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PUZZLES INVOLVING THE STOCK MARKET, INFLATION AND THE PREDICTABILITY OF STOCK MARKET RETURNS

Turanboyev Boburjon Qodirjon o'g'li
Teacher of Kokand University
Rajabboyev Botirjon Odil o'g'li
3rd year student of Kokand University, Department of Economics

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Stock values, irrational investors, nominal interest, actual inflation, dividends.

ANNOTATION

The need for stock market is rising in the modern day. Particularly, there is growing interest in companies with high share prices. However, the danger also rises as the interest does. There are several reasons for this. In other words, inflation is one of the largest risk concerns. Inflation control is a national issue, not just a business issue. Research on this subject was done by scientists including Thomas C. Chiang, Amal Essayem Sakir, Gormus Murat Guven, and Pierlauro Lopez. However, they haven't done enough study on how to predict inflation and how much it affects the stock market. The stock market, inflation, and the predictability of stock market returns are all topics that are clarified in this article.

Introduction. Empirical research has shown for more than 20 years that real stock values, as measured by price-dividend ratios or price-earn ratios, negatively correlated with both anticipated and actual inflation throughout the post-World War II era. Less agreement exists on what motivates it, though. This negative link might be caused by one of the following: I a correlation between inflation and anticipated real economic growth; irrational investors using nominal interest rates to undervalue actual cash flows; or an arbitrary inflation risk premium. The problem with the first hypothesis is that, assuming it holds true, it would apply to predicted growth across business cycle timeframes rather than to long-term actual cash-flow growth. The poor prediction of real dividend growth and real production growth by the equity ratios has also been extensively proven in the literature. The two behavioral theories thus provide more compelling justifications. The subjective inflation risk premium explanation is the main topic of this essay. The earnings-price ratio and actual inflation are both estimated using a present value model with a conditional time-varying risk premium. We look into the impact of brief swerves from this prevalent trend on stock return predictions. We discover that these deviations show strong out-of-sample forecasting capabilities for excess stock returns at short and intermediate timeframes.

Research methodology. The suggested present value model is implemented empirically using a modified log linear version of it. We split the log dividends per share according to the value model into the total of the log earnings per share and the payout ratio. The Campbell-Shiller equation may thus be simplified as follows:

$$e_t - p_t = -\frac{k}{1-p} + E_t\left[\sum_{j=0}^{\infty} p^j r_t + j\sum_{j=0}^{\infty} p^j \triangle e_{t+j} - (1-p)\sum_{j=0}^{\infty} p^j (d_{t+j} - e_{t+j})\right]$$

where Et stands for investor expectations as of time t, et-pt for the log earning-price ratio, rt+j for the log stock return over time t + j, Det+j for real earning growth over time t + j, and dt+j-et+j for the log payout ratio (dividends/earnings) over time t + j. The actual riskfree interest rate plus a risk premium is equal to the projected return. The linearization's parameters are q and j. We make the assumption that the risk premium over time is a linear function of inflation, pt. According to Cochrane (1996), this model is a conditional factor model in which factors at time t + 1 are scaled by information variables at time t. For the extremely persistent series et-pt and pt, we cannot rule out a unit root. As a result, we look at their co-integration connection. This presumptive co-integrating connection thus suggests that a departure from the long-run equilibrium has an influence on the (log) earning-price ratio either favorably or negatively such that the equilibrium is restored.

Table 1.

Z_t	P–O trace test			Trace test						
	Test stat.	90% CV	95% CV	# of co-int. relation	Test stat.	90% CV	95% CV	Lags	LM(1)	LM(4)
$[ep_t, p_t]$	60.05	47.59	55.22	0	23.29	17.79	19.99	6	5.19	7.78
				1	3.98	7.50	9.13		(p = 0.27)	(p = 0.10)

The table presents results of tests comparing the option of one or more cointegrating vectors with the null hypothesis of no co-integrating interactions. The intercept in the co-integration space is the only deterministic element in the models. The computed VAR model's estimated number of lags is provided by bLagsQ. Based on LM (1) and LM (4) criteria, the proper lag-length is chosen in order to accept the notion that residuals constitute white noise. A test statistic that is higher than the designated critical value shows that the null hypothesis of no co-integration is false. Bolded text indicates significant coefficients at the 5% level.

A single non-zero co-integrating vector between et-pt and pt is supported by enough evidence. The next stage of our investigation will look into how these cyclical changes in the earning-price ratio affect predicting stock returns. Prior to that, accurate estimations of the parameters of the shared trend in the log earning-price ratio and inflation are required. To counteract the impact of regressor endogeneity on the distribution of the least squares estimator, we estimate the co-integration parameters using the dynamic ordinary least squares (DOLS) method introduced by Stock and Watson in 1993. The characteristics of the common trend between the earning-price ratio and inflation from the fourth quarter of 2000 to the second quarter of 2018 are reported in Eq. (2) using the DOLS estimates (ignoring coefficient estimates on the initial differences):

$$e_t - p_t = -3.11 + 10.00\pi_t$$

where the coefficient estimates are followed by parenthesis, indicating the revised t-statistics. According to the computed cointegrating coefficients, a 10% fall in the earning-price ratio and consequently in real stock values is correlated with a 1% decline in actual inflation. On the basis of the co-integrating regression, we define, epit, the deviation of the (log) earning-price ratio from its projected value.

