Relationship between Macroeconomic Variables and Stock Market Indices: Cointegration Evidence from Stock Exchange of Singapore's All-S Sector Indices

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ABSTRACT

The relationship between macroeconomic variables and stock market returns is, by now, well-documented in the literature. However, a void in the literature relates to examining the cointegration between macroeconomic variables and stock market's sector indices *rather than the composite index. Thus in this paper we examine the long-term equilibrium relationships between selected macroeconomic variables and the Singapore stock market index (STI), as well as with various Singapore Exchange Sector indices—the finance index, the property index, and the hotel index. The study concludes that the Singapore's stock market and the property index form cointegrating relationship with changes in the short and long-term interest rates, industrial production, price levels, exchange rate and money supply. Implications of the study and suggestions for future research are provided.*

ABSTRAK

Hubungan antara pembolehubah makroekonomi dengan pulangan pasaran saham, sehingga kini, sudah banyak dihasilkan dalam karya lepas. Bagaimanapun, masih terdapat kekosongan dalam literatur ini mengenai hubungan kointegrasi antara pembolehubah ekonomi makro dengan indeks *sektoral dalam pasaran saham berbanding kajian berkatian dengan indeks komposit. Justeru itu, dalam kertas ini, kami mengkaji hubungan keseimbangan jangka panjang antara beberapa pembolehubah ekonomi makro yang terpilih, dengan indeks pasaran saham Singapura (STI) serta beberapa indeks sektoral – indeks kewangan, indeks hartanah, dan indeks perhotelan. Kajian ini mendapati bahawa pasaran saham Singapura dan indeks hartanah menunjukkan hubungan kointegrasi dengan perubahan kadar bunga jangka pendek dan jangka panjang juga dengan pengeluaran industri, paras harga, kadar tukaran mata wang dan penawaran wang. Implikasi kajian dan cadangan kajian untuk masa depan dikemukakan.*

INTRODUCTION

An efficient capital market is one in which security prices adjust rapidly to the arrival of new information and, therefore, the current prices of securities reflect all information about the security. What this means, in simple terms, is that no investor should be able to employ *readily available information* in order to predict stock price movements quickly enough so as to make a profit through trading shares.

Championed by Fama (1970), the efficient market hypothesis (EMH), in particular semi-strong form efficiency, which states that stock prices must contain all relevant information including publicly available information, has important implications for policy-makers and the stock-broking industry alike.

Policy makers, for example, should feel free to conduct national macroeconomic policies without the fear of influencing capital formation and the stock trade process. Moreover, economic theory suggests that stock prices should reflect expectations about future corporate performance, and corporate profits generally reflect the level of economic activities. If stock prices accurately reflect the underlying fundamentals, then the stock prices should be employed as leading indicators of future economic activities, and not the other way around. Therefore, the causal relations and dynamic interactions among macroeconomic variables and stock prices are important in the formulation of the nation's macroeconomic policy.

As for the effect of macroeconomic variables such as money supply and interest rate on stock prices, the efficient market hypothesis suggests that competition among the profit-maximizing investors in an efficient market will ensure that all the relevant information currently known about changes in macroeconomic variables are fully reflected in current stock prices, so that investors will not be able to earn abnormal profit through prediction of the future stock market movements (Chong and Koh 2003).

Therefore, since investment advisors would not be able to help investors earn above-average returns consistently, except through access to and employing insider information, a practice generally prohibited and punishable by law, there should be no stock broking industry, if one were to believe the conclusions of the EMH.

In direct contradiction to the conclusions drawn by the EMH, evidence that key macroeconomic variables help predict the time series of stock returns has accumulated for nearly 30 years. The assault on the conclusions drawn from the EMH includes early studies by Fama and Schwert (1977), Nelson (1977), and Jaffe and Mandelker (1976), all affirming that macroeconomic variables influence stock returns.

Concentrating primarily on the US stock exchanges, such early studies attempted to capture the effects of economic forces in a theoretical framework

based on the Arbitrage Pricing Theory (APT) developed by Ross (1976). The APT essentially seeks to measure the risk premia attached to various factors that influence the returns on assets, whether they are significant, and whether they are "priced" into stock market returns. Accordingly, Chen, Roll and Ross (1986), having first illustrated that economic forces affect discount rates, the ability of firms to generate cash flows, and future dividend payouts, provided the basis for the belief that a long-term equilibrium existed between stock prices and macroeconomic variables.

More recently, Granger (1986) and Johansen and Juselius (1990) proposed to determine the existence of long-term equilibrium among selected variables through cointegration analysis, paving the way for a (by now) preferred approach to examining the economic variables-stock markets relationship. A set of time-series variables are cointegrated if they are integrated of the same order and a linear combination of them is stationary. Such linear combinations would then point to the existence of a *long-term relationship* between the variables. An advantage of cointegration analysis is that through building an error-correction model (ECM), the dynamic co-movement among variables and the adjustment process toward long-term equilibrium can be examined.

Employing this methodology, there has been a growing literature showing strong influence of macroeconomic variables and stock markets, mostly for industrialized countries (see, for example, Hondroyiannis and Papapetrou, 2001; Muradoglu et al. 2001; Fifield et al. 2000; Lovatt and Ashok 2000; and Nasseh and Strauss 2000). Additionally, researchers have begun to turn their attention to examining similar relationships in developing countries, particularly those in the growth engines of Asia (for example, Maysami and Sims 2002, Maysami and Koh 2000).

The majority, if not all, of such studies have examined the influence of the macroeconomic variables on the composite stock indices of the markets under study. A void in the literature, thus, relates to examining the cointegration between macroeconomic variables and stock market's *sector indices* rather than the composite index. This paper aims to complement the literature in this area.

Applying Johansen's (1990) VECM, the study examines the long-term equilibrium relationships between selected macroeconomic variables and (1) the Stock Exchange of Singapore (SES) All-S Equities Finance Index, (2) the SES All-S Equities Property Index, and (3) the SES All-S Equities Hotel Index. Additionally, the study extends Maysami and Koh's (2000) enquiry of the cointegrating relationship between macroeconomic variables and the SES All-S Equities Index, by incorporating the effects of market volatility during the seven-year period between February 1995 and December 2001.

The paper begins with a thorough introduction to the literature and establishes the theoretical and empirical justification for modeling the stock

market and sector indices using macroeconomic variables. The Johansen's (1990) vector error correction model (VECM) and its estimation procedures are discussed next, along with an explanation of macroeconomic variables employed in the study. The last section will report and discusses the results.

LITERATURE REVIEW

Emerging stock markets have been identified as being at least partially segmented from global capital markets. As a consequence, it has been argued that local risk factors rather than world risk factors are the primary source of equity return variation in these markets. Accordingly, Bilson, Brailsford, and Hooper (1999) aimed to address the question of whether macroeconomic variables may proxy for local risk sources. They found moderate evidence to support this hypothesis.

Further, they investigated the degree of commonality in exposures across emerging stock market returns using a principal components approach, and found little evidence of commonality when emerging markets are considered collectively. At the regional level, however, considerable commonality was shown to exist.

