Inflation Hedging and Industry Stock Returns

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ABSTRACT

We examine an inflation-hedging ability of stock returns, using cyclical and non-cyclical industries from 1961Q2 to 2014Q4. We document that the returns of the non-cyclical industry portfolio are positively associated with expected inflation. A sub-period analysis shows that the relation is stronger during the bull market period of 1983Q1-2001Q4. Given the empirical findings of the influence of expected and unexpected inflation on the market-to-book (M/B), return on assets (ROA), and leverage ratios, we test and support validity of the Fisher effect for both cyclical and non-cyclical industry portfolios over the entire period. In addition, using the Fama-French three factor model, we examine whether the excess stock return is further explained by expected inflation. Although its effect seems captured in the risk-free rate, stocks of the non-cyclical industry portfolio have hedged inflation better than stocks of the cyclical industry portfolio particularly during the 1983Q1-2001Q4 period.

Keywords: inflation, stock returns, Fisher effect, cyclical and non-cyclical industries

Data Availability: Data used in this study are available from public sources.

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Introduction

The nominal stock return moves one-on-one with expected inflation under the Fisher hypothesis, given that the real return is independent of a change in expected inflation. Although nominal stock returns are claims against real assets, they are negatively associated with inflation. Fama (1981), Kaul and Seyhun (1990), Geske and Roll (1983), and Kaul (1987) explain the puzzle based on the real economic activity, the relative price variability of oil products, and the Fed's pro- and counter-cyclical policy.[1] Further studies by Boudoukh et al. (1994) document that there are cross-sectional differences in the relationships between industry stock returns and inflation, showing that an increase in expected inflation causes an increase (a decrease) in the expected returns of non-cyclical (cyclical) industries. Pilotte (2003) finds that dividends and capital gains are related differently to inflation in post-World War II data. Dividend yields are significantly positively associated with expected inflation as opposed to capital gains. Encompassing longer sample periods and using modern econometric approaches,[2] a strand of research provides evidence of validity of the Fisher hypothesis, asserting that the Fisher coefficient is negative at shorter horizons, but becomes positive at longer horizons (Boudoukh and Richardson, 1993; Solnik and Solnik, 1997; Schotman and Schweitzer, 2000).[3]

In this paper, we first test whether the Fisher hypothesis holds across cyclical- and noncyclical industries. Cyclical industries include those that produce durable goods such as raw materials and heavy equipment. Gomes et al. (2009) assert that firms producing durable goods are exposed to higher systematic risk than those producing nondurable goods and services because the cash flows of durable goods producers are more volatile and more correlated with aggregate consumption as opposed to those of nondurable goods and services producers. Based on the validity test, we examine stocks of which industry, cyclical or non-cyclical, have earned higher returns and have hedged inflation better over the high inflation period.

Inflation risk is the risk that deteriorates purchasing power and redistributes wealth between parties depending on whether firms are net nominal debtors or creditors (French et al, 1983). Inflation risk is also one of the economic risks faced by individual and institutional investors who must have the appropriate amount of money available to cover retirement expenses and make payments to beneficiaries when inflation is high (Bekaert and Wang, 2010). Boudoukh et al. (1994) view the inflation risk factor in a macroeconomic scope where the variation in its coefficient can be directly related to economic fundamentals, e.g., aggregate output growth, which influence the covariance between stock returns and inflation. In contrast, we employ a firm's financial data to examine the potential microeconomic factors, and thus show their contribution to inflation risk. To be more precise about our microeconomic framework, consider that inflation risk is the risk that stock has poor returns when inflation is high. Low returns can occur for many reasons, one of which is associated with adverse cash flow performance. Campbell and Mei (1993) claim that stock returns are determined by innovations in future cash flows, real interest rates, and excess returns, and show that the coefficient of the inflation rate is negatively associated with expected cash flows and stock returns. In other words, inflation may lead to an increase in volatilities of the firm's operating income, inventory and fixed asset investments, cash flows to creditors and stockholders, debt to equity value, and thus the stock returns.

