Alternative Exchange Regimes in Oil Exporting Economies
The Case of the Gulf Cooperation Council

WAEL M AZZAM JUNDI

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ABSTRACT

During the period between 2004 and 2008 the Gulf Cooperation Council (GCC) countries witnessed high levels of inflation. This was largely due to the US dollar pegged exchange rate regime operating in these economies at the time, and the depreciation of the US dollar over other major currencies during the same period.

This research explores alternative exchange rate regimes available for the GCC, taking into consideration their size, wealth and economic performance. It also evaluates the possible effects on the private sector if an alternative regime is adopted. Finally, it assesses the readiness of the GCC economies to move towards a single currency and compares the GCC proposed currency union with the Euro experience.

Researchers supporting fixed exchange regime believe that it leads to a better inflation performance according to Ghosh *et. al.* (1996), Hausmann *et. al*. (1999) and Eichengreen *et.al.* (1999). Others, like Caramazza *et. al.* (1998) believe that this is not standard for all emerging economies and also Collins (1996) supports a fixed regime for economies with poor growth, which is not the case for the GCC. On the other hand, Duttagupta *et. al.* (2005) and Velasco (2000) support a floating regime for economies with technical knowhow and an international trading volume. The move to a more flexible regime will lead to fluctuation in the nominal exchange rate, which is expected to affect the stock market performance according to Frankel et. al. (2007), Tian et. al. (2010) and Dornbush et. al. (1980). Other researchers such as Bartram et. al. (2012), Nieh et. al. (2002) and Tsai (2012) are of the view that this relation between the stock market and exchange rate doesn't exist. Taking into consideration the size of the combined GCC economy and the integration between these economies, this support the move to a single currency union as the GCC forms an Optimum Currency Area. This move is supported by researchers like Laabas et. al. (2002), Rose (2000) and Pisani-Ferry (2012) who believe that a single currency union will increase intra-trading, liberate reserves and increase the trust of the union economies.

The methodology adopted in this research combines both empirical approach and informal approach and compares the outcome from both methodologies. Tests such as Unit Root Test to examine stationarity, Cointegration to examine long-run relationship between variables, VAR and ECM tests for short-run relationship test and Granger Causality tests to examine if a variable can be used to forecast another variable were used in this research. In addition to the above formal approach, a Mundell-Fleming theory was introduced to examine the relationship between stock market and exchange regime and an informal theoretical analysis was presented to assess the GCC readiness to form a currency union.

The main findings of the research can be summarized as follow:

1. Analysis of economic indicators from the GCC supports the move towards a more flexible exchange rate regime.
2. The effect of nominal currency fluctuation on the private sector is expected to be minimal in the short-run and managabele in the long run.
3. GCC countries still have a long way to go if they are to form a currency union as the underlying infrastructure is weak.

This research was conducted in the period between 2006 and 2015, which has witnessed an abnormal economic cycles, mainly the 2008 international financial crisis. This has led the author to eliminate some years following the 2008 crisis. Also, one of the main complications raised in this research was data collection, especially GCC related data. This has led to following different informal approaches to collect the required data for the research.

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DEDICATION

This research is dedicated to

The soul of my grandfather, Eng. Shakib Omari. He taught me that I should never say no to learning something new. He registered at an institute to learn German at the age of 86, although he already spoke 5 languages. We used to enjoy spending time together talking about universities and research. God bless your soul

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My loving parents who have literally allocated their life and resources to me and my brothers. I am sure that anyone who has parents like you will have no choice but to be happy and successful.

My brothers, Humam, Kinan and their families, Dina, Nana, Azzam and Julia.

The soul of my grandmother Ibtissam, aunts and cousins

My loving in-laws….

DECLARATION

I declare that no portion of the work referred to in the dissertation has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning. Further, all the work in this dissertation is entirely my own, unless referenced in the text as a specific source and included in the bibliography.

TABLE OF CONTENTS

List of Tables

List of Charts

List of Abbreviations

ADF	Augmented Dickey Fuller
AED	Arab Emirates Dirham
AMF	Arab Monetary Fund
AUD	Australian Dollar
BOVESPA	Brasilian Stock Index
BRR	Brasilian Rial
CAD	Canadian Dollar
CHF	Swiss Franc
CU	Currency Union
ECM	Error Correction Model
EEC	European Economic Community
EU	Europe
EUR	Euro Currency
FDI	Foreign Direct Investment
FE	Foreign Exchange Curve
FEM	Foreign Exchange Market

GBP	Great Britain Pound
GCC	Gulf Cooperation Council
GCCEC	Gulf Cooperation Council Economic Community
GDP	Gross Domestic Product
GDPPCAP	GDP per Capita
G-PPP	General Purchasing Power Parity
IERES	(Import + Export) ÷ Reserves
IMF	International Monetary Fund
IS	Goods Market Curve
JPY	Japanese Yen
LM	Money Market Curve
NIKKEI	Japan Stock Market Index
OCA	Optimum Currency Area
OLS	Ordinary Least Squares
RESPCAP	Reserves per Capita
RRB	Russian Ruble
RTS	Russian Trading System
TRADEOPE	Trade Openness
TRADEVPCAP	Trade Volume per Capita
UAE	United Arab Emirates
UK	United Kingdom
US	United States
USD	United States Dollar
US$	United States Dollar
VAR	Vector Autoregression
VER	Vector Error Correction
WTO	World Trade Organisation

CHAPTER ONE

INTRODUCTION

1.1 Introduction and Background

There are plenty of economic discussions and subjects considered “taboo” in the Middle East, especially in Gulf Cooperation Council (GCC) countries. For example, the Middle East is one of the main sources for crude oil in the world, yet there appears to be minimal influence for these economies in oil pricing. At the same time, GCC countries have followed since the 1980’s a pegged regime with the US dollar (USD). The effect of this on the GCC countries has, however, not always been positive. For example, the high inflation levels between 2006 and 2008 have forced the GCC economies to respond by increasing wages for public sector employees. This was a result of not having any monetary tools, due to the pegged currency to the US dollar.

During the last few years and after witnessing high levels of inflation, governments of the GCC countries began to ask the question of whether they should adopt an alternative exchange rate regime. It will likely result in the adoption of a non-dollarization regime but will allow the GCC countries to control their own destiny as they will have effective monetary tools available and will not be tied to US monetary policy.

Unofficial discussion on regime change started in the period of expansion between 2005 and 2008. At that stage the whole world was enjoying a boom and liquidity and investment opportunities were welcomed by both institutions and individuals across the region. Following these discreet discussions, an announcement was made by the Governor of the Central Bank of the UAE in June 2008 that they were considering unpegging their currency with the US dollar and were going to peg it to a basket of currencies instead. There was also talk of adopting a managed floating regime. This statement encouraged economists and investment banks around the world to determine what the real value of the AED (UAE currency) was in case the UAE decided to unpeg its currency. Economic analysis suggested that the AED would immediately appreciate against the US dollar following such an announcement and may have a profound effect.

As a result “hot cash” started to enter the country and deposits at local banks in the United Arab Emirates (UAE) almost doubled. This immediately affected lending in the market. In September 2008, and within a few months of the unofficial announcement, a crisis hit the world. A further statement had to be issued by the UAE Central Bank confirming that they were not now moving ahead with the new regime and that it would continue to peg the currency to the US dollar. Deposits with local banks quickly fell back causing a serious cash shortage for all banks in the UAE. The rest of the GCC and some economists within the UAE, however, linked the volatility of banks’ deposits and instability in the banking sector in the UAE to the announcement of the new regime rather than mismanagement of the UAE Central Bank in dealing with the “hot cash”. This painful experience has forced local banks, the private sector and individuals to be more careful in making public discussions concerning the adoption of alternative exchange rate regimes.

The above experience of the UAE stopped discussion on alternative exchange regimes for some time. However, in 2010 and prior to the pre-announced launch of the GCC single currency, the exchange rate regime which the new union would use came up again. The main questions of this research can be summarized as follows:

1. Should GCC countries individually adhere to the dollarization regime? Should an alternative regime which takes into account the wealth, economic performance and size of these economies be considered?
2. As these economies can afford the short-term negative effect of adopting a different regime (due to the availability of large cash reserves) how will it affect the market and private sector in both the short and long-term?
3. Although the GCC single currency was due to have been launched in 2010, it has not yet been achieved. It is natural to ask therefore how many of the GCC countries are currently ready for it?
4. How can the GCC benefit from other experiences of currency union, such as the Euro experience, in moving forward?

The objective of this research is to provide answers to the above questions. To do so it employs both an empirical and statistical approach. It also investigates previous approaches.

1.2 The Gulf Cooperation Council (GCC): An Overview

The Gulf Cooperation Council (GCC) was created in Abu Dhabi in 1981 and brought together countries that shared similar political, economic, social and religious ties. The members of the GCC comprise the Arab Gulf nations of Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates.

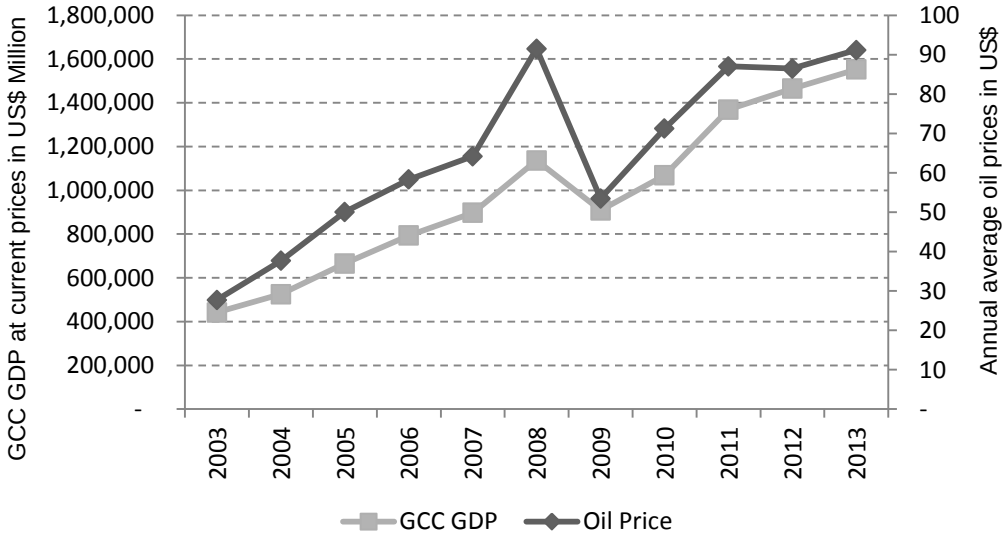
Source: Gulf Cooperation Council publication 2008

The main objectives behind the formation of the GCC can be summarised as follows:

- Formulating regulations in relation to finance, trade, customs, tourism, legislation and administration.
- Fostering scientific and technical progress in industry, mining, agriculture, water and animal resources.
- Establishing scientific research centers.
- Setting up joint ventures.
- Creation of a unified military presence.
- Encouraging cooperation within the private sector.
- Strengthening ties between their peoples.
- Establishing a common currency by 2010.