Maysami and Sims (2002, 2001a, 2001b) employed the Error-Correction Modelling technique to examine the relationship between macroeconomic variables and stock returns in Hong Kong and Singapore (Maysami and Sim, 2002b), Malaysia and Thailand (Maysami and Sim 2001a), and Japan and Korea (Maysami and Sim 2001b).

Through the employment of Hendry's (1986) approach which allows making inferences to the short-run relationship between macroeconomic variables as well as the long-run adjustment to equilibrium, they analysed the influence of interest rate, inflation, money supply, exchange rate and real activity, along with a dummy variable to capture the impact of the 1997 Asian financial crisis. The results confirmed the influence of macroeconomic variables on the stock market indices in each of the six countries under study, though the type and magnitude of the associations differed depending on the country's financial structure.

Islam (2003) replicated the above studies to examine the short-run dynamic adjustment and the long-run equilibrium relationships between four macroeconomic variables (interest rate, inflation rate, exchange rate, and the industrial productivity) and the Kuala Lumpur Stock Exchange (KLSE) Composite Index. His conclusions were similar: there existed statistically significant short-run (dynamic) and long-run (equilibrium) relationships among the macroeconomic variables and the KLSE stock returns.

Ibrahim (1999) also investigated the dynamic interactions between the KLSE Composite Index, and seven macroeconomic variables (industrial production index, money supply M1 and M2, consumer price index, foreign

reserves, credit aggregates and exchange rate). Observing that macroeconomic variables led the Malaysian stock indices, he concluded that Malaysian stock market was informationally inefficient.

Chong and Koh's (2003) results were similar: they showed that stock prices, economic activities, real interest rates and real money balances in Malaysia were linked in the long run both in the pre- and post capital control sub periods.

Mukherjee and Naka (1995) applied Johansen's (1998) VECM to analyze the relationship between the Japanese Stock Market and exchange rate, inflation, money supply, real economic activity, long-term government bond rate, and call money rate. They concluded that a cointegrating relation indeed existed and that stock prices contributed to this relation. Maysami and Koh (2000) examined such relationships in Singapore. They found that inflation, money supply growth, changes in short- and long-term interest rate and variations in exchange rate formed a cointegrating relation with changes in Singapore's stock market levels.

Islam and Watanapalachaikul (2003) showed a strong, significant long-run relationship between stock prices and macroeconomic factors (interest rate, bonds price, foreign exchange rate, price-earning ratio, market capitalization, and consumer price index) during 1992-2001 in Thailand.

Hassan (2003) employed Johansen's (1988, 1991, 1992b) and Johansen and Juselius' (1990) multivariate cointegration techniques to test for the existence of long-term relationships between share prices in the Persian Gulf region. Using a vector-error-correction model, he also investigated the short-term dynamics of prices by testing for the existence and direction of intertemporal Granger-causality.

The analysis of weekly price indices in Kuwait, Bahrain, and Oman stock markets showed that: (1) share prices were cointegrated with one cointegrating vector and two common stochastic trends driving the series, which indicates the existence of a stable, long-term equilibrium relationship between them; and (2) prices were not affected by short-term changes but were moving along the trend values of each other. Therefore, information on the price levels would be helpful for predicting their changes.

Omran (2003) focused on examining the impact of real interest rates as a key factor in the performance of the Egyptian stock market, both in terms of market activity and liquidity. The cointegration analysis through error correction mechanisms (ECM) indicated significant long-run and short-run relationships between the variables, implying that real interest rates had an impact upon stock market performance.

Vuyyuri (2005) investigated the cointegrating relationship and the causality between the financial and the real sectors of the Indian economy using monthly observations from 1992 through December 2002. The financial variables used were interest rates, inflation rate, exchange rate, stock return,

and real sector was proxied by industrial productivity. Johansen (1988) multivariate cointegration test supported the long-run equilibrium relationship between the financial sector and the real sector, and the Granger test showed unidirectional Granger causality between the financial sector and real sector of the economy.

Maghyereh (2002) investigated the long-run relationship between the Jordanian stock prices and selected macroeconomic variables, again by using Johansen's (1988) cointegration analysis and monthly time series data for the period from January 1987 to December 2000. The study showed that macroeconomic variables were reflected in stock prices in the Jordanian capital market.

Gunasekarage, Pisedtasalasai and Power (2004) examined the influence of macroeconomic variables on stock market equity values in Sri Lanka, using the Colombo All Share price index to represent the stock market and (1) the money supply, (2) the treasury bill rate (as a measure of interest rates), (3) the consumer price index (as a measure of inflation), and (4) the exchange rate as macroeconomic variables.

With monthly data for the 17-year period from January 1985 to December 2001 and employing the usual battery of tests, which included unit roots, cointegration, and VECM, they examined both long-run and short-run relationships between the stock market index and the economic variables. The VECM analysis provided support for the argument that the lagged values of macroeconomic variables such as the consumer price index, the money supply and the Treasury bill rate have a significant influence on the stock market.

The literature examining the relation of macroeconomic variables on individual stock market indices is scarce. Maysami et al. (2005), as intermittent illustration, assessed the existence of long-run cointegrating relationship among stocks listed dually in the US and Singapore stock markets. In addition, they used Johansen's (1988) VECM, to examine the co-movement between sectoral stock indices of the U.S. and Singapore, through examining whether the S&P 500 Electronics (Semiconductor) Price Index leads Stock Exchange of Singapore's Electronics Price Index. While their results confirmed the long-term cointegrating sectoral relationships, there was evidence pointing to a short-term disequilibria in the prices of dually listed stocks, leading to the conclusion that short-run arbitrage opportunities may exist.

Ta and Teo (1985) had earlier observed high correlation among six Singapore sector indices in the period 1975 to 1984 and the overall SES market return (e.g. All-S Equities Industrial and Commercial Index, SES All-S Equities Finance Index, SES All-S Equities Property Index, SES All-S Hotel Index, SES All-S Plantation Index and SES All-S Mining Index). Using daily data in examining the relationships, they had concluded that sector returns were highly correlated to each other, although such correlations did not remain

stable over time. Sun and Brannman (1994) similarly found a single long-run relationship among the SES All-S Equities Industrial & Commercial Index, Finance Index, Hotel Index, and Property Index from 1975 to 1992.

The current study builds upon and extends the literature through the employment of Johansen's (1988) VECM to examine the long-run equilibrium relationship between selected macroeconomic variables and *stock market sector indices* represented on the Stock Exchange of Singapore (recently demutualized and renamed the Singapore Exchange (SGX)): the Finance Index, the Property Index, and the Hotel Index. The choice of macroeconomic variables and the hypothesized relations with the sector indices are discussed next.

HYPOTHESES

Based on intuitive financial theory (Chen et al. 1986; Fama 1981) coupled with the results of previous studies, this article hypothesizes certain relationships between short and long-term interest rates, industrial production, price levels, exchange rate and money supply with the SES All-S Equities Finance, Property and Hotel Sector Indices.

