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INFLATION, INFLATION RISK, AND STOCK RETURNS

John Ammer

ABSTRACT

This paper investigates the empirical relation between inflation and stock returns in ten industrialized countries, with a focus on the implications for links between inflation and the macroeconomy. The stock return decomposition of Campbell and Shiller (1988) is used to determine the extent to which the negative contemporaneous stock return associated with a positive inflation surprise is due to (a) lower future real dividends and (b) higher future required real equity returns. The empirical results suggest that generally higher inflation is associated with both lower real dividends and *lower* required real equity returns in the future. The evidences favors corporate tax-related theories (e.g. Feldstein (1980)) -- in which distortions in the tax system cause an increase in inflation to raise the firm's effective cost of capital relative to the return earned by investors in the firm -- relative to the "risk premium story" that has been credited to Tobin (1958). However, for the United States and the United Kingdom, estimates of the arbitrage pricing theory (APT) model with a conditionally heteroscedastic inflation risk factor suggest that inflation may have increased the average real cost of equity capital by as much as fifty basis points.

Inflation, Inflation Risk, and Stock Returns

John Ammer[1]

1. Introduction

Higher inflation can affect equity returns in at least two ways. First, it may lead to weaker economic performance in the future, and, thus, reduced corporate profits. Holding real discount rates constant, the consequences for future real dividends would have a direct negative effect on the *unexpected* part of the asset return. Second, an increase in inflation can increase the riskiness of assets, and thus raise the rate of return that investors require on them, because it is associated with an increase in inflation uncertainty -- an indirect effect on the *expected* part of the asset return. Ceteris paribus, an increase in future expected returns means the stock price must drop now, leading to a negative impact on the current return.[2]

The purpose of this paper is to investigate the empirical relation between inflation and stock returns, with a focus on the implications for links between inflation and the macroeconomy. Both of the above hypotheses will be kept in mind. The risk premium story is particularly compelling, because it provides an explicit channel from inflation to the real

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[1] The author is an Economist in the International Finance Division at the Board of Governors of the Federal Reserve System. We would like to thank Vince Reinhart and participants in a joint meeting of the Federal Reserve System Committees on Business and Financial Analysis for helpful comments. Some of the data used in the analysis were extracted from the London Share Price Database, which is a copyright work of the London Business School. Opinions expressed herein should not be construed to represent those of the Board of Governors or any other employees of the Federal Reserve System. The author is responsible for any errors.

[2] The origination of this argument has been credited to Tobin (1958). Campbell (1991) gives a lucid treatment of the relation between current and future returns.

economy. If inflation increases the amount of risk in financial markets, it could raise the cost of capital and inhibit investment.

On the other hand, if the effect of inflation on the underlying economy were neutral and most firms were leveraged with fixed income securities, higher inflation should be good news for real stock returns, and even better news for *nominal* stock returns.[3] However, Fama and Schwert (1977) found a *negative* relation between U.S. stock returns and unexpected (as well as expected) inflation between January 1953 and July 1971, suggesting that higher inflation is extremely bad news for the economy. In addition, McDevitt (1989) and Ely and Robinson (1989) report negative correlations between real stock returns and inflation for several foreign countries.[4] Using data from nine industrialized countries for the period from 1971 to 1980, Solnik (1983) finds a negative relation between real stock returns and ex ante one-period interest rates, which he takes to be a proxy for expected inflation. However, it will become clear below that for most countries, short interest rates are a poor predictor of inflation.

The next section of the paper will discuss possible explanations for the correlation between stock returns and inflation. The third section deals with measuring expected inflation. In the following section, the empirical relation between stock returns and inflation is assessed for two U.S. sample periods and for nine other countries. The fifth section investigates relations between equity returns, inflation innovations, dividend news, and

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[3] Even without leverage, inflation would engender a transfer of wealth to shareholders from workers whose nominal wages were fixed in the medium term.

[4] Neither paper makes an empirical distinction between expected and unexpected inflation. In addition, McDevitt (1989) uses measures of returns that exclude dividends.

expected future returns through a decomposition of the stock return. The subsequent section addresses the effects of changing degrees of inflation uncertainty on equity risk premiums in a cross-sectional asset pricing setting, in which the return premium associated with a risk factor depends on its conditional variance. The final section summarizes the results and considers potential strategies for further inquiry.

2. Explanations for the Stock-Inflation Correlation

One strand of the literature has focused on interactions between inflation and the tax system, identifying four distortions. Two of these were analyzed by Feldstein (1980). The first involves deductions from corporate earnings for the presumed depreciation of capital assets. In the United States, as in most countries, depreciation deductions are based on the nominal purchase price of the asset.[5] Thus, in an inflationary environment, depreciation deductions from older pieces of equipment may understate the economic loss. In any case, this effect will tend to make real corporate tax liabilities an increasing function of inflation, all else equal.

The second point made by Feldstein relates to taxation of individuals' nominal capital gains. His case here is weaker. Nominal interest is also taxed, and the consequent tax liability cannot be deferred, while capital gains tax can be avoided until the capital gain is realized. If people must put their savings somewhere, stocks may be better than fixed income securities.[6]

Other authors have noted that rules for inventory accounting can also hurt firms in an inflationary environment.[7] This is particularly true when a "first-in-first-out" (FIFO) method

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[5] Among OECD members, only Greece and Iceland appear to have ever indexed depreciation to inflation under any circumstances.

[6] In addition, the capital gains tax story cannot explain the negative stock return-inflation correlation in countries that either index capital gains (Italy and the United Kingdom) or do not tax them (such as Germany, Belgium, the Netherlands, Switzerland, and, effectively, Japan).

[7] See Pearce and Roley (1988), McDevitt (1989), or Ely and Robinson (1989).

is stipulated. Essentially, inflation causes measured increases in the value of inventories as stocks turn over, even if their real value remains constant.

Offsetting these three effects is the advantage of deducting nominal interest payments from corporate income. To the extent that nominal debt service costs rise with inflation (and, if they do not then the firm gains even more by paying less real interest), this effect will outweigh the inventory accounting disadvantage whenever inventories are fully financed by debt. In addition, in many cases, the nominal interest expense advantage will dominate the nominal depreciation effect for debt-financed capital expenditure. In practice, firms fund a substantial portion of their investment through equity and retained earnings. Nevertheless, Hasbrouck (1983) judged that under the tax regime of the 1970's, for inflation rates above about 8 percent, the typical U.S. corporation's tax liability was decreasing in inflation.

