INFLATION AND BOND-STOCK CHARACTERISTICS OF KOREAN SECURITY RETURNS

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Abstract

The Fisher effect is the one-to-one relation between expected nominal interest and expected inflation. Recently, Boudoukh, Richardson, and Whitelaw show that cross-sectional variation in the negative inflation-stock return relation depends on cyclical nature of industries. This study takes an new approach to examine cross-sectional variation in the negative inflation-return relation based on stock and bond characteristics, especially, for Korean securities. This study shows that the cross sectional variation in the sensitivity of security returns to inflation can be also explained by bond and stock market factors for Korean securities.

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I. Introduction

The Fisher (1930) effect shows that the expected nominal interest rate is the sum of the expected real interest rate and the expected inflation rate. Empirical evidence indicates that bond yields are positively related to expected inflation while stock returns move inversely with inflation.[1] Many studies find negative relationships between stock returns and inflation for most of industrialized and Pacific-Basin countries.[2] Thus, bonds behave in accordance to the Fisher effect but stocks do not.

There are several explanations for the negative relationship between inflation and stock returns. Under inflation, taxable earnings are overstated because depreciation is stated based on historical costs. Therefore, as Feldstein (1980) argues, firms pay more taxes to the government, and inflation affects firm's earnings and stock returns negatively. Friedman (1977) and Levi and Makin (1979) explain that inflation creates additional uncertainty to business, which lowers stock returns. Fama (1981) introduces the proxy effect to show that the negative relation between expected inflation and stock returns results from the combination of the negative relation between expected inflation and economic activity and the positive relation between stock returns and expected economic activity. Geske and Roll (1983) and Kaul (1987, 1990) show the monetary proxy effect that the negative relation between expected inflation and stock returns is the combination of the positive relation between money supply and expected inflation and the negative relation between money supply and expected output introduced by a counter-cyclical monetary policy. Boudoukh, Richardson, and Whitelaw (1994) extend the proxy effect to show that the relation between stock returns and expected output growth is non-positive (positive) if

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[1] See Lintner (1975), Fama (1975), Nelson (1976), and Fama and Schwert (1977), for example.

[2] See, for example, Anari and Kolari (2001), Cochran and Defina (1993), Lee (1996), Liu, Hsueh, and Clayton (1993), Kaul (1990), Khil and Lee (2000), and McCarthy, Najand, and Seifert (1990).

industries are non-cyclical (cyclical). Therefore, stock returns of non-cyclical (cyclical) industries are positively (negatively) related to expected inflation. Recently, using a two factor model of stock returns, Kim and Shukla (2005) show that the variation in the inflation sensitivities of stock returns can be explained by their sensitivities to the stock and bond market factors.

In this study, we use the Kim and Shukla (2005) framework to reexamine the cross-sectional variation in the relation between security returns and expected inflation for Korean securities. We also find that the inflation sensitivity of securities is negatively related to their stock market sensitivity and positively related to their bond market sensitivity.

In the next section, we show a testable hypothesis using the Fisher equation and a two-factor market model. Section III explains the sample data and variables used in the study. The hypothesis is tested with stock returns of 481 Korean securities and the results of the test are reported in Section IV. Section V concludes the paper.

II. Expected Inflation and Bond-Stock Characteristics

The Fisher (1930) effect is originally shown as the one-to-one relation between the expected inflation rate and the expected nominal interest rate when the expected real interest rate is constant:

$$E(R_t) = E(i_t) + E(\dot{p}_t) \qquad (1)$$

where $E(R_t)$ = the expected nominal interest rate in t,

$E(i_t)$ = the expected real interest rate in t,

$E(\dot{p}_t)$ = the expected inflation rate in t.

The Fisher effect can be tested using the following time-series regression model:

$$R_{jt} = \phi_j + \lambda_j \dot{p}_t^e + v_t \qquad (2)$$

where $\dot{p}_t^e$ is the measured expected inflation rate. The intercept, ϕ_j, represents the estimate of the real interest rate for security *j*, and λ_j is expected to be 1.0 according to the Fisher effect. However, for stock returns, λ_j has been found to be negative.