INTEREST RATE

The simple dividend-discount valuation model may be used to explain the impact of economic factors on stock returns. Assuming constant growth in dividends,

$$P=D_1/(k-g) \tag{1}$$

where P= stock price, D_1= dividends after first period, g= constant growth rate of the dividends and k= required rate of return on the stock.

Mukherjee and Naka (1995) hypothesized that changes in both short- and long-term government bond rates would affect the nominal risk-free rate and thus affect the discount rate. Fama and Schwert (1977) observed that the relationship applied to both the current period as well as for lagged values of the interest rates. Reily and Brown (2000), however, complicated the matter a bit by stating that cash flows from stocks can change along with interest rates and it is not certain whether this change in cash flows will augment or offset the change in interest rates.

We hypothesize a negative relationship between interest rates and stock prices for the following reasons: (1) interest rates can influence the level of corporate profits which in turn influence the price that investors are willing to pay for the stock through expectations of higher future dividends payment. Most companies finance their capital equipments and inventories through borrowings. A reduction in interest rates reduces the costs of borrowing and

thus serves as an incentive for expansion. This will have a positive effect on future expected returns for the firm; (2) as substantial amount of stocks are purchased with borrowed money, hence an increase in interest rates would make stock transactions more costly. Investors will require a higher rate of return before investing. This will reduce demand and lead to a price depreciation.

INFLATION

The results of studies by Fama and Schwert (1977), Chen, Roll and Ross (1986), Nelson (1976) and Jaffe and Mandelker (1976) pointed to a negative relation between inflation and stock prices. We hypothesize similarly: an increase in the rate of inflation is likely to lead to economic tightening policies, which in turn increases the nominal risk-free rate and hence raises the discount rate in the valuation model (equation 1).

The effect of a higher discount rate would not necessarily be neutralized by an increase in cash flows resulting from inflation, primarily because cash flows do not generally grow at the same rate as inflation. DeFina (1991) attributes this to nominal contracts that disallow the immediate adjustment of the firm's revenues and costs. Cash flows would probably decrease initially if the cost of inputs adjusts faster to rising inflation than output prices.

EXCHANGE RATES

We hypothesize a positive relation between the exchange rate and stock prices. A depreciation of the Singapore dollar will lead to an increase in demand for Singapore's exports and thereby increasing cash flows to the country, assuming that the demand for exports is sufficiently elastic. Alternatively, if the Singapore dollar is expected to appreciate, the market will attract investments. This rise in demand will push up the stock market level, suggesting that stock market returns will be positively correlated to the changes in the exchange rates (Mukherjee and Naka 1995).

The impact of exchange rate changes on the economy will depend to a large extent on the level of international trade and the trade balance. Hence the impact will be determined by the relative dominance of import and export sectors of the economy.

INDUSTRIAL PRODUCTION

Tainer (1993) is of the view that the industrial production index is procyclical – that is, it rises during economic expansion and falls during a recession. It is typically used as a proxy for the level of real economic activity, that is, a rise in industrial production would signal economic growth. Fama (1990) and Geske and Roll, (1983) hypothesized a similar positive relationship through the effects of industrial production on expected future cash flows.

The productive capacity of an economy indeed depends directly on the accumulation of real assets, which in turn contributes to the ability of firms to generate cash flow. Chen, Roll and Ross' (1986) findings based on a US stock portfolio, indicated that future growth in industrial production was a significant factor in explaining stock returns. Hence, suggesting a positive relationship between real economic activities and stock prices. We hypothesize similarly. Fama (1981) had earlier found that the growth rate of industrial production had a strong contemporaneous relation with stock returns.

MONEY SUPPLY

Friedman and Schwartz (1963) explained the relationship between money supply and stock returns by simply hypothesizing that the growth rate of money supply would affect the aggregate economy and hence the expected stock returns.

An increase in M2 growth would indicate excess liquidity available for buying securities, resulting in higher security prices. Empirically, Hamburger and Kochin (1972) and Kraft and Kraft (1977) found a strong linkage between the two variables, while Cooper (1974) and Nozar and Taylor (1988) found no relation.

In the opinion of Mukherjee and Naka (1995), the effect of money supply on stock prices is an empirical question. An increase in money supply would lead to inflation, and may increase discount rate and reduce stock prices (Fama, 1981). The negative effects might be countered by the economic stimulus provided by money growth, also known as the corporate earnings effect, which may increase future cash flows and stock prices. Maysami and Koh (2000), who found a positive relationship between money supply changes and stock returns in Singapore, further support this hypothesis.

THE STOCK EXCHANGE OF SINGAPORE

The Singapore Exchange Ltd (SGX) was formed on December 1, 1999 through the merger of the Stock Exchange of Singapore Ltd (SES) and the Singapore International Monetary Exchange (SIMEX), thus establishing Asia Pacific's first demutualized, integrated securities and derivatives exchange. The origins of the Stock Exchange may be traced back to 1930 with the formation of the Singapore Stockbrokers' Association to regulate trading activities in serving the public's interest. A joint exchange under the name of Stock Exchange of Malaysia was subsequently formed between Singapore and Malaysia.

The Stock Exchange of Singapore Ltd (SES) was incorporated on May 24, 1973, following an official split from the Stock Exchange of Malaysia. On October 1980, SES was admitted into the International Foundation of

Stock Exchanges, marking its advancement in the global arena. In 1986, the failure of private and institutional investors to meet their obligations on forward contracts on Pan Electric shares resulted in a three-day closure of the market. This led to the amendment of the Securities Industry Act of 1986 to include tighter provisions governing securities operations.

The first test facing the revised Act was on Oct 20, 1987, whereby the Straits Times Industrial Index (STI) plunged 261.78 points following the Wall Street's crash on Black Monday. This date marked the biggest one-day drop in the history of the SES. Despite the substantial decline in the market, none of the SES member firms experienced financial difficulty.

In the early phase of incorporation, listed stocks on the SES Main board were classified into seven industry sections, namely, Industrial and Commercial, Finance, Hotel, Property, Plantation, Mining and Debentures Bonds and Loan Stocks. The guiding criteria in the selection of the stocks included in each of these indices were the liquidity of the shares, the company's size and its profitability. The rapid industrialization and transformation of the Singapore economy saw these sectors being replaced or at least complemented by new industrial pillars. An example is the introduction of the SES All-S Equities Electronics in 1996. On 31 August 1998, SES introduced its new 8-sector classification of listed companies. The eight industrial sectors are Multi-industry, Manufacturing, Construction, Commerce, Finance, Hotel/Restaurant, Property, and Transport/Storage/Communication. Table 1 depicts the most recent financial conditions of the SGX.

THE SES ALL-S EQUITIES FINANCE INDEX

Starting September 1994, the Singapore government has embarked on an ambitious plan to develop Singapore into a regional and international portfolio/fund management center. The SES All-S Equities Finance Index tracks the share price performance of all listed financial institutions on the SGX Main board. Specifically, it is a composite of banks, finance companies, investment companies and unit trusts, stockbrokers, insurance and other financial services.

