EMPIRICAL ANALYSIS OF STOCK RETURN SYNCHRONICITY A COMPARISON OF DEVELOPED AND EMERGING MARKETS

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This thesis is submitted in fulfilment of the requirements of the degree of Doctor of Philosophy

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November 2008

DECLARATION

I hereby declare that the thesis titled 'Empirical analysis of stock return synchronicity – A comparison of developed and emerging markets' is my original work and the thesis has not been submitted previously, in whole or in part, to qualify for any other academic award or degree. The research work has been carried out since the official commencement date of this approved research program and any editorial work, paid and unpaid, carried out by a third party is acknowledged.

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ACKNOWLEDGEMENTS

It would not have been possible to complete this thesis without the help and continuous support of Professor Richard Heaney, who showed me the way and helped me throughout the thesis. He is the friendliest and most open-minded professor I have ever met.

Two other people to whom I would like to give my special thanks are my second supervisor and the director of research at RMIT, Professor Timothy Fry and Mrs Prue Lamont. Professor Fry provided excellent guidance and valuable advice throughout the study. Mrs Lamont was always supportive of me and on several occasion she helped well beyond expectations.

There are always a few people quietly providing advice and help, such as Professor Benjamin Hermalin of The University of California, Berkeley and Professor Sinclair Davidson of RMIT University. Professor Hermalin reviewed my thesis and provided valuable comments. His positive and constructive feedback was extremely helpful.

There is a woman behind every successful man. I would like to give 'Peya' my special thanks for her support and cooperation in my life. I would also like to give my special thanks to Mrs. Sam Oliphant for her professional paid proofreading and editing.

Finally and most importantly, I would like to thank Allah and would like to remember my father who died in 2006 without seeing my present success. I am sure he would be the happiest man in the world to see my present success in my education career.

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SUMMARY

This thesis analyses the stock market synchronicity of 34 emerging markets and compares the findings with seven developed markets. The study uses weekly stock return data and the final dataset includes approximately 20.8 million weekly observations for 40,014 firms across the world.

Morck et al. (2000) are among the first to introduce the topic of stock market synchronisation and argue that stock markets in economies with high per capita GDP move in a relatively unsynchronised manner over time, in contrast to stock prices in low per capita GDP economies. They also suggest that stock synchronicity is associated with macroeconomic indicators including rule of law, inflation, corruption and geographical size. In addition, Skaife et al. (2006) propose a further measure of stock synchronicity based on the proportion of zero returns and argue that the zero-return measure is a superior measure of stock market co-movement. The study uses both measures proposed by Morck et al. (2000) and one measure proposed by Skaife et al. (2006) for synchronicity analysis and extends the analysis to cover a ten year period, a larger sample of shares and more recent measures of country specific characteristics.

It is found that stock markets in emerging economies are more synchronous than in developed economies over the sample period using the classical measure. It is also found that over the 10-year study period the synchronicity measure is stationary. There is evidence of a statistically significant negative correlation between stock synchronicity and both government accountability and corruption for the emerging markets using the cross-sectional analysis.

The R-square measure of stock synchronicity averages 0.091 for the emerging markets and 0.045 for the developed economies, suggesting that higher stock price co-movement is evident in emerging economies. Further, there is a statistically significant positive correlation between the R-square measure and both corruption and inflation. There is also a negative correlation evident between the R-square measure and government accountability. In addition, it is found that in civil law countries R-square measures are generally higher than in common law countries.

The study also uses the zero-return measure of stock synchronicity suggested by Skaife et al. (2006). It is found that the zero-return measure for emerging economies is higher than for developed economies. Surprisingly, China and the S&P 500 group of companies exhibit the lowest values for the zero-return measure during this period, which is inconsistent with the classical measure and the R-square measure. Further, panel data analysis shows that GDP per capita and trade openness have a strong effect on the zero-return measure.

The Pearson correlation and Spearman rank correlation coefficient indicate that the classical measure and the R-square measure are positively correlated and appear to capture similar aspects of the markets in the study, which is also consistent with cross-sectional analysis results. In contrast, the zero-return measure shows either insignificant or negative correlation with the classical measure and the R-square measure for most sub-period and full period analysis.

Finally, there is evidence that emerging stock markets are more synchronous over time than in developed financial markets. It is found that common-law country stock synchronicity is lower than in civil-law countries or post-communist countries using the classical measure and the R-square measure. There is evidence that the classical measure and the R-square measure are positively correlated, whereas the zero-return measure is statistically insignificant or negatively correlated with both the classical measure and R-square measure, suggesting that the zero-return measure captures different aspects of stock market behaviour.

CHAPTER 1 Introduction

1.1 History of the topic

It is often argued by the academic researchers that stock prices in emerging economies are more synchronised over time than those in developed economies. This is not only because developed economies have a higher gross domestic product (GDP) per capita; it appears that there are several other factors which directly and indirectly affect the capital markets of these economies, such as low rate of corruption, strong investor protection rights, political stability and low inflation. Stock synchronicity can be explained in terms of the tendency of share market prices to move in the same direction over a particular period of time. Morck et al. (2000) argue that stock prices in economies with a high per capita GDP move in a relatively unsynchronised manner over time, in contrast to stock prices in low per capita GDP economies. They argue that low GDP per capita economies tend to be undiversified which makes firm-level earnings more correlated. Further, Morck et al. (2000) find that low-income economies often cannot provide proper protection of property rights for investors.

Additionally, Morck et al. (2000) propose two models to capture the tendency for stock return synchronicity. The first model captures the broad, market-wide movements in share prices for individual firms for a particular period, referred to as the Classical Synchronicity Measure. The second model is the market model of R-square measure. This captures the level of firm-specific price movement that is reflected in overall share market prices. The thesis will use both of these models to measure stock price synchronicity for developed and emerging markets. The study will also use the zero-return synchronicity measure developed by Skaife et al. (2006) as an alternative measure. Skaife et al. (2006) use the zero-return measure in their analysis of six equity markets (the sample includes Australia, France, Germany, Japan, the UK, and the USA) and argue that the zero-return measure better captures stock price synchronicity for an equity market.

The published literature in the area of stock market synchronicity is limited and this thesis contributes to the literature through its focus on the emerging equity markets. The thesis uses the three measures to capture the stock synchronicity of emerging markets and compares the findings with a selection of developed equity markets. Additionally, the thesis

compares these three synchronicity measures to access the impact of the choice of measure. It is important to determine how closely correlated these measures are.

It is found that stock synchronicity is important for a range of players in the market. There is evidence that synchronous stock market has greater market wide risk of individual assets pricing and market wide firm effects are less important for individual firms. Thus, stock synchronicity is important for arbitrage traders, analyst and for noise traders.

The study analyses all available stock prices from the DataStream database for 34 emerging markets and seven developed markets around the world. The emerging markets span a range of legal origins (for example, common law, civil law and post-communist origin), equity market size and geographical location. La-Porta et al. (1998) examine legal systems around the world and the impact of investor rights protection. They find that common-law countries generally provide the strongest protection of investor rights in contrast to civil law countries. In addition, Morck et al. (2000) argue that weak investor rights protection reflect poor structural systems in a country, leading to market-wide share price swings.

A sample of 12 emerging countries with common law origin, 19 emerging countries with civil law origin, three emerging countries with post-communist origin and seven developed economies have been selected for the analysis. The developed countries are selected on the basis of equity market size. Further, the study includes both the New York Stock Exchange (NYSE) and the S&P 500 groups of companies for the USA. The sampled shares include both dead and live stocks from the DataStream database to avoid the survivorship bias problem. The study period is from January 1996 to December 2005.

1.2 The importance of the topic

Stock synchronicity is an important characteristic of emerging market economies as it has been shown to be closely related to economic development and stock market stability. It also has implications for asset pricing, noise traders and for the investors. Further, stock synchronicity is also closely related to corporate governance mechanisms. For example, Morck et al. (2000) argue that corporate governance mechanisms are more effective when the

stock synchronicity is lower. They also find that stock synchronicity is closely related with the protection of property rights and argue that highly synchronous markets are inefficient markets. However, there is a literature related to this topic dealing with trading volume and cross autocorrelation, though this is beyond the scope of this thesis.

The study is important for the several reasons. First, stock synchronicity is measured for emerging markets and compared with the developed economies. Roll (1988) argues that stock synchronicity can push the value of a stock from its fundamental value and this over- or under-valuation of stocks can adversely affect the overall equity market. Further, Campbell et al. (2001) argue that large investors are exposed to greater risk as stock synchronicity increases. Indeed, stock synchronicity is an important factor for developed market economies as well as for the emerging market economies.

Second, the relationship between corporate governance mechanisms, corruption, inflation, GDP per capita, trade openness and stock synchronicity is analysed. Roll (1988) argues that when stock prices begin to fall, various corporate governance mechanisms come into effect. Further, Morck et al. (2000) argue that corporate governance mechanisms (e.g. investor rights protection and government regulatory controls) are more effective in less synchronous economies (developed economies). The study investigates the impact of corporate governance mechanisms on the stock synchronicity of emerging markets.

Third, three different synchronicity measures are used in analysis of stock market synchronisation. The measures are the classical synchronicity measure, the R-square measure and the zero-return measure. The thesis compares these three synchronicity measures with a view to determining how closely related they are. It is also important to assess whether the three measures capture the same features of a stock market.

1.3 Structure of the thesis

The thesis is divided into eight chapters. Chapter two contains a literature review and chapter three explains the methodology and the data used in the thesis. Chapters four, five and six use the three different synchronicity measures in an analysis of emerging and developed markets. A comparison between the three synchronicity measures is provided in chapter seven.

Chapter eight concludes the thesis, summarising the major findings of the research and emphasising the major contribution of this study to the existing literature.

CHAPTER 2 Literature review

2.1 Synchronicity definition

Synchronicity refers to the tendency for the stocks in a share market to move in the same direction. The stock co-movement direction can be upwards or downwards depending upon the trend in the market. It is argued that stock prices in poor economies are more synchronised over time than those in rich economies. However, finding a definition of stock market synchronicity is not an easy task. Roll (1988) argues that stock market synchronicity depends on the relative amounts of firm-level and market-wide information capitalised into stock prices. In addition, Morck et al. (2000) suggest that stock prices in high per capita GDP economies move in a relatively unsynchronised manner. In contrast, stock prices in low per capita GDP economies tend to move up or down together.

So we can define synchronicity as the co-movement of stocks of a share market in a particular period of time. Measuring stock synchronicity is a difficult task because this involves analysis of market-wide share price co-movement. For example, the New York Stock Exchange (NYSE) in the USA has approximately 4,049[1] firms listed in its stock market. To measure stock synchronicity of the NYSE, the study needs to collect each firm's weekly observations for a relatively long period of time, in our case 10 years. This could include about 2 million weekly firm observations.

2.2 Synchronicity measures

The most widely accepted measures of stock price synchronicity are proposed by Morck et al. (2000). They argue that synchronicity can be measured in different ways although they propose two approaches:

1. Classical synchronicity measure
2. R-square measure

[1] According to DataStream database on July 28, 2006

The third model of stock synchronicity is developed and proposed by Skaife et al. (2006) and is known as the zero-return days measure.

2.2.1 Classical synchronicity measure

The first model expresses the broad, market-wide movements at a particular time as a ratio that focuses on the tendency of stocks to move in the same direction. This model is referred to as the classical stock synchronicity measure. Morck et al. (2000) use this model to capture stock price synchronicity over a period of time for the market as a whole.

The classical synchronicity measure is defined by the following formula:

$$f_{jt} = \frac{MAX\left[n_{jt}^{up}, n_{jt}^{down}\right]}{n_{jt}^{up} + n_{jt}^{down}} \tag{1}$$

Here, f_{jt} is the fraction of the stock of country j in week t . n_{jt}^{up} is the number of the stock in country j whose prices rise in week t and n_{jt}^{down} is the number of stocks whose prices fall.

The classical synchronicity measure captures market-wide share price co-movements over a relatively short period of time, such as a given week. The other measures (R-square measure and zero-return measure) require relatively longer periods to capture share market price co-movement. It should be noted that the synchronicity measures captures the tendency of stock prices to move together. It is not based on a particular asset pricing model though it does have the ability to reflect firm specific information within a market.

However, the main strength of the classical synchronicity measure is that it is a simple model to capture stock price co-movement for a particular period of time. This measure requires only individual firm stock market return data to calculate market-wide share price co-movement. In contrast, one limitation of the classical synchronicity measure is that it requires market-wide stock return data by individual firm, which might be difficult to obtain. In addition, this measure is unable to provide individual firm-level stock synchronicity values, which are important for firm-level stock synchronicity analysis.

2.2.2 R-square measure

The second approach is the market model R-square estimate using all available firms in the share market. This approach captures levels of firm-specific information reflected in share prices. The R-square measure of stock price synchronicity is probably the most widely used method of capturing stock price co-movement in the literature. This measure captures stock price synchronicity at individual firm level, which is then averaged to give a country-level measure. It should be noted that, the R square measure of stock synchronicity is not expected to exhibit mean reversion over time. Higher R-square values indicate greater stock price synchronicity and lower R-square values indicate lower levels of stock price synchronicity.

The R-square is a strong measure to capture firm-level stock price synchronicity. This model measures the correlation between a firm's stock return data and market return data for a given period, which is generally considered to provide an accurate picture of stock market synchronous behaviour.

However, the R-square synchronicity measure is not able to capture stock market synchronicity for a short period of time, such as over a given week. In addition, this measure requires stock return data and market return data from individual firms to measure R-square synchronicity, which is a lengthy process.

2.2.3 Zero-return measure

The zero-return measure is a relatively new model developed by Skaife et al. (2006), who argue that the R-square statistics do not provide a reliable market-level measure of stock market synchronicity. They propose an alternative model to capture stock price synchronicity more effectively than the existing classical synchronicity and R-square measures. They argue that if the value of information signals is not sufficient to exceed the trading cost, then the marginal investor will not trade. Further, if the marginal investor stops trading then there will be no change in price and this will result in a zero-return day.

The zero-return days measure captures the variation in stock price synchronicity across firms due to the differences in firm-specific information. However, this model requires each firm's long-term stock return data to capture the market co-movement.

2.3 Recent literature

2.3.1 Synchronicity and its determinants

Morck et al. (2000) argue that share prices in stock markets in emerging economies move more closely together than in those of developed markets. They use bi-weekly return data to measure stock return synchronicity for 40 countries around the world, including 15,920 firms. They use data from 1993 to 1995 for time series analysis and the 1995 data for cross-sectional analysis. They argue that highly diversified conglomerate[2] companies account for a large fraction of stock market values and that widespread inter-corporate ownership might cause firms to move together.

Morck et al. (2000) find that stock price synchronicity is negatively correlated with a country's geographical size and positively correlated with GDP growth and earning co-movements. They argue that a 'small country effect' causes the higher stock price co-movement found in smaller countries. This finding is further supported by Levine and Zervos (1998), who argue that smaller countries often have unstructured financial markets leading to lower financial growth when compared to developed financial markets. In addition, Morck et al. (2000) find that stock price synchronicity could be affected by the number of stocks in a stock market. They argue that countries with fewer listed firms have stock markets that are more volatile and exhibit higher stock price synchronicity. Nevertheless, they argue that financial markets in emerging economies are more volatile because of the sharp changes in monetary policy and the higher inflation rate. For example, a sudden change in monetary policy is a quite common phenomenon along with changes in government in a country such as Indonesia.

Jin and Mayers (2006) examine the link between measures of corporate transparency and the R-square based measure of stock synchronicity. They find that in a more transparent environment, proportionately more firm-specific information is revealed to outside investors. As a result, market-wide information explains a smaller proportion of the overall return variation, resulting in lower levels of synchronisation and a lower average R-square for the market.

[2] A group of diverse companies run as a single organisation

Additionally, Morck et al. (2000) use three good governance indices as proposed by La-Porta et al. (1998) for cross-sectional analysis – government corruption, risk of expropriation by the government and risk of government repudiation of contracts. The indices range from zero (0) to ten (10), with zero indicating poor governance and 10 indicating strong governance. Morck et al. (2000) find that lower stock price co-movement exists in countries with better protection of private property rights and higher stock price co-movement exists in countries where private property rights are not strongly respected. They find that countries with poor protection of private property rights are mostly emerging countries, whereas higher levels of property rights protection are evident in developed economies. They also find that higher GDP per capita countries rank higher in good governance index values. For example, countries such as Germany, France, the UK and the USA score higher in the good governance indices and these countries also have higher GDP income per capita. Further, they find that those good governance indices are significantly correlated with capital market size. These findings suggest that capital market size is an important explanatory factor for stock synchronicity.

Morck et al. (2000) also argue that stock prices in economies with high per capita GDP are less synchronised than stock prices in low per capita GDP economies. They find that low GDP economies tend to be undiversified which makes firm earnings highly correlated, such that country-wide political instability is more likely to cause market-wide share price swings in emerging economies. Therefore, share prices in emerging economies tend to be more synchronous than in developed economies.

Li et al. (2003) argue that individual stocks are becoming more synchronous for the average country in the sample. They examine the Canadian stock market and compare this with Mexico and the East Asian markets[3], finding that Canadian stocks move less synchronously than Mexican stocks. They also find that since Canada entered into the free trade agreement with the US, its stocks have exhibited a permanent increase in firm-specific variation because of increased market openness to the US market. In contrast, when Mexico entered into NAFTA with the US its stocks exhibited a strong temporary increase in stock price synchronicity. They argue that developed economies like Canada, with well-developed

[3] Li et al. (2003) use *R-square* synchronicity measures for their cross-sectional analysis.

institutions, exhibit permanent increases in firm-specific stock return variation, whereas emerging economies exhibit temporary increases in share price co-movement due to these types of openings. In addition, they find evidence of similar types of temporary stock price co-movement in the East Asian financial markets as a result of economic liberalisation. It is argued that East Asian economies exhibited strong economic growth in the early 1990s but failed to maintain this growth due to their weak economic infrastructure. Li et al. (2003) suggest that in the 1990s individual firm synchronicity fell for the average country's stock market and they argue that the implementation of comprehensive institutional reforms in the 1990s in certain East Asian economies was followed by very large increases in the firm-specific variations between individual stocks. They find that institutional reform in such countries decreased market-wide economic fluctuations and also reduced market-wide stock price variation.

They argue that institutional reforms reduce the overall synchronicity of individual stock prices. For example, following strong political and economic reforms in Poland, inflation dropped dramatically. In the Soviet era Polish inflation was running at three-digit numbers (585.8 percent in 1990) but after the collapse of the Soviet Union, when Poland reformed its monetary and political policy, inflation dropped to a one-digit number within a few years (2.1 percent in 2005). This dramatic change in inflation was made possible by the liberalisation of monetary policy and the development of close economic ties with the Western world. Li et al. (2003) propose that less synchronous stock prices prevail in better functioning economies and highly synchronous stock returns tend to reflect poor economies.

Skaife et al. (2006) use the R-square synchronicity measure, which is associated with firm-specific information in an international setting, to conduct several analyses using data from the six largest equity markets in the world[4]. They find that lower R-square values are associated with more informative prices in Australia and higher R-square values are associated with more informative prices in Germany, Japan and the USA. In addition, they find a statistically significant association between future earnings and returns, conditional on R-square values, in France and the UK. They argue that there are significant differences in

[4] Skaife et al. (2006) use the six largest equity markets of the world for their R-square synchronicity analysis. Their sample countries are Australia, France, Germany, Japan, the UK and the USA.

voluntary information flow, ownership structures, trading activity and market frictions across countries and this affects the price formation process in these markets.

Skaife et al. (2006) conduct five different analyses using the data from the six sample countries. Their first analysis is based on the work of Morck et al. (2000), who suggest that stock synchronicity measures are associated with the more informative prices from the individual firms. However, Skaife et al. (2006) find that lower R-square values are not associated with more informative stock market prices in Australia, France, Germany, Japan, the UK and the USA. Moreover, they find that higher R-square values are associated with more informative prices in Japan, Germany and the USA. They do not find any statistically significant association between a firm's future earnings and the R-square values in France and the UK and so they reject the hypothesis that lower R-square values are associated with more informative prices and suggest that higher R-square values could also be associated with greater informative prices in some countries, such as Japan. Further, they state that R-square based measures of stock synchronicity are not good measures of stock price co-movement. They suggest that R-square statistics are not able to reflect fully the informativeness of stock prices in a country.

Their second analysis, which examines the correlation between the R-square measure of stock synchronicity and analyst forecast error, finds evidence of a positive correlation in Australia, France, Germany, the UK and the USA – the only exception being Japan. However, they find evidence that firms with higher R-square values have lower analyst forecast error, which contradicts the findings of Li et al. (2003).

In addition, Skaife et al. (2006) test whether firms that cross-list in the USA stock market lower their stock price synchronicity measures in Australia, France, Germany, Japan and the UK. According to the US law, cross-listing registration requires more information disclosure by foreign firms in the USA. They find no evidence that R-square values decline after cross-listing on the USA stock market. In contrast, they find that R-square values for French and UK firms increase after cross-listing. This surprising result seriously questions the reliability of the R-square synchronicity measure for cross-country analysis and stock synchronicity analysis.

Skaife et al. (2006) also examine the correlation between synchronicity measures and proxy firm informativeness variables that are reflected in the stock prices[5], finding some inconsistent correlations between R-square synchronicity measures and information proxies across the sample countries. This inconsistency raises further questions concerning the reliability of the R-square statistic measure for stock price synchronicity.

Skaife et al. (2006) argue that R-square statistics are not a reliable measure of stock market synchronicity and propose an alternative model. Based on the work of Bekaert et al. (2003), they suggest that the proportion of zero-return days provides a simple, accurate measure that captures firm-specific information.

They repeat their analysis using the proportion of zero-return days metric and find a significant and consistent relationship between the zero-return metric and information proxies. They recommend the proportion of zero-return days[6] as a better measure of stock price synchronicity than the traditional models, and this measure appears to capture the frequency of information arrival which tends to result in lower zero-return days.

The concept of stock market synchronicity is not new to the literature of finance and economics. For example, French and Roll (1986) and Roll (1988) argue that high stock prices and a well-informed market generate low stock synchronicity. Roll (1988) shows that the movement of stock prices depends on several related factors which include firm-level and market-level information that is capitalised into stock prices. They find that the US stock returns are more volatile during exchange trading hours compared with non-trading hours. They argue that private information is the principal factor behind high trading time variance. Conversely, both French and Roll (1986) and Roll (1988) suggest that most variations in stock prices reflect proprietary firm-specific information.[7]

[5] The proxy firm informative variables include quality of firm information flow, firm size, turnover and industry regulation.
[6] Alternatively, zero-return metric.
[7] Further work on correlation is done by Brennan et al. (1998) while it is beyond the scope of the thesis.

2.3.2 Co-movement across international markets

Karolyi and Stulz (1995) investigate the co-movement between the USA and Japanese stock markets focusing on the daily stock return data. They find evidence that the US and the Japanese cross-country return covariance exhibits a strong 'day of the week' effect and covariance is higher for Monday returns than for other days. They also find evidence that firm covariance in returns is not as high on days of US macroeconomic announcements. They suggest therefore that the global component of national macroeconomic announcements has only a small effect. In addition, Karolyi and Stulz (1995) state that there is a nonlinear relationship between covariance and international stocks. Essentially, the large overnight returns of Japanese stocks lead to higher covariance in the next day's stock returns on the US stock market. Indeed, there is evidence that overnight return covariance is greater for similar firms.

Longin and Solnik (1995) analyse the correlation of monthly excess returns for seven major countries for the period from 1960 to 1990. They find evidence that correlation increases over time and large stocks drive the correlations. In addition, they find that correlation is driven by dividend yield and interest rates. They use a GARCH model with constant conditional correlation for their analysis and find that international correlation is unstable over time, although growing international financial integration around the world could lead to a progressive increase in international market correlation. They argue that international market correlation is higher when the stock markets are volatile, especially when the markets are down. In addition, they argue that growing political, economic and financial market integration affects international financial market co-movement, as more integrated economies are influenced by global market factors. The progressive increase in the number of internationally integrated equity markets will lead to higher correlation between firms worldwide. They further argue that the progressive removal of international investment barriers[8] affects international market co-movements. It is suggested, however, that macroeconomic announcements contain information for daily and intra-day share market returns which may cause the larger stocks to move in the same direction.

[8] Such as financial, political and legal barriers.

Longin and Solnik (1995) find that international equity market correlation is increasing, particularly over the past 30 years and further, the increase in correlation is accompanied by an increase in volatility. There is also some evidence that economic variables, such as dividend yield and interest rates, contain information about future volatility and correlation.

Wurgler (2000) proposes that capital flow is more responsive to value added in countries where firm-specific variation is a greater part of the total variation of individual stock returns. He suggests that capital moves faster to higher-value uses where stock prices move less synchronously. Thus, stock synchronicity is higher in low GDP economies than in high GDP economies.

Nguyen and Aman (2006) observe that corporate governance mechanisms are positively correlated with higher stock price valuation and market valuation in the Japanese stock market. They construct three critical dimensions for governance indices: board structure, ownership composition and disclosure policy, suggesting that ownership structure is one of the most important factors in determining a firm's performance. Further, they argue that accounting transparency has a positive effect on a firm's market valuation.

2.4 Explanatory variables

As one of the main objectives of this thesis is to compare the measures of stock synchronicity, the study can not focus on the firm-specific variables but rather it focuses particularly on the country-wide stock market synchronicity variables. It has been argued that stock price synchronicity is influenced by several economic factors such as corporate transparency, information disclosure and GDP per capita. It is argued that these factors are influential in explaining stock market co-movement for an emerging market. For example, Morck et al. (2000) use macroeconomic instability, small country effects, economic and managerial diversification, synchronous fundamentals and inflation as stock synchronicity descriptive variables and suggests that these variables help to explain stock price co-movement in emerging markets.

In addition, Dasgupta et al.(2006) argue that corporate transparency and stock price synchronicity are strongly correlated, suggesting that greater transparency indicates early and timely disclosure of firm-specific information. Accordingly, stock synchronicity decreases as corporate disclosure and greater transparency increase. They use corporate transparency and cross-listing (ADR) disclosure as descriptive variables for their stock synchronicity analysis. In contrast, Chan and Hameed (2006) use the trading volume of stocks as a descriptive variable to explain stock synchronicity for individual firms. They find that size of the firms has a strong impact on market-wide share price swings and that, when the number of stocks within a market is small, a few large companies tend to dominate overall market movements. Thus, there is evidence of two approaches in the literature. While the first focuses on country-level analysis, the second looks more closely at individual firm-based effects. In this thesis the focus is on country-wide effects, rather than firm-specific effects.

Table 2.1 illustrates the explanatory variables used in recent cross-sectional analyses of share market synchronicity. The table shows that Morck et al. (2000) use only the classical synchronicity measure, while Skaife et al. (2006) use both the zero-return and R-square measures. The R-square measure has been used in every study to date as a measure of stock co-movement analysis, although Skaife et al. (2006) have recently criticised it.

Most of the published literature concentrates on firm-level cross-sectional analysis rather than country-level analysis of stock synchronicity. For example, Durnev et al. (2004a) use corporate diversification, industry size, leverage, advertising spending and R&D spending; Durnev et al. (2004b) use industry size and industry structure variables; Baker et al. (2003) use market capitalisation of the firm, growth rate, market value traded and growth rate of sales variables, while Skaife et al. (2006) use research and development expense, analyst earnings forecast, proportion of shares, standard deviation of sales, standard deviation of ROA, market value of equity and average weekly turnover.

Given the focus of this thesis on country-level analyses, the study does not rely on firm-level explanatory variables in statistical analysis. Further, while a number of explanatory variables have been proposed in the literature they are not all statistically significant. For example, Morck et al. (2000) use several country-level and firm-level explanatory variables

in their analysis, though few of the firm-level variables are found to be statistically significant (e.g. earnings co-movement index and firms variance index).

Table 2.1 Summary of stock synchronicity measures and explanatory variables

Recent literature analysis

No	Author and year	Explanatory variables used	Measure used
1	Morck et al. (2000)	Property rights, good governance index**, no of stock listed in the market**, anti-director right index, GDP per capital*, geographical size*, earning co-movement index, variance on GDP growth.	R-square measure Classical Measure
2	Skaife et al.(2006)	Firm's research and development expense**, analysts forecast earnings**, standard deviation of ROA**, market value of equity**, average weekly turnover **	R-square measure Zero-return measure
3	Li et al. (2003)	Trade openness, capital openness**, good governance, Asian crisis dummy, real crisis dummy, Peso dummy.	R-square measure
4	Durnev et al. (2003)	Industry structure**, size*, diversification**, past earnings volatility, volatility of beta, institutional ownership, research and development expenses, past industry returns, future dividends explanatory power.	R-square measure
5	Durnev et al. (2004b)	Size, liquidity**, leverage**, advertising expenses*, R&D expenses**, firm-specific stock return variation, absolute systematic stock return variation, relative firm-specific stock return variation**, absolute firm-specific fundamental variation**, corporate diversification, relative firm-specific fundamental variation, Herfindahl index**.	R-square measure
6	Chan and Hameed (2006)	Synchronicity, analyst coverage*, size**, trading volume, firm capitalisation.	R-square measure
7	Durnev et al. (2004a)	Market size, initial GDP*, inflation, trade openness*, government size**, bank credit, market capitalisation*, rule of law, educational expenses.	R-square measure

Note:

* represents the significant level by 5 percent and ** indicates the significant level by 10 percent.

A suite of country-level indicator variables has become available in recent times and the explanatory power of these variables is a primary focus of this analysis. They include corporate transparency, information disclosure, political connectivity, legal rule and market openness, although the study also includes commonly used control variables such as GDP per capita and country size for the analysis of stock synchronicity in emerging markets. The following section will discusses these explanatory variables and their ability to explain stock price co-movement in emerging markets.

2.4.1 Corporate transparency and information disclosure

Lack of corporate transparency and poor information disclosure can lead to high levels of stock price synchronicity. It is argued that countries with poor information disclosure and a lack of corporate transparency exhibit higher stock price synchronicity. For example, Chan and Hameed (2006) suggest that emerging markets exhibit poor information disclosure and lack of corporate transparency and this increases the cost of collecting firm-specific information. As a result, security analysts tend to generate their earnings forecasts based on macroeconomic information. Hence, the share prices of firms with poor corporate transparency in emerging markets generate less firm-specific information leading to greater levels of synchronicity in share price movements across the market.

Further, Durnev et al. (2004b) and Durnev et al. (2003) find that higher firm-specific stock price variation is associated with higher information content about future earnings. While Piotroski and Darren (2004) find that stock price synchronicity increases with analyst coverage, they argue that analysts specialise by industry and greater industry and market-wide information tends to get impounded in stock prices.

In contrast, Jin and Mayers (2006) examine the link between corporate transparency and synchronicity and they find that in a more transparent environment, proportionately more firm-specific information is revealed to outside investors. Therefore, market-wide information explains a smaller proportion of the overall return variation, resulting in lower levels of synchronisation.

Dasgupta et al. (2006) present a simple model to illustrate that a more transparent information environment can have an ambiguous effect on measures of stock synchronicity, particularly R-square measures. They suggest that the R-square measure can increase

subsequent to an improvement in corporate transparency through two channels. First, greater transparency (cross-listings) leads to timely disclosure of firm-specific information about future events. So when future events eventually take place there is less surprise news about shares, resulting in a higher R-square. Second, greater transparency allows financial market participants to gain access to firm-specific information, such as managerial quality, leading to a higher R-square. This critique seriously questions the standard synchronicity measure, the R-square, developed by Morck et al. (2000).

However, corporate transparency and information disclosure have an effect on stock price synchronicity. Poor information disclosure and the lack of corporate transparency are often cited as the main causes of higher stock price synchronicity in emerging economies, examples of which include Poland, Malaysia and Indonesia. Yet, well-structured financial markets with good information disclosure and corporate transparency are argued to exhibit low levels of stock price synchronicity, for example Germany, Australia and the UK.

2.4.2 Legal environment

A country's legal structure (origin) has a strong effect on the protection of investor rights. For example, French-based civil law origin countries generally provide weaker protection of investor rights compared to countries of English-based common law origin. La-Porta et al. (1998) examine the legal rules covering protection of corporate shareholders and creditors, the origin of these rules and the enforcement quality for a sample of 49 countries. They argue that there are important differences in investor protection attributed to the legal origin of a country. Further, countries with weak investor protection limit investor participation in the capital markets and encourage private ownership. They divide the world into three basic legal origin categories: German- and Scandinavian-based civil law countries, French-based civil law countries and English-based common law countries. They find that French-based civil law countries have the weakest investor protection and the least developed capital markets compared with English-based common law countries.

La-Porta et al. (1998) also examine voting rights, ease of participation in corporate voting and legal protection against expropriation by management. They argue that common law countries provide shareholders and creditors with the strongest protection and French-based civil law countries the weakest. In addition, the quality of law enforcement is the

highest in countries based on Scandinavian and German civil law and weakest countries based on French civil law. Further, La-Porta et al. (1998) examine the anti-director rights of these countries, which also include voting rights.[9] They argue that common law countries offer the best legal protection to their shareholders. They also find that 94 percent of common law countries provide protection to minority shareholders, which is the highest for the three categories. For example, common law countries allow shareholders with as little as 9 percent of total share capital to call an extraordinary shareholder meeting, which is the lowest percentage for the three legal systems. In contrast, La-Porta et al. (1998) argue that French-based civil law countries offer the least legal protection to their shareholders. They find that such countries require around 15 percent of share capital to call an extraordinary shareholders meeting. In addition, they find that the aggregate anti-director rights score for French-based civil law countries is the lowest of the three legal systems.

Durnev et al. (2004b) and De Long et al. (1990) state that an institutional environment which protects private property rights is an important precursor to economic growth. They suggest that property rights protect shareholder rights in emerging economies, which leads to higher productivity and higher economic growth. In addition, Shleifer and Vishny (1997) and Shleifer (1994) argue that a very high ownership concentration may reflect poor investor protection. It is found that a higher incidence of ownership concentration is evident in civil law countries. They also examine ownership concentration in the largest publicly traded companies in their sample and find a strong negative correlation between concentration of ownership and the quality of investor protection. This argument suggests that countries with a high level of ownership concentration often provide weak investor protection.

2.4.3 Country size

The debt and equity market size of a country often depends on the geographical size of that country. It is argued that most of the countries of the world conduct the major part of their trading internally. Large countries often have structured debt and equity markets which directly influence the growth of the economy (Australia, Canada, Germany and the USA) and they generally have larger capital markets. In contrast, smaller countries tend to have fewer

[9] Anti-director rights measures the quality of law enforcement in favoring minority shareholders against the managers or dominant shareholders in the corporate decision-making and voting processes.

large firms in their capital market. These few large firms can manipulate the financial markets, which could lead to higher stock price synchronicity. For example, Morck et al. (2000) argue that the size of the economy is an important factor in explaining stock market synchronicity. They state that economic activities in less developed economies are concentrated in a small geographical area, while large economies are more likely to be diversified across geographical area and across several industries. They suggest that small economies are likely to be more specialised with a few large firms comprising a large portion of economic activity. Levine (1998) also argues that smaller countries often have smaller debt and equity markets and poor investor protection rights; associated with higher stock price synchronicity.