Empirical efforts to identify the tax effect have had little success. Gonedes (1981) found no link between inflation and the real corporate tax burden in the United States, and he concluded that there was "implicit indexing" through the introduction of accelerated depreciation, subsidies, and other corporate tax advantages.[8] McDevitt (1989) found that including tax variables in a regression did not drive out the negative relation between real stock prices and inflation. An event study conducted by Pearce and Roley (1988) found that the firms' stock returns were decreasing in their inventory level on days when higher than expected inflation was announced, but they were unable to identify a depreciation-related effect.

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[8] Note that such measures would be unlikely to accurately compensate specific industries and companies for their inflation-related costs.

An alternative explanation of the stock return-inflation relation has been referred to as the "proxy effect". This theory posits that the observed relationship between the two variables is not direct, but, rather, that each is related to future output. There is strong empirical evidence of a positive relation between stock returns and future output, and this notion also stands on firm theoretical ground. The other link, a negative relation between current inflation and future output, is weaker, and several different justifications have been proffered. These explanations generally involve explicit assumptions about how monetary policy reacts to a weakening macroeconomy.

Fama (1981) suggests a connection through a money demand function in which interest rates are taken to be exogenous. Expectations of weaker future activity reduces money demand, and, if the money supply does not adjust, prices must rise. In a different version of the "proxy effect", Kaul (1987) assumes that monetary policy is countercyclical, so that the central bank expands the money supply when future output expectations fall, leading to inflation. In the Geske and Roll (1983) model, the decline in the stock market caused by worsening future prospects reduces government tax revenue. The ensuing budget deficits are monetized.

All of the versions of the "proxy effect" mentioned above suffer from several defects. First, it is not clear that the mechanisms that increase inflation in these models would have a strong enough effect on prices to outweigh the disinflationary impact of the simultaneously weakening economy. Second, the posited inflationary channels are unlikely to affect consumer prices quickly enough for their to be a contemporaneous correlation between goods and stock prices. Finally, assuming expectations are rational, these models do not imply a non-zero correlation between expected inflation and expected real stock returns. This correlation is ultimately of more interest to macroeconomists than correlations between contemporaneous shocks to inflation and stock returns.

In contrast, both the tax-related hypotheses described in the first part of this section and the inflation risk premium theory has implications for correlations of stock returns with both expected and unexpected inflation. Under the inflation risk premium theory, higher expected inflation implies greater levels of risk in financial markets, and expected returns must be higher to compensate investors for this risk. Because a positive inflation shock tends to raise expectations of inflation in the near-term future, expected future returns must increase. Barring a concurrent rise in expected future real profits, the stock price must fall today.

3. Measuring Expected Inflation

Because of the important distinction between the correlations among the expected and unexpected components of inflation and stock returns, the issue of how to measure expected inflation must be addressed. Fama and Schwert (1977) began by testing what has become known as the Fisher Hypothesis, after Irving Fisher. Fisher (1930) popularized the notion that the nominal interest rate (i_{t-1}) observed at the beginning of period t should equal the sum of the real rate (r_t) lenders expect to earn and the level of inflation (π_t) that they anticipate will occur:[9]

$$i_{t-1} = E_{t-1}(r_t) + E_{t-1}(\pi_t) \tag{1}$$

If, as is sometimes assumed, the real interest rate is constant over time, then equation (1) can be recast as a forecasting equation for inflation:

$$\pi_t = -r + i_{t-1} + \epsilon_t \tag{2}$$

[9] Fisher deemed this dichotomy to apply to all asset returns. It is interesting to note that with this idea, the rational expectations hypothesis effectively entered into the financial economics literature four decades before it was introduced into macroeconomics. Perhaps this occurred because it is much easier in a financial scenario to judge how an agent will behave, given her expectations.

The term (ε_t) is the error from a forecast of inflation that incorporates all available information at the beginning of the period. Fama and Schwert test this hypothesis by estimating the equation

$$\pi_t = \alpha_0 + \alpha_1 i_{t-1} + \epsilon_t \tag{3}$$

on monthly, quarterly, and semi-annual U.S. inflation and treasury bill yield data from January 1953 to July 1971. Because they are unable to reject the hypotheses that (α^1) is equal to one and that the residual (ε) is uncorrelated with its first three lags, they conclude that the Fisher hypothesis is consistent with the data.[10]

Monthly and quarterly estimates of the same equation for ten countries appear in Tables 1 and 2; data definitions and sources are given in Appendix A. For every country except the United Kingdom and Italy, one can reject the hypothesis that the interest rate enters with a unit coefficient. In most cases, the Durbin-Watson statistic suggests substantial first-order autocorrelation in the residuals. The Wald statistics reported in the rightmost column show that the first three autocorrelations are significant at the 5 percent level in every case except for the earlier quarterly sample for the United States, which was chosen to match

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[10] Technically, the hypothesis could be rejected if *any* available information could improve the forecast of inflation from a starting point of one times the nominal interest rate -- implicitly, Fama and Schwert only consider information that is contained in lags of inflation and the interest rate. However, few economists were aware of this subtle point before Robert Hall's 1978 paper on the random walk in consumption implied by the permanent income hypothesis.

as closely as possible with Fama and Schwert's samples. It is safe to conclude that, in general, nominal interest rates are not an adequate proxy for expected inflation.

One possible rationalization of the monthly results is that there is a timing problem. In most countries, component prices of the CPI are sampled throughout the month. However, the results in Tables 1 and 2 use end-of-month interest rate data -- in essence we proceed under the assumption that the prices apply to the end of the month. Yet if the "Fisher Effect" were true, we would expect to see results that were more favorable to the theory in the quarterly regressions. This is not the case.