If inflation has an effect on the firm's financial characteristics and investment and financing decisions, how does it differ across firms? Do investors require an equity premium on inflation risk? Bernard (1986) finds that unexpected inflation is associated with firm characteristics, e.g., operating profitability, which captures the cross-sectional variations between stock returns and unexpected inflation.[4] Revisiting the puzzle of expected inflation being negatively correlated with stock returns, Sharpe (2002) provides evidence that it could be to the large extent explained by a negative relationship between expected inflation and expected real earnings growth. We investigate whether expected and unexpected inflation has an effect on the microeconomic factors, i.e., the market to book ratio (M/B), return on assets (ROA), and leverage ratio.

We estimate expected inflation based on Sims' (1980) vector autoregressive model (VAR)[5] for six macro variables, i.e., real GDP, M2, CPI, employment in manufacturing, manufacturing wage rates, and import prices for all commodities over the 1959Q1 to 2014Q4 period. Using the CRSP and Compustat databases, sample data are collected for firms that trade on the NYSE and NASDAQ during the period of 1961Q2 to 2014Q4. Sample firms are assigned into fourteen industries based on Fama and French's twelve industry portfolio classification.[6] The industries are further categorized into three non-cyclical and six cyclical industries.

We test validity of the Fisher effect for cyclical and non-cyclical industries over the entire period of 1961Q2-2014Q4 and the sub-periods of 1961Q2-1982Q4, 1983Q1-2001Q4, and 2002Q1-2014Q4. The sub-period classification includes breakpoints of the Federal Reserve's tighter monetary policy in the early 1980s and the collapse of the dot-com bubble during the 1999 to 2001 period.[7] We find that the quarterly industry stock return is positively associated with the coefficient of expected inflation for eight of the nine industries except for mining although the coefficient is statistically insignificant. Moreover, the coefficient is significantly positive for the non-cyclical industry portfolio at least at the level of 10% during the entire period and the first two sub-periods, indicating that returns on the non-cyclical industry portfolio tend to increase with inflation and thus stocks of the portfolio are good inflation hedges when inflation is high (Boudoukh et al., 1994).

Empirical findings of the micro economic factors show that for the cyclical and non-cyclical industries over the entire sample period, the M/B ratio is significantly negatively correlated with expected inflation while the ROA and leverage ratios are overall significantly positively correlated with expected inflation. In addition, the similar correlation is documented between unexpected inflation and the M/B ratio or the ROA ratio. Given the association between expected/unexpected inflation and the M/B, ROA, or leverage ratio, we find that stock returns on both cyclical- and non-cyclical industry portfolios would increase (decrease) more than twice as large as an increase in expected (unexpected) inflation over the entire period. Thus, we confirm the results of Bernard (1986) and Campbell and Mei (1993) that the cross-sectional variation in stock returns is explained by expected and unexpected inflation betas in the microeconomic scope.

Finally, we examine the additional explanatory power of expected and unexpected inflation in the Fama-French three factor model. We find that expected inflation is a weakly positively (negatively) correlated with stock return on the non-cyclical (cyclical) industry portfolio. Although the influence of expected inflation seems captured in the risk-free rate (Sharpe, 2002), stocks of the non-cyclical industry portfolio have hedged inflation better than stocks of the cyclical industry portfolio particularly during the 1983Q1 to 2001Q4 period. In addition, we find that stocks of the non-cyclical industry portfolio have covaried negatively with unexpected inflation.

The paper is organized as follows. The sample data is first described, followed by the model and empirical results for cyclical and non-cyclical industry stock returns. Finally, a brief conclusion is provided.

DATA

We estimate expected inflation, using Sims' (1980) vector autoregressive model (VAR)[8] for six macro variables. These variables include the quarterly growth rates of real GDP (y_t), M2 (m_t), employment in manufacturing (u_t), manufacturing wage rates (w_t), and import prices for all commodities (pm_t), and the inflation rates for the CPI (π_t). The data are provided by the International Monetary Fund eLibrary-Data for the period of 1959Q1 to 2014Q4. Panel A of Table 1 reports results from the augmented Dickey-Fuller tests for the VAR model. The null hypothesis is that the time series has a unit root and thus is nonstationary. The results show that while the growth rates of GDP, M2, employment, and import prices are stationary, both the CPI inflation rate and the growth rate in wages are nonstationary over the sample period. To deal with these nonstationarities, we difference the respective time series of the CPI inflation and the growth rate in wages, which leads to stationary time series of these two variables as shown in Panel B of Table 1.

