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HOW USEFUL ARE THE E/P RATIO AND THE SPREADS BETWEEN THE E/P RATIO AND INTEREST RATES IN FORECASTING HONG KONG STOCK MARKET CONDITIONS?

Key Points:

- *The earnings-price ratio (E/P ratio) of the Hang Seng Index (HSI) and the spreads between the E/P ratio and interest rates are widely used by market practitioners to forecast the stock market outlook. This paper studies their usefulness as indicators of future Hong Kong stock market conditions.*
- *Based on simple regression models, this paper finds that the E/P ratio and the spreads are not particularly useful for forecasting the returns or the excess returns of the Hang Seng Total Return Index.*
- *Trading rules based on the out-of-sample forecasts or the historical extreme values of the E/P ratio and the spreads, which provide market-timing signals for deciding whether to invest in the HSI or to switch to the 1-month Exchange Fund Bill, can reduce the volatility of the portfolio investment without significantly lowering the average return.*
- *Some central banks' financial stability reports include measures of whether stock markets are overvalued by looking at E/P ratios. However, the results in this paper show that the ratios are not useful in assessing the extent to which there is an overvaluation in the Hong Kong stock market in the short run.*

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I. INTRODUCTION

The earnings-price ratio (E/P ratio) of an individual stock is widely used by market practitioners to forecast the movement of the stock. Similarly, the E/P ratio of a stock market index is used to forecast the overall stock market outlook. The spreads between the E/P ratio and interest rates are other indicators used to monitor the stock market. These spreads are used for "market timing" such that, based on the signals generated from the spreads, a decision is made to invest in the stock market index or in bonds. The reason behind such use is that theoretically the E/P ratio and long-term interest rates should have an equilibrium relationship, as investors will arbitrage between stocks and bonds.[1] Whenever there is a deviation from the equilibrium, stock prices will move the E/P ratio and long-term interest rates to the direction of the equilibrium. It is also noted that some central banks' financial stability reports include measures of whether stock markets are overvalued by looking at E/P ratios.[2]

The purpose of this paper is to study the usefulness of the E/P ratio of the Hang Seng Index (HSI) and the spreads between the E/P ratio and interest rates in forecasting the return of the HSI and to test the market-timing ability of the E/P ratio and the spreads between the E/P ratio and interest rates.

Fuller et al. (1993) study the usefulness of E/P ratios of individual stocks in forecasting their returns. They find that stocks with high E/P ratios generate above-normal returns and those with low E/P ratios generate below-normal returns over the eighteen-year period from the fourth quarter of 1973 to the third quarter of 1991, based on the US stock market data. Campbell and Shiller (1998) investigate the relationship between the E/P ratio of the S&P 500 index and the general stock market outlook, and find that the E/P ratio at the beginning of a 10-year period is positively correlated with the return of the S&P 500 index over that 10-year period using data from 1872 to 1997. Lander et al. (1997) find that a market-timing trading strategy based on a simple error-correction model using the expected E/P ratio of the S&P500 index and long-term interest rates yields a higher average return with smaller volatility than that generated by simply buying and holding the S&P 500 index. Rolph and Shen (1999) find that the historical extreme values of the spreads between the E/P ratio of the CRSP index in the US and the long-term and short-term interest rates contain information on the direction of the stock market. A trading rule based on the 10th percentile of the historical values of the spreads produces a higher average return (not statistically significant) and a lower variance (statistically significant) than that produced by simply buying and holding the stock market index.

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[1] This point is explained in Gram, Dodd and Cottle (1962).

[2] See Franklin Allen, Lennart Francke and Mark W. Swinburne, 2004, "Assessment of the Riksbank's Work on Financial Stability Issues", Economic Review, No. 3, Sveriges Riksbank, p. 19.

This paper is organised as follows. Section II studies the effectiveness of the E/P ratio and the spreads between the E/P ratio and the long-term and short-term interest rates in forecasting the return as well as the excess return of the stock market index. The Hang Seng Total Return Index (TRI) is used to calculate the return of the stock market index. The reason for using the TRI instead of the HSI is that the TRI includes the dividend payout. The excess return is defined as the difference between the return of the stock market index and the return of a risk-free asset. The yield of the 1-month Exchange Fund Bill is used as the return of the risk-free asset. For simplicity, the spread between the E/P ratio and the long-term interest rate is called the long spread, and the spread between the E/P ratio and the short-term interest rate is called the short spread. The market-timing ability of the short spread is investigated because investors would like to know the short-term stock market outlook. The short spread might be a more relevant indicator. The long-term interest rate is the yield of the 10-year Exchange Fund Note, and the short-term interest rate is the yield of the 3-month Exchange Fund Bill. Both the yields and the E/P ratio are annualised. Based on three simple regression models, both in-sample and out-of-sample analyses are conducted.