It has been long understood that security returns are sensitive to the stock market returns as well as interest rates (see for example, Stone (1974)). The stock and bond characteristics of a security—the sensitivities of its returns to the stock and bond indexes—can be measured using a two-factor market model:

$$R_{jt} = \alpha_j + \beta_j R_{st} + \gamma_j R_{bt} + w_t \tag{3}$$

where R_{jt} is the security return, R_{st} is the nominal stock market return, R_{bt} is the nominal bond market return, and w_t is the random error term. Coefficient β_j is the return sensitivity of stock *j* to the stock market factor and γ_j is the return sensitivity to the bond market factor.

Taking the derivative of R_{jt} in (3) with respect to $\dot{p}_t^e$ results in

$$\frac{\partial R_{jt}}{\partial \dot{p}_t^e} = \frac{\partial \alpha_j}{\partial \dot{p}_t^e} + \frac{\partial \beta_j}{\partial \dot{p}_t^e} R_{st} + \beta_j \frac{\partial R_{st}}{\partial \dot{p}_t^e} + \frac{\partial \gamma_j}{\partial \dot{p}_t^e} R_{bt} + \gamma_j \frac{\partial R_{bt}}{\partial \dot{p}_t^e} + \frac{\partial w_t}{\partial \dot{p}_t^e} \tag{4}$$

In this two-factor model, changes in security return due to changes in expected inflation include several components: changes in α_j, β_j, γ_j, R_{st}, and R_{bt} due to changes in expected inflation. If inflation affects security return, stock market return, and bond market return at the same rates, the regression coefficients (α_j, β_j, and γ_j) from (3) will not be affected because the returns do not change in relative real terms. However, if inflation affects the security return, stock market return, and bond market return differently, then it becomes a very difficult task, if not impossible, to derive the exact effects of inflation on these regression coefficients.

To focus our interests on inflationary impacts on security returns in relation to stock and bond characteristics, we write (4) as:

$$\frac{\partial R_{jt}}{\partial \dot{p}_t^e} = Q_j + \beta_j \frac{\partial R_{st}}{\partial \dot{p}_t^e} + \gamma_j \frac{\partial R_{bt}}{\partial \dot{p}_t^e} \tag{5}$$

where $Q_j = \frac{\partial \alpha_j}{\partial \dot{p}_t^e} + \frac{\partial \beta_j}{\partial \dot{p}_t^e} R_{st} + \frac{\partial \gamma_j}{\partial \dot{p}_t^e} R_{bt}$, which represents the change in the security return due to changes in the regression coefficients under inflation. We assume there is no inflationary impact on residuals, i.e., $\partial w_t / \partial \dot{p}_t^e = 0$.

Since $\partial R_{jt} / \partial \dot{p}_t^e = \lambda_j$ from (2), equation (5) is rewritten as

$$\lambda_j = Q_j + b\,\beta_j + c\,\gamma_j \tag{6}$$

where $b = \partial R_{st} / \partial \dot{p}_t^e$ and $c = \partial R_{bt} / \partial \dot{p}_t^e$.

Empirical evidence has shown that there is a negative relation between the stock market return factor and expected inflation (i.e., $b < 0$) and there is a positive relation between the bond market return factor and expected inflation (i.e., $c > 0$). Thus, equation (6) provides an empirically testable hypothesis that the inflation sensitivity of a security (λ_j) is negatively related to its stock characteristic (β_j) and positively related to its bond characteristics (γ_j). If a security behaves more like a stock (higher β_j), its inflation sensitivity is lower, but if a security behaves more like a bond (higher γ_j), its inflation sensitivity is higher.

The regression model to test equation (6) is:

$$\lambda_j = \hat{a} + \hat{b}\beta_j + \hat{c}\gamma_j + e_j \tag{7}$$

The hypothesis is that $\hat{b} < 0$ and $\hat{c} > 0$. That is, the cross-sectional variation in λ_j is negatively related to β_j and positively related to γ_j. We test this hypothesis for Korean securities to see if they behave in consistent with U.S. and international security markets.