Table 3 shows an annual version of the equation for the United States only, using a 12-month treasury bill yield. The results are little different from the monthly and quarterly results for the full U.S. sample. Table 4 uses inflation expectations data from the Livingston Survey as an alternative proxy. This performs somewhat better than the bill rate, and one cannot reject the hypothesis that it comes in with a unit coefficient. However there is still substantial first-order autocorrelation in the residuals. Such autocorrelation is suggestive of a real interest rate that varies over time and exhibits "persistent" reactions to shocks.

Overall, the results imply that the Fama and Schwert results were anomalous. Accordingly, we need to find a better model of expected inflation. Lacking a variable that naturally summarizes the available information (as the nominal interest rate would if the real interest were constant), we will resort to multiple regression. To estimate the influence of expected and unexpected inflation on nominal stock returns in the next session, we will need to apply instrumental variables estimation (two-stage least squares), where the first stage regression will involve forecasting inflation over the coming period with variables known at the beginning of the period.

In addition to lagged inflation, candidate regressors include variables that are likely to cause or reflect effects that are likely to impact inflation in the near term. Accordingly, recent changes in exchange rates and wages are included, as well as some interest rates.

4. Stock Returns and Expected and Unexpected Inflation

Table 5 reports the results for our ten countries of instrumental variables estimation of the following equation, where (s) is the *nominal* stock return:

$$s_t = \beta_0 + \beta_1 E_{t-1}(\pi_t) + \beta_2(\pi_t - E_{t-1}\pi_t)) + \nu_t \tag{4}$$

The rightmost column reports the adjusted R-squared from the inflation forecasting regression. Comparing these figures to those in Table 1 shows that the multivariate forecasts are in most cases a big improvement over the interest rate expectation proxy. The second-stage results for the United States are similar to those found by Fama and Schwert (1977). Nominal stock returns react negatively to both expected and unexpected inflation. Although the standard errors are large, both coefficients are significantly different from one. (Note that unit coefficients would be consistent with stocks being a "perfect hedge" against expected and unexpected inflation.) Both coefficients are less than one for every country but Belgium and the United Kingdom, and in many cases, the null hypothesis of a unit coefficient can be rejected. The quarterly results shown in Table 6 are broadly similar, as is the annual result for the United States in Table 7 that uses the Livingston Survey expectations as the inflation forecast.

It is worth point out that the U.S. stocks have the strongest negative reaction to unexpected inflation in both the monthly and quarterly tables. This is somewhat surprising given that holders of U.S. equities are likely to gain the most from an inflation surprise in terms of a transfer of wealth from bondholders. The United States has the most developed corporate bond market in the world. In all other countries, banks play a larger relative role in corporate finance. Because bank loans are generally floating rate, a company leveraged by bank loans cannot gain from inflation at the expense of its creditors.

Note that the risk premium hypothesis discussed earlier in the paper implies that, ceteris paribus, real stock returns should have reactions of opposite sign to changes in expected and unexpected inflation. Thus the theory appears to be at odds with the results in Tables 5 and 6, which suggest that real stock returns have an inverse relation with both types of inflation. In the next section, we will explore further the manner in which ceteris may not be paribus.

One possible criticism of the methodology used here is that the statistical inferences made above would not be valid if there were a unit root in the inflation process. We did test the data for unit roots before beginning the empirical exercise, and we obtained mixed results. It is a well known problem that unit root tests have very little power against the most relevant alternative hypothesis -- a persistent, but stationary data process. Dickey-Fuller tests on the inflation rate for each country yielded rejections at the 5 percent level only for France, Germany, and Switzerland. However, application of a more powerful "adjusted normalized bias" test led to strong rejection of a unit root in inflation for every country.[11] In addition there is a compelling theoretical reason to doubt that inflation is nonstationary -- it seems

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[11] This test was derived by Phillips and Perron and is explained in Campbell and Perron (1991). We used the "Bartlett weights" that these authors describe.

unlikely that the central banks of developed economies would be ready to allow inflation shocks to persist permanently.

5. Inflation News and Stock Returns

Our next empirical endeavor makes use of the Campbell and Shiller (1988) decomposition of the innovation in the log stock return, which is based on an approximate present value formula. In particular, if (g) denotes real dividend growth, one can write the current innovation in the real stock return (h) as:[12]

$$(E_{t+1} - E_t)\, h_{t+1} = (E_{t+1} - E_t)\ \{\sum_{j=0}^{\infty} \rho^j g_{t+1+j} - \sum_{j=1}^{\infty} \rho^j h_{t+1+j}\} \tag{5}$$

The parameter (ρ) is a constant of linearization that is slightly less than one. We will write this relation in simpler notation as:

$$\epsilon_h = n_g - n_h \tag{6}$$

The basic intuition is that a positive surprise in the real stock return today must be associated with higher current or future real dividend growth, with lower future expected real returns, or with both. We define similar notation for the current innovation in inflation (ε_π), and we also

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[12] See Campbell (1991) or Campbell and Ammer (1993) for details on how the formula is derived and used.

write an expression analogous to the terms in (5) that defines (n_π) as a weighted average of expectational revisions in future inflation:

$$n_\pi = (E_{t+1} - E_t) \left\{ \sum_{j=1}^{\infty} \rho^j \pi_{t+1+j} \right\} \tag{7}$$

Campbell and Ammer (1993) show how to estimate expressions like those in (5) and (7) from a vector autoregression (VAR) system. Here we use a first-order VAR in monthly inflation, the real log stock return, the instruments used to forecast inflation for the estimation in the previous section of the paper, and dividend-price ratios for both the national and the world stock return (which are known to help forecast expected stock returns). Estimation via the Generalized Method of Moments provides a covariance matrix for all of the estimates (including the elements of the error covariance matrix). Using this covariance matrix and numerical derivatives, standard errors can be computed for any statistic that is a function of the parameter estimates.

Results are reported in Table 8 for the ten countries. The statistics of interest are covariances and correlations among the innovations and news variables defined above. (Note that the third and fourth columns in the first part of the table sum to the fifth column, because of the identity (6) given above.) In eight of ten cases, the correlation between the current stock and inflation innovations is negative. In most cases, this is because a negative covariance between the inflation surprise and news about future dividend growth outweighs the negative covariance between the inflation surprise and news about future expected real stock returns. The first of these two facts suggests that high inflation is bad news for real corporate profits, which is consistent with the corporate tax-based explanations of the stock return-inflation correlation that were discussed earlier.

