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An Empirical Study of Dividend Payout and Future Earnings in Singapore

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Abstract

This paper applies Johansen's vector error-correction model (VECM) to investigate for the existence of the dividend signalling effect in the Singapore aggregate market through impulse response analysis, forecast error variance decomposition and granger-causality test. Our findings show that a unit shock increase in dividend payout leads to a permanent increase in future earnings over time, thus supporting the existence of informational/signalling content in dividend payout in the Singapore market over the long run. We further find that at least half of the forecast error variance in earnings can be accounted for by innovations in the dividend payout, while the payout ratio is also shown to granger-cause earnings in the Singapore market.

JEL Classification: G000, G350, C320

Keywords: Dividend payout, future earnings, dividend signalling, Singapore, impulse response function

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1. Introduction

The existence of informational content in dividend policy has been a hugely debated topic in the field of corporate finance. The dividend irrelevance theorem expressed in the seminal paper of Miller and Modigliani (1961) showed that in a world of perfect information, full capital mobility, no taxes and no agency costs between managers and outside investors, a company's dividend policy should be irrelevant to its market value. However the existence of real-world market imperfections of asymmetric information means that corporate dividend policy can have an effect on firm value. In particular, the dividend signalling theory was put forward to explain the "dividend puzzle", which represents the conflict between the theoretical framework of Miller and Modigliani (1961) and empirical evidence of the importance of dividend policy to corporations and managers in the real world.

The dividend signalling theory is essentially built upon the relaxation of the assumption of perfect symmetrical information between managers and shareholders, and hypothesised that a change in dividend policy signals a change in firm value if the two critical assumptions of managers having better information about the company than the marketplace, as well as the existence of a cost for bad companies trying to mimick as a good company are satisfied. These cost-structure properties of incorrect signalling may be expressed differently in the various dividend signalling theories, and can range from the tax disadvantage of dividends versus capital gains in the models of Bhattacharya (1979) and John & Williams (1985) to the higher cost of either expensive equity issuance or underinvestment versus paying out cheap internal cash in the model of Miller and Rock (1985). Kalay (1980) however showed that despite these differences in cost-structure properties, they all require managerial reluctance to cut dividends as a necessary condition for dividends to convey information.

Early empirical investigations into the relationship between dividends and future earnings have yielded ambiguous results. While separate studies by Gonedes (1978), Healy and Palepu (1988), Kao and Wu (1994), and Brooks, Charlton, and Hendershott (1998) have found a positive relationship between dividends and future earnings, the work by Penman (1983), DeAngelo, DeAngelo, and Skinner (1996), Benartzi, Michaely, and Thaler (1997), and Mozes and Rapaccioli (1998) have found little or no evidence that dividends predict abnormal increases in earnings.. Recent empirical studies investigating the informational content of dividends have generally found more supportive evidence of the existence of a positive relation between dividend policy and future earnings growth. Zhou and Ruland (2006) conducted a company-by-company analysis of a large sample of companies over a 50-year time period and found that a strong positive relationship exists between current dividend payout and future earnings growth, with the positive relationship being more prominent for companies with limited growth opportunities or a tendency towards overinvestment. Their findings are corroborated by Nissim and Ziv (2001) who studied the dividend events between the period of 1963 to 1998 and found that dividend increases usually indicate increases in future profitability although dividend decreases are not correlated with future earnings. They also found that dividend changes are positively correlated with the earnings level and changes in the two years following the announcement.

While most empirical studies have focused mainly on analyses performed at the micro/company-level, recent studies have also been extended to investigating the informational content of dividend policy at an aggregate market/macro level and they have generally yielded positive results. Arnott and Asness (2003) employed more than 100 years of data of the aggregate S&P500 index, and found strong evidence that expected future earnings growth is fastest when current payout ratios are high and slowest when payout ratios are low, even when controlled for other factors such as simple mean reversion in earnings. Gwilym, Seaton, Suddason and Thomas (2006) extended the analysis of Arnott and Asness (2003) to 10 other international markets including France, Germany, Greece, Italy, Japan, the Netherlands, Portugal, Spain, Switzerland, and the United Kingdom, and found that despite different institutional, tax and legal environments across the countries, international evidence generally supported the findings of Arnott et al (2003) that substantial reinvestment of retained earnings does not lead to faster future real earnings growth. They also highlighted that investing in countries with higher payout ratios had been observed to result in higher earnings growth than investing in markets with low payout ratios, although they were unable to translate their findings into return predictability in a persuasive fashion.

There are several motivations for this paper:

Firstly, the investigation of the informational content of dividends and its effect on future earnings on the aggregate market level is immensely important and has serious implications on portfolio management and asset allocation. In particular, while most studies have used firm-level time series data to analyse the informational content of the dividends hypothesis, analysis of the aggregate time series is interesting both in itd own right and because it can help us understand whether dividends provide information about future aggregate market earnings. If the information provided by managers about their firms' earnings through their dividend policy is largely idiosyncratic, then dividends will have informational content on the individual firm level but not at the aggregate market level. However if managers' dividend decisions provide information that is related to trends in the macroeconomy, then it will be informative at the aggregate level as well. This informational content will be very useful for the purposes of economic and fiscal policy decisions. They may even be more informative at the aggregate market level if the aggregation filters out the idiosyncratic errors.

Secondly, the studies performed at both the micro and macro levels have generally employed simple Ordinary Least Squares (OLS) regression to test for the existence of a relationship between the variables, and there are two particularly shortcomings with the methodology. Firstly, it ignores the possibility that the time series of the payout ratio and earnings may be non-stationary, which would lead to spurious results. For example, it is well established in various studies including Ball and Watts (1972) and Foster (1978) that earnings follow a random walk and are non-stationary with integration of order one. Empirical evidence on the dividend process including Campbell and Shiller (1987), Lintner (1956), and Fama and Babiak (1968) have however found it to be largely trend stationary. This implies that the time series of the payout ratio is likely to be nonstationary. As such, OLS regressions of subsequent earnings growth (a stationary variabls) against payout ratio (a nonstationary variable) in the style of the analysis by Arnott and Asness (2003) may produce spurious results. Secondly, OLS regressions ignore possible endogeneity between the variables, while making *a priori* assumptions about the nature of the inter-relationships, which can be unsatisfactory. For instance, in explaining the trend stationarity of log dividends, Campbell and Shiller (1987) have attributed it to managers' reluctance to raise dividends in line with earnings increases, while Linter (1956) had explained his observation of the slow move by companies towards a target dividend payout ratio as representing managers' unwillingness to cut dividends paid to investors. This "stickiness" in dividends would imply that current dividends and payout ratio are at least functions of both earnings as well as lagged values of dividends and payout ratios respectively. This means that the relationship between payout and earnings is better investigated within a system of simultaneous equations that are endogenously determined.

Thirdly, most of the empirical studies have focused primarily on the US and major European markets with almost no work being done for Asian markets, especially small financial markets like Singapore. With the rapid growth and increasing importance of Asian financial markets and economies relative to the global landscape over the last few years, better understanding of the behaviour of Asian financial markets will be very important.

The paper therefore aims to add to current literature on dividend signalling by incorporating the consideration of the possible existence of non-stationarity properties of the time series of dividend payout and real earnings through the application of newer, more advanced cointegration and vector error-correction modelling techniques to investigate for the existence of informational content in the dividend payout in the under-researched Asian market of Singapore.