The Finance Index is one of the sector leaders on the SGX, taking up 31.7% ordinary shares of total market capitalization as at November 2001. Total turnover amounted to $34.09 billion or 32.43% of overall turnover of $105.10 billion. A series of recent liberalization measures is likely to result in new market entries by large financial entities, thus leading to a further potential increase in total market capitalization.

THE SES ALL-S EQUITIES PROPERTY INDEX

The SES All-S Equities Property Index tracks the share price performance of all listed property companies on the SGX Main board, including stocks

TABLE 1. The Singapore Exchange Statistics

Total Turnover	May 2005		June 2005		Total for 2005	
	Volume '000	Value $'000	Volume '000	Value $'000	Volume '000	Value $'000
SGX Mainboard (S$)	11,423,464	12,727,584	13,128,492	15,312,332	77,248,391	82,386,269
SGX Mainboard (Non S$) + Clob Intl	466,665	1,044,332	399,755	1,291,310	3,135,323	6,684,432
Total Turnover	11,890,129	13,771,916	13,528,247	16,603,642	80,383,714	89,070,701
SGX Sesdaq	1,123,849	188,896	1,479,492	234,814	10,015,387	2,068,957
SGX Xtranet	91	2,025	59	1,340	1,018	22,145

Source: Stock Exchange of Singapore: http://info.sgx.com/webmktstatistics.nsf/0b0324dae84b770948256dad0009440a/ 2754f8ce1be2fabc4

of companies with residential exposure. The listed companies represent a combination of both investment and development firms. Investment in listed Singapore property stocks reported a market capitalization of approximately S$17.13 million or about 8.9% of the total market value and a market turnover of $6.77 billion in November 2001.

Despite the consensus that the property market in Singapore has/will developed in tandem with the economy, unique demand and supply factors (e.g. long gestation period of the construction process, information inefficiency and the inherent physical structure of property assets) has led to higher volatility for property-related stocks (Wang and Liow 2000).

THE SES ALL-S EQUITIES HOTEL INDEX

The SES All-S Equities Hotel Index tracks the share price performance of the 17 listed Hotels on the SGX Main board. At the end of November 2001, the market capitalization of Singapore listed hotels stood at $5.08 billion or 2.64% of the total market capitalization of companies listed. Total turnover generated by the hotel sector amounted to $0.33 billion out of the overall turnover of $105.1 billion. The hotel industry is closely tied to the tourism sector, which has assumed an increasingly important role in Singapore's economic growth. This is reflected by the Republic's attempt to strengthen its status as a major convention and exhibition center in the Asia Pacific region as well as enhancing its standing as a shoppers' paradise.

METHODOLOGY AND DATA

This section provides an overview of the model employed, the econometric tests performed, the source of and the type of data used.

THE MODEL

Examination of the dynamic relations between macroeconomic variables and the various sector indices may be undertaken through either Engle and Granger (1987) or Johansen and Juselius (1990) protocols. While Engle and Granger's (1987) two-step error correction model may be used in a multivariate context, the Johansen's (1990) VECM yields more efficient estimators of cointegrating vectors. This is because the Johansen's (1990) VECM is a full information maximum likelihood estimation model, which allows for testing cointegration in a whole system of equations in one step, without requiring a specific variable to be normalized. This allows researchers to avoid carrying over the errors from the first- into the second step, unlike the case of Engle and Granger's (1987) methodology. It also allows the avoidance of a priori of assumptions of endogenity or exogeniety of variables. The VECM is of the form:

$$\Delta z_t \;=\; \Gamma_1 \sum \Delta z_{t\text{-}1} + \;...\; + \Gamma_{k\text{-}1}\, \Delta z_{t\text{-}k+1} + \Pi z_{t\text{-}k} + \mu_t \tag{2}$$

Where Δ denotes first differences, $\Gamma_i = -(I\text{-}A_1\text{-}...\text{-}A_i)$, $(I = 1, \,...\, , \text{k-1})$, and $\Pi = -(I\text{-}A1\text{-} \,...\, \text{-}A_k)$. The short and long-run adjustments to z is specified by the estimates of Γ_i and Π. $\Pi = \alpha\beta'$ where α is the speed of adjustment to disequilibrium and β is the matrix of long-run coefficients that represents up to n-1 cointegration relationship and ensures that z_ts converge to their long-run steady state.

<div align="center">ESTIMATION</div>

Estimating the VECM proceeds in the following manner:

1. Pre-test for stationary and lag-length:

This is to ensure that the variables are stationary and that shocks are only temporary and will dissipate and revert to their long-run mean. The tests for stationarity or unit roots employ the augmented Dickey-Fuller (ADF) and Phillips-Peron (PP) test performed on the variables in levels and first differences. Cointegration requires that all the variables be integrated of the same order. To test for unit roots, we will use the ADF which tests the null hypothesis of

$$H_0 \;:\; \gamma = 0 \;\; \text{in}$$

$$\Delta y_t \;=\; a_0 \;+\; \gamma y_{t\text{-}1} \;+\; \sum \beta_i \Delta \overset{p}{y}_{t\text{-}i+1} \;+\; \varepsilon_t \tag{3}$$

to examine whether a unit root exists. The ADF test assumes the asymptotic normality of the idiosyncratic error term, ε_t, in (3).

The choice of lag-lengths may be decided using Sims likelihood ratio test. The appropriate lag length is important as too many lags reduce the power of the test due to the estimation of additional parameters and a loss of degrees of freedom. In contrast, too few lags may not capture the dynamics of the actual error correction process, resulting in poor estimates of g and its standard errors. This paper employs the multivariate forms of the Akaike information criterion (AIC) and the Schwartz Bayesian criterion (SBC) to determine lag lengths. Both are model selection criteria developed for maximum likelihood estimation techniques, where:

AIC $= T$ ln (residual sum of squares) $+ 2n$ and
SBC $= T$ ln (residual sum of squares) $+ n$ ln (T)

In minimising the AIC and SBC, we minimise the natural logarithm of the residual sum of squares adjusted for sample size, n, and the number of parameters included, T.

2. Estimate the model by regressing the $\Delta \mathbf{z}$ matrix against the lagged differences of $\Delta \mathbf{z_{t-i}}$ and determine the rank of p = ab¢. The eigenvectors in b¢ are estimated from the canonical correlations of the set of residuals from the regression equations. To determine the rank of p, which will give the order of cointegration, r, the characteristic roots or eigenvalues of p, l_i should be estimated.

We do this by testing the null hypothesis that there are at most r cointegration vectors and thus (*n-r*) unit roots, i.e. H_0: $\lambda_i = 0$ where *i= r+1,....*

The λ test statistics is

$$\lambda_{trace} = -T \sum^{n} \log (1\text{-}l_i) \qquad\qquad r\text{=0, 1, 2, ..., n-2, n-1} \qquad (4)$$

The choice of the number of maximum cointegrating relationships will be based on the λ_{trace} test to examine the specific hypotheses. We will reject models where π has full rank as in such a situation, z_t is stationary and has no unit root and so there is no error correction.