The (economic) health of the GCC economies has a very close relationship with the price of crude oil. A high oil price provides a high level of income to the GCC and with it higher GDP and GDP per capita. Chart 1.1 below shows the recent behavior of GCC GDP and oil prices for the period 2002–2013.

Chart 1.1: GCC GDP and Oil Prices (2002–2013)



Source: Economic Statistics Bulletin of Arab Countries 2013 & inflationdata.com

GCC nominal GDP doubled between 2002 and 2009 from US$ 441 billion to US$ 908 billion. The latest data from the IMF shows that GCC GDP reached US$ 1.39 trillion in 2012, indicating that GDP had increase by almost 46% between 2009 and 2012.

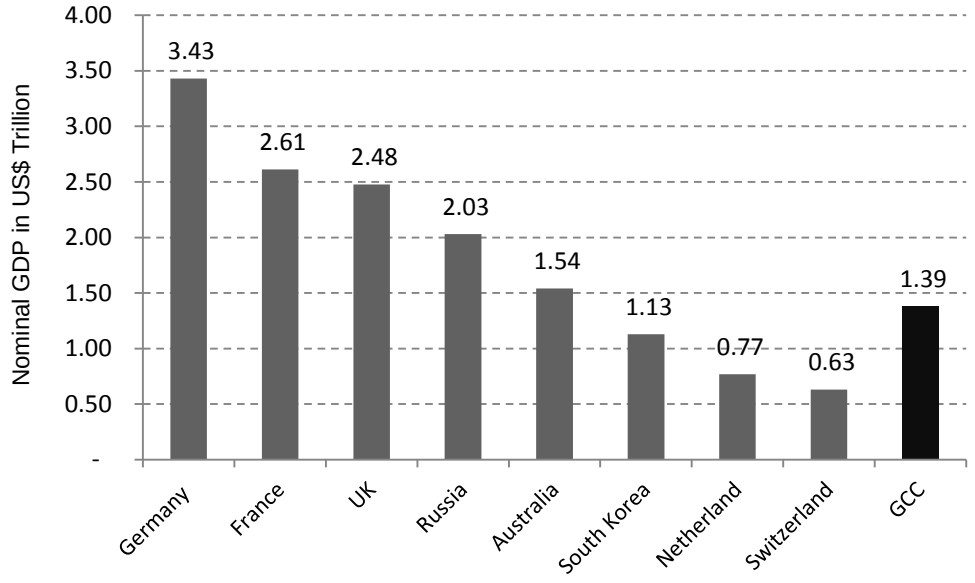
Table 1.1: GDP at Current Market Prices (US$ million) (2003–2013)

GDP	2003	2005	2007	2009	2011	2013
Bahrain	9,747	13,459	18,471	19,621	25,825	29,291
Kuwait	47,869	80,799	114,565	105,993	160,940.0	182,538
Oman	21,543	30,905	41,901	48,268	72,680	82,434
Qatar	23,534	44,530	79,712	97,798	173,519	196,805
Saudi Arabia	214,573	315,337	384,686	376,692	597,086	677,215
UAE	124,346	180,617	257,916	259,733	338,690	384,142
TOTAL	**441,612**	**665,647**	**897,251**	**908,105**	**1,368,740**	**1,552,425**

Source: Economic Statistics Bulletin of Arab Countries 2013 and IMF Data

The size of the GCC combined economy is considered significant when compared to other economies. Its combined GDP of US$ 1.39 trillion dollars places it 12th in a ranking of countries ranked by nominal GDP (8th if the EU countries are considered as individual countries rather than a single entity). Chart 1.2 below compares nominal GDP in the GCC countries to a number of other leading economies.

Chart 1.2: Nominal GDP (2012)



Source: International Monetary Fund, 2012

The GCC region contains some of the fastest growing economies in the world. This is largely due to the rise in oil revenues over the last decade. However it also resulted from the boom in construction and investment resulting from decades of saved petroleum revenues. Ignoring the effects of the Iraq war in 2004 and the severe recession following the September 2008 global crisis, the combined GCC economy maintained an average annual growth rate in excess of 15% between 2001 and 2008.

Table 1.2: GDP Growth (2003–2013)

GDP Growth	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Bahrain	15%	15%	20%	18%	17%	20%	-11%	12%	18%	7%	4%
Kuwait	26%	24%	36%	26%	13%	29%	-28%	13%	34%	8%	6%
Oman	7%	15%	25%	19%	14%	45%	-21%	23%	23%	6%	5%
Qatar	22%	35%	40%	37%	31%	45%	-15%	30%	36%	7%	8%
Saudi Arabia	14%	17%	26%	13%	8%	24%	-21%	21%	31%	5%	6%
UAE	13%	19%	22%	23%	16%	22%	-17%	9%	19%	7%	6%
GCC	**15%**	**19%**	**27%**	**19%**	**13%**	**27%**	**-20%**	**18%**	**28%**	**7%**	**6%**

Source: Computed by the author using Economic Statistics Bulletin of Arab Countries 2013

The strong economic growth was also associated with huge population growth in the GCC countries between 2001 and 2009. This was mainly due to increased job opportunities in the GCC for international job seekers resulting from the rapid economic growth. The combined population of the GCC grew from 29.2 million in 2001 to 40.2 million in 2009 - an average annual growth rate of 4.7% per annum, with Qatar leading the way with annual growth of 12.5% and Saudi Arabia bringing up the rear with annual growth of 3% per annum.

Table 1.3: GCC Population (Millions) (2001–2013)

GDP	2003	2005	2007	2009	2011	2013
Bahrain	0.7	0.8	1.0	1.2	1.2	1.2
Kuwait	2.4	2.7	3.1	3.7	3.7	3.8
Oman	2.5	2.4	2.6	3.2	3.3	3.4
Qatar	0.7	0.8	1.0	1.6	1.7	1.8
Saudi Arabia	21.4	22.6	23.7	25.4	28.4	30.1
UAE	3.4	4.1	6.2	8.2	8.4	9.0
TOTAL	**31.1**	**33.4**	**37.6**	**43.3**	**46.7**	**49.4**

Source: Economic Statistics Bulletin of Arab Countries 2013 and IMF Data

1.3 Justification of the Study

The first reason for undertaking this study is to remedy the lack of empirical studies on GCC exchange rate policy. This is mainly due to the fact that the exchange rate regimes used by most of the GCC countries have remained unchanged since the 1980s. Few researchers have needed to evaluate the effects the existing exchange regime have on the GCC. Others have simply followed classical (theoretical) approaches in determining which regime to adopt. However, the lack of economic (and financial) data and history that results from use of alternative regimes means that it is not easy to generate recommendations regarding exchange rate policy. It demands a new approach in determining which exchange regime should be adopted. This approach is based on available data and creates a benchmark that can also be used in comparing a country (or a group of countries) against another country. In this research a number of widely used economic indicators are employed. The indicators chosen allow the creation of a rule that identifies which countries should follow a fixed exchange rate regime and which should follow a flexible exchange rate regime.

The second justification for this research is that it covers areas that are not among the top priorities of those investigating GCC exchange rate policy. For example, previous work relating to the GCC exchange rate regime uses statistical analysis to focus on the type of regime that the new union should be following, and to test whether the necessary conditions for proposed currency union are satisfied. This research provides analysis of whether the GCC is ready to form a currency union or not and whether further work is required. It also evaluates the rationale behind the formation of the Euro zone and shows whether it has been a success.

Finally, the results of this research can be used by policy makers as a starting point for further detailed discussion in the future in relation to exchange regime policies.

1.4 Motivation of the Research

This research initially started as a personal motivation rather than a requirement by any institution or a university. The author lived in the UAE during the period of expansion between 2004 and 2008 and witnessed first-hand the incredible changes in public

sector wages. Annual increases in salaries of 50% were commonplace. Meanwhile, the private sector, did not enjoy anywhere near the same!

After investigating the rationale underlying these decisions, it was concluded that this was the only way forward for the Government to respond to inflation in the market. And the cause was the lack of available monetary tools and the operation of the pegged exchange rate throughout the UAE.

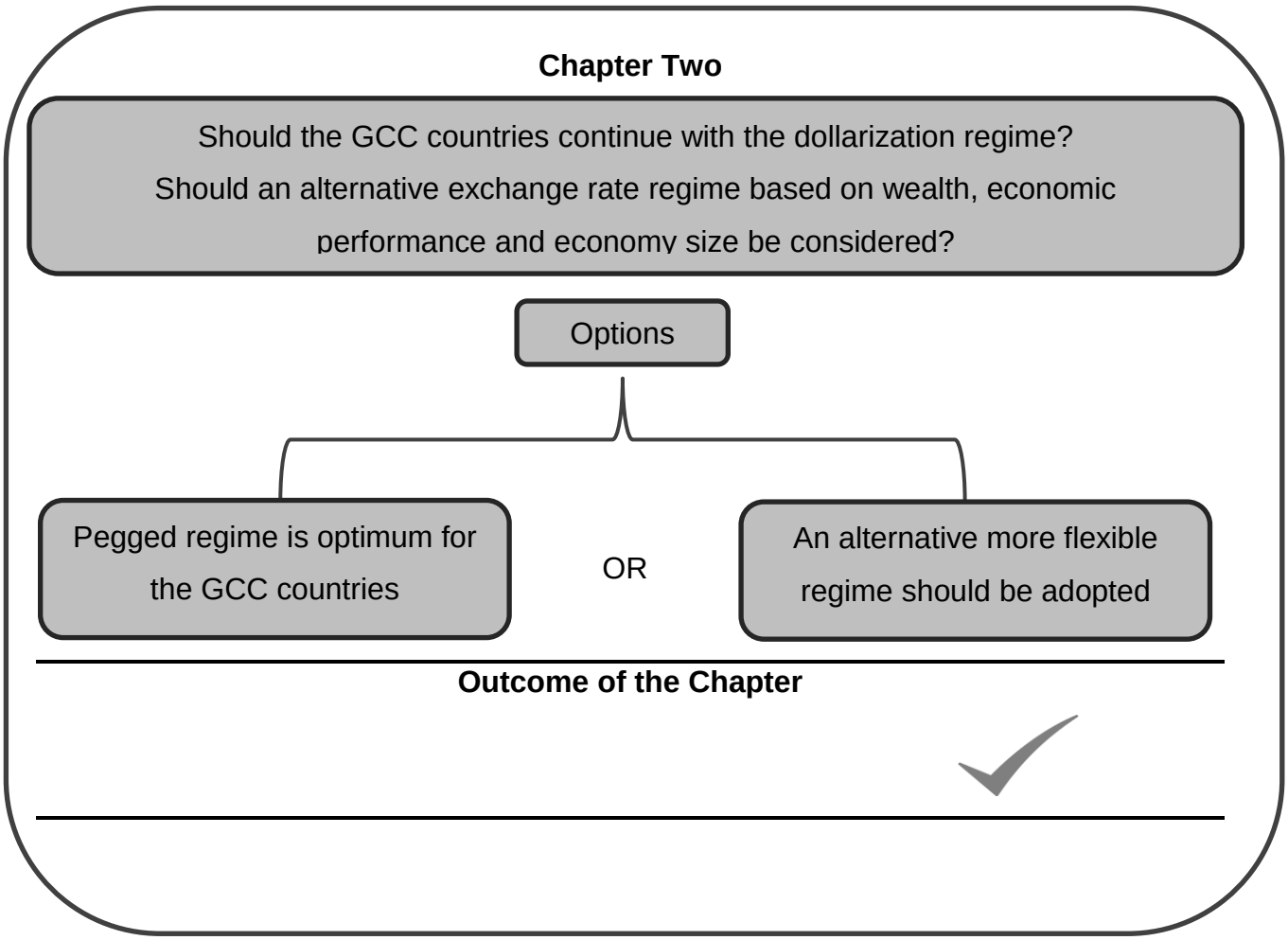
Following this the author had a meeting with the head of research at the UAE Central Bank. The meeting focused on what the UAE should do, taking into consideration that it is a cash rich oil producing economy. The main concern for the central bank was how the private sector should react to the economic changes affecting the country. At that time the UAE was in the process of improving its economic infrastructure to join the GCC currency union that was due to be launched in 2010.