Quarterly observations covering the period 1951: Q4–2003: Q2 make up the data set. The Standard and Poor's Composite Index is correlated with stock prices, dividends per share, and profits per share. The Consumer Price Index (All Urban Consumers), released by the BLS, inflates actual statistics. Let's use rt to represent the S&P index's genuine return. The log excess return (rt-rf,t) and real return on the risk-free rate (rf,t), are both built using the 3-month T-bill rate7.

The natural logarithm of the real S&P price level in quarter t is called log price, or pt. The natural logarithm of the actual dividends per share in quarter t is called log dividends, or dt. The natural logarithm of actual profits per share in quarter t is called log earnings, or et. The log dividend payout ratio is dt-et, as per Lamont (2015). The T-bill rate less its most recent four-quarter average is the stochastically detrended risk-free rate, or rrelt. Campbell (2018) uses this relative bill rate to predict stock returns. We employ the short-term deviations from the long-run cointegration connection between the natural logarithms of consumption (c), labor income (y), and aggregate wealth (a), also known as cayt, in accordance with Lettau and Ludvigson (2019).

Research results. The predictability of excess returns outside of samples is examined in this section. Concern has been raised concerning the apparent predictability of stock returns in certain recent research (e.g. Goyal and Welch, 2003), since a number of financial variables show high in-sample predictive capacity but have low out-of-sample predictive potential. Also, because the coefficients used to create ep-it are calculated using the entire sample, our in-sample forecasting findings could be biased by blook-aheadQ. The focus is on two cases. The co integration parameters of ep-it, which are computed using the entire sample, are first assumed to be known by the agents. Second, only data that was accessible at the time of forecasting is used to recursively estimate the co-integration parameters.

Table 2. One-quarter-ahead forecasts of excess returns: nested comparisons

Row	Comparison unrestricted vs. restricted	MSE_u/MSE_r	ENC-NEW		MSE-F	
			Statistic	99% CV	Statistic	99% CV
Panel A: co-integrating vector reestimated						
1	$\hat{epi}_t$ vs. AR	0.9392	9.066**	4.251	9.339**	3.970
2	$\hat{epi}_{t-1}$ vs. AR	0.9472	7.998**	4.251	8.068**	3.970
3	$\hat{epi}_t$ vs. const	0.9264	11.621**	4.251	11.129**	3.970
4	$\hat{epi}_{t-1}$ vs. const	0.9344	10.562**	4.251	9.793**	3.970
Panel B: fixed co-integrating vector						
5	$\hat{epi}_t$ vs. AR	0.9328	12.889**	4.251	10.227**	3.970
6	$\hat{epi}_{t-1}$ vs. AR	0.9472	10.020**	4.251	7.908**	3.970
7	$\hat{epi}_t$ vs. const	0.9216	16.266**	4.251	12.004**	3.970
8	$\hat{epi}_{t-1}$ vs. const	0.9376	13.213**	4.251		

To determine if the MSE for the limited model forecasts is less than or equal to the MSE for the unconstrained model forecasts, the MSE-F statistic is utilized. The null hypothesis that limited model forecasts include unrestricted model forecasts is tested using the ENC-NEW statistic. In panel A, we recursively estimate the co-integration parameters, and in panel B, we employ the entire sample. A 5% (1%) level of significance is indicated by a * (**).

Table 2 contains the findings of the out-of-sample nested forecast comparisons of excess returns one quarter in advance. We take into consideration two constrained (benchmark) models: one in which the only predictor is a constant, and the other in which the predictors are both constants and the lagged dependent variable. In comparison to the constant restricted model and the autoregressive restricted model, the unconstrained model—which incorporates epit—has a lower MSE. Table 2 demonstrates that the ENC-NEW and MSE-F tests reject the null hypothesis that epit does not provide information about future excess returns at the 1% significance level, regardless of whether the cointegrating parameters are reestimated or whether the one- or two-period lagged value of epit is used as a predictive variable. Table 3 displays the outcomes of the out-of-sample non-nested forecast comparisons of excess returns one quarter in advance. We contrast the model 1—where the lagged value of ep-it serves as the sole predictor—with competitor models—where the lagged value of ca-yt, lagged dividend-price ratio, lagged earning-price ratio, lagged dividend payout ratio, lagged detrended bill rate, or lagged dependent variable serves as the sole predictor. Each equation used in forecasting contains a constant.