The positive entries in the first column of the second part of the table shows that inflation shocks tend to persist in all ten countries. In addition, in every country, news about future inflation is negatively correlated with both news about future dividend growth and news about future expected real returns. The latter correlation is apparently at odds with the inflation risk premium hypothesis that is discussed above -- if higher inflation means greater inflation risk, one would expect investors to insist on higher mean returns to compensate. This will be explored further in the next section.

6. Inflation Uncertainty and Risk Premiums

In this section, we will measure the effect of inflation risk on the cost of equity capital by estimating an equilibrium asset pricing model on cross-sections of returns on individual equity securities for both the United Kingdom and the United States. First we will address explicitly the relationship between the level of inflation and inflation risk by estimating the following conditional heteroscedasticity model by numerical maximum likelihood:

$$\pi_t = Z_{t-1}\theta + \epsilon_t \tag{8}$$

$$\epsilon_t \text{ is } N(0,\ \sigma_t^2) \quad \text{where: } \sigma_t^2 = \overline{s}^2 + \gamma\pi_{t-1}^{12} \tag{9}$$

Results are reported in Table 9. The regressors Z are the same instruments used to forecast inflation earlier. Note that there is a significant positive relationship between inflation and inflation uncertainty (the variance of the innovation ε) for both countries; the t statistic for the null hypothesis that γ is zero is more than 6.

The residual from this equation is then used as an observable risk factor for an estimation of the Arbitrage Pricing Theory (APT) model.[13] The asset pricing restrictions implied by the APT will provide a measurable link between inflation risk and expected stock returns. Together with the relation between the first and second moments of inflation estimated above, this will constitute a means of assessing the effect of the *level* of inflation on expected stock returns.

The APT begins with the assumption that returns are generated by a linear factor process:

$$R_{i,t} = \mu_{i,t} + \sum_{j=1}^{K} b_{i,j,t} f_{j,t} + w_{i,t} \qquad i=1,\ n \qquad t=1,\ T$$

$$E(f_j) = E(w_i) = E(f_j w_i) = 0, \quad \forall j,\ \forall i \neq k \tag{10}$$

The idea is that returns are driven by a small number (K) of common components (f) and "idiosyncratic" risk (w) that can be diversified away as the number of securities increases. Ross (1976) showed that the absence of asymptotic arbitrage opportunities implies that, for some vector λ_t of "factor prices", or risk premiums, in each period t, the expected returns (μ) on the individual securities must satisfy a pricing relationship of the form:

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[13] It would have been better to have estimated the inflation equation and the APT simultaneously. This is a more difficult technical feat that may be included in a future draft of this paper.

$$\mu_{i,t} = \sum_{j=1}^{K} b_{i,j,t}\lambda_j \tag{11}$$

With this restriction imposed on the expected returns (μ), equation (10) can be rewritten as:

$$R_{i,t} = \sum_{j=1}^{K} b_{i,j,t}(\lambda_{j,t} + f_{j,t}) + w_{i,t} \tag{12}$$

Ammer (1993) shows that if one assumes that the factor prices (λ) and the factor loadings (b) are constant over time and that the idiosyncratic components of the returns are uncorrelated across securities (so that the covariance matrix of the w terms is diagonal in a given time period), it is possible to obtain maximum likelihood estimates of the (Kn + K) parameters in equation (13) -- B and Λ -- by numerical search over a parameter space of only K dimensions.[14] We extend this method here slightly, by allowing the factor prices (λ) to vary over time in a specific way.

Empirical implementations of the APT have used both "observable" risk factors that are introduced exogenously and "unobservable", or "latent" factors that are inferred from the covariance structure of the returns. We will use both here. Our observable inflation risk factor will be the residuals from the equations estimated in Table 9. We also extract latent

[14] These assumptions are common in the empirical literature on the APT. Shanken (1992) proposes a similar method.

factors from the panels of security returns, using the principal components method of Connor and Korajczyk (1988). They show that these extracted factors are consistent estimates of the sum of the (mean zero) factors and factor prices -- (λ + f). Using their technique provides the added advantage that only the risk premiums associated with the observable factors need be estimated in the numerical optimization of the likelihood function.

Relative to Ammer (1993), the additional twist is that we will exploit the conditional heteroscedasticity estimates in Table 9 to take explicit account of time variation in factor risk, in this case, inflation risk. In particular, we will allow the conditional variance of the inflation risk factor to affect the factor premium, or risk price. Following King, Sentana, and Wadhwani (1990), we will assume that the risk premium is proportional to the conditional variance of the risk factor (inflation risk):

$$\lambda_{j,t} = \lambda_j Var_t(f_j) \qquad (13)$$

The parameter to be estimated is this ratio (λ_j).

Results are reported in Tables 10 and 11, using excess (over the one-month interest rate) and (ex post) real returns, respectively, for panels of securities drawn from the London Share Price Database and the CRSP tapes. For the United Kingdom, the securities represent all of those from a 35 percent sample of the LSPD database that had at least 120 return observations in the 1975-1989 estimation period. Using excess returns (Table 10), the risk price estimate is positive (and significant). This means that stocks that covary positively with inflation shocks have higher returns. On average, the UK excess stock returns in the sample *do* covary positively with inflation surprises. Thus the presence of the inflation risk increases the cost of equity capital in the UK, relative to a short-term risk-free interest rate. The parameters in Tables 9 and 10 imply that each percentage point in the level of inflation adds 6 or 7 basis points to the required return on the typical equity security.

The results in Table 11 estimated on real UK stock returns are somewhat different. The inflation risk price estimate is still positive (although not statistically significant), but on average real U.K. stock returns are not sensitive to inflation, and the average factor loading is slightly negative. Accordingly, the presence of inflation risk in the UK economy does not appear to affect the real cost of equity capital.

The U.S. estimation was done with three ten-year panels of data (1958-1967, 1968-1977, and 1978-1987), each of which consisted of all the stocks for which CRSP had a complete set of returns in that sub-period. The ratio of the inflation risk premium to the variance of inflation risk was restricted to be the same over the three sub-samples. In contrast to the UK results, negative inflation risk prices are estimated for both excess and real returns, and the risk premium is statistically significant for the real returns. Because the typical US stock return (either excess or real) covaries negatively with the inflation innovation, our point estimates suggest that the presence of inflation risk increases the cost of equity capital in the United States, measured either as a real cost or as the excess over the treasury bill rate.