The VAR model is estimated with four quarterly lags over the 1959Q2 to 2014Q4 period.[9] The parameter estimates for the change in the inflation rate, $\Delta\pi_t = \pi_t - \pi_{t-1}$, are presented in Panel A of Table 2. The results indicate that all lags of the change in inflation, the second, third, and fourth lags of the change in wages, the first and fourth lags of the growth rate of import prices, and the first lag of the employment growth rate are significant at least at the 10% level for the $\Delta\pi_t$ equation. Since all information is available at the end of t−1, expected inflation for period t, conditional on t-1 information, is derived by adding the expected change in the inflation rate, $E_{t-1}(\pi_t - \pi_{t-1})$, to the actual inflation rate in t-1, i.e., $E_{t-1}\pi_t = E_{t-1}(\pi_t - \pi_{t-1}) + \pi_{t-1}$. The average quarterly expected inflation rate is 0.74% with a standard error of 0.72% during the entire sample period. See Panel B of Table 2.[10]

Our sample consists of firms that trade on the NYSE and NASDAQ during the 1961Q2 to 2014Q4 period, covering 215 quarters. Stock return data are collected from the CRSP database, and financial data are from the quarterly Compustat database. Based on Fama and French's twelve industry portfolios, we group financial and non-financial firms into fourteen industries. See Table 3 for details. The industries are categorized into cyclical, non-cyclical, and neither. Consumer non-durables, utilities, and healthcare are classified as non-cyclical industries while consumer durables, manufacturing, chemicals, shops, mining, and construction are classified as cyclical industries. The remaining industries are classified as neither. Thus, the sample consists of three non-cyclical and six cyclical industries.

Panel A in Table 4 documents summary statistics of the nine industries for quarterly nominal return, the market to book ratio (M/B), the return on assets (ROA), and the leverage (total debt) ratio from 1961Q2 to 2014Q4. The M/B, ROA, and leverage ratios are winsorized at 5% and 95% where observations below 5% are replaced with 5%, and observations above 95% with 95%. The average quarterly return is higher for healthcare (4.6%) and lower for utilities (3.1%) while the standard deviation is higher for construction and mining and lower for utilities. The M/B ratio is defined as the market value of equity divided by the book value of equity where the book value of equity is computed by subtracting total liabilities from total assets. The book value of total assets is adjusted to eliminate outliers, adding 10% of the difference between market and book equity to the book value of total assets (Cohen et al., 2003). The average M/B ratio ranges from 1.24 (utilities) and 1.40 (construction) to 1.85 (chemicals) and 2.51 (healthcare). The average quarterly ROA is larger for utilities (.9%) and consumer nondurables (.8%) and lower for healthcare (-1.2%) and mining (-.1%). Leverage is calculated as the book value of total debt divided by the book value of the adjusted total assets.[11] The average leverage ratio varies as high as 65% (utilities) and 56% (construction) and as low as 32% (mining) and 36% (healthcare).

Summary statistics of the variables in Panel A of Table 4 are also tabulated for the cyclical and non-cyclical industry portfolios in Panel B. The entire sample period of 1961Q2 to 2014Q4 is divided into the following three sub-periods, 1961Q2-1982Q4, 1983Q1-2001Q4, and 2002Q1-2014Q4. Determination of breakpoints for the sub-period analysis is based on the Federal Reserve's tighter monetary policy in the early 1980s and the collapse of the dot-com bubble during the 1999 to 2001 period. The average quarterly return is almost same for both portfolios over the entire and the recent sample periods. However, the return is higher by about 1% for the cyclical portfolio during the first sub-period and for the non-cyclical portfolio during the second sub-period. Note that standard deviation of the return is 1.3% to 3.5% higher per quarter for the cyclical portfolio than for the noncyclical portfolio over the periods. The average M/B ratio is consistently higher for the non-cyclical portfolio and has increased for both portfolios over the periods. The average ROA is slightly larger for the cyclical portfolio over the entire sample period. In addition, the average leverage ratio is somewhat higher for the non-cyclical portfolio over the periods. On the other hand, the opposite holds for the median leverage ratio.