3.   Having determined the order of cointegration, we will select and analyse the relevant cointegrating vector and speed of adjustment coefficients. Assuming π does not have full rank and there are multiple cointegrating vectors, we will choose the first eigenvector based on the largest eigenvalue, which is regarded as the most useful. Since we consider the natural logarithm of the SES All-S Equities Price Index, SES All-S Equities Finance Index, SES All-S Equities Property Index and SES All-S Equities Hotel Index to be the dependent variable, we will normalise β' with respect to the coefficients for these indices. $^{i=r+1}$

DATA DESCRIPTION

The monthly time-series were obtained from the Public Access Time-Series system, an online-service by the Singapore Department of Statistics. The SES All-S Equities indices figures are obtained from the *Singapore Statistics* published by the Singapore Department of Statistics.

The brief description for each variable used in the regression and their transformation are presented in Table 2.

Table 3 provides the summary statistics for the variables in levels in first differences. Monthly observations on the natural logarithms of the SES All-S Equities Index, All-S Equities Finance Index, All-S Equities Property Index, All-S Equities Hotel Index, consumer price index, industrial production, proxies for long and short-run interest rates, money supply (M2), and exchange rates from January 1989 to December 2001 are used in this study. The movement of the SES All-S Equities indices are provided in the Figure A-D.

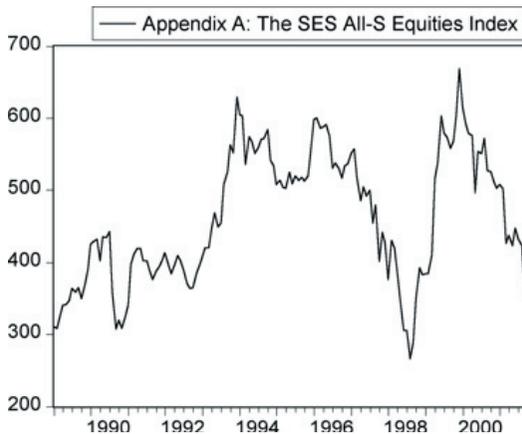TABLE 2. Definitions of Variables and *Transformation*

Variables *Transformations*	Definitions of Variables *Definitions of Transformations*
LSES$_t$	Natural logarithm of the index of market-value weighted average of month-end closing prices for SES All-S Equities shares listed on the SGX.
$\Delta LFNCE_t = LFNCE_t - LFNCE_{t-1}$	*Monthly return on the SES All-S Equities Finance Index (ex dividend).*
LFNCE$_t$	Natural logarithm of the index of market-value weighted average of month-end closing prices for SES All-S Equities Finance shares listed on the SGX.
$\Delta LFNCE_t = LFNCE_t - LFNCE_{t-1}$	*Monthly return on the SES All-S Equities Finance Index (ex dividend).*
LPRO$_t$	Natural logarithm of the index of market-value weighted average of month-end closing prices for SES All-S Equities Property shares listed on the SGX. $\Delta LPRO_t = LPRO_t - LPRO_{t-1}$ *Monthly return on the SES All-S Equities Property Index (ex dividend).*
LHOT$_t$	Natural logarithm of the index of market-value weighted average of month-end closing prices for SES All-S Equities Hotel shares listed on the SGX. $\Delta LHOT_t = LHOT_t - LHOT_{t-1}$ *Monthly return on the SES All-S Equities Hotel Index (ex dividend).*
LCPI$_t$	Natural logarithm of the month-end consumer price index.
$\Delta LCPI_t = LCPI_t - LCPI_{t-1}$	*Monthly-realised inflation rate.*
LIP$_t$	Natural logarithm of the month-end industrial production index.
$\Delta LIP_t = LIP_t - LIP_{t-1}$	*Growth rate of industrial production.*
LLTB$_t$	Natural logarithm of the month-end yield on 1-year inter-bank rates.
$\Delta LLTB_t = LLTB_t - LLTB_{t-1}$	*Monthly return on 1-year inter-bank rates. (long term).*
LSTB$_t$	Natural logarithm of the month-end 3-month inter-bank offer rate.
$\Delta LSTB_t = LSTB_t - LSTB_{t-1}$	*Monthly return on 3-month inter-bank market (short term).*
LM2$_t$	Natural logarithm of the month-end money supply (M2) in Singapore.
$\Delta LM2_t = LM2_t - LM2_{t-1}$	*Monthly growth rate of money supply (M2).*
LSDR$_t$	Natural logarithm of the month-end exchange rate of the Singapore dollar in SDRs (Special Drawing Rights) as defined in the International Financial

EMPIRICAL RESULTS

UNIT ROOT TESTS

Time series data are often assumed to be non-stationary and thus it is necessary
to perform a pretest to ensure there is a stationary cointegrating relationship
among variables to avoid the problem of spurious regression. Based on the
error correction mechanism as indicated by Johansen (1990), it is necessary

TABLE 3. Descriptive Statistics of Variables in Levels and First Differences

Variable	Mean	Std Dev	Minimum	Maximum
LSES$_t$	6.114	0.202	5.584	6.505
ΔLSES$_t$	*0.002*	*0.067*	*-0.209*	*0.232*
LFNCE$_t$	6.415	0.517	5.711	7.515
ΔLFNCE$_t$	*0.009*	*0.100*	*-0.302*	*0.720*
LPRO$_t$	6.119	0.341	5.106	6.702
ΔLPRO$_t$	*0.001*	*0.116*	*-0.386*	*0.478*
LHOT$_t$	6.390	0.211	5.580	6.785
ΔLHOT$_t$	*0.002*	*0.086*	*-0.261*	*0.626*
LCPI$_t$	4.548	0.068	4.394	4.632
ΔLCPI$_t$	*0.001*	*0.003*	*-0.006*	*0.009*

Appendix A: The SES All-S Equities Index

Appendix B: The SES All-S Finance Index

Appendix C: The SES All-S Equities Property Index

Appendix D: The SES All-S Equities Hotel
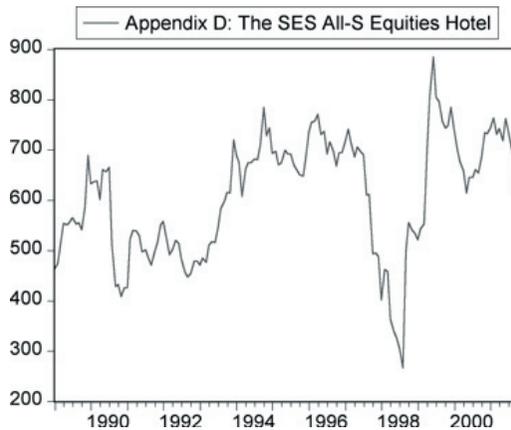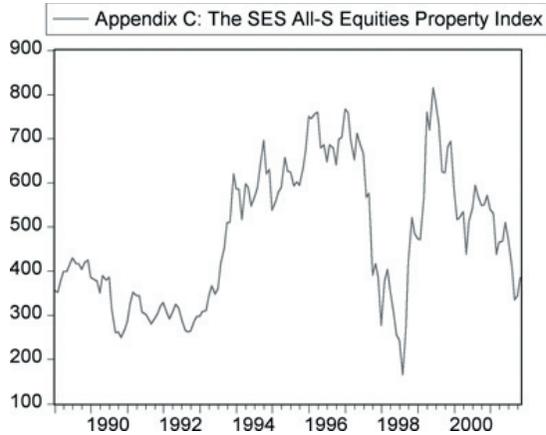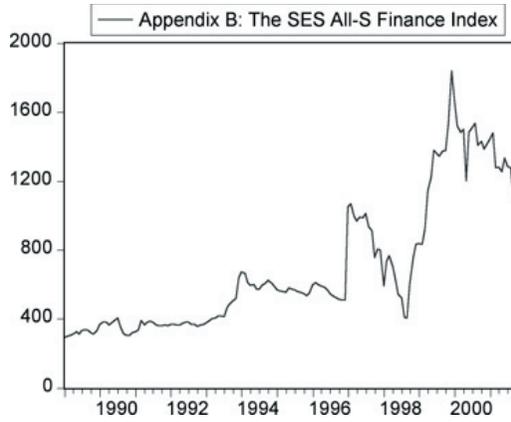
for the variables to be of the same order of integration. Although different forms of the Johansen tests have been used to detect differing orders of integration, it is best not to mix variables with differing orders of integration as recommended by the Johansen's (1990) methodology.