Following further researches, a list of questions were raised with no answers available. As a result, this research was conducted for further comprehensive investigation, and this thesis is the result of that investigation.

1.5 Structure of the Thesis

The thesis consists of an introduction providing a detailed overview of the GCC, three chapters providing answers to each of the major questions asked and a final chapter that draws some tentative conclusions as well as indicating limitations and areas for future research.

The structure of the three main chapters of this thesis can be summarized as follows:



Chapter Three

How is the market and the private sector, as represented by the stock market, affected by exchange rate fluctuation?

Outcome of the Chapter

Minimal short-term and long-term effects are expected in GCC stock markets, assuming that increased exchange rate fluctuations result from the revised regime.

Chapter Four

Do the GCC countries satisfy the requirements necessary to form an optimal currency area (OCA)? Are they ready for the move? How can the GCC benefit from other experiences of currency union such as the Euro in moving forward?

Outcome of the Chapter

The GCC countries satisfy all of the requirements to form an OCA, but are not yet ready to proceed.

1.6 Summary

This chapter has provided the rationale and motivation for conducting the research. The research carried out and described below adds to knowledge by providing answers to questions that are important not only to researchers but to policy makers as well.

CHAPTER TWO

THE RELATIONSHIP BETWEEN KEY ECONOMIC INDICATORS AND EXCHANGE RATE REGIME

IntroductionIn the past few decades, much has been written about the conditions under which countries choose to peg or to float their exchange rate. However, there is no specific answer to the question why economies follow a given exchange rate regime. After the September 2008 credit crisis, many GCC countries reconsidered their exchange rate regimes. It is known that economies working under fixed exchange rate regimes, (and often tied to the US dollar) are more reliant on the fortunes of other, larger economies although there is often no direct evidence of this.

Numerous economies have moved from fixed to floating exchange rate regimes during the last 20 years. For example, Brazil[1] and Poland[2] have moved gradually by adopting intermediate types of exchange rate regimes, such as soft pegs, horizontal and crawling bands and managed float before finally adopting pure floating. On the other hand, Egypt[3] moved immediately to a floating exchange regime.

One of the major consequences of adopting a fixed exchange regime is that it requires the surrender of sovereignty over effective monetary instruments. This often leads local governments to respond to inflationary pressures by raising wages in the public sector and expanding subsidies on a variety of goods.

On the other hand, economists believe that selection of an exchange rate regime should be treated like any other commodity - driven by fundamentals such as demand and supply – in deciding the way forward. These fundamentals include the capability and willingness of public authorities to take such decisions and the expectations and preferences of the private sector. According to Laidler (1999) pp. v (abstract), such

1 See Duttagupta *et. al.* (2005) for more detail.
2 See Kokoszczynski (2001) for more detail
3 See Kamar (2004) for more detail

changes require existence of a coherent monetary order. A coherent monetary order "requires a well-defined goal for monetary policy, one that the authorities are capable of achieving, and that anchors private sector expectations. For it to be liberal, the relevant authorities should be accountable to the electorate for their performance".

Although economists believe that the decision to change exchange regime policy is subject to the character and fundamentals of an economy, and should not be automatically implemented across all countries that exhibit similar criteria, there is still a basic fundamental analysis that should be undertaken before drafting any recommendation for a specific economy.

The motivation for this chapter is to investigate if there is a relationship between choice of exchange rate regime and major economic indicators. The initial sample chosen comprised 100 randomly selected countries. It was then reduced to 86 countries due to data availability problems. Economic variables used reflect the wealth, openness and monetary policy capabilities of each economy and included: GDP per capita; inflation; trade openness; the ratio of trade volume to reserves; trade volume per capita and reserves per capita.

The data used comprised annual observations for the seven year period from 2002 to 2008 in order to test a proper business cycle and ignore the abnormal year following the September 2008 financial crisis. Snapshots for two years are used to investigate exchange rate regime policy. In each of two years - 2005 and 2008 - an exchange rate regime policy recommendation is derived based on the averages of the selected indicators over the previous four years. For example, the exchange regime recommendation for 2008 is based on the averages for the period 2005–2008. The exchange regime is set as the dependent variable and the annual averages of the six variables used as independent variables in a binary logit model. Three variables - GDP per capita, trade openness and the ratio of trade volume to reserves are found to be significant at the 5% level for 2005. Three variables are also found to be significant at

the 5% level for 2008. They comprise GDP per capita, trade openness and reserves per capita.

The chapter provides an interesting outcome for oil exporting economies in general and for the Gulf Cooperation Council (GCC) countries in particular. The results for 2005 show that 17 out of 60 countries are recommended to change their exchange rate regime (after excluding economies using managed floating from the sample). 6 out of the 17 countries have since changed regime. A majority of the remaining 11 countries that did not move to a different regime were oil producers/exporters and includes all of the GCC countries. The same test was then applied to the 2008 sample and similar results found. The same countries are recommended to switch from a fixed to floating exchange rate regime.

Accordingly, this chapter is organized as follows. It begins by considering existing research looking at the effects of changing exchange rate regime. It then reviews the different exchange rate regimes identified by the IMF. Data is identified and a methodology based on a binary logit model is then explained in detail. Finally, an initial recommendation is prepared based on the findings of that analysis.

One of the major objectives of this chapter is to initially identify whether a fixed or floating regime is the optimum exchange rate regime for member states of the GCC. It is found that the GCC appears to have the capabilities and basic requirements to at least make a start by adopting an intermediate exchange rate regime.

External political influences count as one of the main reasons for these economies adhering to the fixed peg or “dollarization” regime. By looking at the findings of the logit model and previous studies, support is provided to the view that it is possible to float the currency or at least start the process by moving to a more flexibly managed regime in the GCC.

2.1 Literature Review

Economists have long disagreed on the extent of financial susceptibility brought about by the various systems of exchange rate.

Higher local currency financial intermediation and trustworthiness, resulting in higher and higher levels of domestic currency debt being issued by organizations and nations, are the main benefits arising out of a strong currency according to advocates of fixed currency idealism. Through the process of creating a negative covariance among the elements of local asset prices and the income process, financial intermediation in domestic currency is enhanced by the fixed rate system for economies that are confronted with routine trade shocks, according to Hausmann *et. al*. (1999). Although, the said approach would be able to keep a tab on the economic inflation rate and affordability of local products, international affordability can be impacted negatively by the same.

Ghosh *et. al.* (1996) argue that pegged exchange rates are associated with significantly better inflation performance (lower inflation and reduced variability). However, countries that observe frequent parity changes have a lower chance of reaping the full anti-inflation benefits of a fixed exchange rate system.

Some countries might find that a fixed “dollarization” exchange rate system is advantageous. However it cannot be said to be the most suitable regime for all the developing nations - a fact pointed out by Velasco (2000). Even though a country might be categorized as developing or emerging it can still follow a floating exchange rate system approach. Complimentary rules and strategies, which consist of financial regulation, capital controls and fiscal institutions, are required by every exchange rate system and specifically by the floating exchange rate system. Technical knowledge and know-how are the key requirements when moving to a flexible system.

Duttagupta *et. al.* (2005) have argued along similar lines that the adoption of flexible exchange rate systems depends on the effective management of a number of

operational and institutional issues. Many foreign exchange markets are feeble and inefficient. Obstacles that prevent floating include the limited number of participants in the foreign exchange market, exchange controls that hinder trading, weak technological infrastructure and underdeveloped money markets.

Caramazza *et. al.* (1998) argue that inflation performance of economies that are still developing and operating under pegged exchange rates is historically quite good. However it does not hold true for all of the developing countries.

Burnside *et. al.* (2001) provides a different view to the use of pegged exchange rate regimes. According to this view, exchange rate guarantees provided by governments influence the borrowing strategies of the banks. As a result banks are more likely to expose themselves to risk by borrowing foreign currency and lending out domestic currency. This can lead to currency crisis. Unhedged foreign currency denominated loans taken out by organizations and private firms would go down, if the floating exchange rate system is taken up by the countries, as can be made out from the above approach. Private firms would be directed towards hedging as the dynamism in the foreign currency and precarious nature of the floating rate system will itself be an effective motivator.

The policy making departments of different economies have taken note of this particular approach, but the repercussions on logic and policy formulation has not been well received by researchers. Certain developing economies are likely to be prone to liability dollarization, due to their essential leaning, and the same is embedded into their system, which can be described by pegged exchange rate system's existence (Eichengreen *et. al.* 1999). Thus, the basic cause of financial instability can be attributed to incompleteness of markets, and not because banks and other organizations have avoided hedging their risks. Eichengreen *et.al.* (1999) further argue that the belief that exposure to currency risk can be reduced by adopting a flexible currency system does not hold true

In floating exchange rate regimes, the nominal exchange rate acts as a shock absorber in that it allows negative external shocks to be safely dealt with. Put simply, the adjustment paths for macroeconomic variables are made smoother. As a result this regime is seen to be a more suitable choice for the emerging market countries (Hoffmann, 2007). The time duration for a fixed exchange rate system should be specified and must not be eternal. Klein *et. al*. (1997) performed a test on the duration of exchange rate pegs using a sample of 16 Latin American countries and found that openness and trade concentration were important influences on duration.

Whilst pegging to a single currency is acceptable, the question on which country to base the peg becomes of paramount importance. Many Asian countries switched during the 1990's from a fixed peg against the US dollar to a multi-level currency system that targeted the currencies of East Asian countries as well (Giardin, 2011). This move has improved the performance of intra-trading between East Asian countries and reduced costs associated with the international trading. The results were obtained using a Markov-Switching approach applied to the synthesis model of Frankel *et. al.* (2007).

The current research is focused on binary results and the results of that study do not point out whether the fixed rate system with dollar as the peg is appropriate for member states of the GCC, or whether they should move to an alternative exchange. For these reasons the methodology above is not considered suitable in this case.