Levine and Zervos (1998) argue that developed countries have large structured debt and equity markets and these structured financial markets contribute to economic growth. They state that countries with developed financial markets have superior growth in capital-intensive sectors. In addition, they argue that size of the country also helps the local firms to produce locally and gives the economy superior growth opportunities. Further, they state that a firm in a large country (China, India and Brazil) has competitive cost advantages over one in a small country. These countries have higher GDP growth rates despite structural problems, and large population size also gives these countries a competitive advantage over smaller countries.

Further, financial markets in large countries tend to be more structured than markets in smaller countries and capital market manipulation is more difficult due to the large number of companies participating in these markets (Bernstein and Weinstein, 2002). In contrast, few big firms exist in small economies and so it is possible for them to manipulate the financial market (Islam, 1988; Islam and Khaled, 2005; Security-And-Exchange-Commission, 1998). Thus capital market size gives the large economies a better functioning and less synchronous stock market.

2.4.4 Political connection

The political connections of firms play a vital role in the business sectors of emerging economies. Firms with close political connections often receive undue favours from the government and in countries with higher corruption rates this situation is even more critical.

For example, Shleifer (1994) argues that politicians in developing countries are very influential in the business and financial sectors. He states that a politician can shut down a business or even refuse to start a business using a variety of tactics such as licensing requirements, legislation and repudiation of commitments. In addition, Fisman (2001) finds that approximately 25 percent of the market values of Indonesian companies are related to political connections. Further, Leuz and Oberholzer (2006) find that politically well-connected firms also attract more investment opportunities for foreign investors. They analyse 130 Indonesian firms which represent over 80% of the Indonesian market capitalisation in December 1996 and find that firms with close political connections do receive undue favours from the Government.

Leuz and Oberholzer (2006) analyse the link between a firm's political connections and international financing, using the data from Indonesian firms. They find evidence that foreign security and political connections under the Suharto regime were legitimate and firms with close ties to the regime were less likely to use foreign debt or equity markets. They argue that political relationships influence global financing for local firms[10]. Firms connected with the Suharto regime did not participate in global financial markets because they attracted benefits from the regime as long as Suharto was in power. When the connection to Suharto was lost due to the change in leadership, raising capital from abroad became a more fruitful solution for those no longer politically well-connected firms.

Leuz and Oberholzer (2006) argue that political ties influence the performance of Indonesian firms in two ways. First, firms with strong political connections underperformed during the Asian financial crisis. Second, investments in political relationships stopped paying off when the Suharto Government was replaced. They suggest that investments in political ties are less desirable for long-term loans in such environments where political stability does not exist. An example is an Indonesian firm called Golden Key, which had a close political relation with the former Suharto regime. Leuz and Oberholzer (2006) state that 'Golden Key is a little-known chemical and manufacturing group, which received an unsecured loan of $430 million from the state-owned Bank Pembangunan Indonesia. Court proceedings subsequently revealed that Hutomo Mandala Putra, the youngest son of President Suharto,

[10] Leuz and Oberholzer. (2006) also argue that firms closely connected with the Suharto regime tended to under-perform during the time of the Asian financial crisis.

was an early investor in Golden Key and had introduced the firm to bank officials who approved the loan at 'neck-breaking speed''(McBeth, 1994)

This is a common phenomenon in emerging economies and the main reason that firms in emerging economies are less interested in raising capital globally. On the other hand, politically well-connected firms can receive cheap government funding and so a large proportion of well-connected firms in emerging markets are not keen to raise capital abroad. For example, Faccio et al (2006) and Wiwattanakantang et al (2006) show that firms with political connections often receive cheap loans from state-owned banks in emerging markets.

Finally, Leuz and Oberholzer (2006) state that long-run political connections could be hazardous at times for emerging market firms. Political connections can lose their value overnight when the government fails to win an election, or when the current leaders are deposed. They suggest that the performance of firms with close political connections is very much dependent upon the political situation at the time.

2.4.5 Gross domestic product (GDP) per capita

Gross domestic product (GDP) per capita is an influential factor in determining stock synchronicity. It is argued that financial markets in high GDP per capita economies are diversified into a large number of firms, where as poor GDP per capita economies tend to concentrate on a few large firms, which could manipulate the share market and push share prices from their fundamental value. For example, Morck et al (2000) suggest that stock prices in economies with high per capita GDP move in a relatively unsynchronised manner in contrast to stock prices in low per capita GDP economies. They argue that low GDP per capita economies often cannot provide proper protection of property rights and country-wide political instability causes market-wide share price swings. Durnev et al. (2004a) also propose that stock returns in low-GDP per capita economies (including economies in transition) tend to move synchronously.

In addition, low GDP per capita economies also tend to have higher corruption rates and smaller debt and equity markets, and private property rights are not properly respected in low GDP per capita economies in general. For example, Chan and Hameed (2006) show that poor information disclosure and lack of corporate transparency causes higher stock price co-movements and market-wide share price swings in emerging markets. They argue that

emerging economies have higher inflation and higher unemployment rates, and that corporate governance mechanisms are less effective in these economies.

2.4.6 Corporate governance mechanisms

It is often argued that stock market synchronicity is closely related to the real market economy and this has implications for corporate governance. For example, Morck et al. (2000) show that corporate governance mechanisms are more effective when the stock market begins to fall. In addition, they suggest that strong property rights promote detailed firm-specific information releases, leading to lower stock price synchronicity. Thus, it is argued that greater levels of stock synchronicity are expected in countries with poor corporate governance systems.

Morck et al. (2000) found that corporate governance mechanisms, such as shareholder lawsuits, proxy contests and executive stock options, are the major influential factors in explaining the difference between poorly-run companies and well-developed firms. They state that corporate governance mechanisms are more effective when more differentiable, firm-specific performance is available through existing information channels. This thesis uses two corporate governance indicators for the synchronicity analysis collected from the World Bank. These indicators are voice and accountability and the regulatory control of the government, which are explained in detail in the data chapter.

2.5 Conclusion

It has been argued that emerging economies produce higher stock synchronicity due to weak infrastructure and less respect for investor protection rights. Academics use a number of explanatory variables to justify higher stock market synchronicity in emerging markets. For example, Morck et al. (2000) find that country size and GDP per capita affect stock price synchronicity in emerging markets. Further, Leuz and Oberholzer (2006), Durnev et al. (2004a) and Fisman (2001) also find that political connection and legal environment have a strong impact on emerging market stock co-movement. This study focuses on a set of explanatory variables drawn from the literature in explaining stock market synchronicity at the country level; these are corporate transparency, regulatory control, voice and

accountability, inflation, trade openness, GDP per capita and country size index. The thesis does not include the firm-level explanatory variable as it is not the main objective of this research.

Finally, it is found from the existing literature that stock markets in emerging economies are more synchronous over the time than in developed markets. Higher stock synchronicity is evident from countries that do not respect private property rights, and corporate governance mechanisms are less effective in those economies. It is also found that higher inflation and low levels of corporate transparency cause higher stock synchronicity in emerging economies.

CHAPTER 3 Methodology and data

3.1 Research methodology

This thesis uses three stock synchronicity measures to capture stock price co-movement. The first and second measures are proposed by Morck et al. (2000) and the third has been developed by Skaife et al. (2006). In addition, this thesis also uses t test statistics, ANOVA, VAR, autocorrelation, ADF test statistics and panel data analysis for time series and cross sectional analysis. The following sections discuss research methodology and different analytical tool used for this research.

3.1.1 Measure One: Classical synchronicity measure

The first stock synchronicity measure is the classical synchronicity measure. Developed by Morck et al. (2000), it is a model designed to capture the tendency for stock price co-movement. It analyses market-wide share price movement in a particular period and focuses on the tendency of stocks to move in a same direction right across the market. The following equation illustrates the classical synchronicity measure developed by Morck et al. (2000).

$$f_{jt} = \frac{MAX\left[n_{jt}^{up}, n_{jt}^{down}\right]}{n_{jt}^{up} + n_{jt}^{down}} \tag{2}$$

Here, f_{jt} is the net change in price (whether up or down) of the stock of country j in week t. n_{jt}^{up} is the number of the stock in country j whose prices rise in week t and n_{jt}^{down} is the number of stocks whose prices fall.

This measure has a maximum of 1.0 for markets where the share prices are perfectly synchronised and a minimum of 0.5 where there are equal numbers of rises and falls over the period, consistent with a market where prices are not synchronised. The classical stock synchronicity measure is further explained by the following example.

Assume country A has four listed firms available in its stock market, firms A, B, C and D (Table 3.1). The following table illustrates the weekly share prices of these listed firms over a five-week period.

Table 3.1 Example: Classical synchronicity measure

Week	Company A	Company B	Company C	Company D
1	5	5	10	8
2	6	4	11	7
3	7	5	12	6
4	6	4	11	9
5	7	4	10	9

In week one, the share price for firm A is \$5, firm B is \$5, firm C is \$10 and firm D is \$8. In week two, the share prices of firm A and C increase, but share price for firm B and D drops. Now by inserting this information into the classical stock synchronicity measure developed by Morck et al. (2000) stock synchronicity for week two is:

$$f_{JT} = \frac{MAX[2,2]}{2+2} \quad (3)$$

$$= 0.50$$

Therefore, stock synchronicity for week two is 0.50 or 50%. This indicates that there are equal numbers of share price increases and decreases for this week. Stock synchronicity for week three, four and five can also be calculated by using the same formula. Table 3.2 provides stock synchronicity measures for weeks two, three, four and five.

Table 3.2 Results: Classical measure example

Week	Up	% share Up	Down	% share down	Synchronicity
1	0	0	0	0	---
2	2	50%	2	50%	0.50
3	3	75%	1	25%	0.75
4	1	25%	3	75%	0.75
5	1	25%	1	25%	0.50

Table 3.2 shows that in week three stock synchronicity is 75% with three share prices up and one share price down. In week four, stock synchronicity is also 75% with three share prices down and one with share price up. For week five, one share price is up and one share price is down and two share prices remain unchanged, resulting in 50% stock synchronicity.

Classical stock synchronicity is a relatively simple measure that is used to capture stock price co-movement. This study will use this model as the first measure to capture market wide share price synchronicity.

3.1.2 Measure Two: R-square measure

The R-square synchronicity measure is the most popular model in the literature for capturing stock market synchronicity. Chan and Hameed (2006) argue that R-square statistics provide an alternative measure of stock price synchronicity. They use this measure to explain analyst coverage for emerging markets and argue that emerging economies exhibit higher stock price co-movement due to the high cost of collecting firm-specific information in emerging economies. Further, Roll (1988) suggests that individual stocks in the USA exhibit low R-square statistics, which indicates a low level of stock price co-movement for the US economy. He argues that the availability of firm-specific information in the USA stock market may explain the low R-square.

Morck et al. (2000) are among first who propose R-square statistics as an alternative measure of stock synchronicity. They argue that lower firm-specific information is produced in emerging markets which results in higher R-square values, while higher firm-specific information produced in developed markets results in lower R-square values. They state that emerging economies often have higher stock synchronicity due to poor corporate governance mechanisms. For example, Jin and Mayers (2006) argue that countries with higher R-square values experience more frequent market crashes.

Given the simple market model, share return can be expressed as a fraction of share market return:

$$R_{i,t} = \alpha_i + \beta_i R_{m,it} + \varepsilon_{i,t} \quad (4)$$

where $R_{i,t}$ is the firm i return for period t, $R_{m,it}$ is the market return of firm i for t period, $\varepsilon_{i,t}$ is the error term and α_1 and β_i are estimated parameters. The R^2 measure is the percentage of variation in weekly return of stock i in country j explained by variations in country j 's market return, or:

$$R_{it}^2 = \left(\frac{Cov(R_i \; R_m)}{\sigma_i \; \sigma_m} \right)^2 \tag{5}$$

where Cov($R_i R_m$) is the covariance between the share returns and share market returns and σ_i is the standard deviation for asset i and σ_m is the standard deviation for asset m.

A high R-square indicates a high degree of stock return synchronicity and a low R-square indicates a low degree of stock return synchronicity for a given stock for a particular period of time. This study uses R-square as the second measure of stock return synchronicity.

3.1.3 Measure Three: Zero-return measure

The zero-return measure is a comparatively new model for capturing stock market synchronicity. Skaife et al. (2006) first proposed this measure, claiming that it is a better model to capture stock synchronicity. They argue that marginal investors have information about share prices in the market. If the value of an information signal is insufficient to exceed the trading cost, then the marginal investor will not trade the share and there is no change in price, leading to a zero-return days.

The thesis defines zero-return measure as a model of the frequency of information arrival for a particular share in a given time. The zero-return measure can also be used as a model of information efficiency for a share market.

The proportion of zero-return days is measured by calculating the number of zero-return trading days over a fiscal year divided by the total number of trading days in that fiscal year. A zero-return day is a day on which the price of a particular share does not change

The zero-return measure is calculated as follows:

$$NOZRD = \frac{No\ of\ Zero\ \mathrm{Re}turn\ Days}{Total\ Trading\ Days\ in\ the\ Year} \times 100 \tag{6}$$

The following example illustrates the calculation of the zero-return measure. Referring to the previous example, the number of zero-return days can be easily calculated. Table 3.3 illustrates the number of zero-return days for firms A, B, C and D.

Table 3.3 Example: Zero return measure

Week	Firm A	Return	Firm B	Return	Firm C	Return	Firm D	Return
1	5	N/A	5	N/A	10	N/A	8	N/A
2	6	0.200	4	-0.200	11	0.100	7	-0.125
3	7	0.167	5	0.250	12	0.091	6	-0.143
4	6	-0.143	4	-0.200	11	-0.083	9	0.500
5	7	0.167	4	0*	10	-0.091	9	0*
Average		0		25		0		25

The figure with star illustrates the zero-return days for firms A, B, C and D. Week one provides no return data for this sample because of the lack of previous trading day data. Weeks two, three and four provide a mix of return data (positive and negative) for each firm. However, week five produces zero-return trading days for firms B and D in this example. In addition, the zero-return measure for firm B and D is 25 percent and the zero-return measure for this stock market is 12.5 percent ((0+0.25+0+0.25)/ 4).

3.1.4 Panel data

Panel data is one of the most important types of data analysis methods, combining both cross-sectional and time series analysis. One of the major advantages of panel data is that it can observe multiple cases at two or more time periods for one firm. This study uses panel data analysis in chapter four, five and six. According to Dougherty (2007) the setup of the panel data model can be described by the following equation:

$$y_i = \alpha + \beta X_{it} + \varepsilon_{it} \tag{7}$$

Where,

α = intercept of the population

β = vector of parameter to be estimated on explanatory variable

X_{it} = vector of observation on the explanatory variables for country i at time t.

ε_{it} = random error for country i at time t.

There are two types of panels, a balanced panel and an unbalanced panel. Balanced panels has the same number of time series observations for each cross sectional unit, where as unbalanced panels have some cross sectional elements with fewer observations or observations to different time to other.

Panel data models can include group effects, time effects or both. These effects are modelled using either fixed effect or random effect. This thesis uses fixed effect panel analysis. The fixed effect model examines group differences in intercepts, assuming the same slopes and constant variance across groups. Fixed effect model can be described in the following equation.

$$y_{it} = \beta X_{it} + \alpha_i + \alpha_t + u_{it} \quad (8)$$

Where,

β = vector of parameter to be estimated on explanatory variable

X_{it} = vector of observation on the explanatory variables

α_i = fixed effect to be estimated for each country

α_t = fixed effect estimated for country i at time t.

u_{it} = error term for country i at time t.

3.1.5 ANOVA

ANOVA is a general technique that is used to test the hypothesis that the means among two or more groups are equal; under the assumption that the sampled populations are normally distributed (Brooks, C., 2008). The thesis uses ANOVA test statistics for comparing the mean between groups of countries, especially between developed and emerging country group.

The ANOVA test statistics can be describe by the following equation derived from Levine et al. (2005)

$$ANOVA\ Test\ Statistics = \frac{MSA}{MSW} \quad (9)$$

Where, MSA = mean square among or variance of the group mean and MSW = mean square within or variance of mean within. The ANOVA F statistics is F distributed. However, MSA and MSW can also be denoted by the following formula.

$$MSA = \frac{SSA}{c-1} \tag{10}$$

SA is the sum of square among the group and c is the number of groups or levels being compared, and

$$MSW = \frac{SSW}{n-c} \tag{11}$$

Where, SSW is the sum of square within the group, n is the number of observation in group and c is the number of group.

3.1.6 VAR

Vector Auto Regression (VAR) is a popular econometric model, which is used to capture the interdependencies between multiple time series. VAR is considered a kind of hybrid between the univariate time series models and it is a very useful for describing the dynamic behaviour of economic time series. The thesis uses VAR models for estimating and forecasting the relationship between geographical region time series behaviour. Following Wooldridge, J. (2006) and Brooks, C. (2008), VAR can be denoted by following equation:

$$y_t = c + A_1 y_{t-1} + A_2 y_{t-2} + ... + A_p y_{t-t} + e_t \tag{12}$$

Where c is a constants (intercept), A_1 is matrix, y_t is a vector of time series variables and e_t is vector of error terms.

3.1.7 Auto Correlation

Autocorrelation is the correlation between values of a process at different points in time (Dougherty, 2007; Levine et al., 2005). The Autocorrelation function is very useful for

finding repeating patterns in a signal or a time series. The autocorrelation function can be defined by the following equation:

$$AC(i) = \frac{Cov(\alpha_{t,}, \alpha_{t-1})}{\delta_{t,}\, \delta_{t-i}} \tag{13}$$

Where, $Cov(\alpha_t, \alpha_{t-i})$ is the covariance of α_t and α_{t-i} and δ_t is the standard deviation of t and $t-i$.

An autocorrelation coefficient could have a value ranging from negative one to positive one. A value of positive one (+1) represents perfect positive correlation, which indicates an increase in one time series value lead to a proportionate increase in the next time series value. A value of negative one (-1) represents perfect negative correlation, that is an increase of one time series value result in a proportionate decrease in the next time series value.

3.2 Sample Selections

The thesis will analyse stock market data from 41 countries, including 34 emerging markets and seven developed economies. The emerging markets are taken from a range of geographical locations. The main criteria for selecting emerging markets include geographical location, legal origin, size of the equity market and the availability of data from DataStream.

Legal origin of a country is one of the dominant factors in selecting an emerging economy for this study. It is argued that legal origin has an enormous effect on investor protection rights in both debt and equity markets. For example, La-Porta et al. (1998) conduct an empirical study on the legal origin of 49 countries around the world. They examine whether investor protection and minority shareholders' rights are affected by the legal origin of the country. They suggest that countries with French-based civil law have the weakest investor protection and the least developed capital markets compared to common-law countries and German-based civil law countries. In addition they argue that German-based civil law countries have the strongest legal system implementation and that French-based civil law countries display the weakest implementation of law.

This study divides emerging economies into three basic categories: English-based common law countries; French- and German-based civil law countries and the former

communist states. Developed economies are not classified into any specific legal origin but are allocated into a single category.

However, among the emerging economies Zimbabwe requires some special consideration. According to the CIA (2007) website the Zimbabwean[11] legal system is a mixture of Roman-Dutch law and English-based common law. Further, the Zimbabwean legal system modified the Criminal Law code to the Common Criminal Law code, which replaced the Roman-Dutch Criminal Law system. As a result Zimbabwe's legal origin is classified as based on common law. The thesis uses DataStream and Yahoo finance for the data used in the analysis to follow.

Table 3.4 Legal origin of selected countries
Based on the legal system of the country

Common law countries	Civil law countries	Post-communist	Developed countries
Bangladesh	Argentina	China	Australia
Cyprus	Brazil	Poland	France
Egypt	Chile	Russia	Germany
Hong Kong	Columbia		Japan
India	Czech Republic		New Zealand
Kenya	Ecuador		UK
Malaysia	Greece		USA
Pakistan	Hungary		
South Africa	Indonesia		
Singapore	Korea		
Sri-Lanka	Mexico		
Zimbabwe	Peru		
	Philippines		
	Portugal		
	Spain		
	Taiwan		
	Thailand		
	Turkey		
	Venezuela		

Table 3.4 provides a list of the selected emerging countries and developed countries used in this study. The list contain 12 emerging countries of English-based common law origin, 19 emerging countries of French- or German-based civil law origin, three countries of post-communist origin and the seven developed countries. The sample size from the post-

[11] The CIA website access date 25/02/2005.
(https://www.cia.gov/library/publications/the-world-factbook/geos/zi.html)

communist countries is three, owing to a lack of reliable data for other countries that fall within this classification. Emerging countries have also been selected from various geographical locations around the world to capture the possibility of changes in stock synchronicity across different geographical locations.

The geographical locations are further divided into six categories: South America, Africa, Europe, Asia Pacific, South Asia and Central Asia. The largest number of emerging countries is selected from the Asia Pacific geographical location (nine countries) and the South American region (eight countries) due to the greater number of emerging markets in these regions. Table 3.5 provides the geographical breakup of the emerging countries selected.

Only two countries, Turkey and Cyprus, are selected from the Central Asian region due to the lack of reliable data from the other countries within that region. The main source of the weekly data is DataStream, although Yahoo finance is used to fill gaps as they arise. Neither database provides reliable and complete datasets for the other Central Asian countries.

Table 3.5 Geographical segment of selected countries
Based on the geographical location of the country

Africa	South America	South Asia	Asia Pacific	Central Asia	Europe
Egypt	Argentina	Bangladesh	China	Cyprus	Czech Rep.
Kenya	Brazil	India	Hong Kong	Turkey	Greece
South Africa	Chile	Pakistan	Indonesia		Hungary
Zimbabwe	Columbia	Sri-Lanka	Korea		Poland
	Ecuador		Malaysia		Portugal
	Peru		Philippines		Russia
	Mexico		Singapore		Spain
	Venezuela		Taiwan		
			Thailand		

3.3 Stock synchronicity time series data

Time-series data is collected from the DataStream database at the individual firm level for each of the countries following Morck et al. (2000). The data is fully adjusted for dividends and capitalisation changes. The data spans the period from January 1996 to December 2005 and has been collected at weekly intervals for synchronicity analysis. Further, the data includes both live stocks and dead stock from DataStream to avoid survivorship bias. The

largest country sample size is obtained for the New York Stock Exchange (NYSE) with 4,049 stocks and the smallest country sample size is Ecuador with only 35 stocks. In total, data for 40,014 firms has been collected which includes approximately 20.8 million weekly firm observations (total 20,847,294 observations). The data is further divided into two categories of full period and sub-period data. Full period data is from January 1996 to December 2005 and sub-period data is from 1996-97, 1998-99, 2000-01, 2002-03 and 2004-05.

Table 3.6 illustrates the number of available firms for which data is available for each of the emerging and developed countries. The study period includes 521 weeks.

Table 3.6 List of available firms from DataStream database[12]

Country	No of firms	Country	No of firms
Argentina	216	Malaysia	1,316
Australia	2,709	Mexico	646
Bangladesh	256	New Zealand	269
Brazil	1,179	Pakistan	413
Chile	274	Peru	370
China	1,905	Philippines	379
Columbia	128	Poland	393
Cyprus	144	Portugal	122
Czech Republic	243	Russia	623
Ecuador	35	Singapore	1,075
Egypt	127	South Africa	1,546
France	1,527	Spain	338
Germany	1,506	Sri-Lanka	301
Greece	443	Taiwan	1,145
Hong Kong	2,705	Thailand	1,236
Hungary	209	Turkey	515
India	2,158	UK	2,707
Indonesia	588	S&P 500 (USA)	500
Japan	2,842	NYSE[13] (USA)	4,049
Kenya	62	Venezuela	111
South Korea	2,604	Zimbabwe	100
		Total firms	40,014

[12] As on February, 2007

[13] The thesis uses two samples from the USA stock market, the New York Stock Exchange (NYSE) with 4,049 firms and the S&P 500 with 500 listed firms. However, the study uses the NYSE firms for stock synchronicity analysis and comparison with the emerging economies.

3.3.1 Data Problems

There are number possible issues arising with the data, through DataStream which provides a most comprehensive coverage of world equity market by value. It should be noted that not all firms in the world equity markets are covered by DataStream and a number of companies in the dataset had limited trading. The study used individual firm level data wherever possible for analysis. We took considerable effort to avoid survivorship bias problems by selecting delisted and new listed stocks for the analysis. However, the study made no attempt to adjust or trim data for analysis; the data has been reported as it is presented by the DataStream.

3.4 Calculated data

This section presents data for the three synchronicity measures used for the thesis (classical synchronicity measure, R-square measure and zero-return measure).

Five sub-periods are included in the study to allow for the possibility of structural break-up. The first sub-period includes the Asian financial market crisis (1996-97). The second covers the period 1998-99, which is the post-Asian financial market crisis period. The third period includes the Y2K crisis (internet crisis) in 2000-01. The fourth sub-period includes the post-internet crisis and Iraq war crisis (2002-03) periods and the fifth sub-period includes the high growth period for world international markets (2004-05).

3.4.1 Classical Synchronicity Measure

3.4.1.1 Full Period Data

Table 3.7 illustrates the stock synchronicity descriptive statistics for the 41 countries observed. It is found the countries with highest stock price synchronicity for the full period are China (73 %), Ecuador (75%), Malaysia (73%), Russia (70%) and Turkey (76%) with the higher standard deviation (China 13%, Ecuador 18%, Malaysia 13%, Russia 12% and Turkey 13%).

Table 3.7 Descriptive statistics for classical measure: Full period

Data include NYSE and S&P 500 group of companies

	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
Argentina	0.69	0.68	0.99	0.50	0.11	0.25	2.12
Australia	0.58	0.56	0.90	0.50	0.07	1.50	5.93
Bangladesh	0.68	0.68	0.97	0.50	0.12	0.32	2.21
Brazil	0.64	0.64	0.88	0.50	0.09	0.37	2.36
Chile	0.65	0.64	0.90	0.50	0.09	0.45	2.38
China	0.73	0.74	0.99	0.50	0.13	-0.04	1.88
Columbia	0.66	0.65	0.95	0.50	0.11	0.46	2.30
Cyprus	0.69	0.67	0.98	0.50	0.12	0.43	2.31
Czech Republic	0.61	0.59	0.92	0.50	0.08	0.87	3.28
Ecuador	0.75	0.71	1.00	0.50	0.18	0.21	1.68
Egypt	0.65	0.65	0.95	0.50	0.10	0.34	2.21
France	0.61	0.60	0.91	0.50	0.08	0.74	3.36
Germany	0.59	0.58	0.82	0.50	0.06	0.64	2.74
Greece	0.72	0.71	1.00	0.50	0.13	0.16	1.90
Hong Kong	0.65	0.63	0.98	0.50	0.10	0.62	2.87
Hungary	0.65	0.64	0.95	0.50	0.10	0.59	2.75
India	0.65	0.65	0.93	0.50	0.10	0.44	2.50
Indonesia	0.68	0.67	0.96	0.50	0.11	0.35	2.26
Japan	0.67	0.66	0.95	0.50	0.11	0.39	2.25
Kenya	0.61	0.59	0.97	0.50	0.09	1.10	3.91
Korea	0.68	0.66	0.97	0.50	0.11	0.33	2.15
Malaysia	0.73	0.71	0.99	0.50	0.13	0.13	1.89
Mexico	0.66	0.65	0.91	0.50	0.10	0.28	2.18
New Zealand	0.62	0.60	0.95	0.50	0.09	1.00	3.82
Pakistan	0.67	0.66	0.96	0.50	0.10	0.34	2.36
Peru	0.65	0.65	0.90	0.50	0.09	0.30	2.21
Philippines	0.65	0.64	0.95	0.50	0.10	0.48	2.36
Poland	0.66	0.63	1.00	0.50	0.12	0.72	2.72
Portugal	0.63	0.62	0.93	0.50	0.09	0.72	2.89
Russia	0.70	0.69	0.96	0.50	0.12	0.14	1.94
South Africa	0.60	0.59	0.86	0.50	0.07	0.67	3.07
Singapore	0.69	0.67	0.98	0.50	0.12	0.36	2.10
Spain	0.66	0.64	0.94	0.50	0.10	0.40	2.25
Sri-Lanka	0.67	0.65	0.99	0.50	0.11	0.52	2.44
Taiwan	0.69	0.68	0.99	0.50	0.13	0.33	2.10
Thailand	0.66	0.66	0.93	0.50	0.10	0.23	2.12
Turkey	0.75	0.75	0.99	0.50	0.13	-0.13	1.89
UK	0.63	0.62	0.93	0.50	0.09	0.72	3.24
USA NYSE	0.63	0.62	0.90	0.50	0.09	0.50	2.55
USA S&P 500	0.67	0.66	0.98	0.50	0.11	0.51	2.50
Venezuela	0.67	0.65	0.97	0.50	0.12	0.59	2.37
Zimbabwe	0.66	0.64	0.98	0.50	0.11	0.60	2.50
Average	0.66						
Developed Avg.	0.62						
Emerging Avg.	0.67						

In contrast, Germany (59%) and Australia (58%) produced the lowest stock price synchronicity during this period with lowest standard deviation (Australia 7% and Germany 6%). The average synchronicity measure is 62 percent for the developed economies and 67 percent for the emerging countries during the study period.

3.4.1.2 Sub-period classical synchronicity measure

To check for the possibility of changes in the level of stock market synchronisation during the observation period from 1996 to 2005, the study divides the time series into five sub-periods, 1996-97, 1998-99, 2000-01, 2002-03 and 2004-05. Table 3.8 illustrates the descriptive statistics for stock price synchronicity over these five sub-periods.

Studies find that countries exhibiting higher stock return synchronicity during the full period also exhibit higher synchronicity for the sub-periods, examples of which include China and Poland. In addition, the level of synchronicity of five observed countries (Poland, Greece, Venezuela, Singapore and Malaysia) has fallen dramatically in these periods.

Further, the Russian stock market synchronicity measure remains volatile during this time and stock markets in developed nations (other than Japan) show low levels of stock price synchronicity. The standard deviation for the developed markets remains lower over the whole period and within sub-periods.

Table 3.8 Descriptive statistics for classical measure: Sub-periods
Data include the USA NYSE and S&P 500 group of companies

	2004-05			2002-03			2000-01			1998-99			1996-97		
	Mean	Med	Std. Dev.	Mean	Med	Std. Dev.	Mean	Med	Std. Dev.	Mean	Med	Std. Dev.	Mean	Med	Std. Dev.
	2004-05			2002-03			2000-01			1998-99			1996-97		
Argentina	0.69	0.69	0.12	0.66	0.65	0.10	0.68	0.67	0.10	0.72	0.72	0.12	0.72	0.72	0.13
Australia	0.58	0.57	0.06	0.57	0.56	0.05	0.58	0.57	0.07	0.57	0.55	0.07	0.59	0.56	0.07
Bangladesh	0.69	0.69	0.12	0.68	0.67	0.12	0.70	0.70	0.12	0.69	0.67	0.11	0.67	0.67	0.12
Brazil	0.65	0.64	0.09	0.65	0.65	0.08	0.64	0.64	0.09	0.65	0.65	0.10	0.61	0.60	0.08
Chile	0.65	0.65	0.08	0.64	0.61	0.10	0.64	0.62	0.10	0.67	0.66	0.09	0.63	0.62	0.08
China	0.74	0.76	0.12	0.75	0.77	0.12	0.72	0.70	0.13	0.72	0.72	0.13	0.74	0.74	0.14
Columbia	0.70	0.69	0.11	0.68	0.68	0.11	0.64	0.60	0.11	0.65	0.63	0.10	0.63	0.61	0.10
Cyprus	0.62	0.59	0.09	0.67	0.66	0.10	0.75	0.76	0.13	0.70	0.68	0.13	0.68	0.68	0.11
Czech Rep.	0.65	0.64	0.10	0.63	0.62	0.10	0.60	0.59	0.07	0.59	0.58	0.06	0.59	0.58	0.07
Ecuador	0.77	0.75	0.19	0.76	0.67	0.21	0.80	0.80	0.19	0.72	0.71	0.15	0.69	0.67	0.15
Egypt	0.67	0.67	0.11	0.64	0.64	0.09	0.65	0.65	0.10	0.67	0.66	0.11	0.65	0.63	0.11
France	0.61	0.61	0.07	0.63	0.62	0.08	0.61	0.59	0.08	0.61	0.59	0.08	0.60	0.60	0.07
Germany	0.59	0.58	0.06	0.60	0.59	0.06	0.60	0.59	0.07	0.59	0.58	0.07	0.59	0.57	0.06
Greece	0.65	0.63	0.11	0.75	0.76	0.12	0.78	0.83	0.15	0.72	0.73	0.12	0.69	0.68	0.10
Hong Kong	0.63	0.61	0.08	0.64	0.63	0.08	0.65	0.64	0.10	0.67	0.68	0.11	0.64	0.63	0.10
Hungary	0.64	0.65	0.09	0.63	0.62	0.09	0.65	0.64	0.09	0.67	0.65	0.11	0.66	0.64	0.11
India	0.69	0.69	0.11	0.65	0.63	0.10	0.64	0.64	0.08	0.63	0.60	0.09	0.66	0.66	0.09
Indonesia	0.67	0.67	0.11	0.67	0.67	0.10	0.68	0.65	0.11	0.72	0.72	0.11	0.64	0.61	0.10
Japan	0.68	0.67	0.11	0.69	0.68	0.10	0.65	0.64	0.11	0.66	0.65	0.10	0.68	0.66	0.11
Kenya	0.64	0.63	0.09	0.64	0.61	0.11	0.59	0.57	0.08	0.59	0.56	0.09	0.62	0.60	0.09
Korea	0.63	0.63	0.09	0.68	0.68	0.12	0.69	0.68	0.12	0.68	0.67	0.11	0.69	0.68	0.11
Malaysia	0.66	0.67	0.10	0.71	0.70	0.12	0.75	0.77	0.14	0.79	0.82	0.13	0.73	0.72	0.13
Mexico	0.68	0.67	0.09	0.65	0.63	0.09	0.63	0.63	0.08	0.69	0.69	0.10	0.67	0.68	0.11
New Zealand	0.62	0.60	0.08	0.60	0.58	0.06	0.61	0.60	0.09	0.63	0.62	0.10	0.63	0.63	0.10
Pakistan	0.67	0.66	0.09	0.67	0.68	0.10	0.65	0.64	0.10	0.65	0.65	0.10	0.68	0.67	0.10
Peru	0.68	0.68	0.09	0.69	0.69	0.09	0.65	0.65	0.10	0.63	0.62	0.09	0.62	0.60	0.09
Philippines	0.64	0.63	0.10	0.64	0.61	0.10	0.66	0.66	0.10	0.67	0.66	0.11	0.65	0.64	0.11

(continued)

Descriptive statistics for classical measure: Sub-periods

Data include the USA NYSE and S&P 500 group of companies

	Mean	Med	Std. Dev.	Mean	Med	Std. Dev.	Mean	Med	Std. Dev.	Mean	Med	Std. Dev.	Mean	Med	Std. Dev.
	2004-05			2002-03			2000-01			1998-99			1996-97		
Poland	0.62	0.62	0.08	0.61	0.59	0.07	0.64	0.62	0.10	0.69	0.68	0.13	0.74	0.74	0.14
Portugal	0.62	0.61	0.09	0.63	0.60	0.09	0.62	0.61	0.09	0.64	0.62	0.09	0.63	0.62	0.09
Russia	0.70	0.70	0.11	0.69	0.70	0.11	0.68	0.65	0.12	0.73	0.71	0.12	0.67	0.67	0.12
Sth Africa	0.61	0.60	0.07	0.59	0.59	0.06	0.60	0.58	0.07	0.61	0.60	0.09	0.61	0.59	0.07
Singapore	0.63	0.61	0.09	0.69	0.69	0.11	0.68	0.66	0.11	0.75	0.76	0.13	0.68	0.67	0.11
Spain	0.66	0.64	0.11	0.65	0.64	0.10	0.64	0.62	0.09	0.66	0.65	0.12	0.68	0.68	0.10
Sri-Lanka	0.68	0.68	0.11	0.69	0.68	0.12	0.66	0.63	0.11	0.66	0.64	0.10	0.65	0.63	0.10
Taiwan	0.66	0.66	0.13	0.69	0.67	0.12	0.72	0.73	0.13	0.71	0.68	0.13	0.69	0.67	0.13
Thailand	0.67	0.67	0.10	0.68	0.69	0.10	0.66	0.66	0.10	0.66	0.64	0.10	0.65	0.64	0.09
Turkey	0.71	0.71	0.12	0.75	0.77	0.13	0.76	0.78	0.14	0.75	0.76	0.14	0.75	0.75	0.12
UK	0.62	0.61	0.08	0.64	0.63	0.09	0.64	0.62	0.09	0.64	0.63	0.09	0.62	0.61	0.08
USA NYSE	0.65	0.65	0.09	0.64	0.63	0.10	0.61	0.60	0.07	0.63	0.61	0.09	0.64	0.63	0.08
USA- S&P	0.68	0.68	0.11	0.69	0.67	0.12	0.66	0.64	0.10	0.67	0.65	0.11	0.68	0.67	0.11
Venezuela	0.63	0.60	0.11	0.65	0.64	0.10	0.63	0.62	0.09	0.72	0.74	0.14	0.74	0.73	0.13
Zimbabwe	0.69	0.67	0.13	0.68	0.66	0.13	0.65	0.63	0.10	0.64	0.63	0.09	0.66	0.64	0.11

3.4.2 R-square measure

3.4.2.1 Full period data

Table 3.9 illustrates the descriptive statistics of R-square for 41 countries, which include 34 emerging markets and seven developed economies. The data span the period from January 1996 to December 2005.

