation})_t + \beta_2 \mathsf{E}(\mathsf{Inflation})_t \times nd2_{it} + \beta_3 \mathsf{E}(\mathsf{Inflation})_t \times nd3_{it} + \beta_4 \mathsf{E}(\mathsf{Inflation})_t \times nd4_{it} + \sum_{i=1}^{41} \gamma_j D_i + \varepsilon_{it}.$$

The sample period is January 1978–December 1997 for the pooled cross-sectional time-series regressions using the Dow Jones 30 stocks. The dependent variable is the natural log of the V/P ratio where V is either Vnom, the residual income model using nominal rates or Vreal, the residual income model using real rates, the debt capital gain adjustment, the EVA real cost of equity, and the depreciation and book value adjustments. $E(\text{inflation})_t$ is the expected change in the GDP deflator over the next year measured in month t obtained from the Survey of Professional Forecasters, measured as a decimal rather than a percentage. Dummy variables: nd2, nd3, nd4 = 1 if Net Debt/TA is the second, third, and fourth quartiles of Net Debt/TA, and zero otherwise. Note that nd1 is omitted from the regression to avoid perfect collinearity. Net Debt is the net leverage position of the firm measured as Compustat items (34 + 70 + 71 + 72 + 9 + 75 + 35 + 38 + 130) - (1 + 2 + 68 + 32). D_t is the firm dummy for the tth firm (42 different firms were in the Dow 30 during the sample period); note that one dummy was omitted from the regression and the results for the firm dummies are not displayed. The regressions are estimated using a Generalized Methods of Moments estimator, incorporating a White (1980) correction for heteroskedasticity and a Newey-West correction for first order autocorrelation. t-statistics are in parentheses.

more undervalued than low-levered firms, the economic significance of these results is small. For the uncorrected model, the results imply that low debt firms are slightly overvalued relative to high debt firms when inflation is high.

This result is consistent with the market failing to make corrections for the debt capital gain error and misvaluing stocks. With regression (3), where $\ln(\text{Vreal/Price})$ is the dependent variable, the results are much stronger. The effect of E(inflation) is reliably positive, regardless of the level of leverage. This is consistent with the market making capitalization rate errors. When leverage is low, the inflation coefficient is 7.31 (t=19.30), and when leverage is high (nd4=1), the combined coefficient is 14.91 (t=32.19). The coefficient on the interaction term is a significant 7.60 (t=16.04). This indicates that valuation

errors are generally more severe the higher the level of leverage, and that at even low levels of leverage, valuation errors are present. A combined coefficient of 14.91 is roughly equivalent to 15% undervaluation for 100 basis points of added inflation for high leverage firms. Regressions (2) and (4) in Table 3 do not include the Net Debt/TA dummies; instead they interact $E(\inf E(\inf E))$ and Net Debt/TA directly. The results of these regressions confirm the results of regressions (1) and (3). The results are generally consistent with the theory illustrated in Figure 1.

Table 4 repeats the tests in Table 3, except that instead of interacting inflation with Net Debt/TA dummies, we interact Net Debt/TA with inflation dummies. The results paint a similar picture as those in Table 3 with the corrected model indicating greater undervaluation when inflation is high. For a firm with a Net Debt ratio of 0.3, increasing inflation from the bottom quartile to the top quartile changes $\ln(\text{Vreal/P})$ by $0.3 \times 2.23 = 0.67$, or 67%.

The results in Tables 3 and 4 show that the level of misvaluation, when measured using Vreal/Price, is correlated with the level of expected inflation and the level of firm leverage. This is consistent with the debt capital gain error, where investors fail to add back the nominal depreciation of liabilities to earnings. High leverage firms in high expected inflation months are most severely undervalued. Furthermore, the overall level of undervaluation as measured by Vreal/Price is correlated with the level of expected inflation. This is consistent with the first valuation error, i.e., investors confuse capitalization rates when valuing equities. The change in the value-to-price ratio during our sample period maps directly into returns. The aggregate Vreal/Price ratio for the Dow in 1982 was 1.2, but by the end of 1997 this had fallen to 0.53. This valuation correction is equivalent to a return of about 5.5% per year. Over that time period, the average compounded total (dividends plus capital gains) real return on the Dow was around 15% per year. If this valuation correction had not occurred, the real return for the period moves closer to 10% per year, only a little above the historical average.

