# THE CONTAGION EFFECT OF THE 2007 GLOBAL FINANCIAL CRISIS ON THE MALAYSIAN STOCK MARKET

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# DEDICATION

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## ABSTRACT

This paper is an investigation on the impact of the 2007/2008 global financial crisis and foreign exchange rateon thestock market of Malaysia,, in two sub periods namely, pre crisis (January 2002 till June 2007) and during crisis (July, 2007 till December 2010).The findings showed that the stock market returns in US and Malaysia were depressed during the period of crisis. The correlation coefficient was strongly significant during the period of the crisis. In addition, multiple regression analysis provided evidence that contagion effectsexistto the Malaysian stock marketdid exist during the US financial crisis, however the foreign exchange rate was not significant during the said financial crisis.



Keywords: Financial crisis, contagion, stock market, Forex

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January 2012

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# CHAPTER ONE

# INTRODUCTION

## 1.1Introduction

This chapter provides a general introduction of the study. It is divided into five parts consisting of background of the study, problem statement, research questions, research objectives, significance of the study and scope and limitations of the study.

## 1.2 Background of the Study

The global financial crisis started in 2007 in the U.S.It began in real estate mortgages; the credit crises arose due to the careless darting in granting facilities and exaggerated estimated value of the mortgaged real estate providing borrowers with guaranteed loans. As a consequence, this led to the disability of many borrowers to repay their debts (Al-Zeer, Al-Khateeb&Areiqat, 2010).

The crisis has not only been affecting the financial markets and the economy of the U.S.A, but it has also spread over the other countries' financial markets worldwide, with no exception to the emerging financial markets. For example, from July 25, 2007 until December 31, 2008, the global financial crisis has severely affected the U.S. stock market as indicated by a decline in the S&P500 index by 40.50 percent. Other stock markets in the advanced and emerging economies have also been affected such as the FTSE100 index of the UK stock market which plunged by 31.30 percent, Nikkei225 index of Japan fell by 50.39 percent, KLSE index of Malaysia decreased by 36.45 percent and Jakarta composite index (JCI) of Indonesia declined by 43.39 percent in the corresponding period (Bloomberg Database, 2008).

The stock market activity is one of the principal activities in the corporate world among the chain of activities and hence, the stock got affected due to the financial crisis. The stock market indices are one of the principal indicators of the economic activities. The movement of stock market indices presents the future economic outlook. A falling stock index reflects the dampening of the investment climate while a rising stock index indicates more confidence and soundness in the economy. The latter attracts more investment demand on stocks and it also raises investment on stocks prices and generates profits.

When crisis affects the real estate activities, it affects the stock market, as profit expectation on financial investments would decrease. If financial investment is affected, its impact would be felt on the real investment, as real investment would not increase. Once the real sector activity lessens, that would affect the entire economy. Thus, the expectation of the investors mainly works affecting both the financial and real investment in the economy.

The integration of global equity markets has been a well-studied topic since the stock market crash of October 1987. Though most of the studies have initially been conducted for the developed markets like the U.S., European countries and Japan, recently, after the Asian crises in particular, literature has started focusing on emerging Asian markets.

This study is an offshoot of Boo Hooi Laing's (2010) study who recommended future studies on the effect of the 2008 world financial crisis on exchange rate to the stock market.

## 1.3 Problem Statement

During times of economic distress, shocks occurring in a stock market can be transmitted among world equity markets, a situation that is commonly known as "contagion". The main question in these cases is, to know how, and to which extent, the impact of contagion will spread across the world equity markets, and more importantly, to understand if there are major differences in relation to a regional *versus*a world market impact (Morales & O`Callaghan, 2010).

Forbes &Rigobon (1999) defined contagion as a significant increase in cross-market linkages after a shock has occurred in one country or a group of countries. According to Forbes &Rigobon (1999), the contagion effect happens when two markets show a moderate degree of co-movement during periods of stability and the shock to one market leads to a significant increase in market co-movement.

The 2007 U.S. financial crisis might have affected developing countries in two possible ways. First, there could be financial contagion and spillovers for stock markets in emerging markets. For example, the global security markets suffered huge losses and Malaysia was no exception. From the14$^{th}$January 2008 till the 12$^{th}$September 2008, a drop of around 670 points (which comes to about 45% of its value) was experienced by the KLSI, which was the main index and market indicator in Malaysia. Such a huge drop was last experienced during the Asian financial crisis of 1997. Moreover, when the global financial crisis hit the Asian equities markets, the decline was even more severe than in the U.S. equity markets with a drop of 27% in Malaysian capital market. The global meltdown in equity markets led to a major decline in Bursa Malaysia which negatively affected investors and consumers. This is because firstly, foreign equity funds in the

whole of Asia withdrew to cover the losses faced by the U.S. Secondly, the economic downturn in developed countries may also have a significant impact on developing countries. According to KLCI info (KLSE INFO, 2009), the Malaysian economy was affected in the fourth quarter of 2008. Exports and industrial output deteriorated and investments declined. Consumer sentiment was also adversely affected. As a result, GDP growth in the fourth quarter of 2008 was significantly lower at 0.1% compared with an average of 5.9% in the first nine months of the year. It is fortunate that Malaysian banks have negligible exposure to securities linked to U.S. subprime loans, and Malaysian financial institutions and banks are in a better shape today than they were during the Asian financial crisis.

Also, the economic downturn in developed countries may also have a significant impact on developing countries through many channels such as Linkages between countries,Remittances; Foreign Direct Investment, Foreign Exchange rate, commercial lending,Aid, and other official flows(Velde and Dirk, 2008).

A small body of literature exists in the Malaysian context. Most previous studies focused on developed markets, and few examined both emerging and developed markets (Majid, M., Kassim, S. 2009;Khoon ,G.S and Mah-hui, M.L 2010; Tambi2005; Pudjiastuti& Mardiyah, 2007; Raghavan, Dark and Maharaj 2010).

It has been observed that there are only few studies in the Malaysian context looking at the contagion of the U.S. stock market impact on Malaysian stock market which is the most recent issue.

Therefore, the aim of this study is to examine whether contagion impacted the Malaysian stock market during the 2007 U.S. financial crisis, and to identify a main channel of impact.

The current study is primarily motivated by two main reasons. First, it is observed that few studies were conducted in Malaysia context which motivated the researcher to carry out the study and see if his findings will differ from the previous studies and second, to examine the impact of the 2007 U.S. financial crisis on integration and co-movements among stock markets.

### 1.4 Research Questions

The main research questions of this study are:

1. Did the 2007 U.S. financial crisis as indicated by US S & P 500 index have contagion effects on the Malaysian stock market?
2. How did the foreign exchange rate (Forex)impactMalaysian stock market?

### 1.5 Research Objectives

The main objectives of this study are:

1. To examine whether contagion effects exist on Malaysian stock market, during the 2007 US financial crisis originated from the US.

   Based on Forbes &Rigobon (2002), Verde (2008) Foreign exchange rate is one of the main channels of contagion between two countries` stock markets.However, there are a number of studies examined the effect of foreign exchange rates on stock market return (Chun,H.2005; Bodnar& Gentry, 1993;Jorion 1990;Kolari,W.

Moorman,C.Sorescu,M 2008).The study uses the foreign exchange rate as one of the factor that impact the stock market returns.

2. To measure the impact of forex onthe Malaysian stock market during the crisis.

**1.6 Significance of the Study**

An accurate assessment of the degree of co-movement among the stock markets is important for several reasons:

- First, for investors - the design of a well-diversified portfolio crucially depends on a correct understanding of how closely the international stock market returns are. In other words, Malaysian and U.S. stock market returns are correlated. Changes in international correlation patterns call for an adjustment of portfolios.
- Second, policy makers are interested in correlations among equity markets because of their implications for the stability of the global financial system.
- Third, monetary policy strategy is also influenced by international stock market developments due to the international propagation of shocks via equity markets, wealth channel, and confidence effects. The global trend towards a greater role of the stock market in the economy has made this type of spillover more important.

**1.7 Scope and limitations of this study**

The main limitations of this study are:

- Many domestic, regional and international factors may influence the KLCI, and yet they are not taken into consideration in this study. The scope of this study is only confined to the three variables; KLCI as dependent variable and two independent variables, S&P500 and foreign exchange rate..

- This study does not consider the effects of psychological factors on the stock markets; Neoh (1991) noted that in the short term, the market is less driven by economic considerations but rather by the psychological perceptions of the stock market players.

The ultimate limitations of this study are in relation to the methodologyused to carry out the analysis. There is a need to perform alternative tests that allow the rigorous verification of obtained results.

# CHAPTER TWO

# LITERATURE REVIEW

## 2.1 Introduction

There are voluminous studies focusing on the issue of stock market integration. Most of these studies, however, focused on the stock markets in the developed countries. For instance, Taylor and Tonk (1989) studied the relationship among the stock markets of the U.S.A, UK, Germany, Netherlands, and Japan, and found that they are getting increasingly co-integrated. Campbell and Hamao (1992) on the other hand, focused on the world's two major stock markets, namely the U.S. and Japanese stock markets and documented greater integration due to multi-factor asset pricing. Other studies include Fischer and Palasvirta (1990), Kasa (1992), Longin and Solnik (1995), and Bracker et al. (1999). There are also increasing bodies of literature on stock market integration in the emerging countries such as in Asia. This includes Ibrahim (2002, 2005), YU.S.of and Majid (2006), and Majid et al. (2008, 2009).

The objective of this chapter is to review the literature on the contagion effects among stock markets of various countries in the world.

Accordingly, the following section focuses on reviewing studies based on the methods used in measuring and examining co-integration and contagion among stock markets.

## 2.2 Literature on measurements of stock markets integration and contagion effects

### 2.2.1 Literature on Co-integration

A large body of literature exists on the equity market integration. Since the seminal work of Grubel (1968), which explained the benefits of international portfolio diversification, the relationship among national stock markets has been analyzed in a series of studies such as Granger and Morgenstern (1970), Ripley (1973), Lessard (1974,1976) and Panton, Lessig and Joy (1976) among others. Following the seminal works of Engle and Granger (1987), Johansen (1988) and Johansen and Juselius (1990), numerous studies beginning with Taylor and Tonks (1989), Kasa (1992) and, subsequently, Masih and Masih (1997, 2002), Chowdhry (1994) and Chowdhry et al. (2007), among several others, have used the co-integration hypothesis to assess the international integration of financial markets. When analyzing linkages among international stock markets, it is of interest to determine if there are any common forces driving the long-run movement of the data series or if each individual stock index is driven solely by its own fundamentals; this relationship can be captured by co-integration analysis.

When markets are said to share a single common stochastic trend, it indicates that these markets are perfectly correlated over long horizons and gains to international diversification will diminish or disappear over the long term. Bekaert and Harvey (1995) point out that a market is completely integrated with the world if its assets have the same expected return with the assets of markets having identical risk level listed in major global markets. In an integrated world, the cross section reward to risk is not important as

it is common to all integrated markets. However, the reward to risk is different for a segmented market due to different risk exposure for each country. In other words, the law of one price can definitely work as the behavior of stock market integration. The nature and extent of financial market integration is thus prominent for investors as it influences international asset allocation potential and portfolio diversification decision.

Accordingly, Malik and Ewing (2009) argue that the increasing integration of major financial markets has generated a good deal of interest in understanding the volatility spillover effects from one market to another. Two lines of thinking have developed as to why these spillovers exist. First, volatility spillovers may result from cross-market hedging and changes in common information, which may simultaneously alter expectations across markets. A second reason given to explain the mean and volatility spillover effect is that of financial contagion, specifically, a shock to one country's financial market. Recently, Engle (2002) develops a dynamic conditional correlation (DCC) GARCH model capable of allowing for conditional asymmetries in both volatilities and correlations. Meanwhile, Kasa (1992) was the first to apply multivariate co-integration method to five well-established financial markets in order to examine the existence of a single common stochastic trend as a driver of the co-integrated system. Using Johansen's test (Johansen and Juselius, 1990) for co-integration, he found a single common trend driving stock markets of U.S., Japan, England, Germany, and Canada, particularly when using quarterly data. According to Kasa (1992), in case of co-integration between equity indices, it is possible that gains from diversification occur in the short term but not in the long term.

Furthermore, Phylaktis and Ravazzolo (2002) applied Kasa's (1992) methodology and examined the potential inter-relationships amongst the trending behavior of the stock price indices of a group of Pacific-Basin countries, Japan and U.S., for the period 1980 to 1998. The paper shows that international investors have opportunities for portfolio diversification by investing in most of the Pacific Basin countries since short-run benefits exist due to substantial transitory fluctuations. Moreover, the estimated common trends showed that although, U.S. markets were found to play a role of smaller magnitude, Japan was found to play a more significant role but neither of the countries had any unique influence in the Pacific Rim stock markets. In a related study, Beine and Candelon (2005) conducted a sample study on 25 developing countries to examine the impact of trade and financial liberalization on the degree of co-movements of the stock markets. They found a positive impact of trade agreements and liberalization on the market linkage between the stock markets. In short, this would imply that trade agreements between countries in a specific regional area or worldwide contributes, to some extent, to the integration of the economies.