In a study of 24 Caribbean and Latin American countries, Collins (1996) was able to analyze the losses due to misalignment when a country shifts from a fixed to floating exchange rate system. It was found that over the period 1978 to 1986 that misalignment occurred as they moved to flexible regimes. However from 1987 to 1992 misalignment appeared less important. This was attributed to the fact that there was a reduction in the perceived difficulty in managing a floating exchange rate system. The analysis also found that countries with poor economic growth were likely to choose a fixed exchange rate system.

Historical evidence of exchange rate transition in which a country switches from one exchange rate system to another has been investigated by Masson (2001). Using a Markov chain model he finds that there is no evidence that exchange rate systems naturally move to the two polar extremes of fixed and floating. He finds sufficient proof that moves to intermediate regimes are both desirable and possible. However, this particular approach cannot be applied to the GCC nations as they do not have a history of changing regimes and they have been using a fixed "dollarization" exchange rate system for almost three decades.

Countries that want to shun transparency are the one's generally using intermediate exchange rate systems according to Frankel *et. al.* (2001). In such cases it becomes difficult for investors to verify if the authorities are actually following the exchange rate system they say they are. Those claiming to use a peg system will often stray away from it. Frankel and Wei (2008) consider the case of China which claimed to be running a peg to the US dollar. They found that in 2005 this was the case, but during 2006 this changed following a basket of Asian currencies as well.

2.2 Types of Exchange Rate Regimes

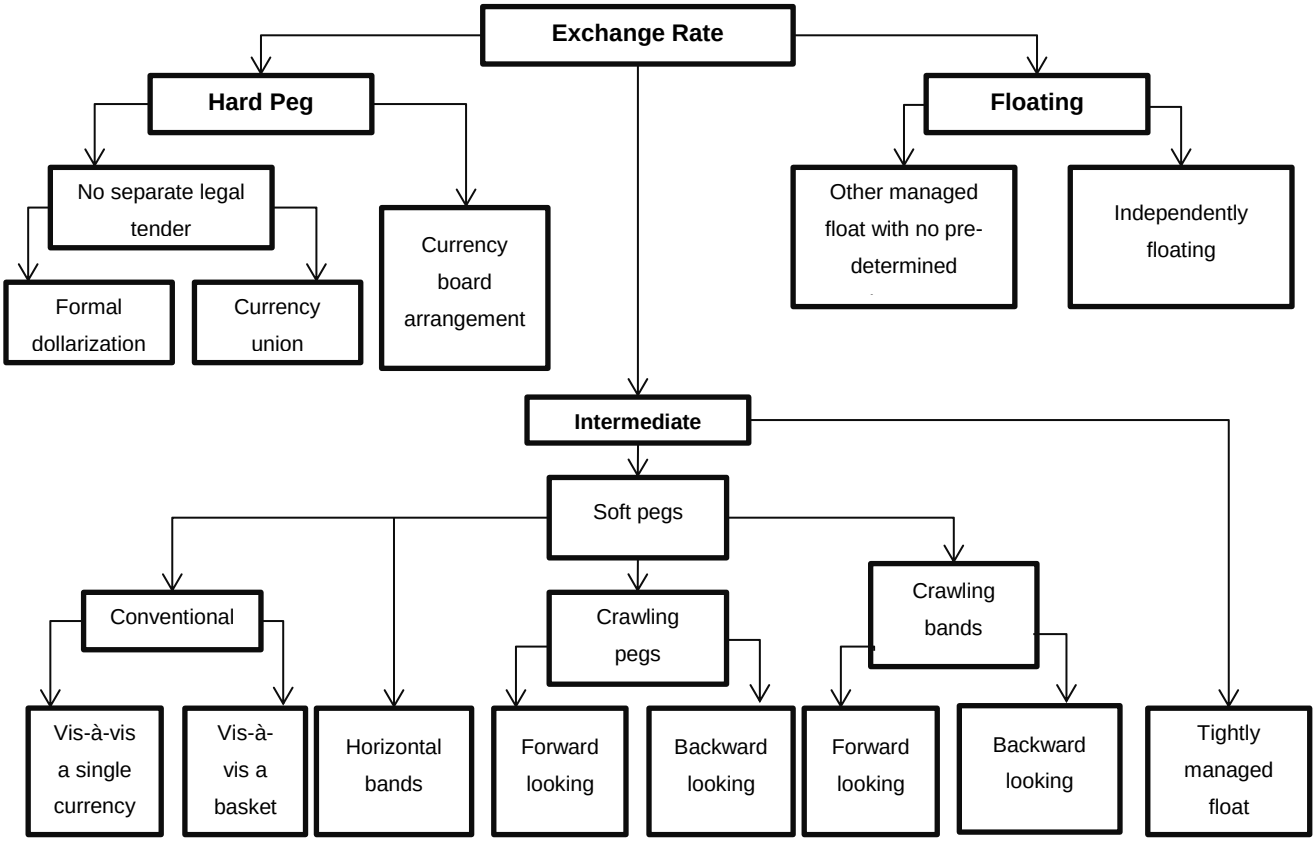
An exhaustive classification, or taxonomy of exchange rate systems has been provided by the IMF It can be noted in passing that in certain countries the *de jure* (i.e. exchange regime that the nation declares), and the *de facto* (i.e. the exchange regime believed by the IMF to be in use) can be different. Fortunately this has no impact on classification!

There are three main types of exchange rate systems followed:

- Hard Peg
- Intermediate
- Floating

The terms hard peg and floating are easy to understand by name alone. Intermediate exchange mechanisms can range from soft peg at one end to tightly managed float at the other end. Chart 2.1 provides a graphical view of the various systems in use. Also, the details and definitions highlighted below are sourced from the IMF definitions.

Chart 2.1: Types of Exchange Rate Regimes



Source: IMF

2.2.1 Hard Peg Regimes

2.2.1.1 No Separate Legal Tender

In this case the currency of another country circulates as the sole legal tender. It occurs when a country has a pegged currency with regards to another nation's currency. This scenario has been termed "dollarization" as many of the countries using it are pegged to the US dollar. This particular situation often holds when the country is a member of a currency union, where all the members of the union share the same legal tender. Adopting this particular regime results in a complete loss of sovereignty as control over domestic monetary policy by the monetary authorities is surrendered. Examples of countries using this particular exchange rate system are provided by Ecuador and El Salvador (who follow the US dollar), and Montenegro (which follows the Euro).

2.2.1.2 Currency Board Arrangements

This is a regime where there is an explicit legal commitment to exchange domestic currency at a fixed exchange rate. It places restrictions on the monetary authorities to ensure that these legal commitments are adhered to. Hong Kong, Bulgaria, Estonia and Brunei are some of the nations that have adopted this particular exchange regime.

2.2.2 Intermediate Regimes

2.2.2.1 Other Conventional Fixed Peg Arrangements

In this regime, the currency of a particular country is pegged at a fixed rate to another currency or to a basket of currencies. The basket of currencies often comprises the currencies of major trading and financial partners. As a result the strength of a currency is determined on the basis of the geographical spread of trade and capital flows. The constituents of the currency can be kept fixed or allowed to vary within a specified range. The exchange rate itself can oscillate in a narrow band around the central rate with the monetary authorities ready to intervene to maintain the fixed parity. This intervention can be direct or indirect. There are a number of measures that can be utilized by the monetary authorities to maintain the fixed parity. These include:

1. Only allowing the exchange of domestic and foreign currencies at specified rates.
2. Placing restrictions on those allowed to access foreign exchange markets. This can be accomplished through licensing and permit systems.
3. Aggressive use of interest rate policy.
4. Intervention by other public authorities.

However there is no commitment to keep the peg parity irrevocably. Fluctuation or movement of a currency is possible in this exchange rate regime, although allowed in a narrow range only. There is also limited flexibility in monetary policy as the monetary authorities can, in the limit, adjust the exchange rate. These, then, are the main advantages when compared to the hard peg system.

The actual scenario however is somewhat different as economies using the above exchange rate regime remain glued to a fixed currency, with no variation within the range. Examples of countries following this regime include the UAE, Saudi Arabia, Qatar and Bahrain. Across the globe, it is the most widely followed exchange rate system.

2.2.2.2 Pegged Exchange Rate within Horizontal Bands

The currency is maintained within margins of fluctuation of at least ±1% around a fixed (central) rate, or the margin between the maximum and minimum value of the exchange rate exceeds 2%. The flexibility of the system is a function of the band width and provides a limited degree of monetary policy discretion to those using it. It also includes arrangements of countries in the (European) exchange rate mechanism (ERM) that later became known as ERM-II. Three economies that are practicing this particular regime are the Slovak Republic, Syria and Tonga.

2.2.2.3 Crawling Pegs

Crawling pegs see the exchange rate periodically adjusted on the basis of movements in selected economic indicators. These can include both domestic and foreign indicators and include, for instance, the inflation rate and its differential *vis-à-vis* its main trading partners. The crawling peg can be set to generate inflation adjusted changes in the exchange rate (backward looking) or set at a preannounced fixed rate and/or below the projected inflation differentials (forward looking). Monetary policy in the crawling peg system is, however, constrained in the same way as a fixed peg system. There is also the need to ensure that the crawling peg remains realistic. Countries such as China, Bolivia, and Iran are examples of nations that have adopted this particular exchange rate system.

2.2.2.4 Crawling Bands

In this regime the currency is maintained in a similar way to the pegged exchange rate within horizontal bands. The currency is maintained, for instance, within ±1% of the central band. Here, however, the horizontal band is allowed to adjust either periodically at a fixed rate or in response to changes in selected economic indicators. Exchange

rate flexibility depends on the band width and the commitment to maintain the exchange rate within the band constrains the use of monetary policy. This particular exchange regime exists in only two economies – Costa Rica and Azerbaijan.

2.2.2.5 Tightly Managed Float

An amalgamation of a floating exchange rate system with that of a fixed rate system results in this regime, with floatation taking place in a very narrow margin. None of the economies worldwide are currently following this particular exchange rate system.

2.2.3 Floating Regimes

2.2.3.1 Managed Floating With No Pre-determined Path for the Exchange Rate

Here the authorities attempt through direct or indirect intervention to influence the exchange rate. Frequently there will be no specific target exchange rate or trajectory profile defined and changes will be *ad-hoc* based on indicators such as the balance of payments position and reserve (capital) inflows/outflows. Active interference by monetary authorities to control the exchange rate is now possible as it has control of a wide range of monetary tools.

Nations including the Ukraine, Algeria, Singapore, Kenya, Sudan, Egypt, India, Malaysia, Pakistan and a majority of the countries in Central America use this particular exchange rate system. It is the second most common system followed across the world. In this regime a country can easily switch from a pegged to flexible exchange rate system based on the demands of market or economy, and is one of the key reasons for its widespread acceptance across the globe.

2.2.3.2 Independently Floating

Demand and supply of the currency are responsible for the determination of the exchange rate in this system. In other words, the exchange rate is market determined. Intervention is limited and aimed at preventing excessive fluctuation. Monetary policies at both home and abroad have a direct impact on the exchange rate. The monetary authorities in the countries following this regime keep a watchful eye on changes in the global economy and can react quickly to them as they have full monetary policy control.