Table 3.9 shows the R-square value for the observed countries to be 0.084 with average standard deviation of 0.114. Malaysia exhibits the highest R-square (0.254), followed by China (0.241) and Turkey (0.239). The lowest R-square countries are Japan, (0.007), Greece (0.007), Germany (0.010) and Kenya (0.009), while Bangladesh (0.021), Ecuador (0.033), Hong Kong (0.015), Peru (0.024) and Singapore (0.023) also exhibit low R-square values during this period.

In addition, Turkey, China and Malaysia exhibit higher stock synchronicity for both the R-square measure and the classical synchronicity measure which is consistent with Morck et al. (2000).

3.4.2.2 Sub-period data

Table 3.10 illustrates R-square variation by sub-periods. Countries with the greatest R-square in sub-period one include China (0.387), Malaysia (0.376), Turkey (0.260) and Venezuela (0.266). This result is to be expected, as China, Malaysia and Turkey exhibit greater R-square estimates in the full period analysis, although the S&P 500 group of US companies exhibit quite high R-square values during the period.

Table 3.9 Descriptive statistics for R-square measure: Full period
Data include the USA NYSE and S&P 500 group of companies

	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
Argentina	0.104	0.035	0.622	0.000	0.141	1.690	5.246
Australia	0.041	0.017	1.000	0.000	0.087	7.050	69.169
Bangladesh	0.021	0.010	0.586	0.000	0.047	8.333	89.807
Brazil	0.070	0.006	0.995	0.000	0.131	2.522	10.057
Chile	0.096	0.017	0.595	0.000	0.147	1.731	5.061
China	0.241	0.260	1.000	0.000	0.127	0.285	5.919
Columbia	0.042	0.003	0.526	0.000	0.099	3.016	11.826
Cyprus	0.159	0.120	0.797	0.000	0.161	1.394	4.722
Czech Republic	0.033	0.006	0.569	0.000	0.083	4.251	22.590
Ecuador	0.033	0.000	0.727	0.000	0.155	4.364	20.047
Egypt	0.089	0.037	0.630	0.000	0.118	1.965	7.487
France	0.098	0.025	1.000	0.000	0.160	2.377	9.250
Germany	0.010	0.001	1.000	0.000	0.069	12.497	169.539
Greece	0.008	0.003	0.268	0.000	0.022	8.787	94.504
Hong Kong	0.015	0.004	1.000	0.000	0.062	12.505	183.323
Hungary	0.101	0.018	1.000	0.000	0.165	2.418	9.691
India	0.081	0.028	1.000	0.000	0.107	1.800	7.614
Indonesia	0.102	0.047	0.730	0.000	0.131	1.747	5.863
Japan	0.007	0.001	1.000	0.000	0.060	14.079	212.741
Kenya	0.009	0.003	0.092	0.000	0.015	3.358	17.060
Korea	0.123	0.090	1.000	0.000	0.124	2.239	12.278
Malaysia	0.254	0.255	0.848	0.000	0.179	0.330	2.230
Mexico	0.092	0.012	0.956	0.000	0.162	2.272	7.898
New Zealand	0.066	0.028	0.748	0.000	0.096	3.107	16.645
Pakistan	0.084	0.011	0.726	0.000	0.151	2.268	7.464
Peru	0.024	0.003	0.586	0.000	0.060	4.774	33.641
Philippines	0.073	0.018	0.665	0.000	0.122	2.329	8.136
Poland	0.067	0.034	0.545	0.000	0.094	2.448	9.678
Portugal	0.102	0.035	0.592	0.000	0.143	1.695	5.102
Russia	0.066	0.007	0.789	0.000	0.140	2.845	10.775
Singapore	0.024	0.012	1.000	0.000	0.058	9.756	127.342
South Africa	0.054	0.016	1.000	0.000	0.090	3.648	24.589
Spain	0.083	0.042	0.663	0.000	0.116	2.549	10.686
Sri-Lanka	0.121	0.044	0.762	0.000	0.157	1.702	5.751
Taiwan	0.173	0.155	1.000	0.000	0.127	0.856	4.245
Thailand	0.109	0.031	1.000	0.000	0.171	2.430	10.010
Turkey	0.239	0.218	0.771	0.000	0.183	0.461	2.350
UK	0.065	0.017	1.000	0.000	0.135	4.040	22.883
USA - S&P 500	0.136	0.129	0.465	0.000	0.081	0.772	3.824
USA - NYSE	0.030	0.014	1.000	0.000	0.060	9.699	141.646
Venezuela	0.067	0.017	0.621	0.000	0.117	2.647	10.508
Zimbabwe	0.122	0.076	0.590	0.000	0.134	1.024	3.386
Average	0.084						
Developed Avg.	0.045						
Emerging Avg.	0.091						

Countries with the greatest R-square values in sub-period two include Argentina, China, Malaysia and Turkey. This result is consistent with sub-period one in which China, Malaysia and Turkey exhibit higher R-square values. The S&P 500 group of US companies exhibit an R-square of 0.213 during this period, which is lower than in sub-period one.

The greatest R-square values are evident in sub-period three and sub-period four are for China, Malaysia, Thailand and Turkey. In addition, developed countries exhibit lower R-square values during this period, (Australia 0.015, France 0.117, Germany 0.011, the UK 0.098 and USA 0.049), while the S&P 500 group of US companies exhibit R-square values of 0.109, which is lower than for the previous two sub-periods.

In sub-period five, the countries with higher R-square values include China, India and Zimbabwe. Surprisingly Malaysia has an R-square equal to 0.112 during this sub-period. The data suggests that the Malaysian R-square varies considerably from one sub-period to another. For example, the R-square for Malaysia is 0.450 in 1998-99, 0.324 in 2000-01, 0.186 in 2002-03 and 0.112 in 2004-05. Zimbabwe is another country with considerable R-square values during these sub-periods.

Table 3.10 Descriptive statistics for R-square measure: Sub-periods
Data include the USA NSYE and S&P 500 group of companies

Name	1996-1997	1998-1999	2000-2001	2002-2003	2004-2005
Country	R-square	R-square	R-square	R-square	R-square
Argentina	0.246	0.238	0.128	0.099	0.176
Australia	0.015	0.028	0.015	0.026	0.019
Bangladesh	0.016	0.012	0.014	0.021	0.020
Brazil	0.077	0.090	0.085	0.085	0.104
Chile	0.116	0.132	0.106	0.091	0.084
China	0.387	0.306	0.252	0.321	0.201
Columbia	0.074	0.072	0.049	0.108	0.134
Cyprus	0.176	0.163	0.283	0.251	0.093
Czech Republic	0.080	0.067	0.046	0.037	0.070
Ecuador	0.011	0.016	0.007	0.015	0.052
Egypt	0.189	0.150	0.112	0.081	0.084
France	0.091	0.093	0.117	0.128	0.107
Germany	0.017	0.024	0.011	0.011	0.021
Greece	0.040	0.020	0.015	0.025	0.013
Hong Kong	0.032	0.026	0.022	0.017	0.019

(continued)

Descriptive statistics for R-square measure: Sub-periods

Data include the USA NSYE and S&P 500 group of companies

Name	1996-1997	1998-1999	2000-2001	2002-2003	2004-2005
Country	R-square	R-square	R-square	R-square	R-square
Hungary	0.203	0.206	0.087	0.074	0.106
India	0.110	0.085	0.089	0.114	0.218
Indonesia	0.163	0.148	0.112	0.108	0.131
Japan	0.008	0.012	0.012	0.012	0.019
Kenya	0.018	0.008	0.019	0.028	0.028
Korea	0.149	0.175	0.180	0.192	0.096
Malaysia	0.376	0.450	0.324	0.186	0.112
Mexico	0.181	0.179	0.121	0.130	0.120
New Zealand	0.132	0.119	0.115	0.075	0.076
Pakistan	0.129	0.089	0.106	0.123	0.125
Peru	0.069	0.077	0.033	0.024	0.048
Philippines	0.114	0.135	0.085	0.077	0.079
Poland	0.258	0.185	0.065	0.038	0.034
Portugal	0.142	0.141	0.109	0.104	0.107
Russia	0.194	0.104	0.080	0.068	0.106
South Africa	0.071	0.104	0.068	0.042	0.067
Singapore	0.030	0.038	0.039	0.030	0.023
Spain	0.015	0.079	0.076	0.151	0.162
Sri-Lanka	0.089	0.098	0.185	0.162	0.149
Taiwan	0.233	0.231	0.254	0.223	0.162
Thailand	0.121	0.131	0.151	0.117	0.164
Turkey	0.259	0.317	0.366	0.284	0.181
UK	0.077	0.089	0.098	0.085	0.074
USA- NYSE	0.070	0.100	0.049	0.029	0.017
USA- S&P 500	0.257	0.213	0.109	0.139	0.099
Venezuela	0.267	0.226	0.048	0.054	0.070
Zimbabwe	0.157	0.100	0.081	0.211	0.238
Average	0.130	0.126	0.103	0.100	0.095

3.4.3 Zero-return measure

3.4.3.1 Full period data

Table 3.11 provides descriptive statistics for the zero-return measure. The proportion of zero-return measure for the full sample is 42.9 percent with standard deviation of 30.1 percent.

The study finds that Ecuador and Russia exhibit the greatest proportion of zero-return measure during this period. In contrast, the lowest proportion of zero-return measure is exhibited by the USA S&P 500. However, the most surprising results are exhibited by China

Table 3.11 Descriptive statistics for zero-return measure: Full period
Data include the USA NYSE and the S&P 500 group of companies

	Mean	Median	Maximum	Minimum	Std. Deviation
Argentina	59.1	64.3	100.0	0.0	36.6
Australia	42.8	30.1	100.0	0.0	34.9
Bangladesh	22.6	11.9	100.0	0.0	25.4
Brazil	61.9	74.9	100.0	0.0	36.0
Chile	49.4	52.1	100.0	0.0	34.1
China	11.5	4.2	100.0	0.0	19.5
Columbia	77.5	93.2	100.0	0.0	29.8
Cyprus	26.9	21.4	81.5	0.6	19.4
Czech Republic	59.7	62.9	100.0	0.0	23.1
Ecuador	84.3	94.5	100.0	5.2	22.9
Egypt	26.8	13.8	100.0	0.0	30.0
France	23.7	9.8	100.0	0.0	28.4
Germany	31.3	17.9	100.0	0.0	31.6
Greece	14.9	4.8	100.0	0.0	23.5
Hong Kong	41.6	33.8	100.0	0.0	30.6
Hungary	57.9	62.2	100.0	0.0	36.6
India	48.3	52.1	100.0	0.0	38.2
Indonesia	52.6	47.9	100.0	0.0	29.0
Japan	12.9	5.2	100.0	0.0	20.3
Kenya	45.3	34.0	100.0	0.0	31.7
South Korea	23.1	5.6	100.0	0.0	30.9
Malaysia	26.5	13.4	100.0	0.0	27.7
Mexico	66.6	81.1	100.0	0.0	36.5
New Zealand	27.1	20.7	100.0	0.0	20.7
Pakistan	53.3	55.0	100.0	0.0	33.5
Peru	74.1	90.2	100.0	0.0	32.0
Philippines	59.2	61.3	100.0	0.0	30.7
Poland	28.1	11.7	100.0	0.0	29.8
Portugal	35.1	20.5	100.0	0.8	33.7
Russia	64.6	77.5	100.0	0.0	33.2
Singapore	35.9	26.2	100.0	0.0	28.6
South Africa	56.2	62.4	100.0	0.0	32.1
Spain	24.8	9.3	100.0	0.0	31.0
Sri-Lanka	55.0	52.8	100.0	0.0	29.5
Taiwan	16.8	5.6	100.0	0.0	25.4
Thailand	53.6	56.0	100.0	0.0	37.8
Turkey	30.0	9.6	100.0	0.0	32.4
UK	38.5	31.0	100.0	0.0	31.1
USA – S&P 500	1.4	1.1	10.3	0.0	1.0
USA - NYSE	25.1	6.3	100.0	0.0	35.4
Venezuela	69.3	77.2	100.0	0.0	29.8
Zimbabwe	44.5	30.2	100.0	0.0	29.1
Average All	42.9				30.1
Emerging Avg.	45.7				30.3
Developed Avg.	28.8				28.9

and Taiwan during this sample period. China shows little evidence of higher zero-return measure during this time, which is inconsistent with both the classical synchronicity and the R-square measures.

Further, Morck et al. (2000) have found countries with considerable stock price variation during their study period to be China and Malaysia. Malaysia also exhibits a lower proportion of zero-return measure for the sample period, which is inconsistent with the previous synchronicity measures and Morck et al. (2000).

Among the developed economies, Australia exhibits a greater proportion of zero-return measure relative to Japan (12.9 percent). In addition, the S&P 500 group of US companies exhibits a zero-return measure of 1.5 percent (standard deviation 1.0 percent) for this period, which is the lowest for all countries in the sample. The NYSE exhibits a higher proportion of zero-return measure than S&P 500 group of companies, which conflicts with the classical synchronicity and R-square measures. In addition, there are some interesting variations between mean and median for some of the sample countries. For example, Australia has a mean of 42.8 for the full period but a median of 30.1. This implies that half of the Australian sample has measures on the metric below 30.1. Further, Egypt has a mean of 26.8 but a median of 13.8. This implies that at least half of the Egyptian observations are below 13.8% non trading days.

3.4.3.2 Sub-period data

Table 3.12 exhibits the proportion of zero-return measures for sub-period data. In 1996-97, 1998-99 and 2000-01 Ecuador and Columbia exhibit a greater proportion of zero-return measure and China exhibits fewer zero-return measures. Surprisingly, the S&P 500 group of US companies show the smallest proportion of zero-return measure for all the sub-periods, followed by China and Japan.

The study finds some variation in sub-period analysis during the observation period in that the zero-return measure for 1996-97 is only 32.2 days, whereas for 2002-03 it is 46.6 days. There is evidence of a higher proportion of zero-return measures in sub-periods three, four and five.

Table 3.12 Descriptive statistics for zero-return measure: Sub-periods
Data include the USA NYSE and the S&P 500 group of companies

	1996-97	1998-99	2000-01	2002-03	2004-05
Argentina	45.2	54.9	65.5	66.0	61.5
Australia	43.2	46.7	47.2	51.9	49.3
Bangladesh	29.0	22.4	23.4	20.5	25.3
Brazil	56.8	61.3	63.0	69.0	65.1
Chile	38.3	47.3	51.5	54.0	49.1
China	4.8	5.6	7.7	10.4	13.3
Columbia	71.5	76.7	82.9	83.2	78.9
Cyprus	35.5	18.2	5.7	26.1	37.1
Czech Republic	21.4	40.4	65.2	81.5	82.8
Ecuador	62.1	73.7	84.9	85.0	87.4
Egypt	20.7	21.7	29.1	32.7	26.5
France	18.8	19.6	21.1	25.7	21.7
Germany	30.1	28.9	28.7	36.8	40.0
Greece	8.4	11.4	11.0	13.3	14.5
Hong Kong	23.1	30.5	37.2	46.0	43.7
Hungary	31.0	40.1	46.5	60.6	66.2
India	35.8	47.4	52.4	56.7	57.2
Indonesia	40.7	48.9	53.1	58.2	57.5
Japan	10.5	11.3	12.6	15.7	16.8
Kenya	40.1	45.7	51.5	50.2	42.4
Korea	19.9	21.6	20.2	26.9	31.6
Malaysia	12.4	22.7	30.2	33.2	35.0
Mexico	53.5	63.3	70.2	75.2	74.1
New Zealand	25.7	24.0	23.2	28.8	26.6
Pakistan	53.0	65.3	55.8	48.2	49.6
Peru	57.5	69.5	74.7	78.7	77.4
Philippines	39.9	48.7	59.3	69.8	65.5
Poland	13.6	13.7	22.6	38.8	37.7
Portugal	32.4	31.1	31.9	38.8	36.7
Russia	49.7	73.0	67.0	67.4	64.8
Singapore	20.3	22.2	35.7	41.3	42.4
South Africa	32.7	40.7	62.6	73.8	71.0
Spain	17.1	18.6	25.5	24.2	21.1
Sri-Lanka	61.5	59.7	65.7	54.1	44.5
Taiwan	10.6	11.1	15.2	20.8	24.2
Thailand	43.7	56.0	63.3	59.5	57.9
Turkey	15.5	18.9	29.5	36.5	31.3
UK	37.7	34.2	34.7	38.8	36.5
USA – S&P 500	3.3	1.5	1.0	0.6	0.6
USA - NYSE	30.9	27.0	25.8	24.6	30.4
Venezuela	25.8	40.4	65.4	80.8	79.7
Zimbabwe	26.9	37.7	51.7	47.2	55.6
Average	32.2	37.0	42.2	46.5	46.0

For example, Venezuela and Cyprus exhibit a higher proportion of zero-return measures during 2000-01, 2002-03 and 2004-05 compared to the previous sub-periods. The average proportion of zero-return measures for these sub-periods are 32.2 days in 1996-97, 37.0 days in 1998-99, 42.2 days in 2000-01, 46.5 days in 2002-03 and 46.0 days in 2004-05.

3.5 Stock synchronicity explanatory variables

Several academics use different explanatory variables for cross-sectional analysis. These include country-level variables (examples include GDP per capita, good governance indices, inflation and geographical size) and industry-level variables (examples include earning co-movement index, percentage of sales by firm and average weekly turnover). However, one main objective of this study is to analyse country-level stock market synchronicity using the classical measure and to compare the findings with the R-square and zero-return measures. Therefore, the study uses only the country-level stock synchronicity explanatory variables for its analysis; these include corporate governance indices, GDP per capita, inflation, geographical size of a country, trade openness and corruption index.

Morck et al. (2000) are among the first to use country-level explanatory variables for stock synchronicity analysis. They find that most of their explanatory variables are correlated with each other, although some variables are statistically significant. This study uses the following explanatory variables for the cross-sectional analysis.

3.5.1 Corporate governance indicators

A good governance system is an important factor for the social and economic development of a society, including both the government and civil sectors. The civil sector includes all large and small private organisations in a society. Corporate governance appears to perform best under a democratic political system, in which all social sectors are free to trade in competitive markets.

This thesis uses two corporate governance indicators for the cross-sectional analysis – regulatory control and voice and accountability. These governance indicators reflect the statistical compilation of responses to questions concerning the quality of governance. It is noted that the World Bank uses six corporate governance indicators for measuring good

governance, which are divided into three clusters. The first cluster includes two indicators, voice and accountability and political stability. According to the World Bank, the voice and accountability indicator measures various aspects such as political process, civil liberties, political rights and independence of the public and private media (for example, newspapers, radio and TV). In contrast, the political stability indicator includes measures of domestic violence and terrorism. The study uses the voice and accountability indicator from this cluster for the cross-sectional analysis.

Cluster two includes the government effectiveness and regulatory control indicators. The World Bank suggests government effectiveness to be a combined indicator for the quality of public service provision, bureaucracy and the independence of the civil service from political pressures. In contrast, the regulatory control indicator focuses primarily on price controls, bank supervision, foreign trade and business development. This indicator focuses mainly on the quality of business and economic development for a given country. The thesis uses the second indicator (regulatory control) from this cluster for the cross-sectional analysis.

Cluster three includes the rule of law and control of corruption indicators. Rule of law measures the incidence of crime, the effectiveness and predictability of the judiciary system and the enforceability of contracts. The second indicator, control of corruption, measures perceptions of corruption within a country. Neither of these indicators is used for the cross-sectional analysis in this study, however, a similar type of corruption indicator named the corruption perception index (CPI) from the German organisation Transparency International has been used for the cross-sectional analysis owing to its greater reliability.

The governance indicators are measured in units ranging from -2.5 to 2.5. Higher values correspond to better governance outcomes and lower values correspond to poorer outcomes. For example, a country that ranks 2.0 in terms of corporate transparency maintains strong transparency in government and private sectors. This also indicates that there is a strong flow of information in the market. By contrast, if a country has a rank of -2.0 for the rule of law index, this would indicate a relatively poor-quality legal system.

These two governance variables provide important criteria for measuring a country's social and economic standards. For example, Nabli and Nugent (1992) argue that stronger

property rights can increase economic efficiency and accelerate economic progress. In addition, Douglass (1987) finds a close relationship between economic progress and the development of specific institutions. He argues that without proper economic development, institutional development could not be possible and economic development is only possible through the implementation of a system of good governance – particularly in emerging countries. Further, he suggests that an efficient market can only function within a well-governed institutional system. Corporate governance mechanisms also help emerging countries to distribute wealth properly. For example, the World Bank (1998) report suggests that development assistance is effective only for those aid-receiving developing countries that possess good institutions and implement good policies. They find that emerging countries with a sound policy background and strong governance system grow much faster than those without a strong governance system (on average 2.7 percent per capita).

Leftwich (1994) argues that the main measure of effective corporate governance should include accountability (government officials must be responsible for their actions), legal structure (legal origin and structure of a country), information disclosure (availability of information about economic conditions and government policies) and transparency (open government systems whose decision-making procedures are clear to all who wish to know about them).

This study includes two highly effective corporate governance indicators to capture the corporate governance system of a country. In addition, the study also includes corruption index, GDP per capita, trade openness measure and inflation indicators to capture country-level stock price co-movement.

Table 3.13 illustrates data for the two good governance indices for 34 emerging markets and seven developed economies published bi-yearly by the World Bank. The study period is divided into five different sub-periods: 1996-97, 1998-99, 2000-01, 2002-03 and 2004-05. In addition, the study uses two-year average index data for annually published indices (corruption index, GDP per capita and inflation data).

Table 3.13 Regulatory control and accountability indices (1996-97 to 2004-05)

This table includes regulatory control and accountability indices from 1996 to 2005, collected from the World Bank. The study is divided into 5 sub periods 1996-97, 1998-99, 2000-01, 2002-03 and 2004-05. The governance indices are measured in units ranging from -2.5 to 2.5. Higher value correspond better governance outcome and lower value correspond poorer governance outcome.

Country	Regulatory control					Voice and accountability				
	96-97	98-99	00-01	02-03	04-05	96-97	98-99	00-01	02-03	04-05
Argentina	0.66	0.87	0.44	-0.84	-0.81	0.58	0.35	0.44	0.12	0.49
Australia	1.15	1.28	1.48	1.64	1.62	1.65	1.5	1.61	1.5	1.4
Bangladesh	-0.53	-0.08	-0.02	-1.05	-1.15	-0.31	-0.17	-0.34	-0.57	-0.69
Brazil	0.13	0.29	0.36	0.26	0.19	0.22	0.6	0.53	0.28	0.34
Chili	1.28	1.22	1.35	1.5	1.62	0.89	0.63	0.56	1.12	1.09
China	-0.1	-0.07	-0.2	-0.41	-0.45	-1.22	-1.51	-1.37	-1.38	-1.54
Columbia	0.37	0.51	0.12	-0.04	-0.12	-0.06	-0.29	-0.53	-0.55	-0.47
Cyprus	0.63	1.13	1.06	1.24	1.23	1.01	1.06	1.22	0.94	1
Czech Republic	0.98	0.78	0.66	1.12	0.97	1.01	1.14	0.99	0.9	1.03
Ecuador	-0.1	0.19	-0.19	-0.6	-0.6	0.07	0.24	-0.14	-0.06	-0.19
Egypt	-0.18	0.16	0.1	-0.45	-0.58	-0.7	-0.83	-0.81	-0.87	-1.04
France	0.98	0.97	0.77	1.25	0.91	1.43	1.09	1.07	1.29	1.24
Germany	1.29	1.19	1.36	1.59	1.29	1.48	1.36	1.35	1.51	1.38
Greece	0.65	0.83	0.91	1.13	0.85	0.93	0.92	1.01	1.05	0.91
Hong Kong	1.75	1.6	1.8	1.5	1.89	0.6	-0.16	-0.45	0.15	0.21
Hungary	0.47	1.15	1.09	1.21	1.22	1.01	1.15	1.14	1.17	1.16
India	-0.13	-0.08	-0.16	-0.34	-0.59	0.27	0.26	0.45	0.38	0.27
Indonesia	0.19	0.1	-0.43	-0.68	-0.42	-1.08	-1.33	-0.52	-0.49	-0.44
Japan	0.68	0.55	0.82	0.97	1.04	1.03	1.05	0.99	0.99	0.98
Kenya	-0.48	-0.18	-0.11	-0.5	-0.43	-0.45	-0.77	-0.84	-0.58	-0.34
Korea	0.55	0.3	0.46	0.86	0.69	0.68	0.68	0.76	0.63	0.73
Malaysia	0.7	0.57	0.35	0.58	0.44	-0.05	-0.25	-0.27	-0.27	-0.36
Mexico	0.46	0.78	0.66	0.49	0.55	-0.21	-0.17	0.09	0.33	0.36
New Zealand	1.67	1.6	1.42	1.69	1.78	1.58	1.37	1.51	1.6	1.47
Pakistan	-0.56	-0.15	-0.4	-0.77	-1.03	-0.93	-0.62	-1.53	-1.1	-1.31
Peru	0.51	0.89	0.58	0.24	0.17	-0.69	-0.75	-0.01	0.22	-0.04
Philippines	0.34	0.71	0.35	0.1	-0.06	0.16	0.46	0.4	0.17	0.02
Poland	0.34	0.83	0.6	0.67	0.64	0.95	1.01	1.12	1.11	1.13
Portugal	1.22	1.19	1.03	1.47	1.14	1.25	1.38	1.35	1.31	1.31
Russia	-0.41	-0.37	-1.55	-0.3	-0.51	-0.34	-0.26	-0.44	-0.52	-0.81
South Africa	0.18	0.33	0.13	0.6	0.44	0.65	0.87	1.05	0.73	0.86
Singapore	1.95	1.65	2.27	1.89	1.87	0.38	0.01	-0.05	0.51	-0.13
Spain	0.96	1.16	1.36	1.41	1.13	1.1	1.27	1.1	1.24	1.17
Sri-Lanka	0.24	0.72	0.46	0.12	0.21	-0.19	-0.29	-0.37	-0.06	-0.16
Taiwan	0.97	1.11	0.93	1.06	1.29	0.53	0.71	0.81	0.89	0.95
Thailand	0.38	0.27	0.68	0.34	-0.01	0.01	0.11	0.25	0.2	0.24
Turkey	0.39	0.86	0.24	0.08	-0.07	-0.39	-0.92	-0.65	-0.47	-0.15
UK	1.54	1.6	1.66	1.75	1.62	1.32	1.4	1.39	1.47	1.37
USA	1.31	1.51	1.5	1.51	1.22	1.46	1.41	1.18	1.32	1.21
Venezuela	-0.12	0.13	-0.54	-0.54	-1.24	0.06	0.14	-0.33	-0.41	-0.46
Zimbabwe	-0.81	-0.35	-1.82	-1.61	-2.15	-0.28	-0.74	-0.97	-1.5	-1.48

3.5.2 Corruption perception index data

The corruption perception index is produced by the German organisation Transparency International in Berlin. Transparency International first presented their corruption index (CP) in 1995. The corruption index is based on the past three years' corruption perception data and uses public opinion surveys to measure the level of corruption in a country. The corruption scale ranges from 0 to 10 points. Countries with greater transparency are awarded higher points (maximum 10) and countries with lower transparency are awarded fewer points (minimum 0)

However, when Transparency International first published the corruption perception indices in 1995 only 41 countries were included. The number of countries measured was increased gradually every year but, surprisingly, the number was reduced from 99 in 1999 to 90 in 2000, and in 2001 only 91 countries were included. Transparency International claim that due to a lack of reliable data it was necessary to decrease the number of observed countries. However, in 2002 they were able to increase the number of observed countries to 102 and then to 159 in 2005. As a result, the study lacks some data in the early years from 1996 to 2001. The missing countries include Bangladesh, Cyprus, Peru, Sri-Lanka and Zimbabwe. The CP index included Bangladesh for the first time in 1996, Cyprus was included in 2003 and Zimbabwe in 1998. Both Kenya and Egypt were included in the CP index in 1996, although data was not available in 1997 due to the lack of reliable observations. However, in 1998 the CP index was again supplied for these countries.

If an observed country does not have sufficient index values (corruption index, GDP and inflation) for two consecutive years, then the study uses whatever observations are available for the index. For example, Argentina ranks 3.41 in 1996 and 2.81 in 1997 given the corruption index. The average corruption index for Argentina in 1996-97 is 3.11 (3.41 + 2.81 /2). But if Argentina had only one index value for 1996 and 1997 (e.g. 3.41 in 1996 and nothing for 1997), then the study uses the 1996 index value of 3.41 for 1996-97.

Table 3.14 illustrates corruption index data for the 41 countries in the sample. The data is divided into five panels, each of which includes two-year average corruption index values.

Table 3.14 Two-year average corruption index data

The following table illustrates corruption perception index collected from Transparency International (TI) database. The table includes 41 countries in the sample divided into five panels, each of which includes two years average corruption index value. The full period data is from 1996 to 2005. The scale range from 0 to 10 points, higher points awarded for greater transparency and lower points awarded for poorer transparency.

Country	1996	1997	Avg.	1998	1999	Avg.	2000	2001	Avg.	2002	2003	Avg.	2004	2005	Avg.
Argentina	3.41	2.81	3.11	3.00	3.00	3.00	3.50	3.50	3.50	2.80	2.50	2.65	2.50	2.80	2.65
Australia	8.60	8.86	8.73	8.70	8.70	8.70	8.30	8.50	8.40	8.60	8.80	8.70	8.80	8.80	8.80
Bangladesh	2.29	NA	2.29	NA	NA	NA	NA	0.40	0.40	1.20	1.30	1.25	1.50	1.70	1.60
Brazil	2.96	3.56	3.26	4.00	4.10	4.05	3.90	4.00	3.95	4.00	3.90	3.95	3.90	3.70	3.80
Chili	6.80	6.05	6.43	6.80	6.90	6.85	7.40	7.50	7.45	7.50	7.40	7.45	7.40	7.30	7.35
China	2.43	2.88	2.66	3.50	3.40	3.45	3.10	3.50	3.30	3.50	3.40	3.45	3.40	3.20	3.30
Columbia	2.73	2.23	2.48	2.20	2.90	2.55	3.20	3.80	3.50	3.60	3.70	3.65	3.80	4.00	3.90
Cyprus	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.10	6.10	5.40	5.70	5.55
Czech Republic	5.37	5.20	5.29	4.80	4.60	4.70	4.30	3.90	4.10	3.70	3.90	3.80	4.20	4.30	4.25
Egypt	2.84	NA	2.84	2.90	3.30	3.10	3.10	3.60	3.35	3.40	3.30	3.35	3.20	3.40	3.30
France	6.96	6.66	6.81	6.70	6.60	6.65	6.70	6.70	6.70	6.30	6.90	6.60	7.10	7.50	7.30
Germany	8.27	8.23	8.25	7.90	8.00	7.95	7.60	7.40	7.50	7.30	7.70	7.50	8.20	8.20	8.20
Greece	5.01	5.35	5.18	4.90	4.90	4.90	4.90	4.20	4.55	4.20	4.30	4.25	4.30	4.30	4.30
Hong Kong	7.01	7.28	7.15	7.80	7.70	7.75	7.70	7.90	7.80	8.20	8.00	8.10	8.00	8.30	8.15
Hungary	4.86	5.18	5.02	5.00	5.20	5.10	5.20	5.30	5.25	4.90	4.80	4.85	4.80	5.00	4.90
India	2.63	2.75	2.69	2.90	2.90	2.90	2.80	2.70	2.75	2.70	2.80	2.75	2.80	2.90	2.85
Indonesia	2.65	2.72	2.69	2.00	1.70	1.85	1.70	1.90	1.80	1.90	1.90	1.90	2.00	2.20	2.10
Japan	7.05	6.57	6.81	5.80	6.00	5.90	6.40	7.10	6.75	7.10	7.00	7.05	6.90	7.30	7.10
Kenya	2.21	NA	2.21	2.50	2.00	2.25	2.10	2.00	2.05	1.90	1.90	1.90	2.10	2.10	2.10
Korea	5.02	4.29	4.66	4.20	3.80	4.00	4.00	4.20	4.10	4.50	4.30	4.40	4.50	5.00	4.75

(continued)

Two-year average corruption index data for 1996 to 2005

The following table illustrates corruption perception index collected from Transparency International (TI) database. The table includes 41 countries in the sample divided into five panels, each of which includes two years average corruption index value. The full period data is from 1996 to 2005. The scale range from 0 to 10 points, higher points awarded for greater transparency and lower points awarded for poorer transparency.

