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INTERTEMPORAL RELATIONS BETWEEN STOCK
INDICES-CORRELATION ANALYSIS FOR THE
STOCK MARKETS OF THE UNITED STATES,
ENGLAND, AND SINGAPORE

A Project
Presented to the
Faculty of
California State University,
San Bernardino

In Partial Fulfillment
of the Requirements for the Degree
Master of Business Administration

by
Michael Nabil Razzouk
March 2009

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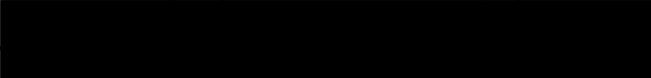


Dr. Mo Vaziri, Chair, Accounting and
Finance

3/25/09
Date



Dr. Rafiqul Bhuyan



Dr. Ghulam Sarwar, Department Chair

ABSTRACT

This research study examines the relationships between various equity markets throughout the world. In this study, returns from the Chicago Stock Exchange, the London Stock exchange and the Singapore Stock Exchange are compared and analyzed to see if correlations between the markets exist. This paper uses regression analysis and examines the correlations between the markets under a variety of scenarios. In essence, this seeks to answer whether the efficient market hypothesis is viable today in a world experiencing globalization and a convergence of technology. It was found that the markets examined display very few relationships, which indicates that the return performance of one market is not a strong predictor of return performance in a different market. This asserts that the efficient market hypothesis is still supported today.

ACKNOWLEDGMENTS

Throughout my life, my family has supported and encouraged me in all that I do. It is with their love and support that I have matured into a successful individual. My father has forged a strong name for the Razzouks at Cal State San Bernardino and I have worked to my full potential in order to strengthen our reputation and to make him proud.

I thank my friends who have always questioned my progress on this paper and who have brought a smile to my face when needed the most. Thank you for understanding my absence while I worked hard to complete this project.

Finally, I appreciate the help of Dr. Vaziri and Dr. Bhuyan. Thank you for helping keep me on track and working in the right direction. It was a pleasure learning from your experiences and obtaining new knowledge.

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CHAPTER ONE

INTRODUCTION

Background

Questions have long been raised whether or not the achievement of abnormal returns can come to fruition by examining the performance behavior of foreign markets which have different open and close times from the home market. With regard to the current state of financial markets in the United States, this question becomes increasingly more important. This paper is written during one of the most devastating financial crisis's in American history. Year to date, the S&P 500 index is down 32.03% (Google Finance, October 14, 2008). In addition, consolidation and regulation are two words that are flooding financial news. Bear Stearns, Lehman Brothers and AIG have been dealt severe blows and required massive bailout efforts. Recently, Merrill Lynch was purchased by Bank of America. Freddie and Fannie, the largest U.S. mortgage entities, are now under government control and finally, Goldman Sachs and Morgan Stanley received Federal Reserve approval to become bank holding companies (Dallas Business Journal, 2008).

With all of these changes in the financial industry of the United States, investors are wondering where their money can grow and if there are investment strategies that they can implement to gain returns while minimizing their risks. For many, this involves looking abroad to foreign financial markets. A few studies have been implemented in order to address this particular issue. Kent G. Becker, Joseph E. Finnerty, and Manoj Gupta explored the intertemporal relations between markets in New York and Tokyo in a study written in the 90s (Becker et al., 1990). The research conducted by these individuals examined the fundamentals of efficient market hypothesis spanning from October 5, 1985 to December 28, 1989. These authors determined in their study that high correlations of return data existed between open and the close percentage returns for U.S. based equities during the previous trading day and the stock performance of Japanese stocks in during the present period (Becker et al., 1990). Throughout their study, Becker, Finnerty, and Gupta did not consider transactions costs when collecting and interpreting their data. With the vast restructuring of the financial industry, the large advancements in technology and other environmental changes, a new study is necessary to test the efficient market hypothesis. Recently, a fellow MBA

student and close friend, Kazuma Koseki, engaged in a similar study in which he examined the intertemporal relations between The New York, the Tokyo, and the Shanghai Stock Exchange. This particular study focuses on markets that are explored less frequently. It analyzes data from the Chicago Stock Exchange, the Singapore Stock Exchange and the London Stock Exchange.

As previously noted, a new study is necessary due to a number of environmental changes that have occurred on a global basis. Markets in Asia have boomed over the last 10 years. China for instance has consistently led the United States in terms of GDP growth for the past several years.

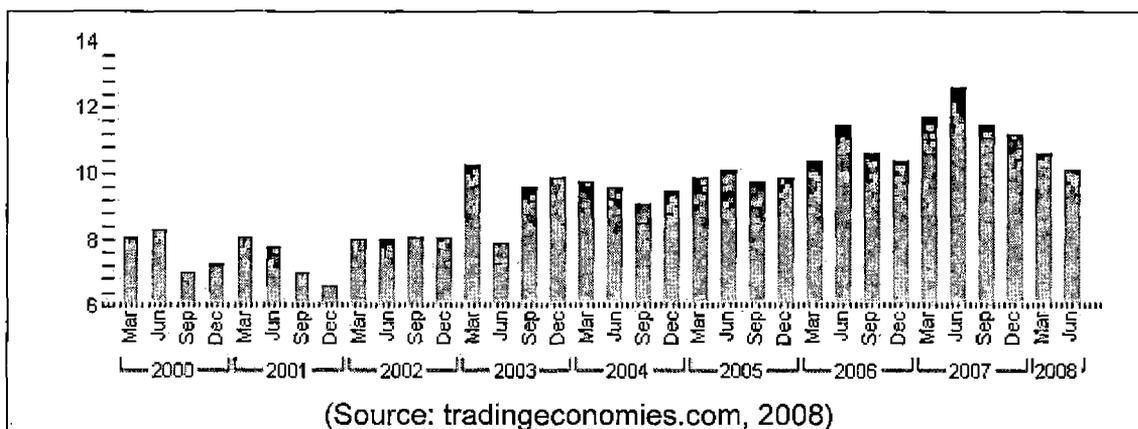


Figure 1. Gross Domestic Product Growth of China

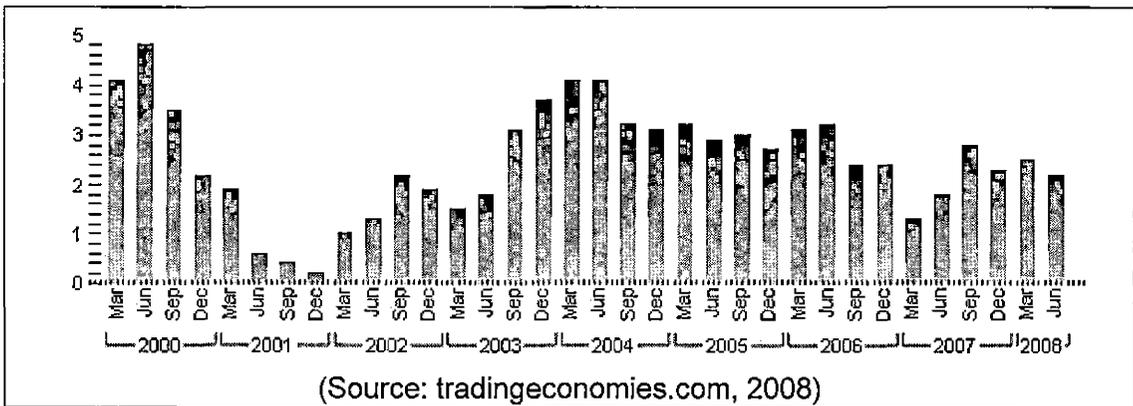


Figure 2. Gross Domestic Product Growth of the United States

The significant GDP growth rate is not only concentrated to China, Singapore and other Asian countries have experienced GDP growth rates that surpass that of the United States. Currently, it is estimated that Singapore will experience between a 4-5% GDP growth rate during 2008 (Dahinten, 2008).

England has long been a financial power in the world. Not only is it the most highly industrialized country in the world, but it is also a financial powerhouse. Currently, London acts as a top financial reference for the rest of the world. Many banks utilize the LIBOR rate as a benchmark interest rate or the FTSE as a financial index. The London Stock Exchange has roots tracing all the way back to the 17th century. With such strong ties to the United States, it is questionable whether or not the

markets of these two countries will be closely tied together.

The United States is without a doubt a world leader in terms of financial development and technological advances. As previously mentioned, deregulation and the recent housing crisis have led to numerous changes within the financial sector of the United States. Many countries still purchase U.S. treasury bills and engage in foreign direct investment within the United States. Even though the country's GDP has grown slower than many other countries as of late, the United States is viewed as a stable political and economic environment for long-term investing. With so many economic and technological changes occurring in the USA, England, and Singapore, it's crucial to engage in an up-to-date study to examine the correlations of the returns among the equity centers.

Historical Evolution of the Three Stock Markets

Singapore

Singapore has traditionally been an exchange and financial core for the Asian region. During the 1970s, leaders of Singapore cited financial services as a vital area for expansion and provided incentives to develop the country's financial markets and infrastructure

(Country-data.com, 2008). The following decade, the government of Singapore focused further on diversification, upgrading, and automation of financial services (Country-data.com, 2008). As a result of these actions, Singapore became the 3rd most significant financial arena in Asia, trailing only Tokyo and Hong Kong. The sector for finance in Singapore contributed nearly twenty three percent of the country's gross domestic product and employed roughly nine percent of the country's work force (Country-data.com, 2008). By 1989, after some minor changes to the financial sector, the markets of Singapore were described as "booming" (Country-data.com, 2008). The Singapore Foreign Exchange Market was also developing significantly around this time. Because Singapore was gaining recognition as an international financial center; "The country experienced benefits from the worldwide increase in business as well as from the related expansion in the financially liberated Japanese market" (Country-data.com, 2008). According to sources, "On December 1, 1999, the merger of the Stock Exchange of Singapore (SES) and the Singapore International Monetary Exchange (SIMEX) led to the creation of the Singapore Exchange Limited (SGX), Asia-Pacific's first demutualised and integrated

securities and derivatives exchange" (Singapore Exchange Limited, 2008). The government of Singapore has consistently played a lively role in the promotion of savings and investments. The country has large reserves invested in the development of the education and technology sectors (Singapore Exchange Limited, 2008). In addition, the country's geological location has significantly contributed to the steady financial growth experienced by the country. With a strong drive to become a regional financial leader, Singapore has great future potential (EconomyWatch-Singapore, 2008).

England

England has a long established past as an economic world power. England began as a strong agricultural and meat producing nation. During the 17th century, the country was making huge advances in technological capabilities. At the beginning of the 18th century, England was utilizing machines in manufacturing (Rempel, 2008). The industrial revolution in England helped the country develop into a strong production nation. The London Stock Exchange has roots tracing back over 300 years. The LSE is one of the strongest exchanges and played a vital role in shifting England from a strong production focus to a service oriented country like the

United States. Recently, England experienced large economic booms during the 1980s; especially in the financial sector. The increase in competition between firms was offset by a rapidly strengthening market. This was stimulated by tax cuts—which presented the middle-class with additional disposable income, the privatization of stocks, the boom of housing prices, recasting of pension laws and the signaled withdrawal of the state from social spending (Tickell, 1997). This effectively translated into massive employment growth in the financial sector between 1981 and 1989. The number of jobs in this sector rose by 32.2 percent according to Tickell (1997). From 1989 to 1990 however, the British economy began to experience a downturn. It was soon clear that the Lawson-Thatcher boom had been masking problems for the English financial industry. This was mostly due to the blurring of lines between domestic and international markets (Tickell, 1997). Most recently, the financial situation in England closely resembles the occurrences in the United States. The sub-prime lending crisis took its toll on English markets as many firms of England's financial sector held mortgage-backed securities. As a result, the FTSE 100 index dipped below the 5,000 level for the first time since June of 2005 (Turner, 2008).

Mervyn King, the Bank of England governor speculates that consumer inflation will soon peak at an annual rate near 5 percent. This figure is well above the Bank of England's target rate of only 2 percent (Turner, 2008). With many similar assets and a common problem affecting both the United States and England, it is questionable whether or not the English and American markets will be highly correlated or not.

The United States

The United States, much like England, is also a world economic powerhouse. The United States began with humble economic roots, but soon flourished into a hegemonic power. One of greatest strengths for the United States has been its vast amount of natural resources. This helped the country begin as a strong producing nation. Like England, the United States soon became a service oriented country. As many firms began to reach near-monopolistic statuses, the Federal government was forced to introduce reforms such and the Sherman Antitrust Act of 1890 and the Clayton Act of 1914 (United States Economic Development, 2003). 1929 marked the beginning of the great depression for the United States in which markets crashed, there were runs on the bank and one in four Americans were unemployed. After a period of slow economic recovery, the Second World War

erupted. Output for the United States boomed during this period as factories operated to supply arms for U.S. troops and employment reached record low levels.

The post-World War II era arose with the United States as a dominant military and economic leader for the world. Acknowledging the political and economic stability of the United States, many foreign countries purchased U.S. treasury securities. This was a trend that continued until recently. One of the recent downfalls of the United States is the country's habit of spending more than it saves. This in turn produced the accrual of a huge trade deficit for the United States. With the rising deficit and a falling of U.S. confidence, the dollar has experienced a period of weakening. This indicates that the demand for U.S. dollars in the international market has significantly declined (United States Economic Development, 2003). The 2001 terrorist attacks of September 11 led to lowered investor confidence as well. Soon after, the Iraq war and the war in Afghanistan led to further economic difficulties for the United States as both wars were quickly consuming a vast amount of resources.

Most recently, the United States is facing the sub-prime mortgage crisis which has led to weak markets and tight lending practices. Change within the financial

sector continues to occur daily. On September 26, 2008 the latest change occurred. Washington Mutual was recently purchased by JP Morgan. With many similar mergers and acquisitions, combined with talks of government action, the U.S. financial sector is rapidly changing.