The major world economies – the US; countries of the Euro zone such as the UK, France and Germany; as well as Japan and Australia are all advocates of the independent floating exchange rate regime.

2.3 Data

There are two different classifications of exchange rate regimes. The first is the *de jure* exchange rate regime that represents the exchange regime announced officially by a given government. The second classification is the *de facto* exchange rate regime that represents the regime that a country actually follows in practice. It is fairly well known that the two can differ. Obstfeld *et. al.* (1995) for instance found that there was a discrepancy between the exchange regimes that governments said they were using and what they were actually using. Calvo *et. al.* (2002) also coined the phrase "fear of floating" to describe the situation where countries that say they allow their exchange rates to float mostly do not!

Using the database of IMF members' *de facto* exchange rate regimes, a sample of 100 countries was selected randomly for further statistical analysis[4]. However, due to data availability the number of countries used in the analysis had to be reduced to 86. Each exchange rate regime was then allocated a numerical code. The codes are defined in Table 2.1 below. The 11 regimes are classified into three major categories: 1) Fixed, 2) Managed, and 3) Floating. The exchange rate arrangements were then identified for two separate years - 2005 and 2008.

[4] The exchange rate regime assumed for each country in 2005 or 2008 is based on the "De facto Classification of Exchange Rate Regimes and Monetary Policy Framework" published by the IMF on 31 December 2005 and 30 April 2008 respectively.

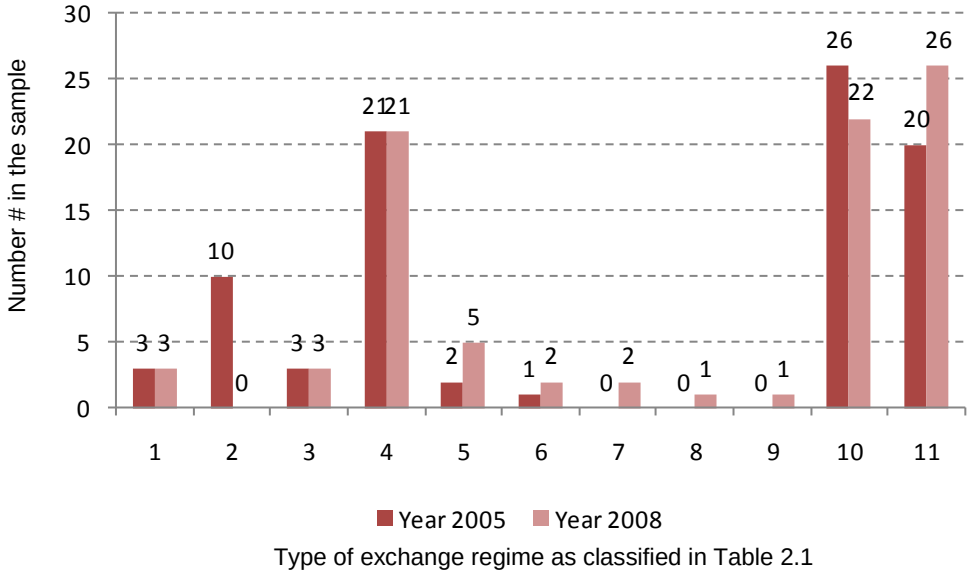
Table 2.1: Exchange Rate Regimes Classifications for the Sample

Code	Exchange regime	2005 #	2005%	2008 #	2008%	Major regime
1	Foreign currency as legal tender (formal dollarization)	3	3.5%	3	3.5%	Fixed
2	Currency union	10	11.6%	0	0.0%	
3	Currency board	3	3.5%	3	3.5%	
4	Conventional fixed peg to a single currency	21	24.4%	21	24.4%	
5	Conventional fixed peg to a currency basket	2	2.3%	5	5.8%	
6	Pegged exchange rate within horizontal bands	1	1.2%	2	2.3%	
7	Crawling peg	0	0.0%	2	2.3%	
8	Crawling band	0	0.0%	1	1.2%	
9	Tightly managed floating	0	0.0%	1	1.2%	Managed
10	Other managed floating	26	30.2%	22	25.6%	
11	Independently floating	20	23.3%	26	30.2%	Independently
	Total	**86**	**100.0%**	**86**	**100.0%**	

Source: IMF and data analysis

Chart 2.2 below compares the exchange rate regime distribution between 2005 and 2008, and summarizes the table above.

Chart 2.2: Sample Exchange Rate Regimes Distribution



Source: IMF and data analysis

Table 2.2: Major Regimes Classifications in the Sample

Exchange regime	2005 #	2005%	2008 #	2008%
Fixed regime	40	46.5%	37	43.0%
Managed floating	26	30.2%	23	26.7%
Independently floating	20	23.3%	26	30.2%
Total	**86**	**100.0%**	**86**	**100.0%**

Source: IMF and data analysis

Major economic indicators were obtained for the sample countries to examine the relationship between them and the *de facto* exchange rate regime. The following indicators are used in the statistical analysis that follows:

Table 2.3: Major Economic Indicators Used in the Tests

Economic indicator	Code	Data source
GDP Per capita	GDPPCAP	IMF & World Bank
Inflation	INFLATION	World Bank
(Import + Export) / Reserves	IERES	IMF & World Bank
Reserves per capita	RESPCAP	IMF & World Bank
Trade openness	TRADEOPE	IMF & World Bank
Trade volume per capita	TRADEVPCAP	IMF & World Bank

2.4 Methodology

Two snapshots are modeled in this chapter, where each snapshot assumes that the exchange regime used in the year of the snapshot is determined by the annual averages of the selected economic indicators in the previous four years. For example, annual averages of the major economic indicators over the period 2005–2008 determine the choice of exchange rate regime in 2008.

Accordingly, economic indicators data for the seven year period (2002–2008) were collected and *de facto* exchange regime obtained from the IMF.

To allow statistical analysis to be used the *de facto* exchange rate regime had to be converted into a numerical value. Exchange regimes were given a value of 1 if the sampled country was following a floating exchange regime and 0 if it was following a fixed exchange regime at the time. This was done in order to allow a test using a binary logit model to be carried out. Countries following managed floating regimes were excluded from the samples allowing analysis to focus on the two extreme cases. However, the final estimated logit model can still be used to investigate whether these countries should switch to an alternative exchange rate regime.

In the final estimated logit model the dependent variable is defined as a 1/0 and the independent variables are as specified in Table 2.3 above

Two logit models were estimated. The first modeled the exchange rate regime in 2005 using data for 2002-2005; whilst the second modeled the exchange rate regime in 2008 using data for 2005-2008.

The logit model represents the choice probability P_i which has a cumulative logistic distribution function:

$$P_i = F(I_i) = \frac{1}{1+e^{-Z_i}} \qquad (1)$$

where $Z_i = \beta_0 + \beta_1 X_i$ and for $-\infty < X < \infty$ P will lie between 0 and 1.

Unfortunately, the logit model cannot be estimated by ordinary least squares (OLS). However, it is possible to transform (1) in a way that allows OLS estimation to take place.

First, equation (1) is transformed

$$(1-P_i) = 1 - \frac{1}{1+e^{-Z_i}} = \frac{1+e^{-Z_i}-1}{1+e^{-Z_i}} = \frac{e^{-Z_i}}{1+e^{-Z_i}} \qquad (2)$$

Knowing that

$$\frac{P_i}{(1-P_i)} = \frac{\frac{1}{1+e^{-Z_i}}}{\frac{e^{-Z_i}}{1+e^{-Z_i}}} = \frac{1+e^{-Z_i}}{e^{-Z}(1+e^{-Z_i})} = \frac{1}{e^{-Z_i}} = e^{Z_i} \qquad (3)$$

is the odds ratio, logarithms of both sides are taken to obtain

$$L_i = \ln\left(\frac{P_i}{1-P_i}\right) = \ln(e^{Z_i}) = Z_i \qquad (4)$$

$$L_i = \beta_0 + \beta_1 X_i \quad (5)$$

The right hand side of (5) is the model that is estimated. To use it however, the odds ratios for each i need to be calculated, and to do that it is essential to re-organise the data according to the frequency of X_i.

$$\hat{P} = \frac{n_i}{N_i} \quad (6)$$

where n_i is the number of occurrences of a certain event and N_i is the total number of observations of X_i.

In (5) β_1 is the slope coefficient and measures the change of the odds. Take the exponential of it, subtract one, and multiply by 100 to obtain the percentage change in the odds for a unit increase in the regressor.

To calculate the level of probability for a given value of X, equation (5) is estimated using OLS to obtain $\hat{\beta}_0$ and $\hat{\beta}_1$. Then the value of X is substituted into the estimated equation and P is calculated.

$$\ln\left(\frac{P_i}{1-P_i}\right) = \hat{\beta}_0 + \hat{\beta}_1 X_i \quad (7)$$

$$\left(\frac{P_i}{1-P_i}\right) = \exp(\hat{\beta}_0 + \hat{\beta}_1 X_i) \quad (8)$$

$$P_i = (1-P_i)\exp(\hat{\beta}_0 + \hat{\beta}_1 X_i) \quad (9)$$

$$P_i + P_i \exp(\hat{\beta}_0 + \hat{\beta}_1 X_i) = \exp(\hat{\beta}_0 + \hat{\beta}_1 X_i) \quad (10)$$

$$P_i = \frac{\exp(\hat{\beta}_0 + \hat{\beta}_1 X_i)}{1 + \exp(\hat{\beta}_0 + \hat{\beta}_1 X_i)} \qquad (11)$$

The marginal change in probability is influenced by the level of probability.

$$\frac{\partial L_i}{\partial X_i} = \frac{\partial \ln(P)}{\partial X_i} - \frac{\partial \ln(1-P)}{\partial X_i} = \frac{\partial L}{\partial X_i}\frac{1}{P_i} + \frac{\partial L}{\partial X_i}\frac{1}{1-P_i} = \frac{\partial L}{\partial X_i}\frac{1-P_i+P_i}{P_i(1-P_i)} = \beta_1 P_i(1-P_i) \qquad (12)$$

Therefore to calculate the change in probability for given value of X_i the probability calculated using (11) must be used.

2.5 Empirical Results

The tables below show the change in exchange regime adopted in the sample countries between 2005 and 2008. The change in regime from 2005 to 2008 is classified in five different categories as follows:

1. **Extreme move to fixed**: When an economy moves from a floating regime to a fixed regime;
2. **Tighter**: When an economy moves from a floating to a managed floating regime, or from a managed floating regime to a fixed regime;
3. **No change**: The economy does not change its exchange regime;
4. **More flexible**: When an economy moves from a fixed regime to a managed floating regime, or from managed floating regime to a floating regime;
5. **Extreme move to floating**: When an economy moves from a fixed regime to a floating regime.

Only Sri Lanka moved toward an extreme fixed regime between 2005 and 2008 (Table 2.4). This move was not in accordance with the recommendation of the 2005 model (Table 2.11). However, the 2008 model (Table 2.13), provides support for the new regime followed by Sri Lanka. This may be due to implementation of new monetary policy that was not captured in the historical data.