MODEL AND EMPIRICAL RESULTS

Fisher Effect

We first test validity of the Fisher effect over the 1961Q2-2014Q4 period and the sub-periods of 1961Q2-1982Q4, 1983Q1-2001Q4, and 2002Q1-2014Q4 as follows:

$$R_{i,t} = \beta_0 + \beta_1 E_{t-1}\pi_t + \varepsilon_{i,t} \quad (1)$$

where $R_{i,t}$ is the average quarterly return, $E_{t-1}\pi_t$ is the expected quarterly inflation rate, and $\varepsilon_{i,t}$ is a residual and distributed as a normal distribution. The residual includes information that is not explained by expected inflation. Variance in equation (1) for each of the nine industries is estimated with the Huber/White/sandwich robust variances estimator (White, 1980). Residuals of the cyclical- and non-cyclical industry portfolios are estimated based on the fixed-effects model in panel regression. The Fisher hypothesis holds when the expected inflation beta is equal to one, implying that the stock return covaries with expected inflation in the same direction and same amount of its change, and thus the stock is a perfect hedge against inflation.

The average quarterly return is regressed on expected inflation for three non-cyclical and six cyclical industries, and the cyclical and non-cyclical industry portfolios. The coefficient of expected inflation ranges from -0.88 (mining) and 0.28 (utilities) to 1.51 (nondurables) and 2.07 (construction), positive for eight of the nine industries, and greater than one for five industries over the entire period although it is statistically insignificant for all of the industries (Table 5). This result indicates that stocks of construction and nondurables industries with high inflation betas have hedged inflation better than stocks of utilities, chemicals, and manufacturing industries with low inflation betas. The negative inflation beta of mining industry exhibits that its stock performed poor when inflation was high.

The bottom of Table 5 presents the inflation betas of the cyclical industry portfolio (0.81) and the non-cyclical industry portfolio (1.05). The inflation beta of the non-cyclical portfolio that is significantly different from zero at 10% provides evidence that it has been a good inflation hedge compared to the cyclical portfolio, earning return of 1.05 percent as inflation increases 1 percent. In contrast to the earlier findings of stock returns being negatively associated with inflation,[12] the result of Boudoukh et al. (1994) is confirmed in our sample.

The sub-period analysis is also documented in Table 5. Results during the high inflation period of 1961Q2-1982Q4 are similar as those during the entire sample period. On the other hand, the inflation betas of the industries except mining and utilities and of the cyclical- and non-cyclical industry portfolios have significantly increased during the 1983Q1-2001Q4 period, ranging 3.37 (manufacturing) to 8.92 (healthcare), and 3.52 (cyclical) to 4.61 (non-cyclical). Note the inflation beta of the non-cyclical industry portfolio is also significantly different from zero at the level of 5%. This empirical finding indicates that the non-cyclical industry portfolio has hedged inflation better than the cyclical industry portfolio. During the 2002Q1-2014Q4 period, the coefficient of expected inflation is almost zero or negative for the industries except consumer nondurables (1.22) and consumer durables (1.31), and negative for the cyclical industry portfolio (-1.03) and almost zero for the non-cyclical industry portfolio (-0.10) in spite of all of the coefficients being insignificant.

As a result, the Fisher hypothesis is not rejected for the non-cyclical industry portfolio at least at the level of 10% during the entire and 1961Q2-1982Q4 periods, and for the cyclical industry portfolio at the level of 10% during the 1983Q1-2001Q4 period. Furthermore, the high inflation betas of both the cyclical- and non-cyclical industry portfolios during the 1983Q1-2001Q4 period approximately coincide with the most prolific bull market period of 1980s and 1990s (Ritter and Warr, 2002). Despite the use of a relatively short investment horizon of quarterly returns, the result of the non-cyclical industry portfolio is overall consistent with that of Boudoukh and Richardson (1993), Solnik and Solnik (1997), and Schotman and Schweitzer (2000) who show to the larger extent that the Fisher hypothesis is not rejected at long investment horizons over the sample period that approximately overlaps our first two sub-periods.