Institutional Specifics of the Chosen Exchanges

The Singapore Stock Exchange exists as a premier exchange within its region. The exchange is highly internationalized with nearly forty percent of its market capitalization derived from foreign institutions and firms (Advfn homepage, 2008). The Singapore Stock Exchange partitions its firm listings into the SGX Mainboard and SGX SESDAQ. The Mainboard portion is comprised of firms and institutions meeting certain requirements including market capitalization, pre-tax profits, and track records of operations (Advfn homepage, 2008). The SESDAQ portion is for newer companies and there are no quantitative requirements for listing. These companies may apply to be added to the Mainboard if they are listed on the SESDAQ system for a minimum of two years and meet the quantitative requirements of the Mainboard platform (Advfn homepage, 2008).

The Singapore Stock Exchange is on a fully electronically integrated platform. To accomplish this, the exchange utilizes the Central Limit Order Book or CLOB. This allows traders/brokers to issue orders online and when buy/sell commands are matched, the electronic system will automatically execute the order and notify the broker that the trade has occurred (Advfn homepage, 2008).

As previously mentioned, the Singapore Stock Exchange was created following the union of the previous two exchanges of Singapore: the Stock Exchange of Singapore and the Singapore International Monetary Exchange (Singapore Stock Exchange, 2007). The Stock Exchange in Singapore is currently supported by a stringent but market-oriented regulatory regime. With this strong backing, Singapore has gained a strong international reputation. Singapore has regularly classified as the world's fourth most active trade center following New York, London and Tokyo (Singapore Stock Exchange homepage, 2008). As a result of its policy of welcoming foreign companies and the available liquidity pool from international funds, Singapore is now the premier international capital market in Asia for the listing and trading of bonds and equities. Singapore also has an internationally renowned fund management center with total

assets of over S\$720 billion under management ending 2005 (Singapore Stock Exchange homepage, 2008).

To further elaborate on the regulatory approach of the Singapore Stock Exchange, "Singapore's financial market has been built on a robust and efficient legal and judicial framework. Singapore is one of the few regional countries with a "AAA" rating" (Singapore Stock Exchange homepage, 2008). In addition to this achievement, Singapore was named by the Political and Economic Risk Consultancy for the sixth year running, as constructing the premier judicial system in all of Asia (Singapore Stock Exchange homepage, 2008). The Singapore Stock Exchange is perceived as a professionally regulated market with a strong basis for disclosure. The regulatory approach adhered to by the Singapore Stock Exchange presents an appealing platform for companies to list their stocks on.

Table 1. Total Turnover of the Singapore Stock Exchange

Singapore Stock Exchange		
Total Turnover	Total for 2008	
	Volume '000	Value \$'000
SGX Mainboard (S\$)	209,754,079	272,529,803
SGX Mainboard (Non S\$) + Clob Intl	3,237,933	8,846,934
Total Turnover	212,992,212	281,376,737
SGX Catalist	26,302,432	3,436,075
SGX Xtranet	199,600	1,785,549

Source: Singapore Stock Exchange homepage, 2008

Table 2. Market Size of the Singapore Stock Exchange

Market Capitalization		As of August 2008	
		No. of Companies	Market Capitalization \$'000
SGX Domestic Listings	SGX Mainboard	358	392,531,086
	SGX Catalist	107	4,045,824
SGX Foreign Listings	SGX Mainboard	273	197,960,468
	SGX Catalist	38	2,418,157
SGX Market Capitalization		776	596,955,535

Source: Singapore Stock Exchange homepage, 2008.

As shown above, the Singapore Stock Exchange has both a substantial listing of domestic and foreign companies

trading on the exchange. The Singapore Stock Exchange is much younger than the Chicago Stock Exchange or the London Stock Exchange, but as noted in the tables above, the Singapore Stock Exchange is still relatively large. In terms of performance, the Singapore Stock Exchange displays solid figures in net income, profit margin and return on equity.

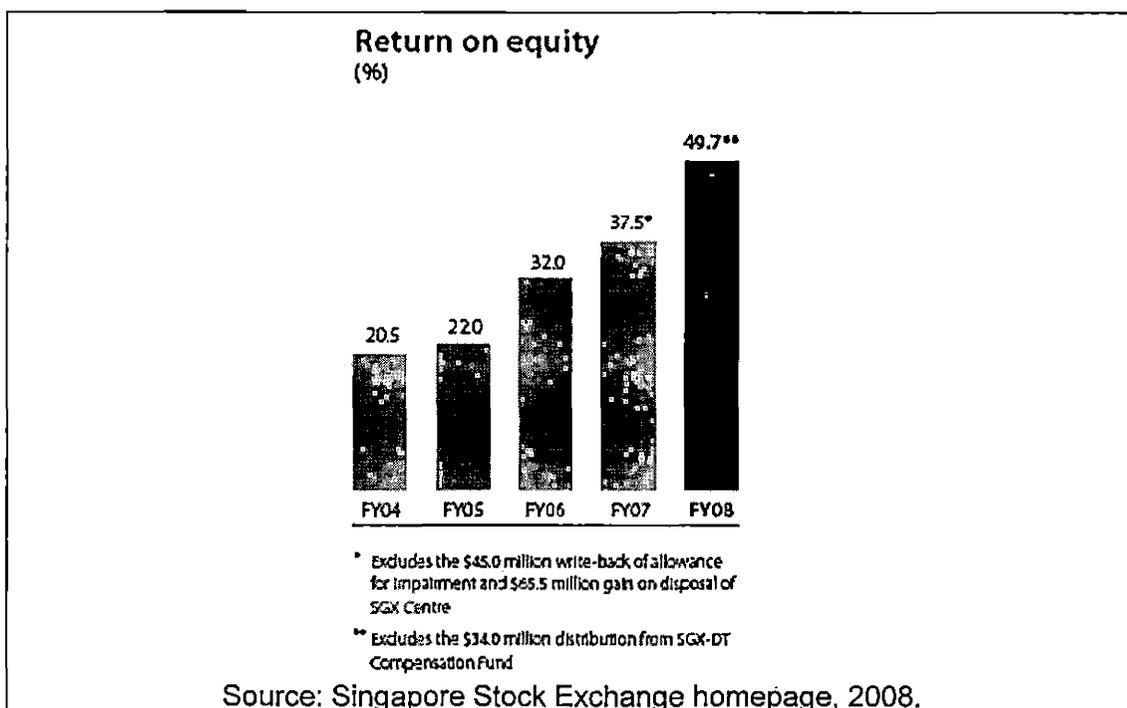


Figure 3. Singapore Stock Exchange Return on Equity

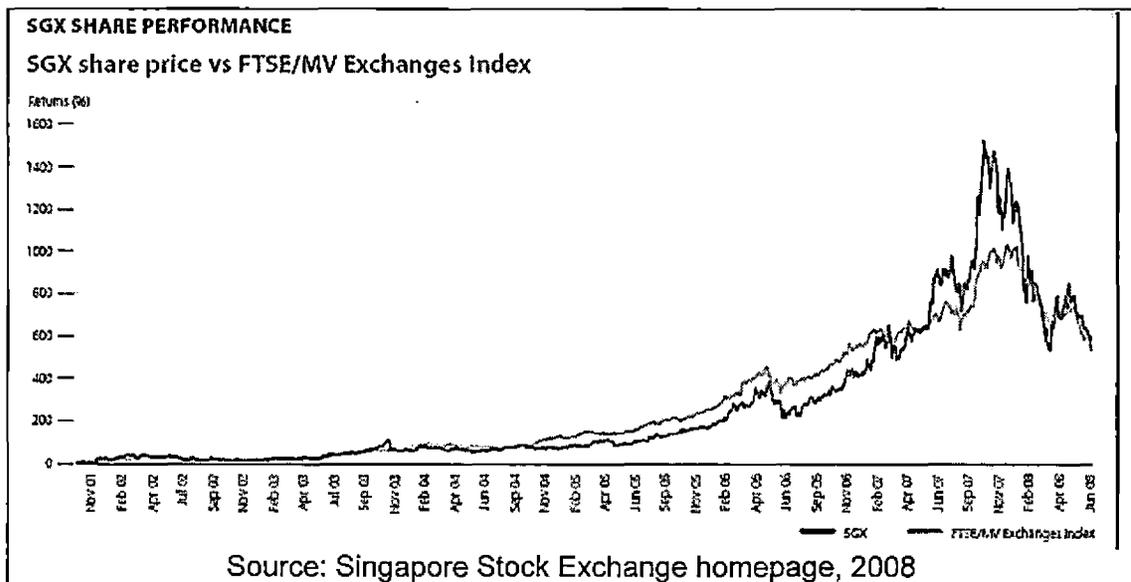


Figure 4. Singapore Exchange Limited Performance

Figure 4, listed above, demonstrates the SGX index has performed similarly to that of the FTSE, the primary index of London. This figure helps demonstrate the competitiveness of the Singapore Stock Exchange relative to other large exchanges around the globe.

The next stock exchange that is examined is the London Stock Exchange. This exchange is one of the oldest in the world. It is possible to trace the history of the LSE back over 300 years (London Stock Exchange homepage, 2008). The London Stock exchange began life in coffee houses throughout London during the 17th century. The stock exchange grew rapidly into the country's most critical institution (London Stock Exchange homepage, 2008).

Currently, this stock exchange is the most international of all the stock exchanges in the world. It consists of 3579 companies from over 60 countries that have been admitted to trading on its market (Figures as of November, 2007). The exchange is made up of two main stock markets; each with unique attributes: The Main Market and the Alternative Investment Market (AIM). The main market is only in use for reputable firms that meet rigorous performance/operational standards set by the London Stock Exchange (Advfn homepage, 2007). Roughly 1,800 of the London Stock Exchange's firm listings are posted to the "Main Market."

The London Stock Exchange, much like the Singapore Stock Exchange is wholly electronically based. Individual shares however, are exchanged on unique systems. Equities classified as very liquid are exchanged utilizing the SETS system which is order driven (Advfn homepage, 2007). The SETS automated system automatically executes orders once a buy/sell match price is determined. The less liquid, less traded securities are on a different platform. These securities utilize the SEAQ system where market makers are present in order to help add liquidity to the securities. These market makers on the SEAQ system must hold shares of particular companies and determine the bid and ask

investments. This ensures that a market for the stocks exists (Advfn homepage, 2007).

In regards to market capitalization, the LSE Main Market has a total capitalization in excess of £3,500 billion. The Alternative Investment Market of the London Stock Exchange has a total market capitalization of £37 billion (London Stock Exchange homepage, 2008).

In recent news for the London Stock Exchange, a computer failure halted trading on September 8, 2008. The timing of this particular event could not have been worse as traders eagerly were awaiting the decision of the U.S. government to bail-out mortgage lenders Freddie Mac and Fannie Mae (Dunkley, 2008). It is speculated that the system crash was partly caused by an overloading attributed to the FTSE 100 falling sharply the previous trading day.

The final exchange examined is the Chicago Stock Exchange. The Chicago Stock Exchange is classified as the 3rd major dynamic equity exchange within the United States compared to that of New York City (Chicago Stock Exchange, 2007). The roots of this exchange trace all the way back to the 21st of March, 1882 at the moment in which the exchange was originally established. In 1949, the Chicago Exchange integrated with the St. Louis, Cleveland and the

Minneapolis/St. Paul Stock Exchanges and was soon referred to as the Midwest Stock Exchange (Chicago Stock Exchange, 2007). Not until 1993 was the new exchange renamed to the Chicago Stock Exchange. In February of 2007, the Chicago Stock Exchange completed its transformation to the New Trading Model platform (Chicago Stock Exchange, 2007).

The New Trading Model utilizes SFTI B2B to aid in the matching of trades and provide a faster, more reliable network for brokers (Chicago Stock Exchange, 2007). The Chicago Stock Exchange previously operated as a membership organization in which a seat on the Exchange implied a partial tenure interest in the exchange, and included the privilege to trade on the exchange floor. Similar to the New York Stock Exchange, this system was recently abandoned. Currently, the Chicago Stock Exchange exists as a wholly-owned subsidiary held by CHX Holdings, Inc., a Delaware corporation (Chicago Stock Exchange homepage, 2008). This transformation occurred on February 9, 2005. The change to the CHX Holdings was fashioned as a for-profit, stock corporation with its shareholders—those who were former member-owners of the Chicago Stock Exchange—having ownership (Chicago Stock Exchange homepage, 2008). Like the other exchanges which were previously described, the Chicago Stock Exchange utilizes

an automated Matching System. This system provides routing to brokers as well as to off-exchange market makers (Chicago Stock Exchange, 2007).

The Chicago Stock Exchange is different than most exchanges. Publically traded companies do not need listing via the Chicago Stock Exchange to be traded on the exchange. Special SEC regulations agree to the exchange trading stocks which are listed on other exchanges. This means that securities with listing on the New York Stock Exchange, the American Stock Exchange and the NASDAQ-Listed Securities are freely exchanged on the Chicago Stock Exchange (Chicago Stock Exchange homepage, 2008). In terms of performance, the Chicago Stock Exchange Holdings Inc. has been operating at a loss. The 2007 income statement exhibits a loss of \$15,007,000 and the 2006 statement demonstrates a loss of \$4,771,000. These figures are a direct result of the new trading model implemented by the Chicago Stock Exchange. It called for significant expenditures over from 2006 to 2008. It is expected though that the changes will significantly increase the competitiveness of the exchange's trading platform and will start producing positive cash flows (Chicago Stock Exchange homepage, 2008).