There are varied views on the after effect of the Asian financial crisis on the integration of the Asian markets. Ghosh, Saidi, and Johnson (1999) considered whether nine Asia-Pacific markets are separately co-integrated with either the U.S. or Japanese stock market. Their results suggest that while some markets are co-integrated with the U.S., some are co-integrated with Japan, and others are not co-integrated with either. However, they consider daily data covering only a nine month period in 1997. Moreover, Sheng and Tu (2000) discovered that the co-integration relation among 12 Pacific nations, including Taiwan and the U.S., did not exist in the stock markets until the

occurrence of the 1997 Asian financial crisis. The variance decomposition further showed that none of the nations, during the financial crisis, had the exogenous characteristic, which verified the existence of the contagion effect. At the same time, causality tests pointed out that the U.S. indices were the leading factors affecting the stock performance of other nations. Applying vector auto-regression (VAR) to test for causal relationship and to analyze the shock response, Nagayasu (2001) discovered the contagion effect of Thailand's currency crisis that affected the industrial indices in Philippine's stock market via foreign exchange rate.

Darrat, Elkhal and Sam (2000) proved in a study that capital markets throughout countries or regions may have various degrees of integration. The authors also explained that the emerging markets are regionally integrated and thus, each market offers little diversification over another. The authors also examined the pattern and extent to which these emerging markets (Morocco, Egypt and Oman) are linked with international stock markets. Their findings showed that there is integration between those markets, which provides investors with potential diversification gains. Moreover, Eun and Shim (1989) argued that greater stock market integration is a natural consequence of greater economic integration, which gradually takes place. They also argued that the U.S. market has influenced most of the world markets, but no single country had a strong influence on U.S. returns.

In another related study, Pittis and Prodromidis (1998) demonstrated that co-integration and causality inferences are strongly affected by the omission of an important causing variable in the system. Finally, different sample time periods could account for the different findings. Asian stock markets may (or may not) be more integrated with

each other and with the world for various reasons, including extensive stock market liberalization, increased economic integration within the region and with the world, technological advances in communication, and stock market crashes. Stock market crashes such as the one in 1987 have been widely argued to strengthen major international as well as Asian stock market linkages. This study contributes to the literature by comprehensively examining Asian stock market integration using a twelve countries VAR system with different currencies and different sample periods surrounding the Asian financial crisis.

Yang and Lim (2002) in an empirical study of nine East Asian stock markets for the period, January 1990 to October 2000, found some evidence of short-term linkages. Their results indicate that there was a significant difference between sub-periods pre-and during/post-Asian crisis, with an overall improvement of correlation coefficients for each pair from the pre-crisis to the post crisis period, except for Malaysia and Taiwan. Unlike results from short-run tests, there is no long run co-movement among East Asian stock markets, as the absence of co-integration in the post-crisis period rules out the existence of a long-term stability trending relationship among East Asian stock markets.

With regard to studies in Malaysian context, they predominantly depend on the bivariate and multivariate co-integration analysis. The study by AbdMajid and Kassim (2009) uses standard time series methods of co-integration and vector autoregressive (VAR) model to capture the mechanism by which S&P 500 daily returns impact the mean KLCI, JCI returns. Morales & O`Callaghan (2009) compared returns on the S&P 500 with those on 9 countries stock markets returns, namely Indonesia, Malaysia, Thailand, South Korea, India, China, Hong Kong, Singapore, Taiwan and found no evidence of

contagion effect, but found the existence of the interdependencies with Asian markets. Tambi (2005) has examined the financial integration between financial emerging markets (India, Singapore, and Malaysia) and developed countries (U.S.A, UK, Canada).He found that the developed stock markets are segmented and proved that some of the emerging markets have some integration with the developed markets to a limited extent. By using Granger causality relationship and the pair wise, multiple and fractional co-integration, Raghavan, Dark and Maharaj (2010) found that the Malaysian stock market is integrated with the matured markets of the World. Nath and Verma (2003) tested for co-integration between the Nifty, STI and Taiex and found no evidence in favor of co-integration. The study by Raj and Dhal (2008) uses correlation and the vector error correction and co-integration model (VECM) to gauge the integration of Asia`s main stock markets with global markets such as the United States, the United Kingdom and Japan. They examined the co-integration for the period 1993-2008 as well as for the sub-periods 1993-2002 and 2003-2008 with different viz., weekly and daily data sets.

Empirical evidence supports the international integration of Malaysia's stock market in terms of U.S. dollars but not in the local currency; a finding attributable to investment decisions of foreign investors. Correlations of daily stock price indices and returns suggest a strengthening of the integration of Malaysia's stock market with global and regional markets in the more recent period since 2003. There is evidence of the differential impact of regional and global stock markets on the Malaysian market in the long run as well as the short run. The absolute size of coefficients in the long-run co-integration relation suggests that the Malaysian market's dependence on global markets,

such as the United States and the United Kingdom, is substantially higher than on regional markets such as Singapore and Hong Kong.

Innovation accounting in the VECM for the more recent period shows that international market developments at regional and global levels together could account for the mass of the total variation in the Malaysian stock market.

### 2.2.2 Literature on Contagion

There is now a reasonably large body of empirical work testing for the existence of contagion during financial crises. The definition of the term contagion varies widely across the literature. Referring to World Bank classification, we can distinguish three definitions of contagion viz., broad, restrictive and very restrictive definitions of contagion. The most widely used definition, the one by Ghosh, Saidi, and Johnson, is a very restrictive one. This is the one adopted by Forbes and Rigobon (2000, 2002), hereafter referred to as F-R. According to F-R, contagion should be interpreted as a change in the transmission mechanisms that takes place during a turmoil period. The authors identify financial contagion with 'a significant increase in cross-market linkages after a shock to one country (or group of countries)' and defend that such definition presents a number of operational advantages; namely, its utility for financial investors engaged in strategies of international diversification, or for monetary authorities aiming at justifying bailing out interventions in markets affected by foreign crises, but displaying sound fundamentals. Dungey*et al*. (2002) included the possibility of contagion across the Latin American, Asian and Russian credit markets. Their major findings show that the world factor explains most of the volatility experienced by various emerging credit

markets, being largely due to the fact that the emerging countries studied were open economies. Given the strong influence of global factors, their results show that the global factors contribute most to total volatility experienced by emerging credit markets.

The common methods adopted by empirical literatures to test for the contagion effect include the analysis of market correlation coefficients, the GARCH model, the co-integration test, and the probability of event happening. Most of the initial empirical assessments of financial contagion are simple comparative analyses of Pearson' correlation coefficients measured between markets in calm and in crisis periods. Evidence of contagion was reported when statistically significant increases in correlations occurred in periods of crisis. King and Wadhwani (1990), and Lee and Kim (1993) employed the correlation coefficient between stock returns to test for the impact of the U.S. stock crash in 1987 on the stock markets in England, Japan, and several other countries. Empirical findings showed that the correlation coefficients between several markets significantly increased during the crash. Thus, these findings supported the contagion hypothesis that states "if the correlation coefficient increases significantly, the contagion effect exists."

Later studies pointed out a number of methodological problems in linear correlation based assessments and proposed alternative approaches. F-R shows that the correlation coefficient underlying conventional tests for contagion is biased. This correlation coefficient is actually conditional on market volatility over the time period under consideration, so that during a period of turmoil when stock market volatility increases, unadjusted estimates of cross market correlations will be biased upward. This can erroneously lead to accept that contagion occurred. They, while examining contagion

and/or interdependence, explain the interdependence effect through four channels, including trade linkages, policy coordination, country reevaluation or learning and random aggregate or global shocks. This is the so-called crisis-contingent hypothesis. They further exemplified multiple equilibriums, endogenous liquidity, political economy, and other non-pre-hypothesized channels to illustrate the transmissions through non-existent channels in stable times. To account for the bias caused by market heteroscedasticity (the variance of the error terms differ across observation) in the simple correlation, they developed an adjusted correlation coefficient. With these adjusted correlation coefficients, the authors found no significant change in correlation coefficients but interdependence effect was observed during the 1997 Asian financial crisis, the 1994 Mexican crisis, and the 1987 U.S. stock market crisis, among 29 nations including 9 in Southeast Asia, 4 in Central and South America, 12 in OECD, and 4 other new nations.

The application of ARCH and GARCH models in contagion analysis has also been reported. Hamao, Masulis, and Ng (1990) employed the conditional variance estimated under the GARCH model to test for correlations between market volatilities during the 1987 U.S. stock market crisis. It was found that the spread out effects from New York to London and Tokyo and from London to Tokyo were observed among the stock markets in New York, London, and Tokyo.

King and Wadhwani (1990) find evidence of an increase in stock returns' correlation in 1987 crash. Calvo and Reinhart (1996) report correlation shifts during the Mexican crisis. Baig and Goldfajn (1999) find significant increases in correlation for

several East Asian markets and currencies during the East Asian crisis, supporting the contagion phenomenon.

Edward and Susmel (2001) considered the systematic changes and adopted the switching ARCH model. They found that many Latin American equity markets, during the times of high market volatility, were significantly correlated which proved the existence of the contagion effect.

The studies prior to the Multivariate GARCH revolution used conventional econometric techniques including co-integration, causality tests and univariate GARCH models. The GARCH revolution brought out the use of a number of multivariate GARCH models that provide more efficient tools for analyzing co-movements and volatility spillovers between financial assets than the other methods. The estimation of Dynamic Conditional Correlation with Bi-variate GARCH has been in use since the work of Engle and Sheppard (2001) and Engle (2002). This, in fact, proved to provide better description of the data than the Constant Conditional Correlation GARCH model (see Cappiello, Engle and Sheppard, 2003).

Wang et al., (2006) used DCC-Bivariate GARCH to examine the impact of Asian financial crisis on Chinese Economic Area (CEA). Their sample period spans from Feb. 21, 1992 to Nov. 15, 2000. The empirical findings showed that the conditional correlation coefficients of stock returns were positive, and co-movement exists among the Thailand and CEA markets. The Asian financial crisis significantly shocked the stock markets in the region. For all the markets, the variances were higher in the post-crisis period than in the pre-crisis period. The conditional correlation coefficient reported that in the post-

crisis period it increased at a significant level, providing the evidence of the contagion effect.

Forbes and Rigobon (2002) define contagion as "a significant increase in cross-market linkages after a shock to one country (or group of countries). The study of financial contagion was conducted mostly around the notion of "correlation breakdown". Chiang et al. (2007) also applied a DCC model to nine Asian stock markets from 1990 to 2003, confirming a contagion effect. In Egert and Kocenda (2007) the bivariate version of the Dynamic Conditional Correlation GARCH (DCC-GARCH) model shed light on the strong correlation between the German and French markets and also between these two and the UK stock market for a common daily window adjusted for the observed U-shaped pattern for the period from June 2003 to January 2006. By contrast, very little systematic positive correlation can be detected between the French index (which was used as a benchmark for Western European stock markets) and the three Central and Eastern Europe (CEE) stock markets. Kenourgios et al., (2007) applied the asymmetric generalized dynamic conditional correlation (AG-DCC) model to find the correlations of stock markets of four emerging markets namely, Brazil, Russia, India and China (BRIC) with U.S. and UK markets during the periods of negative shocks. The AGDCC results provide evidence for higher joint dependence during stock market crashes. When bad news hit stock markets, conditional equity correlations increase dramatically among BRIC and developed markets. Ahmad, Umer, Mammona, and Shahza (2010) studied the effect of global financial crisis on the Pakistan commercial banking sector. In addition, the study shows the impact of financial crises on the performance of commercial banks along with the policy guidance to enhance the performance of commercial banks.

Furthermore, through multiple linear regression analysis, the study shows that profit is influenced by net investment, net advances and operating fixed assets significantly. Borrowing from financial institution, deposits and other accounts, and number of employees also influence profit but insignificantly. The current financial crisis also negatively impacts profit but insignificantly.

Azeez, and Yetunde (2011) estimated the causes and implications of the global financial crisis on the performance of Nigerian banks with a view to determine the extent of this impact and determining various options that could cushion the impact as well as to avoid future reoccurrence. By using Multiple Regression Analysis, the study illustrates that global financial crisis has a negative influence on the performance of Nigerian banks in defiance of high liquidity possessed by these banks immediately after the consolidation exercise of 2005.