V. Alternative Explanations for the Negative Effect of Inflation on Stocks

Jaffe and Mandelker (1976), Fama and Schwert (1977), and others find that stock returns are negatively related to expected inflation. As we show in Table 2, this pattern has continued in our sample period, which post-dates the earlier evidence. A 100 basis point increase in expected inflation is associated with expected real returns being 242 basis points lower over the next year. This puzzling phenomenon is in direct contradiction to the Fisher (1930) hypothesis, which states that stocks, being real assets, should have nominal returns that are positively related to expected inflation. Specifically, the expected nominal return equals the sum of the expected real return and the expected inflation rate. Unless expected real returns fall by more than one-to-one when expected inflation increases, claims on real assets such as stocks should serve as an inflation hedge. We have argued that this negative relation is due to disintermediation. Here we review some of the alternative explanations that have been advanced either for a negative relation between real stock returns and inflation, or for a negative relation between the

	In(Vnor	m/Price)	In(Vreal/Price)		
	1	2	3	4	
Constant	-0.45 (-12.40)	-0.41 (-10.86)	-0.29 (-8.59)	-0.27 (-7.57)	
Net Debt/TA	0.20 (2.79)	0.06 (0.81)	-0.16 (-3.09)	-1.23 (-20.46)	
Net Debt/TA * infd2 (low/modest expected inflation)	0.16 (4.24)	_	0.41 (10.17)	_	
Net Debt/TA * infd3 (modest/high expected inflation)	0.40 (9.17)	_	1.00 (25.08)	_	
Net Debt/TA * infd4 (high expected inflation)	0.50 (9.02)	_	2.23 (45.83)	_	
Net Debt/TA *E(Inflation)	_	6.47 (5.94)	_	41.67 (41.11)	
Firm Fixed Effects	Yes	Yes	Yes	Yes	
Adjusted R ²	32%	32%	68%	68%	
N	6,946	6,946	6,946	6,946	

TABLE 4

Regressions of In (V/P) on Net Debt/TA Interacted with Dummy Variables for Increasing
Levels of Expected Inflation and Firm Fixed Effects

The regression is

$$\ln \left(\frac{\mathsf{V}}{\mathsf{P}} \right)_{it} = \beta_0 + \beta_1 (\mathsf{Net}\,\mathsf{Debt}/\mathit{TA})_t + \beta_2 (\mathsf{Net}\,\mathsf{Debt}/\mathit{TA})_t \times \mathsf{inf} d2_{it} + \beta_3 (\mathsf{Net}\,\mathsf{Debt}/\mathit{TA})_t \times \mathsf{inf} d3_{it} \\ + \beta_4 (\mathsf{Net}\,\mathsf{Debt}/\mathit{TA})_t \times \mathsf{inf} d4_{it} + \sum_{i=1}^{41} \gamma_j D_i + \varepsilon_{it}.$$

The sample period is January 1978–December 1997 for the pooled cross-sectional time-series regressions using the Dow Jones 30 stocks. The dependent variable is the natural log of the V/P ratio where V is either Vnom, the residual income model using nominal rates or Vreal, the residual income model using real rates, the debt capital gain adjustment, the EVA real cost of equity, and the depreciation and book value adjustments. Net Debt/TA is the Net Debt of the firm divided by total assets. Net Debt is measured as Compustat items (34 + 70 + 71 + 72 + 9 + 75 + 35 + 38 + 130) - (1 + 2 + 68 + 32). Expected inflation is the expected change in the GDP deflator over the next year measured in month t obtained from the Survey of Professional Forecasters, measured as a decimal rather than a percentage. Dummy variables: $\inf d_2$, $\inf d_3$, $\inf d_4 = 1$ if expected inflation is the second, third, or fourth quartiles of expected inflation, and zero otherwise. Note that $\inf d_1$ is omitted from the regression to avoid perfect collinearity. D_i is the firm dummy for the tth firm (42 different firms were in the Dow 30 during the sample period): note that one dummy was omitted from the regression and the results for the firm dummies are not displayed. The regressions are estimated using a Generalized Methods of Moments estimator, incorporating a White (1980) correction for heteroskedasticity and a Newey-West (1987) correction for first order autocorrelation. t-statistics are in parentheses.

level of stock prices and inflation. In general, these explanations are not mutually exclusive.