Primary Research Issues

The research and data that is analyzed in this paper is utilized to determine if a high correlation coefficient exists between market returns for the Singapore Stock Exchange, the London Stock Exchange and the Chicago Stock Exchange. This research will examine the soundness of efficient market hypothesis and test if it is supported or rejected through this study. Efficient market hypothesis asserts that every part of currently accessible information is reflected within stock prices. In the semi-strong form of efficient market hypothesis, this would imply that all historical and currently public information is reflected in the current price of stocks. The implication of efficient market hypothesis is that an investor cannot earn abnormal returns by utilizing an investment strategy that is based on public or historical information (Kim, 2008). In this study, if a high correlation is discovered between the tested markets; it could reveal an infringement of the efficient market hypothesis. This is asserted by the possibility that performance figures in one market could be utilized to predict performance in a different market due to the large time differences existing between Chicago, Singapore and London. A theory known as "Random Walk," asserts stock

performance is affected solely by the unexpected segment of newly arriving information. As new information appears randomly, it should be impossible to predict movements of a stock price according to this theory. Through the research and data analysis in this study, it is my hope to reveal whether or not high correlations of returns exist between the three exchanges that are examined.

Objectives of the Research Paper

One of the main reasons this research is being completed is to discover whether or not there exists relationships in the stock market performance of some of the world's premier markets: the United States, England, and Singapore. In addition to this objective, the long-standing and often questioned efficient market hypothesis will be tested. The majority of studies that deal with the inter-temporal relations between markets test the use of international diversification, risk and return relationships and other related topics. Much like current literature, this paper seeks to determine whether or not relationships between major global equity indices exist. This would help determine the benefits of global diversification as well as the possibilities for arbitrage opportunities.

Uniquely, this paper examines a period of time that is infrequently explored. The majority of studies take place before 2000 and include periods of global economic stability. This paper examines a period in which three major economic events hit the U.S. First, the 1999 tech bubble led to a severe decline of the S&P 500, this was followed by the 9/11 terrorist attack. The final economic crisis includes the sub-prime mortgage/housing crisis of 2008. In addition to the unique period of time examined, this study explores relationships between markets from a number of different angles to see if lead-lag dynamics affect market relationships in variety of ways discussed below. This paper seeks to add to recent literature through these two new contributions.

The first study to truly focus on the concepts examined in this paper was conducted in order to determine whether or not there was a potential that technical analysts (chartists) or traders could look at the Tokyo Stock Exchange as a predictor of market movements in the New York Stock Exchange. According to Koseki, "This is due to the fact that the Tokyo Stock Exchange is 14 hours ahead of the New York Stock Exchange in terms of time and there is an eight and a half hour difference between the two markets' open/close" (Koseki, 2008). If it is

identifiable that there exists high correlation coefficients between open to close returns of the various markets; this may be an indication of a breach of efficient market hypothesis due to the fact that publically accessible knowledge of historical returns in a particular market could then be utilized to generate profitable trading within a different market (Koseki, 2008).

A major difference among this study and other studies performed previously is the fact that this study utilizes current market information through 2008. This includes the period of financial instability that was discussed earlier in this study. This study seeks to perform detailed analysis of recent associations involving the performances of the equity exchanges in the United States, Singapore and England.

Another difference between this study and others that are related is the depth in which the correlation coefficients between the returns of the markets are examined. As mentioned before, this was not really the focus of other studies. This study does not look at correlation coefficients from just one perspective. Different scenarios are implemented to test a variety of angles so that a more in depth look at the relationships

between the various markets can be achieved. Some of the aspects of correlations coefficients examined include nightly returns, open/closing returns, close/opening returns during the present period ($t = 0$), and the previous day at $t = -1$.

This particular study is also unique in that it examines markets that are explored less frequently. Other studies have focused on the Tokyo Stock Exchange (TSE) or the Shanghai Stock Exchange (SSE) and usually the New York Stock Exchange (NYSE). Through deep analysis of the correlation coefficients under a variety of circumstances, it is the hope of this study to provide new insight into the current relationships between the markets that are explored.

Limits of the Research Paper

As detailed as this particular research study may be, there are still multiple variables that could be included to test the correlation coefficients of the various markets examined. There are many additional factors that were explored in previous studies. Most commonly, earlier studies included transaction costs, the impact of currency differences and inflation. These factors are often very

difficult to integrate and require advanced knowledge of statistics and financial models.

Some of the factors that may strengthen the overall study include: the impact of transaction costs, currency, the overall economic status of the countries examined, social factors at play, cultural norms, a variety of uncertainties, regulations, and so forth. All of these factors and more could have bearing on the equity returns of the markets explored.

This study is also has limits in that new data must constantly be gathered and examined to produce accurate results. With markets changing very rapidly and the world shifting towards a global economy, correlation coefficients between the returns of markets are rapidly changing. A study must be performed repeatedly and regularly in order to determine whether shifts in the correlations between market returns are remaining static or are changing. Many companies invest in foreign companies; this helps tie markets together in a sense. Financial crisis in one country can often transfer to other countries as well. With such a dynamic environment, new studies must be conducted to provide the most valid data. A well organized and carefully analyzed study

however can provide significant insight to the relationships between various markets around the world.

A final limitation comes in the amount of data that is examined in this paper. It is suggested that thirty to forty years worth of historical data is necessary in order to identify the relationships between markets of differing countries. Previous studies have had a range of periods in which they examined these relationships. Some studies explored five years of data, others explored ten or more. In addition, some studies utilized daily or even monthly returns. This study however looks at weekly returns, which helps eliminate some of the disparities of daily trading (Wong et al., 2004). Even though the study does not utilize thirty to forty years worth of information, it should utilize a sufficient amount to provide an indication of the relationships between the markets analyzed.

Main Hypothesis of this Research Paper

Financial textbooks and financial analysts assert that if high correlations amongst two markets exist, shareholders can potentially use the return data from one equity exchange as an indicator of the future performance of a different foreign market. The key hypothesis of this

study asserts that no linear relationship exists between the markets that are examined. Given this fact, this study takes that position that the markets explored will be correlated, but not highly correlated to a level which would allow a trading rule based on the publically available information to be developed and to produce abnormal returns for an investor.

Different investors have varying levels of access to publically available information. Even under the assumption that all investors have equal and perfect public information, timing for investors may be different depending on their locale and interconnections among other people or networks. In addition to this, the interpretations of information may be different depending on who is examining it. Not all data is interpreted the same.

Terminology of Efficient Market Studies

- The efficient market hypothesis: A theory which addresses how efficiently markets incorporate information in the current stock prices. There are three varieties of the efficient market hypothesis: weak form, semi-strong and strong form. In the weak form of the efficient market

hypothesis, every part of historically accessible information is argued to be instantaneously and fully reflected in current equity prices. The implication of this form of EMH is that no investor can achieve additional return based on historically accessible information (Koseki, 2008). In the semi-strong form of the hypothesis, all publicly accessible knowledge is asserted to be fully and instantaneously reflected in the current equity value. This form implies that no investor can achieve excess returns based on publicly accessible information (Koseki, 2008). In the final form of EMH, all information, regardless of being public or private, is asserted to be reflected in current equity value wholly and instantaneously. The implication of the strong form of efficient market hypothesis is that no investor, which includes insiders as well, can achieve excess returns as all current information is already reflected in equity prices (Koseki, 2008).

- Abnormal/Excess Returns: The difference between the expected returns of an equity and the actual return of that security.
- $S\&P_t^{o-c}$: Returns from the open to the close the of S&P 500
- LSE_t^{o-c} : Returns from the open to the close of the FTSE 100
- STI_t^{o-c} : Returns from the open to the close of the Straits Time Index (STI)
- $S\&P_{t-1}^{o-c}$: Returns from the open to the close of the S&P 500 at $t = -1$ (previous day)
- LSE_{t-1}^{o-c} : Returns from the open to the close of the FTSE 100 $t = -1$
- STI_{t-1}^{o-c} : Returns from the open to the close of STI at a previous day
- $S\&P_t^{c-o}$: Returns from the close to the open of the S&P 500 at $t = 0$ (current day)
- LSE_t^{c-o} : Returns from the close to the open of the FTSE 100 at $t = 0$
- STI_t^{c-o} : Returns from the close to the open of the STI at the $t = 0$
- LSE: London Stock Exchange or FTSE 100

- S&P: S&P 500
- STI: Singapore Stock Exchange or Straits Time Index (STI)

CHAPTER TWO

PREVIOUS STUDIES OF EQUITY MARKET RETURNS

Literature Review

The primary study that this research is modeled after is the paper "The Intertemporal Relation Between the United States and Japanese Stock Markets" written by Becker, Finnerty, and Gupta (1990). In this study, the authors examined a couple prominent equity exchanges: the NYSE and the Tokyo Stock Exchange of Japan. Their research sought to uncover if return performance relationships between the NYSE and the TSE existed by examining the correlation coefficients among the equity markets of the USA and Japan. Baker, Finnerty and Gupta sought to discover if there would be opportunities to earn excess profits through arbitrage in a particular market by utilizing the return data of a foreign exchange (Koseki, 2008).

In their research, the three authors noted that there was no overlap between the NYSE and the TSE. Tokyo leads the NYSE by fourteen hours. In addition there exists a difference of eight and a half hours between the close of the Tokyo Stock Exchange and opening of the Exchange in New York (Becker et al., 1990). Figure 5 which is located

below provides a more clear understanding of the time gaps existing among the equity markets of the USA and Japan. The exchange located in Tokyo opens at 7 o'clock in the evening EST and closes at 1 o'clock a.m. EST. The Stock Exchange of New York however, opens at 9:30 a.m. EST, and closes normal trading at 4 o'clock p.m. eastern standard time (Koseki, 2008). The implication is that when the New York Stock Exchange trading floor is active, the Tokyo Stock Exchange is closed.

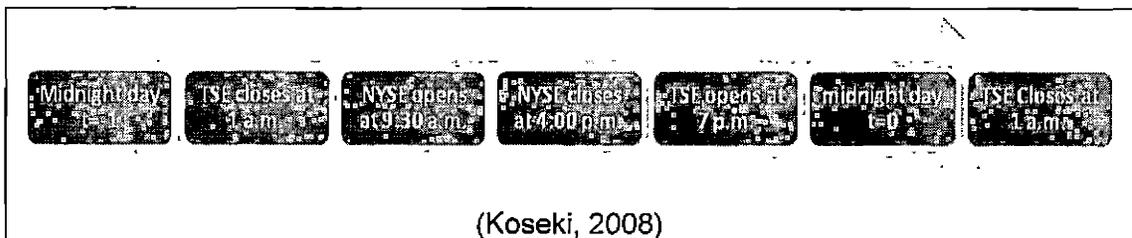


Figure 5. Time Series between Tokyo Stock Exchange and the New York Stock Exchange

Baker, Finnerty, and Gupta (1990) examine O-C (open/close) data for equity market means in the United States of America and in Japan from 1985 to 1988 to explore the synchronization of equity value movements (1990). A primary advantages of utilizing this particular system over solely closing figures was that thorough examinations of exchange efficiency could be initiated where a simulated investor in Japan purchases or offloads

an equity at the opening price, dependent on performance of the United States equity exchange at $t = -1$ (Koseki, 2008).

In their detailed analysis, "The Intertemporal Relation Between the U.S. and Japanese Stock Markets," the authors followed these procedures: "Correlations between the open to close returns were computed for 1) TSE_t^{o-c} and $S\&P_t^{o-c}$, which tests whether the Japanese market leads the U.S. markets, and 2) TSE_t^{o-c} and $S\&P_{t-1}^{o-c}$, a test of the U.S. index leading the Japanese index" (Koseki, 2008). In order to establish how open to close return performance in a particular market is related to close to open returns in the other market which was examined, these correlations were calculated: 1) S&P 500 open/close at $t = -1$ and the close to open returns for the TSE at the $t = 0$ —this determines how the returns of the New York Stock Exchange affect the Tokyo Stock Exchange close to opening returns, and 2) $S\&P_t^{c-o}$ and TSE_t^{c-o} (Becker et al., 1990). This research study, borrows many of the concepts and methodologies utilized by Baker, Finnerty, and Gupta. To complete this study, data for index prices were collected utilizing the Yahoo Finance website.

An explorative paper produced by Gerald P. Dwyer and R.W. Hafer also has bearing on this subject. These authors

researched the relationships existing amongst the movements of equity prices indexed between Germany, the United Kingdom, Japan, and the U.S. between July of 1987 and January of 1988 (Dwyer & Hafer, 1988). Dwyer and Hafer examined the belief that stock market return performance following the "October crash" of 1987 reflected the reality that equity exchanges located around the globe would shift dissimilarly.

Unique to their paper, the authors asserted their opinion that the transaction expenses which are associated with purchasing and selling securities are fairly minute and trivial due to rapid and innovative developments in communication; while a number of scholars highlighted the results of transaction costs solely (Koseki, 2008). As advances in information technology occurred on greater levels, it quickly became evident that these advances assisted corporations in achieving lower transaction expenses. Dwyer and Hafer determined that transactions costs are insignificant when examining the relationships of return performance between various markets around the world. With this in mind, this study also considers transaction costs to be insignificant for this particular scenario. The authors concluded that the degrees of equity price indexes varied depending on which nations were

examined. The final results of their study demonstrated that equity price movements need not be related to one another (Dwyer and Hafer, 1988).

In the paper "Analysis of the Currency Impact in International Investment," researched by John Manley and Anand Shetty (2006), the authors examine the impact of currency on a variety of venture aspects including: volatility, comovements, and earnings; at the same time seeking to uncover the profits of international diversification. They collected and analyzed monthly statistics on equity indices and exchange figures between the years 1988 and 1997 in order to carry out their study. The authors noted in their research that infusing funds in a foreign equity exchange was not the same as buying stocks within a foreign exchange (Koseki, 2008). A primary assertion in their research was that adding funds to a foreign equity exchange was affected not only by the returns of the out-of-state equity exchange but also the overseas currency as well. This research helped trail blaze the importance of currency impacts on equity exchanges (Koseki, 2008).

A key disparity amongst their study and previous studies is their strong emphasis on the effect that currency plays when examining the relationships between

foreign markets. Currency should be addressed whether one is exploring volatility relationships or analyzing correlation coefficients between markets.