This paper applies Johansen's cointegration techniques to the Singapore market to develop a vector error-correction matrix (VECM) between earnings and dividend payout which is then used to derive the impulse response function for tracing the effect of a unit shock in the payout ratio on earnings over time. We also perform both forecast error variance decomposition analysis to investigate the proportion of the forecast error variance in earnings that is accounted for by dividend payout, as well as the Granger-causality test to establish the extent to which the lag process in dividend payout explains future earnings. Our findings show that:

- An unanticipated increase in the dividend payout, represented by a one standard deviation increase in dividend payout in the impulse response function, leads to a permanent increase in future earnings of the Singapore market over time. This supports the dividend signalling theory that dividend payout possesses informational content about future earnings, and that the two variables are positively correlated.
- The magnitude of the informational content of dividend payout on real future earnings is significant, as represented in the forecast error variance decomposition analysis where we find that at least half of the forecast error variance in earnings can be accounted for by innovations in the dividend payout.
- Lagged values of the dividend payout ratio have statistically significant information about future real earnings, as evidenced by the rejection of the null hypothesis of no granger-causality between payout ratio and real earnings in the Singapore market.

The paper is structured as follows: Section 2 gives an overview of the econometric test procedure employed, and more importantly, provides the rationale for the choice of certain methods or specifications. Section 3 gives a description of the data used. This is followed by the empirical results and their interpretations in Section 4 while Section 5 provides the conclusions of the paper.

This paper primarily uses the JMulti package by Helmut Lutkepohl and Markus Kratzig, and the EasyReg package by Herman Bierens for its econometric analysis. All critical values are provided by the two econometric software packages.

2. Econometric Methodology

We define the two variables of earnings as EPS_t, and dividend payout ratio as, $POUT_t$. The following econometric procedure is then pursued: First, we test for non-stationarity and the order of integration for both $POUT_t$ and EPS_t. Typically, an Augmented Dickey-Fuller (ADF) procedure is used for unit root testing as the approach permits sufficient dynamics (in the form of lagged differences) to approximate the ARIMA process in the error term, thereby eliminating autocorrelation. The tests are applied to both model with constant and model with constant and time trend, and performed for 0 to 84 lags i.e. seven years, with the choice of the number of lagged differenced terms (in the ADF) chosen based on the four information criterion: Akaike Information Criterion, Hannan-Quinn Criterion, Schwarz Criterion and Final Prediction Error. The null hypothesis is that of non-stationarity ie $H_0 : \rho = 0$. We also employ the Phillips-Perron (PP) unit root test given the test statistics incorporates an automatic correction to the Dickey-Fuller procedure that allows for autocorrelated residuals, thus freeing the test statistic from parametric errors that may occur in the ADF test statistics.

It has been argued that while both ADF and PP tests have a number of advantages including their simplicity, they are vulnerable to size distortions while suffering a further drawback of not being asymptotically similar. The power of the tests is also low if the process is stationary but with a root close to the non-stationary boundary. We have therefore employed two other unit root tests to supplement the ADF and PP tests. They are the Schmidt-Phillips (SP) test which uses detrending procedures that are optimal under the null hypothesis of a unit root, as well as the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test which uses a null hypothesis of stationarity. The number of truncation lags (*l*) to be to evaluate the serial correlation for the Newey-West correction for PP, SP and KPSS test is computed by $l = q(T/100)^{0.25}$ where q = 4 or 12.

For all four unit root tests, if non-stationarity is not rejected, the variable is differenced once and the unit root tests are performed again. This is repeated until stationarity is achieved. The number of differences taken before the series becomes stationary is then the order of integration ie *I(d)*.

If the two time series are found to be integrated of the same order, we then proceed to test for the existence of cointegration vectors among them by performing the Johansen trace test[2] and the Saikkonen & Lütkepohl cointegration test. Both cointegration tests involve the determination of the rank of the matrix Π which reflects the number of cointegrating vectors in the process governing movements of $POUT_t$ and EPS_t. In this application, there are three possible ranks of Π. If r = 2 (i.e. Π is full rank), that means that both $POUT_t$ and EPS_t are stationary processes. This would however contradict the earlier unit root tests findings that they are both integrated of order one or higher. If r = 0, then there is no cointegration between the two variables, and no stationary long run relationship exists. When r = 1, there is a single cointegrating vector between $POUT_t$ and EPS_t such that Π = αβ', where α contains the cointegrating vector and β is the corresponding error-correction coefficients. This supports the presence of a cointegrating relation between payout ratio and real earnings.

If we find the existence of one cointegrating relation between the two variables of $POUT_t$ and EPS_t, we can then proceed to derive the vector error-correction matrix (VECM) of forms:

$$\Delta EPS_t = \mu_2 + \Sigma^{k-1}_{j=1} \Gamma_{21}(j)\, \Delta POUT_{t-j} + \Sigma^{k-1}_{j=1} \Gamma_{22}(j)\, \Delta EPS_{t-j} + \Pi_{21}\, POUT_{t-k} + \Pi_{22}\, EPS_{t-k} \quad (1)$$

[2] Typically there are two Johansen likelihood ratio (LR) tests available, the maximum eigenvalue test and the trace test. This paper employs the trace test only for the Johansen's cointegration analysis, as justified by Lütkepohl et al (2001).

$$\Delta POUT_t = \mu_1 + \Sigma^{k-1}_{j=1}\ \Gamma_{11}(j)\ \Delta POUT_{t-j} + \Sigma^{k-1}_{j=1}\ \Gamma_{12}(j)\Delta EPS_{t-j} + \Pi_{11}\ POUT_{t-k} + \Pi_{12}\ EPS_{t-k} \qquad (2)$$

where the matrix Γ represents the short run dynamics of the relationship between $POUT_t$ and EPS_t, and the matrix Π captures the long run information in the data. The order (lag length) of the Vector Autoregressive (VAR) form is chosen by selecting the VAR(p) model based on the four information criterion: Akaike Information Criterion, Hannan-Quinn Criterion, Schwarz Criterion and Final Prediction Error. Lags of 0 to 84 months are tested.

To investigate for the existence of informational content in dividend policy about future earnings, we perform three particular analyses. First, we test for causality in the VECM by applying the Granger-causality test. Granger (1969) defined a variable as being causal for another variable if inclusion of the lagged values of the former helps to improve the forecasts of the latter. If the dividend payout ratio contains information content about future earnings as hypothesised by the dividend signalling theory, then payout should granger-cause earnings. While the examination of the granger-causal relationship between the two variables can be useful, it does not fully illustrate the dynamic interactions between the variables in the system. We will therefore proceed to employ impulse response analysis to trace the effect of innovations in one variable on the other variable over time. We are particularly interested in examining the impulse response function of earnings to a unit shock in payout. A forecast error variance decomposition analysis is finally performed to determine the proportion of the forecast error variance that is accounted for by innovations in the endogenous variables.

3. Data Sample

This study looks at the Singapore market. The data required are the monthly values of price-earnings ratio, dividend yield, the stock market index level and the consumer price index. We have chosen the Straits Times Index as the index that best represents the country's aggregate equity market. Although earlier stock market data is available since June 1973 when the Stock Exchange of Singapore (SES) was established out of the dissolution of the Stock Exchange of Malaysia and Singapore, Malaysian and Singaporean companies were still cross-listed on each other's exchanges until 1 January 1990 when Malaysian shares were completely delisted from the SES board. We have therefore employed the time period from January 1990 to June 2007 for this empirical study. All data is obtained from Datastream.