Mathur, Gleason, Dibooglu, and Singh (2002) used Multiple Regression analysis to observe the contagion effect of the 1994 Mexican crisis on the Chilean stocks. The study found that the spillover contagion effects were very efficiently transmitted from the Mexican market to the Chilean market then to the Chilean American Depository (ADR). Also, it shows that the most significant impact on the pricing of Chilean ADR is the raw Chilean index.

Looking at the survey of literature, few studies were carried out on contagion effect in Malaysian context. This study examines this issue and finds whether there exists a contagion effect of the crisis on the Malaysian stock market. The details of Methodology and data are explained in chapter three.

### 2.2.3 Literature on foreign exchange rate (Forex)

Forex also function as a tool that influences stock returns through its effect on both the individual stock level and the market level. On the individual firm level, the sensitivity of the firm`s discounted stream of profits to Forex is dependent on the characteristics of the firm`s liability and asset positions. At the market level, exchange rate is determined through the use of a market equilibrium pricing relationship (Bodnar& Gentry, 1993). Mainly, according to Verde (2008) and Forbes &Rigobon (2002), Forex is one of the main channels or meeting points and/or an interdependence instrument between two countries` stock markets. Khalid and Rajaguru (2006) study and trace the alleged origin, and the subsequent path of the currency contagion using data from a sample of selected Asian countries. In an attempt to study currency contagion effects, nine empirical estimations were used with high frequency data (daily observation) on exchange rates from 1994 to 2002. The researcher split the sample into four periods (full, pre-crisis, crisis, and post crisis periods). To further test the constructs, a multivariate GARCH model was used and Granger causality test was applied to identify the interlinkages among exchange rate markets in selected Asian countries. The evidence suggests that currency links increased during and after the crisis. However, they found weak support for contagion in the pre-crisis period.Kolari,W. Moorman,C.Sorescu,M(2008) examine the relation between the cross-section of USA stock returns and foreign exchange rates during the period from 1973 to 2002. The study finds that stocks most sensitive to foreign exchange risk in absolute value have lower returns than others stock markets.

Lee et al. (2007) examine whether the South-East Asian Tsunami of 2004, as an external and unpredictable shock, influenced the stability of the correlation structure in international stock and foreign exchange markets. Heteroskedasticity biases based on correlation coefficients are used to test for the contagion effects, across twenty two economies. The results indicate that no international stock market suffered contagion due to any crisis situation; however five economies (India, Philippines, Hong Kong, Mexico and Argentina) and three (India, Philippines, Hong Kong) international foreign exchange markets displayed contagion for one to three months after the South-East Asian Tsunami of 2004, respectively. An important result is that contagion effects are more obvious in developing financial markets than those of developed ones. Chun,H.(2005) shows during the Asian financial crisis Thai baht exchange rate led to contagious effects on Asian American Depository Receipts (ADRs) and country fund returns, with contagion also being observed with regard to the volatility of ADRs and country funds in Asia.

The previous studies are conducted in the developed markets,(Japan, Singapore,United Kingdom,South Korea) emerging markets (India, Thailand, Indonesia, Hong Kong, Malaysia, Philippines, Taiwan).

The present study is limited to the contagion effect of the US financial crisis to the stock market of Malaysia,taking into consideration the foreign exchange rate as factor of contagion. Also the study uses a monthly data to investigate whether there is different in the result from the previous studies that used daily data.

# CHAPTER THREE

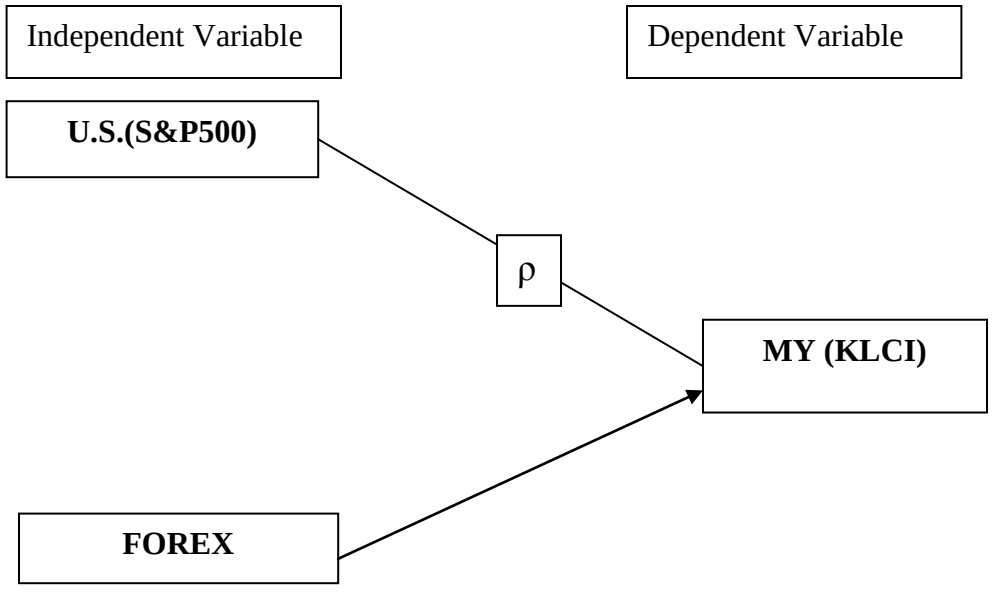
# METHODOLOGY

## 3.1 Introduction

This chapter discusses the theoretical framework of the impact of the 2007 U.S. financial crisis on Malaysian stock market, and explores the hypothesis development. Section 2 is focused on the definition of variables followed by data collection. The final section explains the method of regression analysis.

## 3.2 Variables and Theoretical Framework

The dependent variable is Malaysia stock market (MY), which is expected to be influence by USA. stock market and foreign exchange rate during the period of the crisis. Therefore US and foreign exchange rate are independent variables in this paper. Figure 1 theoretical framework of this study.




**MY** and **U.S.** refer to the stock Markets of Malaysia and the United State of America, respectively .**FOREX** represent Foreign Exchange rate.

**In this study, the hypotheses to be tested are:**

H1 The contagion effect exist between the stock markets of Malaysia and U.S.A stock markets, during the 2007 U.S. Financial Crisis

H2 The foreign exchange rate channel influences stock market of Malaysia during the 2007 US financial crisis.

### 3.3 Variables Definition

1. *The Kuala Lumpur Composite Index (MY or KLCI)*

Stock market indices are used to monitor the direction and size of movements of the prices of quoted securities. They are used as a test for investment performance of the portfolios of both individuals and professional fund managers (Kerridge, 1988).

The KLCI is one of three primary stock indices of Malaysia. It reflects the Malaysian stock market performance and also its economy. KLCI index is often referred to as the local stock market barometer of Malaysia.

There are approximately 650 companies in the Main Board in Malaysia and 100 companies among them are listed in KLCI (MY). The index is a capitalization-weighted index and comprises of the multi sector companies.

The major objectives of the KLCI are: (KLSE INFO, 2010)

- Reflecting the performance of listed companies, which represent the major sectors in the Malaysian economy;
- To ensure providing a standard performance for the Malaysian equity market;
- Reflecting the development and growth in the corporate and economic sectors of Malaysia.

In this study, KLCI is the dependent variable, and it is assumed to be influenced by the independent variables, such as, trading linkages, S&P500, and foreign exchange).

- *Foreign exchange rate (Forex).*

Forex is one of the most important prices in the economy. It is the price of one country's currency in terms of another, and, as such, it converts prices denominated in one currency into prices in other currency.

Forex will influence stock returns through its effect on both the individual stock level and the market level. On the individual firm level, the sensitivity of the firm`s discounted stream of profits to Forex is dependent on the characteristics of the firm`s liability and asset positions. On the other hand, on the market level, exchange rate is via market equilibrium pricing relationship (Bodnar& Gentry, 1993).

Mainly, according to Verde (2008) and Forbes &Rigobon (2002), Forex is one of the main channels of contagion and/or interdependence between two countries` stock markets. The study uses the foreign exchange rate as one of the major channel of the impact to observe the impact of the crisis on the Malaysian stock market.

- *S&P 500 Index (U.S.)*

The S&P 500 Index is an index of 500 stocks chosen for market size, liquidity and industry grouping, among other factors. The S&P500 (U.S.) is designed to be a leading indicator of U.S. equities and is meant to reflect the risk/return characteristics of the large cap universe. Companies included in the index are selected by the S&P Index Committee, a team of analysts and economists at Standard & Poor's. The S&P500 is a market value weighted index - each stock's weight is proportionate to its market value

The S&P 500stock market index, maintained by Standard & Poor's, comprises 500 large-cap American companies covering about 75% of the American equity market by capitalization.

**3.4Empirical Model**

The data obtained were analyzed using ordinary least square (OLS) methods. According To Gujarati (2004), ordinary least square (OLS) is BLUE estimator. BLUE stands for best linear unbiased estimator. To be a best linear unbiased estimator (BLUE) of β's the following must hold:

1. It is linear, that is, a linear function of a random variable, such as the dependent variable Y in the regression model. .
2. It is unbiased, that is, its average or expected value, E (β's), is equal to the true value, β's;
3. It has minimum variance in the class of all such linear unbiased estimators; an unbiased estimator with the least variance is known as an efficient estimator.

OLS is a method for estimating the unknown parameter in a linear regression model. This method minimizes the sum of squared vertical distances between the observation responses in data set, and the responses predicted by the linear approximation.

Since, $\hat{\beta}_i = \frac{\sum X_i Y_i}{\sum X_i^2}$

An alternative expression for computing $\sum \hat{u}_i^2$ is

$$\sum \hat{u}_i^2 = \sum y_i^2 - \frac{(\sum x_i y_i)^2}{\sum x_i^2}$$

In passing, the positive square root of $\hat{\sigma}^2$

$$\hat{\sigma} = \sqrt{\frac{\sum \hat{u}_i^2}{n-2}}$$

The OLS formula is $\hat{\beta}_i = \frac{n\sum X_i Y_i - \sum X_i \sum Y_i}{n\sum X_i^2 - (\sum X_i)^2}$

$$= \frac{\sum (X_i - \bar{X})(Y_i - \bar{Y})}{\sum (X_i - \bar{X})^2}$$

$$= \frac{\sum x_i y_i}{\sum x_i^2}$$

$\hat{\beta}_i = \frac{\sum X_i y_i}{\sum X_i^2}$

$$= \frac{\sum X_i Y_i}{\sum X_i^2 - n\bar{X}^2}$$

$$= \frac{\sum X_i y_i}{\sum X_i^2 - n\bar{X}^2}$$

$\hat{\beta}_1 = \frac{\sum X_i^2 \sum Y_i - \sum X_i \sum X_i Y_i}{n\sum X_i^2 - (\sum X_i)^2}$

$$= \bar{Y} - \widehat{\beta_2}\bar{X}$$

Model (linear)

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \varepsilon$$

Where

*y* = Stock market of Malaysia KLCI (MY)

$x_1$= United States stock Market S&P500 (US)

$x_2$= Foregin exchange rate (Forex)

$\varepsilon$= error term

This study explored two models to examine the relationship between US stock market returns,foregin exchange rate, and stock market returns of Malaysia.

Fristly the period pre the global financal crisis Jannuary,2002 till June,2007.The model tested is:

Model 1: $\mathbf{MY_t = \alpha + \beta_1 U.S._t + \beta_3 FOREX + \varepsilon}$

*MY*= Stock market of Malaysia KLCI

US= United States stock Market S&P500

*FOREX*= Foregin exchange rate

$\varepsilon$= error term

Secandly,The period of the crisis from July,2007 till Decmber, 2010.The model tested is:

Model 2: $\mathbf{MY_t = \alpha + \beta_1 U.S._t + \beta_3 FOREX + \varepsilon}$

The variables are defined above.

### 3.5 Collection of Data

*Sample population*

We used stock price indices of U.S. and Malaysia to compute the stock returns and find the correlation between the two series. MY and U.S. are taken as representatives of

Malaysian and U.S. stock markets respectively. Independent variables include U.S. index and foreign exchange rate; the factors are defined in Ringgit Malaysian value of a unit foreign currency.

*Sampling*

As MY (KLCI) represents hundred main leading Malaysian stocks indices, U.S. (S&P500) represents five hundred main leading U.S. stocks indices, purposive sampling was employed.

The sample period is from January, 2002 till December, 2010 as the pre-crisis period began January 2002 till June, 2007, while the crisis began from July, 2007 and ended in December 2010. Monthly data is collected from Data Stream.

**3.6 Data analysis**

In order to examine the impact of 2007 U.S. financial crisis on Malaysian stock market, this study, after running all the necessary prerequisite tests, used multiple regression technique to investigate and analyse the contagion effects of US stock market and FOREX on the Malaysian stock market in two sub periods namely, pre crisis (January 1, 2002 till June 30, 2007) and post crisis (July1, 2007 till December 31,2010). A number of studies used this method in similar studies (Mathur et al., 2002; Ahmad, Umer, Mammona, and Shahza, 2010; Azeez, and Yetunde 2011; Ruben, 2011 ;).