A research study conducted by Joseph E. Finnerty and Thomas Schneeweis (1979) examined the weekly co-movement of long bond performances and international equity for 9 nations. The final figures of their analysis revealed miniscule co-movements existing amongst the United States and foreign equity exchanges which were involved in their study. In addition, their paper demonstrated the vitalness of compensating for currency rate movements before conducting further analysis. This particular principle is adopted in the research that is conducted in this study (Koseki, 2008).

In a research study conducted by Eric Brandhorst, CFA (2002), Brandhorst emphasized that few investors questioned the benefit of foreign diversification around the 1990s. As of late, investors are more educated with regards to diversification. A majority of investors realized diversifying their portfolios into foreign markets would provide risk exposure reductions so long as the stocks held abroad were not absolutely correlated (Koseki, 2008). In addition, his study tested whether international diversification worked well by use of

analysis of yearly returns, wealth, risk, and co-movements. In his study, Brandhorst states previous studies discovered correlations among U.S. and foreign exchanges averaging 0.5 over the periods examined. The author's study showed that correlation ranged from 0.1 to 0.8 (low to high correlations) (Eric Brandhorst, 2002). Brandhorst asserted that the correlation between the United States and foreign exchanges moved in tandem when abnormal market activities, like the 1987 crash, the Gulf War, and the 1999-2000 tech bubble for instance occurred (Koseki, 2008). In all, he concluded that the use of foreign diversification in a portfolio helped to lower the overall risk of the portfolio (Brandhorst, 2002).

In a study conducted by Patricia Chelley-Steeley, Chelley-Steeley (2005) explains volatility and serial correlation in terms of open/close percentage returns. An examination of the FT-30 components examined the performance of open/close returns for the particular index (2005). Chelley-Steeley asserted that a speed difference exists between the close and opening returns of indices reflecting the incorporation of new information. This disparity in speed led to the difference in return performance. The author concluded that open returns often

reflected over-reactions while close figures usually demonstrated characteristics of an under reaction.

A 2004 study called "The Relationship Between Stock Markets of Major Developed Countries and Asian Emerging Market," by Wing-Keung Wong, Jack Penm, Richard Terrell, and Karen Yann Ching Lim (2004) provides some inside into the relationships between develop and emerging market return performance. In this study, the authors examined data from developed countries consisting of Japan, the U.K., and the USA. Emerging markets consisted of Malaysia, Thailand, Korea, Taiwan, Singapore, and Hong Kong.

In their study, the authors collect weekly data from the major indices for each of the countries mentioned above; all of which is expressed in terms of local currencies. The data they utilized was compiled from Datastream and covers a period from January 1, 1981 through December 31, 2002. This study argues from the use of weekly performance in order to eliminate the problem of non-synchronous trading that occurs when daily indices are in use. The authors assert that an erroneous representation of the true relationships among markets may result if daily indices are used (2004). The true purpose of the study conducted by Wong, Penm, Terrell and Lim was to examine the relationships that exist between the return

performance of markets and to test the true benefits that are achieved from international diversification in a portfolio of securities. The authors assert that the benefits of an internationally diversified portfolio would be limited if the national equity markets tended to move together over the long run. From their study, it was observed that there has been increasing interdependence between most of the developed and emerging markets since the 1987 Stock Market Crash. This interdependence intensified after the 1997 Asian Financial Crisis which occurred only a decade later. The authors conclude stating that with the phenomenon of increasing co-movement between developed and emerging stock markets, the benefits of international diversification become limited.

A research paper titled, "The Intertemporal Stability of the Relationships Between the Asian Emerging Equity Markets and the Developed Equity Markets," by Yan-Leung Cheung and Yan-Ki Ho (1991) examines correlations between markets of developed countries and those of emerging Asian countries. This 1991 study is conducted with data compiled from 1977 to 1988. Their study utilizes weekly information that was compiled using return data from the major indices of the countries that were examined. Their results showed that a strong benefit from international diversification

could be achieved by investing in Asian emerging markets for the period that was analyzed. They also noted that the correlations between developed countries was much higher than the correlations between emerging and developed markets.

Another study that was examined was titled, "Behaviors of the Stock Indexes—Correlation Analysis For the Stock Markets of Japan, The United States, and China," and was conducted by Kazuma Koseki (2008). This 2008 study examines the correlation coefficients that exist between the exchanges in China, Japan and the United States (Koseki, 2008). In his paper, Koseki compiles daily index return data for each of the three countries mentioned above. He examines their return relationships under a variety of circumstances.

The main focus of Koseki's study is to answer whether or not efficient market hypothesis is correct by testing whether excess returns can be earned by looking at performance in foreign markets. His paper utilizes correlation coefficients that are examined under a variety of different scenarios. In addition, he utilizes both local and common currencies to ensure that currency does not skew the results of his study.

Koseki's study revealed that in most cases, the returns amongst the NYSE and the Tokyo Stock Exchange were somewhat correlated (Koseki, 2008). It was his conclusion however that his research did support the efficient market hypothesis. In his examination of returns between the NYSE and the Shanghai Stock Exchange, he noted that the two markets were non-correlated a majority of the time; thus providing additional support for the efficient market hypothesis (Koseki, 2008).

A study titled "Comovements in International Stock Markets," by Claudio Morana and Andrea Beltratti (2004) examines monthly realized moments for stock market returns for the U.S., the U.K., Germany and Japan (2004). This paper assesses the linkages holding across moments and markets over the period 1973-2004. In this study, Morana and Beltratti assert that evidence of a positive and non-spurious linkage between volatility and correlation, and a trend increase in correlation coefficients over time is found. Through their research, they demonstrate that a progressive integration of the four stock markets has occurred over the period examined; this has led to increasing comovements in prices, returns, volatilities and correlations. The authors discovered that the

comovements of stock returns was especially strong between the US and Europe.

In his work titled "Equity Market Price Interactions Between China and the Other Markets Within the Chinese States Equity Markets," Gary Gang Tian (2008) examines the cointegrating and long-term casual relationships of equity market prices in equity markets of Chinese states including: Shanghai, Shenzhen, Hong Kong, Taiwan and Singapore. This particular study focuses on a period between October 5, 1992 and March 20, 2006. This covers both the Asian financial crisis and the opening-up of China's equity markets in recent years. Tian utilizes a method created by Johansen (1988) to analyze the cointegration of the markets explored. Through his analysis, Tian reveals that a long-term equilibrium relationship measured by cointegration has been established among Shanghai, Shenzhen, Hong Kong and Taiwanese markets (2008). In addition, his study examines causality by exploring the bootstrapped Toda-Yamamoto non-causality tests. Utilizing this method, Tian found that there is strong evidence of a bi-directional causality between Shanghai and Shenzhen markets after 1998. Over time, his study showed that the connections

between markets strengthened; as confirmed by other studies discussed previously.

Abbas Valadkhani and Surachai Chancharat (2008) tested ties amongst Thai markets and other equity markets in their paper titled, "Dynamic Linkages Between Thai and International Stock Markets." In their paper, Valadkhani and Chancharat seek, "To investigate the existence of cointegration and causality between stock market price indices of Thailand and the country's major trading partners: Australia, Hong Kong, Indonesia, Japan, Korea, Malaysia, the Philippines, Singapore, Taiwan, the UK, and the USA" (Valadkhani, 2008). The authors utilize monthly return data from December 1987 to December of 2005. The approach they utilize is a combination of the Engle-Granger two-step method and the Gregory Hansen assessment (Valadkhani, 2008). Their research reveals that, "Potential long-run benefits exist from diversifying the investment portfolios internationally to reduce the associated systematic risks across countries. In the short-run however, unidirectional Granger causalities run from the stock returns of Hong Kong, the Philippines and the UK, suggesting a slight cointegration of these markets" (Valadkhani, 2008). In general however, it was

found that relationships between markets were insignificant.

In the paper, "Re-assessing Co-movements among G7 Equity Markets: Evidence from iShares," Mahua Barari, Brian Lucey and Svitlana Voronkova (2006) utilized iShares funds to examine relationships between equity markets. iShares funds are designed to mimic the movements of MSCI stock market indices (2006). iShare data is devoid of problems associated with trading restrictions, exchange-rate fluctuations and non-synchronous trading. The authors apply recent time-varying methodology for the analysis of short- and long-term co-movements; this provides a detailed analysis of the dynamics of the equity market linkages over the period 1996-2005. The authors show that increasing conditional correlations and significant time-varying long-run relationships between the US and the majority of other G7 markets since 2001 exists. Their findings suggest that the results of earlier studies based on stock market indices should be interpreted with caution and that iShares funds do not represent perfect diversification products.

In the paper, "Time-varying Inter-Market Linkage of International Stock Markets," Hu, Lin, and Kao (2008) examine relationships between markets. They utilize the

Pena-Box model to capture time-varying relationships of the returns of 13 stock indices during 1993-2002 (2008). The results of this study indicate a dynamic relationship of world major stock markets over time. Monthly data is compiled to analyze the relationships between the 13 stock indices which were examined. The model utilized by the authors forms conclusions contrary to many of the previous studies examine earlier. The period examined however was a stable economic environment, unlike the current global situation is.

The paper, "Interdependence between the US and Major European Equity Markets: Evidence from Spectral Analysis," by Ioannis Asimakopoulos, John Goddard and Costas Siriopoulos (2000) utilizes spectral analysis to examine interrelationships between the daily returns generated by the by US and three major European share price indices. Their research showed strong interdependence between the European returns series, as well as a lead/lag relationship amongst the U.S. and each of the European series; best explained by non-synchronous trading (2000). Their research also revealed some evidence of cyclical fluctuations in the return series. The authors indicate that the patterns are similar among the European series for cycles of all frequencies, while similarities between

the US and the European series are evident at low, but not at high frequencies (2000). The data they utilized complete this study ranges from January 1, 1990 to October 31, 1996. They collected daily return information to execute their spectral analysis.

Dennis Quinn and Hans-Joachim Voth (2008) wrote a paper called "A Century of Global Equity Correlations." This 2008 study sought to explain correlations among global stock markets by examining capital account openness. The authors assert that overtime, stock market correlations around the world are not stable. Quinn and Voth utilize regression techniques to examine over the past 100 years both stock market correlations and market openness as reflected through data provided by the International Monetary Fund on exchange restrictions. It was shown through their research that correlations among markets increase when capital is free to flow among nations. They revealed that correlations between certain markets were significant, but overtime, correlations between the majority of stock markets were not stable.

CHAPTER THREE

METHODOLOGIES

Conceptual Foundation

This research paper adopts comparable methodologies that were utilized by past studies. This study examines market returns based on local currencies, much like the study done by Wong et al. (2004). This is applied because the examination of returns already provides a standardized basis when utilizing regression to examine the relationship between the two markets. Unlike Koseki's study, this research examines the relationship that exists between the two foreign markets which are examined as well.

Another point worth mentioning is that to add to the accurateness of the research, weekly market returns are utilized. The study by Koseki utilized daily returns in an attempt to have a larger data set. This strategy however is vulnerable to the influence of some thinly traded stocks. As a result, an erroneous representation of the true relationships among markets may occur (Wong et al., 2004).

When implementing regression analysis, the confidence level, utilized to indicate the dependability of an

estimation, is set at ninety-five percent. This is applied since predicting the parameter using a single value in this type of study is nearly impossible (Koseki, 2008). The coefficient of determination, the R-squared, was calculated in order to demonstrate the amount of variability in the figures examined that could be elucidated by the statistical model itself (Koseki, 2008). In other words, "The coefficient of determination explains how much of the variability evident in the data can be reasonably explained by the statistical model" (Koseki, 2008). With this particular statistical calculation, the greater the coefficient of determination, the more precisely deviation in the data is logically explained.

In regression analysis, the R^2 is a statistical calculation of how accurately the regression line estimates the actual data series in the set of data (Kim, 2008). An R^2 value of 1.0 shows the regression line exactly matches the data explored. In this particular study, R-squared rises as the amount of variables in the model rise (Koseki, 2008). R-square will not diminish with the rising number of variables. This presents a downside to one possible use of R^2 ; a person may attempt to include a large amount of variables in a model they utilize until no additional improvement can be achieved (Koseki, 2008).

This fault has led to an alternate method which involves analyzing the adjusted R^2 . This particular statistic is explained in a very similar fashion as the R-square value, except it penalizes the value as additional figures are added in the model (Investopedia.com, 2008). Standard errors, which demonstrate the differences amongst the predicted values of standard deviation and the actual values of standard deviation, are provided as well (Koseki, 2008).

Another important point is that the following time differences occur between the markets. The Chicago Stock Exchange opens for trading at 9:30 a.m. Eastern Standard Time and closes at 4:00 p.m. Eastern Standard Time. The London Stock Exchange opens at 7:00 a.m. GMT and closes at 3:30 p.m. GMT. The Singapore Stock Exchange opens at 9:00 a.m. and closes at 5:00 p.m. Singapore time. When converted to EST, it is evident where overlaps exist between the foreign markets and the US markets. The London Stock Exchange opens at 2:00am EST and closes at 10:30am. This allows a 1 hour trading block in which both exchanges are open. The Singapore stock exchange however opens at 8:00pm on $t = -1$ (the previous day) and closes at 4:00am on the same day. This asserts that the Singapore Stock Exchange is far enough ahead of the Chicago Exchange so

that there is no overlap between the Chicago Stock Exchange and the Singapore Stock Exchange.