A. Biases in Analysts' Forecasts

Our results using Vreal/Price find evidence of undervaluation that is correlated with leverage and inflation. There is widespread agreement that during our sample period, analysts' forecasts are biased upward (see Sharpe (2002) for evidence on the magnitude of the bias). To the degree that the ex ante bias in EPS forecasts is the same every year, this has little impact on our analysis, for we are concerned with cross-sectional differences and time-series trends in the valuation

measures. There are reasons, however, to expect that earnings forecasts are biased in a manner that is correlated with expected inflation.

Throughout this paper, we take earnings forecasts as exogenous. But if analysts are Bayesians, when they see that a stock price has fallen, they will lower their earnings forecasts unless they are supremely confident that they are right and the market is wrong. If the market undervalues stocks when inflation is high, Bayesian analysts will lower their earnings forecasts. Since these forecasts are used in the EVA/residual income model, forecasted earnings growth rates will be lowered when inflation is high, and raised when inflation abates. This would have the effect of biasing Vreal/Price ratios toward one, lowering the power of our tests.

B. The Proxy Hypothesis

An alternative explanation for the low real returns and the low level of the stock market when inflation is high asserts that high expected inflation is proxying for slower expected economic growth (see Fama (1981)). Fama did not have access to analyst earnings forecasts to test this alternative "proxy" hypothesis (for the failure of the Fisher equation to hold). Sharpe (2002), however, finds that low P/Es during inflationary times are attributable partly to lower forecasted real earnings growth. Early work in this area generally did not decompose expected stock returns into an equity risk premium and a real rate of interest. While it is plausible that slower real economic growth should result in a lower real rate of interest, the effect on the equity risk premium is ambiguous. Thus, the proxy hypothesis does *not* predict a relation between expected inflation and expected excess stock returns, where excess stock returns are defined as stock returns minus the risk-free rate.

Boudoukh and Richardson (1993) find that the Fisher equation holds in the long run (five-year horizons) but not in the short run. Boudoukh, Richardson, and Whitelaw (1994) find support for their hypothesis that the short-run failure of the Fisher equation is due to industry output cycles being correlated with expected inflation. However, the empirical relationship is more negative than their model predicts. This overreaction could be due to inflation-induced valuation errors.

Like the inflation illusion hypothesis, the proxy hypothesis also has cross-sectional implications based upon firm leverage. Firms with a high degree of financial leverage will have greater reductions in net income for a given decline in operating income. Therefore, if a decline in real demand is correlated with the level of inflation, this decline will impact the net income of high-levered firms more than low-levered firms. This cross-sectional effect will be reduced if firms trade off financial leverage against operating leverage to maintain a target total leverage, as high debt firms will tend to have lower fixed operating costs. Additionally, a valuation methodology that uses earnings or forecasted earnings should control for these potential effects.

At the root of the proxy story is the belief that operating cash flows are depressed when inflation is high. In the Dow 30, there is no evidence of this. Figure 4 examines the time series of some basic profitability ratios for high leverage firms in the Dow and for all the Dow firms together. The top graph presents operating

cash flows (operating income before depreciation and amortization) as a percentage of total assets. Note that this is measured as a ratio of averages and not as an average of ratios—therefore, more weight is given to the larger Dow firms. Figure 4 shows that while operating cash flows for higher leverage stocks have remained fairly constant at around 15% of total assets, the same ratio for the Dow as a whole has actually declined over the sample period. Thus, the operating profitability of the high leverage firms in the sample is not negatively correlated with inflation. The lower graph shows cash flow (net income before extraordinary items plus depreciation and amortization) as a percentage of book equity. Again these are computed as a ratio of averages. The graph shows that throughout the sample period, cash flows have remained fairly level, although they have increased as a percentage of book equity in the 1990s. (Write-offs and share repurchases reduced book equity in the 1990s.) These results are consistent with other studies that have also documented a decline in operating profitability in the 1980s and early 1990s (Barber and Lyon (1996)).