Following the procedure of Arnott and Asness (2003) and Gwilym et al (2006), we have derived the 12-month trailing earnings in index points for each country by dividing the price series through by the price-earnings ratio. The real earnings series is then obtained by dividing the earnings series through by the consumer price index. The payout ratio is defined as the ratio of one-year trailing dividends to one-year trailing earnings, and is derived by multiplying the dividend yield with the price-earnings ratio. The logarithms of real earnings and payout ratio are used for this analysis.

As pointed out by Arnott et al (2003), the issue to note with these indices is the variation of their compositions over time. Because poorer-performing stocks tend to be replaced by better-performing stocks in the index, while rebalancing also occurs for new listings, therefore the divisor of the index will increase over time. This reduces the EPS of the index, thus causing the EPS to lag the GDP growth of the economy.

4. Empirical Results

Figures 1 and 2 show the time series plots of the payout ratio (POUT) and real earnings (EPS) of the Singapore Straits Time Index respectively versus the 5-year moving average over time. It can be seen from the 5-year moving averages that both time series appear to display certain time trending properties, thus hinting at the need for the inclusion of time trends in both the unit root tests as well as the cointegration tests.

Table 1 shows the results of the various unit root tests. All the variables are tested in levels and first-difference terms for non-stationarity using unit root tests with (1) a constant term, and (2) a constant term with time trend. It can be seen that the unit root tests for non-stationarity (i.e. the ADF, PP and SP tests) generally fail to reject the null hypotheses of non-stationarity at 10% significance levels for both POUT and EPS in level terms, while rejecting the null hypotheses at 1% significance levels for both variables in first-differenced terms. It is worth noting that when estimating the models with constant and time trend for use in the ADF tests, the coefficients of the time trend for both POUT and EPS are fairly significant with t-statistics of -2.1132 and 2.7124 respectively. This, combined with our earlier time series plots showing the existence of time trends in POUT and EPS, points at evidence of time trending properties in both variables. As such the conclusions from the unit root tests with constant and time trends will be more appropriate than the unit root tests and intercept only. It also means that the cointegration analysis and VECM model should incorporate a time trend.

For the unit root test for trend stationarity i.e. *KPSS(c+t)*, the null hypotheses of trend stationarity are rejected at 1% significance levels for both POUT and EPS in level terms but not in first-differenced terms, thus corroborating the findings of the unit root tests for non-trend stationarity that POUT and EPS are non-trend stationary in levels terms and are integrated of order one. The unit root test for stationarity i.e. KPSS(c) is less conclusive. For POUT, the null hypothesis of stationarity in level terms is rejected at 5% significance level for 5 truncation levels but not rejected for 14 truncation lags. The null hypothesis for the first differenced terms is not rejected at both lag lengths. For EPS, the null hypothesis of stationarity in level terms is rejected at 1% and 5% significance levels respectively for truncation lags of 5 and 14 respectively. The null hypothesis for the first differenced terms is similarly rejected at 5% significance levels at both lag lengths.

The unit root tests results therefore show strong evidence that the payout ratio (POUT) and real earnings (EPS) of the Singapore Straits Times Index are non-trend stationary and are integrated of order one. The unit root tests results generally also reject the hypothesis of level stationarity with integration of order one for both POUT and EPS. Given the significant t-statistics of the coefficients of the time trend in the ADF models as well as our graphical analysis, it is clear that both time series have time trending properties, thus rendering the results of the unit root tests for level stationarity less meaningful.

After confirming that both processes are *I(1)*, we then proceed to perform cointegration tests. Before performing Johansen's trace test and the Saikkonen-Lütkepohl cointegration test, we must first determine the lag lengths to be used based on the four information criteria: Akaike Information Criterion, Hannan-Quinn Criterion, Schwarz Criterion and Final Prediction Error. A maximum lag length of 84 lags is tested and an optimal lag length of 61 lags is universally recommended by the four information criteria.

Table 2 shows the results of the Johansen and Saikkonen-Lütkepohl cointegration tests for a model with intercept and time trend. The use of a model including time trend is supported by our analysis before. Both cointegration tests reject the null hypothesis of no cointegrating relation at 1% significance level while accepting the null hypothesis of one cointegrating relation at 5% significance level.

Having established that cointegration exists between the variables of POUT and EPS, we proceed to estimate a vector error correction model for analysis. While interpretation of the individual coefficients is not within the scope of this paper, the derived VECM is nevertheless shown in Table 3 for interested readers. The VECM is then used to perform particular analyses for investigating the informational effect of dividend payout on future earnings.

We first perform the Granger-causality test to check for the existence of granger-causal relations between the payout ratio and real earnings of the Singapore market. In particular, we have focused on the test of the null hypothesis that POUT does not granger-cause EPS. The results of the test are shown in Table 4. The null hypothesis is strongly rejected, which means the POUT granger-causes EPS i.e. lagged values of POUT provide statically significant information about the future values of EPS. This indicates the existence of an informational/signalling effect in current dividend policy on future earnings.

An impulse response function (IRF) tracing the response of EPS to a one standard deviation innovation in POUT is also derived. Figure 3 shows the impulse response function with the upper and lower limits of the 95% confidence interval. It can be seen that an unanticipated increase in dividend payout leads to a permanent increase in real earnings over time, with the accumulated effect peaking at 46 months. This confirms our earlier finding that changes in dividend policy provide information/signals about future real earnings. The impulse response function also shows that increases in the dividend payout leads to increases in future earnings. These findings are consistent with the dividend signalling theory. We also decompose the forecast error variance (FEV) of the EPS variable to distinguish the proportion of the forecast error variance that is accounted for by unanticipated changes in EPS versus unanticipated changes in POUT. Figure 4 shows the FEV decomposition. It can be seen that innovations in POUT can account for slightly more than half of the forecast error variance of EPS, peaking at 52% 22 months after the innovation.

Our analyses have therefore established that changes in dividend policy provide statistically significant information about future earnings, with unanticipated increases in dividend payout leading to positive and permanent increases in future real earnings. The magnitude of the informational effect is also significant, with the structural errors of dividend payout explaining at least half of the forecast error variance of real earnings. These results support the dividend signalling theory or the information content of dividends hypothesis.

5. Conclusion

This paper applies Johansen's vector error-correction model (VECM) to investigate for the existence of the dividend signalling effect in the Singapore aggregate market through impulse response analysis, forecast error variance decomposition and granger-causality test. Our findings show that:

- An unanticipated increase in the dividend payout, represented by a one standard deviation increase in dividend payout in the impulse response function, leads to a permanent increase in future earnings of the Singapore market over time. This supports the dividend signalling theory that dividend payout possesses informational content about future earnings, and that the two variables are positively correlated.

- The magnitude of the informational content of dividend payout on real future earnings is significant, as shown in our forecast error variance decomposition analysis where we find that at least half of the forecast error variance in earnings can be accounted for by innovations in the dividend payout.
- Lagged values of the dividend payout ratio have statistically significant information about future real earnings, as evidenced by the rejection of the null hypothesis of no granger-causality between payout ratio and real earnings in the Singapore market.

Our analyses have therefore established that changes in dividend policy provide statistically significant information about future earnings, with unanticipated increases in dividend payout leading to positive and permanent increases in future real earnings. The magnitude of the informational effect is also significant, with the structural errors of dividend payout explaining at least half of the forecast error variance of real earnings. These results support the dividend signalling theory or the informational content of dividends hypothesis.