This paper follows these steps:

Methodologies Utilizing Local Currencies

- 1) Weekly open prices and close prices of the Straits Time Index (STI), S&P 500, and FTSE 100 from September 1, 1998 to current data--September, 2008--was collected utilizing Yahoo Finance.
- 2) $[(A \text{ closing price}_t - A \text{ n open price}_t) / A \text{ n open price}_t]$ is used to calculate weekly price returns for each stock index for the period explored. "t" indicates time in this case. To calculate a weekly return of the stock indices on September 24, 2008, the opening value of the S&P 500 on September 24, 2008 is subtracted from the closing value of the S&P 500 on September 24, 2008 and then divided by the open price. This step provides weekly returns for the three indices that were examined in terms of change in the return for the period examined. As previously mentioned, weekly data as opposed to daily data is selected to avoid the issue of non-synchronous trading. In addition, weekly data helps smooth some

of the volatility that has been experienced in recent months.

- 3) Close-to-open returns are collected by discovering the close price of one of the indexes at $t = -1$ and the opening value of the index at the $t = 0$, and subtracting the open value from the close value. After this step, the difference is then divided by the closing price to find the change in terms of a percentage (Koseki, 2008).
- 4) Regression analysis is applied to establish the relationship that exists amongst the equity markets.

The Following equations are utilized to run regression analysis. r_{m1} (return of market #1) indicates the dependent variable, while r_{m2} (return of market #2) indicates the independent variable. The dependent variables are listed first.

- Regression Analysis among S&P 500 open-close and London Stock Exchange open-close:

$$\text{Equation 1: } r_{m1t}^{\text{o-c}} = \alpha_L + \beta_L r_{m2t}^{\text{o-c}} + \varepsilon_L$$

- Regression Analysis among S&P 500 open-close and STI open-close:

$$\text{Equation 2: } r_{m1t}^{\text{o-c}} = \alpha_s + \beta_s r_{m2t}^{\text{o-c}} + \varepsilon_s$$

- Regression Analysis among FTSE 100 open-close and S&P 500 open-close at $t = -1$:

$$\text{Equation 3: } r_{m1t}^{o-c} = \alpha_{us} + \beta_{us}r_{m2t-1}^{o-c} + \varepsilon_{us}$$

- Regression Analysis among STI open-close and S&P 500 open-close at $t = -1$:

$$\text{Equation 4: } r_{m1t}^{o-c} = \alpha_{us} + \beta_{us}r_{m2t-1}^{o-c} + \varepsilon_{us}$$

- Regression Analysis among S&P 500 close-open and FTSE 100 open-close:

$$\text{Equation 5: } r_{m1t}^{c-o} = \alpha_L + \beta_L r_{m2t}^{o-c} + \varepsilon_L$$

- Regression Analysis among S&P 500 close-open and STI open-close:

$$\text{Equation 6: } r_{m1t}^{c-o} = \alpha_S + \beta_S r_{m2t}^{o-c} + \varepsilon_S$$

- Regression Analysis among FTSE 100 close-open and S&P 500 open-close at $t = -1$:

$$\text{Equation 7: } r_{m1t}^{c-o} = \alpha_{us} + \beta_{us}r_{m2t-1}^{o-c} + \varepsilon_{us}$$

- Regression Analysis among STI close-open and S&P 500 open-close at $t = -1$:

$$\text{Equation 8: } r_{m1t}^{c-o} = \alpha_{us} + \beta_{us}r_{m2t-1}^{o-c} + \varepsilon_{us}$$

- Regression Analysis among FTSE 100 open-close and STI open-close:

$$\text{Equation 9: } r_{m1t}^{o-c} = \alpha_S + \beta_S r_{m2t}^{o-c} + \varepsilon_S$$

- Regression Analysis among STI open-close and FTSE 100 open-close at $t = -1$:

$$\text{Equation 10: } r_{m1t}^{o-c} = \alpha_L + \beta_L r_{m2t-1}^{o-c} + \varepsilon_L$$

- Regression Analysis among FTSE 100 close-open and STI open-close:

$$\text{Equation 11: } r_{m1t}^{c-o} = \alpha_S + \beta_S r_{m2t}^{o-c} + \varepsilon_S$$

- Regression Analysis among STI close-open and FTSE 100 open-close at $t = -1$:

$$\text{Equation 12: } r_{m1t}^{c-o} = \alpha_L + \beta_L r_{m2t-1}^{o-c} + \varepsilon_L$$

- 5) Excel functions are implemented to identify the correlations in each of the tests.

CHAPTER FOUR

EXAMINING THE FINDINGS AND RESULTS

Analysis Utilizing Local Currencies: United States Equity Market and Foreign Markets

Regression Analysis among S&P 500 Open-Close and London Stock Exchange Open-Close

This analysis examines if the London Stock Exchange in the current period influences the Chicago Stock Exchange returns during the current period. Regression analysis is applied with the FTSE 100 as the independent variable and the S&P 500 as the dependent variable at a confidence level of ninety-five percent in this particular study. To complete the regression analysis, weekly returns were calculated utilizing local currencies. Price figures were collected via Yahoo Finance.

Table 3. Analysis of Equation 1 Utilizing Local Currencies

<u>Equation 1</u>				
Multiple R	0.754529833	<i>F</i>	688.7016	
R Square	0.569315269	<i>Sig F</i>	2.31E-97	
Adjusted R Square	0.568488619			
Standard Error	0.015792316			
Observations	523			
ANOVA				
	<i>df</i>	<i>SS</i>	<i>MS</i>	
Regression	1	0.171760276	0.17176	
Residual	521	0.129935964	0.000249	
Total	522	0.301696241		
	<i>Coefficient</i>	<i>Std Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	0.000263	0.00069056	0.380217	0.70394
FTSE 100 Return	0.815845	0.031087941	26.24312	2.3E-97

Based on the observations above, the regression analysis which examines the ability of the FTSE 100 to predict the returns of the S&P 500, provides some interesting insight. First, the adjusted R square in this study is relatively high compared to other observations which will be examined later in this paper. The adjusted R square is 0.568488619. This indicates that the FTSE 100 can be utilized to predict roughly 56.8% of the variance of the S&P 500. Even though this figure is higher than other correlation tests conducted later, this is still not a significant enough figure to discredit the efficient market hypothesis.

Further examination into the statistical data is necessary with the adjusted R square value that was calculated. Looking to the significance of F, which is equivalent to 0.000, the null hypothesis is rejected on the ANOVA table. The null hypothesis in this study asserts that no linear relationship exists between the two markets that are examined; in this case, the FTSE 100 has no linear relationship with the S&P 500. Rejecting this null hypothesis indicates that an alternative hypothesis (H_A) is necessary to explain the relationship between the data examined.

Further analysis is necessary with the rejection of the null hypothesis from the ANOVA table. Examining the coefficients, it is revealed that the intercept—the constant—is insignificant since the p-value of 0.7039 is greater than the alpha of 0.05. The p-value of the FTSE 100 return on the other hand is significant at 0.000 which also indicates a rejection of the null hypothesis.

This data is consistent with earlier studies completed by Wong, Penm, Terrell, and Lim and also a study by Cheung and Ho. Their research indicated a relationship between the returns of the London Stock Exchange and the Returns observable in U.S. Stock Exchanges. Even though the data shows that the returns of the FTSE 100 do have a

slight relation to the S&P 500, a strong enough correlation amongst the returns of the two exchanges does not exist which would allow a trading strategy to be created in which excess returns can be achieved by examining the returns from the market that closes first—the FTSE 100 in this case. The relationship between the London Stock Exchange and the Chicago Stock Exchange is best explained by the similarity between the two countries in terms of culture, technology and investment strategy. Both markets are long established and share many of the same investment strategies (Wong et. al., 2004). The two countries utilize the same interbank lending figures or LIBOR, and often hold many of the same securities. This makes it so movements in the London Stock Exchange, slightly influence movements in the Chicago Stock Exchange.

Regression Analysis among S&P 500 Open-Close and Straits Time Index Open-Close

To examine if the Singapore Stock Exchange influenced the S&P 500 in terms of returns, regression analysis is performed. This particular test uses the STI as the independent variable and S&P 500 as the dependent variable at a conf. level of ninety-five percent. This test seeks to gain insight on whether the returns from the Strait

Times Index of Singapore can be an indication of the returns of the S&P 500 which opens after the close of the Singapore Stock Exchange, the same day. Data was collected using Yahoo Finance and the results are below.

Table 4. Analysis of Equation 2 Utilizing Local Currencies

<u>Equation 2</u>				
Multiple R	0.47248298	<i>F</i>	149.73499	
R Square	0.22324016	<i>Sig F</i>	1.931E-30	
Adj R Square	0.22174926			
Standard Error	0.02120848			
Observations	523			
ANOVA				
	<i>df</i>	<i>SS</i>	<i>MS</i>	
Regression	1	0.0673507	0.0673507	
Residual	521	0.2343455	0.0004498	
Total	522	0.3016962		
	<i>Coefficients</i>	<i>Std Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	-0.0002677	0.0009288	-0.288169	0.77333
STI Return	0.40484681	0.0330848	12.236625	1.9E-30

The results from the data examining relationship between the returns of the Singapore Stock Exchange and the Chicago Stock Exchange are different from the previous data set. In this analysis which examines a period from September of 1998 to September of 2008, the adjusted R square value was much lower than the study comparing the affect the FTSE 100 has on predicting the S&P 500. For

this data set, the adjusted R square was 0.22174926. This figure is once again, relatively higher than other market relationships that are examined further in this study. Wong et al., assert that the level of foreign direct investment from Singapore, into the United States has helped bring the two markets closer together (2004).

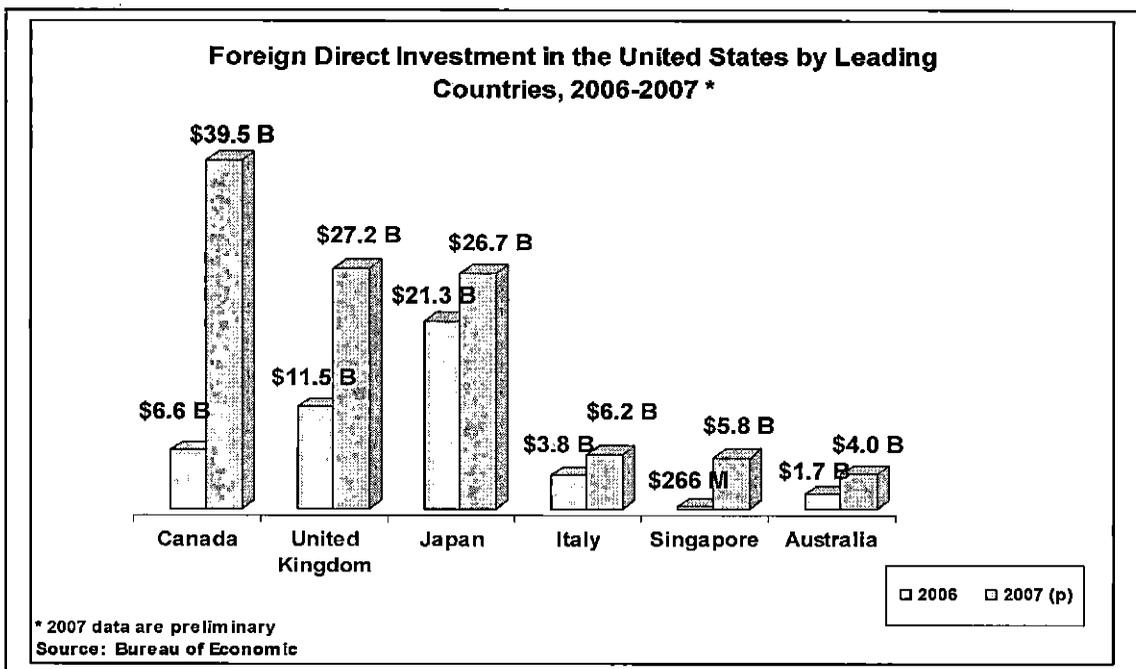


Figure 6. Foreign Direct Investment in the United States

Figure 6, shown above, indicates the vast amount of foreign direct investment that has poured into the United States from Singapore alone. The preliminary estimate provided by the Bureau of Economic Analysis shows a 2,074% increase in foreign direct investment into the United

States from Singapore alone. Even though this increase in foreign direct investment has helped establish a strong relationship between the two markets, the regression analysis reveals that the relationship is still pretty weak. An adjusted R square of only 0.22174926 reveals that the Singapore Stock Exchange is not a strong predictor of the performance of the S&P 500 which opens following the close of the Singapore Stock Exchange.

The Significance of F reveals a value of 0.000 which indicates a rejection of the null hypothesis. This again calls for the creation of an alternative hypothesis in order to explain the linear relationship of the two markets examined. As the previous study revealed, the coefficients also indicate a similar story as the ANOVA table. Once again, the intercept is shown to be insignificant with the p-value exceeding the alpha of 0.05. The coefficient of the return for the Strait Times Index however is significant and also is a rejection of the null hypothesis. With the rejection of the null hypothesis, it is concluded that the Strait Times Index can act as a predictor of the S&P 500, but not in an effective enough capacity to create an investment strategy which would have an investor achieve excess returns. With

this noted, the relationship examined reveals that the efficient market hypothesis is once again supported.

Regression Analysis among FTSE 100 Open-Close and S&P 500 Open-Close at $t = -1$

Regression analysis is applied to determine if lagged U.S. return influences the return of the FTSE 100 in London. This set of data analysis will unveil the co-movements between returns of the LSE_t^{o-c} and returns of S&P 500 at $t = -1$. Data is once again collect from Yahoo's financial section. The regression test in this case is executed with the S&P 500 being the independent variable and London Stock Exchange as the dependent variable. This trial utilizes a confidence level set at ninety-five percent to remain consistent throughout the research study. Returns are computed based on local currency of the United States and England.