The proxy story above is, therefore, not a reasonable explanation for our results as our model explicitly incorporates earnings forecasts, and the data actually show that the alleged real effects of inflation are not present in the direction that the proxy story predicts. There is another version of the proxy hypothesis, however, that is not so easy to dismiss. This alternative version argues that the probability of a future hyperinflation, with significant real consequences, increases as inflation increases. Even though no hyperinflation has been observed, this does not mean that these fears are irrational. This changing probability of a hyperinflation would rationally depress stock prices when inflation was high, and so it could potentially explain some of our time-series results. This hypothesis would suggest that other financial assets, especially bonds, should also see their real yields increase when stock prices fall. There is no evidence during our sample period of this occurring, however.

C. Tax and Accounting-Based Earnings Distortions

Feldstein (1980) and others argue that the presence of taxation and historically based depreciation expense will result in higher taxes and thus depress the real cash flow of the firm. This happens as historically based depreciation expense does not adequately fund the replacement of assets in times of rapidly rising prices. As a result, the accounting earnings of firms with large depreciation charges will overstate the firm's dividend-paying ability when inflation has been high.¹² The lower "quality" of earnings should result in lower P/Es following periods of high inflation for firms with low leverage, ceteris paribus. We adjust for this effect explicitly in our empirical analysis (for a straightforward examination of the effect of inflation on depreciation and inventory see Meric and Meric (1997)).

With stable inflation, the failure of historical cost depreciation to cover replacement cost will result in an overstatement of earnings, which works to offset

¹²In 1981, partly in response to high inflation, the U.S. tax code was changed to accelerate depreciation, reducing the distortion. In 1986, after inflation decreased, depreciation schedules were lengthened.

FIGURF 4

Average Operating Cash Flow as a Percentage of Total Assets and Net Cash Flow as a Percentage of Book Equity for the High Leverage Firms in the Dow 30 and All of the Firms in the Dow 30

Figure 4A. Operating Cash Flows/Assets

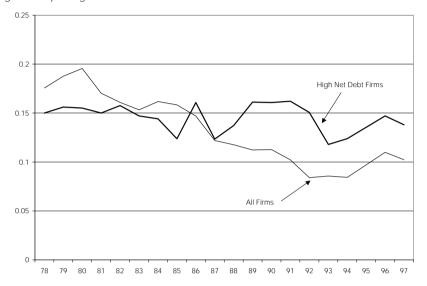
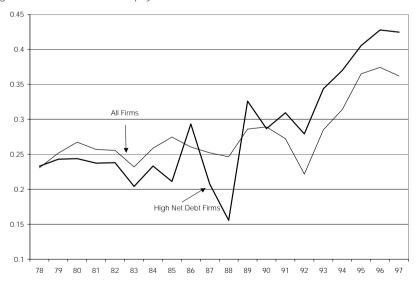


Figure 4B. Net Cash Flow/Book Equity



High Net Debt firms are the 10 Dow 30 firms that have highest net debt. The top graph shows operating cash flows (operating income before depreciation and amortization) as a percentage of total assets. The bottom figure shows net cash flows (net income before extraordinary items plus depreciation and amortization) as a percentage of book equity.

the inflation illusion-induced undervaluation caused by using a nominal discount rate that does not explicitly incorporate growth. For firms that depreciate assets over many years, historical cost accounting earnings will be overstated relative to replacement cost accounting earnings by a greater amount, the greater is the length of time to depreciate the asset. These offsetting distortions will tend not to cancel out for leveraged firms, where high nominal interest cost depresses EPS without an offsetting debt capital gain being explicitly incorporated. Even for unlevered firms, the historical cost depreciation distortion will not offset the use of nominal discount rates when inflation changes. This is because historical cost depreciation will differ from replacement cost based upon the cumulative inflation, whereas the discount rate changes quickly when inflation changes. In the extreme, when inflation rapidly falls after a period of high inflation, the discount rate will drop rapidly but historical cost depreciation will remain well below replacement cost, overstating earnings, until the existing capital stock is largely replaced.

In our valuation equation (6), we explicitly adjust for these distortions. Furthermore, since these distortions are forecastable, they should not lead to a relation between real stock returns and predictable inflation in an efficient market.

D. The Nominal Contracting Hypothesis

French, Ruback, and Schwert (1983) empirically examine the influence of nominal contracts on firm value in the face of unexpected inflation. Firms that are net debtors should experience positive stock returns upon the announcement of unexpected inflation. They find that the nature of a firm's nominal contracts has very little impact on the degree of sensitivity of the firm's stock returns to unexpected inflation. These results are consistent with the market making valuation errors of the type suggested by Modigliani and Cohn by failing to understand the valuation implications of nominal liabilities in a firm's capital structure.