To investigate validity of the Fisher effect, we also employ the real return that is regressed on the expected inflation.[13] The real return is defined as the average quarterly return minus the actual inflation rate. The regression result exhibits that the expected inflation betas are not significant for all of the industries and for the cyclical- and non-cyclical industry portfolios over the above sample periods except for the non-cyclical industry portfolio during the 1983Q1-2001Q4 period at the level of 10%. Therefore, the Fisher effect is broadly not rejected in our sample. See Appendix A for details.

Inflation and the Microeconomic Factors

The cross-sectional variation in the inflation beta can be explained by the cyclicality of an industry. Boudoukh et al. (1994) provide evidence that stocks of non-cyclical industries have higher inflation betas and lower correlations with aggregate industrial production growth than stocks of cyclical industries. Compared to their view of the cross-sectional variation being macroeconomic in scope, we employ a firm's financial data to examine the potential microeconomic factors, and thus show their contribution to inflation risk. Campbell and Mei (1993) show that the inflation beta is negatively associated with the firm's cash flows and stock returns. Inflation is likely to cause the equity value of a firm to change, the product cost to increase, and the leverage ratio to change. Using the potential microeconomic factors, we examine the influence of inflation on the industry's investment and financing decisions, i.e., volatilities in its market-to-book (M/B) ratio, return on assets (ROA), and total liabilities to total assets (leverage) ratio. In other words, we investigate whether the M/B ratio, ROA, and leverage ratio are influenced by the expected and unexpected inflation rates, using the following equations (2) to (4),

$$M/B_{i,t} = \beta_0 + \beta_1 U_t\pi_t + \beta_2 E_{t-1}\pi_t + \varepsilon_{i,t} \quad (2)$$

$$ROA_{i,t} = \beta_0 + \beta_1 U_t\pi_t + \beta_2 E_{t-1}\pi_t + \varepsilon_{i,t} \quad (3)$$

$$LEV_{i,t} = \beta_0 + \beta_1 U_t\pi_t + \beta_2 E_{t-1}\pi_t + \varepsilon_{i,t} \quad (4)$$

where $U_t\pi_t$ is the unexpected quarterly inflation rate, $E_{t-1}\pi_t$ is the expected quarterly inflation rate, $M/B_{i,t}$ is the average quarterly market to book ratio, $ROA_{i,t}$ is the average quarterly return on assets, $LEV_{i,t}$ is the average quarterly leverage ratio, and $\varepsilon_{i,t}$ is a residual and distributed as a normal distribution. The unexpected inflation rate is defined as the actual inflation rate minus the expected inflation rate.

Panels A and B of Table 6 show that the sensitivity of the M/B ratio to expected inflation is significantly negative for all of the nine industries over the entire sample period and for cyclical and non-cyclical industry portfolios over the sample periods except for 2002Q1- 2014Q4. In addition, the unexpected inflation beta is negative for the industries except mining over the entire period, and significantly negative for both industry portfolios over the entire and the 1961Q2-1982Q4 periods and for the non-cyclical industry portfolio over the 1983Q1-2001Q4 period. In contrast, the unexpected inflation betas become significantly positive for both industry portfolios over the 2002Q1-2014 period. These empirical findings indicate that increases in expected and unexpected inflation overall lower the equity value of a firm relative to its book value over the period before 2002 when inflation was high, confirming the findings of Campbell and Mei (1993) and Sharpe (2002).

The sensitivities of the ROA to expected and unexpected inflation are significantly positive for all of the nine industries and both industry portfolios over the 1961Q2 to 2014Q4 period. Moreover, the sub-period analysis shows that the coefficient of expected inflation is significant for the cyclical portfolio over the first and third sub-periods, and for the non-cyclical portfolio over the second sub-period. In addition, the coefficient of unexpected inflation is significantly positive for both industry portfolios during the sub-periods except the non-cyclical portfolio for the first period. These findings indicate that facing higher inflation, a firm in the cyclical- or non-cyclical industry is likely to pass an increase in its product cost on to its customers although the firm's ability to raise the product price may depend on the sample period.

