Fisher Theory and Stock Returns: An empirical investigation for industry stocks on Vietnamese stock market

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---**ABSTRACT**--
This paper examines the Fisher hypothesis using 24 industry stocks in Vietnamese stock market. Empirical results in both ex post and ex ante models show a clear rejection of one-to-one relationship between stock returns and (actual/expected/unexpected) inflation, for all industry stock returns. Interestingly, the Fisher hypothesis that common stocks can provide a complete hedge against expected inflation is strongly rejected, given these findings. However, the results show that a number of industry stocks can provide a partial hedge against both ex post and expected inflation. This study has several implications for investors.
Keywords: industry stock returns, Fisher hypothesis, Vietnamese stock market, hedge
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I. INTRODUCTION

It is believed that nominal stock returns are positively and (and even on a one-for-one basis) correlated with (expected or actual) inflation (Lintner, 1975; Groenewold, et al., 1997). This belief is grounded on the well-known Fisher hypothesis in its *ex ante* form (Fisher, 1896; Fisher, 1930), assuming that in the long-run firms can increase their output prices in order to pass on the inflation to the customer (Mishkin, 1992; Boudoukh and Richardson, 1993). Given that stocks are claims on physical assets, or "real" assets, nominal stock returns must also co-vary positively with actual (*ex post*) inflation, suggesting that stocks can also provide a good hedge against unexpected inflation (Sharpe, 2002). These wide spread beliefs have been extensively investigated for stock markets around the world. Most empirical studies for developed stock markets document a significantly negative relationship between (real and nominal) stock returns and (actual, expected and unexpected) inflation (see, e.g., Lintner (1975); Bodie (1976); Fama and Schwert (1977); Gultekin (1983b)), obviously indicating a serious violation of the (extended) Fisher hypothesis. However, mixed findings are found for developing countries. Meanwhile a large number of studies provides evidence of a significant and positive stock return-inflation relationship (see, e.g., Choudhry (2001); Spyrou (2004); Alagidede (2009); Alagidede and Panagiotidis (2010)), other studies find a significantly negative one (see, e.g., Chatrath, et al. (1997); Zhao (1999); Omran and Pointon (2001)). Generally, the Fisher hypothesis seems to be an empirical issue given that it holds in a limited number of cases.

For Vietnamese stock market, Hau *et al.* (2013) examines the hedging properties of stock market against inflation using the aggregate stock market index over July 2000-December 2011. Findings show that, for the whole period, stock returns are negatively related (although not statistically significant) to *ex post* inflation, but are statistically positively related to expected inflation. Moreover, Fisher hypothesis cannot be also rejected in the study. In this paper, we investigate the Fisher effects using industry stock indices in the Vietnamese stock market. This study can help to separate the effects of inflation on industry stock returns, thereby revealing the extent to which each industry stock portfolio in Vietnam can protect the wealth of investors against inflation. Empirical evidence from this study has important implications for both investors and policymakers.

The remainder of the paper is structured as follows. Section 2 presents the methodology. In section 3, data and summary statistics are shown. The empirical results are discussed in section 6. Finally, I conclude.

II. METHODOLOGY

Following previous studies (see, e.g., Nelson (1976); Boudoukh and Richardson (1993); Lintner (1975); Bodie (1976); Fama and Schwert (1977); Gultekin (1983b)), two empirical specifications are estimated. Firstly, the *ex post* relationship between nominal returns and inflation is examined in the first specification. In the second step, an *ex ante* model is conducted to investigate the relation between nominal stock returns and both expected and unexpected inflation rates with the second specification.

The *ex post* relationship between the nominal asset return and inflation is represented as

$$R_t = \varphi + \omega\pi_t + \epsilon_t,$$ (1)

where φ and ω are coefficients and ϵ_t is the error term.

The specification to test for *ex ante* relationship between the nominal asset return and inflation reads

$$R_t = \alpha + \beta E_{t-1}(\pi_t) + \gamma UE_{t-1}(\pi_t) + n_t,$$ (2)

where n_t is the error term, and $UE_{t-1}(\pi_t)$ denotes the unexpected component of inflation given information available at time $t-1$.

Using the approach by Fama and Schwert (1977), three cases for the hedging potential of an asset can be checked: asset is *a complete hedge against expected inflation* ($\beta = 1.0$), asset is *a complete hedge against unexpected inflation* ($\gamma = 1.0$,) and asset is considered as *a complete hedge against inflation* ($\beta = \gamma = 1.0$).