Table 2.4: Countries within the sample moving towards an extreme fixed regime

Country	Exchange regime in 2005	Exchange regime in 2008	Change status
Sri Lanka	Floating regime	Fixed regime	Extreme Fixed

13 countries moved to a tighter regime between 2005 and 2008 (Table 2.5). Four of these countries - Papua New Guinea, Tanzania, Uganda and Uruguay - moved from a floating regime to managed floating. Only Papua New Guinea followed the recommendations of the 2005 model (Table 2.11). Tanzania, Uganda and Uruguay moved to managed floating which was not in accordance with the model's recommendation. However, moving to managed floating can be justified in these cases as they are not extreme.

Table 2.5: Countries within the sample moving towards a tighter regime

Country	Exchange regime in 2005	Exchange regime in 2008	Change status
Angola	Managed floating regime	Fixed regime	Tighter
Argentina	Managed floating regime	Fixed regime	Tighter
Croatia	Managed floating regime	Fixed regime	Tighter
Iran	Managed floating regime	Fixed regime	Tighter
Kazakhstan	Managed floating regime	Fixed regime	Tighter
Papua New Guinea	Floating regime	Managed floating regime	Tighter
Russia	Managed floating regime	Fixed regime	Tighter
Tanzania	Floating regime	Managed floating regime	Tighter
Tunisia	Managed floating regime	Fixed regime	Tighter
Uganda	Floating regime	Managed floating regime	Tighter
Uruguay	Floating regime	Managed floating regime	Tighter
Uzbekistan	Managed floating regime	Fixed regime	Tighter
Yemen	Managed floating regime	Fixed regime	Tighter

A total of 58 countries - a majority of countries in the sample - did not change their exchange rate regime between 2005 and 2008 (Table 2.6). 16 countries were employing a managed floating regime in 2005 and were excluded from the estimation work. Out of the remaining 42 countries that were included in the 2005 model, 30 countries followed the recommendation from the model (Table 2.11). The remaining 12 countries that failed to follow the recommendation include: El Salvador, Kuwait, Libya, Morocco, Oman, Panama, Qatar, Saudi Arabia, Senegal, Trinidad & Tobago, United Arab Emirates and Venezuela. 7 of these countries including Kuwait, Libya, Oman, Qatar, Saudi Arabia, United Arab Emirates and Venezuela are major oil producers/exporters. In addition, the results from the 2008 model (Table 12.3) suggest that these economies should have moved towards a more flexible regime.

Table 2.6: Countries within the sample with no change in regime

Country	Exchange regime in 2005	Exchange regime in 2008	Change status
Algeria	Managed floating regime	Managed floating regime	No change
Australia	Floating regime	Floating regime	No change
Azerbaijan	Fixed regime	Fixed regime	No change
Bahrain	Fixed regime	Fixed regime	No change
Belarus	Fixed regime	Fixed regime	No change
Brazil	Floating regime	Floating regime	No change
Bulgaria	Fixed regime	Fixed regime	No change
Canada	Floating regime	Floating regime	No change
Colombia	Managed floating regime	Managed floating regime	No change
Dominican Republic	Managed floating regime	Managed floating regime	No change
Ecuador	Fixed regime	Fixed regime	No change
Egypt	Managed floating regime	Managed floating regime	No change
El Salvador	Fixed regime	Fixed regime	No change
Equatorial Guinea	Fixed regime	Fixed regime	No change
Estonia	Fixed regime	Fixed regime	No change
Gabon	Fixed regime	Fixed regime	No change
Georgia	Managed floating regime	Managed floating regime	No change

Ghana	Managed floating regime	Managed floating regime	No change
India	Managed floating regime	Managed floating regime	No change
Indonesia	Managed floating regime	Managed floating regime	No change
Israel	Floating regime	Floating regime	No change
Japan	Floating regime	Floating regime	No change
Jordan	Fixed regime	Fixed regime	No change
Korea, South	Floating regime	Floating regime	No change
Kuwait	Fixed regime	Fixed regime	No change
Latvia	Fixed regime	Fixed regime	No change
Libya	Fixed regime	Fixed regime	No change
Lithuania	Fixed regime	Fixed regime	No change
Mexico	Floating regime	Floating regime	No change
Morocco	Fixed regime	Fixed regime	No change
Nigeria	Managed floating regime	Managed floating regime	No change
Norway	Floating regime	Floating regime	No change
Oman	Fixed regime	Fixed regime	No change
Panama	Fixed regime	Fixed regime	No change
Paraguay	Managed floating regime	Managed floating regime	No change
Peru	Managed floating regime	Managed floating regime	No change
Poland	Floating regime	Floating regime	No change
Qatar	Fixed regime	Fixed regime	No change
Romania	Managed floating regime	Managed floating regime	No change
Saudi Arabia	Fixed regime	Fixed regime	No change
Senegal	Fixed regime	Fixed regime	No change
Serbia	Managed floating regime	Managed floating regime	No change
Singapore	Managed floating regime	Managed floating regime	No change
Slovakia	Fixed regime	Fixed regime	No change
South Africa	Floating regime	Floating regime	No change
Sudan	Managed floating regime	Managed floating regime	No change
Sweden	Floating regime	Floating regime	No change
Switzerland	Floating regime	Floating regime	No change
Syria	Fixed regime	Fixed regime	No change

Thailand	Managed floating regime	Managed floating regime	No change
Trinidad and Tobago	Fixed regime	Fixed regime	No change
Turkey	Floating regime	Floating regime	No change
Turkmenistan	Fixed regime	Fixed regime	No change
United Arab Emirates	Fixed regime	Fixed regime	No change
United Kingdom	Floating regime	Floating regime	No change
United States	Floating regime	Floating regime	No change
Venezuela	Fixed regime	Fixed regime	No change
Vietnam	Fixed regime	Fixed regime	No change

Table 2.7 below lists the countries that moved toward a more flexible regime. The Czech Republic was excluded from the 2005 model. However, the 2008 model results supports a move towards a floating regime (Table 2.13). Only Pakistan was recommended to move to a more flexible regime. This became reality in 2008. Malaysia and Ukraine were recommended to continue with the fixed regime. However, and as argued previously, the move towards an intermediate regime can be justifiable in some cases. For example, in the Ukraine the move is seen as a result of its membership of the European Union. Membership requires more control of domestic monetary policy, i.e. moving away from the fixed regime.

Table 2.7: Countries within the sample moving towards a more flexible regime

Country	Exchange regime in 2005	Exchange regime in 2008	Change status
Czech Republic	Managed floating regime	Floating regime	More flexible
Malaysia	Fixed regime	Managed floating regime	More flexible
Pakistan	Fixed regime	Managed floating regime	More flexible
Ukraine	Fixed regime	Managed floating regime	More flexible

Table 2.8 below lists countries moving from a fixed to a floating regime. This extreme change can be considered amongst the riskiest. Such a move requires very sophisticated monetary policy tools and know-how. In the case of the countries listed

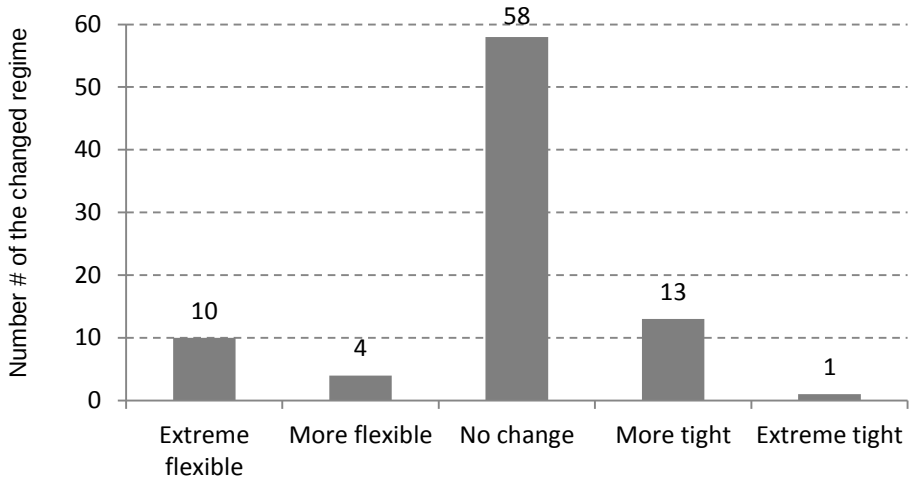
below, the move was a result of entering into the Euro zone. However, Table 2.11 provided later in this chapter shows that economies such as Greece were not ready for it. Greece has, and continues to suffer from a credit crisis, largely the result of the international financial crisis and the lack of economic fundamentals needed to deal with it.

Table 2.8: Countries within the sample moving towards an extreme flexible regime

Country	Exchange regime in 2005	Exchange regime in 2008	Change status
Austria	Fixed regime	Floating regime	Extreme flexible
Belgium	Fixed regime	Floating regime	Extreme flexible
Finland	Fixed regime	Floating regime	Extreme flexible
France	Fixed regime	Floating regime	Extreme flexible
Germany	Fixed regime	Floating regime	Extreme flexible
Greece	Fixed regime	Floating regime	Extreme flexible
Italy	Fixed regime	Floating regime	Extreme flexible
Netherlands	Fixed regime	Floating regime	Extreme flexible
Portugal	Fixed regime	Floating regime	Extreme flexible
Spain	Fixed regime	Floating regime	Extreme flexible

To summarize: the tables above, and the chart below, show that the majority of economies within the sample did not change their exchange regime. Only one country - Sri Lanka – changed its regime, moving from a floating regime to a fixed regime during the period of study. On the other hand, 10 countries from the Euro zone moved from a fixed regime to a floating regime. In general, most of the economies analyzed have adopted the long term view that the exchange rate regime should not be altered. Where it has occurred, the pace of change has been gradual.

Chart 2.3: Change in Exchange Regime between 2005 & 2008



In order to be able to quantify the data and implement the proposed methodology countries following a managed floating regime were filtered out. This allows us focus on the two extreme regimes - fixed and floating.

As a first step in implementing the proposed methodology, each exchange rate regime is given a value of 1 if it is a floating exchange rate regime and 0 if it is a fixed exchange rate regime. Obviously, some countries may have different values for 2005 & 2008; and some may exist in the 2005 sample but not in the 2008 sample (and *vice versa*). This will be the result of countries changing their exchange rate regimes, for instance, from fixed or floating to a managed floating.

The test assumes that economies around the world adopt their optimal exchange rate regimes. The GCC countries are excluded from the test. The model can then be applied to the GCC economies to evaluate if the exchange regime used in these countries should be changed.

For each year in the sample (2005 & 2008), a binary choice logit model was estimated. It was estimated using the Eviews (v7.0) econometric software package with the exchange rate regime as dependent variable and the six economic variables identified

in Table 2.3 as independent variables. The objective of the estimation was to calculate the odds of adopting a given exchange rate regime in each country.

The GCC countries and those following a managed floating regime are removed from the data to obtain the sample data sets for 2005 and 2008. The 2005 sample contained 54 observations (countries) whilst the 2008 sample contained 57 observations (countries).