References:

1. Akaike, H. (1969), "Fitting Autoregressive Models for Prediction", Annals of the Institute of Statistical Mathematics
2. Akaike, H. (1971), "Autoregressive Model Fitting for Control", Annals of the Institute of Statistical Mathematics
3. Arnott, R. and Asness, C. (2003), "Surprise! Higher Dividends = Higher Earnings Growth", Financial Analysts Journal
4. Atkins, F.J. (1989), "Co-integration, Error Correction and the Fisher Effect", Applied Economics
5. Ball, R. and Watts, R. (1972), "Some Time-Series Properties of Accounting Income", Journal of Finance
6. Bernartzi, S., Michaely, R. and Thaler, R. (1997), "Do Changes in Dividends Signal the Future or the Past?", Journal of Finance
7. Bhattacharya, S. (1979), "Imperfect Information, Dividend Policy, and "the Bird in the Hand" Fallacy", Bell Journal of Economics
8. Brooks, L.D. and Buckmaster, D. (1976), "Further Evidence of the Time Series Properties of Accounting Income", Journal of Finance
9. Brooks, Y., Charlton, R. and Hendershott, W. (1998), "Do Firms Use Dividends to Signal Large Future Cash Flows?", Financial Management
10. Campbell, J. and Shiller, R. (1988), "Stock Prices, Earnings, and Expected Dividends", Journal of Finance
11. Davidson, R. and MacKinnon, J. (1993), Estimation and Inference in Econometrics, Oxford University Press, London.
12. DeAngelo, H., DeAngelo, L. and Skinner, D. (1992), "Dividends and Losses", Journal of Finance
13. DeAngelo, H., DeAngelo, L. and Skinner, D. (1996), "Reversal of Fortune, Dividend Signaling, and the Disappearance of Sustained Earnings Growth", Journal of Financial Economics

14. DeAngelo, H., DeAngelo, L. and Skinner, D. (2000), “Special Dividends and the Evolution of Dividend Signaling”, Journal of Financial Economics

15. DeAngelo, H., DeAngelo, L. and Skinner, D. (2003), “Are Dividends Disappearing? Dividend Concentration and the Consolidation of Earnings”, Journal of Financial Economics.

16. Dickey, D. A. and Fuller, W. A. (1979), “Estimators for Autoregressive Time Series With a Unit Root”, Journal of the American Statistical Association

17. Dickey, D.A. and Fuller, W.A. (1979), “Distribution of the Estimators for Autoregressive Times Series With a Unit Root”, Journal of the American Statistical Association

18. Dickey, D.A. and Fuller, W.A. (1981), “Likelihood Ratio Statistics for Autoregressive Time Series With a Unit Root”, Econometrica

19. Doornik, J. A. (1998), “Approximations to the Asymptotic Distributions of Cointegration Tests”, Journal of Economic Surveys

20. Engle, R.F. and C.W.J. Granger (1987). “Cointegration and Error Correction: Representation, Estimation, and Testing”, Econometrica

21. Fama, E.F. and Babiak, H. (1968), “Dividend Policy: An Empirical Analysis”, Journal of the American Statistical Association

22. Foster, G. (1978), Financial Statement Analysis, Prentice-Hall, Englewood Cliffs, NJ.

23. Fuller, W. A. (1976), Introduction to Statistical Time Series, John Wiley & Sons, New York.

24. Fuller, W.A. (1996), Introduction to Statistical Time Series, John Wiley, New York

25. Gonedes, N. (1978), “Corporate Signaling, External Accounting, and Capital Market Equilibrium: Evidence on Dividends, Income, and Extraordinary Items”, Journal of Accounting Research

26. Granger, C.W.J. (1969). “Investigating Causal Relation By Econometric and Cross-sectional Method”, Econometrica

27. Gwilym, O., Seaton, J., Suddason, K. and Thomas, S. (2006), “International Evidence on the Payout Ratio, Earnings, Dividends, and Returns”, Financial Analysts Journal

28. Hannan, E. J. and Quinn, B. G. (1979), “The Determination of the Order of an Autoregression”,

Journal of the Royal Statistical Society

29. Healy, P. and Palepu, K. (1988), "Earnings Information Conveyed by Dividend Initiations and Omissions", Journal of Financial Economics
30. Johansen, S. (1988), "Statistical Analysis of Cointegration Vectors", Journal of Economic Dynamics and Control
31. Johansen, S. and Juselius, K., (1990), "Maximum Likelihood Estimation and Inference on Cointegration - With Applications to the Demand for Money', Oxford Bulletin of Economics and Statistics
32. John, K. and Williams, J. (1985), "Dividends, Dilution, and Taxes: A Signalling Equilibrium", Journal of Finance
33. Kalay, A. (1980), "Signaling, Information Content, and the Reluctance to Cut Dividends", Journal of Financial and Quantitative Analysis
34. Kao, C. and Wu, C. (1994), "Rational Expectations, Information Signalling and Dividend Adjustment to Permanent Earnings", Review of Economics and Statistics
35. Kwiatkowski, D., Phillips, P.C.B., Schmidt, P. and Shin, Y. (1992), "Testing the Null of Stationarity Against the Alternative of a Unit Root", Journal of Econometrics
36. Lanne, M., Lütkepohl, H. and Saikkonen, P. (2001), "Test Procedures for Unit Roots in Time Series With Level Shifts At Unknown Time", Discussion paper, Humboldt-Universität Berlin.
37. Lanne, M., Lütkepohl, H. and Saikkonen, P. (2002), "Comparison of Unit Root Tests for Time Series With Level Shifts", Journal of Time Series Analysis
38. Lintner, J. (1956), "Distribution of Incomes of Corporations Among Dividends, Retained Earnings, and Taxes", American Economic Review
39. Lütkepohl, H. (1991), Introduction to Multiple Time Series Analysis, Springer Verlag, Berlin.
40. Lütkepohl, H., Saikkonen, P. and Trenkler, C. (2001), "Maximum Eigenvalue versus Trace Tests for the Cointegrating Rank of a VAR Process", Econometric Journal
41. MacKinnon, J.G., (1991), "Critical values for cointegration tests" in R.F. Engle and C.W.J Granger

(eds), Long Run Economic Relationships, Oxford University Press, pp. 267-276.

42. Miller, M. and Modigliani, F. (1961), "Dividend Policy, Growth, and the Valuation of Shares", Journal of Business
43. Miller, M. and Rock, K. (1985), "Dividend Policy Under Asymmetric Information", Journal of Finance
44. Newey, W.K. and K.D. West (1987), "A Simple Positive Definite Heteroskedasticity and Autocorrelation Consistent Covariance Matrix", Econometrica
45. Nissim, D. and Ziv, A. (2001), "Dividend Changes and Future Profitability", Journal of Finance
46. Penman, S. (1983), "The Predictive Content of Earnings Forecasts and Dividends", Journal of Finance
47. Phillips, P.C.B. and Perron, P. (1988), "Testing For a Unit Root in Time Series Regression", Biometrika
48. Quinn, B. G. (1980), "Order Determination for a Multivariate Autoregression", Journal of the Royal Statistical Society
49. Saikkonen, P. and Lütkepohl, H. (2000a), "Testing for the Cointegrating Rank of a VAR Process With an Intercept", Econometric Theory
50. Saikkonen, P. and Lütkepohl, H. (2000b), "Testing for the Cointegrating Rank of a VAR Process With Structural Shifts", Journal of Business & Economic Statistics
51. Saikkonen, P. and Lütkepohl, H. (2000c), "Trend Adjustment Prior to Testing for the Cointegrating Rank of a Vector Autoregressive Process", Journal of Time Series Analysis
52. Saikkonen, P. and Lütkepohl, H. (2002), "Testing For a Unit Root in a Time Series With a Level Shift at Unknown Time", Econometric Theory
53. Schmidt, P. and Phillips, P. C. B. (1992), "LM Tests for a Unit Root in the Presence of Deterministic Trends", Oxford Bulletin of Economics and Statistics
54. Schwarz, G. (1978), "Estimating the Dimension of a Model", Annals of Statistics
55. Sims, C. (1980), "Macroeconomics and Reality," Econometrica
56. Zhou, P. and Ruland, W. (2006), "Dividend Payout and Future Earnings Growth", Financial Analysts