We used stock returns in the Kuala Lumpur stock exchange (KLCI)and U.S. Stock market composite (S&P500) as representatives of Malaysian and U.S. markets respectively to measure the degree of co-movement. In order to recognize the contagion

effect, we test whether the mean of correlation coefficients in crisis period differs from that in the pre-crisis stable period.

### 3.6.1 Regression Test for Three-Factor model.

Regression model is used to empirically examine the impact of U.S. Stock market composite (S&P500), and foreign exchange (Forex) on Malaysian stock Market (KLCI):

$$\mathbf{MY_t = \alpha + \beta_1 U.S._t + \beta_3 FOREX + \varepsilon}$$

Where:

MY = Kuala Lumpur Stock Exchange Composite;

U.S. = U.S. Stock market composite; S&P500

FOREX = Foreign exchange;

The multiple regression coefficients $\beta_1$, $\beta_2$, and $\beta_3$,measure the net relationship between dependent variable, MY and each of the independent variables (U.S., and foreign exchange). The positive sign indicates that the independent variable favorably affects the dependent variable and a negative sign indicates adverse effect.

# CHAPTER 4

# FINDINGS AND ANALYSIS

## 4.1 Introduction

This chapter consists of three sections. The first section provides the descriptive analysis of the data and variables for the study. The second section discusses the results of the linear regression that constitute the main findings of this study while the last section presents the application of the model.

## 4.2 Descriptive statistics

### 4.2.1 Line plot

The following figures (Fig. 2 and Fig. 3) show the monthly trend series of KLCI (MY) and US S & P500 stock returns before and during the crises.

Figure 2 KLCI (MY) stock returns series monthly

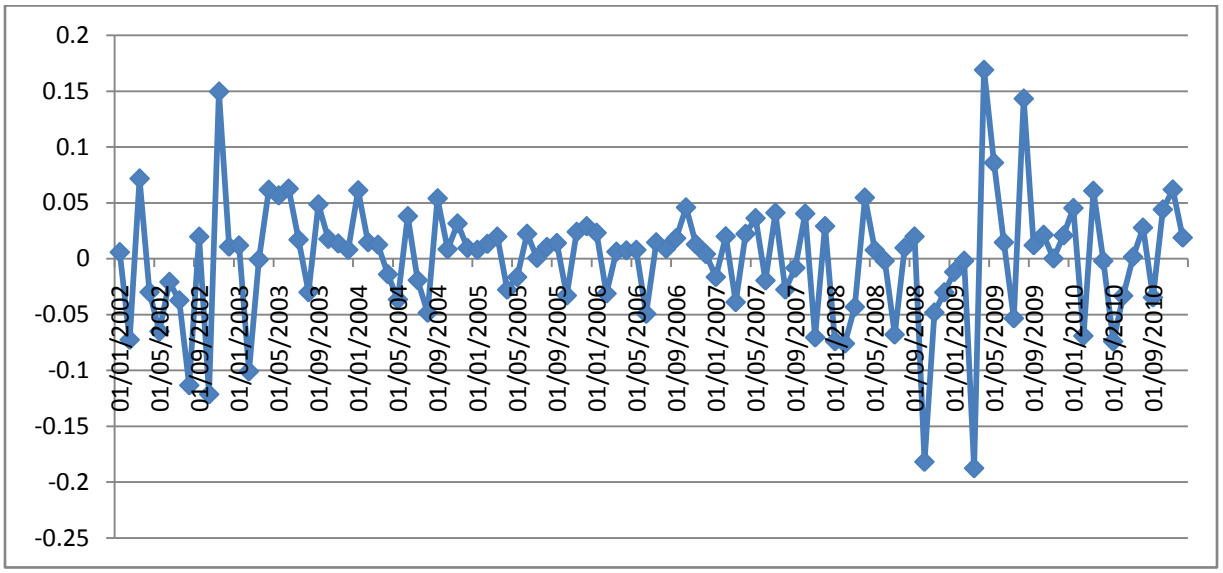
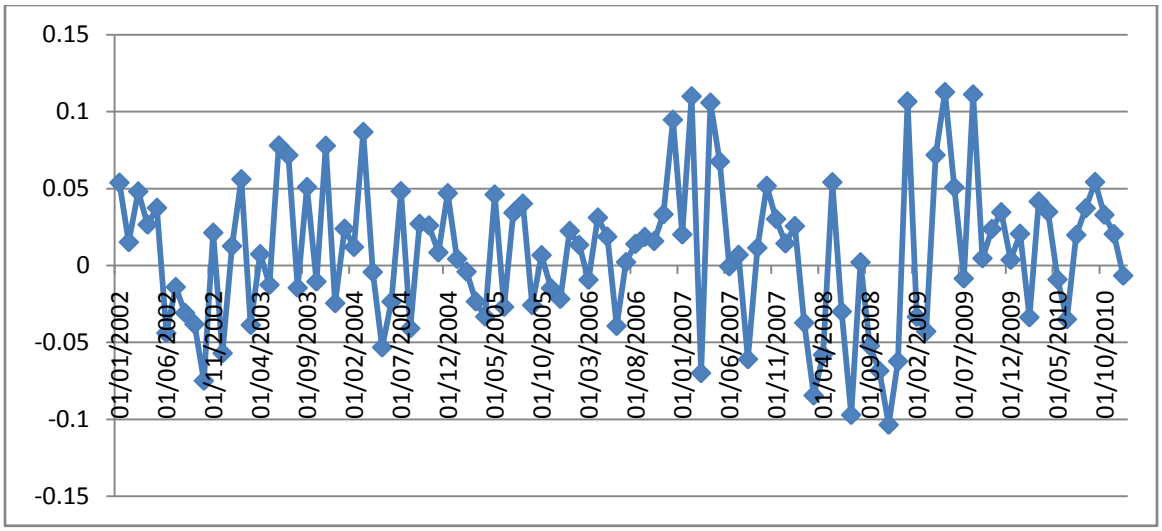


Figure 3: S&P500 (US) stock returns series monthly




'MY' Variable exhibits no trend as it can be seen from the line plot. This suggests that the variable 'MY' exhibits a relatively constant amount of variation around a relatively constant level. The trend line will be a horizontal line indicating no trend. This is neither a decreasing nor an increasing trend.From the graph below, the line plot can be seen to fluctuate erratically, which indicates the time series under analysis is dominated by its cyclical (regular) component as well as seasonal variations. The same can be seen from the US trend series. It follows a similar pattern as does the 'MY' variable. It is showing no trend behavior. This also implies the stationary of the variable at level. This is further illustrated by the graph below.

Figure 4 KLCI (MY) stock returns series yearly

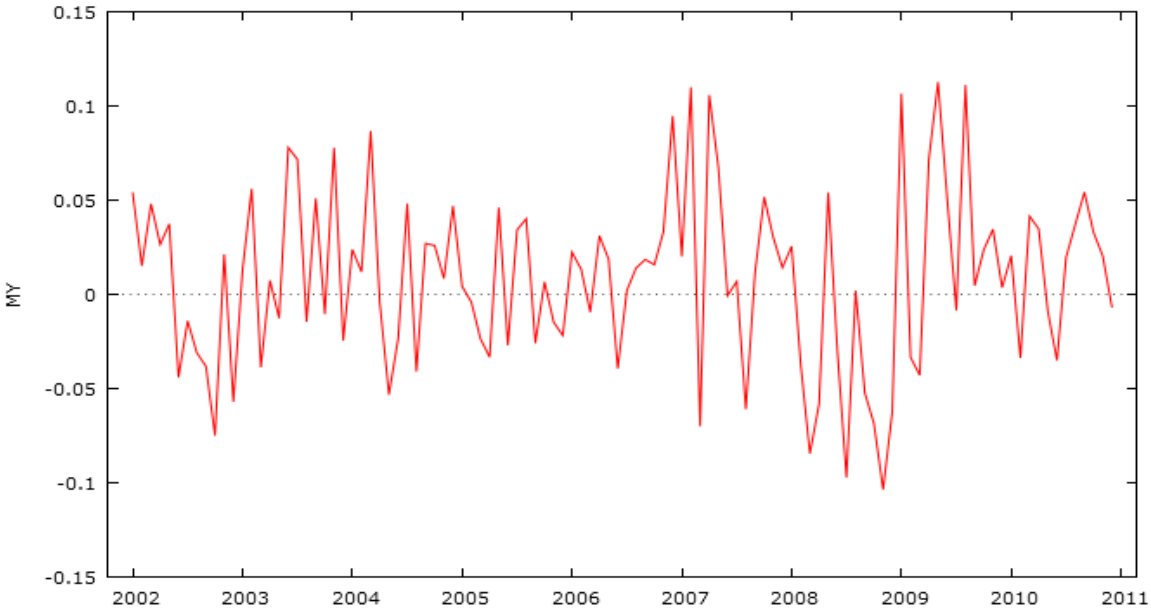
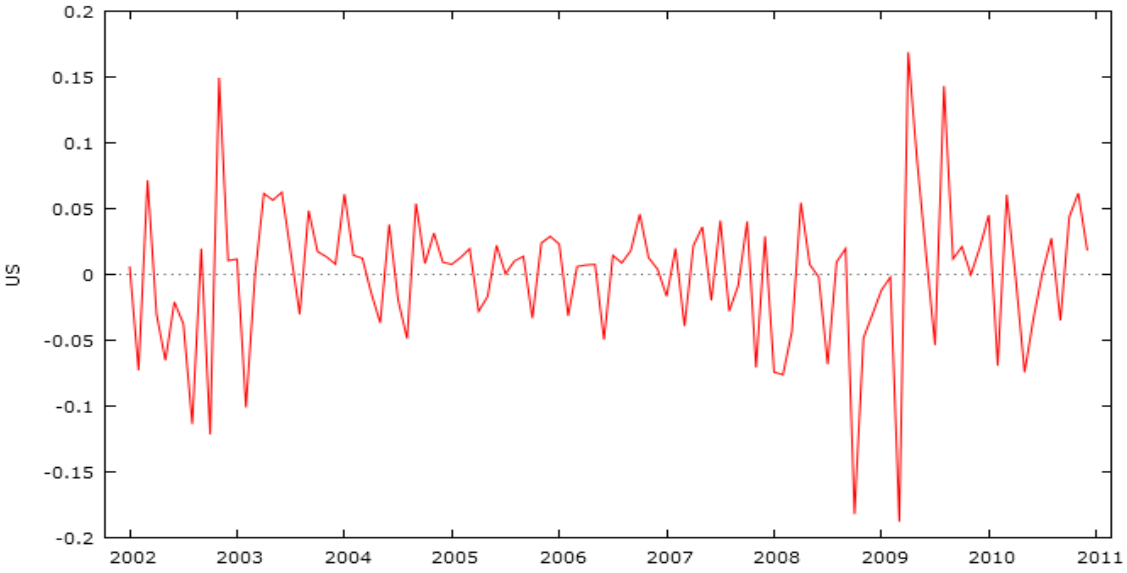



Figure 5: S&P500 (US) stock returns series yearly




The FOREX variable exhibits a decreasing trend and a stationary behavior. There is little or no sign of seasonal variation. This implies relative stability of the Malaysian ringgit as pegged against the US dollar.