Section III studies the market-timing ability of the E/P ratio and the long and short spreads. This section evaluates the performance of two sets of trading rules in deciding whether to invest in the HSI or the 1-month Exchange Fund Bill. The first set of trading rules is based on the out-of-sample forecasts. The second set of trading rules is based on the 10th percentile of the historical values of the E/P ratio and the spreads. The returns of the investments based on these trading rules will be compared with those based on a benchmark strategy of buying and holding the HSI. Section IV is the conclusion.

II. REGRESSION ANALYSIS

In this section, three simple models are estimated to see if the E/P ratio and the long and short spreads are able to forecast the returns of the TRI. The models use the value of the E/P ratio and the two spreads as the independent variable, and the return of the TRI as the dependent variable in the following three regressions. All independent variables are lagged one period so that the models can be implemented in real time.

$$R_t = \alpha_1 + \beta_1 (e/p)_{t-1} + \varepsilon_t \quad (1)$$

$$R_t = \alpha_2 + \beta_2 (e/p - r_s)_{t-1} + \eta_t \quad (2)$$

$$R_t = \alpha_3 + \beta_3 (e/p - r_l)_{t-1} + \xi_t \quad (3)$$

where R_t is the monthly return of the TRI, and it is calculated as the log difference of the TRI. e/p is the E/P ratio. r_s is the short-term interest rate. r_l is the long-term interest rate. $(e/p - r_s)$ is the short spread and $(e/p - r_l)$ is the long spread.

These three models are very simple. They leave out many other variables that could possibly explain the returns of the TRI. However, if too many variables are put into the models, the models might not be very useful practically. Also as it has been the case in asset return forecasting, the resulting improvement with more explanatory variables is not substantial. In the following subsections, both in-sample and out-of-sample analyses are provided. The three models are also re-estimated using the excess return as the dependent variable.

All data used are monthly data with the end of month data chosen. The sample period for the TRI and the E/P ratio is from January 1990 to December 2004. The sample period for the yields of 1-month and 3-month Exchange Fund Bills is from June 1991 to December 2004. The sample period for the yield of 10-year Exchange Fund Note is from October 1996 to December 2004. All data are from CEIC.

2.1 In-Sample Regressions

For the in-sample regression, full sample of the E/P ratio and both spreads are used. Because of the lag in independent variables, all sample sizes are adjusted for the end points. The regression results are reported in Table 1.

Table 1. Estimation with the Return of the TRI as the Dependent Variable

Independent Variable	E/P Ratio	Short Spread	Long Spread
Sample Period	Feb 90 - Dec 04	Jul 91 - Dec 04	Nov 96 - Dec 04
β	0.538	0.343	0.090
	(0.180)	(0.307)	(0.086)
α	-0.025	0.002	0.004
	(0.382)	(0.849)	(0.663)
R-squared	0.011	0.007	0.000
S.E. of Regression	0.079	0.081	0.086

Notes: 1. Sample periods are different because of different data availability.
2. The numbers in the parentheses are the p-values.

The results in Table 1 show that in the three regressions above the estimated coefficients β are positive, which is consistent with the finding in Campbell and Shiller (1998) that a higher E/P ratio implies a more favourable stock market outlook. However, none of the estimated coefficients α or β is statistically significant. The R-squared statistics are very low. These results suggest that in-sample, the E/P ratio and the two spreads are not very effective in explaining the variation of the total returns of the TRI.

Table 2 shows the results of the three models using the monthly excess return of TRI as the dependent variable. Again, the signs of the estimated coefficients β are positive, but the estimated coefficients α or β are not statistically significant. The R-squared statistics are also very low. In essence, the use of the E/P ratio and the two spreads to forecast the excess returns of TRI is also not successful.

Table 2. Estimation with the Excess Return of TRI as the Dependent Variable

Independent Variable	E/P Ratio	Short Spread	Long Spread
Sample Period	Jun 91 - Dec04	Jul 91 - Dec 04	Nov 96 - Dec 04
β	0.456	0.414	0.141
	(0.373)	(0.243)	(0.777)
α	-0.023	-0.003	0.001
	(0.511)	(0.809)	(0.947)
R-squared	0.006	0.009	0.001
S.E. of Regression	0.081	0.081	0.0867

Notes: 1. Sample periods are different because of different data availability.
2. The numbers in the parentheses are the p-values.