Table 5. Analysis of Equation 3 Utilizing on Local Currencies

<u>Equation 3</u>				
Multiple R	0.007484	<i>F</i>	0.02913	
R Square	5.6E-05	<i>Sig F</i>	0.86455	
Adj R Square	-0.00187			
Standard Error	0.022274			
Observations	522			
ANOVA				
	<i>df</i>	<i>SS</i>	<i>MS</i>	
Regression	1	1.45E-05	1.4E-05	
Residual	520	0.257998	0.0005	
Total	521	0.258013		
	<u><i>Coefficients</i></u>	<u><i>Std Error</i></u>	<u><i>t Stat</i></u>	<u><i>P-value</i></u>
Intercept	0.000136	0.000975	0.13963	0.88901
S&P 500 Return	-0.00696	0.040764	-0.1707	0.86455

This particular set of data that is examined provides strong support for the efficient market hypothesis. The first indication is found in the extremely low adjusted R square of only -0.00187. This figure alone demonstrates that the return figures of the S&P 500 during the past week have almost no bearing on the performance of the FTSE 100 in London during the current period. In this case, the S&P 500 in the previous period ($t = -1$), accounts for roughly 0.000% of the variability of the returns in the London market. This is a much different result from the previous two sets of data that were examined. The previous

two studies demonstrated a slight ability of a foreign market to be a predictor of the performance of the S&P 500.

Looking to the ANOVA table for clarification of these results, it is revealed that the significance of F is not significant in this particular scenario. The significance of F is 0.86455 in this study. This indicates that $H = 0$ is not rejected in this instance. The null hypothesis states that no relationship exists amongst the two markets being examined (Koseki, 2008). This indicates that one index is not a good predictor of performance of a foreign market.

In this case, the regression analysis also reveals that the coefficients are not significant. The constant in this case is 0.000136 while the slope population is -0.00696. Both of these coefficients are shown to be insignificant at the ninety-five percent confidence level when the p-values of each are examined. In the case of the intercept, the p-value is 0.88901. This particular figure is greater than the alpha of 0.05 and therefore indicates that the null hypothesis should not be rejected. This indicates that no alternative hypothesis is necessary to explain the results of the data. The p-value for the slope of the return of the S&P 500 is 0.86450, which leads to

the same conclusion as that of the intercept. Combined, the regression analysis for examining the ability of the previous period of the S&P 500 to predict that current period of the FTSE 100, reveals that the efficient market hypothesis is supported. Knowledge of the returns of the S&P 500 do not help investors create a strategy that can be utilized to predict the returns of the markets in London.

Regression Analysis among Straits Time Index
Open-Close and S&P 500 Open-Close at $t = -1$

Regression analysis is once again applied to examine just how the performance of the S&P 500 during the previous period influences the performance of the Singapore Stock Exchange currently at $t = 0$. The statistical analysis is executed with the S&P 500 as the independent variable and the Strait Times Index of Singapore as the dependent variable (Koseki, 2008). The confidence level is set at ninety-five percent to practice consistency throughout the paper. Same as before, returns are calculated utilizing local currencies of the United States and Singapore. The weekly prices were compiled through Yahoo Finance and returns were calculated using excel.

Table 6. Analysis of Equation 4 Utilizing Local Currencies

Equation 4				
Multiple R	0.12783328	<i>F</i>	8.63866854	
R Square	0.01634135	<i>Sig F</i>	0.00343729	
Adj R Square	0.0144497			
Stdd Error	0.02787668			
Observations	522			
ANOVA				
	<i>df</i>	<i>SS</i>	<i>MS</i>	
Regression	1	0.00671319	0.00671319	
Residual	520	0.40409692	0.00077711	
Total	521	0.41081012		
	<i>Coeffs</i>	<i>Std Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	0.00146263	0.00122036	1.19851927	0.231261
S&P 500 Ret	0.14994444	0.05101607	2.9391612	0.003437

This regression analysis reveals that the S&P 500 at $t = -1$ has little predictive value of the returns of the Strait Times Index during the current period. The U.S. stock markets are a better indication of the performance of the Singapore market than they are a predictor of returns in the Market on the United Kingdom. Even with this empirical evidence, it is still shown that the relationship amongst the two indexes is very weak. The adjusted R square in this case is 0.0144497. This demonstrates that the S&P 500 is only able to account for approximately 1 percent of the variability of the Strait Times Index of Singapore.

Examining the results presented in the ANVOA table reveals that the significance of F is 0.00343729. This indicates that further analysis should be complete as the null hypothesis is rejected according to the significance of F. Looking next at the coefficients reveals that the intercept is once again insignificant. The slope of the population, the S&P 500 returns at $t = -1$, is significant however. The coefficient for this figure is 0.14994444 while the p-value is 0.003437. Once again, this indicates that approximately 0.03% of the results are derived from sheer chance in the model. This would indicate that the null hypothesis should be rejected and that an alternative hypothesis be created. The regression analysis indicates that there is a weak linear relationship between the returns of the S&P 500 on the previous period and the STI during the current period.

Cheung and Ho, in their study titled "The Intertemporal Stability of the Relationships Between the Asian Emerging Equity Markets and the Developed Equity Markets," noted that the U.S. markets did slightly influence the market in Singapore. As mentioned before, this is heavily due to the amount of Foreign Direct Investment that Singapore has invested within the United

States. In addition the amount of U.S. Foreign Direct Investment into Singapore also plays a significant role.

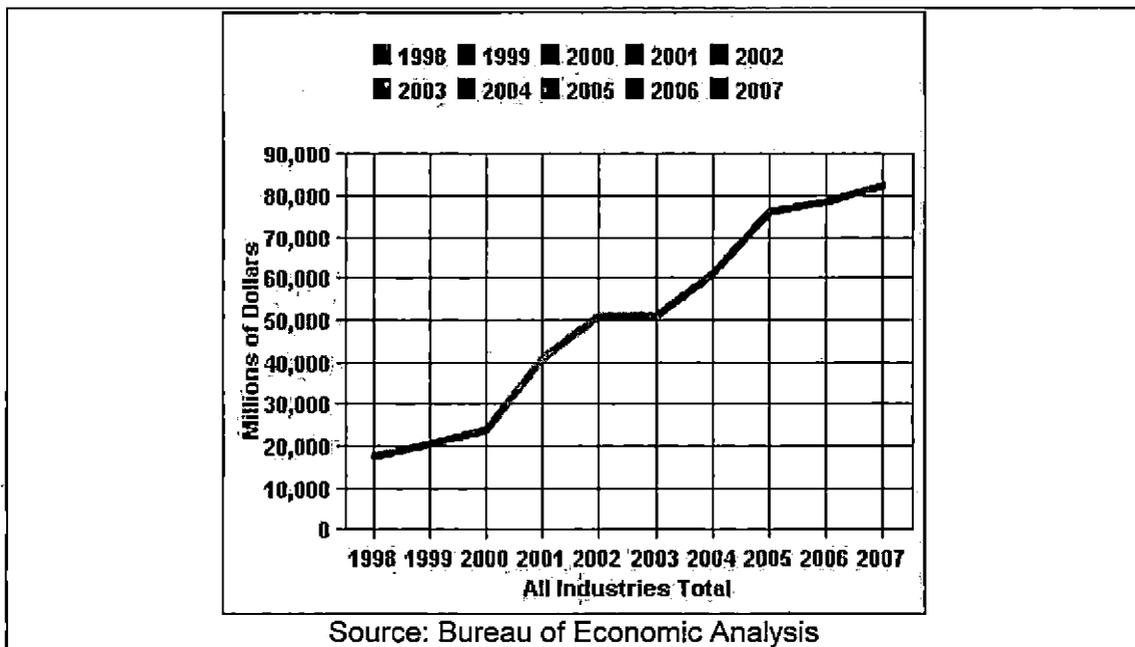


Figure 7. United States Foreign Direct Investment in Singapore

Figure 7, shown above, demonstrates the amount of foreign direct investment that the U.S. has invested into Singapore. This figure provides data for the duration of this study. Even though the FDI in both countries plays a role in the connectivity of the two markets, the ability of the S&P 500 to predict the returns of the Strait Times Index is just not significant enough. With such a low adjusted R square value—shown above—the markets are not strong predictors of one another. This indicates that

changes in the returns of the two markets are occurring randomly. This gives credit to the random walk theory as well as the efficient market hypothesis which is examined closely in this research study.

Regression Analysis among S&P 500 Close-Open and FTSE 100 Open-Close

In this next regression study, the influence that the returns of the FTSE 100 have on the close-open returns of the S&P 500 are examined. This trial tests to see if the London weekly returns have bearing on the U.S. close to open performances. If the exchanges are indeed efficient, all publicly available information should be instantaneously reflected in the equity prices. This would assert that when the markets in Chicago opened over a weekend, the performance of the London market already should be built into the opening value of the U.S. market (Koseki, 2008). The regression is implemented with the FTSE 100 as the independent variable and S&P 500 as the dependent variable at the confidence level of ninety-five percent (Koseki, 2008). The same as the earlier studies, the regression analysis was calculated utilizing returns which were computed based on local currency.

Table 7. Analysis of Equation 5 Utilizing Local Currencies

<u>Equation 5</u>				
Multiple R	0.13335567	<i>F</i>	9.414976	
R Square	0.01778373	<i>Sig F</i>	0.002264	
Adj R Square	0.01589486			
Std Error	0.00544527			
Observations	522			
ANOVA				
	<u>df</u>	<u>SS</u>	<u>MS</u>	
Regression	1	0.0002792	0.000279	
Residual	520	0.0154185	2.97E-05	
Total	521	0.0156976		
	<u>Coeffs</u>	<u>Std Error</u>	<u>t Stat</u>	<u>P-value</u>
Intercept	0.00023634	0.0002383	0.991618	0.32185
FTSE 100 Ret	-0.0328934	0.0107201	-3.06838	0.00226

The table above indicates that the FTSE 100 has almost no influence on the overnight returns of the S&P 500. This is best shown by examining the adjusted R square. For this set of data, the adjusted R square is 0.01589486. This shows that just over 1.5 percent of the variability in the S&P 500 is due to the movements of returns in the FTSE 100. As previously mentioned this figure is very insignificant and demonstrates that an investment strategy cannot be created by utilizing the returns of the FTSE 100 to predict the overnight returns of the S&P 500.

Continuing with the analysis, the coefficients in this case are very small figures. As usual, the intercept is shown to be insignificant while the population slope is slightly significant in this case with a p-value of 0.00226. This shows that the figures in the model are not derived from sheer probability and that the null hypothesis in this case should be rejected based on the linear relationship between the two data sets. This indicates that a linear relationship may exist, but with such an insignificant adjusted R square value, the efficient market hypothesis is once again shown to be credible.

The relationship between the returns of the two markets is best explained by the random walk theory and even though some relationship does exist, it is best explained as random movements. The conclusion from this regression analysis is that a trading rule cannot be created to help investors achieve arbitrage returns utilizing the FTSE 100, to predict the returns of the S&P 500.

Regression Analysis among S&P 500 Close-Open and Straits Time Index Open-Close

This regression analysis series examines the effect of the Strait Times Index weekly returns on the S&P 500

overnight return figures. The regression analysis is executed having the Singapore Stock Exchange as the independent variable and the S&P 500 as the dependent variable at a confidence level of ninety-five percent. This set of data is based on local currency.

Table 8. Analysis of Equation 6 Utilizing Local Currencies

<u>Equation 6</u>				
Multiple R	0.1442335	<i>F</i>	11.047543	
R Square	0.0208033	<i>Sig F</i>	0.0009506	
Adj R Square	0.01892023			
Std Error	0.00543689			
Observations	522			
ANOVA				
	<u>df</u>	<u>SS</u>	<u>MS</u>	
Regression	1	0.0003266	0.0003266	
Residual	520	0.0153711	2.956E-05	
Total	521	0.0156976		
	<u>Coeffs</u>	<u>Std Error</u>	<u>t Stat</u>	<u>P-value</u>
Intercept	0.00027518	0.0002383	1.1546765	0.248753
STI Return	-0.0281944	0.0084826	-3.323784	0.000951

The analysis above reveals a similar situation as the previous observation involving the relationship between the London Stock Exchange and the open to close returns of the Chicago Stock Exchange S&P 500 index. The adjusted R square is slightly higher indicating a slightly stronger connection between the USA equity exchange and the

Singapore exchange in terms of the foreign exchange influencing the close-opening returns of the S&P 500 (Koseki, 2008). The adjusted R square value of 0.01892023 is very small and demonstrates an insignificant relationship between the performance of the Strait Times Index and the overnight returns of the S&P 500. This figure once again provides support for the efficient market hypothesis. It demonstrates that the performance of the Strait Times Index of Singapore cannot be utilized to predict the overnight returns of the S&P 500 in the United States.

Regression Analysis among FTSE 100 Close-Open and S&P 500 Open-Close at $t = -1$

In this section of the study, regression analysis is utilized to gauge the influence of the delayed S&P 500 returns on the overnight performance in London. This statistical trial examines if the weekly returns in the United States affected the stock returns in London overnight (LSE_t^{c-o}). If the efficient market hypothesis is indeed credible, all openly available knowledge and data should be instantaneously reflected into the open price of the FTSE 100 so that investors cannot generate arbitrage profits by creating a trading strategy based on the performance of one market (Koseki, 2008). The statistical

analysis is executed with the S&P 500 as the independent variable and the FTSE 100 as the dependent variable at a confidence level of ninety-five percent (Koseki, 2008). The regression analysis is based on local currency in this trial.

Table 9. Analysis of Equation 7 Utilizing Local Currencies

<u>Equation 7</u>				
Multiple R	0.05011864	<i>F</i>	1.309466	
R Square	0.002511878	<i>Sig F</i>	0.253018	
Adj R Square	0.000593632			
Std Error	0.002082919			
Observations	522			
ANOVA				
	<u>df</u>	<u>SS</u>	<u>MS</u>	
Regression	1	5.681E-06	5.68E-06	
Residual	520	0.002256	4.34E-06	
Total	521	0.0022617		
	<u>Coeffs</u>	<u>Std Error</u>	<u>t Stat</u>	<u>P-value</u>
Intercept	0.00014549	9.118E-05	1.59556	0.111195
S&P 500 Return	0.004361997	0.0038119	1.144319	0.253018

The results of this analysis are clear-cut. The adjusted R square value in this trial is 0.000593632. This figure shows a very insignificant relationship between the lagged U.S. returns and their influence on the close to open returns of the London Stock Exchange. This provides

strong support for the efficient market hypothesis and is confirmed upon further analysis of the table above.