Figure 6: Forging exchange rate (Forex) monthly

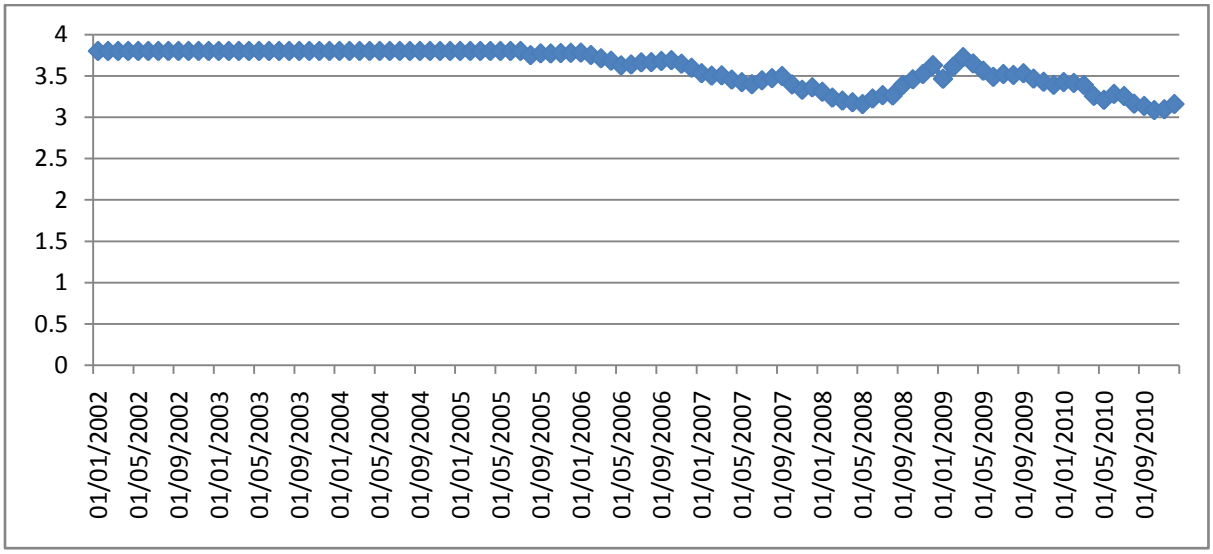
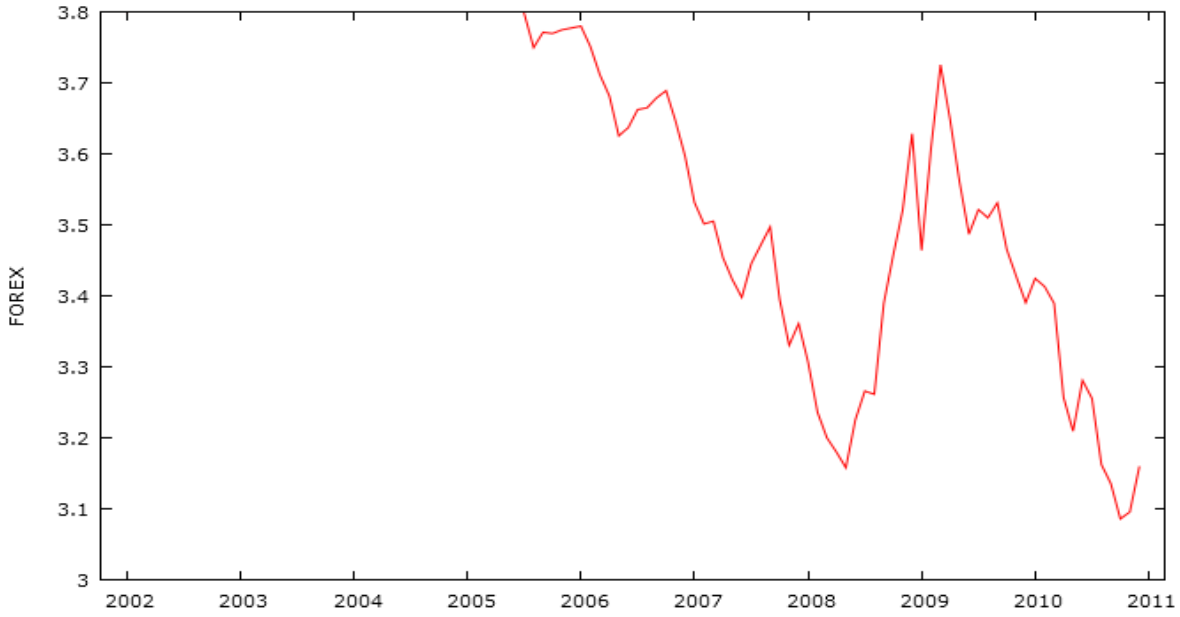



Figure 7: Forging exchange rate (Forex) yearly




It can be seen from the graphs that all the variables are dominated by irregular component of the time series. The irregular component (sometimes also known as the residual) is what remains after the seasonal and trend components of a time series have been estimated and removed. It results from short term fluctuations in the series which

are neither systematic nor predictable. In irregular series, these fluctuations can dominate movements, which will mask the trend and seasonality.

Normality of residual,non-linearity, autocorrelation,heteroskedasticity,multicollinearity, stationary tests and scatter plots for the variables are attached in the Appendix. Standard error values are inserted in the tables, since all the conditions of using multiple linear regressions are met, we can therefore proceed to carry out the analysis.

### 4.2.2Summary of descriptive statistics

**Table 1:Descriptive analysis for the dependent and independent variables**

| | | MY | US | FOREX |
|---|---|---|---|---|
| Pre-crisis | Mean | 0.011875 | 0.003070 | 3.745171 |
| | Max | 0.109934 | 0.149463 | 3.800000 |
| | Min | -0.074918 | -0.121532 | 3.398000 |
| | Std. Dev. | 0.041801 | 0.043476 | 0.102975 |
| | Observations | 66 | 66 | 66 |
| | | MY | US | FOREX |
| During-crisis | Mean | 0.003666 | -0.004116 | 3.370007 |
| | Max | 0.112661 | 0.168901 | 3.725500 |
| | Min | -0.103567 | -0.187730 | 3.086000 |
| | Std. Dev. | 0.053189 | 0.067724 | 0.161721 |
| | Observations | 42 | 42 | 42 |

**Notes:**Pre-crisis period starts from 1, January 2002 to30 June 2007; during crisis period spans from July 2007 to 31 December 2010

MY and US refer to the stock Markets of Malaysia and the USA, respectively .FOREX represent Foreign Exchange rate.

Table 1 provides the summary of mean, standard deviation, maximum and minimum for the all variables over the pre- and during-the 2007 global financial crisis.The table shows that the means of the stock markets return (pre-crisis) is 0.011875 for MY, 0.003070 for US, 3.745171 for Forex, during-crisis, the means for the variables

are; 0.003666 for MY, -0.004116 for US, and 3.370007 for Forex,respectively. It is interesting to note that in the period before the crisis, the averages of monthly stocks returns for MY and US are higher than the average returns during the crisis period which indicates that the stock market returnsslowed down during the global financial crisis that originated from USA. The average of Forex shows that the mean in the pre-crisis period 3.745171 is higher than during the crisis period, i.e. 3.370007. Obviously, as a consequence of the crisis, the Malaysian ringgit became stronger as against the US dollar.

## 4.3 **Correlation analysis**

The significance of a correlation coefficient of a particular magnitude will change depending on the size of the sample from which it was computed. Here, we analyzed the significant correlations between the dependent variable and each independent variable separately to decide whether to accept or reject the hypothesis.

**Table 2: Correlationsbetween MY, US and FOREX(pre- crisis)**

| | | | MY | US | FOREX |
|---|---|---|---|---|---|
| Spearman's rho | MY | Correlation Coefficient | 1.000 | .273* | -.139 |
| | | Sig. (2-tailed) | . | .026 | .266 |
| | | N | 66 | 66 | 66 |
| | US | Correlation Coefficient | .273* | 1.000 | .002 |
| | | Sig. (2-tailed) | .026 | . | .989 |
| | | N | 66 | 66 | 66 |
| | FOREX | Correlation Coefficient | -.139 | .002 | 1.000 |
| | | Sig. (2-tailed) | .266 | .989 | . |
| | | N | 66 | 66 | 66 |

*. Correlation is significant at the 0.05 level (2-tailed).

As shown in Table 2, Spearman's rho order correlation in the pre-crisis period, shows that US has positive correlation with MY at 0.05 level while Forexwasnot strongly correlated with MY Malaysia stock Market since the *rho'* coefficients estimateswere less than 0.05.

**Table3: Correlation between MY, US and FOREX(during-crisis)**

| | | MY | US | FOREX |
|---|---|---|---|---|
| MY | Pearson Correlation | 1 | .578** | .020 |
| | Sig. (2-tailed) | | .000 | .900 |
| | N | 42 | 42 | 42 |
| US | Pearson Correlation | .578** | 1 | -.030 |
| | Sig. (2-tailed) | .000 | | .850 |
| | N | 42 | 42 | 42 |
| FOREX | Pearson Correlation | .020 | -.030 | 1 |
| | Sig. (2-tailed) | .900 | .850 | |
| | N | 42 | 42 | 42 |

**. Correlation is significant at the 0.01 level (2-tailed).Normality test for during crisis period shows that all the variables are normally distributed.

The table shows that during the crisis the highest positive percentage was US with 57.8% coefficient correlations. Forex has a weak correlation with MY which is less than 0.05. From this result we can find that MY might be strongly impacted by US, because the correlation is high.

**4.4Multiple regression**

**Table 4: summary analysis (Pre-crisis)**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | .389[a] | .151 | .124 | .03912 | 5.615 | .006[a] |

a. Predictors: (Constant), US, FOREX

b. Dependent Variable: MY

Based on figures generated in table 4, the regression of model 1 (pre-crisis) is significant at 1%, the value of R Square is 0.151 or 15.1% for the pre-crisis period, with adjusted R square of 0.124 or 12.4% indicate that the changes in the independent variables explain 12.4% changes in the dependent variable ( MY ) which shows co-movement.

**Table 5: Regression result (Pre-crisis)**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | .382 | .177 | | 2.165 | .034 |
| | US | .291 | .112 | .303 | 2.607 | .011 |
| | FOREX | -.099 | .047 | -.244 | -2.103 | .039 |

a. Dependent Variable: MY

According to the results in Table 5, all the variables have significant impact on the Malaysian stock market (MY). US is significant on MY at 5%.Forex as well

significant at 5%.based on the table Forex was one of the channels of the impact in the pre-crisis period.

**Table 6: summary analysis (During-crisis)**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | F | Sig. |
|---|---|---|---|---|---|---|
| 2 | .579[a] | .336 | .302 | .04445 | 9.855 | .000[a] |

a. Predictors: (Constant), FOREX, US

It can be seen from the table above thatthe regression of Model 2 (during crisis) is strongly significant as indicated by p-value (.000). R square is 33.6%. The adjusted R square is 30.2%. This shows that all of the independent variables are collectively 30.2% related to the dependent variables MY. There are two variables are collectively have been explained in this analysis, these variables are (US) U.S Stock market composite,(FOREX) foreign exchange. The remaining 69.8% of changes were identified by other factors not captured in the model.

**Table 7: Regression result (During-crisis)**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 2 | (Constant) | -.036 | .145 | | -.248 | .806 |
| | US | .455 | .103 | .579 | 4.437 | .000*** |
| | FOREX | .012 | .043 | .037 | .286 | .776 |

a. Dependent Variable: MY

According to the results shown in the previous tables, there is one variable significant which is US (0.000). And it's consistent with our first hypothesis (H1) that the

contagion effect exists between the stock markets of Malaysia and USA stock markets,during the 2007 US Financial Crisis.On the other hand, forex is not significant at 5% level of significance. This result is contrary to our expectation as indicated in our hypothesis two (H2). This might be due to the difference in time period, type of data, econometric models and economic policies of countries.

# CHAPTER FIVE

# CONCLUSION AND RECOMMENDATION

This paper examined whether during the US sub- prime financial crisis, there was any contagion from the US economy to Malaysia; moreover, the study examined the impact of foreign exchange rate on the stock market of Malaysia. It used correlation coefficients and regression linear model, in two sub periods namely, pre crisis (January 2002 till June 2007) and during crisis (July, 2007 till December 2010).

The empirical finding showed that the descriptive statistic analysis indicates that the returns of the stock markets were depressed during the global financial crisis .The correlation coefficients of stock returns are positive, and therefore, contagion exists between US and Malaysia markets. The correlation coefficient mean in the crisis period increased at a strong significant level, providing evidence of the contagion effect. The empirical results also showed that the foreign exchange rate is significant in the pre-crisis period but not during-crisis; hence, may not affect KLCI at all because the significant level is less than .50.

A number of studies have been conducted on the contagion effects of the economic crisis which showed mixed empirical evidence. Moreover, the result changes from one economy to another. The reasons for these differences can be explained by differing time periods, econometric models and economic policies of countries. This result is in line with the other studies of similar nature [e.g., Wang et al., (2006), Kenourgios et.al., (2007)]. As Kenourgioset.al., (2007) putforth – the equity correlations increase when bad news hit stock markets and policy responses to a crisis are unlikely to

prevent the spread among countries since cross-market correlations dynamics are driven by behavioral reasons.

Subbarao(2008)indicates that, in the advanced countries, the contagion spread from the financial to the real sector. This requires to be discovered more as an extension of this study. For instance, there is a need to study the other channels of contagion effect that might affect the financial market in Malaysia.

Since the study was limited to the contagion effects of US S & P 500 index and foreign exchange to the economy of Malaysia as indicated by KLCI, it is recommended that further studies need to be conducted to determine the contagion effects of the financial crisis based on other factors like market behavioral and psychological factors.