For the testing of unit roots, the Augmented Dickey-Fuller (ADF) or Phillips-Perron (PP) Tests may be used. The result of the ADF to determine the presence of unit roots is reported in Table 5. Since the results of the unit root test can be sensitive to the lag length selected, we will select the lag length p using the multivariate generalizations of the Akaike Information Criteria (AIC). The lag length chosen for each variables based on the lowest AIC is also reported in Table 4.

All the variables reported are stationary at 1% significance level based on the MacKinnon critical values for unit root test. The final vector of variables to be included is:

$$Y_t = (LSES_t \quad LCPI_t \quad LIP_t \quad LSDR_t \quad LSTB_t \quad LM2_t \quad LLTB_t) \tag{5}$$

for the model examining the cointegration relationship between the SES and the macroeconomic variables;

TABLE 4. Augmented Dickey-Fuller Unit Root Test (sample 1989-2001)

	Lags	Estimated a_1	Standard Error	t-Statistic for a_1=0
$LSES_t$	2	-0.076068	0.026078	-2.916931
$\Delta LSES_t$	2	-0.953031**	0.130446**	-7.305925**
$LFNCE_t$	2	-0.019523	0.015987	-1.221164
$\Delta LFNCE_t$	2	-1.015492**	0.137024**	-7.411061**
$LPRO_t$	2	-0.066760	0.028188	-2.368355
$\Delta LPRO_t$	2	-1.029136**	0.132901**	-7.743630**
$LHOT_t$	7	-0.121812	0.037374	-3.259266
$\Delta LHOT_t$	10	-1.196675**	0.270135**	-4.429912**
$LCPI_t$	6	-0.013090	0.004095	-3.196382
$\Delta LCPI_t$	2	-0.960021**	0.151379**	-6.341828**
LIP_t	13	-0.031073	0.021547	-1.442103
ΔLIP_t	11	-3.165593**	0.716744**	-4.416628**
$LLTB_t$	2	-0.038102	0.026687	-1.427738
$\Delta LLTB_t$	2	-0.894071**	0.138855	-6.438871**

$$Y_t = (LFNCE_t \quad LCPI_t \quad LIP_t \quad LSDR_t \quad LSTB_t \quad LM2_t \quad LLTB_t) \tag{6}$$

for the integration between the Finance sector and the macroeconomic variables;

$$Y_t = (LPRO_t \quad LCPI_t \quad LIP_t \quad LSDR_t \quad LSTB_t \quad LM2_t \quad LLTB_t) \tag{7}$$

for the integration between the Property sector and the macroeconomic variables; and

$$Y_t = (LHOT_t \quad LCPI_t \quad LIP_t \quad LSDR_t \quad LSTB_t \quad LM2_t \quad LLTB_t) \tag{8}$$

for integration between the Hotel sector and the macroeconomic variables.

DETERMINATION OF RANK

The next step involves estimating the model and determining the rank of p. By testing for cointegration rank we will be able to determine the number of cointegrating relations in our model. The model based on the lowest AIC was the one with the truncated lag length of *p*=5 for SES All-S Equities Index, *p*=2 for SES All-S Equities Finance Index, *p*=5 for SES All-S Equities Property Index and *p*=5 for SES All-S Equities Hotel Index. We report l_{trace} and l_{max} values and their critical values at both 1% and 5% in Table 5.

When the results obtained from the λ_{trace} and λ_{max} tests yield different conclusions, the λ_{trace} statistic is preferred. This is supported by Cheung and Lai (1993) who found that the λ_{trace} test shows more robustness to both skewness and excess kurtosis in the residuals than that of the λ_{max} test. The results for the λ_{trace} test with the selected lag lengths indicate that there is no more than one cointegrating relationship at either the 1% and 5% level for all the models specified. We thus conclude that there is one cointegrating vector (i.e. r = 1).

COINTEGRATION RESULTS

The normalized cointegrating coefficients for the SES All-S Equities Index ($LSES_t$) are

$$Y_t = (LSES_t \quad LCPI_t \quad LIP_t \quad LSDR_t \quad LSTB_t \quad LM2_t \quad LLTB_t)$$
$$\beta_1' = (1.00, \quad -11.66, \quad -4.20, \quad 5.91, \quad -2.51, \quad -4.34, \quad 4.41)$$

These values represent long-term elasticity measures, due to logarithmic transformation of SES (normalized), CPI, IP, SDR, STB, LM2 and LTB. Thus, the cointegration relationship can be re-expressed as:

$$LSES_t = 11.66LCPI_t + 4.20LIP_t - 5.91\ LSDR_t + 2.51\ LSTB_t + 4.34\ LM2_t$$
$$\qquad\qquad [-1.58]^* \qquad [-3.68] \qquad [2.30] \qquad\qquad [-1.98]$$

TABLE 5. Results and Critical Values for the λ_{trace} and λ_{max}

SES and Macroeconomic Variables based on $p=5$

H_0	l_{trace}	$CV_{(trace, 1\%)}$	$CV_{(trace, 5\%)}$	l_{max}	$CV_{(Max, 1\%)}$	$CV_{(max, 5\%)}$
R=0	170.31**	146.99	136.61	50.52*	54.48	48.45
R≤1	119.79**	114.36	104.94	48.06*	48.17	42.48
R≤2	71.74	85.78	77.74	30.71	41.58	36.41
R≤3	41.02	61.24	54.64	23.70	35.68	30.00
R≤4	17.33	40.49	34.55	10.84	28.83	23.78
R≤5	6.49	23.46	18.17	5.40	21.47	16.87

Finance and Macroeconomic Variables based on $p=2$

H_0	l_{trace}	$CV_{(trace, 1\%)}$	$CV_{(trace, 5\%)}$	l_{max}	$CV_{(Max, 1\%)}$	$CV_{(max, 5\%)}$
R=0	170.37**	158.49	146.76	52.10*	54.71	49.42
R≤1	118.27**	124.75	114.90	36.09	49.51	43.97
R≤2	82.19	96.58	87.31	31.99	42.36	37.52
R≤3	50.20	70.05	62.99	20.87	36.65	31.46
R≤4	29.33	48.45	42.44	15.07	30.34	25.54
R≤5	14.26	30.45	25.32	11.83	23.65	18.96