III. Data

Monthly inflation rates in Korea are computed based on its monthly Consumer Price Index. Expected inflation may be measured in several ways. In this study, expected inflation rates are obtained from one-month-ahead forecasts of the time-series regression of the current inflation rate on recent past twelve monthly inflation rates. The average Korean corporate bond yield (AA-) is used as the bond factor. Monthly returns on the Korean Composite Stock Price Index (KOSPI) are used for the stock market factor. There are a total of 481 stocks that have complete data for the 10-year study period from 1996 through 2005.

IV. Empirical Tests with Korean Security Returns

Table 1 shows summary statistics for the variables used in regressions such as the stock market return, the bond yield, and actual and expected inflation for the three periods: (i) the 10-year period (1996-2005), (ii) the first five-year period (1996-2000), and (iii) the second 5-year period (2001-2005). Actual and expected inflation have almost no correlation with each other for the total and the first subperiod but negatively correlated (-0.26) in the second subperiod. It is interesting to note that these two inflation rates are often positively correlated for the U.S. and international cross-sectional data. The expected inflation is negatively correlated with stock returns (-0.25) as can be found in other countries.

[Insert Table 1 about here.]

The inflation sensitivity coefficient (λ_j), the stock sensitivity (β_j), and the bond sensitivity (γ_j) are estimated according to equations (2) and (3) for 481 securities and are reported in Table 2. The inflation sensitivity and bond sensitivity are positively correlated for the total (0.53) and Superiod 1 (0.68) but are little correlated in the Superiod 2 (-0.03). The inflation sensitivity and stock sensitivity are negatively related as expected (-0.33, -0.23, and -0.43, respectively, for the total and the two subperiods.) The mean λ_j values are negative (–8.26,

–9.31, and –4.55, respectively, for the three periods) in consistent with the findings of previous studies. The proportions of positive λ_j coefficients are 7%, 10%, and 27%, respectively, for the three periods.

[Insert Table 2 about here.]

Figure 1 shows the distributions of λ_j coefficients in the total period, Subperiod 1 and Subpeirod 2. There is an extremely low one less than –40. There are two extremely high ones greater than 24. We will show the results of the test of the hypothesis with and without extreme λ_j coefficients.

[Figure 1 about here]

Table 3 reports the results of the GLM regression tests of the hypothesis of (7). To mitigate the potential heteroscedasticity problem, the GLM regression is performed using the predicted value of the dependent variable as the weight. For the total and the first subperiod, the coefficients for β_j are negative and significant at the one percent level, and the coefficients for γ_j are positive and significant at the one percent level. These results support the hypotheses that inflation sensitively is negatively related to stock characteristics and positively related to bond characteristics.

[Insert Table 3 about here.]

For the second subperiod, the coefficient for β_j is negative and significant at the 1% level but the coefficient for γ_j is close to zero. To remove the possible effect of extreme values, the three securities are excluded and the hypothesis are retested. The second panel of Table 3 shows the results of the test without extreme values. The coefficients for β_j are all negative and significant, and the coefficients for γ_j are all positive and significant at the at least 5% level for all three periods.

The results indicate that `stock returns are more sensitive to the stock market, the inflation sensitivity coefficient becomes lower, and if stock returns are more sensitive to the bond market, the inflation sensitivity coefficient becomes higher. Thus, these results support the hypothesis that Korean securities behaving more like stocks have lower inflation sensitivities and securities behaving more like bonds have higher inflation sensitivities. This result appears to be consistent with the results of Kim and Shukla's (2005) study with U.S. securities and international mutual funds.

V. Conclusions

This study investigates the cross-sectional variation in the sensitivity of returns to inflation for Korean securities. We hypothesize that the inflation sensitivity of a security is negatively related to its stock characteristic (sensitivity to a stock factor) and positively related to its bond characteristic (sensitivity to a bond factor). The results of the tests with 481 Korean securities support the hypothesis. In summary, the sensitivities of Korean security returns to bond and stock market returns may be used to assess their sensitivities to inflation and to explain cross-sectional variation in the negative relation between expected inflation and stock returns.