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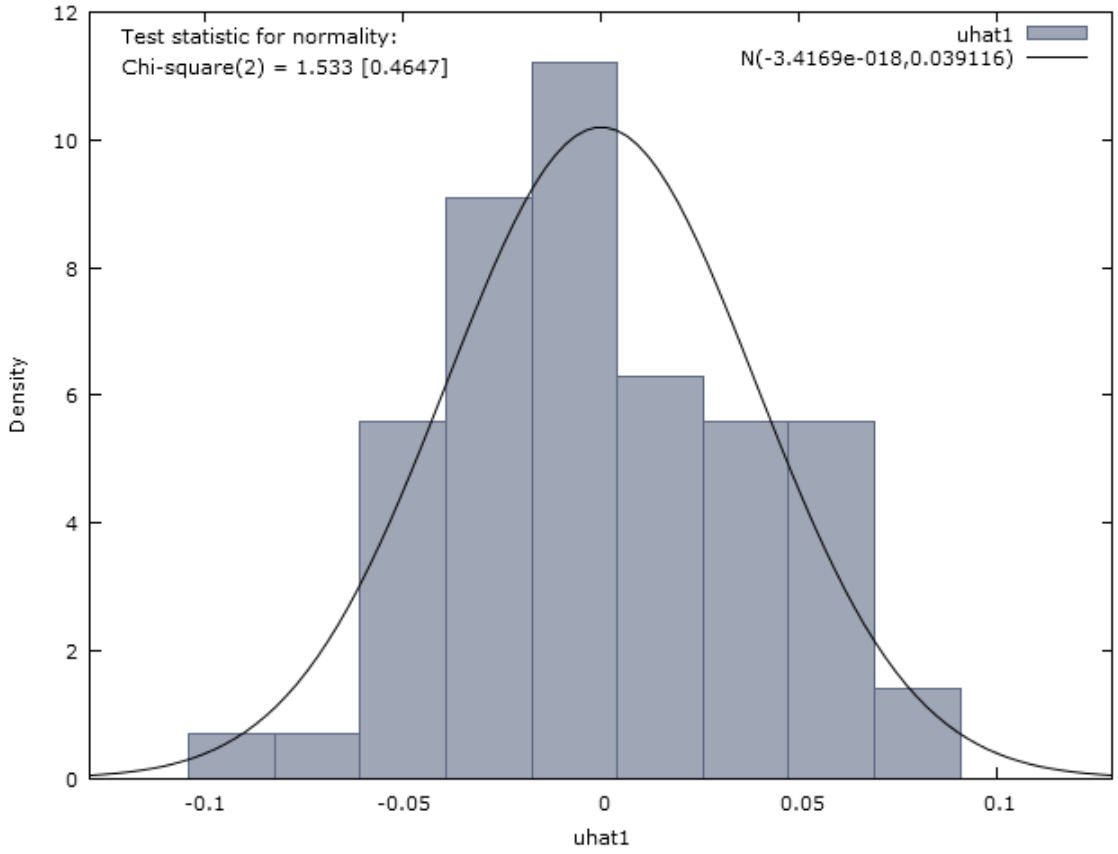
**Normality of the residual**

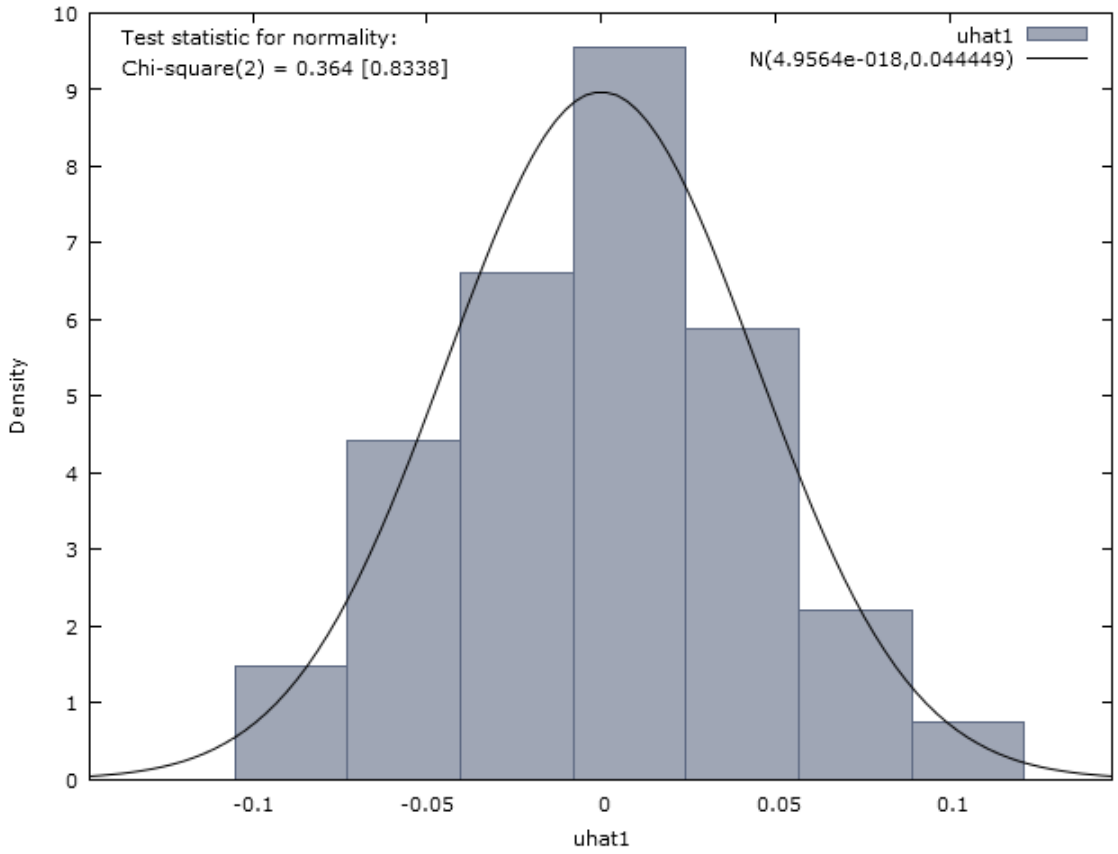



Test for normality of residual -

Null hypothesis: error is normally distributed

Test statistic: Chi-square(2) = 1.53252

with p-value = 0.464748




Test for normality of residual -

Null hypothesis: error is normally distributed

Test statistic: Chi-square(2) = 0.36359

with p-value = 0.833772

**Autocorrelation**

Breusch-Godfrey test for autocorrelation up to order 12

OLS, using observations 2002:01-2007:06 (T = 66)

Dependent variable: uhat

| | Coefficient | std. error | t-ratio | p-value |
|---|---|---|---|---|
| **Const** | -0.130563 | 0.192035 | -0.6799 | 0.4996 |
| **US** | -0.0422573 | 0.120820 | -0.3498 | 0.7280 |
| **FOREX** | 0.0347599 | 0.0512249 | 0.6786 | 0.5005 |
| **uhat_1** | -0.228328 | 0.141168 | -1.617 | 0.1120 |
| **uhat_2** | 0.0301368 | 0.135286 | 0.2228 | 0.8246 |
| **uhat_3** | 0.0139058 | 0.136740 | 0.1017 | 0.9194 |
| **uhat_4** | -0.0254501 | 0.142528 | -0.1786 | 0.8590 |
| **uhat_5** | -0.0168435 | 0.147230 | -0.1144 | 0.9094 |
| **uhat_6** | -0.185693 | 0.144077 | -1.289 | 0.2033 |
| **uhat_7** | -0.167520 | 0.149513 | -1.120 | 0.2678 |
| **uhat_8** | -0.0999277 | 0.151510 | -0.6595 | 0.5125 |
| **uhat_9** | 0.0618668 | 0.155121 | 0.3988 | 0.6917 |
| **uhat_10** | -0.0647965 | 0.152587 | -0.4247 | 0.6729 |
| **uhat_11** | -0.342329 | 0.152888 | -2.239 | 0.0295 |
| **uhat_12** | -0.199712 | 0.158986 | -1.256 | 0.2148 |

Unadjusted R-squared = 0.180840

Test statistic: LMF = 0.938243,

with p-value = P(F(12,51) > 0.938243) = 0.518

Alternative statistic: TR^2 = 11.935457,

with p-value = P(Chi-square(12) > 11.9355) = 0.451

Ljung-Box Q' = 9.56433,

with p-value = P(Chi-square(12) > 9.56433) = 0.654

Summary of autocorrelation

LM test for autocorrelation up to order 12 -

Null hypothesis: no autocorrelation

Test statistic: LMF = 0.938243

with p-value = P(F(12,51) > 0.938243) = 0.517534

Breusch-Godfrey test for autocorrelation up to order 12

OLS, using observations 2007:07-2010:12 (T = 42)

Dependent variable: uhat

| | Coefficient | std. error | t-ratio | p-value |
|---|---|---|---|---|
| **Const** | 0.0431163 | 0.216015 | 0.1996 | 0.8433 |
| **US** | -0.141528 | 0.176555 | -0.8016 | 0.4298 |
| **FOREX** | -0.0134070 | 0.0642986 | -0.2085 | 0.8364 |
| **uhat_1** | 0.0856837 | 0.202967 | 0.4222 | 0.6763 |
| **uhat_2** | 0.0224784 | 0.208613 | 0.1078 | 0.9150 |
| **uhat_3** | 0.139907 | 0.237479 | 0.5891 | 0.5607 |
| **uhat_4** | 0.0636296 | 0.203425 | 0.3128 | 0.7568 |
| **uhat_5** | 0.0901924 | 0.207263 | 0.4352 | 0.6669 |
| **uhat_6** | -0.245834 | 0.208162 | -1.181 | 0.2479 |
| **uhat_7** | 0.170320 | 0.232706 | 0.7319 | 0.4705 |
| **uhat_8** | 0.0659262 | 0.202749 | 0.3252 | 0.7476 |
| **uhat_9** | -0.261499 | 0.211343 | -1.237 | 0.2266 |
| **uhat_10** | -0.179663 | 0.206633 | -0.8695 | 0.3922 |
| **uhat_11** | -0.0816843 | 0.215563 | -0.3789 | 0.7077 |
| **uhat_12** | -0.00335350 | 0.221692 | -0.01513 | 0.9880 |

Unadjusted R-squared = 0.187063

Test statistic: LMF = 0.517741,with p-value = P(F(12,27) > 0.517741) = 0.885

Alternative statistic: TR^2 = 7.856628,with p-value = P(Chi-square(12) > 7.85663) = 0.796

Ljung-Box Q' = 8.80685,with p-value = P(Chi-square(12) > 8.80685) = 0.719

**Heteroskedasticity**

Breusch-Pagan test for heteroskedasticity OLS, using observations 2002:01 2007:06 (T = 66)

Dependent variable: scaled uhat^2

| | Coefficient | std. error | t-ratio | p-value |
|---|---|---|---|---|
| **Const** | 9.55590 | 5.38196 | 1.776 | 0.0806 |
| **US** | -5.52264 | 3.40241 | -1.623 | 0.1096 |
| **FOREX** | -2.27999 | 1.43650 | -1.587 | 0.1175 |

Explained sum of squares = 7.3242

Test statistic: LM = 3.662098,with p-value = P(Chi-square(2) > 3.662098) = 0.160245

Summary of heteroskedasticity

Breusch-Pagan test for heteroskedasticity -
Null hypothesis: heteroskedasticity not present
Test statistic: LM = 3.6621
with p-value = P(Chi-square(2) > 3.6621) = 0.160245

Breusch-Pagan test for heteroskedasticity

OLS, using observations 2007:07-2010:12 (T = 42)

Dependent variable: scaled uhat^2

| | Coefficient | std. error | t-ratio | p-value |
|---|---|---|---|---|
| **Const** | 0.358022 | 4.59346 | 0.07794 | 0.9383 |
| **US** | -1.67053 | 3.25149 | -0.5138 | 0.6103 |
| **FOREX** | 0.188457 | 1.36163 | 0.1384 | 0.8906 |

Explained sum of squares = 0.571349

Test statistic: LM = 0.285674,

with p-value = P(Chi-square(2) > 0.285674) = 0.866895

**Non-linearity test**

Auxiliary regression for non-linearity test (squared terms)

OLS, using observations 2002:01-2007:06 (T = 66)

Dependent variable: uhat

| | Coefficient | std. error | t-ratio | p-value |
|---|---|---|---|---|
| **Const** | 1.96105 | 6.21004 | 0.3158 | 0.7532 |
| **US** | -0.00238010 | 0.113453 | -0.02098 | 0.9833 |
| **FOREX** | -1.08087 | 3.41383 | -0.3166 | 0.7526 |
| **Sq_US** | -0.484789 | 1.33429 | -0.3633 | 0.7176 |
| **Sq_FOREX** | 0.148746 | 0.468556 | 0.3175 | 0.7520 |

Unadjusted R-squared = 0.003378

Test statistic: TR^2 = 0.222974,

with p-value = P(Chi-square(2) > 0.222974) = 0.894503

Auxiliary regression for non-linearity test (squared terms)

OLS, using observations 2007:07-2010:12 (T = 42)