The coefficients in this trial are very small in this case. The intercept shows 0.0001 while the slope of the population shows 0.0043. Both of these coefficients are shown to be insignificant by noting the p-values of each. The constant has a p-value of 0.111195 while the slope has a p-value of 0.253018. Both of these p-values are greater than the alpha of 0.05. This indicates that the null hypothesis cannot be rejected. This means that there is no linear relationship between the close to open returns of the FTSE 100 and the lagged returns of the S&P 500. This once again supports the efficient market hypothesis.

Regression Analysis among Straits Time Index
Close-Open and S&P 500 Open-Close at $t = -1$

In this trial, statistical analysis is applied in order to examine the influence of the delayed S&P 500 returns on the overnight return performance in the Singapore stock market. This regression examines if the weekly returns of the United States ($S\&P_{t-1}^{o-c}$) influenced the close to open return performances of Singapore markets (STI_t^{c-o}) (Koseki, 2008). The regression is calculated with the S&P 500 as the independent variable and the Strait Times Index as the dependent variable at the confidence

level of ninety-five percent. In order to complete the regression analysis, returns were computed utilizing local currencies.

Table 10. Analysis of Equation 8 Utilizing Local Currencies

<u>Equation 8</u>				
Multiple R	0.311589433	<i>F</i>	55.914359	
R Square	0.097087975	<i>Sig F</i>	3.24E-13	
Adj R Square	0.095351605			
Std Error	0.00723458			
Observations	522			
ANOVA				
	<u>df</u>	<u>SS</u>	<u>MS</u>	
Regression	1	0.0029265	0.0029265	
Residual	520	0.0272164	5.234E-05	
Total	521	0.0301429		
	<u>Coeffs</u>	<u>Std Error</u>	<u>t Stat</u>	<u>P-value</u>
Intercept	0.00073131	0.0003167	2.3090871	0.0213298
S&P 500 Ret	0.099001294	0.0132397	7.4775904	3.24E-13

In this trial, the efficient market hypothesis is shown to be supported. Similar to the previous trial examining the affect that the delayed S&P 500 returns have on the close to open returns of the London Stock Exchange, this trial also shows an insignificant relationship between the two markets examined. The adjusted R square of 0.095351605 indicates the delayed weekly returns of the

S&P 500 have practically no predictive ability when examining the close to open returns of the Strait Times Index of Singapore. This effectively shows that the efficient market hypothesis has strong credibility.

Further examination of the regression analysis in table 10 reveals that the coefficients are very tiny, indicating only a slight linear relationship assuming both the slope and the constant are significant. In this particular trial, the constant and the slope are shown to be significant as the p-value value of each is less than the alpha of 0.05. This indicates that the results of the regression analysis are not based on chance, thus providing additional credibility to the efficient market hypothesis.

It has been shown so far that the strongest relationship based on local currency is the ability of the FTSE 100 to predict returns of the S&P 500 on the same day. This was evident in the slightly significant adjusted R square value that was present in the first trial. The other trials based on local currency demonstrated either tiny relationships between the two markets or very insignificant relationships. This demonstrates that a trading rule based on the performance of a particular

index will not be useful in predicting the return performance of a foreign market (Koseki, 2008).

Tests Utilizing Local Currencies: Comparison of
the Returns between the Foreign Markets

Regression Analysis among FTSE 100 Open-Close and
Straits Time Index Open-Close

After examining the relationships that exist between the foreign markets and the markets of the United States, it was shown that is almost no predictive value of examining the returns of foreign markets and comparing those to the returns of the U.S. markets. This leads to the question of whether or not a relationship exists between the two foreign markets which were examined in this study. In this first trial, the returns of the Strait Times Index of Singapore are compared with the returns of the FTSE 100 in London to see if the market of Singapore, which closes before the London Exchange, influences the returns of the FTSE 100. In this trial, the returns of the FTSE 100 are the dependent variable and the returns of the STI are the independent variable. This trial utilizes a ninety-five percent confidence level and local currencies to denote the returns.

Table 11. Analysis of Equation 9 Utilizing Local Currencies

<u>Equation 9</u>				
Multiple R	0.52397747	<i>F</i>	197.17729	
R Square	0.27455238	<i>Sig F</i>	3.234E-38	
Adj R Square	0.27315997			
Std Error	0.01895562			
Observations	523			
ANOVA				
	<i>df</i>	<i>SS</i>	<i>MS</i>	
Regression	1	0.070849	0.0708489	
Residual	521	0.187203	0.0003593	
Total	522	0.258052		
	<i>Coeffs</i>	<i>Std Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	-0.0005241	0.00083	-0.631323	0.528106
STI Return	0.41522748	0.02957	14.041983	3.23E-38

The regression analysis in table 11 reveals that there exists a slight relationship between the returns of the STI and the FTSE 100 of London. This is observable in the adjusted R square value of 0.27315997. This shows that approximately 27.3% of the variability of the FTSE 100 is explained by returns of the Strait Times Index of Singapore. While this is a lot stronger relationship compared to most of the other trials conducted earlier in this research, this is still not a significant figure. The regression analysis reveals that the STI is not a sufficient predictor of the FTSE 100.

The significance of F indicates the rejection of the null hypothesis since the figure is greater than 0.05. This indicates that there is a linear relationship between the STI and the FTSE 100. This result is consistent with the value of the adjusted R square. The coefficient of the slope has a value of 0.41522748 and a p-value of 3.23E-38, which indicates that the slope coefficient is significant. This significance implies a rejection of the null hypothesis as well. This is consistent with other data mentioned in the table and again demonstrates that a slight linear relationship exists between the FTSE 100 and the STI of Singapore. This relationship however is insignificant in terms of creating an investment strategy. A much higher adjusted R square value would be necessary in order to provide any predictive capabilities between the markets.

Regression Analysis among Straits Time Index
Open-Close and FTSE 100 Open-Close at t = -1

This trial is utilized to determine whether the lagged London Stock Exchange returns will influence the Singapore Stock Exchange return performances. In this trial, Singapore's Strait Times Index is the dependent variable while the FTSE 100 of London is the independent variable. If the Efficient Market Hypothesis is indeed

supported, the results of this test should indicate an insignificant correlation between the two markets. This trial is completed at a ninety-five percent confidence level and the returns calculated for the trial are based on local currencies.

Table 12. Analysis of Equation 10 Based on Local Currency

<u>Equation 10</u>				
Multiple R	0.149524	<i>F</i>	11.891706	
R Square	0.022357	<i>Sig F</i>	0.0006096	
Adj R Square	0.020477			
Std Error	0.027791			
Observations	522			
ANOVA				
	<u>df</u>	<u>SS</u>	<u>MS</u>	
Regression	1	0.0091846	0.0091846	
Residual	520	0.4016255	0.0007724	
Total	521	0.4108101		
	<u>Coeffs</u>	<u>Std Error</u>	<u>t Stat</u>	<u>P-value</u>
Intercept	0.001495	0.0012164	1.2291165	0.219584
FTSE 100 Ret	0.189269	0.0548856	3.4484353	0.0006096

This particular regression study shows that only a miniscule relationship exists between the delayed returns of the FTSE 100 and the current returns of the STI of Singapore. This is evident in the adjusted R square value of only 0.020477. This figure provides support for the efficient market hypothesis and indicates that only 2% of

the variability in the Singapore Stock Exchange can be accounted for through the FTSE 100.

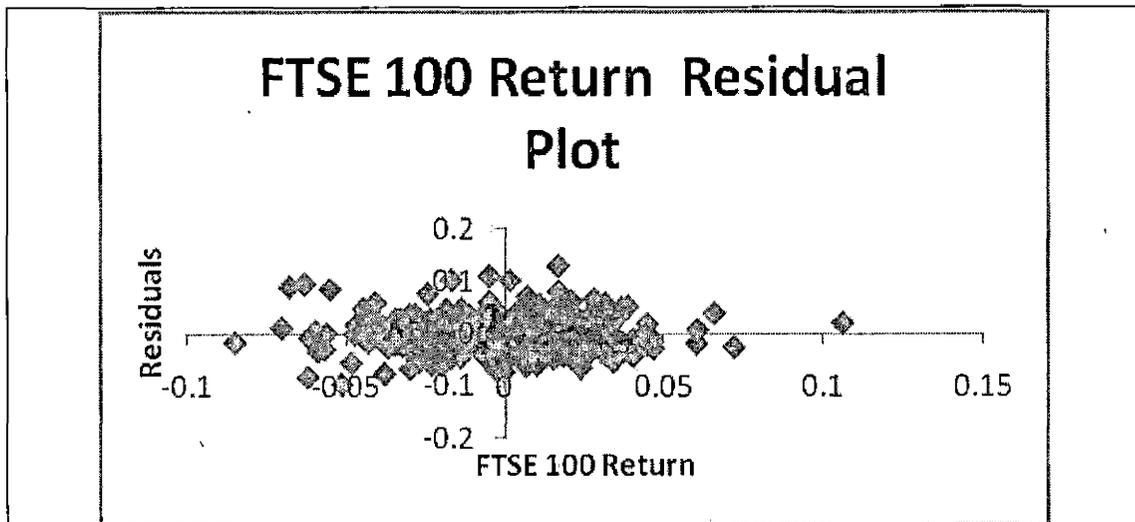


Figure 8. Cluster Analysis for Adjusted R^2 amongst STI_t^{o-c} and LSE_{t-1}^{o-c}

Figure 8 above provides a visual example of the clustering of the two markets. It should be noted that a strong portion of the points in the chart are near the 0 point, indicating a linear relationship does exist, however, the majority of points fall outside of this mark. This is supported when the ANOVA table is examined as well as the coefficients in table 12. In this trial, the value of the constant, as well as the p-value of the constant, is shown to be insignificant. The slope coefficient however is significant, indicating a rejection of the null

hypothesis. This concludes that a linear relationship does exist between the delayed returns of the FTSE 100 and the current returns of the STI. With the adjust R square value so low however, this trial provides support for the efficient market hypothesis. The connections visible between the markets are best explained as random occurrences and indicate that a trading rule cannot be created using this information.

Regression Analysis among FTSE 100 Close-Open and Straits Time Index Open-Close

In this trial, the regression analysis is completed utilizing weekly close-open returns of the FTSE 100 and current weekly returns of the Singapore Stock Exchange using the Strait Times Index (STI). This trial examines the affect of Singapore's weekly returns on the overnight performances of the FTSE 100 (Koseki, 2008). The FTSE 100 is the dependent variable in this trial, while the STI is the independent variable. This trial is conducted at a ninety-five percent confidence level and the returns that were calculated are based on local currencies.

Table 13. Analysis of Equation 11 Based on Local Currency

Equation 11				
Multiple R	0.0454165	<i>F</i>	1.07479918	
R Square	0.0020627	<i>Sig F</i>	0.30034579	
Adj R Square	0.0001435			
Std Error	0.0020834			
Observations	522			
ANOVA				
	<i>df</i>	<i>SS</i>	<i>MS</i>	
Regression	1	4.665E-06	4.6652E-06	
Residual	520	0.0022571	4.3405E-06	
Total	521	0.0022617		
	<i>Coeffs</i>	<i>Std Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	0.0001424	9.132E-05	1.55891742	0.1196243
STI Return	0.0033699	0.0032505	1.03672522	0.3003458

The results of this regression analysis provide superb support for the efficient market hypothesis. To begin, the adjusted R square value in this particular trial is extremely small: 0.0001435. This indicates that the two markets demonstrate almost no correlation. This falls in line with the definition of the efficient market hypothesis.

Continuing with the analysis present in the ANOVA table, the significance of F is actually shown to be insignificant because its value exceeds the value of alpha-0.05. This asserts that $H = 0$ cannot be rejected. This is further supported with the extremely low values of

the coefficients. In addition, both the coefficients of the constant as well as the slope are shown to be insignificant as their p-values both exceed 0.05 or Alpha. This also asserts that the null hypothesis cannot be rejected.

The null hypothesis states that a linear relationship does not exist between the close to open returns of the FTSE 100 and the current period returns of the STI.

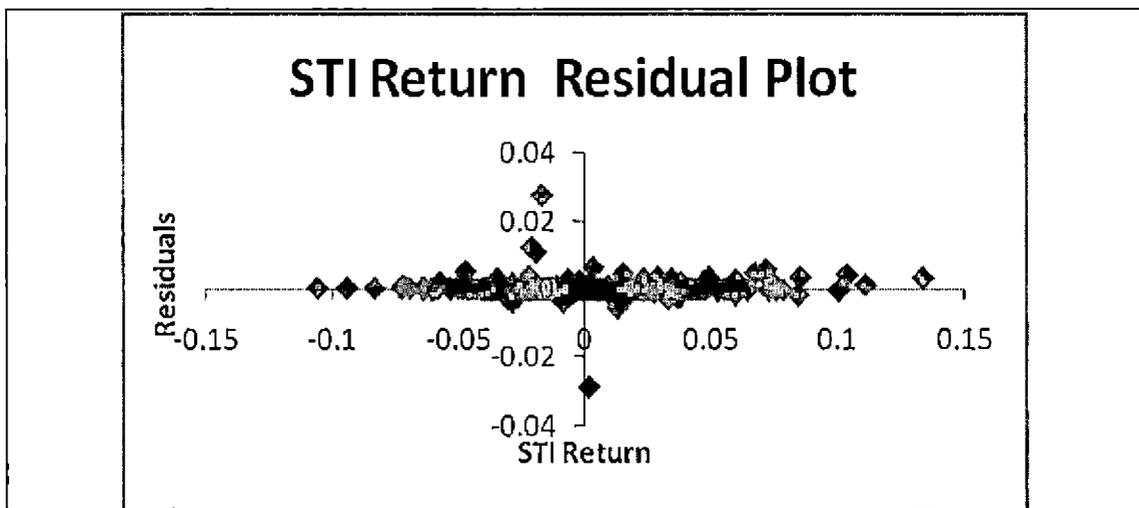


Figure 9. Cluster Analysis of the LSE_t^{c-o} and STI_t^{o-c}

Figure 9, shown above, provides a visual representation of the data contained in table 13. This figure demonstrates that the majority of correlations are spread out and tend to cluster away from the 0 mark. This trial once again provides support for the efficient market hypothesis indicating that a trading rule cannot be

established to predict the returns of a particular index by examining the return performance of a foreign market in a different time zone.