Figure 1: Time Series Plot of Payout Ratio of Singapore Straits Times Index

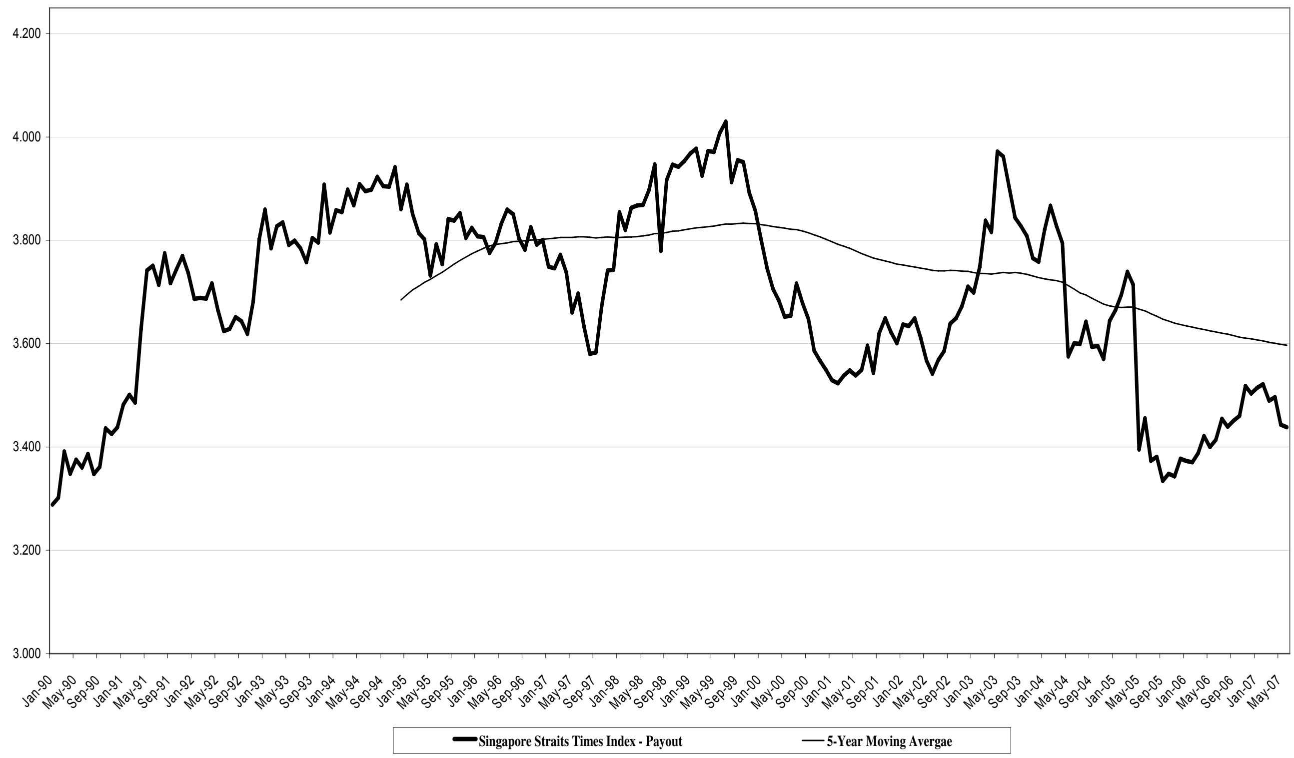

Figure 2: Time Series Plot of Earnings Singapore Straits Times Index

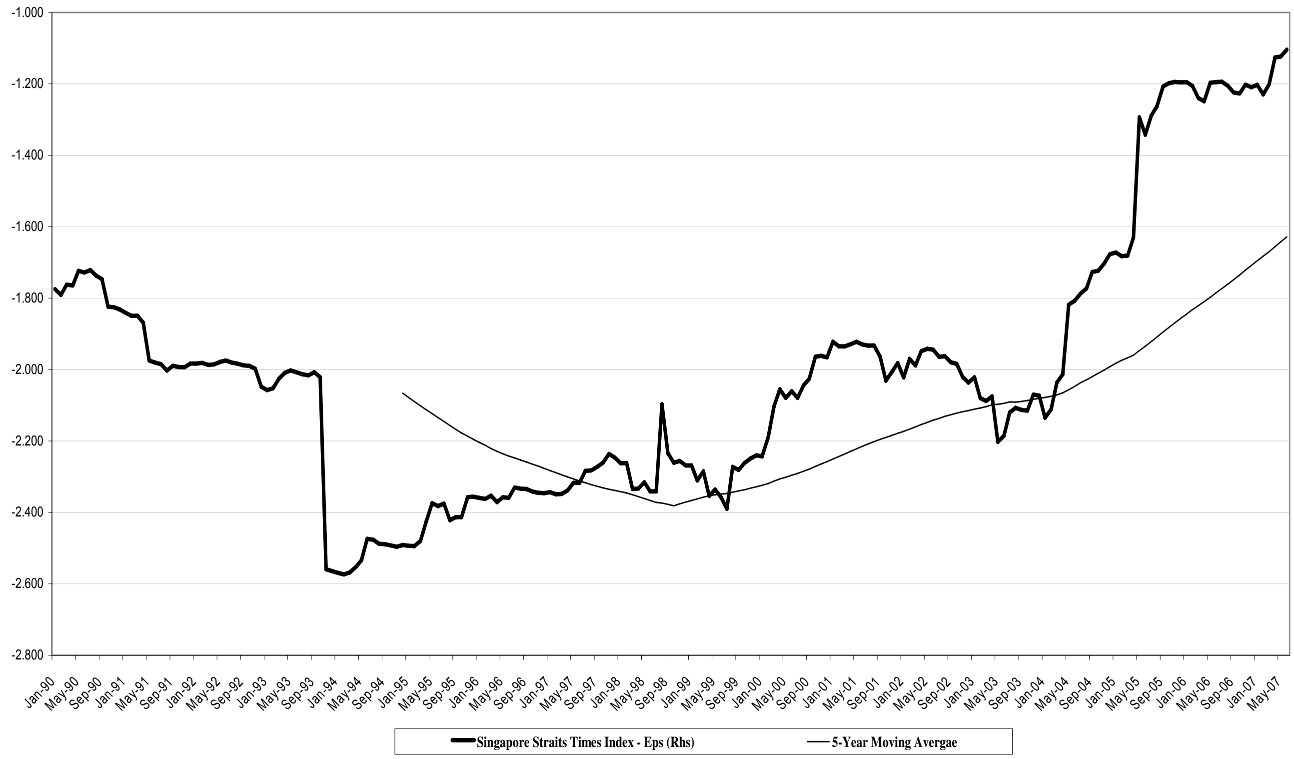

Table 1: Unit Root Test

			Lags	*Variables in Levels*		*Variables in First Difference*	
				POUT	EPS	ΔPOUT	ΔEPS
Augmented Dickey-Fuller							
H_0: Unit Root	H_1: Level Stationary	*ADF(c)*	0	-2.58	0.11	-16.06***	-14.52***
H_0: Unit Root with Drift	H_1: Trend Stationary	*ADF(c+t)*	0	-2.99	-1.29	-16.22***	-14.90***
Phillips-Perron							
H_0: Unit Root	H_1: Level Stationary	*PP(c)*	5	-11.50	0.02	-244.44***	-222.56***
			14	-12.37*	-0.41	-244.39***	-241.96***
H_0: Unit Root with Drift	H_1: Trend Stationary	*PP(c+t)*	5	-12.94	-3.37	-243.36***	-218.68***
			14	-12.47	-3.29	-232.47***	-212.25***
Schmidt-Phillips							
H_0: Unit Root	H_1: Stationary Process	*SP: Z(Rho)*	5	-8.50	-3.93	-266.60***	-223.73***
			14	-9.37	-4.69	-262.05***	-208.52***
H_0: Unit Root	H_1: Stationary Process	*SP: Z(Tau)*	5	-2.07	-1.39	-17.32***	-15.24***
			14	-2.17	-1.51	-17.17***	-14.72***
Kwaitowski, Phillips, Schmidt and Shin							
H_0: Level Stationary	H_1: Unit Root	*KPSS(c)*	5	0.66**	1.51***	0.28	0.56**
			14	0.32	0.66**	0.28	0.49**
H_0: Trend Stationary	H_1: Unit Root with Drift	*KPSS(c+t)*	5	0.44***	0.69***	0.05	0.03
			14	0.22***	0.31***	0.05	0.04

*Notes: All variables in logarithms. Period: Jan 1990 – Jun 2007. Significance levels: *** = 1%, ** = 5%, * = 10%. ADF-Tests: Critical values provided by JMulti and EasyReg. Lag lengths for ADF test according to the Akaike Information Criterion, Hannan-Quinn Criterion, Schwarz Criterion and Final Prediction Error. Truncation lags (l) to evaluate the serial correlation for the Newey-West correction for PP, SP and KPSS test is computed by l = q(T/100)^0.25 where q = 4 or 12.*

Table 2: Cointegration Analysis of Dividend Payout and Earnings for Singapore Straits Times Index

		Intercept With Time Trend		
Test for the cointegration rank				
H_0	***H_1***	**Test statistic**	**Critical Values**	
			1%	*5%*
Johansen's Cointegration Trace Test				
r = 0	r ≥ 1	76.95	30.67	25.73
r ≤ 1	r ≥ 2	11.32	16.22	12.45
Saikkonen & Lütkepohl Cointegration Test				
r = 0	r ≥ 1	44.41	19.71	15.76
r ≤ 1	r ≥ 2	0.65	9.73	6.79
Number of cointegrating relations:		*1*		
Choice of rank of Var(p):		*61*		

Notes: r is the number of cointegrating relations. The rank of Var(p) is chosen based on Akaike Information Criterion, Hannan-Quinn Criterion, Schwarz Criterion and Final Prediction Error.