In specification (2), the expected and unexpected inflation is separated utilizing an ARIMA model (Box and Jenkins, 1970), commonly employed by other studies (e.g., Gultekin (1983b); Wahlroos and Berglund (1986); Li, et al. (2010)). Since our focus is to examine the short-run influence of inflation on the asset returns, and not the feedback from returns to inflation, all regressions are estimated by OLS (Ordinary Least Squares). We use the Newey-West corrected covariance matrix when computing the test statistics in order to account for heteroskedasticity and residual autocorrelation (Newey and West, 1987).

III. DATA

Time series data are in monthly and are obtained from various sources. All industry stock price indices (VS-Sector Index) over the January 2012-December 2016 period are constructed and provided by Vietstock, a Vietnamese data provider.[1] Consumer price index (CPI) for the same period is obtained from General Statistics Office of Vietnam. Time length of this research is dictated by data availability. Stock price indices and CPI are transformed into monthly returns and inflation rates, respectively using log changes. Both stock returns and inflation rates are stationary using the ADF test.[2]

IV. EMPIRICAL RESULTS

Summary statistics for inflation and all industry stock returns are presented in table 1.

Table 1. Descriptive statistics of industry stock returns and inflation

				Unit: %
	Mean	Std.	Min	Max
Inflation	0.344	0.489	-0.440	2.200
Air transportation	0.016	0.068	-0.225	0.163
Construction materials	0.011	0.031	-0.060	0.097
Education services	0.011	0.029	-0.064	0.111
Services	0.011	0.026	-0.048	0.062
Plastics	0.011	0.025	-0.080	0.058
Construction	0.010	0.041	-0.071	0.158
Production and Business	0.010	0.025	-0.049	0.080
Seafood	0.008	0.026	-0.053	0.073
Energy	0.008	0.021	-0.042	0.091
Trade	0.007	0.036	-0.095	0.134
Steel	0.007	0.031	-0.076	0.079
Transportation	0.007	0.027	-0.063	0.069
Development Investment	0.006	0.055	-0.137	0.216
Pharmacy	0.006	0.024	-0.051	0.080
Technology	0.005	0.026	-0.051	0.071
Food	0.005	0.023	-0.049	0.060
Securities	0.004	0.038	-0.073	0.121
Investment and Construction	0.004	0.032	-0.070	0.091
Rubber	0.004	0.022	-0.057	0.091
Banking	0.003	0.030	-0.072	0.065
Oil	0.002	0.040	-0.085	0.067
Fertilizers	0.002	0.030	-0.094	0.010
Real estate	0.001	0.030	-0.052	0.069
Minerals	-0.007	0.029	-0.094	0.067
No. of observations	60			

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[1] Industries are classified using NAICS 2007 (North American Industry Classification System)

[2] Stationarity of all variables is checked by both the Augmented Dickey-Fuller unit root test (ADF) (Dickey and Fuller, 1979). Optimal lag length selection for these tests is based on the Akaike Information Criterion (AIC) (Akaike, 1974). Results are available upon request.

From the table, monthly inflation rates have a mean of 0.34% and a standard deviation of 0.49%. For industry stock returns, the mean ranges from 0.001% to 0.016%, and the minerals stocks have a negative return. In general, no outliers in data can be observed, showing the reliability of the estimated results.

Table 2 presents the regression results of stock returns on actual inflation rates for all industry stock returns. The results show a positive coefficient for all industries, ranging from 0.003 to 0.021, except for plastic and pharmacy industries, yet the coefficient is statistically significant only 12 industries from 1% to 5% levels. Noticeably, the statistical test for the coefficient equal to one (H_0: ω = 1) is significant at the 1% level for all industry stocks, strongly rejecting the fact that stock returns may move in one-to-one correspondence with *ex post* inflation. These results obviously show that industry stocks do not provide a complete hedge against the *ex post* inflation, although some industry stocks (12 out of 24 industries) can provide a partial hedge against *ex post* inflation. These industry stocks are of trade, transportation, securities, real estate, investment and constructions, fertilizers, construction materials, banking, rubber, manufacturing and businesses, steel and energy.