7. Conclusions

Despite earlier indications to the contrary, the cross-sectional results reported in the last section are consistent with the inflation risk premium hypothesis for the U.S. Insofar as it operates through an increase in inflation uncertainty, higher inflation does seem to increase the cost of equity capital, which could in turn have an adverse impact on the economy. For the United Kingdom, the evidence for the theory is weaker, but there is much less of a puzzle to explain for that country. (In interpreting the results, of course, one should bear in mind that the standard errors are large, and that they may be sensitive to specification choices.)

It also appears that at the same time something else is going on -- the return decomposition results reported in Table 8 imply that, via some other channel, higher inflation decreases expected stock returns by a more than offsetting amount in both the U.S. and the UK, and that something similar is going on in other countries. Such a phenomenon may be due to one or more of the tax-related hypotheses discussed above.

One possible avenue for further research into the inflation-stock return relationship would be to begin to consider either theoretically or empirically, but explicitly, the *source* of inflation risk -- an issue that is beyond the scope of this paper. The evidence uncovered here might bode well for a model with a supply shock that simultaneously increased prices, reduced output (and profits), and reduced the marginal product of capital.

Regarding the last effect, one shortcoming of much of the empirical research in financial economics that has been done in recent years is that it focuses only on the pricing of a given set of assets with fixed properties. A deeper understanding of the pressures that move capital markets might be achieved through a richer model that considered forces that could potentially change the set of available investment opportunities.

Appendix A

Data Definitions and Sources

General:

- financial data (returns, interest and exchange rates, and D/P ratios) are end-of-month
- except for the returns used in the APT estimation, variables are measured in logs
- variables are usually measured in percent units

Stock Market Data:

- U.S. national stock market return pertains to the value-weighted NYSE index
- U.K. national stock market return pertains to the FT All Shares Index (from LSPD)
- other national stock market returns are from Morgan Stanley Capital International
- individual U.S. stock returns are from the Center for Research in Securities Prices
- individual U.K. stock returns are from the London Share Price Database (LSPD)
- dividend-price ratios are the past year's dividends divided by the current price

Inflation:

- data are generally the log change in the all-items CPI, not seasonally adjusted
- housing component in U.S. data is "rental-equivalent" (1954-1982 source: CBO)

Interest and Exchange Rates:

- UK exchange rate in the 1960's is from Morgan Stanley Capital International
- Other exchange rates are from the Federal Reserve System's FAME database
- U.S. 1-month treasury bill rate is from Ibbotson Associates

- U.S. 3-month treasury bill rate is from the Federal Reserve's FAME database
- Canadian 3-month rate is a commercial paper rate (from the BIS database)
- UK 3-month rate is treasury bill rate (from last auction in month)
- French 1-month rate is the Paris Inter-Bank Offer Rate
- Other foreign short rates are Euro-market rates (from BIS)
- U.S. 12-month bill rate is from Huston McCulloch[15] through 1958, then FAME

Bond Yields:

- U.S. yield is 10-year bond from FAME (1962-1992) and McCulloch (1943-1961)
- Foreign data are government bond yields from the BIS database
- UK, Japanese, and German bonds are 10-year maturity
- Canadian bonds are 5-10 years maturity
- Through 1984, Dutch series is average yield on 3 longest outstanding bonds
- From 1985, Dutch series is average yield on 5 longest outstanding bonds
- French, Italian, and Swiss series are for bonds of unspecified maturity

Wages:

U.S.: average hourly earnings in manufacturing, n.s.a.

Belgium: hourly wage in manufacturing, mining, and transport, n.s.a.

Canada: hourly wage in manufacturing, n.s.a.

France: hourly wage in manufacturing, s.a.

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[15] McCulloch's data appear in an appendix to Robert Shiller's term structure article in The Handbook of Monetary Economics.

Germany: hourly wage in mining and manufacturing, n.s.a.

Italy: hourly wage in industry, s.a.

Japan: earnings index for industry excluding services, n.s.a.

Netherlands: hourly wage in manufacturing, n.s.a.

Switzerland: no data available

U.K.: hourly wage in "industry" to 1979; average earnings all employees from 1980

Sources: FAME for U.S. data; BIS for foreign data

References

Ammer, John (1993), "Macroeconomic Risk and Asset Pricing: Estimating the APT with Observable Factors", International Finance Discussion Paper 448, Federal Reserve Board (August).

Ammer, John and Jianping Mei (1993), "Measuring International Linkages with Stock Market Data", International Finance Discussion Paper 449, Federal Reserve Board (August).

Buono, Mark (1989), "The Relationship between the Variability of Inflation and Stock Returns: An Empirical Investigation", Journal of Financial Research 12(4):329-339.

Campbell, John Y. (1991), "A Variance Decomposition for Stock Returns", Economic Journal 101:157-179.

Campbell, John Y., and John Ammer (1993), "What Moves the Stock and Bond Markets? A Variance Decomposition for Long-Term Asset Returns", Journal of Finance 48(1):3-37.

Campbell, John Y. and Pierre Perron (1991), "Pitfalls and Opportunities: What Macroeconomists Should Know about Unit Roots", in NBER Macroeconomics Annual 1991, Olivier Blanchard and Stanley Fisher, editors, 141-201, Cambridge, Massachusetts: National Bureau of Economic Research.

Campbell, John Y. and Robert Shiller (1988), "The Dividend-Price Ratio and Expectations of Future Dividends and Discount Factors", Review of Financial Studies 1(3):195-228.

Connor, Greg and Robert Korajczyk (1988), "Risk and Return in an Equilibrium APT: Application of a New Test Methodology", Journal of Financial Economics 21(2):255-289.

Ely, David P. and Kenneth J. Robinson (1989), "The Stock Market and Inflation: A Synthesis of the Theory and Evidence", Federal Reserve Bank of Dallas Economic Review, (March):17-29.