Dependent variable: uhat

| | Coefficient | std. error | t-ratio | p-value |
|---|---|---|---|---|
| **Const** | -1.43293 | 3.15881 | -0.4536 | 0.6527 |
| **US** | 0.0269250 | 0.107103 | 0.2514 | 0.8029 |
| **FOREX** | 0.870728 | 1.88185 | 0.4627 | 0.6463 |
| **Sq_US** | 1.05037 | 1.02498 | 1.025 | 0.3121 |
| **Sq_FOREX** | -0.132312 | 0.279990 | -0.4726 | 0.6393 |

Unadjusted R-squared = 0.027629Test statistic: TR^2 = 1.16043,

with p-value = P(Chi-square(2) > 1.16043) = 0.559777

Auxiliary regression for non-linearity test (squared terms)

OLS, using observations 2007:07-2010:12 (T = 42)

Dependent variable: uhat

| | **Coefficient** | **std. error** | **t-ratio** | **p-value** |
|---|---|---|---|---|
| **const** | -1.43293 | 3.15881 | -0.4536 | 0.6527 |
| **US** | 0.0269250 | 0.107103 | 0.2514 | 0.8029 |
| **FOREX** | 0.870728 | 1.88185 | 0.4627 | 0.6463 |
| **Sq_US** | 1.05037 | 1.02498 | 1.025 | 0.3121 |
| **Sq_FOREX** | -0.132312 | 0.279990 | -0.4726 | 0.6393 |

Unadjusted R-squared = 0.027629Test statistic: TR^2 = 1.16043,

with p-value = P(Chi-square(2) > 1.16043) = 0.559777

Multicolnarty

Pre-crisis

**Coefficients[a]**

| Model | | Collinearity Statistics | |
|---|---|---|---|
| | | Tolerance | VIF |
| 1 | US | .998 | 1.002 |
| | FOREX | .998 | 1.002 |

a. Dependent Variable: MY

During-crisis

**Coefficients[a]**

| Model | | Collinearity Statistics | |
|---|---|---|---|
| | | Tolerance | VIF |
| 1 | US | .999 | 1.001 |
| | FOREX | .999 | 1.001 |

a. Dependent Variable: MY

## Stationary

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(MY)
Method: Least Squares
Date: 01/15/12 Time: 17:26
Sample (adjusted): 2002M02 2007M06
Included observations: 65 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| MY(-1) | -1.097905 | 0.124472 | -8.820481 | 0.0000 |
| C | 0.012412 | 0.005412 | 2.293380 | 0.0252 |

| | | | |
|---|---|---|---|
| R-squared | 0.552560 | Mean dependent var | -0.000838 |
| Adjusted R-squared | 0.545457 | S.D. dependent var | 0.062177 |
| S.E. of regression | 0.041919 | Akaike info criterion | -3.475856 |
| Sum squared resid | 0.110705 | Schwarz criterion | -3.408951 |
| Log likelihood | 114.9653 | F-statistic | 77.80089 |
| Durbin-Watson stat | 1.967517 | Prob(F-statistic) | 0.000000 |

US

Null Hypothesis: US has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=10)

| | t-Statistic | Prob.* |
|---|---|---|

| | | | |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -9.167665 | 0.0000 |
| Test critical values: | 1% level | -3.534868 | |
| | 5% level | -2.906923 | |
| | 10% level | -2.591006 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(US)
Method: Least Squares
Date: 01/15/12 Time: 17:28
Sample (adjusted): 2002M02 2007M06
Included observations: 65 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| US(-1) | -1.145234 | 0.124921 | -9.167665 | 0.0000 |
| C | 0.003526 | 0.005436 | 0.648665 | 0.5189 |

| | | | |
|---|---|---|---|
| R-squared | 0.571563 | Mean dependent var | -0.000390 |
| Adjusted R-squared | 0.564762 | S.D. dependent var | 0.066230 |
| S.E. of regression | 0.043693 | Akaike info criterion | -3.392950 |
| Sum squared resid | 0.120275 | Schwarz criterion | -3.326045 |
| Log likelihood | 112.2709 | F-statistic | 84.04609 |
| Durbin-Watson stat | 1.921533 | Prob(F-statistic) | 0.000000 |

Null Hypothesis: FOREX has a unit root
Exogenous: None
Lag Length: 1 (Automatic based on SIC, MAXLAG=1)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -1.637297 | 0.0954 |
| Test critical values: | 1% level | -2.601596 | |
| | 5% level | -1.945987 | |
| | 10% level | -1.613496 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(FOREX)
Method: Least Squares
Date: 01/15/12 Time: 17:30
Sample (adjusted): 2002M03 2007M06
Included observations: 64 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| FOREX(-1) | -0.000965 | 0.000589 | -1.637297 | 0.1066 |
| D(FOREX(-1)) | 0.437130 | 0.115151 | 3.796127 | 0.0003 |

| | | | |
|---|---|---|---|
| R-squared | 0.182558 | Mean dependent var | -0.006281 |
| Adjusted R-squared | 0.169374 | S.D. dependent var | 0.018554 |
| S.E. of regression | 0.016910 | Akaike info criterion | -5.291099 |
| Sum squared resid | 0.017728 | Schwarz criterion | -5.223634 |
| Log likelihood | 171.3152 | Durbin-Watson stat | 2.069486 |

Null Hypothesis: FOREX has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 5 (Automatic based on SIC, MAXLAG=10)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | 3.464601 | 1.0000 |
| Test critical values: | 1% level | -4.118444 | |
| | 5% level | -3.486509 | |
| | 10% level | -3.171541 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(FOREX)
Method: Least Squares
Date: 01/23/12 Time: 22:39
Sample (adjusted): 2002M07 2007M06
Included observations: 60 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| FOREX(-1) | 0.191017 | 0.055134 | 3.464601 | 0.0011 |
| D(FOREX(-1)) | -0.101498 | 0.158442 | -0.640599 | 0.5246 |
| D(FOREX(-2)) | -0.186001 | 0.137441 | -1.353309 | 0.1818 |

| | | | | |
|---|---|---|---|---|
| D(FOREX(-3)) | -0.121297 | 0.134651 | -0.900824 | 0.3718 |
| D(FOREX(-4)) | -0.474957 | 0.146901 | -3.233189 | 0.0021 |
| D(FOREX(-5)) | -0.416382 | 0.161758 | -2.574108 | 0.0129 |
| C | -0.722371 | 0.211699 | -3.412257 | 0.0013 |
| @TREND(2002M01) | -0.000183 | 0.000171 | -1.070082 | 0.2895 |

| | | | |
|---|---|---|---|
| R-squared | 0.463508 | Mean dependent var | -0.006700 |
| Adjusted R-squared | 0.391288 | S.D. dependent var | 0.019098 |
| S.E. of regression | 0.014900 | Akaike info criterion | -5.451314 |
| Sum squared resid | 0.011545 | Schwarz criterion | -5.172068 |
| Log likelihood | 171.5394 | F-statistic | 6.417994 |
| Durbin-Watson stat | 2.129010 | Prob(F-statistic) | 0.000018 |

## During

Null Hypothesis: MY has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=9)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -4.883088 | 0.0003 |
| Test critical values: | 1% level | -3.596616 | |
| | 5% level | -2.933158 | |
| | 10% level | -2.604867 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(MY)
Method: Least Squares
Date: 01/15/12 Time: 17:36
Sample: 2007M07 2010M12
Included observations: 42

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| MY(-1) | -0.747336 | 0.153046 | -4.883088 | 0.0000 |
| C | 0.002704 | 0.008061 | 0.335406 | 0.7391 |

| | | | |
|---|---|---|---|
| R-squared | 0.373478 | Mean dependent var | -0.000142 |
| Adjusted R-squared | 0.357815 | S.D. dependent var | 0.065020 |

| | | | |
|---|---|---|---|
| S.E. of regression | 0.052104 | Akaike info criterion | -3.024688 |
| Sum squared resid | 0.108595 | Schwarz criterion | -2.941942 |
| Log likelihood | 65.51846 | F-statistic | 23.84455 |
| Durbin-Watson stat | 1.940000 | Prob(F-statistic) | 0.000017 |

Null Hypothesis: US has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=9)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -7.066157 | 0.0000 |
| Test critical values: | 1% level | -3.596616 | |
| | 5% level | -2.933158 | |
| | 10% level | -2.604867 | |

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(US)
Method: Least Squares
Date: 01/15/12 Time: 17:37
Sample: 2007M07 2010M12
Included observations: 42

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| US(-1) | -1.111270 | 0.157267 | -7.066157 | 0.0000 |
| C | -0.004676 | 0.010544 | -0.443430 | 0.6598 |

| | | | |
|---|---|---|---|
| R-squared | 0.555212 | Mean dependent var | 0.000914 |
| Adjusted R-squared | 0.544093 | S.D. dependent var | 0.100917 |
| S.E. of regression | 0.068140 | Akaike info criterion | -2.488051 |
| Sum squared resid | 0.185724 | Schwarz criterion | -2.405304 |
| Log likelihood | 54.24906 | F-statistic | 49.93057 |
| Durbin-Watson stat | 1.996028 | Prob(F-statistic) | 0.000000 |

Forex

Null Hypothesis: D(FOREX) has a unit root
Exogenous: Constant, Linear Trend

Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -5.778605 | 0.0001 |
| Test critical values: | 1% level | -4.192337 | |
| | 5% level | -3.520787 | |
| | 10% level | -3.191277 | |

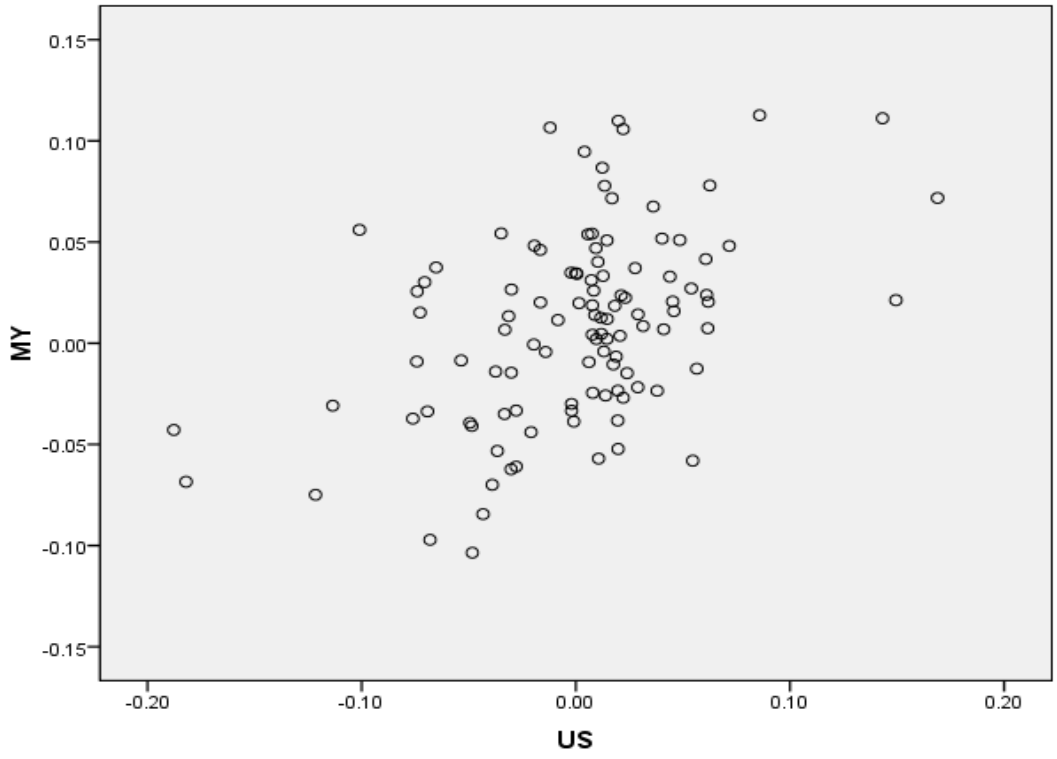
*MacKinnon (1996) one-sided p-values.