Table 2. Regression results of stock returns on actual inflation for all industry stock returns

Industry stock returns	Inflation		Adjusted R^2	F-value
	Coefficient (ω)	Robust std.		H_0: ω = 1
Trade	0.021***	0.006	0.088	24.455***
Transportation	0.021***	0.004	0.140	51.821***
Securities	0.020**	0.008	0.072	16.883***
Real estate	0.019**	0.008	0.097	15.967***
Investment and constructions	0.019***	0.006	0.088	20.499***
Fertilizers	0.018**	0.008	0.095	15.919***
Construction materials	0.018**	0.008	0.083	13.737***
Banking	0.016**	0.007	0.068	17.574***
Rubber	0.014***	0.004	0.095	73.081***
Manufacturing and business	0.014***	0.004	0.078	48.841***
Steel	0.012**	0.005	0.036	40.652***
Energy	0.010**	0.004	0.057	54.188***
Development Investment	0.014	0.013	0.015	5.529***
Oils	0.012	0.010	0.023	10.369***
Technology	0.011	0.007	0.040	20.841***
Air transportation	0.010	0.019	0.006	2.716***
Constructions	0.010	0.011	0.015	7.769***
Services	0.010	0.007	0.035	17.946***
Seafood	0.007	0.005	0.017	34.846***
Food	0.005	0.006	0.015	28.812***
Minerals	0.004	0.007	0.005	22.662***
Education	0.003	0.007	0.003	23.048***
Plastic	-0.001	0.005	0.001	40.334***
Pharmacy	-0.003	0.007	0.004	23.532***
No. of observations		60		

*Notes: *, ** and *** denote the significance levels of 10%, 5% and 1%, respectively.*

In the next part, the regression for industry stock returns on expected and unexpected inflation is implemented. In order to decompose actual inflation into expected inflation and unexpected inflation, the autoregressive model, AR(1), is employed as

$$AR(1): \pi_t = 0{,}245 + 0{,}259\ \pi_{t-1} + \varepsilon_t$$

Regression results for stock returns on expected and unexpected inflation rates for all industry stocks are reported in table 3. As can be seen from the table, the coefficients on expected returns share a similar pattern with those on actual inflation, i.e., they all are positive, except for plastic and pharmacy industries, and for only 12 out of 24 industries the coefficient is statistically significant from 1% to 5% level. In terms of size, these coefficients are *vis-à-vis* slightly greater than those on actual inflation are, ranging from 0.04 to 0.08, implying that those industry stocks provide a better hedge against expected inflation than they do against actual inflation. Regarding the unexpected inflation, none of the coefficients for industry stocks is statistically significant at the traditional levels with the exception of industry "Development Investment" (i.e., the coefficient is negative and statistically significant at the 10% significance level). Hence, it can be concluded that industry stocks cannot hedge unexpected inflation.

Table 3. Regression results of stock returns on expected and unexpected inflation for all industry stock returns

Industry	Expected inflation		Unexpected inflation		Adjusted R²
	Coefficients (β)	Robust std.	Coefficients (γ)	Robust std.	
Trade	0.081***	0.024	0.001	0.008	0.089
Transportation	0.080***	0.017	-0.003	0.011	0.143
Securities	0.074***	0.024	-0.007	0.008	0.167
Real estate	0.073**	0.030	0.002	0.009	0.185
Investment and constructions	0.073**	0.029	-0.005	0.015	0.065
Fertilizers	0.071**	0.033	-0.009	0.013	0.196
Construction materials	0.071**	0.030	0.001	0.009	0.149
Banking	0.060**	0.029	-0.001	0.007	0.068
Rubber	0.052***	0.017	-0.007	0.010	0.087
Manufacturing and business	0.052***	0.014	0.006	0.005	0.136
Steel	0.047**	0.020	0.009	0.012	0.053
Energy	0.040**	0.016	0.002	0.008	0.060
Development Investment	0.011	0.025	-0.009*	0.005	0.024
Oils	0.053	0.052	-0.002	0.009	0.015
Technology	0.048	0.036	0.017	0.013	0.061
Air transportation	0.042	0.027	-0.011	0.007	0.078
Constructions	0.039	0.076	-0.028	0.027	0.049
Services	0.039	0.045	0.010	0.015	0.054
Seafood	0.035	0.029	0.006	0.006	0.035
Food	0.026	0.020	-0.008	0.006	0.038
Minerals	0.021	0.023	0.003	0.006	0.018
Education services	0.017	0.025	0.011	0.009	0.033
Plastic	-0.002	0.019	-0.001	0.009	0.003
Pharmacy	-0.012	0.028	-0.003	0.004	0.016
No. of observations			60		