Evans, Martin and Paul Wachtel (1993), "Inflation Regimes and the Sources of Inflation Uncertainty", Journal of Money, Credit and Banking 25(3):475-511.

Fama, Eugene (1981), "Stock Returns, Real Activity, Inflation, and Money", American Economic Review 71:545-565.

Fama, Eugene and William Schwert (1977), "Asset Returns and Inflation", Journal of Financial Economics 5:115-146.

Feldstein, Martin (1980), "Inflation and the Stock Market", American Economic Review

70(5):839-847.

Fisher, Irving (1930), The Theory of Interest Rates, New York: MacMillan.

Geske, Robert and Richard Roll (1983), "The Fiscal and Monetary Linkage between Stock Returns and Inflation", Journal of Finance 38:1-33.

Gonedes, Nicholas (1981), "Evidence on the 'Tax Effects' of Inflation under Historical Cost Accounting Methods", Journal of Business 54:227-270.

Gultekin, N. Bulent (1983), "Stock Market Returns and Inflation: Evidence from Other Countries", Journal of Finance 38:49-65.

Huberman, Gur and William Schwert (1985), "Information Aggregation, Inflation, and the Pricing of Indexed Bonds", Journal of Political Economy 93(1):92-114.

Kaul, Gautam (1987), "Stock Returns and Inflation: The Role of the Monetary Sector", Journal of Financial Economics 18:253-276.

King, Mervyn, Enrique Sentana, and Sushil Wadhwani (1990), "A Heteroscedastic Factor Model of Asset Returns and Risk with Time-Varying Volatility: An Application to Sixteen World Stock Markets", Financial Markets Group Discussion Paper 80, London School of Economics (May).

Kopits, George (1975), International Comparison of Tax Depreciation Practices, Paris: OECD.

McDevitt, Catherine L. (1989), "The Role of the Nominal Tax System in the Common Stock Returns/Expected Inflation Relationship", Journal of Monetary Economics 24(1):93-107.

Mishkin, Frederic S. (1990), "Is the Fisher Effect for Real? A Reexamination of the Relationship between Inflation and Interest Rates", unpublished paper, Columbia University (August).

Najand, Mohammad (1991), "A Test of the Risk Premium Hypothesis", Journal of Financial Research 14(3):207-216.

Organization for Economic Cooperation and Development (1991), Taxing Profits in a Global Economy, Paris: OECD.

Pearce, Douglas K. and Vance Roley (1988), "Firm Characteristics, Unanticipated Inflation, and Stock Returns", Journal of Finance 43(4):965-981.

Rose, Andrew K. (1988), "Is the Real Interest Rate Stable?", Journal of Finance

43:1095-1112.

Ross, Steven (1976), "The Arbitrage Theory of Capital Asset Pricing", Journal of Economic Theory 13:341-360.

Shanken, Jay (1992), "On the Estimation of Beta Pricing Models", Review of Financial Studies 5(1):1-34.

Solnik, Bruno (1983), "The Relation Between Stock Prices and Inflationary Expectations: The International Evidence", Journal of Finance 38:35-48.

Tobin, James (1958), "Liquidity Preferences as Behavior toward Risk", Review of Economic Studies 26:65-86.

Table 1

"Fisher Effect" Inflation Equations (monthly)

country	constant	i^1_{t-1}	$\bar{R}^2$	D-W statistic	$\chi^2(3)$ for (ρ_1,ρ_2,ρ_3)
Belgium (1977:10-1993:6)	-0.175 (0.084)	0.645 (0.099)	0.18	1.62	10.7
Canada (1960:2-1993:6)	0.062 (0.046)	0.537 (0.062)	0.15	1.66	40.9
France (1969:2-1993:6)	0.078 (0.076)	0.616 (0.091)	0.13	0.66	338.7
Germany (1963:8-1993:6)	0.146 (0.039)	0.300 (0.073)	0.04	1.31	55.8
Italy (1977:10-1993:6)	-0.094 (0.109)	0.740 (0.086)	0.28	1.00	86.3
Japan (1977:10-1993:6)	0.005 (0.107)	0.431 (0.207)	0.02	1.84	21.3
Netherlands (1963:8-1993:6)	0.389 (0.077)	0.000 (0.133)	0.00	1.71	9.5
Switzerland (1963:8-1993:6)	0.248 (0.043)	0.215 (0.099)	0.01	1.60	20.7
United Kingdom (1968:2-1993:6)	-0.077 (0.141)	0.843 (0.144)	0.10	1.25	95.9
United States (1954:2-1991:12)	0.037 (0.025)	0.653 (0.047)	0.29	1.09	141.4
United States (1954:2-1971:7)	-0.037 (0.029)	0.777 (0.094)	0.24	1.95	8.4
United States (1973:1-1991:12)	0.291 (0.062)	0.313 (0.092)	0.04	0.86	113.7

Note: The 95 percent quantile of the χ^2 distribution is 7.8; the 99 percent quantile is 11.3. Variables are measured in units of percent per month. Standard errors are in parentheses.

Table 2

"Fisher Effect" Inflation Equations (quarterly)

country	constant	i^1_{t-1}	$\bar{R}^2$	D-W statistic	$\chi^2(3)$ for (ρ_1,ρ_2,ρ_3)
Belgium (1965:3-1993:2)	0.427 (0.248)	0.382 (0.108)	0.09	1.03	64.2
Canada (1960:2-1993:2)	0.163 (0.170)	0.543 (0.076)	0.27	0.97	65.5
France (1968:2-1993:2)	0.715 (0.244)	0.363 (0.082)	0.15	0.64	124.2
Germany (1963:4-1993:2)	0.481 (0.168)	0.267 (0.104)	0.04	1.51	21.3
Italy (1974:2-1993:2)	-0.496 (0.386)	0.824 (0.094)	0.49	1.03	32.8
Japan (1975:2-1993:2)	0.164 (0.278)	0.441 (0.169)	0.07	1.34	17.8
Netherlands (1963:4-1993:2)	1.042 (0.258)	0.071 (0.145)	-0.01	1.47	33.1
Switzerland (1962:3-1993:2)	0.586 (0.164)	0.323 (0.121)	0.05	1.67	11.1
United Kingdom (1961:2-1993:2)	0.105 (0.369)	0.780 (0.154)	0.16	1.20	106.8
United States (1954:2-1991:4)	0.066 (0.104)	0.660 (0.064)	0.41	1.09	77.0
United States (1954:2-1971:2)	-0.119 (0.097)	0.750 (0.100)	0.44	1.77	2.7
United States (1973:1-1991:4)	0.753 (0.274)	0.363 (0.132)	0.08	0.97	44.6

Note: The 95 percent quantile of the χ^2 distribution is 7.8; the 99 percent quantile is 11.3. Variables are measured in units of percent per quarter. Standard errors are in parentheses.