The sensitivity of the leverage ratio to expected inflation is significantly positive for healthcare, chemicals, shops, durables, and non-durables, and for both cyclical and non-cyclical industry portfolios while significantly negative for chemicals during the entire sample period. The coefficient of unexpected inflation is also significantly negative for chemicals at the level of 5%. The sub-period analysis documents that the coefficient of expected inflation is significantly positive for both industry portfolios during the first two sub-periods, and that the coefficient of unexpected inflation is significantly positive and negative for the portfolios during the first and recent sub-periods. In sum, expected inflation appears to increase the leverage ratio during the sample period before 2002, and unexpected inflation appears to increase (decrease) it during the high (low) inflation period before (after) 2002. This result implies that when inflation is high, a firm is likely to increase the amount of liabilities relative to assets because inflation increases the wealth of the firm as a debtor, confirming to some extent the nominal contracting hypothesis.

Up to this point, we assume that the M/B, ROA, and leverage ratios are influenced by the expected inflation rate estimated one quarter earlier and the contemporaneous unexpected inflation rate. However, it would take longer than a quarter for a firm to examine the inflation impact and make investment and financing decisions.[14] Therefore, we examine the impact of the lagged expected inflation rate estimated two quarters earlier and the unexpected inflation rate estimated one quarter earlier on the above microeconomic factors at the current quarter. Appendix B shows that over the entire sample period the lagged expected inflation betas are almost same as the expected inflation betas for all of the nine industries and the cyclical- and non-cyclical industry portfolios, while the lagged unexpected inflation betas are overall larger than the unexpected inflation betas in the M/B and leverage equations of Table 6. In addition, the lagged expected and unexpected inflation betas are somewhat smaller than their counterparts in the ROA equation of Table 6. The sub-period analysis with the lagged variables in the leverage equation exhibits the similar findings in Table 6 except that the lagged expected inflation betas are significantly negative for both industry portfolios in all of the sub-periods while the lagged unexpected inflation betas are significantly positive before 2002 and significantly negative after 2002 for both industry portfolios.

Fisher Effect with the Microeconomic Factors

Given the influence of expected and unexpected inflation on the M/B ratio, ROA, and leverage ratio, we examine whether the Fisher effect holds for the cyclical- and non-cyclical industries over the sample periods. To test its validity, stock returns of the industries are regressed on the expected and unexpected inflation and the three ratios as follows:

$$R_{i,t} = \beta_0 + \beta_1 U_t\pi_t + \beta_2 E_{t-1}\pi_t + \beta_3 M/B_{i,t} + \beta_4 ROA_{i,t} + \beta_5 LEV_{i,t} + \varepsilon_{i,t} \quad (5)$$

where $R_{i,t}$ is the average quarterly return, $U_t\pi_t$ is the unexpected quarterly inflation rate, $E_{t-1}\pi_t$ is the expected quarterly inflation rate, $M/B_{i,t}$ is the average quarterly market to book ratio, $ROA_{i,t}$ is the average quarterly return on assets, $LEV_{i,t}$ is the average quarterly leverage ratio, and $\varepsilon_{i,t}$ is a residual and distributed as a normal distribution.

Panels A and B of Table 7 report that the coefficient of unexpected inflation is insignificantly negative for all of the nine industries, but significantly negative at 5% for cyclical and non-cyclical industry portfolios over the entire period and the sub-periods before 2002. Thus, this finding indicates that stock returns on these industries fall as inflation unexpectedly rises during the periods.

The expected inflation betas are positive for the industries except mining (-5.72), ranging from .51 (utilities) to 4.79 (durables). The significantly positive betas of durables, manufacturing, and construction are good inflation hedges compared with the significantly negative beta of mining. In addition, the expected inflation betas of cyclical- and non-cyclical industry portfolios are significantly positive, 2.58 and 2.72, during the entire period, and 3.14 and 4.04 during the 1983Q1-2001Q4 period. Controlling for the effect of expected inflation on the aforementioned three ratios as well as unexpected inflation, these empirical findings provide evidence that the expected inflation betas are much larger for all of the industries except mining, and significantly positive and larger for the cyclical- and non-cyclical industry portfolios than those in equation (1) over the entire sample period. As a result, we find that stock returns of the cyclical- and non-cyclical industry portfolios would increase more than twice as large as an increase in inflation.