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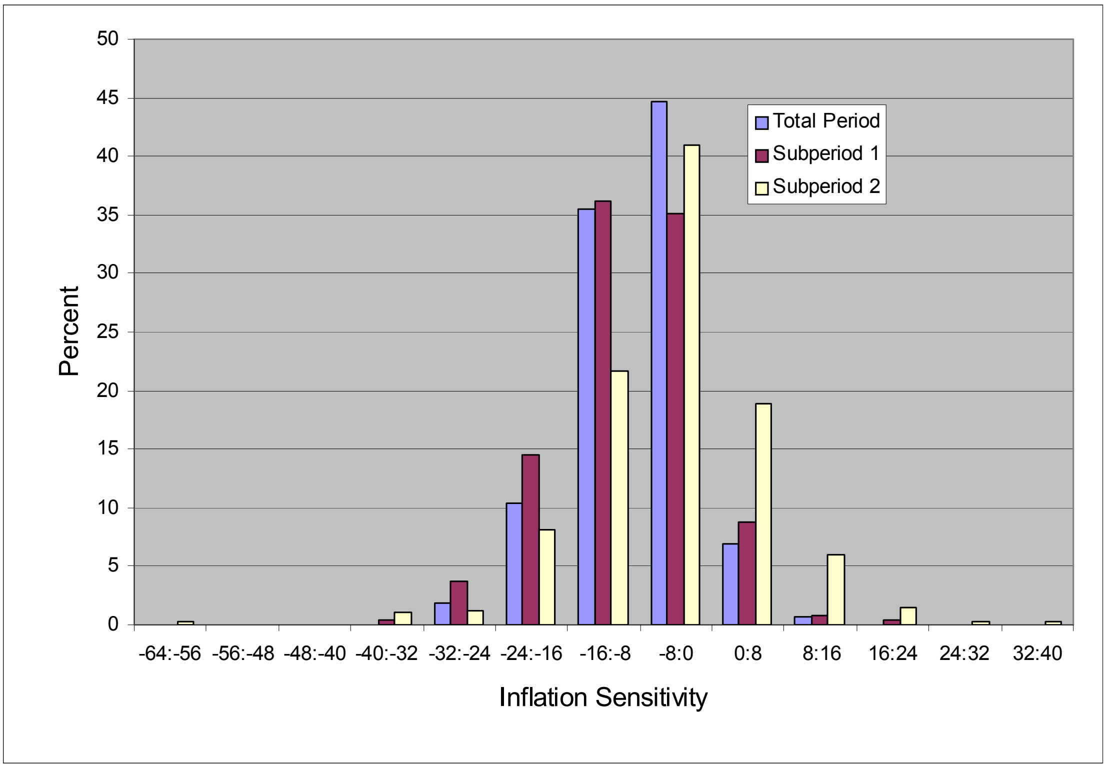

Figure 1. The distribution of the inflation sensitivity coefficient during the total period (1996-2005), Subperiod 1 (1996-2000), and Subperiod 2 (2001-2005)

Table 1. Correlation Coefficients, Means, and Standard Deviations of the Variables Used in the Study Using Monthly Data during 1996–2005

(i) Total Period (1996-2005, 120 months)

	Mean	Standard Deviation	Correlation Coefficient		
			$\dot{p}_t^e$	R_s	AA-
Actual Inflation ($\dot{p}_t$)	0.0029	0.0052	-0.04	0.06	0.32
Expected Inflation ($\dot{p}_t^e$)	0.0029	0.0037	1.00	–0.25	0.38
Korean Stock Market Return(R_s)	0.0093	0.1088		1.00	-0.11
Korean Corporate Bond Yield (AA-)	0.0073	0.0033			1.00

(ii) Subperiod 1 (1996-2000, 60 months)

Actual Inflation ($\dot{p}_t$)	0.0032	0.0060	0.05	0.16	0.51
Expected Inflation ($\dot{p}_t^e$)	0.0032	0.0045	1.00	-0.25	0.61
Korean Stock Market Return (R_s)	-0.0013	0.1317		1.00	-0.07
Korean Corporate Bond Yield (AA-)	0.0098	0.0029			1.00