Country	1996	1997	Avg.	1998	1999	Avg.	2000	2001	Avg.	2002	2003	Avg.	2004	2005	Avg.
Malaysia	5.32	5.01	5.17	5.30	5.10	5.20	4.80	5.00	4.90	4.90	5.20	5.05	5.00	5.10	5.05
Mexico	3.30	2.66	2.98	3.30	3.40	3.35	3.30	3.70	3.50	3.60	3.60	3.60	3.60	3.50	3.55
New Zealand	9.43	9.23	9.33	9.40	9.40	9.40	9.40	9.40	9.40	9.50	9.50	9.50	9.60	9.60	9.60
Pakistan	1.00	2.53	1.77	2.70	2.20	2.45	NA	2.30	2.30	2.60	2.50	2.55	2.10	2.10	2.10
Peru	NA	NA	NA	4.50	4.50	4.50	4.40	4.10	4.25	4.00	3.70	3.85	3.50	3.50	3.50
Philippines	2.69	3.05	2.87	3.30	3.60	3.45	2.80	2.90	2.85	2.60	2.50	2.55	2.60	2.50	2.55
Poland	5.57	5.08	5.33	4.60	4.20	4.40	4.10	4.10	4.10	4.00	3.60	3.80	3.50	3.40	3.45
Portugal	6.53	6.97	6.75	6.50	6.70	6.60	6.40	6.30	6.35	6.30	6.60	6.45	6.30	6.50	6.40
Russia	2.58	2.27	2.43	2.40	2.40	2.40	2.10	2.30	2.20	2.70	2.70	2.70	2.80	2.40	2.60
South Africa	5.68	4.95	5.32	5.20	5.00	5.10	5.00	4.80	4.90	4.80	4.40	4.60	4.60	4.50	4.55
Singapore	8.80	8.66	8.73	9.10	9.10	9.10	9.10	9.20	9.15	9.30	9.40	9.35	9.30	9.40	9.35
Spain	4.31	5.90	5.11	6.10	6.60	6.35	7.00	7.00	7.00	7.10	6.90	7.00	7.10	7.00	7.05
Sri-Lanka	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.70	3.40	3.55	3.50	3.20	3.35
Taiwan	4.98	5.02	5.00	5.30	5.60	5.45	5.50	5.90	5.70	5.60	5.70	5.65	5.60	5.90	5.75
Thailand	3.33	3.06	3.20	3.00	3.20	3.10	3.20	3.20	3.20	3.20	3.30	3.25	3.60	3.80	3.70
Turkey	3.54	3.21	3.38	3.40	3.60	3.50	3.80	3.60	3.70	3.20	3.10	3.15	3.20	3.50	3.35
Ecuador	3.19	NA	3.19	2.30	2.40	2.35	2.60	2.30	2.45	2.20	2.20	2.20	2.40	2.50	2.45
UK	8.44	8.22	8.33	8.70	8.60	8.65	8.70	8.30	8.50	8.70	8.70	8.70	8.60	8.60	8.60
USA	7.66	7.61	7.64	7.50	7.50	7.50	7.80	7.60	7.70	7.70	7.50	7.60	7.50	7.60	7.55
Venezuela	2.50	2.77	2.64	2.30	2.60	2.45	2.70	2.80	2.75	2.50	2.40	2.45	2.30	2.30	2.30
Zimbabwe	NA	NA	NA	4.20	4.10	4.15	3.00	2.90	2.95	2.70	2.30	2.50	2.30	2.60	2.45

3.5.3 GDP, inflation and geographical size data

Gross domestic product (GDP) per capita and inflation data were collected from the International Monetary Fund (IMF) and the World Bank (2007) databases. The study uses five panels for cross-sectional analysis and two-year averages of historical data for each panel. For example, if country A has a GDP per capita of $100 for 2006 and $200 for 2007, the study uses the average GDP data for the years 2006-07 in this panel (i.e. $150). The only country with missing GDP and inflation data for the cross-sectional analysis is Peru as it was not possible to find any reliable source of data for these measures. Further GDP per capita is divided by 10,000 in cross sectional analysis to reduce the size of the variable.

In addition, geographical size data for the sample countries is collected from the CIA (2007) world factbook. The CIA world factbook is published by the Central Intelligence Agency, USA. The CIA website provides accurate and reliable country-level data including geographical size.

Table 3.15 illustrates GDP per capita, inflation and sample country geographical size data. The data is arranged into five panels, each panel including two-year average data for GDP per capita and inflation for the sample countries. Country geographical size data is provided in the last column.

Table 3.15 Two-year average GDP per capita, inflation and geographical size data

Table 3.15 illustrates inflation and GDP per capita data in five panels (1996-97, 1998-99, 2000-01, 2002-03 and 2004-05) and geographical size of a country in the last panel (1996-2005). The study uses two years average inflation (annual percentage) and GDP per capita (US $) data for each of the five panels. Geographical size data is in square kilometer for each country collected from CIA website.

Country	1996-1997		1998-1999		2000-2001		2002-2003		2004-2005		1996-2005
Name	Inflation	GDP	Inflation	GDP	Inflation	GDP	Inflation	GDP	Inflation	GDP	Geographical size
Argentina	100.93	8169.9	101.54	8248.6	99.46	7665.8	132.90	3056.6	154.61	4430.8	2766890
Australia	1.45	22642.4	1.2	20550.5	4.45	19641.8	2.9	23748.7	2.5	33180.9	7686850
Bangladesh	3.75	332.2	7.4	341.7	1.85	338.0	4.6	357.2	6.55	396.7	144000
Brazil	11.45	4869.7	4.05	3960.1	6.95	3248.1	11.6	2717.8	6.75	3820.3	8511965
Chili	6.75	5459.07	4.2	5107.9	3.7	4698.1	2.65	4486.1	2.1	6471.7	756950
China	5.55	735.0	-1.1	839.1	0.55	991.8	0.2	1200.8	2.85	1594.3	9596960
Columbia	9.6	2667.0	6.4	2328.2	-0.05	2011.8	2.25	1880.8	4.85	2475.2	1138910
Cyprus	3.3	5987.8	1.9	6637.5	3.05	7542.0	3.45	8221.6	2.45	9128.7	9250
Czech Rep.	8.65	5818.3	6.35	5895.5	4.3	5688.1	0.95	8055.7	2.3	11328.5	78866
Egypt	6.65	1206.9	4.2	1409.3	2.6	1505.4	2.8	1255.2	10.85	1225.8	1001450
Ecuador	27.5	1899.0	44.15	1626.8	66.9	1494.7	10.25	2019.1	2.55	2413.1	283560
France	1.7	25135.1	0.65	24364.0	1.8	21972.2	2.05	26436.3	2.1	33316.4	547030
Germany	1.35	28075.0	0.65	26407.7	1.6	23086.6	1.2	27103.5	1.85	33656.1	357021
Greece	5.8	11409.0	3.35	11373.9	3.3	10548.4	3.7	13955.2	3.25	19404.7	131940
Hong Kong	6.05	25819.0	-0.55	24976.6	-2.65	24891.0	-2.8	23637.2	0.35	24712.1	1092
Hungary	20.8	4475.2	12.1	4715.7	9.5	4975.9	4.95	7524.0	5.1	10743.9	93030
India	8.1	422.9	8.95	441.8	3.9	465.7	4.05	512.7	4	668.4	3287590
Indonesia	6.6	1224.2	39.35	630.9	7.65	796.3	9.3	1029.4	8.3	1217.4	1919440
Japan	1	35208.3	0.15	32499.3	-0.8	34421.7	-0.6	31951.3	-0.15	35850.1	377835
Kenya	10.4	454.5	6.25	458.4	7.9	416.1	5.9	442.9	10.95	531.9	582650
Korea	4.65	11742.0	4.15	8508.7	3.2	10530.5	3.15	12098.1	3.15	15278.6	98480

(continued)

Two-year average GDP per capita, inflation and geographical size data

Table 3.15 illustrates inflation and GDP per capita data in five panels (1996-97, 1998-99, 2000-01, 2002-03 and 2004-05) and geographical size of a country in the last panel (1996-2005). The study uses two years average inflation (annual percentage) and GDP per capita (US $) data for each of the five panels. Geographical size data is in square kilometer for each country collected from CIA website.

Country	1996-1997		1998-1999		2000-2001		2002-2003		2004-2005		1996-2005
Name	Inflation	GDP	Inflation	GDP	Inflation	GDP	Inflation	GDP	Inflation	GDP	Geographical Size
Malaysia	3.05	4693.7	3.95	3369.5	1.5	3754.4	1.45	4021.7	2.2	4842.9	329750
Mexico	27.5	3935.3	16.25	4702.2	7.95	6097.4	4.75	6343.0	4.35	6941.5	1972550
New Zealand	1.75	18208.0	0.6	14632.5	2.6	13418.1	2.25	17440.3	2.65	25250.1	268680
Pakistan	10.9	583.3	5.3	534.2	3.75	511.3	3.05	570.3	8.25	726.9	803940
Peru	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1285220
Philippines	7.5	1188.2	8.2	964.6	5.2	954.1	3.2	971.5	6.8	1100.5	300000
Poland	17.4	4054.5	9.55	4390.1	7.8	4699.5	1.35	5424.1	2.8	7242.4	312685
Portugal	2.4	11552.6	2.2	12034.7	3.6	11150.8	3.5	13614.0	2.3	17169.4	92391
Russia	31.25	2693.4	56.7	1585.5	21.15	1943.2	14.75	2685.8	11.75	4742.7	17075200
South Africa	7.95	8898.7	6.05	9108.5	5.55	9870.5	7.5	10687.1	2.4	11818.0	1219912
Singapore	1.7	25242.6	-0.15	20959.3	1.15	21900.1	0.05	21529.1	1.1	25866.4	692.7
Spain	2.75	15195.6	2	15416.7	3.15	14798.3	3.35	19270.8	3.25	26269.0	504782
Sri-Lanka	12.75	823.5	6.7	870.2	6.8	862.4	6.4	909.3	9.25	1114.9	65610
Taiwan	2	13638.5	0.95	13063.5	0.65	13726.9	-0.25	13173.8	1.95	14662.3	35980
Thailand	5.75	2766.8	4.2	1906.8	1.65	1901.2	1.2	2110.9	3.65	2535.1	514000
Turkey	82.2	2947.3	73.55	3025.5	54.1	2647.2	35	3069.1	8.4	4675.2	780580
USA	2.6	29300.1	1.85	31987.6	3.1	34646.4	1.95	36499.3	3.05	40388.2	9631420
UK	2.15	21633.5	1.5	24671.7	1	24415.8	1.35	28441.7	1.7	36120.2	244820
Venezuela	74.95	3469.9	29.7	4030.2	14.35	4938.3	26.75	3506.9	18.8	4637.9	912050
Zimbabwe	20.2	3469.9	44.65	4030.2	64.5	4938.3	249.1	3506.9	293.9	4637.9	390580

3.6 Trade openness

The thesis also uses the trade openness measure variable for the stock market synchronicity analysis. Morck et al. (2000) argue that more open economies have a lower level of stock synchronicity than less open economies. They find that emerging countries tend to have less open economic policies than developed countries and the communist states especially used to have closed economic policies. This argument is further supported by La-Porta et al. (1998), who suggest that post-communist countries provide very little protection to their market shareholders. However, this study uses the trade openness measure developed by Li et al. (2003).

$$[Trade\,Openness] = \frac{I_{nt}}{GDP_{nt}} - \left(1 - \frac{GDP_{nt}}{\sum_{n} GDP_{nt}}\right) \tag{14}$$

Here I_{nt} is the total import of a country n in year t and GDP_{nt} is the gross domestic product (GDP) for country n for the same period. $\sum_{n} GDP_{nt}$ is the world aggregate GDP at period t.

The trade openness measure calculates the total domestic consumption = one minus the nation's share of world production (country GDP / world aggregate GDP). The value of the individual country openness measure is zero. In a completely closed economy, this measure is negative one plus the country's GDP as a fraction of world GDP. However, as the economy become more and more open, the measure shifts toward a zero value.

The study collects the total import data and country GDP data from the DataStream database and then calculates the trade openness measure using the above formula (equation 6). It uses the two-year average trade openness measure for the cross-sectional analysis. It should be noted that it is possible to have a positive trade openness measure for entrepôt[14] countries. However, the trade openness variable is always negative for the sample countries, except for Singapore and Hong Kong. This result is consistent with Li et al. (2003) who argue that Singapore and Hong Kong are the most important entrepôt states in the world; in

[14] An entrepôt (from the French 'warehouse') is a trading post where merchandise can be imported and exported without paying import duties, often at a profit.
(http://en.wikipedia.org/wiki/Entrep%C3%B4t)

particular Hong Kong is a unique example, having switched from being a UK colonial state to a Chinese special administration region during the observation period. Li et al. (2003) suggest that trade openness is a direct measure of the openness of an individual country's stock market to foreign investors. In addition, they argue that trade openness reflects the value of stocks that can be purchased by foreign investors as a percentage of total domestic market capitalisation.

The study calculates trade openness measures for the sample countries from 1996 to 2005. A summary of the trade openness measure is shown in table 3.16.

Table 3.16 Trade openness measures for the sample countries

Table 3.16 illustrates the trade openness measure for the observed 41 countries following the equation in section 3.6. The study uses a 2 years average trade openness measure for cross sectional analysis. The full dataset is divided into five sub periods, which are 1996-97, 1998-99, 2000-01, 2002-03 and 20004-05. In a completely closed economy, this measure is negative one, as the economy becomes more and more open this measure moves towards zero. It is found that the trade openness variable is always negative for sample countries except for Singapore and Hong Kong consistent with Li et al (2003).

	1996-97	1998-99	2000-01	2002-03	2004-05
Argentina	-0.894	-0.892	-0.908	-0.960	-0.949
Australia	-0.828	-0.814	-0.808	-0.813	-0.811
Bangladesh	-0.832	-0.831	-0.815	-0.822	-0.774
Brazil	-0.900	-0.897	-0.882	-0.889	-0.889
Chile	-0.745	-0.762	-0.748	-0.740	-0.729
China	-0.818	-0.820	-0.779	-0.726	-0.663
Columbia	-0.634	-0.672	-0.738	-0.756	-0.715
Cyprus	-0.064	-0.241	-0.261	-0.352	-0.329
Czech Republic	-0.509	-0.508	-0.389	-0.418	-0.366
Ecuador	-0.793	-0.784	-0.755	-0.754	-0.734
Egypt	-0.814	-0.813	-0.855	-0.845	-0.807
France	-0.782	-0.766	-0.707	-0.750	-0.762
Germany	-0.739	-0.722	-0.658	-0.696	-0.702
Greece	-0.802	-0.811	-0.776	-0.772	-0.771
Hong Kong	0.220	0.109	0.240	0.372	0.667
Hungary	-0.567	-0.435	-0.350	-0.433	-0.408
India	-0.888	-0.883	-0.877	-0.867	-0.823
Indonesia	-0.799	-0.732	-0.748	-0.808	-0.753
Japan	-0.768	-0.786	-0.770	-0.791	-0.787
Kenya	-0.754	-0.775	-0.740	-0.752	-0.697
Korea	-0.976	-0.979	-0.977	-0.977	-0.976
Malaysia	-0.213	-0.179	-0.161	-0.222	-0.160
Mexico	-0.704	-0.674	-0.682	-0.705	-0.681
New Zealand	-0.779	-0.758	-0.735	-0.757	-0.759
Pakistan	-0.832	-0.862	-0.847	-0.845	-0.787
Peru	-0.827	-0.831	-0.834	-0.839	-0.822
Philippines	-0.559	-0.550	-0.555	-0.514	-0.517
Poland	-0.741	-0.723	-0.720	-0.697	-0.653
Portugal	-0.695	-0.683	-0.650	-0.718	-0.713
Russia	-0.790	-0.762	-0.799	-0.794	-0.803
South Africa	-0.779	-0.786	-0.765	-0.742	-0.745
Singapore	0.403	0.311	0.409	0.357	0.626
Spain	-0.771	-0.752	-0.723	-0.740	-0.724
Sri-Lanka	-0.611	-0.629	-0.618	-0.644	-0.627
Taiwan	-0.630	-0.610	-0.586	-0.598	-0.484
Thailand	-0.588	-0.598	-0.476	-0.475	-0.367
Turkey	-0.729	-0.811	-0.724	-0.730	-0.747
UK	-0.722	-0.732	-0.725	-0.739	-0.737
USA	-0.613	-0.578	-0.543	-0.566	-0.584
Venezuela	-0.841	-0.839	-0.852	-0.871	-0.839
Zimbabwe	-0.592	-0.599	-0.667	-0.517	0.183

3.7 Conclusion

The thesis uses three stock synchronicity measures for the analysis – the classical synchronicity measure, the R-square measure and the zero-return measure. Additionally, a number of explanatory variables are used for the cross-sectional analysis. The individual firm stock return data and the market indices are collected from the DataStream database, supplemented where necessary by data from Yahoo finance. The data span the period from January 1996 to December 2005 in an analysis of 34 emerging markets and seven developed markets. In addition, two sets of time series data are used for US firms (NYSE and S&P 500). The study has selected 12 emerging countries of common law origin, 19 emerging countries of civil law origin and three emerging countries of post-communist origin for the analysis.

Further, corporate governance index data are collected from the World Bank database (biannual data), geographical size data is collected from the CIA database, corruption index data is collected from the Transparency International website, and inflation and GDP per capita data are collected from the IMF and World Bank databases.

CHAPTER 4 Classical synchronicity measure*

4.1 Introduction

This chapter analyses the stock market synchronicity of the developed and emerging markets using the classical stock synchronicity measure developed by Morck et al. (2000). The chapter also investigates reasons for higher stock price synchronicity in emerging markets using cross-sectional analysis for both the emerging markets and the developed economies.

The study covers the period from January 1996 to December 2005. It should be noted that the study uses both the New York Stock Exchange (NYSE) and S&P 500 shares for the analysis. However, the S&P 500 shares are used only in descriptive statistics whereas the NYSE shares are used for both the descriptive statistics and the cross-sectional analysis.

4.2 Full period: Legal segment and geographical segment

The descriptive statistics for legal origin reported in table 4.1 shows that Malaysia (73 percent), Bangladesh (69 percent), Singapore (69 percent) and Cyprus (69 percent) have the highest stock return synchronicity within the group of countries with common law origin. South Africa (60 percent) and Kenya (61 percent) exhibit the lowest level of stock return synchronicity during the observation period, whereas the average synchronicity for countries of common law origin is 66 percent.

* Some of the results reported in this chapter for counties in the South Asian region were presented in conference paper entitled 'Stock Synchronicity in South-Asia: An Analysis of Monthly Changes Over the Periods'. This paper, co-authored with my supervisor (Richard Heaney), was presented by me at the 11th FINSIA Banking and Finance conference on 26th September, 2006 at RMIT University. The key results from this of this chapter form the basis a further conference paper entitled 'Do emerging markets have higher stock price synchronicity? The International evidence' which has been accepted for the presentation at 9th International Business Research Conference on 24-26th November, 2008.

Table 4.1 Descriptive statistics for classical measure: Legal segment analysis

Data include emerging common law, civil law and post-communist countries and the developed countries

Emerging common law countries		Emerging civil law countries		Emerging post-communist countries		Developed nations	
Country	Sync.	Country	Sync.	Country	Sync.	Country	Sync.
Bangladesh	0.69	Argentina	0.69	China	0.73	Australia	0.58
Cyprus	0.69	Brazil	0.64	Poland	0.66	France	0.61
Egypt	0.66	Chile	0.65	Russia	0.69	Germany	0.59
Hong Kong	0.65	Columbia	0.66			Japan	0.67
India	0.65	Czech Republic	0.61			New Zealand	0.62
Kenya	0.61	Ecuador	0.75			UK	0.63
Malaysia	0.73	Greece	0.72			USA - NYSE	0.63
Pakistan	0.67	Hungary	0.65				
South Africa	0.6	Indonesia	0.68				
Singapore	0.69	Korea	0.68				
Sri-Lanka	0.67	Mexico	0.66				
Zimbabwe	0.66	Peru	0.65				
		Philippines	0.65				
		Portugal	0.63				
		Spain	0.66				
		Taiwan	0.69				
		Thailand	0.66				
		Turkey	0.74				
		Venezuela	0.67				
Average	0.66		0.67		0.69		0.62

Civil law origin countries have higher levels of synchronicity (67 percent) on average, with Greece having 72 percent, Ecuador 75 percent and Turkey 74 percent. The Czech Republic shows an unexpectedly low average of 61 percent for its synchronicity measure.

At the same time, emerging post-communist countries show higher levels of synchronicity than those of common law and civil law origin. However, the study has selected three samples from post-communist countries, which are China (73 percent), Poland (66 percent) and Russia (69 percent). The average synchronicity for post-communist countries is 69 percent.

By contrast, developed countries show lower levels of stock synchronicity during this observation period regardless of their legal origin. The synchronicity data for New Zealand (62 percent), Australia (58 percent), France (61 percent), Germany (59 percent), the UK (63 percent) and the USA (63 percent) average 62 percent during the observation period. Japan is the only country with high levels of stock price co-movement amongst the developed nations during this period. The analysis suggests that Japanese stocks are more volatile on average. This market has a long history of higher stock price co-movement, as noted by Morck et al. (2000).

Table 4.2 illustrates the data for stock return synchronicity by geographical location, the initial analysis suggesting that geographical location has a very small impact on stock price synchronicity.

South America and South Asia both average 67 percent stock return co-movements while in European market the average synchronicity is 66 percent and the Asia/Pacific average synchronicity is 68 percent.

Central Asian countries have somewhat higher levels of stock price co-movement. However, the sample size for this location includes only Cyprus (69 percent) and Turkey (74 percent). African countries exhibit lower levels of stock synchronicity (63 percent) with South Africa and Kenya having the lowest level of stock market synchronisation. Overall the results are consistent with Morck et al. (2000) who find that the five most synchronised countries were Poland, China, Malaysia, Taiwan and Turkey. Similar results are also exhibited in table 4.2.

Table 4.2 Descriptive statistics for classical measure: Geographical segment analysis

Emerging – Africa		Emerging – South America		Emerging – South Asia		Emerging – Asia/Pacific		Emerging – Central Asia		Emerging – Europe	
Country	Sync.	Country	Sync.	Country	Sync.	Country	Sync.	Country	Sync.	Country	Sync.
Egypt	0.66	Argentina	0.69	Bangladesh	0.69	China	0.73	Cyprus	0.69	Czech Republic	0.61
Kenya	0.61	Brazil	0.64	India	0.65	Hong Kong	0.65	Turkey	0.74	Greece	0.72
South Africa	0.60	Chile	0.65	Pakistan	0.67	Indonesia	0.68			Hungary	0.65
Zimbabwe	0.66	Columbia	0.66	Sri-Lanka	0.67	Korea	0.68			Poland	0.66
		Ecuador	0.75			Malaysia	0.73			Portugal	0.63
		Peru	0.65			Philippines	0.65			Russia	0.69
		Mexico	0.66			Singapore	0.69			Spain	0.66
		Venezuela	0.67			Taiwan	0.69				
						Thailand	0.66				
Average	0.63		0.67		0.67		0.68		0.72		0.66

4.3 Sub-period: Legal and geographical segment

Appendix A-4.1 illustrates the data for legal segment analysis for the classical synchronicity measure. It appears that common law countries exhibit lower stock synchronicity than civil law or post-communist countries. Among the common law countries Malaysia exhibits the highest stock synchronicity, and Ecuador and Turkey exhibit the highest synchronicity among the civil law countries. Of the post-communist countries, China exhibits a high stock price co-movement over all sub-periods. On average, post-communist country stock synchronicity is the highest among the legal origin groups.

Appendix A-4.2 illustrates the data for analysis by geographical segment sub-periods for the classical synchronicity measure. There is evidence that Central Asian countries exhibit higher stock synchronicity during these sub-periods, followed by South Asian countries. In addition, developed economies exhibit the lowest synchronicity measure for all sub-periods.

Figure 4.1 illustrates the variation in stock return synchronicity evident from Germany, Australia, Brazil, Mexico, China and Turkey, with a 10-week moving average classical synchronicity measure based on stock return data from January 1996 to December 2005. This figure shows that stock return co-movements for Chinese and Turkish markets are more synchronous than for the Australian and German markets. During this period the Chinese and Turkish stock markets show average synchronicity of 74 percent and 75 percent respectively, whereas the Australian and German markets show average synchronicity of 58 percent and 59 percent respectively.

Appendix A-4.7 graphs the 10-week moving average synchronicity for the US, Australian and Chinese stock markets for the period 1996-2005. It is found that the Chinese stock market moves 73 percent in the same direction during these periods, whereas Australian stock synchronicity is about 58 percent. Further, the USA (63 percent) exhibits somewhat average synchronicity. This suggests that stock synchronicity in emerging economies is higher than in developed markets. Further, the NYSE share group exhibits lower levels of stock synchronicity than S&P 500 shares, although it should be noted that the NYSE includes approximately 4,049 stocks while the S&P includes only 500 stocks. This suggests that larger stocks in the S&P group move more synchronously than NYSE shares (appendix A-4.8).

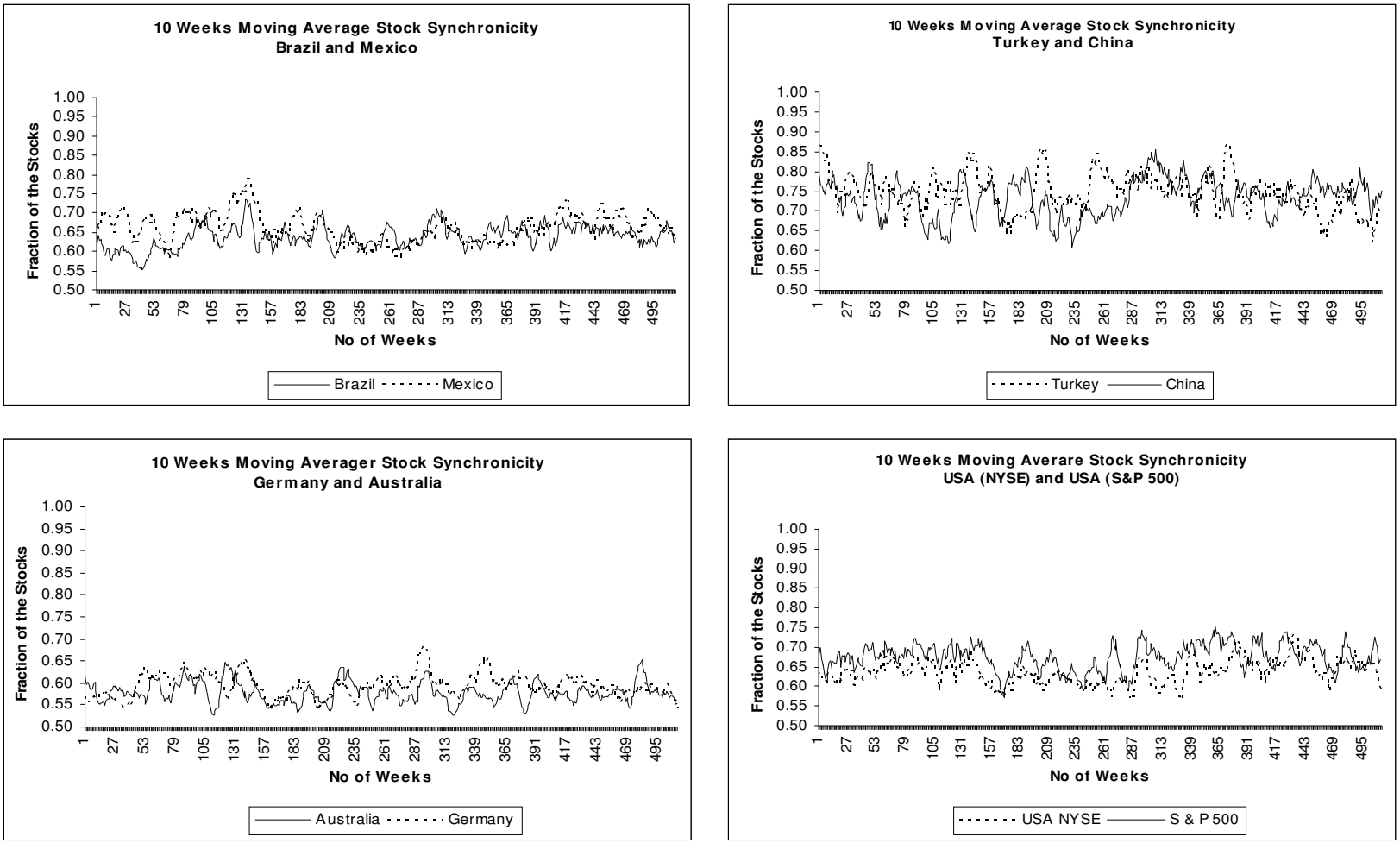


Figure 4.1: The 10 Weeks Moving Average Synchronicity for Selected Markets.
The study graphs both the lowest synchronous countries and highest synchronous countries. It is found that China and Turkey exhibit the highest synchronicity during the observation period and lowest level of synchronicity are evident from Germany and Australia. The graph also includes stock synchronicity for the NYSE and the S&P 500 group of companies. The data shows that the S&P 500 group of companies exhibits higher stock price co-movement than the NYSE (please refer Appendix A-4.8 for more detail).

Table 4.3 shows the t test statistics between the emerging economies and the developed economies. The study finds a significant mean difference between the two groups at α 0.01 level. Further, while not reported here, a comparison of mean across the sub-periods is reported in appendix A-4.3 (panels A to E). There is evidence of statistical mean difference between the sub-periods at the one percent significance level.

Table 4.3 t-test statistics for the classical measure

Developed vs. emerging country groups (equal variance estimate)

t test statistics	Degrees of freedom	Sig. (2-tailed)
3.606	39	0.001

To test whether synchronicity differs across the sample country group, ANOVA tests also run across the synchronicity measures between the groups (table 4.4). The test statistic indicates that there is a statistically significant difference in the mean variance at the one percent significant level.

Table 4.4 ANOVA test statistics for the classical measure

Developed vs. emerging country groups (equal variance estimate)
The data include two sets of countries, the emerging and the developed groups. Emerging countries include 34 sample countries and developed countries include seven sample developed nations.

	Sum of squares	Degrees of freedom	Mean square	F	Sig.
Between groups	.016	1	.016	13.002	.001
Within groups	.047	39	.001		
Total	.062	40			

In addition, panel F of appendix A-4.4 reports the Kruskal-Wallis test statistics to show that there is a significant difference in the median for the groups of observed countries (emerging and developed country groups) from January 1996 to December 2005.

Table 4.5 illustrates the ANOVA test statistics between the legal origin groups of countries (the common law, civil law and post-communist countries). However, the study did not find significant difference between mean variance in legal origin groups.

Table 4.5 ANOVA test statistics for the classical measure: Legal segment analysis

Developed vs. emerging country groups (equal variance estimate)

The data include three emerging country groups: emerging common law countries (12), emerging civil law countries (19) and emerging post-communist countries (3).

	Sum of squares	Degrees of freedom	Mean square	F	Sig.
Between groups	.002	2	.001	.807	.455
Within groups	.039	31	.001		
Total	.041	33			

Table 4.6 illustrate autocorrelation coefficient to estimate the repenting pattern of error term for stock synchronicity time series data. There is statistically significant autocorrelation during the observed period for most of the countries. Exceptions include Bangladesh, Pakistan, Brazil, China, Egypt, Hungary, the Philippines, Thailand and Turkey from the emerging market group, and the USA and Japan from the developed economy group.

Table 4.6 Autocorrelation coefficient for the classical synchronicity measure

From January 1996 to December 2005

	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5	Lag 6	PAC	Prob. (6 lags)	Auto Lag	Prob. (Auto lags)
Argentina	0.01	0.17	-0.01	0.09	0.12	0.16	0.14	0.00	1	0.00
Australia	0.19	0.04	0.02	-0.02	0.01	-0.03	-0.03	0.00	n/a	0.00
Bangladesh	0.07	0.04	-0.01	-0.01	-0.06	-0.04	-0.03	0.42	n/a	0.13
Brazil	0.08	0.05	-0.07	0.03	0.05	-0.03	-0.05	0.13	n/a	0.07
Chile	0.13	0.09	0.08	0.00	0.02	-0.03	-0.04	0.01	n/a	0.00
China	0.08	0.02	0.09	0.00	0.06	0.00	-0.02	0.12	n/a	0.06
Columbia	0.13	0.11	0.05	0.03	0.02	0.00	-0.01	0.01	n/a	0.00
Cyprus	0.24	0.25	0.17	0.20	0.18	0.05	-0.08	0.00	1	0.00
Czech Rep.	0.13	0.20	0.14	0.06	0.10	0.13	0.10	0.00	1	0.00
Ecuador	0.10	0.08	0.09	0.02	0.01	0.06	0.05	0.03	n/a	0.03
Egypt	0.11	-0.01	0.05	-0.03	-0.01	-0.01	-0.01	0.26	n/a	0.02
France	0.10	0.14	0.10	0.11	0.08	-0.02	-0.06	0.00	1	0.02
Germany	0.06	0.12	0.12	0.03	0.08	-0.01	-0.04	0.00	1	0.15

(continued)

Autocorrelation coefficient for the classical synchronicity measure

From January 1996 to December 2005

	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5	Lag 6	PAC	Prob. (6 lags)	Auto Lag	Prob. (Auto lags)
Greece	0.12	0.21	0.16	0.19	0.14	0.08	-0.01	0.00	3	0.00
Hong Kong	0.14	0.10	0.13	0.04	0.08	0.08	0.04	0.00	n/a	0.00
Hungary	0.08	0.10	0.05	0.05	0.01	-0.01	-0.02	0.11	n/a	0.06
India	0.12	0.07	0.10	0.03	0.04	0.05	0.04	0.01	n/a	0.01
Indonesia	0.13	0.14	0.13	0.07	0.07	0.03	0.00	0.00	1	0.00
Japan	-0.06	-0.02	-0.02	-0.12	0.06	0.02	0.02	0.06	n/a	0.14
Kenya	0.21	0.18	0.09	0.10	0.15	-0.03	-0.11	0.00	1	0.00
Korea	0.08	0.03	0.05	0.15	0.06	0.03	0.02	0.00	n/a	0.06
Malaysia	0.11	0.20	0.19	0.22	0.15	0.14	0.04	0.00	3	0.00
Mexico	-0.01	0.08	0.12	0.02	0.06	0.10	0.09	0.01	n/a	0.90
New Zealand	0.12	0.10	0.12	0.01	0.04	-0.05	-0.07	0.00	n/a	0.01
Pakistan	0.07	-0.01	0.03	-0.03	0.01	-0.01	-0.01	0.77	n/a	0.13
Peru	0.29	0.16	0.11	0.14	0.13	0.06	-0.02	0.00	n/a	0.00
Philippines	0.08	0.04	0.09	0.05	-0.05	0.03	0.03	0.07	n/a	0.06
Poland	0.22	0.18	0.24	0.19	0.22	0.22	0.11	0.00	5	0.00
Portugal	0.09	0.04	0.03	0.05	0.10	-0.07	-0.09	0.03	n/a	0.04
Russia	0.11	0.07	0.04	0.06	0.10	0.08	0.05	0.00	n/a	0.02
South Africa	0.09	0.14	0.02	0.01	0.07	0.01	-0.01	0.01	n/a	0.03
Singapore	0.13	0.14	0.10	0.10	0.14	-0.01	-0.06	0.00	1	0.00
Spain	0.06	-0.02	0.04	0.09	0.12	0.02	0.01	0.02	n/a	0.20
Sri-Lanka	0.16	0.11	0.04	0.01	0.06	0.00	-0.02	0.00	n/a	0.00
Taiwan	0.03	0.04	0.04	0.11	0.03	0.11	0.10	0.02	n/a	0.52
Thailand	-0.06	0.02	0.02	0.06	-0.02	0.02	0.02	0.60	n/a	0.16
Turkey	0.10	0.04	0.00	0.02	0.00	0.01	0.01	0.40	n/a	0.02
UK	0.17	0.11	0.07	0.04	-0.02	-0.02	-0.02	0.00	n/a	0.00
USA-NYSE	0.00	0.02	0.05	0.06	0.05	0.05	0.05	0.40	n/a	0.96
S&P 500	-0.09	-0.01	-0.01	0.09	-0.05	0.04	0.03	0.10	n/a	0.05
Venezuela	0.16	0.20	0.18	0.14	0.17	0.18	0.11	0.00	1	0.00
Zimbabwe	0.16	0.07	0.08	0.04	-0.02	0.10	0.10	0.00	n/a	0.00

However, the study arbitrarily chooses six (6) lags for autocorrelation coefficient. In the last column, we also include the probability of automatic lag selection from ADF test statistics. The result is fairly consistent with some variation in result for some countries.