As expected, the M/B ratio has a significantly positive effect on nominal stock returns for all of the industries but utilities and for both industry portfolios except for the high inflation period of 1961Q2-1982Q4. Similar but weaker results are found for the ROA. These results are consistent with those of Bernard (1986) who documents that the cross-sectional variation in unexpected inflation is explained in part by an interaction between unexpected inflation and operating profitability. Finally, the coefficient of the leverage ratio is significantly positive for mining and healthcare while significantly negative for utilities. In addition, the coefficient is significantly positive for the cyclical industry portfolio over the 1961Q2-1982Q4 and 2002Q1-2014Q4 periods.

Fisher Effect with Three Factor Model

In this section we employ the excess stock return over the risk-free rate to examine the additional explanatory power of expected and unexpected inflation in the three-factor return model as follows:

$$R_{i,t} - R_{f,t} = \beta_0 + \beta_1 U_t\pi_t + \beta_2 E_{t-1}\pi_t + \beta_3 MRP_t + \beta_4 SMB_t + \beta_5 HML_t + \varepsilon_{i,t} \quad (6)$$

where $R_{i,t}$ is the average quarterly return, R_{ft} is the quarterly rate on one-month Treasury bill, $U_t\pi_t$ is the unexpected quarterly inflation rate, $E_{t-1}\pi_t$ is the expected quarterly inflation rate, MRP_t is the quarterly market risk premium, SMB_t is the quarterly size premium, and HML_t is the quarterly value premium. See Fama and French (1993) for definitions of the equity risk premium variables.

Panels A and B of Table 8 document regression results of equation (6). We find the coefficient of unexpected inflation is significantly negative for durables, nondurables, healthcare, and shops while significantly positive for mining. Furthermore, the coefficient of unexpected inflation for the non-cyclical industry portfolio is significantly negative over the entire and 1962Q2-1982Q4 periods. Therefore, the stock return on the non-cyclical industry portfolio tends to decrease as inflation is unexpectedly higher during the sample periods. In contrast, the unexpected inflation beta of the cyclical industry portfolio is insignificantly positive over the sample periods. The expected inflation betas of the industries are overall smaller and insignificant than those in equations (1) and (5), ranging from -1.48 (mining) to 0.93 (healthcare) over the entire period. The betas of the non-cyclical industry portfolio are all positive over the sample periods and significantly positive during the 1983Q1-2001Q4 period, while the betas of the cyclical industry portfolio are insignificantly negative except the period of 1983Q1-2001Q4. These results show that although the influence of expected inflation seems to be captured in the risk-free rate as in Sharpe's (2002) claim, stocks of the non-cyclical industry portfolio are better inflation hedges than stocks of the cyclical industry portfolio.

The sensitivity of the return on the market risk premium varies from .69 (utilities) and .70 (mining) to 1.35 (construction) and 1.29 (healthcare), and is consistently larger for the cyclical industry portfolio than the non-cyclical industry portfolio during the sample periods (Gomes et al., 2009). The coefficients of the size and value premiums are significantly positive for the industries except for both premiums being insignificant for healthcare, and the size premium being insignificant for utilities. Moreover, the size and value betas are also larger for the cyclical industry portfolio than the non-cyclical industry portfolio over the sample periods, indicating that the cyclical industries are smaller in market capitalization than the non-cyclical industries, and that the former is comprised of value stocks while the latter is comprised of growth stocks.

Conclusion

We examine an inflation-hedging ability of stock returns on cyclical and non-cyclical industries over the entire period of 1961Q2-2014Q4, and the sub-periods of 1961Q2-1982Q4, 1983Q1-2001Q4, and 2002Q1-2014Q4. Expected inflation is estimated based on Sims' (1980) vector autoregressive model (VAR), and the sample data of three non-cyclical and six cyclical industries are collected using the CRSP and Compustat databases. We find that the expected inflation beta is significantly positive for the non-cyclical industry portfolio at 10% over the entire period and the sub-period of 1961Q2-1982Q4 when inflation was high, and at 5% over the sub-period of 1983Q1-2001Q4. Thus, the result of Boudoukh et al. (1994) is confirmed in our sample, indicating that returns on the non-cyclical industry portfolio covary positively with inflation and the stocks of the portfolio have hedged inflation better than stocks of the cyclical industry portfolio. Moreover, the high inflation beta of the non-cyclical industry portfolio over the 1983Q1-2001Q4 period corresponds to the bull market period of 1980s and 1990s (Ritter and Warr, 2002).