Table 3: Vector Error Correction Matrix (VECM)

$$\begin{bmatrix} \Delta EPS_t \\ \Delta Payout_t \end{bmatrix} = \begin{bmatrix} 0.94 \\ -1.42 \end{bmatrix} \begin{bmatrix} 1.00 & 4.16 \end{bmatrix} \begin{bmatrix} EPS_{t-1} \\ Payout_{t-1} \end{bmatrix} + \begin{bmatrix} -1.32 & -3.68 \\ 1.90 & 5.68 \end{bmatrix} \begin{bmatrix} \Delta EPS_{t-1} \\ \Delta Payout_{t-1} \end{bmatrix} + \begin{bmatrix} -0.82 & -3.46 \\ 1.22 & 5.23 \end{bmatrix} \begin{bmatrix} \Delta EPS_{t-2} \\ \Delta Payout_{t-2} \end{bmatrix}$$

$$+ \begin{bmatrix} -0.29 & -2.95 \\ 0.76 & 4.46 \end{bmatrix} \begin{bmatrix} \Delta EPS_{t-3} \\ \Delta Payout_{t-3} \end{bmatrix} + \begin{bmatrix} -0.34 & -2.87 \\ 0.66 & 4.64 \end{bmatrix} \begin{bmatrix} \Delta EPS_{t-4} \\ \Delta Payout_{t-4} \end{bmatrix} + \begin{bmatrix} -0.70 & -3.00 \\ 0.94 & 4.44 \end{bmatrix} \begin{bmatrix} \Delta EPSg_{t-5} \\ \Delta Payout_{t-5} \end{bmatrix}$$

$$+ \begin{bmatrix} -0.73 & -0.27 \\ 0.90 & 4.14 \end{bmatrix} \begin{bmatrix} \Delta EPS_{t-6} \\ \Delta Payout_{t-6} \end{bmatrix} + \begin{bmatrix} -0.73 & -2.84 \\ 1.18 & 4.34 \end{bmatrix} \begin{bmatrix} \Delta EPS_{t-7} \\ \Delta Payout_{t-7} \end{bmatrix} + \begin{bmatrix} -1.16 & -3.33 \\ 1.34 & 4.47 \end{bmatrix} \begin{bmatrix} \Delta EPS_{t-8} \\ \Delta Payout_{t-8} \end{bmatrix}$$

$$+ \begin{bmatrix} -0.73 & -2.67 \\ 1.41 & 4.39 \end{bmatrix} \begin{bmatrix} \Delta EPS_{t-9} \\ \Delta Payout_{t-9} \end{bmatrix} + \begin{bmatrix} -0.95 & -2.67 \\ 1.37 & 4.16 \end{bmatrix} \begin{bmatrix} \Delta EPS_{t-10} \\ \Delta Payout_{t-10} \end{bmatrix} + \begin{bmatrix} -1.29 & -2.89 \\ 1.88 & 4.32 \end{bmatrix} \begin{bmatrix} \Delta EPS_{t-11} \\ \Delta Payout_{t-11} \end{bmatrix}$$

$$+ \begin{bmatrix} -1.30 & -2.92 \\ 1.66 & 4.30 \end{bmatrix} \begin{bmatrix} \Delta EPS_{t-12} \\ \Delta Payout_{t-12} \end{bmatrix} + \begin{bmatrix} -1.31 & -2.95 \\ 2.20 & 4.54 \end{bmatrix} \begin{bmatrix} \Delta EPS_{t-13} \\ \Delta Payout_{t-13} \end{bmatrix} + \begin{bmatrix} -0.96 & -2.65 \\ 1.55 & 3.98 \end{bmatrix} \begin{bmatrix} \Delta EPS_{t-14} \\ \Delta Payout_{t-14} \end{bmatrix}$$

$$+ \begin{bmatrix} -1.01 & -2.50 \\ 1.67 & 4.10 \end{bmatrix} \begin{bmatrix} \Delta EPS_{t-15} \\ \Delta Payout_{t-15} \end{bmatrix} + \begin{bmatrix} -1.03 & -2.37 \\ 1.56 & 3.69 \end{bmatrix} \begin{bmatrix} \Delta EPS_{t-16} \\ \Delta Payout_{t-16} \end{bmatrix} + \begin{bmatrix} -1.54 & -2.88 \\ 1.94 & 4.08 \end{bmatrix} \begin{bmatrix} \Delta EPS_{t-17} \\ \Delta Payout_{t-17} \end{bmatrix}$$