The study also runs an Augmented Dickey Fuller test (model includes intercept, no time frame) to determine whether the stock synchronicity measures are stationary over the period. The ADF test is an important test statistics for determining the quality of the data. Table 4.7 reports the ADF test statistics which are statistically significant and consistent with

the synchronicity measures being stationary over the period of the study. This suggests that the time series data has constant mean and constant mean variance.

Table 4.7 ADF test statistics for the classical synchronicity measure

ADF test statistics			
Argentina	-13.54	Mexico	-22.94
Australia	-18.98	New Zealand	-20.15
Bangladesh	-21.25	Pakistan	-21.28
Brazil	-21.08	Peru	-16.92
Chile	-19.88	Philippines	-20.94
China	-20.92	Poland	-5.47
Columbia	-19.73	Portugal	-20.82
Cyprus	-11.19	Russia	-20.47
Czech Republic	-12.40	South Africa	-20.95
Egypt	-20.42	Singapore	-13.19
France	-13.23	Spain	-21.57
Germany	-13.73	Sri-Lanka	-19.29
Greece	-7.69	Taiwan	-22.18
Hong Kong	-19.78	Thailand	-24.22
Hungary	-21.11	Ecuador	-3.44
India	-20.14	Turkey	-20.60
Indonesia	-13.23	UK	-19.13
Japan	-24.28	USA	-22.70
Kenya	-12.36	Venezuela	-12.07
Korea	-21.00	Zimbabwe	-19.05
Malaysia	-7.03		

Table 4.8 illustrates the correlation coefficients for the sample of countries using the classical measure over the period from January 1996 to December 2005 to test the relationship between synchronicity values. The study finds evidence of considerable variation in correlation coefficient sign and significance at the 5 percent significant level across the countries for the full period.

Table 4.8 Correlation-coefficient of the sample countries

	AR	AU	BD	BR	CL	CN	CO	CY	CZ	EG	FR	DE	GR	HK	HU	IN	ID	JP	KE
Australia (AU)	**0.15**																		
Bangladesh (BD)	-0.01	**0.08**																	
Brazil (BR)	-0.03	0.02	0.06																
Chile (CL)	0.11	0.05	0.08	0.02															
China (CN)	0.01	0.04	0.00	-0.02	0.02														
Columbia (CO)	-0.05	-0.08	-0.05	**0.11**	**0.11**	0.03													
Cyprus (CY)	-0.01	-0.04	0.02	-0.03	0.01	0.05	**-0.11**												
Czech Rep (CZ)	0.01	0.02	-0.01	0.07	0.06	0.06	0.06	-0.08											
Egypt (EG)	-0.02	-0.02	0.07	0.06	-0.01	-0.08	-0.08	0.06	**0.09**										
France (FR)	**0.14**	**0.27**	0.03	0.05	**0.12**	0.02	0.05	0.00	**0.11**	0.01									
Germany (DE)	**0.14**	**0.23**	0.04	-0.02	0.06	0.02	0.02	0.02	0.07	-0.03	**0.67**								
Greece (GR)	-0.05	0.00	-0.01	0.01	0.05	-0.07	0.02	**0.20**	0.05	0.08	**0.15**	**0.18**							
Hang Kong (HK)	**0.16**	**0.24**	**-0.11**	-0.02	**0.09**	**-0.10**	-0.03	**0.10**	0.03	0.03	**0.26**	**0.24**	**0.12**						
Hungary (HU)	**0.17**	**0.12**	**0.10**	0.07	**0.11**	-0.02	-0.04	0.04	**0.10**	**0.11**	**0.17**	**0.19**	0.04	0.08					
India (IN)	0.06	**0.13**	0.06	-0.04	0.08	-0.02	**0.11**	-0.03	0.08	0.03	**0.15**	0.08	-0.03	**0.13**	**0.10**				
Indonesia (ID)	**0.11**	**0.16**	-0.01	0.04	**0.11**	-0.07	0.04	0.01	-0.06	0.02	**0.09**	**0.11**	**0.11**	**0.19**	**0.13**	-0.03			
Japan (JP)	0.07	0.08	-0.02	-0.04	0.07	0.07	0.04	0.01	0.05	-0.08	**0.19**	**0.19**	0.01	**0.11**	0.02	0.07	0.05		
Kenya (KE)	-0.02	0.04	0.02	0.05	0.07	0.08	0.07	-0.07	**0.14**	0.02	0.07	0.08	-0.08	0.03	-0.05	0.11	-0.06	0.07	
Korea (KR)	0.01	**0.11**	-0.05	**-0.11**	-0.01	-0.07	**-0.09**	0.05	-0.03	0.02	**0.13**	**0.13**	**0.12**	**0.11**	0.03	0.00	**0.11**	0.06	0.06
Malaysia (MY)	0.06	**0.14**	0.00	0.03	-0.02	-0.03	**-0.13**	**0.11**	**-0.14**	0.00	0.06	**0.13**	**0.10**	**0.24**	**0.12**	-0.02	**0.16**	-0.04	**-0.10**
Mexico (MX)	**0.27**	**0.14**	0.02	-0.02	**0.18**	-0.06	0.02	**-0.11**	**0.10**	-0.03	**0.18**	**0.16**	**-0.13**	**0.09**	**0.14**	0.04	0.07	0.07	0.04
New Zealand (NZ)	**0.14**	**0.31**	-0.03	**0.09**	**0.10**	-0.02	-0.02	-0.02	0.08	0.05	**0.15**	**0.17**	**0.06**	**0.12**	**0.19**	0.07	**0.14**	0.04	**0.10**
Pakistan (PK)	0.04	0.02	0.01	0.01	0.06	-0.05	-0.01	-0.05	0.04	0.00	0.05	0.02	-0.01	0.00	0.01	0.08	0.00	0.00	0.01
Peru (PE)	-0.07	-0.04	0.00	0.07	0.05	**0.11**	0.05	-0.08	**0.18**	-0.01	0.06	-0.02	-0.01	**-0.12**	-0.04	0.04	-0.02	-0.06	**0.12**
Philippine (PH)	**0.17**	**0.14**	0.03	0.00	**0.12**	-0.02	-0.02	0.05	0.05	0.03	**0.12**	**0.16**	0.05	**0.17**	**0.14**	0.04	**0.20**	**0.10**	-0.04
Poland (PL)	**0.17**	**0.18**	0.03	-0.02	0.00	-0.02	**-0.13**	0.02	-0.06	0.07	**0.15**	**0.14**	0.05	**0.19**	**0.29**	0.01	0.04	0.08	-0.02
Portugal (PT)	0.05	**0.12**	0.04	-0.03	0.06	**-0.09**	0.02	0.02	-0.02	0.01	**0.35**	**0.28**	0.07	**0.12**	**0.12**	0.11	0.06	0.06	-0.04
Russia (RU)	0.01	0.03	-0.04	**0.11**	**0.20**	0.02	0.07	-0.05	**0.12**	0.02	0.08	0.02	0.01	0.02	**0.11**	0.06	0.03	-0.05	0.00
S-Africa (SA)	**0.22**	**0.27**	-0.01	0.01	**0.19**	0.02	0.03	-0.04	**0.11**	-0.04	**0.20**	**0.16**	-0.03	**0.18**	**0.13**	0.09	0.08	**0.09**	0.03
Singapore (SG)	**0.12**	**0.15**	-0.05	-0.01	**0.10**	-0.04	-0.03	**0.16**	0.00	-0.02	**0.18**	**0.17**	**0.09**	**0.42**	**0.15**	0.10	**0.21**	0.08	-0.03
Spain (ES)	**0.19**	**0.17**	0.04	-0.03	0.08	-0.08	-0.01	-0.02	0.08	-0.01	**0.53**	**0.45**	0.03	**0.17**	**0.17**	0.09	**0.10**	**0.17**	0.03
Sri-Lanka (LK)	0.00	0.00	0.01	0.04	0.06	0.00	**0.19**	**-0.10**	**0.12**	-0.03	**0.13**	**0.10**	0.00	0.02	0.01	0.01	-0.04	0.04	0.07
Taiwan (TW)	0.07	**0.10**	0.01	0.03	0.08	0.00	0.05	0.06	-0.08	-0.04	**0.10**	**0.12**	**0.13**	**0.23**	-0.03	-0.01	0.05	0.08	-0.06
Thailand (TH)	**0.13**	0.06	-0.01	0.04	**0.10**	0.03	0.04	-0.02	0.07	-0.05	0.08	**0.10**	0.07	**0.14**	0.06	0.07	**0.12**	0.06	-0.01
Zimbabwe (ZM)	-0.01	0.06	-0.03	0.04	-0.08	-0.01	0.00	-0.03	0.00	0.08	0.00	0.00	-0.05	-0.03	0.06	**0.09**	0.00	0.00	0.06
Ecuador (EC)	-0.03	0.06	0.02	0.05	-0.01	0.06	0.01	-0.01	0.06	0.05	-0.05	-0.01	0.02	-0.08	-0.02	-0.01	-0.07	0.00	-0.06
Turkey (TR)	0.06	0.02	-0.02	-0.05	0.02	0.01	0.01	**0.11**	-0.01	-0.04	**0.09**	0.07	**0.13**	0.01	**0.16**	0.09	-0.05	0.03	-0.01
UK	**0.14**	**0.29**	0.01	0.08	**0.11**	0.01	0.01	0.03	**0.10**	0.00	**0.56**	**0.49**	**0.11**	**0.23**	**0.23**	0.15	0.08	**0.13**	0.06
Venezuela (VE)	**0.10**	0.04	-0.02	-0.04	**0.09**	-0.07	0.00	-0.08	0.00	0.01	-0.01	0.01	0.00	**0.09**	**0.11**	-0.02	0.04	0.04	-0.07
USA	**0.17**	**0.18**	**-0.09**	-0.02	**0.12**	-0.04	0.08	-0.07	**0.11**	-0.01	**0.31**	**0.28**	-0.04	**0.17**	0.08	0.13	0.06	0.07	0.05

(continued)

Correlation-coefficient of the classical synchronicity measure for observed countries

	KE	KR	MY	MX	NZ	PK	PE	PH	PL	PT	RU	SA	SG	ES	LK	TW	TH	ZM	EC	TR	UK	VE
Korea (KR)	0.06																					
Malaysia (MY)	**-0.10**	**0.14**																				
Mexico (MX)	0.04	0.03	0.00																			
New Zealand (NZ)	**0.10**	0.05	0.03	0.04																		
Pakistan (PK)	0.01	0.03	-0.02	0.02	0.02																	
Peru (PE)	**0.12**	-0.06	**-0.14**	0.08	-0.06	-0.01																
Philippine (PH)	-0.04	0.07	**0.11**	0.05	**0.11**	0.07	-0.07															
Poland (PL)	-0.02	0.04	**0.19**	**0.10**	**0.20**	0.04	**-0.13**	0.07														
Portugal (PT)	-0.04	0.05	**0.10**	**0.11**	0.02	0.02	-0.02	0.07	**0.13**													
Russia (RU)	0.00	-0.02	0.01	**0.15**	0.05	0.03	**0.13**	0.01	0.02	**0.09**												
S-Africa (SA)	0.03	0.08	**0.10**	**0.24**	**0.19**	0.00	**0.09**	**0.17**	**0.19**	**0.09**	**0.17**											
Singapore (SG)	-0.03	**0.14**	**0.36**	**0.13**	0.07	0.05	**-0.11**	**0.22**	**0.13**	**0.12**	0.08	**0.16**										
Spain (ES)	0.03	**0.13**	0.01	**0.26**	**0.15**	0.05	0.00	0.08	**0.15**	**0.31**	0.06	**0.16**	**0.10**									
Sri-Lanka (LK)	0.07	-0.04	-0.02	**0.13**	0.01	0.03	0.04	-0.04	-0.04	0.06	**0.09**	0.05	-0.01	0.07								
Taiwan (TW)	-0.06	**0.16**	**0.14**	-0.02	0.05	-0.02	**-0.12**	0.06	**0.13**	0.05	0.05	0.05	**0.17**	0.07	0.05							
Thailand (TH)	-0.01	**0.09**	0.01	0.08	0.00	**0.09**	0.05	**0.16**	0.01	0.04	**0.13**	**0.13**	**0.18**	**0.13**	0.06	0.06						
Zimbabwe (ZM)	0.06	-0.07	-0.06	0.02	0.04	-0.03	0.06	-0.02	0.00	0.02	-0.05	-0.01	-0.06	-0.02	0.02	-0.05	-0.08					
Ecuador (EC)	-0.06	-0.01	0.02	-0.04	-0.06	-0.04	0.06	0.05	**-0.12**	0.00	0.05	-0.04	**-0.10**	-0.01	-0.03	-0.01	0.00	0.07				
Turkey (TR)	-0.01	**0.09**	0.01	-0.01	0.04	0.03	-0.05	-0.02	0.06	0.03	0.03	0.02	**0.10**	0.06	0.06	**0.13**	0.00	0.05	0.08			
UK	0.06	**0.12**	**0.08**	**0.18**	**0.16**	0.05	-0.05	**0.10**	**0.21**	**0.25**	0.04	**0.25**	**0.19**	**0.32**	0.05	**0.10**	**0.08**	0.03	0.00	0.04		
Venezuela (VE)	-0.07	0.00	0.05	**0.15**	0.07	0.01	-0.05	0.00	**0.23**	0.04	**0.09**	0.07	0.05	**0.13**	0.03	-0.08	0.00	-0.03	**-0.09**	0.04	0.02	
USA	0.05	0.04	**-0.08**	**0.31**	**0.13**	0.08	0.06	0.08	0.06	**0.16**	0.05	**0.20**	0.06	**0.34**	**0.10**	0.04	**0.16**	**0.12**	0.00	0.03	**0.22**	0.06

It is found that among the South American countries Argentina is positively correlated with Mexico (27 percent) and South Africa (22 percent). There is also some positive correlation with the European countries (examples include Poland, Spain and the UK) and the USA. Chile is correlated with Mexico, Russia and South Africa. In addition, Mexico has strong positive correlation with the USA (31 percent), Spain (26 percent) and South Africa (24 percent). Finally, Brazil and Ecuador shows no sign of significant correlation with any of the other countries in the sample.

South Africa is positively correlated with Australia, Argentina, France, Germany, Hong Kong, Mexico, the UK and the USA. Surprisingly, however, Egypt, Kenya and Zimbabwe show no sign of significant correlation with any countries in Africa or the rest of the world. This finding suggests that synchronicity measures for common law origin countries are somewhat more correlated with each other than with other countries in the same region. However, in South Asia, the study finds no significant correlation for Bangladesh, India and Pakistan with other countries of the world; whereas Sri-Lanka is positively correlated with Columbia, France and Mexico.

Among the Asia/Pacific group, Hong Kong shows significant positive correlation with Malaysia, Singapore, Taiwan, France, Germany and the UK and also shows some significant positive correlation with other Asian and European countries. Indonesia exhibits positive correlation only with the Philippines and Singapore, while Malaysia shows strong positive correlation with Singapore and Hong Kong but negative correlation with Peru. The other Asia/Pacific countries show somewhat mixed correlations.

Hungary shows some positive correlation with Asian and European countries, such as Poland (29 percent) and the UK (23 percent), and there is mixed correlation with other countries in the sample. Portugal is positively correlated with France and Germany, and Spain is correlated with France, Germany and Mexico.

Developed countries are somewhat more positively correlated with each other than with the emerging countries. For example, the Australian synchronicity measure is significantly correlated with France, Germany, Hong Kong, New Zealand and the UK. In Europe the UK measure is strongly correlated with Germany, France, Spain and Portugal. Further, the USA is correlated with France, Germany, Spain, Mexico and the UK. The

strongest correlation evident in table 4.8 is between Germany with France (67 percent). This suggests that strong economic and political relationships exist between these two countries. However, the study finds no significant positive correlation between Japan and the other Asian countries. The Japanese synchronicity measure is significantly correlated only with France (19 percent), Germany (19 percent) and Spain (17 percent).

In summary, there is evidence that synchronicity measures for the common law countries are somewhat more correlated with each other than is the case with civil law countries. It is also found that developed countries exhibit higher levels of synchronicity correlation than do the emerging countries.

4.3.1 Regional synchronicity time series links: A VAR analysis

The previous sections looked at the time series behaviour of stock synchronicity measures for individual countries. It is also important to look at the direction of these relationships. The study provides a first order auto-regression model to study the links that exists between the geographical region synchronicity measures. The study includes a Vector Autoregression (VAR) model (reported in table 4.9, test includes one lag) to test the relationship and the direction of the relationship that exists between geographical region stock synchronicity.

It is found that the synchronicity of a geographical region is most affected by the past synchronicity values of its own geographical region. However, there also appears to be some link with other geographical regions, such as the developed economies appearing to predict South America and South Asia, and Central Asia appearing to predict Africa.

Table 4.9 The vector auto-regression (VAR) analysis

The data include six emerging geographical region groups and the developed country group. The emerging country groups are South America, South Asia, Africa, Central Asia, Europe and Asia/Pacific. The developed country group includes Australia, France, Germany, New Zealand, Japan, the UK and the USA. The data span the period from January 1996 to December 2005. Further, two values are reported below the estimated coefficient. The first value in parenthesis is the P value and the second value in brackets is the t statistic.

	South America	South Asia	Europe	Developed	Central Asia	Asia/ Pacific	Africa
South America (-1)	0.1929 (0.04) [4.33]	-0.0103 (0.06) [-0.19]	-0.0213 (0.05) [-0.43]	-0.0584 (0.05) [-1.22]	-0.1675 (0.09) [-1.78]	-0.0685 (0.05) [-1.31]	-0.0552 (0.05) [-1.11]
South Asia (-1)	0.0051 (0.04) [0.14]	0.1316 (0.04) [2.90]	-0.0064 (0.04) [-0.16]	0.0472 (0.04) [1.24]	-0.0259 (0.07) [-0.35]	-0.0647 (0.04) [-1.56]	0.0880 (0.04) [2.22]
Europe (-1)	0.0005 (0.05) [0.01]	0.0084 (0.06) [0.15]	0.0221 (0.05) [0.43]	-0.0034 (0.05) [-0.07]	0.2046 (0.10) [2.14]	0.0511 (0.05) [0.96]	0.0786 (0.05) [1.55]
Developed (-1)	0.1274 (0.05) [2.64]	0.1266 (0.06) [2.11]	-0.0089 (0.05) [-0.16]	0.0964 (0.05) [1.86]	-0.1296 (0.10) [-1.27]	0.0467 (0.06) [0.82]	0.0320 (0.05) [0.59]
Central Asia (-1)	-0.0189 (0.02) [-0.91]	-0.0149 (0.03) [-0.58]	0.0165 (0.02) [0.70]	-0.0084 (0.02) [-0.38]	0.1460 (0.04) [3.32]	0.0278 (0.02) [1.14]	-0.0553 (0.02) [-2.38]
Asia/Pacific (-1)	0.0183 (0.04) [0.46]	-0.0717 (0.05) [-1.44]	0.0579 (0.05) [1.28]	0.0095 (0.04) [0.22]	0.0327 (0.08) [0.39]	0.0908 (0.05) [1.93]	0.0054 (0.04) [0.12]
Africa (-1)	-0.0028 (0.04) [-0.07]	0.0814 (0.05) [1.67]	0.0088 (0.04) [0.20]	0.0288 (0.04) [0.68]	-0.1498 (0.08) [-1.81]	-0.0336 (0.05) [-0.73]	0.1855 (0.04) [4.23]
R-squared	0.070	0.045	0.006	0.017	0.049	0.029	0.070
Adj. R-squared	0.057	0.032	-0.007	0.003	0.036	0.016	0.058
F-statistic	5.520	3.422	0.473	1.247	3.792	2.214	5.530

4.4 Panel data analysis

The study uses two corporate governance indicators for cross-sectional analysis (regulatory control and voice & accountability). These governance indicators reflect the statistical compilation of responses concerning the quality of governance and are measured in units ranging from -2.5 to +2.5. The higher values correspond with better governance outcomes and lower values correspond with poor governance outcomes. In addition the study also the corporate transparency index (CPI), country geographical size, a trade openness measure, GDP per capita and an inflation index in cross-sectional analysis.

Country geographical size is collected from the CIA[15] world factbook website, and GDP per capita and inflation rate are collected from the World Bank[16] database. Further, the trade openness measure is calculated using the Li et al. (2003) trade openness approach, which was discussed in the data section. The corruption index was collected from the Transparency International database[17].

4.4.1 The model

The study uses the following model to explain stock return synchronicity:

$$SYNC_i = \alpha + \beta_1 RC_i + \beta_2 VC_i + \beta_3 IN_i + \beta_4 CP_i + \beta_5 GDP_i + \beta_6 \log(SIZE)_i + \beta_7 TR_i + \varepsilon_i \quad (15)$$

where for each country i $SYNC_i$ represents stock return synchronicity and α is a constant. RC_i is the regulatory control index, VC_i is the voice and accountability index, IN_i is the inflation, CP_i is the corruption perception index, GDP_i is the gross domestic product per capita / 10,000, TR_i is the trade openness measure, $SIZE_i$ is geographical size and ε_i is the error term. The natural log of geographical size is used to minimise the impact of skewness in this variable.

[15] https://www.cia.gov/library/publications/the-world-factbook/

[16] http://www.worldbank.org/

[17] http://www.transparency.org/

4.4.2 Panel analysis

The study uses white adjusted standard errors in a fixed effect model for the panel analysis. Table 4.10 illustrates analysis for all countries, developed countries and emerging countries. Correlations between the explanatory variables are provided in Appendix A-4.5. The results obtained from the equation (8) to the data are reported in table 4.10. The thesis uses 41 sample countries for the analysis, 34 of which are emerging countries. Analysis of the descriptive statistics in table 3.8 shows that most of the emerging countries rank lower in the corruption index due to higher levels of corruption present, while developed economies rank higher in the corruption index due to their lower levels of corruption.

The country corruption index is negatively correlated with synchronicity at the 1 percent significance level for the all country group and positively correlated with the developed country group. However, this effect is insignificant for the emerging country group, although the corruption index is negatively correlated with synchronicity in this case. In addition, the inclusion of Singapore, South Korea and Hong Kong in the emerging country sample could exacerbate the problem, as the corruption index is quite high (low corruption) for these countries. However, to check the variation in the analysis the study runs the cross-sectional analysis without Singapore, Hong Kong and South Korea for the all country group and the emerging country group. It is found that corruption become statistically significant at the 15 percent level for the emerging country group, which was statistically insignificant in the prior analysis. This suggests a significant impact of these countries within the emerging country group. Further, there is no other strong evidence of significant difference between the findings. The result of this analysis is provided in Appendix A-4.6.

Table 4.10 Panel data analysis: Classical measure

The panel of this table contains estimates of:

$$SYNC_i = \alpha + \beta_1 RC_i + \beta_2 VC_i + \beta_3 IN_i + \beta_4 CP_i + \beta_5 GDP_i + \beta_6 \log(SIZE)_i + \beta_7 TR_i + \varepsilon_i$$

where SYNC, the dependent variable, is the stock synchronicity measure and α is a constant. Control (RC) is regulatory control index, Corruption (CP) is the corruption index produced by Transparency International, GDP is gross domestic product per capita / 10,000, Inflation (IN) is a country's inflation rate, Trade (TR) is the trade openness measure, Accountability (VC) is the voice and accountability index and Size (SIZE) is the natural log of the geographical size of a country. Two values are reported below the estimated coefficient. The first in parenthesis is the t statistic using white adjusted standard errors and the second, in brackets, is the P value for the statistic.

Variables	All countries	Developed countries	Emerging countries
Control	**0.01603**	**0.00951**	**0.00972**
	(3.83)	(1.83)	(1.98)
	[0.00]	[0.08]	[0.05]
Corruption	**-0.00789**	**0.00953**	**-0.00317**
	(-5.48)	(31.25)	(-1.21)
	[0.00]	[0.00]	[0.23]
GDP	**0.00325**	**0.01262**	**0.01198**
	(1.62)	(1.04)	(1.77)
	[0.11]	[0.31]	[0.08]
Inflation	**0.00018**	**-0.00273**	**0.00020**
	(1.15)	(-0.81)	(1.18)
	[0.25]	[0.42]	[0.24]
Trade	**-0.01257**	**0.04789**	**-0.01726**
	(-1.18)	(0.56)	(-1.32)
	[0.24]	[0.58]	[0.19]
Accountability	**-0.02376**	**-0.12679**	**-0.02129**
	(-6.39)	(-3.09)	(-6.45)
	[0.00]	[0.01]	[0.00]
Log (Size)	**-0.00381**	**-0.00355**	**-0.00044**
	(-3.45)	(-1.10)	(-0.35)
	[0.00]	[0.28]	[0.73]
R-square	0.269	0.614	0.128

The same effect also appears for inflation and GDP per capita. It is often argued that high inflation is bad for the real market economy and that synchronicity is positively correlated with higher inflation (Morck et al., 2000). Regardless, inflation is positively correlated with stock synchronicity for the all country group and for the emerging country group, but the effect is statistically insignificant. It is found that few emerging countries (Singapore, Taiwan, and Argentina) exhibit low inflation rates during the sample period, while the remaining emerging countries exhibit higher inflation. This variation in inflation

rates between the emerging countries appears to cause inflation to be positively correlated with the synchronicity measure but the effect remains statistically insignificant.

The voice and accountability variable is negatively correlated with stock synchronicity at the one percent significance level for the all country group, the developed country group and the emerging country group. Voice and accountability is one of the most important corporate governance mechanisms identified in the panel analysis. The World Bank produces six good governance indicators in three clusters and three of these indicators are used in this study for measuring good governance. Voice and accountability and political stability are included in the first of the three clusters.

The World Bank states that the voice and accountability indicators include various aspects of civil rights, political rights and independence of public and private media. This provides a measure of a country's legal environment and legal enforcement quality. Morck et al. (2000) argue that synchronicity is higher for countries that do not respect private property rights and have less enforcement quality in their legal system. This argument is further supported by Roll (1988). It is argued that strong civil and property rights produce lower levels of stock synchronicity.

Surprisingly, regulatory control exhibits a positive correlation with the stock return synchronicity at the one percent significance level for the all country group, and at the five percent significance level for the emerging country group. It was predicted in section 3.4.1 that regulatory control and voice and accountability would have the same impact on stock synchronicity. However, it is found that some among the sample of emerging countries exhibit strong positive regulatory control systems (examples include Poland, Malaysia and Singapore) during the observation period, while these countries exhibit higher stock market co-movement in the same period. This may explain the reason for the positive correlation between regulatory control and stock price co-movement for the panel analysis.

Log geographical size is used to control for country size. It is found that the geographical size of a country is negatively correlated with stock synchronicity at the one percent significance level for the all country group but the effect disappears for the developed country and emerging country groups. Emerging countries generally have small geographical size (except for China, India and Brazil), while developed countries are generally larger in

size. Therefore, geographical size becomes statistically significant within groups rather than between groups.

4.4.3 Panel data analysis: Legal origin effects

Separate analysis is also conducted for groups based on legal origin (common law countries and civil law countries) to check for variation across legal groups (table 4.11). Post-communist countries are not analysed separately due to the small size of the sample.

It is found that inflation and accountability in common law countries is negatively correlated with stock synchronicity at the 10 percent significance level and trade openness is positively correlated with synchronicity at the 5 percent level. In contrast, accountability is negatively correlated with stock synchronicity at the 10 percent significance level for the civil law country group and trade openness, geographical size and corruption are negatively correlated at the one percent significance level.

There is evidence that stock synchronicity in civil law countries is driven mainly by weak corporate governance systems and high inflation, whereas the effect is less significant for the common law countries. Additionally, the trade openness measure has the same effect for both the common law and the civil law country groups.

Regulatory control is positively corrected with stock synchronicity at the 10 percent level for civil law countries. This may be due to the weak regulatory control systems appears in the emerging civil law country group (La-Porta et al., 1998). However, this effect is insignificant for common law countries.

Table 4.11 Panel data analysis between legal origin groups: Classical measure

The study compares the panel data analysis between the common law country group and the civil law country group. The post-communist countries are not analysed separately due to the small sample size.

The panel of this table contains estimates of:

$$SYNC_i = \alpha + \beta_1 \ RC_i + \beta_2 VC_i + \beta_3 IN_i + \beta_4 CP_i + \beta_5 GDP_i + \beta_6 \log(SIZE)_i + \beta_7 TR_i + \varepsilon_i$$

where SYNC, the dependent variable, is the stock market synchronicity ands α is a constant. Control (RC) is the regulatory control, Corruption (CP) is the corruption index produce by transparency international, GDP is the gross domestic product per capita / 10,000, Inflation (IN) is the inflation rate of a country, Trade (TR) is the trade openness measure, Accountability (VC) is the voice and accountability index and Size (SIZE) is the natural log of a country's geographical size. Two values are reported below the estimated coefficient. The first, in parenthesis, is the t statistics using white adjusted standard errors and the second, in brackets, is the P value for the statistics.

	Common law countries	Civil law countries
Control	**-0.01031**	**0.01846**
	(-0.75)	(1.82)
	[0.46]	[0.07]
Corruption	**-0.00106**	**-0.01350**
	(-0.30)	(-2.69)
	[0.77]	[0.01]
GDP	**0.00247**	**0.00396**
	(-0.33)	(0.87)
	[0.75]	[0.39]
Inflation	**-0.00014**	**0.00102**
	(-1.69)	(3.98)
	[0.10]	[0.00]
Trade	**0.05513**	**-0.10639**
	(2.12)	(-3.52)
	[0.04]	[0.00]
Accountability	**-0.00935**	**-0.01287**
	(-1.98)	(-1.69)
	[0.05]	[0.09]
Log (Size)	**0.00015**	**-0.01254**
	(0.06)	(-4.07)
	[0.95]	[0.00]
R-square	0.391	0.469

4.5 Discussion

The study finds evidence that emerging economies exhibit greater levels of stock synchronicity over the study period. It is found that measures of stock synchronicity for developed economies average 62 percent, whereas emerging countries exhibit higher average stock synchronicity (66 percent) (see table 3.7)

Further, synchronicity is lower in more transparent economies such as Australia, the UK, France and Germany than in less transparent economies. These developed economies have low corruption rates and rank higher in terms of voice and accountability measures. In contrast, the Japanese stock market exhibits high stock return synchronicity relative to the developed countries. This result is consistent with Morck et al. (2000) who also note the high Japanese stock market synchronicity.

There is also evidence that stock price synchronicity is associated with a country's legal origin. Post-communist countries exhibit higher stock synchronicity than countries of common law or civil law origin. However, the sample size for the post-communist country group is small and China exhibits the highest stock return synchronicity among the post-communist countries (73 percent). Ex-communist countries like Poland, that are reforming their economic system, have exhibited lower levels of stock synchronisation in recent years relative to the early 1990s. Further, stock synchronicity for civil law origin countries is associated with corruption rate, inflation, country size and accountability, whereas for common law countries synchronicity is associated mainly with inflation and accountability.

It is found that stock synchronicity is negatively correlated with country geographical size, consistent with Morck et al. (2000), which suggests that large countries like the USA, Australia and Mexico exhibit lower stock price co-movement than small countries such as Singapore and Ecuador. In addition, there is evidence that higher synchronicity is associated with higher inflation rates (examples include Ecuador, Russia, Turkey and Argentina).

Finally, voice and accountability is negatively correlated with stock synchronicity for the all countries group as well as for the emerging economies, suggesting that countries with low corporate governance systems often exhibit higher levels of stock synchronicity (for example, Turkey, Ecuador and China) and this finding is consistent with Morck et al. (2000).

4.6 Conclusion

This study presents empirical analysis of the classical measure of stock return synchronicity. It is found that the highest stock synchronicity is exhibited by China (73 percent), Malaysia (73 percent) and Turkey (75 percent) during the study period, while the developed countries average 62 percent. In addition, the study finds statistically significant correlation in the time

series data and this correlation is significantly different from zero for most common law countries. The study finds that corruption is negatively correlated with stock price synchronicity. This suggests that more corrupt economies exhibit higher stock return synchronicity than less corrupt economies and these results are also consistent with Morck et al. (2000). There is also evidence that country stock synchronicity is associated with higher inflation rate. High-inflation economies such as Turkey exhibit higher synchronicity during the study period. In contrast, low-inflation economies, such as Australia and Germany, exhibit low level of stock return synchronicity.

It is also found that voice and accountability has a strong impact on country stock co-movement. The study used the voice and accountability index as an alternative measure for the quality of law enforcement and civil rights indices. Voice and accountability is negatively correlated with stock synchronicity. Countries that are highly accountable for civil and private property rights rank higher in the accountability index and exhibit lower stock synchronicity, while countries that do not respect private property rights and civil rights rank lower in the accountability index and exhibit higher stock return synchronicity.

There is evidence that the trade openness measure is negatively correlated for civil law countries but the effect is insignificant for the common law country group. The synchronicity measures are stationary over the 10-year period of study.