Bernard (1986) and Pearce and Roley (1988) reexamine the French, Ruback, and Schwert study and find some evidence of a positive relationship between unanticipated inflation and stock returns on stocks with nominal liabilities. These findings do not, however, exclude the possibility of valuation errors, as they focus on the effects of unanticipated inflation, while the inflation illusion hypothesis is concerned with fully anticipated inflation.

E. Changes in the Equity Risk Premium

A possible explanation for the bull market starting in 1982 could be a reduction in the equity risk premium. A reduction in the risk premium would result in an increase in equity values for any set of positive expected cash flows to equity holders. For the sample, the equity risk premium that we use, the historical average excess return on the NYSE/AMEX value-weighted portfolio, is fairly steady (although increasing) over the time period.

¹³For example, firms that are net debtors should benefit from a wealth transfer from lenders when an unexpected increase in inflation occurs. As most firms are net debtors, we should observe a positive stock market reaction to unexpected inflation—the complete opposite of what actually occurs.

Blanchard (1993), Sharpe (2002), and Fama and French (2002) interpret the rise in stock prices from the late 1970s as partly due to a falling equity risk premium. We agree that part of the bull market beginning in 1982 can be attributed to a fall in the equity risk premium expected by investors. Tautologically, there is always some equity risk premium that sets value equal to price. The issue is one of whether the implied risk premium is in fact expected by investors, or whether investors would change their asset allocation in stocks if they knew what the implied equity risk premium was. If the latter is true, then stocks are misvalued.

To investigate the possibility that the decrease in Vreal/Price ratios that we report is being driven by misestimation of the equity risk premium, we compute the implied risk premium for each firm/month that would equate Vreal to the price. The results are displayed in Figure 5, which shows that for the Vreal model, the implied risk premium in the late 1970s and early 1980s was between 5% and 12%. The implied risk premium for all firms that set value equal to price in our model drops from a high of 12% in 1980 to below zero in the late 1990s. Also included in Figure 5 is the implied risk premium for the nominal model, which generally stays between 0% and 7%. In Section V.A, we argued that Bayesian analysts would raise their earnings forecasts when they observe high stock prices. For both our real model and the nominal model, the time-series variation in the equity risk premium is underestimated if analyst forecasts are not strictly exogenous.

Even at a zero equity premium, our model calculates that stocks were overvalued at the end of our sample period. Thus, a drop in the equity risk premium demanded by investors is unable to account for all of the rise in valuations, especially since there is no corroborating survey evidence that the returns expected by investors have dropped this much. Indeed, in 1998, at the end of our sample period, most finance professors expected a future equity risk premium in the 6% range, according to Welch (2000).

The inflation illusion hypothesis states that the stocks with the highest leverage will be the most undervalued when inflation is high. Figure 5 also presents the implied risk premium for stocks with Net Debt/TA greater than the median level of Net Debt/TA. For this subset of firms, the implied risk premium ranges between 10% and 20% in the late 1970s and early 1980s. During these high inflation years, the implied risk premium on the high debt firms is roughly twice that on the low debt firms.

The changing equity risk premium hypothesis predicts that high expected inflation should be associated with high realized excess returns (stock returns minus the risk-free rate), which is unsupported by the evidence. Indeed, the opposite is true, as shown in Table 2. Equally importantly, a time-varying equity risk premium cannot explain the cross-sectional results relating leverage to undervaluations in the presence of inflation, unless one makes additional strong assumptions. We are not arguing that a changing equity risk premium does not explain some of the change in the valuation of equities during our sample period. We are merely arguing that it cannot explain all of the increase.

FIGURE 5 Implied Risk Premia, 1978–1997

Figure 5A.

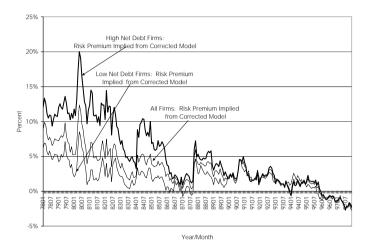


Figure 5B.