*Notes: *, ** and *** denote the significance levels of 10%, 5% and 1%, respectively.*

Results of statistical tests for Fisher hypothesis, a one-to-one relationship between industry stock returns and (expected/unexpected and either) inflation, are shown in table 4. As for table 4, all *t*-tests for coefficients on expected inflation equal to 1.0 (H$_0$: β = 1) are statistically significant at the 1% level, showing a clear rejection of Fisher hypothesis for all industry stocks. In other words, a one-to-one relationship between stock returns and the *ex-ante* inflation for all industries is strongly rejected. Also, *t*-tests for coefficients on unexpected inflation equal to 1.0 (H$_0$: γ = 1) are statistically significant at the 1% levels, reflecting the fact that industry stock returns do not move in a one-to-one fashion with unexpected inflation. Finally, it can be seen that both coefficients on expected and unexpected inflation are found to be statistically jointly indistinguishable from unity at the significance level of 1% using an *F*-test (H$_0$: $\beta = \gamma = 1$).

Table 4. Results of *F*-test and *t*-test for Fisher effects for all industry stock returns

Industry	*t*-value	*t*-value	*F*-value
	H$_0$: β = 1	H$_0$: γ = 1	H$_0$: β = γ = 1
Trade	35.44***	137.85***	9.888***
Transportation	54.15***	87.98***	6.433***
Investment and constructions	35.20***	123.69***	8.249***
Real estate	30.59***	114.19***	6.535***
Securities	31.84***	66.19***	2.468***
Construction materials	89.44***	27.06***	3.989***
Fertilizers	27.60***	120.76***	7.714***
Banking	34.97***	132.25***	8.918***
Development Investment	18.33***	107.87***	6.354***
Manufacturing and business	54.63***	117.04***	9.741***
Rubber	68.10***	213.09***	29.391***
Oils	26.17***	78.43***	3.169***
Steel	48.93***	80.53***	4.503***
Technology	36.14***	140.52***	9.876***
Energy	55.60***	124.06***	6.993***
Education services	39.51***	189.14***	17.957***
Air transportation	12.61***	37.67***	1.049***
Constructions	21.49***	66.78***	2.644***
Services	33.82***	173.24***	15.063***
Seafood	48.70***	155.79***	13.647***
Food	40.45***	184.01***	16.979***
Minerals	11.09***	111.52***	7.006***
Plastic	42.50***	112.36***	7.170***
Pharmacy	39.10***	239.23***	32.738***

*Notes: *, ** and *** denote the significance levels of 10%, 5% and 1%, respectively.*

To sum up, all findings show a strong rejection of Fisher hypothesis both in *ex post* and *ex ante* models for all industry stocks. These results imply that common stocks of all industries in Vietnamese stock market cannot provide a complete hedge against inflation (*ex post*, *ex ante* and unexpected inflation). Nevertheless, findings indicate that some industry stocks (12 out of 24 industries) can provide a partial hedge (although relatively small) against both actual and expected inflation rates. These industry stocks comprise of trade, transportation, securities, real estate, investment and constructions, fertilizers, construction materials, banking, rubber, manufacturing and businesses, steel and energy. For surprises in inflation, no industry stock can provide hedge.

V. CONCLUSIONS

This paper examines the inflation-hedging properties of 24 industry stocks in Vietnamese stock market. Empirical results show that 12 out of 24 industry stock returns have a positive and statistically significant relationship with *ex post* inflation, but the one-to-one relationship between stock returns and actual inflation is strongly rejected for all industry stocks. These results indicate that a number of industry stocks can provide a partial hedge against actual inflation. Estimating an *ex ante* model, similar to the *ex post* model only stock returns of 12 industries are statistically positively related to expected inflation, yet the size of coefficients is *vis-à-vis* greater than that in the *ex post* model. Reversely, almost all but one industry stock returns are found to be statistically significant related to unexpected inflation. Findings show a clear rejection of either the Fisher hypothesis of a one-to-one relationship between stock returns and the *ex-ante* inflation, or a complete hedge against surprises in inflation of stocks.

Taken all together, the present study has several implications. In general, common stocks for a number of industries in Vietnam can provide a partial hedge against actual and expected inflation rates, while almost no industry stocks can hedge against unexpected inflation. Interestingly, statistical evidence strongly rejects the Fisher hypothesis for all industry stocks in both *ex post* and *ex ante* models. These results provides more empirical evidence on the Fisher theory validation.

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