4.7 Appendices

A 4.1 Classical measure descriptive statistics for sub-periods: Legal origin

Panel A
Common law countries

	2004-05	2002-03	2000-01	1998-99	1996-97
	Mean	Mean	Mean	Mean	Mean
Bangladesh	0.69	0.68	0.70	0.69	0.67
Cyprus	0.62	0.67	0.75	0.70	0.68
Egypt	0.67	0.64	0.65	0.67	0.65
Hong Kong	0.63	0.64	0.65	0.67	0.64
India	0.69	0.65	0.64	0.63	0.66
Kenya	0.64	0.64	0.59	0.59	0.62
Malaysia	0.66	0.71	0.75	0.79	0.73
Pakistan	0.67	0.67	0.65	0.65	0.68
South Africa	0.61	0.59	0.60	0.61	0.61
Singapore	0.63	0.69	0.68	0.75	0.68
Sri Lanka	0.68	0.69	0.66	0.66	0.65
Zimbabwe	0.69	0.68	0.65	0.64	0.66
Average	0.66	0.66	0.66	0.67	0.66

Panel B
Civil law countries

	2004-05	2002-03	2000-01	1998-99	1996-97
	Mean	Mean	Mean	Mean	Mean
Argentina	0.69	0.66	0.68	0.72	0.72
Brazil	0.65	0.65	0.64	0.65	0.61
Chile	0.65	0.64	0.64	0.67	0.63
Columbia	0.70	0.68	0.64	0.65	0.63
Czech Rep.	0.65	0.63	0.60	0.59	0.59
Ecuador	0.77	0.76	0.80	0.72	0.69
Greece	0.65	0.75	0.78	0.72	0.69
Hungary	0.64	0.63	0.65	0.67	0.66
Indonesia	0.67	0.67	0.68	0.72	0.64
Korea	0.63	0.68	0.69	0.68	0.69
Mexico	0.68	0.65	0.63	0.69	0.67
Peru	0.68	0.69	0.65	0.63	0.62
Philippines	0.64	0.64	0.66	0.67	0.65
Portugal	0.62	0.63	0.62	0.64	0.63
Spain	0.66	0.65	0.64	0.66	0.68
Taiwan	0.66	0.69	0.72	0.71	0.69
Thailand	0.67	0.68	0.66	0.66	0.65
Turkey	0.71	0.75	0.76	0.75	0.75
Venezuela	0.63	0.65	0.63	0.72	0.74
Average	0.67	0.67	0.67	0.68	0.66

Panel C
Post-communist countries

	2004-05	2002-03	2000-01	1998-99	1996-97
	Mean	Mean	Mean	Mean	Mean
China	0.74	0.75	0.72	0.72	0.74
Poland	0.62	0.61	0.64	0.69	0.74
Russia	0.70	0.69	0.68	0.73	0.67
Average	0.69	0.68	0.68	0.71	0.72

Panel D
Developed countries

	2004-05	2002-03	2000-01	1998-99	1996-97
	Mean	Mean	Mean	Mean	Mean
Australia	0.58	0.57	0.58	0.57	0.59
France	0.61	0.63	0.61	0.61	0.60
Germany	0.59	0.60	0.60	0.59	0.59
Japan	0.68	0.69	0.65	0.66	0.68
New Zealand	0.62	0.60	0.61	0.63	0.63
UK	0.62	0.64	0.64	0.64	0.62
US - NYSE	0.65	0.64	0.61	0.63	0.64
Average	0.62	0.62	0.61	0.62	0.62

A 4.2 Classical measure descriptive statistics for sub-periods: Geographical segments

Panel A
Geographical segment: Europe

	2004-05	2002-03	2000-01	1998-99	1996-97
	Mean	Mean	Mean	Mean	Mean
Czech Republic	0.65	0.63	0.60	0.59	0.59
Greece	0.65	0.75	0.78	0.72	0.69
Hungary	0.64	0.63	0.65	0.67	0.66
Poland	0.62	0.61	0.64	0.69	0.74
Portugal	0.62	0.63	0.62	0.64	0.63
Russia	0.70	0.69	0.68	0.73	0.67
Spain	0.66	0.65	0.64	0.66	0.68
Average	0.65	0.66	0.66	0.67	0.67

Panel B
Geographical segment: Asia/Pacific

	2004-05	2002-03	2000-01	1998-99	1996-97
	Mean	Mean	Mean	Mean	Mean
China	0.74	0.75	0.72	0.72	0.74
Hong Kong	0.63	0.64	0.65	0.67	0.64
Indonesia	0.67	0.67	0.68	0.72	0.64
Korea	0.63	0.68	0.69	0.68	0.69
Malaysia	0.66	0.71	0.75	0.79	0.73
Philippines	0.64	0.64	0.66	0.67	0.65
Singapore	0.63	0.69	0.68	0.75	0.68
Taiwan	0.66	0.69	0.72	0.71	0.69
Thailand	0.67	0.68	0.66	0.66	0.65
Average	0.66	0.68	0.69	0.71	0.68

Panel C
Geographical segment: Africa

	2004-05	2002-03	2000-01	1998-99	1996-97
	Mean	Mean	Mean	Mean	Mean
Egypt	0.67	0.64	0.65	0.67	0.65
Kenya	0.64	0.64	0.59	0.59	0.62
South Africa	0.61	0.59	0.60	0.61	0.61
Zimbabwe	0.69	0.68	0.65	0.64	0.66
Average	0.65	0.64	0.62	0.63	0.64

Panel D
Geographical segment: South America

	2004-05	2002-03	2000-01	1998-99	1996-97
	Mean	Mean	Mean	Mean	Mean
Argentina	0.69	0.66	0.68	0.72	0.72
Brazil	0.65	0.65	0.64	0.65	0.61
Chile	0.65	0.64	0.64	0.67	0.63
Columbia	0.70	0.68	0.64	0.65	0.63
Ecuador	0.77	0.76	0.80	0.72	0.69
Peru	0.68	0.69	0.65	0.63	0.62
Mexico	0.68	0.65	0.63	0.69	0.67
Venezuela	0.63	0.65	0.63	0.72	0.74
Average	0.68	0.67	0.66	0.68	0.66

Panel E
Geographical segment: South Asia

	2004-05	2002-03	2000-01	1998-99	1996-97
	Mean	Mean	Mean	Mean	Mean
Bangladesh	0.69	0.68	0.70	0.69	0.67
India	0.69	0.65	0.64	0.63	0.66
Pakistan	0.67	0.67	0.65	0.65	0.68
Sri-Lanka	0.68	0.69	0.66	0.66	0.65
Average	0.68	0.67	0.66	0.66	0.67

Panel F
Geographical segment: Central Asia

	2004-05	2002-03	2000-01	1998-99	1996-97
	Mean	Mean	Mean	Mean	Mean
Cyprus	0.62	0.67	0.75	0.70	0.68
Turkey	0.71	0.75	0.76	0.75	0.75
Average	0.67	0.71	0.76	0.73	0.72

A 4.3 ANOVA test statistics between the sub-periods: Classical measure
Developed vs. emerging country group

Panel A
1996-97

	Sum of squares	Degrees of freedom	Mean square	F-statistics	Sig.
Between groups	.013	1	.013	7.844	.008
Within groups	.062	39	.002		
Total	.075	40			

Panel B
1998-99

	Sum of squares	Degrees of freedom	Mean square	F-statistics	Sig.
Between groups	.022	1	.022	11.284	.002
Within groups	.075	39	.002		
Total	.097	40			

Panel C
2000-01

	Sum of squares	Degrees of freedom	Mean square	F-statistics	Sig.
Between groups	.018	1	.018	7.811	.008
Within groups	.090	39	.002		
Total	.108	40			

Panel D
2002-03

	Sum of squares	Degrees of freedom	Mean square	F-statistics	Sig.
Between groups	.012	1	.012	7.659	.009
Within groups	.062	39	.002		
Total	.074	40			

Panel E
2004-05

	Sum of squares	Degrees of freedom	Mean square	F-statistics	Sig.
Between groups	.011	1	.011	8.656	.005
Within groups	.048	39	.001		
Total	.059	40			

A 4.4 Kruskal-Wallis test statistics for full period: Classical measure
January 1996 to December 2005

Chi-square	Degrees of freedom	Probability
3.818	2	0.148

A 4.5 Correlation-coefficient between explanatory variables

Here, Control is the regulatory control, Corruption is the corruption index produced by Transparency International, GDP is the gross domestic product per capita, Inflation is the inflation rate of a country, Trade is the trade openness measure, Account is the voice and accountability index and Size is the geographical size of a country. Values in bold letters indicate significance at the 5 percent level and values in bold letters including star '*' indicate significance at the 10 percent level.

Panel A
1996-97

	Sync	Inflation	Control	Account	GDP	Corruption	Size
Inflation	0.156						
Control	**-0.601**	**-0.466**					
Accountability	**-0.637**	**-0.377**	**0.798**				
GDP	**-0.553**	-0.145	**0.726**	**0.68**			
Corruption	**-0.596**	-0.214	**0.88**	**0.681**	**0.87**		
Size	0.201	-0.049	-0.136	-0.19	0.002	-0.083	
Trade	-0.111	**0.32**	0.236	-0.139	0.124	**0.292(*)**	-0.218

Panel B
1998-99

	Sync	Inflation	Control	Account	GDP	Corruption	Size
Inflation	**0.335**						
Control	-0.108	**-0.41**					
Accountability	**-0.407**	**-0.447**	**0.615**				
GDP	**-0.302(*)**	**-0.389**	**0.68**	**0.608**			
Corruption	**-0.284**	**-0.469**	**0.843**	**0.641**	**0.807**		
Size	0.008	0.215	-0.245	-0.107	-0.014	-0.12	
Trade	0.313	-0.164	**0.449**	0.006	0.243	**0.403**	-0.209

Panel C
2000-01

	Sync	Inflation	Control	Account	GDP	Corruption	Size
Inflation	**0.367**						
Control	-0.175	**-0.513**					
Accountability	**-0.284(*)**	**-0.32**	**0.636**				
GDP	**-0.289(*)**	**-0.28(*)**	**0.651**	**0.553**			
Corruption	**-0.328**	**-0.318(*)**	**0.83**	**0.638**	**0.804**		
Size	-0.075	0.013	**-0.286(*)**	-0.108	-0.001	-0.096	
Trade	0.11	-0.138	**0.476**	0.006	**0.29**	**0.411**	-0.225

Panel D
2002-03

	Sync	Inflation	Control	Account	GDP	Corruption	Size
Inflation	0.113						
Control	**-0.366**	**-0.439**					
Accountability	**-0.507**	**-0.401**	**0.871**				
GDP	**-0.308(*)**	-0.168	**0.757**	**0.697**			
Corruption	**-0.383**	-0.235	**0.895**	**0.731**	**0.835**		
Size	0.018	-0.034	-0.13	-0.156	-0.003	-0.064	
Trade	0.064	0.009	0.376	0.051	0.239	**0.392**	-0.208

Panel E
2004-05

	Sync	Inflation	Control	Account	GDP	Corruption	Size
Inflation	0.156						
Control	**-0.601**	**-0.466**					
Accountability	**-0.637**	**-0.377**	**0.798**				
GDP	**-0.553**	-0.145	**0.726**	**0.68**			
Corruption	**-0.596**	-0.214	**0.88**	**0.681**	**0.87**		
Size	0.201	-0.049	-0.136	-0.19	0.002	-0.083	
Trade	-0.111	0.32	0.236	-0.139	0.124	**0.292(*)**	-0.218

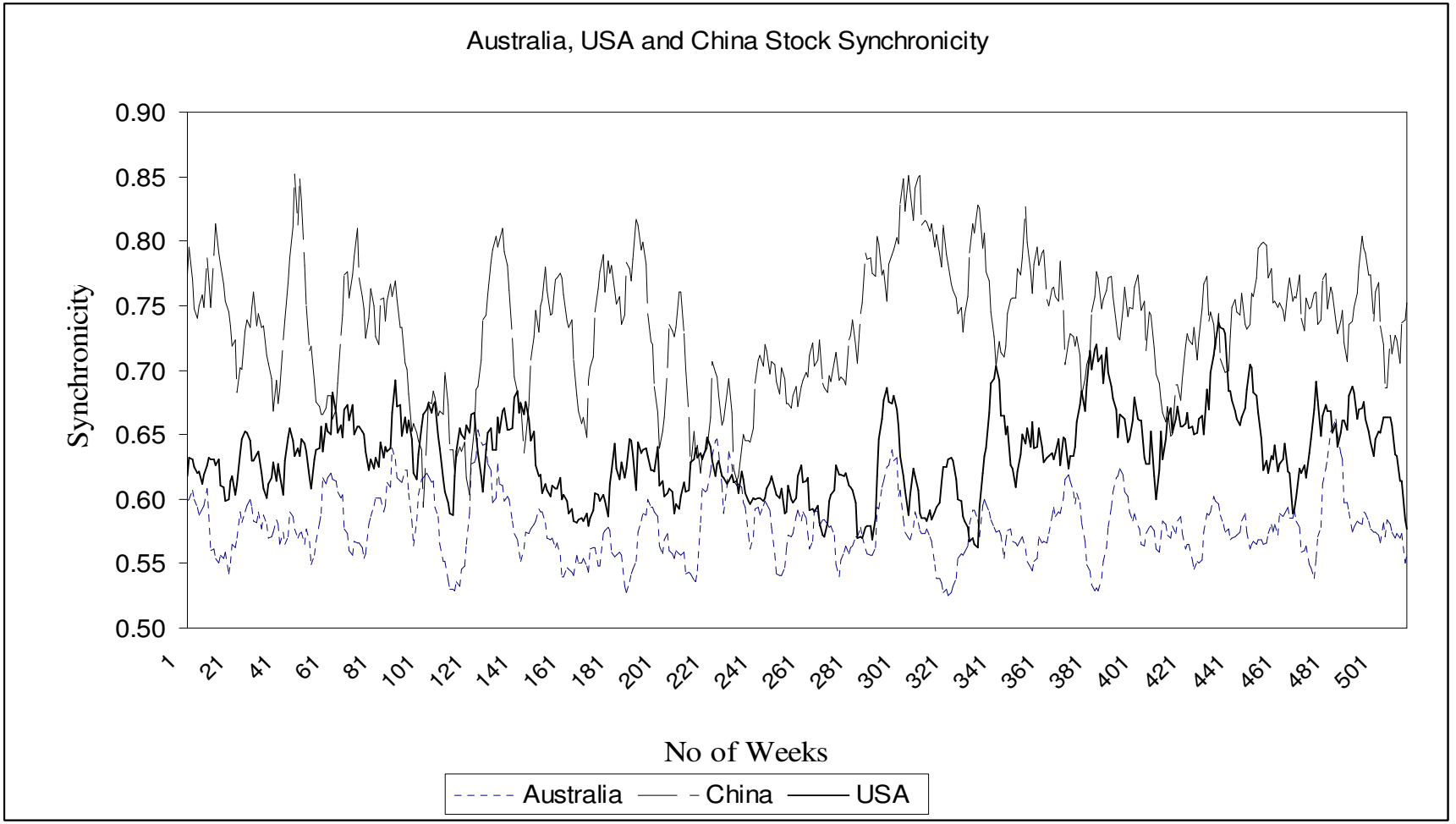
A 4.6 Panel data analysis: excluding Singapore, South Korea and Hong Kong

The study compares the panel data analysis between the all country group and the emerging country group without Singapore, Hong Kong and South Korea. The panel of this table contains estimates of:

$$SYNC_i = \alpha + \beta_1 \ RC_i + \beta_2 VC_i + \beta_3 IN_i + \beta_4 CP_i + \beta_5 GDP_i + \beta_6 \log(SIZE)_i + \beta_7 TR_i + \varepsilon_i$$

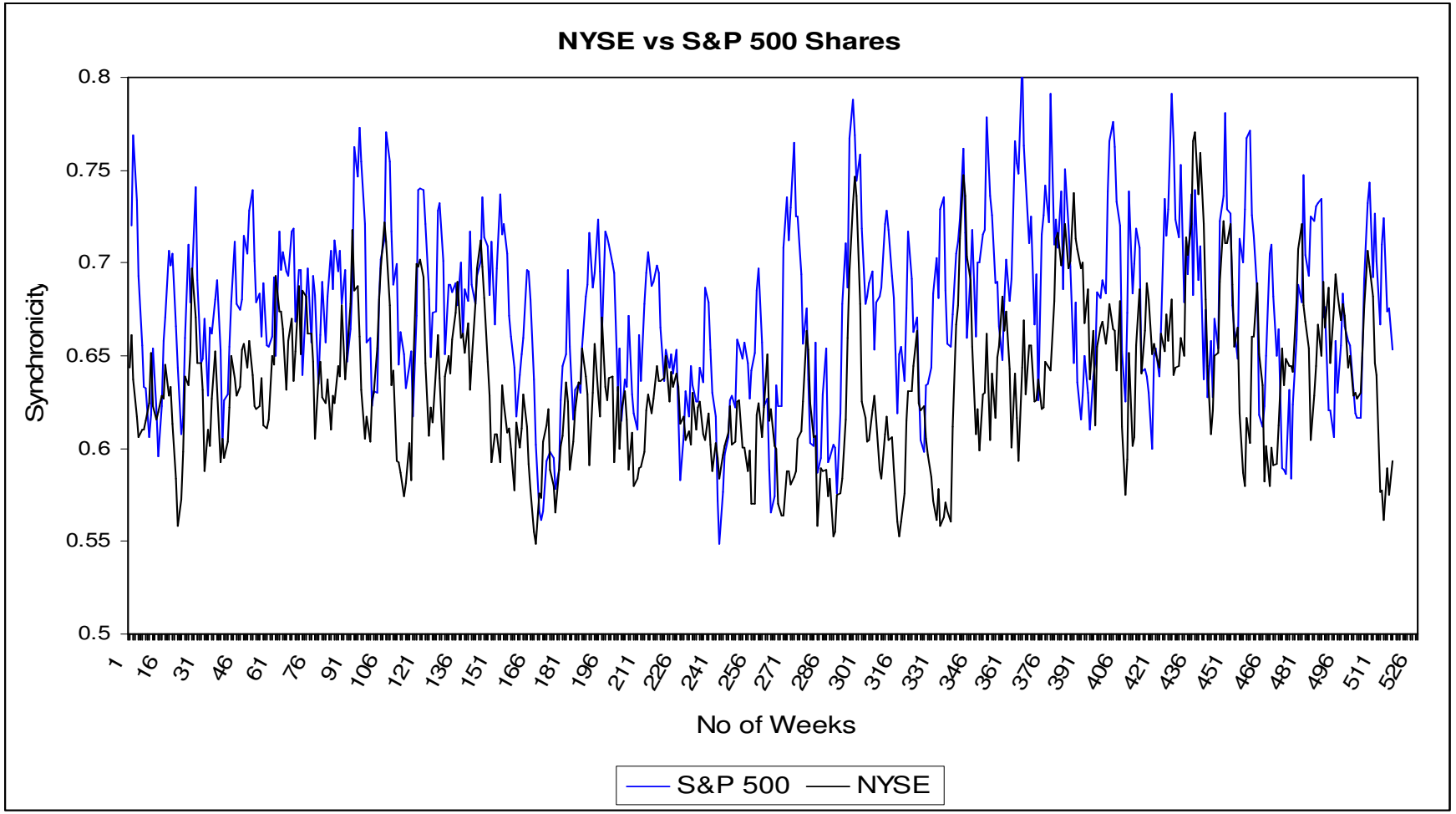
where SYNC, the dependent variable, is the stock synchronicity measure and α is a constant. Control (RC) is regulatory control index, Corruption (CP) is the corruption index produced by transparency international, GDP is gross domestic product per capita / 10,000, Inflation (IN) is the inflation rate of a country, Trade (TR) is the trade openness measure, Accountability (VC) is the voice and accountability index and Size (SIZE) is the natural log of the geographical size of a country. Two values are reported below the estimated coefficient. The first, in parenthesis, is the t statistic using white adjusted standard errors and the second, in brackets, is the P value for the statistic.

	All country group	Emerging country group
Control	**0.01872**	**0.01087**
	(3.73)	(2.14)
	[0.00]	[0.03]
Corruption	**-0.00884**	**-0.00470**
	(-5.25)	(-1.54)
	[0.00]	[0.13]
GDP	**0.00503**	**0.02289**
	(1.85)	(1.69)
	[0.07]	[0.09]
Inflation	**0.00017**	**0.00015**
	(1.00)	(0.88)
	[0.32]	[0.38]
Trade	**0.00199**	**0.00763**
	(0.14)	(0.32)
	[0.89]	[0.75]
Accountability	**-0.02585**	**-0.02578**
	(-5.90)	(-7.20)
	[0.00]	[0.00]
Log (Size)	**-0.00335**	**0.00042**
	(-2.35)	(0.24)
	[0.02]	[0.81]
R-squared	0.283	0.149



A 4.7 Weekly Stock Market Synchronicity for the USA, Australia and China

The figure exhibits the US, Australian and Chinese weekly stock market synchronicity for 1996-2005. The study graphs the 10-week moving average synchronicity for these markets. It is found that Australian stock synchronicity is about 58% in a given week, which is lower than the USA (63 percent) and China (73 percent). It is also found that the Chinese stock market moves more synchronously than developed markets, which is consistent with Morck et al. (2000).



A 4.8 The 10 Weeks Moving Average Synchronicity for the NYSE (USA) and S&P 500.
The figure illustrates 10 weeks moving average synchronicity data for the NYSE and S&P 500 group of companies from 1996 to 2005. The study compares both stock markets and finds variation across the series. It is found that S&P 500 group of companies' shares are more synchronous than those of the NYSE shares.

CHAPTER 5 R-Square measure

5.1 Introduction

The previous chapter analyses the classical synchronicity measure to capture stock return synchronicity for the 41 countries sampled. It is found that stock synchronicity is higher in emerging economies than developed economies. Further, English-origin common law countries have lower stock synchronicity than the post-communist and civil law origin countries. This chapter uses the R-square synchronicity measure to capture stock synchronicity for the same sample of countries from January 1996 to December 2005.

5.2 Full period: Legal and geographical segments

The study uses weekly stock return data and weekly stock indices to calculate R-square for individual firms. This measure relies on individual firm-level R-squares for determining the stock synchronicity of emerging and developed financial markets. A higher R-square value indicates higher stock market co-movement and a lower R-square indicates a lower level of stock market synchronicity. The Full period and sub-period R-square data already having been discussed in the data chapter, this section will discuss the legal and geographical segments of the R-square measure.

5.2.1 Geographical segment

To determine the regional effect of R-square the full dataset is further divided into six geographical locations and compared with the developed economies. The six geographical segments are Africa, Central Asia, South Asia, Asia/Pacific, South America and Europe.

Table 5.1 illustrates the geographical segments for the observed emerging markets and the developed economy segment. The average R-square for Africa (0.069), South America (0.066), Europe (0.081) and South Asia (0.077) are somewhat similar. Further, Asia/Pacific and Central Asian emerging economies exhibit a higher level of R-square values than other emerging markets. Asia/Pacific emerging economies exhibit average R-square values of 0.124, with China 0.241 and Malaysia 0.254. Central Asia, on the other hand, exhibits the

Table 5.1 Descriptive statistics for the R-square measure: Geographical segments
Full period data
From January 1996 to December 2005

Emerging Africa		Emerging South America		Emerging South Asia		Emerging Asia/ Pacific		Emerging Central Asia		Emerging Europe		Developed Countries	
Country	R^2	Country	R^2	Country	R^2	Country	R^2	Country	R^2	Country	R^2	Country	R^2
Egypt	0.089	Ecuador	0.033	Bangladesh	0.021	China	0.241	Cyprus	0.159	Hungary	0.101	Australia	0.041
Kenya	0.009	Argentina	0.104	India	0.081	Hong Kong	0.015	Turkey	0.239	Czech Rep.	0.033	France	0.098
Sth. Africa	0.054	Brazil	0.070	Pakistan	0.084	Indonesia	0.102			Poland	0.067	Germany	0.010
Zimbabwe	0.122	Chile	0.096	Sri-Lanka	0.121	Korea	0.123			Portugal	0.102	Japan	0.007
		Columbia	0.042			Malaysia	0.254			Russia	0.102	New Zealand	0.066
		Peru	0.024			Philippine	0.073			Spain	0.083	UK	0.066
		Venezuela	0.067			Singapore	0.024			Greece	0.008	USA NYSE	0.030
		Mexico	0.092			Taiwan	0.173						
						Thailand	0.109						
Average	0.069	Average	0.066	Average	0.077	Average	0.124	Average	0.199	Average	0.081	Average	0.046

highest average R-square value (0.199). However, the Central Asian segment includes only two emerging country (Turkey and Cyprus). Descriptive analysis from the full period R-square data shows that Turkey is the third most synchronous equity market in terms of R-square values. In contrast, developed economies exhibit considerably lower R-square values during this period (0.046), which is consistent with Morck et al. (2000).

A t test for the mean difference between R-square values for the emerging countries and developed countries is reported in panel A of table 5.2. The t statistics illustrates a significant mean difference between the R-square values at the 10 percent significance level for the emerging countries and five percent significance level for the developed countries.

Table 5.2 t-test statistics for the R-square measure

Emerging vs. developed country groups
(Equal variance estimates)

t- statistics	Degrees of freedom	Sig. (2-tailed)
1.869	39	0.069

Table 5.3 reports the ANOVA test statistics between the emerging and developed country groups. The ANOVA test statistics indicate that there is a statistically significant difference in R-square variance between the two groups at the 10 percent significance level.

Table 5.3 ANOVA test statistics for the R-square measure

The data include two sets of countries, the emerging and the developed group. Emerging countries include 34 sample countries and developed countries include seven sample nations.

	Sum of squares	Degrees of freedom	Mean square	F- statistics	Sig.
Between groups	.012	1	.012	3.492	.069
Within groups	.139	39	.004		
Total	.151	40			

In addition, Table 5.4 illustrates ANOVA test statistics between the emerging country / geographical segment groups to check the statistical significant mean difference between

these groups. It is found that there is a statistically significant difference in R-square variance between the geographical region groups at the five percent significant level.

Table 5.4 ANOVA test statistics for the R-square measure: Geographical segments
The data include six emerging geographical region groups. The emerging country groups are South America, South Asia, Africa, Central Asia, Europe and Asia/Pacific. The data span the period from January 1996 to December 2005.

	Sum of squares	Degrees of freedom	Mean square	F- statistics	Sig.
Between groups	.044	5	.009	2.759	.038
Within groups	.089	28	.003		
Total	.132	33			

5.2.2 Legal segment

Table 5.5 exhibits the impact of legal origin for the same dataset. Legal origin is divided into three basic categories: common law countries, civil law countries and the post-communist countries. The study does not classify the developed countries by legal category.

There is some small variation between English-origin common law country R-square values and French- and German-origin civil law country R-square values. Common law countries exhibit R-square values of 0.085 and civil law countries exhibit R-square values of 0.088 on average. Further, post-communist countries exhibit higher R-square values than the other two groups, on average exhibiting R-square values of 0.137. This finding is also consistent with Morck et al. (2000), La-Porta et al. (1998) and the classical synchronicity measure in chapter four.

Further, La-Porta et al. (1998) suggest that English-origin common law countries provide better protection to investors than do their counterparts, although this difference is not particularly evident in the R-square measured synchronicity. The average R-square synchronicity for the developed economies remains the lowest of the groups, consistent with Morck et al. (2000) and is considerable difference in synchronicity between developed countries and emerging countries.

Table 5.5 Descriptive statistics for the R-square measure: Legal segments

Emerging common law countries		Emerging civil law countries		Emerging post-communist		Developed countries	
Country	R-square	Country	R-square	Country	R-square	Country	R-square
Bangladesh	0.021	Argentina	0.104	China	0.241	Australia	0.041
Cyprus	0.159	Brazil	0.070	Poland	0.067	France	0.098
Egypt	0.089	Chile	0.096	Russia	0.102	Germany	0.010
Hong Kong	0.015	Columbia	0.042			Japan	0.007
India	0.081	Czech Rep	0.033			New Zealand	0.066
Kenya	0.009	Ecuador	0.033			UK	0.066
Malaysia	0.254	Greece	0.008			USA	0.030
Pakistan	0.084	Hungary	0.101				
Singapore	0.024	Indonesia	0.102				
South Africa	0.054	Mexico	0.092				
Sri-Lanka	0.121	Peru	0.024				
Zimbabwe	0.122	Philippines	0.073				
		Portugal	0.102				
		Korea	0.123				
		Spain	0.083				
		Taiwan	0.173				
		Thailand	0.109				
		Turkey	0.239				
		Venezuela	0.067				
Average	0.086	Average	0.088	Average	0.137	Average	0.046

In addition, table 5.6 illustrates the ANOVA test statistics of R-square synchronicity between the legal origin groups. The study did not find any statistically significant mean difference between the groups. However, there is a strong difference in mean variance within groups than between groups, suggesting that R-square synchronicity varies between countries.

Table 5.6 ANOVA test statistics for R-square measure: Legal origin groups

The data include three emerging country groups – emerging common law countries, emerging civil law countries and emerging post-communist countries. The common law group includes 12 sample countries, the civil law group 19 sample countries and the post-communist group only three sample countries.

	Sum of squares	Degrees of freedom	Mean square	F	Sig.
Between groups	.008	2	.004	.044	.957
Within groups	5.857	65	.090		
Total	5.865	67			

5.3 Sub-period: Legal and geographical segments

5.3.1 Geographical segment

The sub-period data is also analysed and further divided into six geographical segments. Panel A of appendix 5.1 illustrates five sub-period R-square data for South Asian countries. The average R-square for South Asian countries is 0.086 (1996-97), 0.071 (1998-99), 0.099 (2000-01), 0.105 (2002-03) and 0.128 (2004-05). There is some variation in R-square values for South Asian countries in 2004-05. In addition, Pakistan and Sri-Lanka exhibit higher R-square values, whereas Bangladesh exhibits lower R-square values during this sub-period.

R-square values are somewhat higher for China and Malaysia during these sub-periods for the Asia/Pacific group. The average R-square values for these sub-periods is 0.178 (1996-97) 0.182 (1998-99), 0.158 (2000-01), 0.141 (2002-03) and 0.110 (2004-05). The lowest R-square values are evident for Singapore and Hong Kong during these periods, which is consistent with the classical synchronicity measure and with the finding of Morck et al. (2000).

In Europe, most of the countries exhibit somewhat moderate R-square values except for Poland in 1996-97 and Hungary in 1996-97 and 1998-99. In addition, R-square values for the Central Asian countries are 0.217 (1996-97), 0.240 (1998-99), 0.325 (2000-01), 0.267 (2002-03) and 0.137 (2004-05), which is the highest of all geographical segments. It is found that historically Central Asian equity markets are more volatile – for example, the Istanbul Stock Exchange, Turkey (Alper and Yilmaz, 2004).

Surprisingly, African countries exhibit low levels of R-square values. The average R-square values for these countries are 0.109 in 1996-97, 0.090 in 1998-99, 0.070 in 2000-01, 0.090 in 2002-03 and 0.104 in 2004-05; which are the lowest among the emerging economy groups. Among African countries the exception is Zimbabwe, which shows somewhat higher R-square values during 2001-02 and 2004-05.

In developed economies Germany exhibits the lowest R-square synchronicity, while the highest R-square synchronicity is exhibited by France and New Zealand. Further, the S&P 500 group of companies exhibit higher R-square than the NYSE group, which is consistent with the classical synchronicity measure results.

5.3.2 Legal segment

Panels A, B and C of appendix 5.2 illustrate the legal segment average R-square values for the five sub-periods. It is found that R-square values for the common law countries is 0.087 (1996-97), 0.085 (1998-99), 0.093 (2000-01), 0.111 (2002-03) and 0.119 (2004-05). Malaysia exhibits the highest R-square values from the common law country group. Civil law origin countries, on the other hand, exhibit somewhat higher R-square values during these five sub-periods, particularly Turkey and Taiwan. The other countries with higher R-square values during these sub-periods include Argentina in 1996-97 and 1998-99; Hungary in 1996-97 and 1998-99, and Venezuela in 1996-97 and 1998-99.

Post-communist countries exhibit greater R-square values than common law and civil law countries. China exhibits the highest R-square values among the post-communist countries, followed by Poland and Russia. The average R-square values for post-communist countries are 0.280, 0.199, 0.132, 0.143 and 0.114 respectively. It is found that post-communist countries exhibit higher R-square values for all sub-periods while in contrast, common law countries exhibit the lowest R-square values. This result is consistent with Morck et al. (2000) and La-Porta et al. (1998).

5.4 Panel data analysis

5.4.1 The model

This chapter uses the following R-square regression model to explain the stock market synchronicity.

$$R-Squ_i = \alpha + \beta_1\ RC_i + \beta_2 VC_i + \beta_3\ IN_i + \beta_4\ CP_i + \beta_5\ GDP_i + \beta_6 \log(SIZE_i) + \beta_7\ TR_i + \varepsilon_i \quad (16)$$

where $R-Squ_i$ represents R-square measure for stock synchronicity of country i and α is a constant. RC_i is the regulatory control index, VC_i is the voice and accountability index, IN_i is inflation, CP_i is the corruption perception index, GDP_i is the gross domestic product per capita / 10,000, TR_i is the trade openness measure, $SIZE_i$ is geographical size and ε_i is the error term. The natural log of geographical size is used to limit the effect of skewness on this variable.

5.4.2 Panel data analysis

Table 5.7 illustrates fixed effect panel analysis using white adjusted standard error for the all-country, developed and emerging country groups. Here, the dependent variable is the R-square measure and explanatory variables are voice and accountability, corruption index, GDP per capita, inflation, regulatory control, trade openness measure and log geographical size.

Voice and accountability is negatively correlated with R-square measure at the one percent significance level for the all-country and emerging country groups but the impact is insignificant for the developed country group. Voice and accountability is an important governance mechanism thought necessary to establish a good governance system in a country and this measure is also used to capture property rights. Morck et al. (2000) argue that countries with less investor protection rights exhibit higher stock return synchronicity, hence a higher R-square value. Additionally, the classical synchronicity measure found that accountability is negatively correlated with stock synchronicity, which is consistent with the R-square based results in table 5.7.

It is found that regulatory control is positively correlated with the R-square measure at the one percent significance level for the all-country and emerging country groups. This result is surprising, as both corporate governance mechanisms reflect the quality of a country's the governance system and this mechanism should negatively correlate with the R-square measure.

Table 5.7 Panel data analysis: R-square measure

The panel of this table contains estimates of:

$$R - Squ_i = \alpha + \beta_1 \ RC_i + \beta_2 VC_i + \beta_3 IN_i + \beta_4 CP_i + \beta_5 GDP_i + \beta_6 \log(SIZE)_i + \beta_7 TR_i + \varepsilon_i$$

where $R - Squ_i$ is the dependent variable ands α is a constant, Control (RC) is the regulatory control, Corruption (CP) is the corruption index produce by transparency international, GDP is the gross domestic product per capita / 10,000, Inflation (IN) is the inflation rate of a country, Trade (TR) is the trade openness measure, Accountability (VC) is the voice and accountability index and Size (SIZE) is the natural log of the geographical size of a country.

Two values are reported below the estimated coefficient. The first, in parenthesis, is the t statistic using white adjusted standard errors and the second, in brackets, is the P value for the statistic.

	All countries	Developed countries	Emerging countries
Control	**0.04639**	**0.05171**	**0.03728**
	(2.98)	(1.30)	(2.63)
	[0.00]	[0.21]	[0.01]
Corruption	**0.00407**	**-0.01595**	**0.01030**
	(1.46)	(-0.91)	(7.58)
	[0.15]	[0.37]	[0.00]
GDP	**-0.03399**	**-0.05327**	**-0.01677**
	(-8.05)	(-3.15)	(-1.86)
	[0.00]	[0.01]	[0.07]
Inflation	**0.00064**	**0.00912**	**0.00065**
	(6.71)	(0.78)	(7.62)
	[0.00]	[0.44]	[0.00]
Trade	**-0.01346**	**0.17039**	**-0.00861**
	(-0.58)	(2.13)	(-0.33)
	[0.57]	[0.04]	[0.74]
Accountability	**-0.03340**	**-0.07945**	**-0.03039**
	(-3.28)	(-1.07)	(-2.91)
	[0.00]	[0.30]	[0.00]
Log (Size)	**0.00689**	**-0.00755**	**0.01455**
	(2.45)	(-1.26)	(4.29)
	[0.02]	[0.22]	[0.00]
R-square	0.240	0.460	0.210

There is evidence that several of the emerging countries exhibit relatively high regulatory control (examples include Singapore and Hong Kong) and this may be driving this unexpected result. It should be noted that positive correlation is also found between regulatory control and the classical synchronicity measure in chapter four.

Corruption is positively correlated with the R-square synchronicity measure at the 15 percent significance level for the all-country group and at the one percent significance level

for the emerging country group. This is a significant result, as it is argued that higher corruption causes higher stock price synchronicity. This finding is also consistent with Morck et al. (2000) and the classical synchronicity measure in chapter four. It is found that emerging countries rank lower in the corruption index produced by Transparency International. In contrast, developed economies rank higher due to their lower corruption levels. Further, Morck et al. (2000) found positive correlation between corruption rates and lower respect for private property rights. They argue that higher corruption indicates weak political and civil rights and so causes corrupt economies to rank lower in the property rights index. This study also found that countries ranked lower in the corruption index also rank lower in the voice and accountability index. Stock market synchronicity for these countries is higher and negatively correlated with the governance indicator (examples include China and Indonesia).