Tables 2.9 and 2.10 present the estimation results for 2005 and 2008 after exclusion of statistically insignificant variables.

Table 2.9: Logit model - 2005

Dependent Variable: REGIME
Method: ML - Binary Logit (Quadratic hill climbing)
Sample: 1 54
Included observations: 54
Convergence achieved after 6 iterations
Covariance matrix computed using second derivatives

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	1.926017	1.063995	1.810175	0.0703
GDPPCAP	9.21E-05	4.36E-05	2.11457	0.0345
IERES	-0.109698	0.047136	-2.32729	0.02
TRADEOPE	-3.464521	1.498495	-2.312	0.0208

McFadden R-squared	0.326335	Mean dependent var	0.37037
S.D. dependent var	0.487438	S.E. of regression	0.378704
Akaike info criterion	1.036244	Sum squared resid	7.170838
Schwarz criterion	1.183576	Log likelihood	-23.9786
Hannan-Quinn criter.	1.093064	Restr. log likelihood	-35.5942
LR statistic	23.23129	Avg. log likelihood	-0.44405
Prob(LR statistic)	0.000036		
Obs with Dep=0	34	Total obs	54
Obs with Dep=1	20		

Table 2.10: Logit model - 2008

Dependent Variable: REGIME
Method: ML - Binary Logit (Quadratic hill climbing)
Sample: 1 57
Included observations: 57
Convergence achieved after 8 iterations
Covariance matrix computed using second derivatives

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-5.963127	3.319363	-1.79647	0.0724
GDPPCAP	0.001818	0.000843	2.156437	0.031
RESPCAP	-0.00737	0.003736	-1.97307	0.0485
TRADEOPE	-6.488025	3.239802	-2.0026	0.0452

McFadden R-squared	0.82022	Mean dependent var	0.45614
S.D. dependent var	0.5025	S.E. of regression	0.206743
Akaike info criterion	0.388193	Sum squared resid	2.265368
Schwarz criterion	0.531565	Log likelihood	-7.06351
Hannan-Quinn criter.	0.443913	Restr. log likelihood	-39.2898
LR statistic	64.4526	Avg. log likelihood	-0.12392
Prob(LR statistic)	0		
Obs with Dep=0	31	Total obs	57
Obs with Dep=1	26		

The above tables show GDP per capita and trade openness are significant at the 5% level in both years. This indicates that the exchange rate regime adopted in each country can be explained by the wealth of the economy (measured by GDP per capita) and openness of the economy (measured by trade openness). Table 2.9 shows that trade volume as a percentage of central bank reserves is a statistically significant variable in the 2005 model. Table 2.10 shows that central bank reserves per capita is a significant variable in the 2008 model.

The estimated logit model allows us to calculate the odds probability of adopting each exchange regime in the sampled countries. The same model can then be applied to investigate those countries not in the estimation sample. These of course include the GCC countries. Table 2.11 shows that the higher the probability, the better it is for the economy to adopt a floating exchange regime. For example, the probability of Japan

adopting a floating exchange regime in 2005 is 100%. On the other hand, the probability of Belarus adopting a floating exchange regime is only 2.5%. This indicates that Belarus should stick to a fixed regime.

However, since economies operating under managed floating regimes have been excluded from the model, a recommendation to move to a floating regime will only take place if the probability is in excess of 90%. This is a subjective probability; however, it shows that only countries that have the economic capabilities to adopt a floating regime should be recommended to move.

Table 2.11 shows the odds, probability, and exchange rate regime operating in 2005 (where 1 indicates the given country was following a floating regime and 0 if it was following fixed regime). The recommendation for each country is based on its probability.

Table 2.11: Countries included in the 2005 test

	Country	Odds	Probability	Exchange regime in 2005	Recommendation
1	Australia	2.21	99.7%	1	No change
2	Brazil	0.95	99.0%	1	No change
3	Canada	(0.28)	96.5%	1	No change
4	Israel	1.12	99.1%	1	No change
5	Japan	4.09	100.0%	1	No change
6	Korea, South	0.75	98.7%	1	No change
7	Mexico	(0.28)	96.5%	1	No change
8	Norway	4.60	100.0%	1	No change
9	Papua New Guinea	(4.57)	27.5%	1	Move to a tighter regime
10	Poland	(0.15)	97.0%	1	No change
11	South Africa	(0.69)	94.9%	1	No change
12	Sri Lanka	(1.13)	92.2%	1	No change
13	Sweden	1.50	99.4%	1	No change
14	Switzerland	3.08	99.9%	1	No change

15	Tanzania	0.48	98.3%	1	No change
16	Turkey	0.44	98.3%	1	No change
17	Uganda	0.77	98.8%	1	No change
18	United Kingdom	0.55	98.5%	1	No change
19	United States	0.29	98.0%	1	No change
20	Uruguay	0.44	98.3%	1	No change
21	Austria	(1.84)	85.3%	0	No change
22	Azerbaijan	(1.43)	89.8%	0	No change
23	Belarus	(7.27)	2.5%	0	No change
24	Belgium	(9.13)	0.4%	0	No change
25	Bulgaria	(1.64)	87.7%	0	No change
26	Ecuador	(1.61)	88.1%	0	No change
27	El Salvador	(0.75)	94.6%	0	Move to a more flexible regime
28	Equatorial Guinea	(2.84)	68.3%	0	No change
29	Estonia	(3.39)	55.3%	0	No change
30	Finland	1.35	99.3%	0	Move to a more flexible regime
31	France	(0.59)	95.3%	0	Move to a more flexible regime
32	Gabon	(3.63)	49.4%	0	No change
33	Germany	(1.61)	88.0%	0	No change
34	Greece	(4.33)	32.6%	0	No change
35	Italy	(0.25)	96.6%	0	Move to a more flexible regime
36	Jordan	(1.59)	88.2%	0	No change
37	Latvia	(1.41)	90.0%	0	No change
38	Libya	(0.76)	94.5%	0	Move to a more flexible regime
39	Lithuania	(1.83)	85.5%	0	No change
40	Malaysia	(4.46)	29.9%	0	No change
41	Morocco	0.10	97.6%	0	Move to a more flexible regime
42	Netherlands	(7.56)	1.9%	0	No change
43	Pakistan	0.38	98.2%	0	Move to a more flexible regime
44	Panama	0.53	98.4%	0	Move to a more flexible regime
45	Portugal	(0.68)	94.9%	0	Move to a more flexible regime
46	Senegal	(0.42)	96.0%	0	Move to a more flexible regime

47	Slovakia	(2.67)	71.8%	0	No change
48	Spain	(1.70)	87.1%	0	No change
49	Syria	(2.43)	76.4%	0	No change
50	Trinidad and Tobago	(1.17)	92.0%	0	Move to a more flexible regime
51	Turkmenistan	(1.93)	84.2%	0	No change
52	Ukraine	(2.05)	82.5%	0	No change
53	Venezuela	0.12	97.6%	0	Move to a more flexible regime
54	Vietnam	(2.63)	72.7%	0	No change
55	Bahrain	(3.64)	49.0%	0	No change
56	Kuwait	1.06	99.1%	0	Move to a more flexible regime
57	Oman	(0.95)	93.5%	0	Move to a more flexible regime
58	Qatar	1.62	99.5%	0	Move to a more flexible regime
59	Saudi Arabia	(0.15)	97.0%	0	Move to a more flexible regime
60	United Arab Emirates	(0.89)	93.8%	0	Move to a more flexible regime

Table 2.12 lists all the economies that are recommended to change exchange rate regime based on the outcome of the logit model. The table shows that 17 countries out of 60 are recommended to adopt a different exchange regime. 6 countries had followed the recommendation by 2008. Of the 11 economies that did not change regime, 7 of them - Libya, Venzuela, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates are major oil producers.

Table 2.12: Countries with a recommendation to adopt a different exchange regime based on the 2005 logit model

#	Country	Recommendation	Action made in 2008
1	Papua New Guinea	Move to a tighter regime	Moved to managed floating
2	Finland	Move to a more flexible regime	Moved to floating regime
3	France	Move to a more flexible regime	Moved to floating regime
4	Italy	Move to a more flexible regime	Moved to floating regime
5	Pakistan	Move to a more flexible regime	Moved to managed floating
6	Portugal	Move to a more flexible regime	Moved to floating regime
7	Libya	Move to a more flexible regime	No change
8	Morocco	Move to a more flexible regime	No change
9	Panama	Move to a more flexible regime	No change
10	Senegal	Move to a more flexible regime	No change
11	Trinidad and Tobago	Move to a more flexible regime	No change
12	Venezuela	Move to a more flexible regime	No change
13	Kuwait	Move to a more flexible regime	No change
14	Oman	Move to a more flexible regime	No change
15	Qatar	Move to a more flexible regime	No change
16	Saudi Arabia	Move to a more flexible regime	No change
17	United Arab Emirates	Move to a more flexible regime	No change

The 2008 results (Table 2.13) shows that 10 out of 63 countries are recommended to adopt a different exchange rate regime. 6 of them are both major oil producers and member states of the GCC.

From the logit models it is concluded that all of the GCC countries, with the exception of Bahrain are recommended (with probability of 100%) to adopt a floating exchange rate.

Table 2.13: Countries included in the 2008 test

	Country	Odd	Probability	Exchange regime in 2008	Recommendation
1	Australia	53.4616	100.0%	1	No change
2	Austria	61.1134	100.0%	1	No change
3	Belgium	52.9055	100.0%	1	No change
4	Brazil	1.1465	99.1%	1	No change
5	Canada	55.5280	100.0%	1	No change
6	Czech Republic	(1.0370)	92.9%	1	No change
7	Finland	61.5939	100.0%	1	No change
8	France	60.3746	100.0%	1	No change
9	Germany	56.5509	100.0%	1	No change
10	Greece	40.2594	100.0%	1	No change
11	Israel	9.4610	100.0%	1	No change
12	Italy	49.9485	100.0%	1	No change
13	Japan	22.0669	100.0%	1	No change
14	Korea, South	1.9280	99.6%	1	No change
15	Mexico	3.2331	99.9%	1	No change
16	Netherlands	63.4184	100.0%	1	No change
17	Norway	77.3156	100.0%	1	No change
18	Poland	1.8298	99.6%	1	No change
19	Portugal	25.2728	100.0%	1	No change
20	South Africa	(2.0754)	82.2%	1	Move to a tighter regime
21	Spain	45.8360	100.0%	1	No change
22	Sweden	60.2678	100.0%	1	No change
23	Switzerland	62.6781	100.0%	1	No change
24	Turkey	2.4400	99.8%	1	No change
25	United Kingdom	63.2641	100.0%	1	No change
26	United States	70.4611	100.0%	1	No change
27	Angola	(9.1082)	0.4%	0	No change
28	Argentina	(1.5880)	88.3%	0	No change