Property and Macroeconomic Variables based on $p=5$

H_0	l_{trace}	$CV_{(trace, 1\%)}$	$CV_{(trace, 5\%)}$	l_{max}	$CV_{(Max, 1\%)}$	$CV_{(max, 5\%)}$
R=0	168.03**	158.49	146.75	50.02*	54.71	49.42
R≤1	118.01*	124.75	114.90	40.10	49.51	43.97
R≤2	77391	96.58	87.31	27.31	42.36	37.52
R≤3	50.59	70.05	62.99	21.29	36.65	31.46

[-2.60]
   - 4.41 LLTB$_t$
      [2.83]   (9)

* t-statistics are shown in [ ]

The coefficients and cointegrating relations for SES All-S Equities Finance, are respectively given as:

FINANCE:
Y_t = (LFNCE$_t$ LCPI$_t$ LIP$_t$ LSDR$_t$ LSTB$_t$ LM2$_t$ LLTB$_t$)
b_1' = (1.00,   -10.99, 0.34, 5.08, -2.28, -1.03, 2.52)
LFNCE$_t$ = 10.99LCPI$_t$ - 0.34LIP$_t$ - 5.08 LSDR$_t$ + 2.28 LSTB$_t$ + 1.03 LM2$_t$
          [-2.34]   [0.49]   [3.05]   [-3.16]   [-0.94]
   - 2.52 LLTB$_t$
    [2.81]   (10)

PROPERTY:
Y_t = (LPRO$_t$ LCPI$_t$ LIP$_t$ LSDR$_t$ LSTB$_t$ LM2$_t$ LLTB$_t$)
b_1' = (1.00, -18.07, -7.83, 6.76, -5.21, -4.87, 8.12)
LPRO$_t$ = 18.07LCPI$_t$ + 7.83LIP$_t$ − 6.76 LSDR$_t$ + 5.21 LSTB$_t$ + 4.87 LM2$_t$
          [-1.87]   [-5.19]   [2.00]   [-3.13]   [-2.29]
   - 8.12 LLTB$_t$
    [3.91]   (11)

HOTEL:
Y_t = (LHOT$_t$ LCPI$_t$ LIP$_t$ LSDR$_t$ LSTB$_t$ LM2$_t$ LLTB$_t$)
b_1' = (1.00, 14.76, -4.45, -3.55, 0.87, 0.83, -0.24)
LHOT$_t$ = −14.76LCPI$_t$ + 4.45LIP$_t$ + 3.55LSDR$_t$ − 0.87LSTB$_t$ − 0.83LM2$_t$
          [3.24]   [-5.15]   [-2.12]   [1.54]   [1.23]
    + 0.24 LLTB$_t$
    [-0.34]   (12)

ANALYSIS OF RESULTS

SES ALL-S EQUITIES INDEX

The coefficients for LCPI$_t$, LIP$_t$, LSTB$_t$ and LM2$_t$ are positive, while the signs between LSDR$_t$, LLTB$_t$ and LSES$_t$ are both negative. The intercept term is positive.

Fama and Schwert (1977), Geske and Roll (1983), Chen, Roll and Ross

(1986) and Mukherjee and Naka (1995) have suggested a negative relation between stock returns and inflation. These finding are contrary to the results of our study which documents a significant positive relationship between inflation and Singapore stock returns.

A possible explanation for the positive relationship might be the government's active role in preventing prices escalation as the economy continued to improve after the 1997 crisis. Firth (1979) posited that holding stocks might be an effective hedge against inflation and hence the "Fisher effect" would explain this positive correlation. Marshall (1992) stated that if inflation is caused by money shock, it would lower the rate of interest and investors would shift their cash holdings to stocks and bonds in order to maximize potential capital gains. The increase in demand would in turn raise stock prices. Increases in expected inflation may also signal a potential increase in real activity, production and hence higher stock returns (Fama and Gibbons, 1982).

There is evidence that stock returns are positively and significantly related to the level of real economic activity as proxied by the industrial production index. Fama (1981) explained this by suggesting that the market makes rational forecasts of the real sector, while Chen, Roll and Ross (1986) argued that the positive relation reflects the value of insuring against real systematic production risks. Changes in productive activity, through their impact on expected dividends, should in turn influence stock returns (Maysami and Koh 2000).

Short- and long-term interest rates have significant respectively positive and negative relations with the Singapore's stock market based on the results of the current study. This is consistent with the findings of Bulmash and Trivoli (1991) in the case of the United States, and by Mukherjee and Naka (1995) for Japan. Maysami and Koh (2000) similarly observed a positive relationship between the Singapore stock market and short-term interest rates while the long-term rate was negative. The reason is probably that long-term interest rate serve as a better proxy for the nominal risk-free component used in the discount rate in the stock valuation models and may also serve as a surrogate for expected inflation in the discount rate.

The positive correlation between money supply changes and stock returns is consistent with the findings of Mukherjee and Naka (1995) who attributed a rise in the discount rate to the expansionary effect of money supply increase. Fama (1981) explained a spurious, rather than causal, positive relation between money supply and stock prices through a simple quantity theory model, where money demand is stimulated through increases in real activity, which in turn drive stock returns.

The results of our study support the hypothesis of a positive relationship between exchange rate and the Singapore stock market. This is similar to the findings of Maysami and Koh (2000). They explained that with the high

import and export content in the Singapore's economy, a stronger domestic currency lowers the cost of imported inputs and allows local producers to be more competitive internationally. Yip (1996) also explained that a strong Singapore dollar limits imported inflation and hence is perceived as favourable news by the Singapore stock market, thereby generating positive returns.

SES ALL-S EQUITIES FINANCE INDEX

The coefficients for $LCPI_t$, $LSTB_t$ and $LM2_t$ are positive, while those between LIP_t, $LSDR_t$, $LLTB_t$ and $LFNCE_t$ are negative. The intercept term is also positive. The relationships between the finance index and the macroeconomic variables are similar for the Singapore stock market except in the case of the real economic activity, which depicts an insignificant relationship. One possible explanation for this maybe the fact that the accumulation of real assets, which contributes to the economy's productive capacity, and investments in the finance sector are viewed as alternative investments.

The finance sector is significantly affected by changes in inflation rates, exchange rates, and both short- and long- term interest rates. The impact of changes in money supply to the finance sector is weaker as compared to the Singapore's stock market.

SES ALL-S EQUITIES PROPERTY INDEX

The coefficients for $LCPI_t$, LIP_t, $LSTB_t$ and $LM2_t$ are positive, while those of $LSDR_t$ and $LLTB_t$ are negative. The intercept term is also positive. All relations between the property sector and the macroeconomic variables are Significant.