Inflation is positively correlated with the R-square synchronicity measure at the one percent significance level for the all-country and emerging country groups but this effect is insignificant for the developed economies. Morck et al. (2000) argue that higher inflation causes higher stock market co-movement. For example, the Polish economy exhibits higher inflation due to the fall of communism and its inflation attained 100 percent during the study period. Further, Morck et al. (2000) include Poland in their list of countries with higher stock market synchronicity during the 1990s. They argue that economies in transition exhibited higher stock return synchronicity during the 19^{th} century (examples include Turkey and Malaysia).

GDP per capita is negatively correlated with the R-square measure at the ten percent significance level for the all-country, the emerging country and the developed country groups. This is an expected result as it is assumed that high GDP per capita countries produce lower stock market synchronicity and lower R-square values.

Geographical size is positively correlated with R-square synchronicity measures at the five percent significance level for the all-country and the emerging country groups but is statistically insignificant for the developed country group. This result is inconsistent with the classical synchronicity measures in chapter four and Morck et al. (2000). Previous studies have found that country geographical size was negatively correlated with stock market synchronicity. However, there is evidence that large emerging countries, such as Russia,

China and Argentina exhibit higher R-square values during the sample period, whereas smaller emerging countries such as Singapore and Bangladesh exhibit lower levels of R-square synchronicity. It is assumed that the R-square values for the larger emerging countries might influence the geographical size effect.

5.4.3 Legal origin effects

Separate panel analysis is also conducted between the common law / emerging country group and the civil law / emerging country group to check the variation across legal origin groups. Table 5.8 illustrates the fixed effect panel analysis result for the common law and civil law country groups. Post-communist countries are not analysed separately due to the small sample size.

There is evidence that inflation is positively correlated with R-square measure at the 10 percent significance level for the common law country group and at the one percent significance level for the civil law country group. Additionally, voice and accountability and geographical size are negatively correlated with the civil law countries at the 10 percent and 15 percent significance levels respectively.

In addition, GDP per capita is negatively correlated with both the common law country and the civil law country group at one percent significant level. Unexpectedly, the trade openness measure is positively correlated with the common law country group and negatively correlated with the civil law country group. This result suggests a stronger international trade participation effect in the civil law country group than in the common law country group.

Table 5.8 Panel data analysis between the legal origin groups: R-square measure

The study compares the panel data analysis between the common law and civil law country groups. The panel of this table contains estimates of:

$$R - Squ_i = \alpha + \beta_1 \ RC_i + \beta_2 VC_i + \beta_3 IN_i + \beta_4 CP_i + \beta_5 GDP_i + \beta_6 \log(SIZE)_i + \beta_7 TR_i + \varepsilon_i$$

where $R - Squ_i$ is the dependent variable ands α is a constant, Control (RC) is the regulatory control, Corruption (CP) is the corruption index produce by transparency international, GDP is the gross domestic product per capita / 10,000, Inflation (IN) is the inflation rate of a country, Trade (TR) is the trade openness measure, Accountability (VC) is the voice and accountability index and Size (SIZE) is the natural log of the geographical size of a country. Two values are reported below the estimated coefficient. The first, in parenthesis, is the t statistic using white adjusted standard errors and the second, in brackets, is the P value for the statistic.

Variables	Common law countries	Civil law countries
Control	**0.04592**	**0.05031**
	(1.16)	(2.17)
	[0.25]	[0.03]
Corruption	**0.00540**	**-0.00180**
	(0.60)	(-0.23)
	[0.55]	[0.82]
GDP	**-0.06234**	**-0.01739**
	(-3.43)	(-5.51)
	[0.00]	[0.00]
Inflation	**0.00052**	**0.00138**
	(1.98)	(5.15)
	[0.05]	[0.00]
Trade	**0.08940**	**-0.04676**
	(1.34)	(-1.32)
	[0.19]	[0.19]
Accountability	**-0.00825**	**-0.03387**
	(-0.49)	(-1.86)
	[0.63]	[0.07]
Log (Size)	**0.01714**	**-0.00689**
	(1.64)	(-1.60)
	[0.11]	[0.11]
R-square	0.306	0.256

Further, geographical size is positively correlated with synchronicity for the common law country group and negatively correlated for civil law country group at the 15 percent significance level. It is found that some large emerging countries of common law exhibit high R-square values (examples include India and Indonesia) and small emerging common law

countries exhibit lower R-square values, for example Singapore. In contrast, large civil law countries exhibit low R-square values (examples include Brazil and Columbia).

Finally, there is evidence that corporate governance mechanisms are more effective in the civil law country group than the common law country group, and that country geographical size and inflation effect are more visible in the civil law country group than in the common law country group.

5.5 Discussion

It is found that R-square values for emerging economies are higher than for developed economies. On average, emerging economies exhibit R-square values of 0.091, whereas developed economies exhibit R-square values of 0.046 during the sample period (table 5.1). The high R-square values are evidenced for China, Malaysia and Turkey, a result which is consistent with Morck et al. (2000) and with the classical synchronicity measure results reported in Chapter 4. Additionally, low R-square values are evident for Japan and Germany. In the USA, the S&P 500 group of companies exhibits higher R-square values than the NYSE shares, which is consistent with classical synchronicity measures.

There is evidence that R-square values for Central Asian countries are higher than for other geographical regions and for the developed country group. However, Central Asia includes only two countries – Turkey and Cyprus – both of which exhibit high levels of R-square synchronicity. This result is consistent with Alper and Yilmaz (2004), who argue that the Turkish stock market is historically volatile and exhibits high levels of stock co-movement.

It is found that R-square synchronicity is lower in high inflationary economies than low inflationary economies. The study also finds a statistically significant positive correlation between R-square values and inflation (examples include Turkey and China). Further, the common law country group exhibits lower R-square synchronicity (0.086) than the civil law (0.088) and post-communist country (0.137) groups.

5.6 Conclusion

The study presents empirical analyses using the R-square stock synchronicity measure. It is found that emerging economies exhibit higher R-square values (0.091) than developed economies (0.045). Further, R-square values for the post-communist country group are higher than for the common law country and civil law country groups, which is consistent with Morck et al. (2000) and classical synchronicity measures.

There is evidence that a higher R-square value is associated with higher inflation and lower GDP per capita. Additionally, countrywide corruption can affect the value of the stock market and could influence stock market co-movement. Countries ranking lower in the corruption index (high corruption) are often found to exhibit greater levels of synchronicity than the average country (for example, Turkey). The corruption index is also positively correlated with R-square values at the 15 percent significance level for the all-country and emerging country groups.

There is also evidence that corporate governance mechanisms have more effect in the civil law country group than in the common law country group. It is found that higher R-square values are associated with the civil law country group, a result that is consistent with La-Porta et al. (1998)). Additionally, the trade openness measure suggests trade environment has a greater impact on synchronicity in civil law countries.

5.7 Appendices

A 5.1 R-square measure descriptive statistics for sub-periods: Geographical segments

Panel A

South Asia

Country	1996-1997	1998-1999	2000-2001	2002-2003	2004-2005
	R-square	R-square	R-square	R-square	R-square
Bangladesh	0.016	0.012	0.014	0.021	0.02
India	0.11	0.085	0.089	0.114	0.218
Pakistan	0.129	0.089	0.106	0.123	0.125
Sri-Lanka	0.089	0.098	0.185	0.162	0.149
Average	0.086	0.071	0.099	0.105	0.128

Panel B

Asia/Pacific

Country	1996-1997	1998-1999	2000-2001	2002-2003	2004-2005
	R-square	R-square	R-square	R-square	R-square
China	0.387	0.306	0.252	0.321	0.201
Hong Kong	0.032	0.026	0.022	0.017	0.019
Indonesia	0.163	0.148	0.112	0.108	0.131
Korea	0.149	0.175	0.18	0.192	0.096
Malaysia	0.376	0.45	0.324	0.186	0.112
Philippines	0.114	0.135	0.085	0.077	0.079
Singapore	0.03	0.038	0.039	0.03	0.023
Taiwan	0.233	0.231	0.254	0.223	0.162
Thailand	0.121	0.131	0.151	0.117	0.164
Average	0.178	0.182	0.158	0.141	0.11

Panel C

Central Asia

Country	1996-1997	1998-1999	2000-2001	2002-2003	2004-2005
	R-square	R-square	R-square	R-square	R-square
Cyprus	0.176	0.163	0.283	0.251	0.093
Turkey	0.259	0.317	0.366	0.284	0.181
Average	0.217	0.24	0.325	0.267	0.137

Panel D

Africa

Country	1996-1997	1998-1999	2000-2001	2002-2003	2004-2005
	R-square	R-square	R-square	R-square	R-square
Egypt	0.189	0.15	0.112	0.081	0.084
Kenya	0.018	0.008	0.019	0.028	0.028
South Africa	0.071	0.104	0.068	0.042	0.067
Zimbabwe	0.157	0.1	0.081	0.211	0.238
Average	0.109	0.09	0.07	0.09	0.104

Panel E
Europe

Country	1996-1997	1998-1999	2000-2001	2002-2003	2004-2005
	R-square	R-square	R-square	R-square	R-square
Hungary	0.203	0.206	0.087	0.074	0.106
Czech Republic	0.08	0.067	0.046	0.037	0.07
Poland	0.258	0.185	0.065	0.038	0.034
Portugal	0.142	0.141	0.109	0.104	0.107
Greece	0.04	0.02	0.015	0.025	0.013
Russia	0.194	0.104	0.08	0.068	0.106
Spain	0.015	0.079	0.076	0.151	0.162
Average	0.133	0.115	0.068	0.071	0.085

Panel F
South America

Country	1996-1997	1998-1999	2000-2001	2002-2003	2004-2005
	R-square	R-square	R-square	R-square	R-square
Ecuador	0.011	0.016	0.007	0.015	0.052
Argentina	0.246	0.238	0.128	0.099	0.176
Brazil	0.077	0.09	0.085	0.085	0.104
Chile	0.116	0.132	0.106	0.091	0.084
Columbia	0.074	0.072	0.049	0.108	0.134
Peru	0.069	0.077	0.033	0.024	0.048
Mexico	0.181	0.179	0.121	0.13	0.12
Venezuela	0.267	0.226	0.048	0.054	0.07
Average	0.13	0.129	0.072	0.076	0.098

Panel G
Developed Countries

Country	1996-1997	1998-1999	2000-2001	2002-2003	2004-2005
	R-square	R-square	R-square	R-square	R-square
Australia	0.015	0.028	0.015	0.026	0.019
France	0.091	0.093	0.117	0.128	0.107
Germany	0.017	0.024	0.011	0.011	0.021
Japan	0.008	0.012	0.012	0.012	0.019
New Zealand	0.132	0.119	0.115	0.075	0.076
UK	0.077	0.089	0.098	0.085	0.074
USA	0.07	0.1	0.049	0.029	0.017
Average	0.059	0.066	0.059	0.052	0.048

Panel H
Developed countries including S&P 500 group of companies

Country	1996-1997	1998-1999	2000-2001	2002-2003	2004-2005
	R-square	R-square	R-square	R-square	R-square
Australia	0.015	0.028	0.015	0.026	0.019
France	0.091	0.093	0.117	0.128	0.107
Germany	0.017	0.024	0.011	0.011	0.021
Japan	0.008	0.012	0.012	0.012	0.019
New Zealand	0.132	0.119	0.115	0.075	0.076
UK	0.077	0.089	0.098	0.085	0.074
USA S&P 500	0.257	0.213	0.109	0.139	0.099
Average	0.085	0.082	0.068	0.068	0.059

A 5.2 R-square measure descriptive statistics for sub-periods: Legal segments

Panel A
Common law countries

Country	1996-1997	1998-1999	2000-2001	2002-2003	2004-2005
	R-square	R-square	R-square	R-square	R-square
Bangladesh	0.016	0.012	0.014	0.021	0.02
Cyprus	0.176	0.163	0.283	0.251	0.093
Egypt	0.189	0.15	0.112	0.081	0.084
Hong Kong	0.032	0.026	0.022	0.017	0.019
India	0.11	0.085	0.089	0.114	0.218
Kenya	0.018	0.008	0.019	0.028	0.028
Malaysia	0.376	0.45	0.324	0.186	0.112
Pakistan	0.129	0.089	0.106	0.123	0.125
Singapore	0.03	0.038	0.039	0.03	0.023
South Africa	0.071	0.104	0.068	0.042	0.067
Sri-Lanka	0.089	0.098	0.185	0.162	0.149
Zimbabwe	0.157	0.1	0.081	0.211	0.238
Average	0.116	0.110	0.112	0.106	0.098

Panel B
Post-communist countries

Country	1996-1997	1998-1999	2000-2001	2002-2003	2004-2005
	R-square	R-square	R-square	R-square	R-square
China	0.387	0.306	0.252	0.321	0.201
Poland	0.258	0.185	0.065	0.038	0.034
Russia	0.194	0.104	0.08	0.068	0.106
Average	0.28	0.199	0.132	0.143	0.114

Panel C
Civil law countries

Country	1996-1997	1998-1999	2000-2001	2002-2003	2004-2005
	R-square	R-square	R-square	R-square	R-square
Argentina	0.246	0.238	0.128	0.099	0.176
Brazil	0.077	0.09	0.085	0.085	0.104
Chile	0.116	0.132	0.106	0.091	0.084
Columbia	0.074	0.072	0.049	0.108	0.134
Czech Republic	0.08	0.067	0.046	0.037	0.07
Ecuador	0.011	0.016	0.007	0.015	0.052
Greece	0.04	0.02	0.015	0.025	0.013
Hungary	0.203	0.206	0.087	0.074	0.106
Indonesia	0.163	0.148	0.112	0.108	0.131
Mexico	0.181	0.179	0.121	0.13	0.12
Peru	0.069	0.077	0.033	0.024	0.048
Philippines	0.114	0.135	0.085	0.077	0.079
Portugal	0.142	0.141	0.109	0.104	0.107
Korea	0.149	0.175	0.18	0.192	0.096
Spain	0.015	0.079	0.076	0.151	0.162
Taiwan	0.233	0.231	0.254	0.223	0.162
Thailand	0.121	0.131	0.151	0.117	0.164
Turkey	0.259	0.317	0.366	0.284	0.181
Venezuela	0.267	0.226	0.048	0.054	0.07
Average	0.135	0.141	0.108	0.105	0.108

CHAPTER 6 Zero-return measure

6.1 Introduction

The previous two chapters analyse stock market synchronicity using the classical synchronicity and R-square synchronicity measures. There is evidence that stock markets in emerging economies are somewhat more synchronous than the developed markets. This chapter uses the third measure of stock synchronicity proposed by Skaife et al. (2006) (proportion of zero-return measure) to analyse the across-country variation in this measure.

6.2 Zero-return measure: Full period data

6.2.1 Geographical segment

It is found from the full period sample data that emerging economies exhibit a zero-return measure of 45.7 percent, whereas the developed economies exhibit a zero-return measure of 28.8 percent during the sample period (see table 3.11). In addition, to check whether zero-return measures vary across geographical regions, the full period data is divided into six geographical regions. Table 6.1 illustrates variation in the proportion of zero-returns across geographical regions.

Pakistan and Sri Lanka exhibit quite high zero-return measures, yet the Bangladesh zero-return measure (22.6 percent) is considerably smaller than for the South Asian countries (the average zero-return measure for South Asian countries is 44.8 percent). This result conflicts with the classical synchronicity measure and the R–square measure, as South Asian classical and R-square synchronicity is generally lower than for other geographical regions. Additionally, the Dhaka Stock Exchange (Bangladesh) exhibits higher classical and R-square stock synchronicity than other South-Asian countries due to its higher volatility, which is not fully reflected in the zero-return measure of synchronicity (Hassan et al., 2007).

Within Africa, most countries exhibit a high proportion of zero-returns except for Egypt. (26.8 percent). The zero-return measure for the African countries as a group is 43.2 percent, which is lower than for other regions.

Table 6.1 Descriptive statistics for the zero-return measure: Geographical segments

From January 1996 to December 2005

Emerging Africa		Emerging South Asia		Emerging Central Asia		Emerging South America		Emerging Asia/Pacific		Emerging Europe		Developed Country	
Country	Return	Country	Return	Country	Return	Country	Return	Country	Return	Country	Return	Country	Return
Egypt	26.8	Bangladesh	22.6	Cyprus	26.9	Ecuador	84.3	China	11.5	Hungary	57.9	Australia	42.8
Kenya	45.3	India	48.3	Turkey	30.0	Argentina	59.1	HongKong	41.6	Czech Rep.	59.7	France	23.7
Sth. Africa	56.2	Pakistan	53.3			Brazil	61.9	Indonesia	52.6	Poland	28.1	Germany	31.3
Zimbabwe	44.5	Sri-Lanka	55.0			Chile	49.4	S. Korea	23.1	Portugal	35.1	Japan	12.9
						Columbia	77.5	Malaysia	26.5	Greece	14.9	NewZealand	27.1
						Peru	74.1	Philippines	59.2	Russia	64.6	UK	38.5
						Venezuela	69.3	Singapore	35.9	Spain	24.8	USA	25.1
						Mexico	66.6	Taiwan	16.8				
								Thailand	53.6				
Total	43.2	Total	44.8	Total	28.5	Total	67.8	Total	35.6	Total	40.7	Total	28.8

Surprisingly, Turkey and Cyprus exhibit lower zero-return measures. On average, these two Central Asian countries exhibit zero-return measures of 28.5 percent, which is lower than for many of the developed economies. In contrast, findings from the classical synchronicity and R-square measures show that Turkey exhibits higher stock synchronicity for the sample period. The results from the zero-return based analysis are not consistent with Morck et al. (2000) who argue that the Turkish stock market exhibits high stock synchronicity, and Alper and Yilmaz (2004) who argue that the Turkish stock market is historically quite volatile and synchronous.

One-way ANOVA test statistics are reported in tables 6.2 and 6.3. Table 6.2 illustrates a significant difference in mean zero return measures for the emerging country group and developed economies at the five percent significance level.

Table 6.2 ANOVA test statistics for the zero-return measure
Emerging country vs. developed country groups

	Sum of squares	Degrees of freedom	Mean square	F-statistics	Sig.
Between groups	1682.091	1	1682.091	5.085	.030
Within groups	12901.253	39	330.801		
Total	14583.344	40			

Further, Table 6.3 exhibits the ANOVA test statistics for the geographical segments. The analysis uses six geographical segments for the emerging country groups, which include emerging South Asian, emerging African, emerging European, emerging Asia/Pacific, emerging South American and emerging Central Asian countries. The ANOVA test statistics find a significant difference in the average zero-return measure at one percent significance level.

Table 6.3 ANOVA test statistics for zero-return measure: Geographical segments
The data include zero-return measures for six emerging geographical region groups. The six emerging country groups are South America, South Asia, Africa, Central Asia, Europe and Asia/Pacific. The data span the period from January 1996 to December 2005.

	Sum of squares	Degrees of freedom	Mean square	F-statistics	Sig.
Between groups	5604.542	5	1120.908	4.681	.003
Within groups	6704.977	28	239.463		
Total	12309.519	33			

6.2.2 Legal segment

Table 6.4 illustrates the country zero-return results sorted by legal segment for zero-return measures. It is found that the proportion of zero-returns is lower in post-communist countries than in common law and civil law countries, which is inconsistent with the classical synchronicity measure and R-square measure results. Among the post-communist countries, China and Poland exhibit lower levels of zero-returns during the sample period. However, the Russian stock market exhibits a somewhat higher proportion of zero-returns.

Table 6.4 Descriptive statistics for the zero-return measure full period: Legal segments
From January 1996 to December 2005

Emerging common law countries		Emerging civil law countries		Emerging post-communist countries	
Country	Return	Country	Return	Country	Return
Bangladesh	22.6	Argentina	59.1	China	11.5
Cyprus	26.9	Brazil	61.9	Poland	28.1
Egypt	26.8	Chile	49.4	Russia	64.6
Hong Kong	41.6	Columbia	77.5		
India	48.3	Czech Republic	59.7		
Kenya	45.3	Ecuador	84.3		
Malaysia	26.5	Greece	14.9		
Pakistan	53.3	Hungary	57.9		
Singapore	35.9	Indonesia	52.6		
South Africa	56.2	Mexico	66.6		
Sri-Lanka	55	Peru	74.1		
Zimbabwe	44.5	Philippines	59.2		
		Portugal	35.1		
		Korea	23.1		
		Spain	24.8		
		Taiwan	16.8		
		Thailand	53.6		
		Turkey	30		
		Venezuela	69.3		
Average	40.2		51.0		34.7

In common law countries, Bangladesh exhibits fewer zero-return measures while South-Africa exhibits greater levels of zero-returns. The average proportion of zero-returns for common law countries is 40.2 percent, which is higher than for post-communist countries.

In addition, the proportion of zero-returns among the civil law countries is the highest for all the groups. This result is surprising; as there is evidence that stock synchronicity for post-communist country is higher when using the classical measure and R-square measure.

Table 6.5 shows the ANOVA test statistics for the legal segment group of countries, which include common law and civil law countries. There is a variation in legal origin across the groups at the 15 percent significant level. Further, the study also reports Kruskal-Wallis test statistics in appendix A-6.3 for the legal origin countries group, which includes common law and civil law countries. It is found that there is a median difference between the legal origin groups, though the effect is not statistically significant at the 10 percent level.

Table 6.5 ANOVA test statistics for the zero-return measure: Legal origin
Common law country group vs. civil law country group

	Sum of squares	Degrees of freedom	Mean square	F-statistics	Sig.
Between groups	858.774	1	858.774	2.602	.118
Within groups	9572.397	29	330.083		
Total	10431.171	30			

6.3 Zero-return measure: Sub-period data

6.3.1 Geographical segments

Geographical segments by sub-period are also analysed for the zero-return measures to check for variation between the groups (appendix A-6.1). African countries exhibit comparatively fewer zero-return measures during the observation period. In contrast, higher proportions of zero-returns are exhibited by South American countries. Further, China and the S&P 500 group of companies exhibit the lowest levels of zero-returns for all sub-periods, which is surprising and conflicting with the classical synchronicity measure, R-square measure and Morck et al. (2000). Of the developed economies Japan exhibits the lowest proportion of zero-returns, which is consistent with Skaife et al. (2006) who found that Japanese and US stock markets exhibit the lowest zero-return measures during their study period.

6.3.2 Legal segment

Panels A and B of appendix A-6.2 illustrate sub-period zero-return measures for the common law, civil law and post-communist country groups. The study finds that the post-communist country group exhibits a lower level of zero-returns than common law and civil law countries for all sub-periods. Additionally, the common law country group exhibits fewer zero-returns than the civil law country group.

This is an unexpected result and conflicts with both the R-square and classical synchronicity measures. For example, it is found that China and Poland exhibit fewer zero-returns for the study period, whereas the classical synchronicity measure and R-square measure show that both Poland and China exhibit higher synchronicity for the same period. In addition, zero-return measures for post-communist countries are smallest for all sub-periods, which conflicts with the classical synchronicity measure and R-square synchronicity results in chapters four and five.

6.4 Panel data analysis

6.4.1 The model

The study uses the following model to explain stock return synchronicity:

$$ZRET_i = \alpha + \beta_1 RC_i + \beta_2 VC_i + \beta_3 IN_i + \beta_4 CP_i + \beta_5 GDP_i + \beta_6 \log(SIZE)_i + \beta_7 TR_i + \varepsilon_i \quad (17)$$

where $ZRET_i$ represents proportion of zero-return measure for country i and α is a constant. RC_i is the regulatory control index, VC_i is the voice and accountability index, IN_i is the inflation, CP_i is the corruption perception index, GDP_i is the gross domestic product per capita / 10,000, TR_i is the trade openness measure, $SIZE_i$ is geographical size and ε_i is the error term. Natural log for geographical size been used to minimise the impact of skewness in this analysis. This model is described in greater detail in previous chapters.

6.4.2 Panel data analysis

Table 6.6 illustrates fixed effect panel analysis for the zero-return measure. For this model, the dependent variable is the proportion of zero-returns and explanatory variables are voice and accountability, corruption index, GDP per capita, inflation, regulatory control, trade openness measure and geographical size, consistent with previous studies.

Table 6.6 Panel data analysis: Zero-return measure

The panel of this table contains estimates of:

$$ZRET_i = \alpha + \beta_1\ RC_i + \beta_2\, VC_i + \beta_3\, IN_i + \beta_4\, CP_i + \beta_5\, GDP_i + \beta_6 \log(SIZE)_i + \beta_7\, TR_i + \varepsilon_i$$

where $ZRET_i$ is the zero-return measure of stock synchronicity and α is a constant. Control (RC) is the regulatory control index, Corruption (CP) is the corruption index produced by transparency international, GDP is gross domestic product per capita / 10,000, Inflation (IN) is the inflation rate of a country, Trade (TR) is the trade openness measure, Accountability (VC) is the voice and accountability index and Size (SIZE) is the natural log of the geographical size of a country. Two values are reported below the estimated coefficient. The first, in parenthesis, is the t statistic using white adjusted standard errors and the second, in brackets, is the P value for the statistic.

	All countries	Developed countries	Emerging countries
Control	**0.77944**	**18.09835**	**1.67845**
	(0.35)	(2.280	(0.69)
	[0.73]	[0.03]	[0.49]
Corruption	**-2.75819**	**-2.11969**	**-4.84351**
	(-5.13)	(-0.81)	(-3.46)
	[0.00]	[0.43]	[0.00]
GDP	**-7.96318**	**2.64978**	**-7.37127**
	(-6.07)	(0.68)	(-3.40)
	[0.00]	[0.50]	[0.00]
Inflation	**-0.00296**	**0.59291**	**-0.01335**
	(-0.13)	(0.83)	(-0.53)
	[0.90]	[0.41]	[0.60]
Trade	**27.77115**	**-61.80561**	**33.89200**
	(11.270	(-2.66)	(14.65)
	[0.00]	[0.01]	[0.00]
Accountability	**7.88461**	**25.21017**	**8.31786**
	(3.66)	(1.67)	(3.94)
	[0.00]	[0.11]	[0.00]
Log (Size)	**3.76442**	**2.50366**	**3.68596**
	(30.98)	(6.58)	(17.52)
	[0.00]	[0.00]	[0.00]
R square	0.36	0.74	0.33

It is found that corruption index is negatively correlated with the zero-return measure at the one percent significance level for the all-country and emerging country groups. However, the effect is not statistically significant for the developed economies.

Transparency International ranks the economies on the basis of various characteristics and this index tends to capture the level of corruption. The countries are ranked on a scale of 0 to 10; higher points are awarded for lower corruption. On average there is an inverse relationship between corruption and the zero-return measure. Additionally, Skaife et al. (2006) argues that when markets do not have enough information about share prices, then the marginal investor will not trade and this results in zero-return days.

Further, there is evidence that in emerging economy stock markets there is insufficient information provided for accurate share valuation due to higher levels of corruption and poor disclosure practices. This finding is consistent with Morck et al. (2000), the classical synchronicity and R-square measure results. All three synchronicity measures show that corruption is negatively correlated with stock market synchronicity and higher synchronicity is associated with higher countrywide corruption rates.

GDP per capita is negatively correlated with the zero-return measure for the all-country and emerging country groups at the one percent significance level, but the impact is insignificant for the developed country group due to the small sample size. However, when the developed country group merge with the emerging country group (the all country group), this effect disappear. The finding is consistent with the R-square measure in chapter five and Morck et al. (2000), who argue that poor GDP per capita economies can not provide proper protection for their shareholders and essentially, countrywide political instability causes higher stock market synchronisation. Further, Skaife et al. (2006) argue that the zero-return measure is a better model of stock market synchronicity. They argue that poor GDP per capita economies produce more zero-return days in a year than do developed economies, which is consistent with this analysis and with Morck et al. (2000). However, among the emerging economies China exhibits the lowest proportion of zero-return measure for the sample period, which is surprising and inconsistent with the analyses in chapters four and five for the classical measure and the R-square measure.

Trade openness is positively correlated with the zero-return measure at the one percent significance level for the all-country and emerging country groups. The trade openness measure ranges from zero to one with most open countries having a value of zero (as a country becomes more open, the measure shifts toward to zero). However, some of the entrepôt[18] countries could have a positive trade openness measure due to their higher trading volume. In addition, few emerging countries rank highly on the trade openness measure due to the large volumes of imports (examples include Cyprus, Thailand and Hungary) as a percentage of GDP, which might cause the trade openness measure to be positively correlated with the zero-return measure.

Accountability is positively correlated with the zero-return measure at the one percent significance level for the all-country and emerging country groups. There is evidence that some emerging economies exhibit very low zero-return measures during the study period (e.g. China, Greece and Taiwan), even though these countries rank lower in terms of the corporate governance index. Perhaps these newly booming, emerging economies result in the zero-return measure being positively correlated with the voice and accountability indicator.

Country geographical size is positively correlated with the zero-return measure at the one percent significance level for the-all country, developed country and emerging country groups – which is again an unexpected result. However, there is evidence that a number of the large countries in the analysis exhibit higher zero-return measures during the sample period (examples include Russia, India and Brazil). In contrast, a number of small emerging countries exhibit very low zero-return measures (e.g. Taiwan and Bangladesh) during the study period. This might cause the impact of geographical size to be positively correlated with the zero-return-measures. This finding is consistent with the R-square measure but inconsistent with the classical synchronicity measure and with Morck et al. (2000).

6.4.3 Legal origin effects

Table 6.7 illustrates panel data analysis results for the common law and civil law country groups. The study does not include the post-communist country group due to the small sample size.

[18] An *entrepôt* is a trading post where merchandise can be imported and exported without paying import duties.

Table 6.7 Panel data analysis between the legal origin groups: Zero-return measure

The study compares the panel data analysis between the common law and civil law country groups The post-communist countries are not analysed separately due to the small sample size. The panel of this table contains estimates of:

$$ZRET_i = \alpha + \beta_1\ RC_i + \beta_2 VC_i + \beta_3 IN_i + \beta_4 CP_i + \beta_5 GDP_i + \beta_6 \log(SIZE)_i + \beta_7 TR_i + \varepsilon_i$$

where $ZRET_i$ is the zero-return measure of stock synchronicity ands α is a constant. Control (RC) is regulatory control index, Corruption (CP) is the corruption index produced by Transparency International, GDP is gross domestic product per capita / 10,000, Inflation (IN) is the inflation rate of a country, Trade (TR) is the trade openness measure, Accountability (VC) is the voice and accountability index and Size (SIZE) is the natural log of the geographical size of a country. Two values are reported below the estimated coefficient. The first, in parenthesis, is the t statistic using white adjusted standard errors and the second, in brackets, is the P value for the statistic.

	Emerging common law countries	Emerging civil law countries
Control	**-0.48759**	**-7.71994**
	(-0.09)	(-3.25)
	[0.93]	[0.00]
Corruption	**-0.73735**	**-0.56613**
	(-0.55)	(-1.00)
	[0.58]	[0.32]
GDP	**-3.68447**	**-11.17116**
	(-1.20)	(-12.29)
	[0.24]	[0.00]
Inflation	**0.03466**	**-0.22523**
	(1.23)	(-3.03)
	[0.22]	[0.00]
Trade	**4.96750**	**40.98045**
	(0.77)	(19.10)
	[0.44]	[0.00]
Accountability	**4.55112**	**1.47108**
	(2.89)	(1.34)
	[0.01]	[0.19]
Log (Size)	**0.86952**	**6.56606**
	(1.03)	(9.20)
	[0.31]	[0.00]
R-square	0.250	0.660

Regulatory control, inflation and GDP are negatively correlated with the zero-return measure at the one percent significance level, and the trade openness measure is positively correlated at the one percent significance level for the civil law country group. In contrast, the common law country group exhibits negative correlation between both corruption index and regulatory control with synchronicity but the effect is not statistically significant.

The civil law country group's zero-return measure is associated with regulatory control, GDP per capita and inflation, whereas these effects are insignificant for the common law county group. It is also evident that corporate governance mechanisms are more effective in the civil law county group than in the common law country group. The R-square value for the civil law country group (0.66) is higher than for the common law country group (0.25), suggesting that the model better explains variation in civil law country synchronicity. In general, the results are consistent with the previous discussion detailed in chapters four and five.

6.5 Discussion

Emerging economies exhibit greater levels of zero-return measures than the developed economies. On average emerging economies exhibit 45.7 percent zero-return whereas developed economies exhibit 28.8 percent (see table 3.11). South American countries exhibit the greatest zero-return measure during the study period (67.8 percent) and the lowest zero-return measure is exhibited by Central Asian countries. However, this is inconsistent with the classical synchronicity measure and R-square synchronicity measure (chapters four and five), where it is found that stock synchronicity is the highest for Central Asian countries. Nevertheless, all three synchronicity measures suggest that synchronicity is higher for emerging economies than for developed economies.

It is found that regulatory control is negatively correlated with the zero-return measure and this effect is more significant in the civil law country group than the common law country group (table 6.7). In addition, voice and accountability is positively correlated with the zero-return measure. This result is unexpected, as the previous analysis shows that voice and accountability is negatively correlated with the classical synchronicity and R-square measures. There is also evidence that some emerging countries exhibit low zero-return measures (e.g. China), even though these countries rank lower in terms of corporate governance indicators such as voice and accountability.

GDP per capita is negatively correlated with the zero-return measure at the one percent significance level for the all-country and the emerging country groups. This is an expected result, as one of the hypotheses of this study is to determine whether high GDP per

capita economies exhibit lower levels of stock synchronisation. The finding is consistent with Morck et al. (2000), who argue that poor GDP per capita economies exhibit higher stock synchronicity. They suggest that poor GDP per capita economies can not provide proper protection of investor rights, so that countrywide share price swings can result in higher stock synchronicity. The finding is also consistent with the R-square measure in chapter five, Durnev et al. (2004a) and Chan and Hameed (2006).

The study finds that corruption is negatively correlated with the zero-return measure, a finding that is consistent with the classical synchronicity measure and Morck et al. (2000). Further, Shleifer (1994) argues that politicians in emerging economies can be very influential. A politician can shut down a business or even refuse to start a business using a variety of tactics. This interference could result in emerging financial markets being more synchronous as the share markets are more generally subject to political whims.

6.6 Conclusion

There is evidence that the zero-return measure is higher in emerging economies than in developed economies. Yet the lowest zero-return measures are found for China and the USA S&P 500 firms. In contrast, the highest zero-return measure is calculated for Ecuador. In addition, corruption is found to be negatively correlated with the zero-return measure at the one percent significance level. This finding is consistent with both Morck et al. (2000) and the classical synchronicity measure. Additionally, GDP per capita is negatively correlated with the zero-return measure at the one percent significance level.

Finally, corporate governance mechanisms are more pronounced for the civil law country group relative to the common law country group. It is found also that GDP per capita and inflation are negatively associated with the civil law country group at the one percent significance level, but this impact is insignificant for the common law country group.