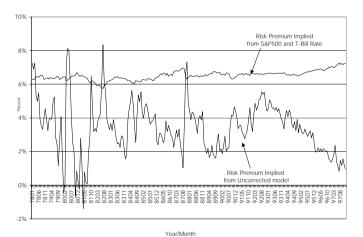


Figure 5 shows the risk premia implied by the corrected valuation model (Vreal), the uncorrected model (Vnom), and the geometric average historical difference between the return on the S&P 500 and the T-bill rate since 1926. For the corrected valuation model, the figure also shows the implied risk premia for high Net Debt stocks (Net Debt > median Net Debt) and low Net Debt stocks (Net Debt < median Net Debt). The series derived from the valuation models represent the average risk premia for the stocks in the Dow 30 in a particular month that sets value equal to price. Summary data for the 240 months January 1978–December 1997 are provided below.

Annual Implied Risk Premia	N	Mean	Median	Standard Dev.	Min	Max
From Vnom	240	3.40%	3.33%	1.56%	-1.39%	8.34%
From Vreal all firms	240	3.10%	2.47%	2.79%	-2.65%	12.36%
From Vreal high Net Debt firms	240	5.05%	3.64%	4.76%	-2.68%	20.01%
From Vreal low Net Debt firms	240	1.91%	1.83%	1.97%	-2.74%	8.54%
S&P 500—Annual T-bill risk premium	240	6.52%	6.53%	0.27%	5.73%	7.28%

VI. Conclusion

One can decompose the change in equity valuations between 1978 and 1997 into three parts: changes in future economic value added, rational changes in the real risk-free rate and the equity risk premium, and changes in valuation errors. Equivalently, since the value of a stock is the present value of dividends, changes in equity valuations can be attributed to changes in the numerator, changes in the denominator, and changes in the value/price ratio. Our opinion is that all three components contribute to explaining the bull market since 1982. In this paper, we test the hypothesis that the bull market starting in 1982 was due in part to equities being undervalued in the late 1970s and early 1980s. The cause of this undervaluation, it is hypothesized, is cognitive valuation errors of levered stocks in the presence of inflation and mistakes in the use of nominal and real capitalization rates. The results presented in this paper are consistent with such a hypothesis. Not only is the level of debt and inflation a predictor of undervaluation, but also the magnitudes of the results are economically significant. In the low inflation environment that we are enjoying today, this misvaluation has largely subsided. This correction is not necessarily due to the market now understanding how to value equities in the presence of inflation, but may be merely because of the subsidence of inflation. Our model, as is true for other valuation models (Lee, Myers, and Swaminathan (1999), Claus and Thomas (2001), and Fama and French (2002)), predicts low equity returns in the future. Indeed, even with an equity risk premium of zero, our model concludes that stocks were overvalued at the end of the 1990s.

Several alternative hypotheses for the strong negative relation between stock valuations and inflation are also addressed. The proxy hypothesis, which asserts that expected real output and inflation are negatively correlated, is dealt with by the use of earnings forecasts and a time-varying real rate of interest. The changed equity premium hypothesis, which asserts that the market price of risk and/or the level of risk, is positively correlated with inflation, is dealt with by calculating the implied equity premium that sets value equal to price. We argue that the change in this number is implausibly large to fully account for the increased valuations. Furthermore, the realized returns on equities are negatively related to expected inflation, in direct contradiction to the prediction of the changing risk premium hypothesis.

In regressions predicting returns, we find that our value/price measure has a strong ability to predict real returns on the Dow when combined with expected inflation. We achieve an R^2 of 27% in a two-variable regression predicting annual real returns on the Dow. The coefficients of the regression can be interpreted as showing that there is a strong financial disintermediation effect (money flows out of stocks when nominal interest rates are high) along with a tendency for stock prices to revert toward fundamental value, with approximately one-third of valuation errors corrected over one year.

The paper also contributes to the literature on equity valuation. First, we demonstrate how residual income models must be adjusted to deal with inflation. For these models to produce accurate measures of true economic value they should use real required returns, adjust depreciation for the distorting effects of

inflation, and make adjustments for leverage-induced capital gains. Second, we have hopefully brought back into focus the importance of adjusting the earnings of a firm for the depreciation of nominal liabilities. When inflation is low, this is not a huge concern, but if the market fails to incorporate this adjustment when inflation increases (which it surely will at some point in the future), the level of stock prices will suffer.

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