$$+ \begin{bmatrix} -1.32 & -2.68 \\ 1.99 & 4.14 \end{bmatrix} \begin{bmatrix} \Delta EPS_{t-18} \\ \Delta Payout_{t-18} \end{bmatrix} + \begin{bmatrix} -0.98 & -2.31 \\ 1.53 & 3.61 \end{bmatrix} \begin{bmatrix} \Delta EPS_{t-19} \\ \Delta Payout_{t-19} \end{bmatrix} + \begin{bmatrix} -0.88 & -2.17 \\ 1.48 & 3.57 \end{bmatrix} \begin{bmatrix} \Delta EPS_{t-20} \\ \Delta Payout_{t-20} \end{bmatrix}$$

$$+ \begin{bmatrix} -0.72 & -2.02 \\ 1.23 & 3.24 \end{bmatrix} \begin{bmatrix} \Delta EPS_{t-21} \\ \Delta Payout_{t-21} \end{bmatrix} + \begin{bmatrix} -0.93 & -2.37 \\ 1.14 & 3.34 \end{bmatrix} \begin{bmatrix} \Delta EPS_{t-22} \\ \Delta Payout_{t-22} \end{bmatrix} + \begin{bmatrix} -1.00 & -2.38 \\ 1.48 & 3.57 \end{bmatrix} \begin{bmatrix} \Delta EPS_{t-23} \\ \Delta Payout_{t-23} \end{bmatrix}$$

$$+ \begin{bmatrix} -1.02 & -2.25 \\ 1.26 & 3.30 \end{bmatrix} \begin{bmatrix} \Delta EPS_{t-24} \\ \Delta Payout_{t-24} \end{bmatrix} + \begin{bmatrix} -0.95 & -2.20 \\ 1.34 & 3.36 \end{bmatrix} \begin{bmatrix} \Delta EPS_{t-25} \\ \Delta Payout_{t-25} \end{bmatrix} + \begin{bmatrix} -0.48 & -1.55 \\ 1.03 & 2.74 \end{bmatrix} \begin{bmatrix} \Delta EPS_{t-26} \\ \Delta Payout_{t-26} \end{bmatrix}$$

$$+ \begin{bmatrix} -0.38 & -1.65 \\ 0.61 & 2.52 \end{bmatrix} \begin{bmatrix} \Delta EPS_{t-27} \\ \Delta Payout_{t-27} \end{bmatrix} + \begin{bmatrix} -0.55 & -1.83 \\ 0.81 & 2.75 \end{bmatrix} \begin{bmatrix} \Delta EPS_{t-28} \\ \Delta Payout_{t-28} \end{bmatrix} + \begin{bmatrix} -0.95 & -1.70 \\ 1.10 & 2.49 \end{bmatrix} \begin{bmatrix} \Delta EPSg_{t-29} \\ \Delta Payout_{t-29} \end{bmatrix}$$

$$+ \begin{bmatrix} -0.69 & -1.58 \\ 0.87 & 2.31 \end{bmatrix} \begin{bmatrix} \Delta EPS_{t-30} \\ \Delta Payout_{t-30} \end{bmatrix} + \begin{bmatrix} -0.57 & -1.37 \\ 0.96 & 2.26 \end{bmatrix} \begin{bmatrix} \Delta EPS_{t-31} \\ \Delta Payout_{t-31} \end{bmatrix} + \begin{bmatrix} -0.52 & -1.07 \\ 0.75 & 1.56 \end{bmatrix} \begin{bmatrix} \Delta EPS_{t-32} \\ \Delta Payout_{t-32} \end{bmatrix}$$

$$+ \begin{bmatrix} -0.56 & -1.20 \\ 0.88 & 1.93 \end{bmatrix} \begin{bmatrix} \Delta EPS_{t-33} \\ \Delta Payout_{t-33} \end{bmatrix} + \begin{bmatrix} -0.44 & -0.98 \\ 0.83 & 1.63 \end{bmatrix} \begin{bmatrix} \Delta EPS_{t-34} \\ \Delta Payout_{t-34} \end{bmatrix} + \begin{bmatrix} -0.54 & -0.96 \\ 0.55 & 1.20 \end{bmatrix} \begin{bmatrix} \Delta EPS_{t-35} \\ \Delta Payout_{t-35} \end{bmatrix}$$

$$+\begin{bmatrix} -0.63 & -0.81 \\ 1.02 & 1.57 \end{bmatrix}\begin{bmatrix} \Delta EPS_{t-36} \\ \Delta Payout_{t-36} \end{bmatrix} + \begin{bmatrix} -0.68 & -0.97 \\ 0.97 & 1.12 \end{bmatrix}\begin{bmatrix} \Delta EPS_{t-37} \\ \Delta Payout_{t-37} \end{bmatrix} + \begin{bmatrix} -0.31 & -0.61 \\ 0.64 & 1.09 \end{bmatrix}\begin{bmatrix} \Delta EPS_{t-38} \\ \Delta Payout_{t-38} \end{bmatrix}$$

$$+\begin{bmatrix} -0.50 & -0.58 \\ 0.74 & 0.97 \end{bmatrix}\begin{bmatrix} \Delta EPS_{t-39} \\ \Delta Payout_{t-39} \end{bmatrix} + \begin{bmatrix} -0.54 & -0.57 \\ 0.76 & 0.73 \end{bmatrix}\begin{bmatrix} \Delta EPS_{t-40} \\ \Delta Payout_{t-40} \end{bmatrix} + \begin{bmatrix} -0.53 & -0.52 \\ 0.71 & 0.91 \end{bmatrix}\begin{bmatrix} \Delta EPS_{t-41} \\ \Delta Payout_{t-41} \end{bmatrix}$$

$$+\begin{bmatrix} -0.51 & -0.46 \\ 0.89 & 0.78 \end{bmatrix}\begin{bmatrix} \Delta EPS_{t-42} \\ \Delta Payout_{t-42} \end{bmatrix} + \begin{bmatrix} -0.62 & -0.42 \\ 0.68 & 0.39 \end{bmatrix}\begin{bmatrix} \Delta EPS_{t-43} \\ \Delta Payout_{t-43} \end{bmatrix} + \begin{bmatrix} -0.61 & -0.41 \\ 0.98 & 0.88 \end{bmatrix}\begin{bmatrix} \Delta EPS_{t-44} \\ \Delta Payout_{t-44} \end{bmatrix}$$

$$+\begin{bmatrix} -0.45 & -0.45 \\ 0.98 & 0.79 \end{bmatrix}\begin{bmatrix} \Delta EPS_{t-45} \\ \Delta Payout_{t-45} \end{bmatrix} + \begin{bmatrix} -0.27 & 0.05 \\ 0.36 & 0.09 \end{bmatrix}\begin{bmatrix} \Delta EPS_{t-46} \\ \Delta Payout_{t-46} \end{bmatrix} + \begin{bmatrix} -0.73 & -0.37 \\ 0.82 & 0.58 \end{bmatrix}\begin{bmatrix} \Delta EPS_{t-47} \\ \Delta Payout_{t-47} \end{bmatrix}$$