2.2 Out-of-Sample Forecasts

This subsection studies the out-of-sample forecasting performance of the three models. The out-of-sample forecasts of the returns of the TRI and the excess returns of the TRI are generated based on a rolling procedure.

The rolling procedure starts with estimating the three models using the first two-year data. Based on this estimation, a one-period-ahead forecast of the dependent variable is generated. The difference between the forecasted return and the realised return is the one-period-ahead forecasting error. Then the procedure is repeated with one more observation added to the sample until the end of the full sample. The three models are estimated using both the return of the TRI and the excess return of the TRI as the dependent variable. Table 3 reports the mean errors, the mean absolute errors and the root mean squared errors (RMSEs) of the out-of-sample forecast, and compares the RMSEs with the standard deviation of the dependent variable over the forecast period.

Table 3. Out of Sample Forecast Comparison

Dependent Variable	Return of TRI			Excess Return of TRI		
Independent Variables	E/P Ratio	Short spread	Long Spread	E/P ratio	Short Spread	Long Spread
Forecasting Period	Feb 92 - Dec 04	Jul 93 – Dec 04	Nov 98 – Dec 04	Jun 93 – Dec 04	Jul 93 – Dec 04	Nov 98 - Dec 04
Mean Error	-0.0005	0.0032	0.0079	0.0137	0.0011	-0.0049
Mean Absolute Error	0.0632	0.0659	0.0580	0.0170	0.0195	0.0084
Root Mean Square Error	0.0834	0.0863	0.0727	0.0240	0.0224	0.0126
S.D of the Dependent Variable	0.0823	0.0841	0.0685	0.0840	0.0845	0.0690

Note: The forecasting periods are different because of the different data availability.

The forecast results show that the performances of the models based on the E/P ratio and the two spreads are very similar. For the returns of the TRI, the mean absolute error is about 0.06. The model using the long spread has the smallest mean absolute error of 0.058 and the smallest RMSE of 0.0727, while the model using the short spread has the largest mean absolute error of 0.0659 and the largest RMSE of 0.0863. The RMSEs of all three models are greater than the standard deviations of the dependent variable over their respective forecasting periods, which are equivalent to the RMSEs of using the mean of the dependent variable as the one-step forecast. The standard deviation of the full sample for the dependent variable is 0.079, which is smaller than the RMSEs of the E/P ratio and the short spread, but is slightly larger than that of the long spread. Although theoretically it is possible that the mean of the dependent variable of the full sample is a better forecast because it uses later or more information, the RMSEs being larger than the standard deviations highlights the poor performances of the models.

For the excess returns of the TRI, the performances of the three models improve to a limited extent. All the RMSEs are smaller than the standard deviations of the dependent variable over the forecasting period as well as the standard deviation of the full sample, which is 0.081. The performance of the model using the long spread is relatively better since it has the smallest mean absolute error and the smallest RMSE. However, as in the in-sample exercise, none of the estimated coefficients is significant statistically. Similar results are obtained by using the total return of the TRI as the dependent variable.

In summary, both in-sample and out-of-sample performances of the three models using the E/P ratio and the two spreads to forecast the returns and excess returns of the TRI are not satisfactory. This is consistent with the efficient market hypothesis which implies that the returns of the stock market cannot be systematically predicted.

III. MARKET TIMING

In practice, many market participants use the E/P ratio and the two spreads to gauge the direction of the stock market in order to decide whether to stay in the stock market or to switch to cash or bonds. In this section, the market-timing ability of the E/P ratio and the two spreads is studied.

The performances of two different sets of trading rules are evaluated here. The first set of trading rules is based on the out-of-sample forecasts. The second set of trading rules is based on the extreme value of the E/P ratio and the two spreads. The extreme value refers to the 10th percentile of the historical data of the E/P ratio and the spreads. This section compares the investment returns from the switching strategy based on the trading rules with those from a benchmark strategy which is to buy and hold the HSI.

3.1 Out-of-Sample Forecasts

For the out-of-sample forecasts, the three regression models specified in equations (1) to (3) are estimated using the same rolling procedure as in section 2.2 above, with both the return and the excess return of the TRI as the dependent variables. The procedure begins by estimating the return (or excess return) of the TRI based on the first two-year data, and one-month-ahead forecasts are then generated. If the forecast is positive, which means the stock market will go up, the investor will invest in the HSI. If the forecast is negative, the investor will switch the investment to the 1-month Exchange Fund Bill. Then the models are re-estimated using one more observation, and new one-month-ahead forecasts are generated. This procedure is repeated such that the investor follows this switching strategy at the beginning of every following period until the end of the sample.