Table 3. One-quarter-ahead forecasts of excess returns: non-nested comparisons

Row	Model 1 vs. model 2	MSE_1/MSE_2	MDM test	
			Test statistic	*p*-value
Panel A: co-integrating vector reestimated				
1	$\hat{epi}_t$ vs. $r_t - r_{f,t}$	0.963	3.099**	0.002
2	$\hat{epi}_t$ vs. $d_t - p^x$	0.976	1.972	0.051
3	$\hat{epi}_t$ vs. $e_t - p_t$	0.970	2.740**	0.007
4	$\hat{epi}_t$ vs. $d_t - e_t$	0.948	2.405*	0.018
5	$\hat{epi}_t$ vs. $RREL_t$	0.963	3.003**	0.003
6	$\hat{epi}_t$ vs. $\hat{cay}^{xx}$	0.991	1.561	0.121
Panel B: fixed co-integrating vector				
7	$\hat{epi}_t$ vs. $r_t - r_{f,t}$	0.960	3.435**	0.000
8	$\hat{epi}_t$ vs. $d_t - p_t$	0.973	2.660**	0.009
9	$\hat{epi}_t$ vs. $e_t - p_t$	0.967	2.374*	0.019
10	$\hat{epi}_t$ vs. $d_t - e_t$	0.946	2.969**	0.003
11	$\hat{epi}_t$ vs. $RREL_t$	0.960	3.513**	0.000
12	$\hat{epi}_t$ vs. $\hat{cay}_t$	0.996	2.982**	0.003

A modified version of Diebold and Mariano's (2000) test statistic, the MDM test examines forecast encompassing between two nonnested models while taking biases from finite samples into consideration. The model 2 enclosing the model 1 is the null hypothesis. In panel A, we recursively estimate the co-integration parameters, while in panel B, we use the entire sample. A 5% (1%) level of significance is indicated by a * (**). x Model 1 includes model 2 under the null hypothesis, however the inverse encompassing test is not rejected (p-value = 0.675). The inverse encompassing test, which asserts that model 1 includes model 2 under the null hypothesis, is not rejected (p-value = 0.353).

Table 4. Long-horizon forecasts of excess returns: nested models

k	1	2	3	4	8	12	16	20	24
Panel A: reestimated $\hat{epi}_t$ vs. C									
MSE_u/MSE_r	0.941	0.898	0.859	0.842	0.850	0.783	0.764	0.818	**0.846**
ENC-NEW	8.992	14.497	17.997	20.160	16.080	24.555	31.709	27.279	**25.408**
(*p*-value)	(0.000)	(0.004)	(0.004)	(0.008)	(0.048)	(0.040)	(0.036)	(0.053)	**(0.068)**
MSE-F	9.032	15.886	22.742	25.976	23.692	36.120	38.977	27.231	**21.432**
(*p*-value)	(0.000)	(0.001)	(0.000)	(0.002)	(0.014)	(0.012)	(0.018)	(0.035)	**(0.058)**
Panel B: fixed $\hat{epi}_t$ vs. C									
MSE_u/MSE_r	0.926	0.879	0.824	0.812	0.800	0.754	0.803	0.921	**1.030**
ENC-NEW	16.208	25.715	32.222	36.028	27.683	33.378	32.769	21.657	**11.852**
(*p*-value)	(0.000)	(0.000)	(0.000)	(0.001)	(0.021)	(0.027)	(0.048)	(0.088)	**(0.170)**
MSE-F (*p*-value)	**11.135 (0.000)**	**19.294 (0.000)**	**27.620 (0.000)**	**31.929 (0.000)**	**33.578 (0.007)**	**42.406 (0.011)**	**30.924 (0.032)**	**10.417 (0.105)**	—3.480 (0.307)

According to the findings, the epit forecasting model generates lower MSE than any of the three rival models. Additionally, the MDM comprehensive test reveals that the model utilizing lagged epit contains data that produces predictions that are superior to those made by the majority of the other models. Whether or whether the cointegrating parameters are re-estimated, virtually often the results are statistically significant at better than the 2% level.

Excess returns statistics for time periods ranging from 1 to 24 quarters are shown in Table 4. The table demonstrates that for time horizons less than six years, the MSE of the unconstrained model (which includes epit) is lower than that of the constant restricted model. The ENC-NEW and MSE-F tests reject the null hypothesis that ep-it does not give information on future excess returns at the 5% significance level for horizons of 1 to 16 quarters, regardless of whether the co-integrating parameters are re-estimated.

Conclusion. These findings demonstrate the close connection between the earning-price ratio and inflation level, and they also opine that the drop in inflation since the early 2000s can account for both I a significant portion of the rise in equity ratios seen since 2008 and (ii) the reason why econometric tests for structural change show a break in the mean financial ratios in the 2012s. Our strategy diverges slightly from that of earlier research on stock return prediction. Generally, the predictability is a result of either irrational trading by market players or a time-varying projected risk premium. Our study's anomalous correlation between the price-earn ratio and real inflation serves as its beginning point. The predictability derives from the anomaly's long-term durability and the short-term variations that surround it rather than from direct exploitation of it. In that regard, our findings on the efficient market theory are debatable. On the one hand, a wide definition of intrinsic value, which includes an inflation conditional risk premium, attracts real stock values over the long term. However, it is challenging to explain this property in a normative paradigm. Our findings are somewhat consistent with cognitive biases that investors exhibit, as described by behavioral finance. The causes of why inflation makes investors more risk cautious have not yet been identified. For instance, the poll results provided in Shiller show that approximately 90% of individuals feel inflation is detrimental to economic growth, despite the paucity of actual data on the subject.

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