Table 3

"Fisher Effect" Inflation Equation (annual)

country	constant	i^1_{t-1}	$\bar{R}^2$	D-W statistic	$\chi^2(3)$ for (ρ_1,ρ_2,ρ_3)
United States (1948-1992)	0.054 (0.748)	0.658 (0.112)	0.45	0.70	26.8

Table 4

Regression of Inflation on Survey Expectation (annual)

country	constant	i^1_{t-1}	$\bar{R}^2$	D-W statistic	$\chi^2(3)$ for (ρ_1,ρ_2,ρ_3)
United States (1948-1992)	0.872 (0.433)	0.901 (0.101)	0.66	1.18	11.5

Note: The 95 percent quantile of the χ^2 distribution is 7.8; the 99 percent quantile is 11.3. Variables are measured in units of percent per quarter. The survey data is from the December Livingston Survey of 12-month-ahead inflation. Standard errors are in parentheses.

Table 5

Impact of Expected and Unexpected Inflation on Stock Returns

(monthly instrumental variables estimates)

country	constant	π^e	$\pi - \pi^e$	$\bar{R}^2$ (1st stage)
Belgium (1970:1-1990:12)	2.213 (0.675)	-2.504 (1.273)	1.297 (1.043)	0.39
Canada (1970:1-1990:12)	1.197 (0.951)	-0.671 (1.626)	-1.258 (1.016)	0.27
France (1970:1-1990:12)	1.600 (0.982)	-1.051 (1.433)	0.798 (1.662)	0.57
Germany (1970:1-1990:12)	0.721 (0.736)	-0.410 (2.096)	-1.351 (1.259)	0.25
Italy (1970:1-1990:12)	0.703 (1.072)	0.052 (1.065)	-0.021 (0.959)	0.44
Japan (1971:2-1990:12)	1.791 (0.530)	-1.457 (0.934)	-0.473 (0.482)	0.19
Netherlands (1970:1-1990:12)	1.528 (0.587)	-1.641 (1.256)	-0.592 (0.842)	0.30
Switzerland (1970:1-1990:12)	1.573 (0.619)	-3.328 (1.554)	-0.704 (0.829)	0.21
United Kingdom (1962:2-1990:12)	0.794 (0.648)	0.448 (0.847)	1.221 (0.575)	0.31
United States (1955:2-1991:12)	1.394 (0.390)	-1.498 (0.962)	-3.109 (0.966)	0.50

Note: The instruments used were the monthly and annual inflation rates, a long bond yield less the annual inflation rate, the 12-month change in the real exchange rate (versus the U.S. dollar), and the 12-month change in the real wage. For Switzerland, the difference between the 3-month and 1-month interest rates was used instead of the wage variable (which was not available), and for the United States, this spread supplanted the exchange rate. Variables are measured in units of percent per month. Standard errors are in parentheses.

Table 6

Impact of Expected and Unexpected Inflation on Stock Returns

(quarterly instrumental variables estimates)

country	constant	π^e	$\pi - \pi^e$	$\bar{R}^2$ (1st stage)
Belgium (1970:1-1990:4)	5.603 (2.306)	-1.771 (1.465)	-2.362 (1.570)	0.49
Canada (1970:1-1990:4)	4.540 (2.709)	-1.247 (1.539)	-2.410 (1.751)	0.52
France (1970:1-1990:4)	5.261 (3.365)	-1.297 (1.650)	-0.948 (2.337)	0.64
Germany (1970:1-1990:4)	1.949 (2.673)	-0.180 (2.597)	-0.982 (1.796)	0.26
Italy (1974:2-1990:4)	5.781 (4.558)	-1.036 (1.432)	1.263 (1.903)	0.60
Japan (1975:2-1990:4)	6.289 (2.273)	-3.551 (2.109)	0.736 (1.684)	0.31
Netherlands (1970:1-1990:4)	3.413 (1.835)	-0.644 (1.322)	-2.853 (1.890)	0.64
Switzerland (1970:1-1990:4)	4.275 (2.562)	-2.898 (2.276)	-2.359 (1.267)	0.18
United Kingdom (1961:2-1990:4)	0.726 (2.035)	1.220 (0.910)	-0.122 (0.844)	0.43
United States (1955:2-1990:4)	3.273 (1.321)	-0.634 (1.097)	-4.361 (1.375)	0.59

Note: The instruments used were the quarterly and annual inflation rates, a long bond yield less the annual inflation rate, the 12-month change in the real exchange rate (versus the U.S. dollar), the 12-month change in the real wage, the 12-month change in the real oil price, and the 3-month interest rate. The wage variable was omitted for Switzerland, the exchange rate was excluded for the United States. Variables are measured in units of percent per quarter. Standard errors are in parentheses.