Table 4 compares the performances of the switching strategies and the buy-and-hold benchmark strategy. The switching strategies are based on the regression models with the return of the TRI as the dependent variable, and the E/P ratio and the two spreads as the independent variables respectively. The portfolio starts with $1 initial value at the beginning of the forecast period. The results show that the mean returns of the investments with the switching strategies according to the three models are not statistically different from those with the benchmark strategy. However, the standard deviations of the returns with the switching strategies are smaller than that with the benchmark strategy. Except the model using the E/P ratio as the independent variable, statistical tests reject the null hypothesis of equality between the standard deviations of the two strategies. The result shows that the switching strategies in general succeed in reducing the volatility of the investment returns over the forecasting period and do not significantly lower the average returns of the investments.[3]

Table 4. Benchmark Strategy vs. Switching Strategies (I)

Dependent variable	**Return of TRI**					
Independent variable	E/P Ratio		Short Spread (SS)		Long Spread (LS)	
Sample period	Feb 92 – Dec 04		Jul 93 – Dec 04		Nov 98 – Dec 04	
Model	BM	E/P	BM	SS	BM	LS
Mean monthly return	0.0101	0.0075	0.0078	0.0060	0.0072	-0.0017
Test of equality against benchmark (p-value)		0.7750		0.8390		0.3570
Standard deviation	0.0823	0.0775	0.0841	0.0590	0.0685	0.0461
Test of equality against benchmark (p-value)		0.4530		0.0000		0.0009

Note: The sample periods are different because of different data availability. BM stands for the benchmark strategy.

In Table 5, the switching strategy is based on the regression models that use the excess return of the TRI as the dependent variable. Again, the portfolio starts with $1 initial value at the beginning of the forecast period. We can see from the table that the mean monthly return of the investment from the switching strategy is not statistical different from that using the benchmark strategy in all three cases that use the E/P ratio, the two spreads as the independent variable respectively. However, the standard deviation of the investment return from the switching strategy in all three cases is smaller than that from the benchmark strategy. Statistical tests in all three cases reject the null hypothesis of equality between the standard deviation from the two strategies. These results are similar to the results of Table 4.

[3] When transaction costs are taken into account, the findings remain the same.

Table 5. Benchmark Strategy vs. Switching Strategy (II)

Dependent variable	**Excess Return of TRI**					
Independent variable	E/P Ratio		Short Spread (SS)		Long Spread (LS)	
Sample period	Jun. 93 – Dec. 04		Jul. 93 – Dec. 04		Nov. 98 – Dec. 04	
Model	BM	E/P	BM	SS	BM	LS
Mean monthly return	0.0075	0.0075	0.0078	0.0056	0.0072	-0.0031
Test of equality against benchmark (p-value)		0.9740		0.7990		0.2350
Standard deviation	0.0839	0.0692	0.0841	0.0587	0.0685	0.0300
Test of equality against benchmark (p-value)		0.0244		0.0000		0.0000

Note: The sample periods are different because of different data availability. BM stands for benchmark strategy.

3.2 Extreme Values

In the case of the trading rule based on the extreme values, the historical 10th percentile of the decision variable is chosen as the threshold. For example, when the E/P ratio is used as the decision variable, the decision procedure is as follows. We first calculate the 10th percentile of the E/P ratio using the first two-year data from February 1990 to January 1992. The 10th percentile is compared with the next observation which is the E/P ratio as of February 1992. If the value of the next observation is larger than the 10th percentile, the investment will stay with the HSI. If it is smaller than the 10th percentile, the investment will switch to the 1-month Exchange Fund Bill. Then one more observation is added to calculate the 10th percentile of the E/P ratio and the procedure is repeated until the end of the sample. The same procedure is applied to the switching strategies using the long spread and the short spread as the decision variable.

The comparison between the performances of the switching strategies and the buy-and-hold benchmark strategy by using the portfolio with $1 initial value at the beginning of the forecast period is demonstrated in Table 6. The end values generated from the two types of strategies are reported together with the Sharpe ratios.[4] The results show that the switching strategies based on the three decision variables reduce the volatility of the investment returns, since the standard deviations from the switching strategies are smaller than the standard deviation from the benchmark strategy. The statistical test rejects the null hypothesis of equality of standard deviations between

[4] The Sharpe ratio is defined as the ratio of the mean excess return from a particular strategy over its standard deviation. The mean excess return is the average monthly return from the strategy less the average yield of the 1-month Exchange Fund Bill.

the two types of strategies at 10 percent significance level. However, there is no statistical difference between the average monthly returns obtained from the switching strategies and the benchmark strategy.