$$+\begin{bmatrix} -0.95 & -0.95 \\ 1.13 & 1.03 \end{bmatrix}\begin{bmatrix} \Delta EPS_{t-48} \\ \Delta Payout_{t-48} \end{bmatrix} + \begin{bmatrix} -0.76 & -0.63 \\ 0.83 & 0.74 \end{bmatrix}\begin{bmatrix} \Delta EPS_{t-49} \\ \Delta Payout_{t-49} \end{bmatrix} + \begin{bmatrix} -0.19 & -0.10 \\ 0.66 & 0.61 \end{bmatrix}\begin{bmatrix} \Delta EPS_{t-50} \\ \Delta Payout_{t-50} \end{bmatrix}$$

$$+\begin{bmatrix} -0.32 & -0.11 \\ 0.45 & 0.21 \end{bmatrix}\begin{bmatrix} \Delta EPS_{t-51} \\ \Delta Payout_{t-51} \end{bmatrix} + \begin{bmatrix} -0.34 & -0.12 \\ 0.56 & 0.25 \end{bmatrix}\begin{bmatrix} \Delta EPS_{t-52} \\ \Delta Payout_{t-52} \end{bmatrix} + \begin{bmatrix} -0.20 & -0.06 \\ 0.34 & 0.06 \end{bmatrix}\begin{bmatrix} \Delta EPS_{t-53} \\ \Delta Payout_{t-53} \end{bmatrix}$$

$$+\begin{bmatrix} -0.58 & -0.49 \\ 0.55 & 0.22 \end{bmatrix}\begin{bmatrix} \Delta EPS_{t-54} \\ \Delta Payout_{t-54} \end{bmatrix} + \begin{bmatrix} -0.38 & -0.41 \\ 0.58 & 0.47 \end{bmatrix}\begin{bmatrix} \Delta EPS_{t-55} \\ \Delta Payout_{t-55} \end{bmatrix} + \begin{bmatrix} -0.14 & -0.02 \\ 0.24 & 0.18 \end{bmatrix}\begin{bmatrix} \Delta EPS_{t-56} \\ \Delta Payout_{t-56} \end{bmatrix}$$

$$+\begin{bmatrix} -0.49 & 0.20 \\ 0.47 & -0.14 \end{bmatrix}\begin{bmatrix} \Delta EPS_{t-57} \\ \Delta Payout_{t-57} \end{bmatrix} + \begin{bmatrix} -0.20 & 0.55 \\ 0.29 & -0.48 \end{bmatrix}\begin{bmatrix} \Delta EPS_{t-58} \\ \Delta Payout_{t-58} \end{bmatrix} + \begin{bmatrix} -0.15 & -0.10 \\ 0.16 & -0.26 \end{bmatrix}\begin{bmatrix} \Delta EPS_{t-59} \\ \Delta Payout_{t-59} \end{bmatrix}$$

$$+\begin{bmatrix} -0.17 & -0.36 \\ 0.27 & 0.16 \end{bmatrix}\begin{bmatrix} \Delta EPS_{t-60} \\ \Delta Payout_{t-60} \end{bmatrix} + \begin{bmatrix} -13.24 & 0.01 \\ 20.02 & -0.01 \end{bmatrix}\begin{bmatrix} CONST \\ TREND(t) \end{bmatrix} + \begin{bmatrix} u1_t \\ u2_t \end{bmatrix}$$

Table 4: Granger-Causality Analysis of Dividend Payout and Earnings for Singapore Straits Times Index

	Test statistic	*pval-F(1,61,44)*
With Intercept and Time Trend		
H_0: POUT Does Not Granger-cause EPS	7.54	0.00
H_1: POUT Granger-causes EPS		

Figure 3: Impulse Response Function of EPS to a Unit Shock in POUT for Singapore Straits Times Index (with 95% Confidence Interval)

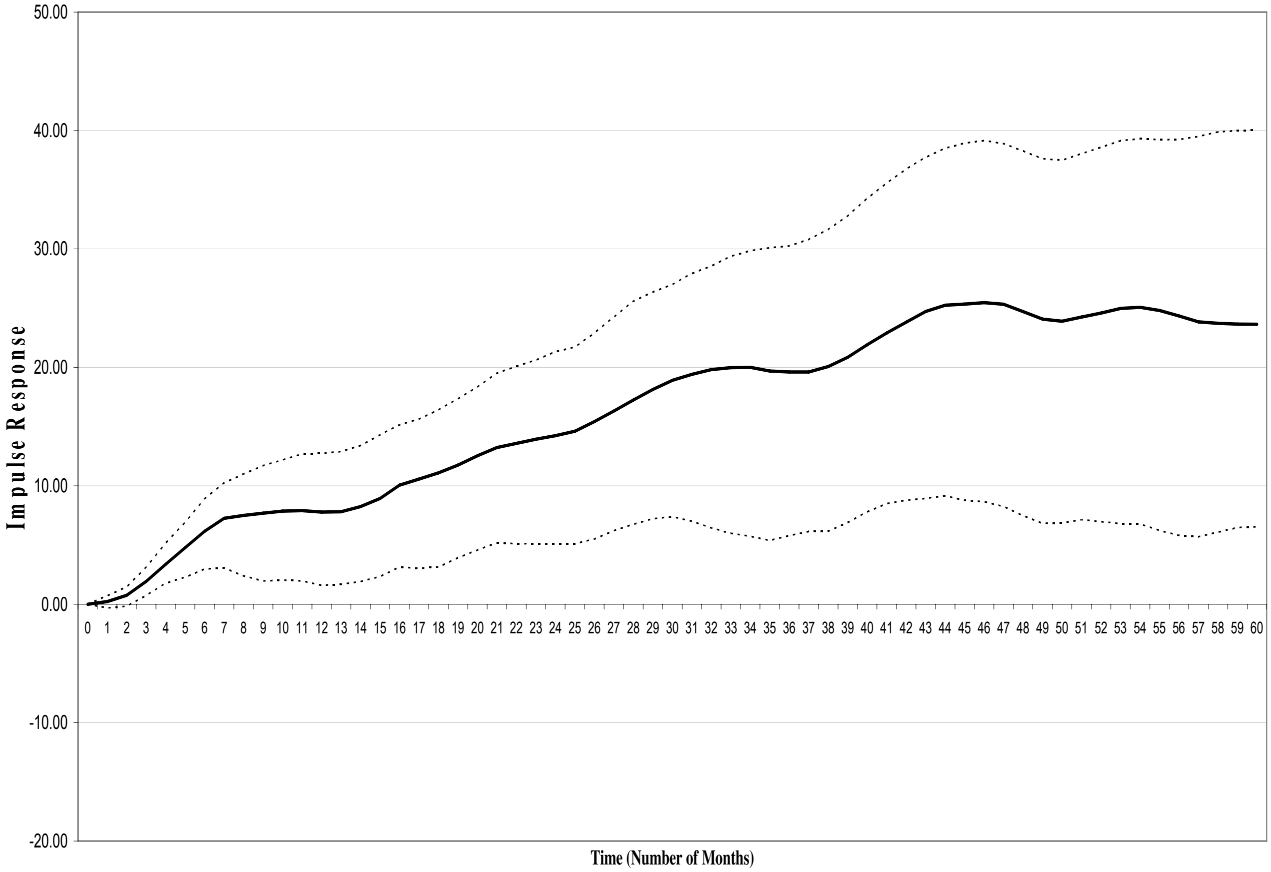

Figure 4: VECM Forecast Error Variance Decomposition of EPS of Singapore Straits Times Index