Table 7

Impact of Expected and Unexpected Inflation on Stock Returns

(using annual survey expectations)

country	constant	π^e	$\pi - \pi^e$	$\bar{R}^2$
United States (1948-1992)	16.762 (3.909)	-0.854 (0.878)	-4.977 (1.376)	0.21

Table 8, part 1

Co-Movements of News about Inflation, Expected Returns, and Dividend Growth

country	$\rho(\varepsilon_\pi,\varepsilon_h)$	$Cov(\varepsilon_\pi,\varepsilon_h)$	$Cov(\varepsilon_\pi,n_h)$	$Cov(\varepsilon_\pi,n_g)$
Belgium (1971:1-1990:12)	0.025 (0.063)	0.035 (0.088)	-0.313 (0.171)	-0.278 (0.150)
Canada (1971:1-1990:12)	-0.116 (0.058)	-0.185 (0.096)	0.121 (0.192)	-0.064 (0.166)
France (1971:1-1990:12)	-0.007 (0.060)	-0.010 (0.087)	-0.507 (0.535)	-0.517 (0.518)
Germany (1971:1-1990:12)	-0.121 (0.061)	-0.166 (0.086)	-0.245 (0.321)	-0.411 (0.310)
Italy (1971:1-1990:12)	-0.068 (0.073)	-0.220 (0.241)	0.223 (0.913)	0.003 (0.941)
Japan (1971:2-1990:12)	-0.176 (0.057)	-0.630 (0.212)	-0.550 (0.948)	-1.180 (0.941)
Netherlands (1971:1-1990:12)	-0.111 (0.056)	-0.206 (0.107)	-0.204 (0.257)	-0.410 (0.232)
Switzerland (1971:1-1990:12)	-0.102 (0.073)	-0.188 (0.138)	-0.322 (0.426)	-0.510 (0.420)
United Kingdom (1962:2-1990:12)	0.025 (0.057)	0.082 (0.193)	-0.798 (0.487)	-0.716 (0.454)
United States (1955:2-1990:12)	-0.184 (0.052)	-0.157 (0.047)	-0.066 (0.148)	-0.223 (0.139)

Note: Computations are based on a 1-lag VAR in the 1-month and 12-month inflation rates, the long bond yield minus the 12-month inflation rate, the real stock return, the world and national dividend-price ratios, and 12-month real changes in wages, the price of oil, and the exchange rate versus the U.S. dollar. For Switzerland, a treasury bill spread is used instead of the wage variable, and for the U.S., this spread replaces the exchange rate. For the UK, the U.S. dividend-price ratio is used instead of the world D/P; for the U.S., a bond minus bill treasury spread replaces the world D/P. Standard errors are in parentheses.

Table 8, part 2

Co-Movements of News about Inflation, Expected Returns, and Dividend Growth

country	$\rho(\varepsilon_\pi, n_\pi)$	$\rho(n_\pi, n_h)$	$\rho(n_\pi, n_g)$
Belgium (1971:1-1990:12)	0.307 (0.159)	-0.687 (0.346)	-0.717 (0.296)
Canada (1971:1-1990:12)	0.163 (0.156)	-0.061 (0.432)	-0.249 (0.725)
France (1971:1-1990:12)	0.516 (0.308)	-0.482 (0.435)	-0.570 (0.506)
Germany (1971:1-1990:12)	0.472 (0.175)	-0.101 (0.719)	-0.788 (0.240)
Italy (1971:1-1990:12)	0.416 (0.166)	-0.426 (1.069)	-0.322 (0.730)
Japan (1971:2-1990:12)	0.345 (0.160)	-0.646 (0.306)	-0.540 (0.364)
Netherlands (1971:1-1990:12)	0.177 (0.128)	-0.730 (0.239)	-0.862 (0.176)
Switzerland (1971:1-1990:12)	0.500 (0.176)	-0.626 (0.288)	-0.706 (0.415)
United Kingdom (1962:2-1990:12)	0.367 (0.143)	-0.251 (0.369)	-0.567 (0.389)
United States (1955:2-1990:12)	0.571 (0.214)	-0.577 (0.179)	-0.675 (0.223)

Note: Computations are based on a 1-lag VAR in the 1-month and 12-month inflation rates, the long bond yield minus the 12-month inflation rate, the real stock return, the world and national dividend-price ratios, and 12-month real changes in wages, the price of oil, and the exchange rate versus the U.S. dollar. For Switzerland, a treasury bill spread is used instead of the wage variable, and for the U.S., this spread replaces the exchange rate. For the UK, the U.S. dividend-price ratio is used instead of the world D/P; for the U.S., a bond minus bill treasury spread replaces the world D/P. Standard errors are in parentheses.

Table 9

Conditionally Heteroscedastic Model of Inflation

coefficient on:	United Kingdom (2/62-12/90)	United States (2/56-12/91)
constant	-0.095 (0.109)	0.022 (0.026)
lagged 1-month inflation	0.179 (0.056)	0.221 (0.051)
lagged 12-month infl. (π^{12})	0.069 (0.012)	0.058 (0.006)
bond yield - (π^{12})	0.016 (0.017)	-0.000 (0.000)
12-mo. Δ in real wage	0.031 (0.011)	0.015 (0.007)
12-mo. Δ in real exch. rate	-0.003 (0.003)	
3-month bill - 1-month bill		0.078 (0.042)
constant part of variance	0.073 (0.028)	0.031 (0.005)
(π^{12}) effect on variance	0.032 (0.005)	0.003 (0.001)

Note: The conditional variance of the residual is $\sigma^2_t = \bar{s}^2 + \gamma\pi^{12}_{t-1}$. Standard errors are in parentheses.

Table 10

APT Estimates with Conditionally Heteroscedastic Risk (excess returns)

	United Kingdom (2/75-8/89)	United States (1/58-12/87)
# samples	1	3
# securities	545	3341
inflation factor price	0.115 (0.046)	-0.017 (0.082)
average factor loading	6.930	-69.059
average effect on expected return of inflation risk	0.797 % / year	1.174 % / year
average 12-month inflation rate	9.619 %	4.332 %
mean inflation risk premium under zero inflation	0.153 % / year	0.831 % / year
change in average cost of equity capital from eliminating inflation	-0.646 % / year	-0.343 % / year
change in cost of capital from 1% inflation drop	6.7 basis points	7.9 basis points

Table 11

APT Estimates with Conditionally Heteroscedastic Risk (real returns)

	United Kingdom (2/75-8/89)	United States (1/58-12/87)
# samples	1	3
# securities	545	3341
inflation factor price	0.032 (0.032)	-0.022 (0.004)
average factor loading	-0.061	-81
average effect on expected return of inflation risk	-0.002 % / year	1.782 % / year
average 12-month inflation rate	9.619 %	4.332 %
mean inflation risk premium under zero inflation	-0.000 % / year	1.262 % / year
change in average cost of equity capital from eliminating inflation	+0.002 % / year	-0.520 % / year
change in cost of capital from 1% inflation drop	-0.0 basis points	12.0 basis points

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