(iii) Subperiod 2 (2001-2005, 60 months)

Actual Inflation ($\dot{p}_t$)	0.0026	0.0043	-0.26	-0.16	0.14
Expected Inflation ($\dot{p}_t^e$)	0.0027	0.0026	1.00	-0.22	0.10
Korean Stock Market Return (R_s)	0.0199	0.0794		1.00	0.04
Korean Corporate Bond Yield (AA-)	0.0047	0.0009			1.00

Table 2. Summary Statistics of the Inflation (λ_j), Stock Market (β_j), and Bond Market Sensitivities (γ_j) of Stock Returns of 481 Korean Securities during 1996–2005.

The Inflation(λ_j), Stock Market (β_j), and Bond Market Sensitivities (γ_j) of Stock Returns estimated from:

$$R_{jt} = \phi_j + \lambda_j \dot{p}_t^e + v_t$$
$$R_{jt} = \alpha_j + \beta_j R_{st} + \gamma_j R_{bt} + w_t$$

where $\dot{p}_t^e$ is the expected inflation, R_{jt} is the security j's return in t, R_{st} is the stock market return, and R_{bt} is the bond market factor (Korean corporate AA- bond yield).

(i) Total Period (1996-2005, 120 months)

	Mean	Standard Deviation	Min	Max	P(>0)[+]	Correlation Coefficient	
						β_j	γ_j
λ_j	–8.26	6.64	-27.67	13.48	0.07	–0.33	0.53
β_j	0.90	0.34	-0.17	2.06	0.998	1.00	0.32
γ_j	–5.85	6.16	-20.68	23.68	0.36	0.32	1.00

(ii) Subperiod 1 (1996-2000, 60 months)

λ_j	–9.31	8.14	–37.72	17.81	0.10	–0.24	0.68
β_j	0.90	0.38	-0.16	2.87	0.997	1.00	0.26
γ_j	–5.05	12.62	–45.19	34.23	0.33	0.26	1.00

(iii) Subperiod 2 (2001-2005, 60 months)

λ_j	–4.55	9.729	-62.17	33.46	0.27	-0.43	-0.03
β_j	0.90	0.44	-0.40	2.52	0.99	1.00	0.13
γ_j	–5.69	24.41	–84.46	90.70	0.37	0.13	1.00

[+] P (>0) = the proportion of stocks that have positive coefficients

Table 3. GLM Regressions during the Total Period (1996–2005), Subperiod 1 (1995-2000), and Subperiod 2 (2001-2005):

$$\lambda_j = \hat{a} + \hat{b}\beta_j + \hat{c}\gamma_j + e_j$$

where λ_j is the inflation sensitivity, and β_j and γ_j are security's sensitivities to stock and bond factors (*t*-values are in parentheses).

	$\hat{a}$	$\hat{b}$	$\hat{c}$	R^2
(i) With the Total Sample Stocks				
Total Period (N=481)	4.09 (5.56)*	-12.06 (–18.46)*	0.78 (20.35)*	0.53
Subperiod 1 (N=481)	1.88 (2.47)**	-9.79 (-15.04)*	0.50 (25.94)*	0.60
Subperiod 2 (N=481)	5.42 (4.50)*	-10.69 (-11.63)*	0.01 (0.89)	0.22
(ii) With the sample stocks without extremely large coefficients[+]				
Total Period (N=481)	4.09 (5.56)*	-12.06 (-18.46)*	0.78 (20.35)*	0.53
Subperiod 1 (N=481)	1.88 (2.47)**	-9.79 (-15.04)*	0.50 (25.94)*	0.60
Subperiod 2 (N=478)	5.07 (4.58)*	-10.22 (-12.01)*	0.03 (2.19)**	0.23

* significant at the 1% level.
** significant at the 5% level.
*** significant a the 10% level.

[+] Any stock that has the inflation sensitivity coefficient less than –40 or greater than 24 is excluded.