Compared to the Boudoukh et al. (1994) view of the inflation risk factor being macroeconomic in scope, we employ a firm's financial data to examine the potential microeconomic factors, and thus show the contribution of real microeconomic factors to inflation risk. In other words, we investigate whether expected and unexpected inflation has an effect on the M/B, ROA, and leverage ratios. We report that the M/B ratio (ROA/leverage) is significantly negatively (positively) correlated with expected inflation. In addition, we find the similar correlation between unexpected inflation and the M/B and ROA ratios. These results broadly indicate that when inflation is high, the market value of equity is lowered relative to its book value (Campbell and Mei, 1993; Sharpe, 2002), the operating profitability is maintained via passing the cost increase on to customers, and the leverage ratio is increased. Controlling for the above microeconomic factors, we next test validity of the Fisher effect and find that returns of the cyclical- and non-cyclical industry portfolios would increase (decrease) much larger than an increase in expected (unexpected) inflation over the entire sample period. Thus, we offer some evidence that a portion of the cross-sectional differences in returns is predicted by inflation in the microeconomic scope (Bernard, 1986; Campbell and Mei, 1993).

Finally, we investigate the additional explanatory power of the expected and unexpected inflation rates in explaining the industry return based on the Fama-French three factor model. We find that expected inflation is broadly positively (negatively) associated with the return on the non-cyclical (cyclical) industry portfolio, while unexpected inflation is negatively associated with the return on the non-cyclical industry portfolio. Although the influence of expected inflation seems captured in the risk-free rate (Sharpe (2002)), stocks of the non-cyclical industry portfolio have hedged inflation better than stocks of the cyclical industry portfolio particularly during the 1983Q1 to 2001Q4 period.

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Web Appendix

A web appendix for this paper is available at:

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Notes

1. Fama develops the proxy hypothesis where an increase in inflation signals a decrease in expected output which leads to lower stock prices. Thus, stock returns are inversely related to inflation.
2. Modern econometric approaches that are used to test validity of the Fisher hypothesis are the cointegration, instrumental variable regression, vector autoregressive model, and vector error correction model.
3. Engsted and Tanggaard (2002) and Kim and Ryoo (2011) support the sensitivity of stock returns to inflation turns positive over the longer horizon during the lower inflation period, using the cointegration and vector autoregressive model (VAR),
4. Bernard (1986) show that the cross-sectional differences between stock returns and unexpected inflation are explained by the revaluation of nominal monetary assets and liabilities and tax shields, firm characteristics that could capture an interaction between unexpected inflation and operating profitability, and cross-sectional variations in systematic risk that reflect changes in aggregate real activity.
5. Lee (1992), Bagliano and Favero (1998), Engsted and Tanggaard (2002), and Bekaert and Engstrom (2010) estimate expected inflation using the VAR.
6. See Kenneth French's data library, http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.
7. We thank an anonymous referee for the sub-period determination.
8. See endnote 5.
9. Given quarterly data, four lags capture potential seasonal patterns.
10. The sub-period analysis also documents that the expected inflation rates/standard errors are 1.09%/0.93%, 0.57%/0.33%, and 0.42%/0.48% over the sub-periods of 1961Q2-1982Q4, 1983Q1-2001Q4, and 2002Q1-2014Q4, respectively.
11. To compute the ROA and leverage, the book value of total assets are also adjusted, following the procedure of Cohen, Polk, and Vuolteenaho (2003).
12. See Fama (1981), Kaul and Seyhun (1990), Geske and Roll (1983), and Kaul (1987).
13. We thank an anonymous referee for suggesting a test of the Fisher effect in the real return framework.

14. We thank an anonymous referee for providing the possible interaction effect between the lagged expected and unexpected inflation and the microeconomic factors.