Table 6. Benchmark Strategy vs. Switching Strategies Based on Extreme Values

Decision variable	Short Spread (SS)		Long Spread (LS)		E/P Ratio	
Sample period	Jul 93 – Dec 04		Nov 98 – Dec 04		Feb 92 – Dec 04	
Strategy	BM	SS	BM	LS	BM	E/P
Mean monthly return	0.0080	0.0073	0.0072	0.0013	0.0101	0.0103
Test of equality against benchmark (p-value)		0.9360		0.5630		0.9880
Standard deviation	0.0844	0.0624	0.0685	0.0560	0.0823	0.0642
Test of equality against benchmark (p-value)		0.0005		0.0897		0.0020
End value	1.8200	2.0910	1.4400	0.9700	2.8300	3.5800
Sharpe ratio	0.0553	0.0633	0.0709	- 0.0196	0.0838	0.1095

Note: The sample periods are different because of different data availability. BM stands for the benchmark strategy.

With the initial $1 investment, the end values of the switching strategies based on the short spread and the E/P ratio are higher than that of the benchmark strategy. However, for the switching strategy based on the long spread, its end value is smaller than that of the benchmark strategy. The Sharpe ratios show a similar pattern. The investments using the switching strategies based on the short spread and the E/P ratio have higher Sharpe ratios than that using the benchmark strategy. The Sharpe ratio for the switching strategy based on the long spread is negative. The reason for this negative Sharpe ratio is a negative mean excess return in the switching strategy. The result remains the same by using the yield of the 5-year Exchange Fund Note to calculate the long spread.

Regarding the switching strategies, the investments are switched to the 1-month Exchange Fund Bill during the second half of 1997 to 2000 when the Hong Kong stock market was very volatile. Therefore, the switching strategies in general avoid the most volatile market conditions. This point can also be seen from comparing the standard deviations of the returns of the TRI during the sub-periods when the investment is in or out of the stock market. Table 7 reports the average monthly return of the TRI and the volatility of the monthly returns of the TRI for the entire sample period, and sub-periods when the investment is in or out of the stock market, based on the extreme values of the short and long spreads and the E/P ratio. For all three decision variables, the volatility as

measured by the standard deviation is smaller in the sub-period when the investment is in the stock market than that when it is out. Statistical tests reject the null hypothesis of equality of the standard deviations between the two sub-periods at 5 percent significance level for the decision variables of the short spread and E/P ratio. Furthermore, the standard deviation for the sub-period when the investment is in the stock market is smaller than the standard deviation of the entire sample period in all three cases. The difference in average return is not statistically significant in the two sub-periods for the decision variables of the short spread and E/P ratio. For the decision variable of the long spread, the results of the two equality tests are not significant.

Table 7. Comparison of the Returns of the TRI in Different Sample Periods

Decision variable	Short Spread			Long Spread			E/P Ratio		
Sample period	Jul 93 – Dec 04			Nov 98 – Dec 04			Feb 92 – Dec 04		
	Entire Sample	Out	In	Entire Sample	Out	In	Entire Sample	Out	In
Mean monthly return	0.0080	0.0070	0.0084	0.0072	0.0411	0.0007	0.0101	0.0026	0.0127
Test of equality of means between in and out sub-periods (p-value)		0.9298			0.0612			0.5048	
Standard deviation	0.0844	0.1076	0.0739	0.0685	0.0938	0.0614	0.0823	0.1024	0.0744
Test of equality of means between in and out sub-periods (p-value)		0.0103			0.1248			0.0245	

Note: The sample periods are different because of different data availability.

IV. CONCLUSION

This paper studies the usefulness of the E/P ratio, and the long and short spreads as indicators of future stock market conditions. Based on the simple regression analyses, it is found that the E/P ratio and the two spreads are not effective variables to forecast the returns or the excess returns of the TRI both in-sample and out-of-sample.

However, it is found that the trading rules based on the out-of-sample forecasts or the historical extreme values of the E/P ratio and the spreads, which provide market-timing signals for deciding whether to invest in the HSI or to switch to the 1-month Exchange Fund Bill, can reduce the volatility of the portfolio investment without significantly lowering the average return.

Some central banks' financial stability reports include measures of whether stock markets are overvalued by looking at E/P ratios. However, the results in this paper show that the ratios are not useful in assessing the extent to which there is an overvaluation in the Hong Kong stock market in the short run.

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