6.7 Appendices

A 6.1 Descriptive statistics for the zero-return measure sub-periods: Geographical segments

Panel A

South Asia

	1996-97	1998-99	2000-01	2002-03	2004-05
Bangladesh	29	22.4	23.4	20.5	25.3
India	35.8	47.4	52.4	56.7	57.2
Pakistan	53	65.3	55.8	48.2	49.6
Sri-Lanka	61.5	59.7	65.7	54.1	44.5
Average	44.8	48.7	49.3	44.9	44.2

Panel B

Africa

	1996-97	1998-99	2000-01	2002-03	2004-05
Egypt	20.7	21.7	29.1	32.7	26.5
Kenya	40.1	45.7	51.5	50.2	42.4
South Africa	32.7	40.7	62.6	73.8	71
Zimbabwe	26.9	37.7	51.7	47.2	55.6
Average	30.1	36.5	48.7	51	48.9

Panel C

South America

	1996-97	1998-99	2000-01	2002-03	2004-05
Ecuador	62.1	73.7	84.9	85	87.4
Argentina	45.2	54.9	65.5	66	61.5
Brazil	56.8	61.3	63	69	65.1
Chile	38.3	47.3	51.5	54	49.1
Columbia	71.5	76.7	82.9	83.2	78.9
Peru	57.5	69.5	74.7	78.7	77.4
Venezuela	25.8	40.4	65.4	80.8	79.7
Mexico	53.5	63.3	70.2	75.2	74.1
Average	51.3	60.9	69.8	74	71.7

Panel D

Europe

	1996-97	1998-99	2000-01	2002-03	2004-05
Hungary	31	40.1	46.5	60.6	66.2
Czech Republic	21.4	40.4	65.2	81.5	82.8
Poland	13.6	13.7	22.6	38.8	37.7
Portugal	32.4	31.1	31.9	38.8	36.7
Greece	8.4	11.4	11	13.3	14.5
Russia	49.7	73	67	67.4	64.8
Spain	17.1	18.6	25.5	24.2	21.1
Average	24.8	32.6	38.5	46.4	46.3

Panel E

Asia/Pacific

	1996-97	1998-99	2000-01	2002-03	2004-05
China	4.8	5.6	7.7	10.4	13.3
Hong Kong	23.1	30.5	37.2	46	43.7
Indonesia	40.7	48.9	53.1	58.2	57.5
Korea	19.9	21.6	20.2	26.9	31.6
Malaysia	12.4	22.7	30.2	33.2	35
Philippines	39.9	48.7	59.3	69.8	65.5
Singapore	20.3	22.2	35.7	41.3	42.4
Taiwan	10.6	11.1	15.2	20.8	24.2
Thailand	43.7	56	63.3	59.5	57.9
Average	23.9	29.7	35.8	40.7	41.2

Panel F

Central Asia

	1996-97	1998-99	2000-01	2002-03	2004-05
Cyprus	35.5	18.2	5.7	26.1	37.1
Turkey	15.5	18.9	29.5	36.5	31.3
Average	25.5	18.6	17.6	31.3	34.2

Panel G

Developed nations

	1996-97	1998-99	2000-01	2002-03	2004-05
Australia	43.2	46.7	47.2	51.9	49.3
France	18.8	19.6	21.1	25.7	21.7
Germany	30.1	28.9	28.7	36.8	40
Japan	10.5	11.3	12.6	15.7	16.8
New Zealand	25.7	24	23.2	28.8	26.6
UK	37.7	34.2	34.7	38.8	36.5
USA - NYSE	30.9	27	25.8	24.6	30.4
Average	28.1	27.4	27.6	31.8	31.6

Panel H

Developed nations including S&P-500 – USA

	1996-97	1998-99	2000-01	2002-03	2004-05
Australia	43.2	46.7	47.2	51.9	49.3
France	18.8	19.6	21.1	25.7	21.7
Germany	30.1	28.9	28.7	36.8	40
Japan	10.5	11.3	12.6	15.7	16.8
New Zealand	25.7	24	23.2	28.8	26.6
UK	37.7	34.2	34.7	38.8	36.5
USA S&P 500	3.3	1.5	1	0.6	0.6
Average	24.2	23.7	24.1	28.3	27.4

A 6.2 Descriptive statistics for the zero-return measure sub-periods: Legal segments

Panel A

Common law emerging country group

	1996-97	1998-99	2000-01	2002-03	2004-05
Bangladesh	29.0	22.4	23.4	20.5	25.3
Cyprus	35.5	18.2	5.7	26.1	37.1
Egypt	20.7	21.7	29.1	32.7	26.5
Hong Kong	23.1	30.5	37.2	46.0	43.7
India	35.8	47.4	52.4	56.7	57.2
Kenya	40.1	45.7	51.5	50.2	42.4
Malaysia	12.4	22.7	30.2	33.2	35.0
Pakistan	53.0	65.3	55.8	48.2	49.6
Singapore	20.3	22.2	35.7	41.3	42.4
South Africa	32.7	40.7	62.6	73.8	71.0
Sri-Lanka	61.5	59.7	65.7	54.1	44.5
Zimbabwe	26.9	37.7	51.7	47.2	55.6
Average	32.6	36.2	41.8	44.2	44.2

Panel B

Civil law emerging countries group

	1996-97	1998-99	2000-01	2002-03	2004-05
Argentina	45.2	54.9	65.5	66.0	61.5
Brazil	56.8	61.3	63.0	69.0	65.1
Chile	38.3	47.3	51.5	54.0	49.1
Columbia	71.5	76.7	82.9	83.2	78.9
Czech Rep	21.4	40.4	65.2	81.5	82.8
Ecuador	62.1	73.7	84.9	85.0	87.4
Greece	8.4	11.4	11.0	13.3	14.5
Hungary	31.0	40.1	46.5	60.6	66.2
Indonesia	40.7	48.9	53.1	58.2	57.5
Mexico	53.5	63.3	70.2	75.2	74.1
Peru	57.5	69.5	74.7	78.7	77.4
Philippines	39.9	48.7	59.3	69.8	65.5
Portugal	32.4	31.1	31.9	38.8	36.7
Korea	19.9	21.6	20.2	26.9	31.6
Spain	17.1	18.6	25.5	24.2	21.1
Taiwan	10.6	11.1	15.2	20.8	24.2
Thailand	43.7	56.0	63.3	59.5	57.9
Turkey	15.5	18.9	29.5	36.5	31.3
Venezuela	25.8	40.4	65.4	80.8	79.7
Average	36.4	43.9	51.5	56.9	55.9

Panel C

Post-communist country group

	1996-97	1998-99	2000-01	2002-03	2004-05
China	4.8	5.6	7.7	10.4	13.3
Poland	13.6	13.7	22.6	38.8	37.7
Russia	49.7	73.0	67.0	67.4	64.8
Average	22.7	30.8	32.4	38.9	38.6

A 6.3 Kruskal-Wallis test statistics for the zero-return measure: Legal origin groups

Sample include common law countries, civil law countries and the post-communist countries

Chi-Square	Degrees of Freedom	Probability
3.584	2	0.167

CHAPTER 7 Comparison of synchronicity measures

7.1 Introduction

Analysis in the previous three chapters found that synchronicity is higher in emerging markets than in developed economies. In addition, it is found that the classical synchronicity measure and the R-square measure capture a similar image of stock markets, whereas the zero-return measure appears to capture other aspects of stock market behaviour. This chapter analyses the three measures of stock synchronicity to explore further the synchronicities and differences that exist between these models.

7.2 Comparison

7.2.1 Panel data comparison

Table 7.1 replicates the main features of the panel data analysis for the all-countries, developed countries and emerging economies groups using the classical synchronicity measure, the R-square measure and the zero-return measure detailed in the previous three chapters.

One common feature of the panel data analysis is the positive correlation between regulatory control and stock market synchronicity using all three synchronicity measures. Regulatory control is found to be an important variable for the R-square and classical measures, though the impact is not statistically significant for the zero-return measure.

Table 7.1 Summary panel data analysis results

The results reported in this table are based on the following model:

$$Stock\ \ Synch\ Measure_{\ i} = \alpha + \beta_1\ RC_i + \beta_2 VC_i + \beta_3\ IN_i + \beta_4\ CP_i + \beta_5\ GDP_i + \beta_6 \log(SIZE_i) + \beta_7\ TR_i + \varepsilon_i$$

where $Stock\ \ Synch\ Measure_{\ i}$, the dependent variable, is the stock synchronicity measure and α is a constant. Control (RC) is regulatory control index, Corruption (CP) is the corruption index produced by Transparency International, GDP is gross domestic product per capita / 10,000, Inflation (IN) is the inflation rate of a country, Trade (TR) is the trade openness measure, Accountability (VC) is the voice and accountability index and Size (SIZE) is the natural log of the geographical size of a country. Two values are reported below the estimated coefficient. The first, in parenthesis, is the t statistic using white adjusted standard errors and the second, in brackets, is the P value for the statistic.

	Classical synchronicity measure			R-square measure			Zero-return measure		
Variables	All	Developed	Emerging	All	Developed	Emerging	All	Developed	Emerging
Control	**0.01603**	**0.00951**	**0.00972**	**0.04639**	**0.05171**	**0.03728**	**0.77944**	**18.09835**	**1.67845**
	(3.83)	(1.83)	(1.98)	(2.98)	(1.30)	(2.63)	(0.35)	(2.28)	(0.69)
	[0.00]	[0.08]	[0.05]	[0.00]	[0.21]	[0.01]	[0.73]	[0.03]	[0.49]
Corruption	**-0.00789**	**0.00953**	**-0.00317**	**0.00407**	**-0.01595**	**0.01030**	**-2.75819**	**-2.11969**	**-4.84351**
	(-5.48)	(31.25)	(-1.21)	(1.46)	(-0.91)	(7.58)	(-5.13)	(-0.81)	(-3.46)
	[0.00]	[0.00]	[0.23]	[0.15]	[0.37]	[0.00]	[0.00]	[0.43]	[0.00]
GDP	**0.00325**	**0.01262**	**0.01198**	**-0.03399**	**-0.05327**	**-0.01677**	**-7.96318**	**2.64978**	**-7.37127**
	(1.62)	(1.04)	(1.77)	(-8.05)	(-3.15)	(-1.86)	(-6.07)	(0.68)	(-3.40)
	[0.11]	[0.31]	[0.08]	[0.00]	[0.01]	[0.07]	[0.00]	[0.50]	[0.00]
Inflation	**0.00018**	**-0.00273**	**0.00020**	**0.00064**	**0.00912**	**0.00065**	**-0.00296**	**0.59291**	**-0.01335**
	(1.15)	(-0.81)	(1.18)	(6.71)	(0.78)	(7.62)	(-0.13)	(0.83)	(-0.53)
	[0.25]	[0.42]	[0.24]	[0.00]	[0.44]	[0.00]	[0.90]	[0.41]	[0.60]
Trade	**-0.01257**	**0.04789**	**-0.01726**	**-0.01346**	**0.17039**	**-0.00861**	**27.77115**	**-61.80561**	**33.89200**
	(-1.18)	(0.56)	(-1.32)	(-0.58)	(2.13)	(-0.33)	(11.27)	(-2.66)	(14.65)
	[0.24]	[0.58]	[0.19]	[0.57]	[0.04]	[0.74]	[0.00]	[0.01]	[0.00]
Accountability	**-0.02376**	**-0.12679**	**-0.02129**	**-0.03340**	**-0.07945**	**-0.03039**	**7.88461**	**25.21017**	**8.31786**
	(-6.39)	(-3.09)	(-6.45)	(-3.28)	(-1.07)	(-2.91)	(3.66)	(1.67)	(3.94)
	[0.00]	[0.01]	[0.00]	[0.00]	[0.30]	[0.00]	[0.00]	[0.11]	[0.00]
Log (Size)	**-0.00381**	**-0.00355**	**-0.00044**	**0.00689**	**-0.00755**	**0.01455**	**3.76442**	**2.50366**	**3.68596**
	(-3.45)	(-1.10)	(-0.35)	(2.45)	(-1.26)	(4.29)	(30.98)	(6.58)	(17.52)
	[0.00]	[0.28]	[0.73]	[0.02]	[0.22]	[0.00]	[0.00]	[0.00]	[0.00]
R-square	0.269	0.614	0.128	0.240	0.460	0.210	0.360	0.740	0.330

Except for the developed country group, corruption is negatively correlated with the classical synchronicity measure and the zero-return measure but this effect is mostly positive for the R-square measure. There is also evidence that trade openness and log geographical size have a greater role for the zero-return measure than the classical synchronicity or the R-square measure.

In addition, inflation is positively correlated with the R-square measure for the all-country and emerging country groups at the one percent significance level. However, the effect is not statistically significant for other synchronicity measures such as the classical measure and the zero-return measure, though mostly it is positively correlated with the classical measure. Surprisingly, inflation is negatively correlated with the zero-return measure except for the developed country group, although the effect is not statistically significant. These results suggest a negative correlation between zero-return measures with the two other measures of synchronicity.

It is often argued by academic researchers that high inflation causes high levels of stock synchronicity. For example, Morck et al. (2000) find that Turkey and Malaysia exhibit higher stock synchronicity and both countries also exhibit high inflation during their study period. It is also found that inflation is positively correlated with the classical synchronicity and R-square measures. The study results from the zero-return measure conflict with the classical measure, the R-square measure and the results of Morck et al. (2000).

Further, emerging countries that exhibit greater stock synchronicity using the classical measure and the R-square measure surprisingly exhibit a low zero-return measure during the observation period. For example, China and Malaysia exhibit a low zero-return measure (China 11.5 percent and Malaysia 26.5 percent) relative to the mean of 42.9 percent, even though both exhibit high stock synchronicity. In contrast, Australia exhibits lower stock synchronicity using the classical measure (58 percent) and the R-square measure (0.041) but exhibits a greater zero-return measure than the other developed economies sampled. These results suggest that the zero-return measure captures somewhat different aspect of stock market behaviour rather than stock synchronicity.

Accountability is negatively correlated with the classical measure and the R-square measure at the one percent significance level, with the exception of the R-square measure for

the developed country group. However, the zero-return measure is positively correlated with accountability for all three country groups (the all-country, the developed country and the emerging country groups). This result conflicts with the classical measure and the R-square measure, and is also inconsistent with the findings of Morck et al. (2000).

Geographical size exhibits a negative correlation with the classical synchronicity measure, although it is statistically significant only for the all-country group. This is an expected result as it is assumed that larger capital markets are less synchronous than small capital markets due to the financial market size. However, geographical size shows somewhat mixed correlation with the R-square synchronicity measure. In contrast, geographical size is positively correlated the zero-return measure at the one percent significance level for all groups. It is found that this result is mainly driven by the large countries that exhibit high R-square measures (such as China) and high zero-return measures (such as Russia and Mexico) during the observation period. In addition, GDP per capita is positively correlated with the classical synchronicity measure, though this effect is mainly negative for the R-square measure and the zero-return measure at the 10 percent significance level, except for the developed country group.

The overall result suggests that the classical measure and the R-square measure capture somewhat similar images of stock markets synchronicity, whereas the zero-return model measures somewhat different aspect of stock market behaviour. It is found that Skaife et al. (2006) analyse the zero-return measure for six sample developed countries including Australia, France, Germany, Japan, the UK and the USA. If, as seems possible, the zero-return measure does capture different aspects of stock markets, then it has implications for the developed financial markets. However, there is some doubt about the implementation of the zero–return measure on emerging economies like China and Malaysia, where the stocks are heavily traded.

7.2.2 Correlation between synchronicity measures

Table 7.2 exhibits the correlation between the classical measure, the R-square measure and the zero-return measure over the study period from January 1996 to December 2005. Further, the data is divided into three sub-sets, the all-country group (developed and emerging countries), the emerging country group and the developed country group.

Table 7.2 Correlation between synchronicity measures

The classical synchronicity measure, the R-square measure and the zero-return measure

The value in parentheses is the P value for the correlation-coefficient. Values in bold including star '*' indicate that the coefficient is statistically significant at the 5 percent level. Values in bold without star indicate significance at the 10 percent level. The data span the period from January 1996 to December 2005. The sample includes 41 countries for the all-country group, 34 emerging countries for the emerging country group and seven developed countries for the developed country group.

All countries	Classical synchronicity measure	R-square measure
R-square measure	**0.508***	
	(0.00)	
Zero-return measure	-0.078	**-0.272**
	(0.63)	(0.09)
Emerging countries	Classical synchronicity measure	R-square measure
R-square measure	**0.500***	
	(0.00)	
Zero-return measure	-0.269	**-0.429***
	(0.12)	(0.01)
Developed countries	Classical synchronicity measure	R-square measure
R-square measure	-0.153	
	(0.74)	
Zero-return measure	**-0.746**	0.185
	(0.05)	(0.69)

Table 7.2 illustrates that the classical measure is positively correlated with the R-square measure at the one percent significance level for the all country group. In addition, both the classical measure and the R-square measure are negatively correlated with the zero-return measure, though the effect is only statistically significant for the R-square measure with the zero-return measure correlation-coefficient at the 10 percent significance level for the all-country and the emerging country groups.

Further, correlation-coefficients for the emerging country synchronicity show that the classical synchronicity measure is positively correlated with the R-square measure and negatively correlated with the zero-return measure, which is consistent with the cross-sectional analysis.

The developed country group, on the other hand, shows somewhat mixed correlation between the synchronicity measures. For example, the R-square measure shows positive correlation with the zero-return measure, although the effect is not statistically significant. This may result from the small sample size that is used for the developed economies.

Spearman rank correlation coefficients are also reported in table 7.3 with little change in the results.

Table 7.3 Spearman rank correlation-coefficient for synchronicity measures: Full period

Values in bold including star '*' indicate that the correlation-coefficient is statistically significant at the 5 percent level and values in bold without star indicate significance at the 10 percent level. The sample includes 41 countries for the all-country group, 34 emerging countries for the emerging country group and five developed countries for the developed country group. The data span the period from January 1996 to December 2005.

All countries	Classical measure	R-square measure
R-square measure	**0.370***	
	(0.02)	
Zero-return measure	-0.148	-0.145
	(0.36)	(0.37)
Emerging countries	Classical measure	R-square measure
R-square measure	**0.353***	
	(0.04)	
Zero-return measure	**-0.307**	**-0.327**
	(0.08)	(0.06)
Developed countries	Classical measure	R-square measure
R-square measure	-0.174	
	(0.71)	
Zero-return measure	-0.595	0.109
	(0.16)	(0.82)

There is evidence of positive correlation between the classical measure and the R-square measure at the five percent significance level for the all-country and emerging country groups, whereas the zero-return measure is negatively correlated with the R-square measure and the classical measure at the 10 percent significance level for the emerging country group. Further, the developed country group shows some negative correlation between the classical measure and the R-square measure but the effect is not statistically significant. This suggests that a strong correlation exists between the classical measure and the R-square measure, whereas the zero-return measure is capturing a picture different from stock market co-movement.

In addition, to check whether the same effect also appears in synchronicity measures for sub-periods, the full period data is further divided into five sub-periods. The sub-periods are 1996-97, 1998-99, 2000-01, 2002-03 and 2004-05. Table 7.4 exhibits the correlation-coefficient of synchronicity measures for the above sub-periods. It is found that the R-square

measure is positively correlated with the classical measure in each of the sub-periods in both the all-country and the emerging country groups, although the effect is only statistically significant for 2000-01 and 2002-03 at the five percent level; for 2004-05 at the 10 percent significance level for the all-country group; and for 1996-97 and 2000-01 at the five percent level and 2002-03 at the 10 percent level for the emerging country group.

The zero-return measure is negatively correlated with the classical measure and the R-square measure for every sub-period for the all-country and emerging country groups, with the exception of the classical measure in 1996-97 and the zero-return measure in 2004-05.

Table 7.4 Correlation-coefficient of synchronicity measures: Sub-period analysis
(The classical measure, the R-square measure and the zero-return measure)

Here, CS is the classical synchronicity measure, RS is the R-square synchronicity measure and the ZS is the zero-return measure. The value in parenthesis is the P value for the correlation-coefficient. Values in bold including star '*' indicate statistically significance at the five percent level and values in bold without star indicate significance at the 10 percent level. The sample includes 41 countries in the all-country group, 34 emerging countries in the emerging country group and five developed countries in the developed country group. The sample includes five sub-periods, which are 1996-97, 1998-99, 2000-01, 2002-03 and 2004-05.

	1996-97		1998-99		2000-01		2002-03		2004-05	
All countries	CS	RS	CS	RS	CS	RS	CS	RS	CS	RS
R-square measure	0.221		0.247		**0.472***		**0.371***		**0.290**	
	(0.17)		(0.12)		(0.00)		(0.02)		(0.07)	
Zero-return measure	0.227	**-0.302**	-0.027	-0.229	-0.210	**-0.305**	-0.131	**-0.313**	-0.213	0.066
	(0.15)	(0.06)	(0.87)	(0.15)	(0.19)	(0.05)	(0.41)	(0.05)	(0.18)	(0.68)
Emerging countries	1996-97		1998-99		2000-01		2002-03		2004-05	
R-square measure	**0.500***		0.171		**.442***		**0.302**		0.203	
	(0.00)	.	(0.33)		(0.01)		(0.08)		(0.25)	
Zero-return measure	-0.269	**-0.429***	-0.083	**-0.335**	**-.389***	**-0.427***	**-0.324**	**-0.469***	**-0.394***	-0.046
	(0.12)	(0.01)	(0.63)	(0.05)	(0.02)	(0.01)	(0.06)	(0.01)	(0.02)	(0.80)
Developed countries	1996-97		1998-99		2000-01		2002-03		2004-05	
R-square measure	-0.022		-0.085		0.119		0.087		-0.203	
	(0.96)		(0.86)		(0.80)		(0.85)		(0.66)	
Zero-return measure	**-0.677**	-0.01	**-0.771***	-0.028	-0.631	-0.132	**-0.780***	-0.034	**-0.712**	-0.376
	(0.10)	(0.98)	(0.04)	(0.95)	(0.13)	(0.78)	(0.04)	(0.94)	(0.07)	(0.41)

However, the correlation-coefficient for the developed economies shows some variation between synchronicity measures, possibly due to the small sample size. Correlation-coefficients for the developed economies are mixed; however, this effect disappears when the developed economies and the emerging economies are merged into a single group (the all-country group).

In addition, the study also tests the Spearman rank correlation-coefficients for robustness test. It is found that Spearman rank correlation-coefficients also capture the same trend between the synchronicity measures for the observed sub-period. There is evidence that the R-square measure is positively correlated with the classical measure for each of the sub-periods except for the developed country group in 1996-97, 1998-99 and 2004-05, and negatively correlated with the zero-return measure for every sub-period except for the all-country group in 2004-05 and the developed country group in 1998-99 and 2002-03 (see table 7.5), although none of these correlations is statistically significant. It seems that the small sample size of the developed country group erratically uncorrelated with the R-square measure and the classical measure. In addition, the classical measure shows negative correlation with the zero-return measure for all sub-periods, except in 1996-97 for the all-country group and the emerging country group.

The correlation-coefficient result for the sub-periods is consistent with the full period analysis. There is evidence of a positive correlation between the classical measure and the R-square measure for the full period and sub-periods, though this effect is mostly negative for the zero-return measure. These correlation-coefficient analyses are also consistent with the cross-sectional analyses that are discussed in table 7.1 in this chapter.

Table 7.5 Spearman rank correlation-coefficient for synchronicity measures: Sub-periods

Where CS is the classical synchronicity measure, RS is the R-square synchronicity measure and the ZS is the zero-return measure. The value in parenthesis is the P value for the correlation-coefficient. Values in bold including star '*' indicate statistical significance at the 5 percent level and values in bold without star indicate significance at the 10 percent level. The sample includes 41 countries in the all-country group, 34 emerging countries in the emerging country group and five developed countries in the developed country group. The sample includes five sub-periods, which are 1996-97, 1998-99, 2000-01, 2002-03 and 2004-05.

	1996-97		**1998-99**		**2000-01**		**2002-03**		**2004-05**	
All countries	CS	RS	CS	RS	CS	RS	CS	RS	CS	RS
R-square measure	0.153		0.069		**0.319***		0.252		**0.266**	
	(0.34)		(0.67)		(0.04)		(0.11)		(0.09)	
Zero-return measure	0.206	-0.19	-0.028	-0.155	-0.156	-0.151	-0.112	-0.168	-0.245	0.076
	(0.20)	(0.23)	(0.86)	(0.33)	(0.33)	(0.35)	(0.48)	(0.29)	(0.12)	(0.64)
Emerging countries	**1996-97**		**1998-99**		**2000-01**		**2002-03**		**2004-05**	
R-square measure	0.062		0.171		**0.298**		0.142		0.203	
	(0.73)		(0.33)		(0.09)		(0.42)		(0.25)	
Zero-return measure	0.299	**-0.321**	-0.083	**-0.335***	**-0.343***	-0.257	**-0.299**	**-0.350***	**-0.394***	-0.046
	(0.09)	(0.06)	(0.64)	(0.05)	(0.05)	(0.14)	(0.09)	(0.04)	(0.02)	(0.80)
Developed countries	**1996-97**		**1998-99**		**2000-01**		**2002-03**		**2004-05**	
R-square measure	-0.055		-0.138		0.094		0.009		-0.040	
	(0.91)		(0.77)		(0.84)		(0.98)		(0.93)	
Zero-return measure	-0.487	-0.018	-0.546	0.036	-0.593	-0.127	-0.577	0.200	**-0.739**	-0.394
	(0.27)	(0.97)	(0.21)	(0.94)	(0.16)	(0.79)	(0.18)	(0.67)	(0.06)	(0.38)

7.3 Discussion

The panel data analysis shows that there is some consistency between the R-square measure and the classical measure; whereas the zero return measure is capturing a different aspect of stock market behaviour. It is found that trade openness, accountability and geographical size have a greater impact on the zero-return measure. In addition, there is evidence that synchronicity values can vary across countries depending on the approach used. For example, China and Malaysia exhibit higher stock synchronicity using the classical measure (China 73 percent and Malaysia 73 percent) and the R-square measure (China .241 and Malaysia .254), although these countries exhibit lower zero-return measures (China 11.5 percent and Malaysia 26.5 percent) relative to the mean (42.9 percent).These results reinforce the possibility that the zero-return measure does capture a different aspect of stock market behaviour. Further analysis of this question is left to future research.

It is found that in general the classical measure and the R-square measure are positively correlated, whereas the zero-return measure is negatively correlated with both these measures, though this effect is not statistically significant for all sub-periods. There is some inconsistency across the three synchronicity measures in correlation analysis over sub-period and full period data. For example, the zero return measure is positively correlated with the classical measure in 1996-97 (the all-country group) and with the R-square measure in 2004-05 (the all-country group) using the Pearson correlation-coefficient, although this effect is not statistically significant. However, there is some evidence of similarities between the cross-sectional analysis result and both the Spearman rank and Pearson correlation results. Both Pearson correlation and Spearman rank correlation find that the classical synchronicity measure and the R-square measure are positively correlated, whereas the zero-return measure is erratically uncorrelated with the classical measure and the R-square measure.

Overall, the study finds that the R-square measure and the classical measure are positively correlated though there is some variation between the two measures. It is also found that the zero-return measure is not positively correlated with either the classical measure or the R-square measure. The possibility remains that the zero-return measure captures some aspect of broad equity market performance other than stock market

synchronicity and this is borne out to some extent in the panel data analysis reported in chapters three, four and five.

CHAPTER 8 Conclusion

8.1 Introduction

This thesis investigates whether stock market synchronicity is higher in emerging economies than in the developed economies. It is found that stock markets in emerging economies are more synchronous than in developed economies using the classical measure, the R-square measure and the zero-return measure. In addition, using the classical measure it is found that all of the securities in an emerging economy can move in the same direction over a given week (examples include Poland and Greece). This phenomenon is not observed in the limited developed market sample.

Panel data analysis shows that stock synchronicity increases with inflation (except for the developed economies group) and decreases with higher degrees of government accountability using the classical measure and the R-square measure. Regulatory control is found to be positively correlated with all three of the synchronicity measures (the classical measure, the R-square measure and the zero-return measure).

It is found that in emerging countries such as China and Malaysia, stock synchronicity is higher in terms of the classical measure and the R-square measure; but these countries also exhibit a low level of zero-return measure during the study period. It seems that the zero-return measure may provide a good measure of synchronicity for developed economies but not for emerging economies. It also appears that the zero-return measure captures aspects of stock market behaviour other than those captured by the classical and R-square measures of stock synchronicity.

The Pearson correlation and Spearman rank correlation-coefficient are estimated to determine the relation that exists between these measures. It is found that the classical measure is positively correlated with the R-square measure, although both measures are generally negatively correlated with the zero-return measure using both the Pearson correlation and Spearman rank correlation-coefficient.

8.2 Summary of the thesis

The key focus of this thesis is the analysis of the synchronous behaviour of share price changes in emerging stock markets with comparisons against selected developed financial markets. It is found that stock prices in developed economies are less synchronous than stock prices in emerging financial markets.

Chapter two introduces the concept of stock return synchronicity and discusses the literature. Morck et al. (2000) are among the first to introduce the topic of stock market synchronisation and argue that stock markets in economies with high per capita GDP move in a relatively unsynchronised manner over time, in contrast to stock prices in low per capita GDP economies. Additionally, they suggest that stock synchronicity is associated with macroeconomic indicators including rule of law, inflation, corruption and geographical size. They propose two measures of stock synchronicity to capture stock market synchronisation – the classical synchronicity measure and the R-square measure). Skaife et al. (2006) propose a further measure of stock synchronicity based on the proportion of zero-return days and argue that the zero-return measure is a superior measure of stock market co-movement.

Research methodology and data are described in chapter three. There are 34 emerging economies and seven developed markets in the sample. Weekly stock return data is collected from DataStream and additional data are collected as required from the Yahoo finance website where gaps exist in DataStream. The final dataset includes approximately 20.8 million firm week observations for 40,014 firms across the world. Data used in cross-sectional analysis is also discussed in this chapter; they include two corporate governance indicators (regulatory control and voice and accountability) as well as other index data including inflation, a corruption index, GDP per capita, a measure of trade openness and geographical size of a country.

The first of the three stock synchronicity measures is analysed in chapter four. This chapter uses the classical synchronicity measure to capture stock market synchronicity for the sample of 41 countries. There is evidence that over the 10-year period the synchronicity measure is stationary. Indeed, there is little evidence of autocorrelation in the data over the study period. It is evident that stock markets in emerging economies are more synchronous than in developed economies over the sample period. Additionally, there is evidence of a

statistically significant negative correlation between stock synchronicity and both government accountability and corruption. There is also a positive correlation found between inflation and stock synchronicity.

Analysis of the second measure of stock synchronicity (the R-square measure) is presented in chapter five. The R-square measure of stock synchronicity averages 0.091 for the emerging markets and 0.045 for the developed economies. China, Malaysia and Turkey exhibit the highest R-square values among the emerging economies during the study period. In contrast, Japan exhibits the lowest R-square value among the developed economies. In panel data analysis, there is evidence of a statistically significant positive correlation between the R-square measure and both corruption and inflation. There is also a negative correlation evident between the R-square with government accountability and GDP per capita. Finally, R-square measures for the civil law countries are generally higher than for the common law countries, suggesting that corporate governance mechanisms are more effective in civil law countries.

Chapter six provides analysis and discussion of the third measure of stock synchronicity, the zero-return measure, suggested by Skaife et al. (2006). It is found that the zero-return measure for emerging economies is higher than for developed economies. Unexpectedly, China and the S&P 500 group of companies exhibit the lowest values for the zero-return measure during this period. It is also found that both GDP per capita and corruption are negatively correlated with the zero-return measure at the one percent significance level, and both trade openness and accountability are positively correlated with this measure. These results differ from those for the first two measures, particularly for GDP per capita and trade openness.

A comparison of the three synchronicity measure is presented in chapter seven. It is found that the classical synchronicity measure and the R-square measure are positively correlated. These measures appear to capture similar characteristics of the markets in the study. In contrast, the zero-return measure shows either insignificant or negative correlation with the classical measure and the R-square measure for most sub-periods and the full period.

8.3 Key contributions of the thesis

The study uses three measures of stock synchronicity and finds that stock synchronicity is higher is emerging economies than in developed markets. To the authors knowledge there is no comparison of the three measures of synchronicity provided in the literature to date. It is also found that synchronicity is statistically significantly associated with a range of country-level variables.

Some of the major findings presented in this thesis include:

8.3.1 Time series analysis

A. Consistent with the literature review, while there have been few time series analyses, this study provides a comprehensive analysis of three synchronicity measures, particularly with respect to emerging markets.

B. It is found that stock markets in the emerging countries are more synchronous than in the developed economies using the classical measure, the R-square measure and the zero-return measure. In addition, high levels of stock synchronicity are evident for China, Turkey and Malaysia and a low level of stock synchronicity is evident for Germany and Australia using the classical measure and the R-square measure.

C. Common law origin countries exhibit lower levels of stock synchronicity than civil law origin countries and post-communist countries. Further, post-communist stock markets tend to be more synchronous on average (examples include China and Poland) using the classical measure and the R-square measure. In contrast, the zero return measure shows post-communist countries to exhibit a lower proportion of zero-return than civil law countries and common law countries.

D. Time series stock return data is stationary over the study period.

8.3.2 Panel data analysis

A. The study extends the work of Morck et al. (2000) and introduces some new country level variables that have greater explanatory power; such as regulatory control and trade openness. There is evidence of statistically significant correlation between these explanatory variables and stock market synchronicity.

B. Inflation is positively correlated with stock market synchronicity in general, suggesting that higher inflation levels are associated with higher stock synchronicity levels.

C. The country corruption index is negatively correlated with stock synchronicity using the classical measure (except for the developed countries) and the zero-return measure, which suggests that high levels of corruption are associated with high levels of stock price co-movement.

D. Country geographical size is negatively correlated with stock synchronicity using the classical measure. This suggests that stock markets in large economies are less synchronous than those in small economies.

E. There is evidence that accountability and geographical size are positively correlated with the zero-return measure of stock synchronicity, which is inconsistent with the classical measure.

F. GDP per capita is negatively correlated with the R-square measure and the zero return measure in general, suggesting that lower GDP per capita countries exhibit higher stock market co movement.

8.3.3 Comparison between the synchronicity measures

A. The classical synchronicity measure and the R-square measure are generally positively correlated, suggesting that both measures capture similar aspects of the stock markets. In contrast, the zero-return measure is negatively correlated with both the classical measure and the R-square measure, so that perhaps the zero-return measure captures a different aspect of broad equity market behaviour.

B. While Skaife et al. (2006) use Australia, France, Germany, Japan, the UK and the USA stock market data for their zero-return measure analysis, this thesis expands the application of the synchronicity method to 41 countries. This measure appears to work well for developed economies but for emerging economies like China and Malaysia with heavily traded stocks, the zero-return measure based rankings are inconsistent with both the classical and R-square measures.

8.4 Limitations and directions for future research

Stock market synchronicity is a new area of research within the finance literature. This study uses stock return data from 41 countries over the period from January 1996 to December 2005 for analysis. Additional country data may provide a more robust analysis of stock synchronicity. The study uses country-level stock market data in synchronicity analysis; however, individual firm-level synchronicity analysis would provide a valuable extension for further research.

The study uses seven explanatory variables for cross-sectional analysis. Additional explanatory variables – such as anti-director rights index and analyst forecast earning index – could be useful for cross-country synchronicity analysis.

While the study uses all available stocks from DataStream following Morck et al. (2000), it is possible that some listed stocks may have been ignored. Thus, a possible extension could involve analysis of more extensive datasets as they become available.

Finally, it is found that the classical measure and the R-square measure capture similar aspects of stock market behaviour, whereas the zero-return measure appears to capture different aspects of stock market movements. It is assumed that emerging stock markets exhibit greater zero-return measures than developed financial markets, yet important examples such as China and Malaysia provide inconsistent results. Further analysis of this question is left to future research.

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