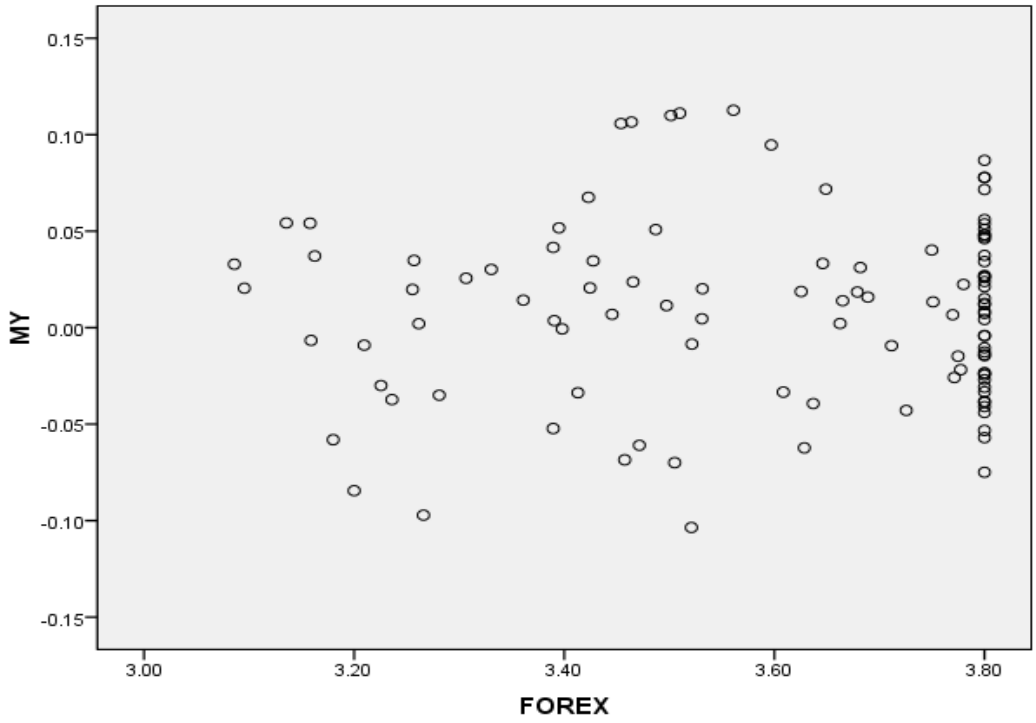
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(FOREX,2)
Method: Least Squares
Date: 01/23/12 Time: 22:50
Sample: 2007M07 2010M12
Included observations: 42

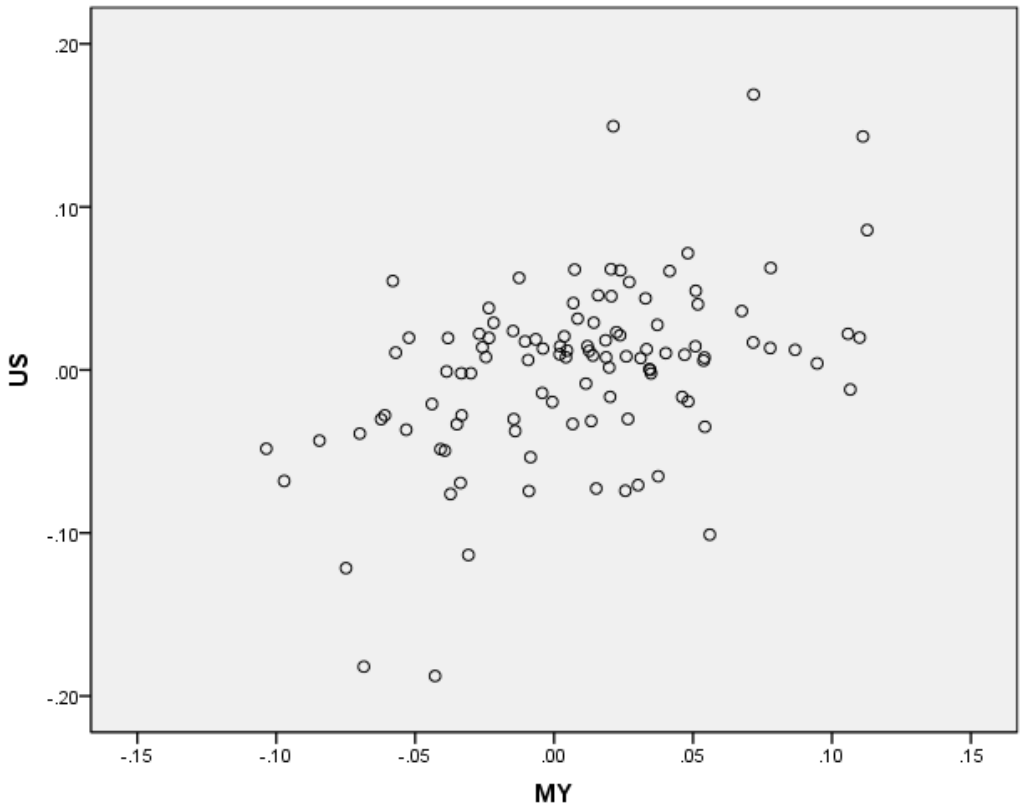
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(FOREX(-1)) | -0.938167 | 0.162352 | -5.778605 | 0.0000 |
| C | 0.006919 | 0.021780 | 0.317666 | 0.7524 |
| @TREND(2007M07) | -0.000592 | 0.000922 | -0.641525 | 0.5249 |

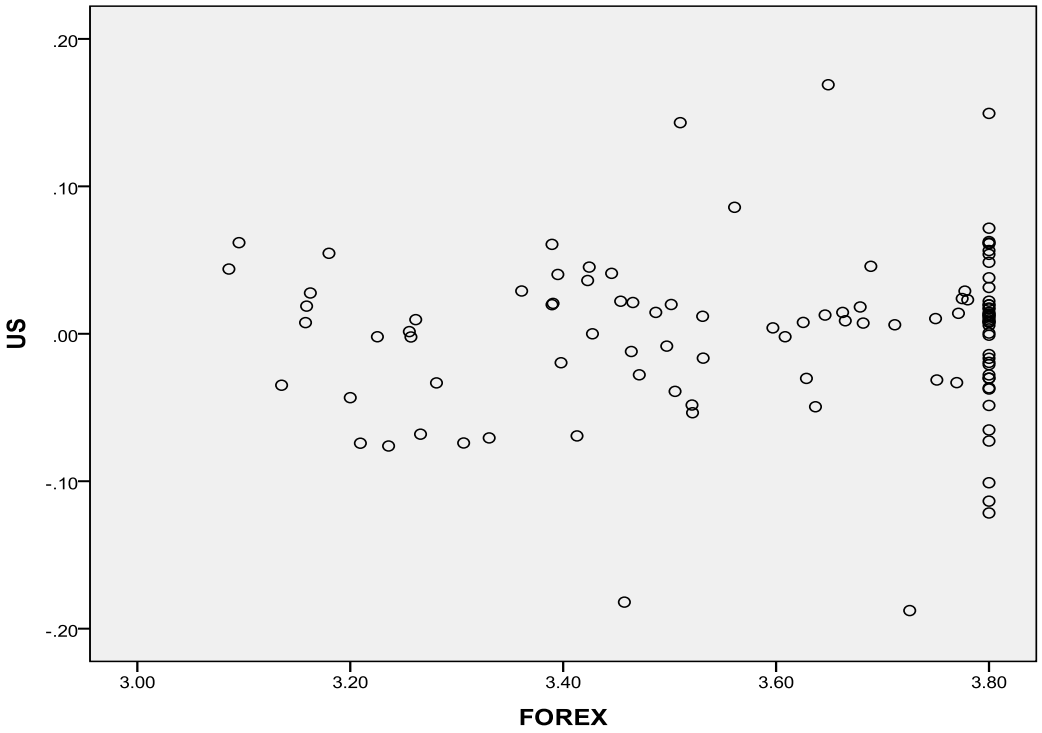
| | | | |
|---|---|---|---|
| R-squared | 0.461548 | Mean dependent var | 0.002107 |
| Adjusted R-squared | 0.433935 | S.D. dependent var | 0.095269 |
| S.E. of regression | 0.071678 | Akaike info criterion | -2.364515 |
| Sum squared resid | 0.200372 | Schwarz criterion | -2.240396 |
| Log likelihood | 52.65482 | F-statistic | 16.71494 |
| Durbin-Watson stat | 1.926431 | Prob(F-statistic) | 0.000006 |

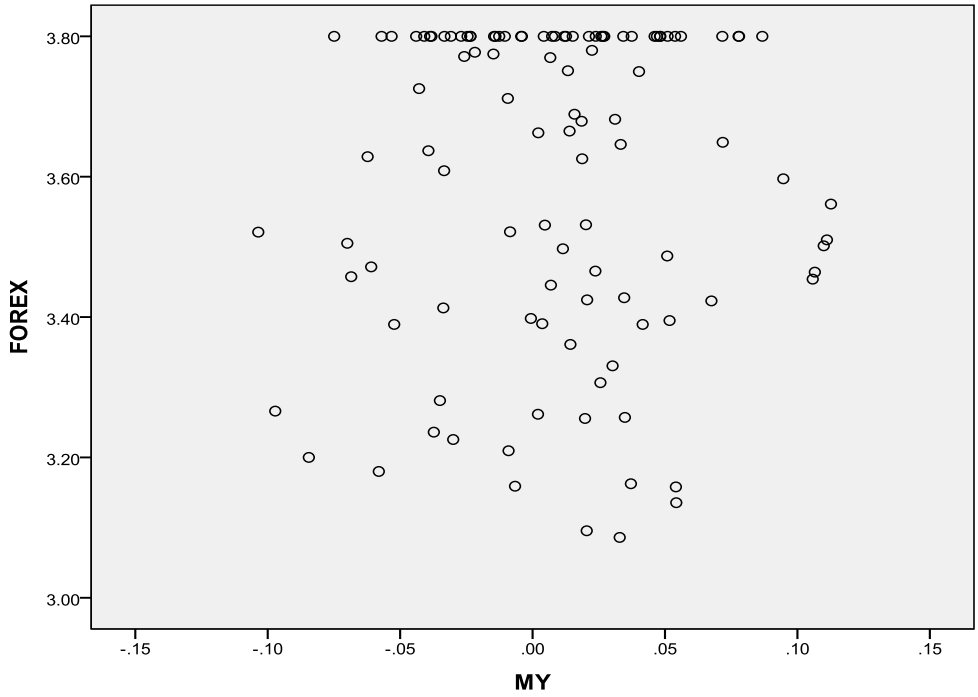
**Scatter plot**

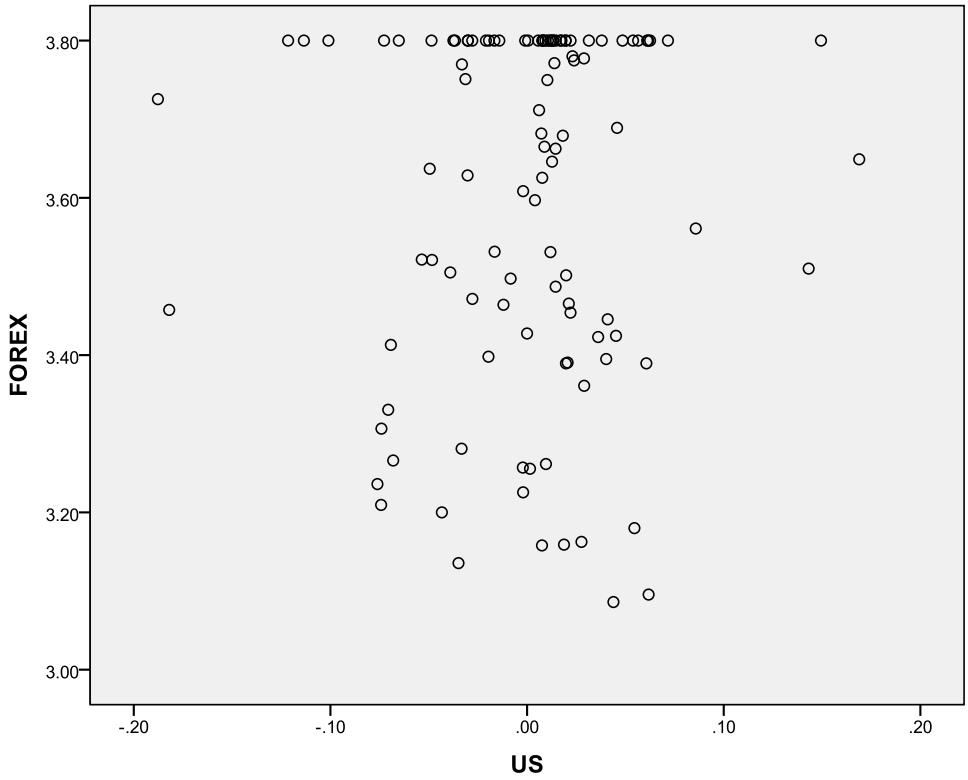



.20
.10
.00
-.10
-.20
US
-.15
-.10
-.05
.00
.05
.10
.15
MY


.20
.10
.00
-.10
-.20
US
3.00
3.20
3.40
3.60
3.80
FOREX


FOREX
3.80
3.60
3.40
3.20
3.00
-.15
-.10
-.05
.00
.05
.10
.15
MY


FOREX
3.80
3.60
3.40
3.20
3.00
-.20
-.10
.00
.10
.20
US