The signs of the coefficients are similar to those of the Singapore stock market. This is supported by the findings of Wang and Liow (1999) who reported a strong co-movement in the returns of property stocks and the general market. Although the property sector reacts in tandem with the stock market to changes in the macroeconomic variables, the impact is relatively higher. For instance, a 1% increase in real activity would result in a 7.83% rise in the property index, while the stock market return would increase by 4.2%. The higher volatility in the property sector relative to the overall market, also coincides with Wang and Liow's (2000) findings.

SES ALL-S EQUITIES HOTEL INDEX

The coefficients for LIP_t, $LSDR_t$ and $LLTB_t$ are positive, while those for $LCPI_t$, $LSTB_t$ and $LM2_t$ are negative. The intercept term is positive. Curiously, the signs for all coefficients are opposite of those observed for the Singapore stock market, except for real economic activity.

Based on our results, short- and long-term interest rates as well as the money supply do not have significant effects on the Singapore Hotel Index.

The significant negative relation between the Hotel sector returns and the exchange rate is the result of the fact that depreciation is deemed favourable for the Singapore tourism industry as hotel rates will become relatively cheaper in terms of foreign currencies and hence would increase demand. Justification for the government of Singapore's continuous attempts to control inflation is given by the results that a 1% rise in inflation rate would result in a significant 14.76% fall in the Hotel index. Controlling inflation would ensure that tourism remains a competitive sector of the Singapore economy.

CONCLUSION

This paper examined the relation between macroeconomic variables and the Sector Stock Indices represented by the SES All-S Equities Finance Index, SES All-S Equities Property Index and SES All-S Equities Hotel Index, as well as the Singapore's composite stock index, using Johansen's (1990) VECM, a full information maximum likelihood estimation model.

Our conclusions were that the Singapore stock market and the SES All-S Equities Property Index formed significant relationships with all macroeconomic variables identified, while the SES All-S Equities Finance Index and SES All-S Equities Hotel Index form significant relationships only with selected variables.

Specifically, for the SES All-S Equities Finance Index, real economic activity and money supply were not significant, and in the case of SES All-S Equities Hotel Index, money supply, and short- and long-term interest rates were insignificant.

The conclusions drawn from the study will be beneficial in two ways: (1) whether there exists opportunities for profit from the inefficiencies of stock market mechanisms in the transfer of information between stock markets, and (2) more specifically, whether "stock picking" could lead to a superior earning capability.

The presence of a cointegrating relationship between macroeconomic variables and stock prices brings the conclusions of the efficient market hypothesis in doubt. Principally, the behavior of stock market may indeed be predicted, contrary to the EMH conclusions and policy-makers may need to reevaluate their economic policy if affecting the stock market is not something they desire.

The fact that specific sectors represented in the SGX are individually affected by to different extent by various macroeconomic variables points to the possibility of superior returns based on selecting stocks from specific sectors of the economy as information becomes available on specific macroeconomic variables. Additionally, the benefits of diversification as suggested by Grubel (1968) and Lessard (1973) through selecting stocks from different sectors of

Singapore economy become evident.

Policy-makers need to be careful too when trying to influence the economy through changes in macroeconomic variables such as the money supply, interest rates, or the exchange rate. While aiming to correct macroeconomic ills such as inflation or unemployment, they may inadvertently depress the stock market, and curtail capital formation which itself would lead to further slowdown of the economy.

Extending the conclusions of this study to other sectors and to other markets is a matter of empirical study and one which is worth pursuing. Ahlgren, Sjoo, and Zhang, for example, have examined market segmentation, information asymmetry and diffusion of the Chinese stock exchanges and found evidence of cointegration between A and B share prices *for most firms, but not for all*. They then used a probit model to identify the firm characteristics that determine whether A and B share prices cointegrate or not. Their results showed cointegration was more likely among newly-listed firms and those in the service and manufacturing sectors.

At the same time, the relationship between macroeconomic variables and stock markets, though widely documented, is not universally shown or accepted. For example, to the contrary, Cauchie, et al. (2003) examination of the determinants of stock returns in the Swiss stock market and showed that the statistically determined factors yield a better representation of the determinants of stock returns than the macroeconomic variables and that stock returns were influenced by both global and local economic conditions, suggesting that the Swiss stock market is an internationally imperfectly integrated market.

Panetta (2003) similarly found the relation between stock returns in Italy and the macroeconomic factors to be unstable: not only were the factor loadings of individual securities virtually uncorrelated over time, but a high percentage of the shares experience a reversal of the sign of the estimated loadings.

Limitations of the study include the fact that the Error Correction Model methodology, either as employed by Engle and Granger (1987) or Johansen (1990) have been known to be sensitive to the choice of lag lengths. The ADF tests are also sensitive to the specification of the variables and the lag lengths used. For the purpose of comparison, our paper used the same macroeconomic variables to test for the relationships on the SES All-S Equities Index and the various SES All-S Sector indices. It may be useful for future studies to include other economic variables that might affect each sector specifically.

Two points are worth noting and may provide grounds for further research. First, since cointegration refers to long-run relationships between the variables appearing in the cointegrating vector(s), long-term relationship between macroeconomic variables and sector indices discovered in this paper, does not by itself prove similar relations exit in the short run. Second, Johansen's method is known to be sensitive to the choices of lags and the dimensions.

Mukherjee and Naka (1995) used 20 years of data while employing seven variables. Due to a more limited number of observations, we used six macro variables instead. Experimenting with various dimensions and time series data may, in itself, be a useful study.

The study may be extended by employing Engle and Granger's (1987) error correction model so that the short-run dynamics between the variables could be addressed, much the same way as Maysami and Sim did in the cases of Hong Kong and Singapore (Maysami and Sims 2002b), Malaysia and Thailand (Maysami and Sims 2001a), and Japan and Korea (Maysami and Sims 2001b), or as Islam (2003) did for the Kuala Lumpur Stock Exchange (KLSE) Composite Index.

However, given that ours was a preliminary investigation without much literature precedent, the study concentrated on examining only the long-term equilibrium relationship among the macroeconomic variables and sector indices. Moreover, although Engle and Granger's (1987) two-step error-correction model may be used in a multivariate context, the VECM yields more efficient estimators of cointegrating vectors.

This is because the VECM is a full information maximum likelihood estimation model, which allows for testing for cointegration in a whole system of equations in one step and without requiring a specific variable to be normalised. This allowed us to avoid carrying over the errors from the first into the second step, as will be the case if Engle-Granger's methodology is used.

Finally, in order to address the limitations of Johansen's (1990) methodology, e.g. problems with the order of integration, Pesaran and Shin (1997) proposed the Autoregressive Distributive Lag (ADRL) method. They showed that the ARDL model remains valid when the underlying variables are non-stationary, provided the variables are cointegrated. Bentzen and Engstead (1999) used the ARDL approach to estimated a demand relationship for Danish residential energy consumption, and compared the ARDL estimates to the estimates obtained using cointegration techniques and error-correction models. They concluded that that both quantavely and qualitatively, the ARDL approach and the cointegration/ECM approach give very similar results. Nevertheless, further experimentation with the ARDL may prove a worthy extension of this study.

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