Regression Analysis among Straits Time Index
Close-Open and FTSE 100 Open-Close at $t = -1$

In this final trial, it is examined whether the returns of the Singapore Stock Exchange can be predicted by analyzing the returns of the London Stock exchange during the previous period. Through a number of previous trials, it has so far been conclusive that one market is not a sufficient indicator of return performances for a foreign market. This strongly supports the efficient market hypothesis. This trial is conducted at a ninety-five percent confidence level and is based on local currencies.

Table 14. Analysis of Equation 12 Based on Local Currency

<u>Equation 12</u>				
Multiple R	0.184790927	<i>F</i>	18.384588	
R Square	0.034147687	<i>Sig F</i>	2.152E-05	
Adj R Square	0.032290278			
Std Error	0.007482487			
Observations	522			
ANOVA				
	<i>df</i>	<i>SS</i>	<i>MS</i>	
Regression	1	0.00102931	0.0010293	
Residual	520	0.02911356	5.599E-05	
Total	521	0.03014287		
	<i>Coeffs</i>	<i>Std Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	0.000765032	0.00032751	2.3358833	0.0898765
FTSE 100 Ret	0.063361054	0.01477731	4.2877253	0.4225891

The results of this trial are much like the previous trials that have been conducted. In this run, the adjusted R square shows a value of 0.032290278. Once again, this figure is insignificant and demonstrates that a strong relationship between the two foreign markets does not exist. This result is very similar to the results of the tests base on the Chicago Stock Exchange and the two foreign stock markets.

The Coefficients in this trial are shown to be very small with the constant at roughly 0.000 and the slope with a value of only 0.063361054. This indicates that the constant will not have a linear affect on the values of

the Singapore Stock Exchange and the value of the slope will have only a very tiny affect. Even though this is shown, both of the p-values for the coefficients are insignificant as their values exceed the alpha of 0.05. This asserts that $H = 0$ is not rejected in this trial.

The null hypothesis is not rejected and therefore posits that a linear relationship between the close to open returns of the Singapore Stock Exchange and the $t = -1$ returns of the London Stock Exchange does not exist (Koseki, 2008. This provides support for the efficient market hypothesis.

CHAPTER FIVE

RESULTS AND DISCUSSION

Discussing the Findings for United States and Foreign Equity Exchanges Utilizing Local Currencies

- 1) The impact of Equation 1: This trial indicated that the strongest relationship of all existed between the FTSE 100 and S&P 500. The adjusted R square value on this trial was 0.5684886191. This indicated that the FTSE 100 could be utilized to predict some of the returns of the S&P 500, however the correlation is not strong enough to develop a sound trading strategy that would allow an investor to generate arbitrage earnings. This was consistent with the 2004 study by Wong et al., in which they discovered a slight relationship between these two markets.
- 2) The impact of Equation 2: This trial asserted that a weak relationship existed between the STI and the S&P 500. It demonstrated that the STI could be utilized to predict roughly 22 percent of the returns of the S&P 500. The adjusted R square value of this trial was 0.22174926. This was the second strongest relationship between two markets out of all the trials executed in this study. It is best explained

by the degree of Foreign Direct Investment that Singapore has within the United States. While a greater correlation exists between these two markets than most of the other trials, a figure of 0.22174926 is still rather insignificant and indicates that the efficient market hypothesis remains supported.

- 3) The impact of Equation 3: This trial provided conclusive evidence for the efficient market hypothesis. The adjusted R square value in this study was -0.00187, indicating that no linear relationship between the two markets exists. This asserts that the previous period returns of the S&P 500 are not an indicator of the future performance of the FTSE 100 occurring the following day ($t = 0$).
- 4) The impact of Equation 4: This trial was similar to the results of trial 3. The adjusted R square value was 0.0144496, which indicates a very weak relationship between the markets. While the p-values of this study indicate that a linear relationship does exist, it is shown to be extremely weak. This provides support for the efficient market hypothesis and the random walk theory.
- 5) The impact of the Equation 5: In this trial it was demonstrated that the close to open returns of the

S&P 500 did not impact the standard performance of the London Stock Exchange. The adjusted R square value in this trial was 0.01589486. This indicates an extremely weak influence from the open-close returns of the S&P 500 on the FTSE 100 (Koseki, 2008). The same as before, this trial asserts that the efficient market hypothesis is supported.

- 6) The impact of the Equation 6: This trial examined the effect that the close-open returns of the S&P 500 would have on influencing the standard returns of the Strait Times Index of Singapore. This trial yield results which supported the hypothesis of this paper. The adjusted R square value was 0.01892 which demonstrates an extremely week predictive value between the two markets. This provides support for the efficient market hypothesis and indicates that an arbitrage strategy cannot be created using the close-open returns of the S&P 500 (Koseki, 2008).
- 7) The impact of the Equation 7: This test examined the impact that the close to open returns of the FTSE 100 would have on the predictability of the previous period returns of the S&P 500. It was shown that the adjusted R square value was only 0.000593632. This was one of the weakest relationships that was

calculated throughout this entire study. This weak relationship was further compounded other statistical data that was calculated in the regression analysis.

- 8) The impact of Equation 8: This test examined the impact that the close to open returns of the STI would have on the predictability of the previous period returns of the S&P 500. It was shown that a strong relationship existed between this trial and data from the 7th trial. The adjusted R square value was 0.0953516 compared to the very insignificant adjusted R square value of the previous trial. This figure however is still very insignificant and once again demonstrates that the efficient market hypothesis is not rejected.

Discussion of the Findings for Foreign Markets Utilizing Local Currencies

- 1) The impact of the Equation 9: In this set of trials, the impact that the foreign markets demonstrated on one another was calculated. This particular trial sought to unveil the effects the returns of the STI would have in predicting returns of the FTSE 100 which closes later in the day. The adjusted R square in this trial was 0.27315997. This figure is significant compared to most of the other trials and

shows that 27% of the variability in the FTSE 100 can be explained by returns of the STI. This figure is still not significant enough to create an arbitrage strategy with. This provides support for the efficient market hypothesis since one market is not a clear indicator of returns in the other market.

- 2) The impact of Equation 10: This study in the paper was conducted to test whether the previous period returns of the London Stock Exchange could be utilized to predict current period returns of the Singapore Stock Exchange. The evidence in this trial, much like the other trials, proved that this was not the case. The adjusted R square of this trial was only 0.0204773. This shows that the STI was a stronger indicator of performance in the FTSE 100 than vice versa. The adjusted R square is very weak in this case and demonstrates that the efficient market hypothesis is credible.
- 3) The impact of Equation 11: This trial examined the possibility that the returns of the STI could be utilized to predict the close to open returns of the FTSE 100. This trial indicates that this is not plausible. The adjusted R square in this trial is 0.0001435, which indicates that no relationship

exists between the markets and the conditions laid forth in this trial. This trial provides additional support for the EMH.

- 4) The impact of Equation 12: This portion of the study examined the previous period returns of the FTSE 100 and their impact of the close to open returns of the STI of Singapore. This trial produced an adjusted R square value of 0.032290, which indicates that almost no relationship exists. This figure is show to be conclusive with additional figures generated in the regression analysis.

Comparisons to Previous Research

As noted earlier in this research study, the model utilized was similar to that of Kazuma Koseki's and the model by Becker, Finnerty and Gupta. Slight variations were made however so that the model would be more accurate and hopefully produce better results than previous studies. Unique to this paper, many angles were examined in order to examine possible relationships between markets under a variety of circumstances.

In the paper "The Relationship Between Stock Markets of Major Developed Countries and Asian Emerging Market," Wong, Penm, Terrell and Lim noted that the strongest

return correlations existed between developed markets such as the United States and the United Kingdom. In their study they asserted that this connection was due to the close social and political ties that existed between developed countries as well as the technological resources that were available in their markets. Both the London Stock Exchange and the Exchanges of the United States have been in operation for hundreds of years. This has led to similar concepts and investment strategies between the two countries. In addition, the use of London's LIBOR rate and the amount of foreign investment that both the UK and the U.S. share, has led to a noticeable correlation of the two markets. As this paper demonstrated, the strongest connection was the ability of the FTSE 100 to influence the same day returns of the S&P 500. This was consistent with the paper by Wong, et. al., written in 2004.

In addition, their paper examined the relationships existing between developed markets and those in Asia; including Singapore. In their study, it was noted that a weak connection existed between Singapore and the markets of the United States. This was consistent with the findings of this research paper. In this study it was shown that the Strait Times Index had a weak influence on the predictability of the S&P 500 returns on the same day.

This meant that the Strait Times Index was able to predict some of the returns for the S&P 500, but nowhere near as well as the FTSE 100 was able. Wong, et. al., noted that the degree of foreign direct investment between the United States and Singapore was responsible for the weak connection between the two countries. The foreign direct investment connected some of the assets within each country and caused shifts in one market to be reflected in the other market as well.

The study title, "The Intertemporal Stability of the Relationships Between the Asian Emerging Equity Markets and the Developed Equity Markets," by Cheung and Ho also demonstrated similar results to those of this research study. They concluded that the Singapore Stock Exchange had a weak correlation with the New York Stock Exchange. Their study also demonstrated that the London Stock Exchange and the NYSE demonstrated strong connections with one another. This was also the case with this research study. Cheung and Ho noticed an increasing trend of markets becoming more correlated with one another. Following the Asian Crisis, markets shared more relationships that ever before. This research study helps support this claim by demonstrating that as technologies and trading strategies have changed, markets have begun to

mirror each other more than past years. Koseki's study also demonstrated that will some connections exist between foreign markets and the United States under some circumstances, the efficient market hypothesis is still supported overall. This was the same conclusion that was reached through the analysis in this paper.

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

Summary of the Preceding Test Results

Through the use of regression analysis, this paper sought to explore the current validity of the efficient market hypothesis in its semi-strong form. This form of the hypothesis states that all public and historical information is fully and instantaneously reflected in the price of stocks. The implication of this is that a trading rule cannot be created to generate excess returns based on public or historical information.

This paper demonstrated that the efficient market hypothesis is indeed valid today, much as it was in previous studies. Many different trials were run to check the relationships existing between markets from a variety of different angles. Weekly returns were utilized under local currency conditions in order to run these trials; because these criteria were found to produce the most accurate results according to many previous studies. It was revealed that under the majority of trial, practically no relationship existed between the two markets examined. This meant that the performance of one market was not an indicator of return performance in the other market. The

strongest connection was found to be the influence of the FTSE 100 in predicting the returns of the S&P 500. Even though this trial had the strongest connection, the adjusted R square value was still not significant enough to create a trading strategy based on the intertemporal relation of the London Stock Exchange and the Chicago Stock Exchange. This trial, as well as all other trials, conclusively demonstrated that the efficient market hypothesis and the random walk theory are valid and credible.

A shift toward more interconnected markets is becoming evident however as cultures, technology and investor sentiments are beginning to align throughout the world. This is also compounded by Foreign Direct Investment as well has a trend toward foreign investing. As these properties continue to grow in strength, the benefit from investing abroad could begin to diminish and the foreign markets could become strong indicators of return performance in the United States.

This study aligned with many previous studies that also asserted that markets becoming more correlated with one another. The results from this trial, which utilized data through September of 2008, indicate that the influence of the STI and the FTSE 100 on the S&P 500 has

risen over the last four years from the time that Wong et al., completed their study. While the markets have shown a trend of becoming better correlated with one another, it should be noted that both academically and practically, many anomalies are unexplainable using present financial theories (Lawrence, Edward R., McCabe, George, Prakash, Arun J., 2007). This indicates that some the trend could be attributed to unforeseen relationships, to chance or even problems with the models utilized to examine the correlations between the market returns.

This study has demonstrated consistency with previous studies and has helped reaffirm that the efficient market hypothesis is supported. It demonstrates that diversification is still vital to successful portfolios and that arbitrage opportunities do not exist by examining the returns of foreign markets and attempting to apply that information to the markets of the United States.

Recommendations for Future Studies in this Field

This particular study followed many of the models and methodologies utilized by previous studies in order to see if the efficient market hypothesis is still true today with advances in technology and a general shift toward globalization. This paper demonstrated that utilizing

these tested models and methods that the efficient market hypothesis is still viable in this age.

A recommendation for future studies is to examine factors that traditional models have not considered which could affect the correlations between markets. This would involve the creation of a new model, but it would provide better insight into the relationships of markets and may even reveal new factors affecting the markets. In addition, that majority of studies examine relationships between the largest countries. It is recommended to examine smaller markets that benefit from the intertemporal relationships. If it is discovered that some of the smaller markets are highly correlated, the efficient market hypothesis can be challenged and an arbitrage opportunity could be discovered. This paper sought to examine the relationships between some of the less frequently explored markets, however, the London Stock Exchange is a major exchange and the Chicago Stock Exchange is very similar to the New York Stock Exchange in terms of indexes and product offerings.

A final recommendation is to examine multiple angles when comparing markets. This research study did this when examining the correlations between the markets. There are not clear-cut patterns in this field of research. One must dig deeper and explore a variety of scenarios in order to

provide an interesting and legitimate contribution to this field of research.

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