29	Azerbaijan	(6.1179)	7.5%	0	No change
30	Belarus	(6.3390)	6.1%	0	No change
31	Bulgaria	(12.8799)	0.0%	0	No change
32	Croatia	(0.0666)	97.2%	0	Move to a more flexible regime
33	Ecuador	(4.6879)	25.3%	0	No change
34	El Salvador	(5.7623)	10.4%	0	No change
35	Equatorial Guinea	(2.5295)	74.6%	0	No change
36	Estonia	(0.1172)	97.0%	0	Move to a more flexible regime
37	Gabon	(1.0308)	92.9%	0	Move to a more flexible regime
38	Iran	(8.5265)	0.7%	0	No change
39	Jordan	(14.2310)	0.0%	0	No change
40	Kazakhstan	(4.2456)	34.5%	0	No change
41	Latvia	(6.7201)	4.2%	0	No change
42	Libya	(45.9294)	0.0%	0	No change
43	Lithuania	(2.1696)	80.8%	0	No change
44	Morocco	(8.8082)	0.5%	0	No change
45	Panama	(1.6983)	87.1%	0	No change
46	Russia	(5.4403)	13.8%	0	No change
47	Senegal	(8.3828)	0.8%	0	No change
48	Slovakia	(7.3053)	2.4%	0	No change
49	Sri Lanka	(7.6262)	1.8%	0	No change
50	Syria	(9.7082)	0.2%	0	No change
51	Trinidad and Tobago	(11.0806)	0.1%	0	No change
52	Tunisia	(9.2789)	0.3%	0	No change
53	Turkmenistan	(12.5650)	0.0%	0	No change
54	Uzbekistan	(9.7292)	0.2%	0	No change
55	Venezuela	(0.1157)	97.0%	0	Move to a more flexible regime
56	Vietnam	(15.7969)	0.0%	0	No change
57	Yemen	(10.3347)	0.1%	0	No change
58	Bahrain	(6.9657)	3.4%	0	No change
59	Kuwait	37.2617	100.0%	0	Move to a more flexible regime
60	Oman	3.6553	99.9%	0	Move to a more flexible regime

61	Qatar	60.6514	100.0%	0	Move to a more flexible regime
62	Saudi Arabia	11.4648	100.0%	0	Move to a more flexible regime
63	United Arab Emirates	20.0488	100.0%	0	Move to a more flexible regime

Table 2.14: Countries with a recommendation to adopt a different exchange regime based on the 2008 logit model

	Country	Odd	Probability	Exchange regime in 2008	Recommendation
1	South Africa	(2.0754)	82.2%	1	Move to a tighter regime
2	Croatia	(0.0666)	97.2%	0	Move to a more flexible regime
3	Estonia	(0.1172)	97.0%	0	Move to a more flexible regime
4	Gabon	(1.0308)	92.9%	0	Move to a more flexible regime
5	Venezuela	(0.1157)	97.0%	0	Move to a more flexible regime
6	Kuwait	37.2617	100.0%	0	Move to a more flexible regime
7	Oman	3.6553	99.9%	0	Move to a more flexible regime
8	Qatar	60.6514	100.0%	0	Move to a more flexible regime
9	Saudi Arabia	11.4648	100.0%	0	Move to a more flexible regime
10	United Arab Emirates	20.0488	100.0%	0	Move to a more flexible regime

2.6 Conclusions

First, it is quite important to note that the analysis contained in this chapter is not sufficient to provide any government with a final recommendation towards selection of its exchange rate regime. The chapter starts by presenting a basic understanding of the relationship between major economic indicators (related to wealth and openness of an economy), and exchange rate regime. The models developed can be used to indicate whether or not a country should move to an alternative exchange rate regime.

The outcome of this chapter is very interesting for the GCC countries in that they are all, except for Bahrain, among the countries recommended to move towards a more flexible regime. By applying the same logic to the GCC as a single entity, it is clear that the

recommendation for Bahrain to move towards a more flexible exchange rate regime is still valid assuming that economic union happens and a single currency is realized.

The charts below shows inflation rates over the period 2001–2008 for the countries that followed the recommendations made in Table 2.12. Except for 2008, inflation appears stable and less volatile following the change of exchange rate regime in 2005. It is also clear that there is no obvious direction of change in the inflation rate in these countries.

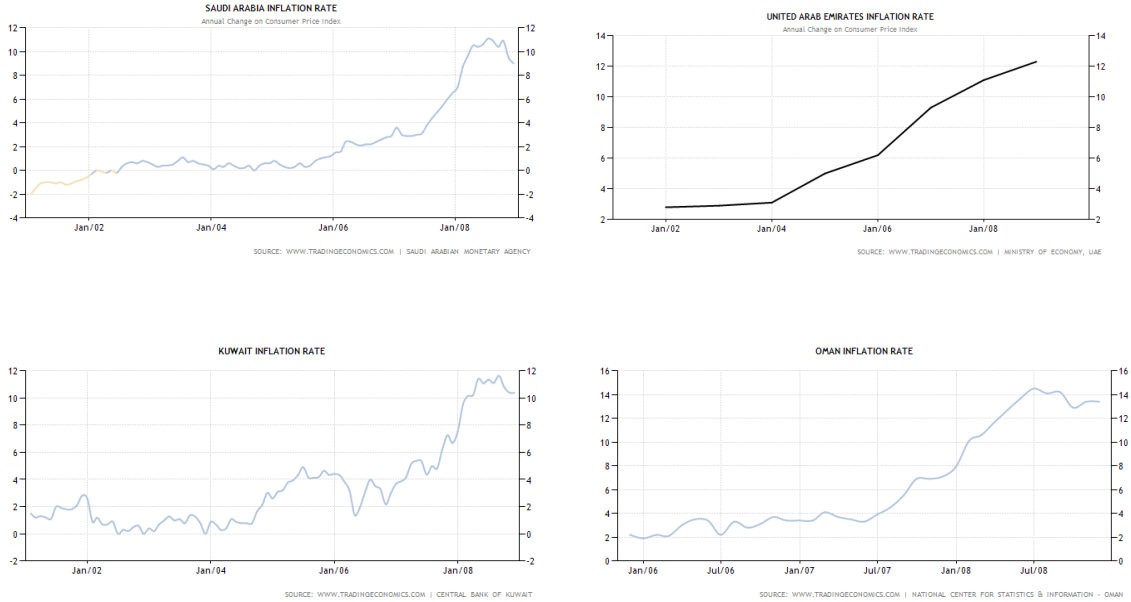
Chart 2.4: Inflation in Countries Following the 2005 Model Recommendation

Source: Trading Economics website

On the other hand, the GCC countries listed below were recommended to change their exchange rate regime but failed to do so. Here it is noticed that inflation was rising continually upward. The cause was largely a result of the lack of effective monetary

tools in these countries. However, the fact that the cause of this was the rapid increase in oil prices during the period that led to a significant increase in cash liquidity within the GCC cannot be excluded.

Chart 2.5: Inflation in Countries Not Following the 2005 Model Recommendations



Source: Trading Economics website

In summary, this chapter investigated exchange rate policies of the GCC countries. It provided recommendations based on the estimation of a logit model linking exchange rate regime to a number of important (macro)economic indicators. The analysis does not indicate that a country has to move immediately from one regime to another. It provides an incentive for a country to investigate the advantages of changing its exchange rate system based on economic indicators it is able to observe. Taking into consideration the outcome of the modeling, it is concluded that the wealthier and more open that an economy is, the higher the probability that it should adopt a more flexible regime. Accordingly, movement towards a more flexible regime is to be expected when forming a currency union that improves economic integration between its members.

CHAPTER THREE

THE RELATIONSHIP BETWEEN STOCK MARKET AND EXCHANGE RATE REGIME

3.1 Introduction

There are three competing views on the nature of the relationship between the exchange rate and stock prices. The first view suggests that there is no relationship between the exchange rate and the stock market. Nieh *et. al.* (2002) found that there was no long run relationship in a study of G7 countries. They did find existence of a significant short run relationship but it was limited to a single day in a small number of the countries.

The second approach argues that the exchange rate Granger causes stock price movements. Dornbush *et. al.* (1980) claim that changes in the exchange rate affect the competitiveness of firms, firm's earnings, net worth and accordingly stock prices.

The third approach according to Frankel (2003) argues that stock prices Granger cause exchange rates. This approach suggests that changes in stock prices influence capital flows of foreign investors who then substitute local/foreign currency for foreign/local currency. Accordingly, changes in stock prices lead to appreciation/depreciation of the exchange rate as a result of increases in the demand/supply of foreign currency.

The purpose of this chapter is to further investigate the relationship between the stock market and domestic exchange rate (against the US dollar) for the Gulf Cooperation Council (GCC) countries. However, since the GCC countries apart from Kuwait, have been following fixed exchange rate regimes for the last 30 years, it is not possible to examine this relationship directly.

Accordingly, this study selects countries that have similar characteristics to the GCC economies. The analysis can then be applied to the GCC economies at some point in the future, assuming they move to a non-dollarization regime.

The main criteria is dependence on the US dollar. In some cases this will occur as the result of a country having the US as a main trading partner. In others it will be due to the fact that commodities bought and sold are priced in US dollars. This is the case for all of the GCC economies since they are all major exporters of oil and the price of oil is measured in USD/barrel. In addition, the selected countries need to have:

- Been following a non-dollarization exchange regime for the last 10 years at least;
- A stock market index with long historical data available.

As a result, three countries were selected. They comprise:

- Japan - a major oil importer and major trading partner of the US.
- Russia - the only major oil exporter with a non-dollarization regime and the largest gas exporter in the world.
- Brazil - the US is Brazil's main trading partner in terms of both imports and exports.

This chapter will evaluate the relationship between the stock market and the foreign exchange market using two separate approaches.

The first approach uses economic theory by employing a standard Mundell-Fleming model. In this approach, the IS curve, that represents the goods market is assumed to move in the same direction as the stock market. This is a common assumption, since the goods market is represented by stock market indices. In other words, a change in the exchange rate and/or government policy will affect the IS curve and the stock market index in the same direction. Hence, the movement of the stock market can be concluded from the movement of the IS curve.

The second approach examines the relationship between the domestic exchange rate and stock market index for Japan, Russia and Brazil using time series methods. A unit root test is used to investigate stationarity of the data. This is followed by testing and

estimation of cointegration and vector autoregression (VAR) models. Finally Granger causality tests are performed to check if causality exists and in which direction it runs.

The empirical work carried out provides evidence of a long-run relationship in Russia and Brazil but not in Japan. Estimating a VAR model suggests that there is also a minimal short-run relationship in both Russia and Brazil. However, the results of Granger Causality testing suggest that there is no Granger causation in either direction between the two variables.

3.2 Literature Review

Researchers have long been interested in the relationship between the behavior of the stock market and key macroeconomic variables. The role of the exchange rate has been of particular interest.

Pan *et. al.* (2002) investigated and found existence of a causal relationship between stock market prices and the exchange rate using data for Hong Kong, Japan, Korea, Malaysia, Singapore, Taiwan and Thailand. Additionally it was found that during the 1997 Asian financial crisis that the relationship became even stronger.

Bartram *et. al.* (2012) use a large sample of non-financial organizations from 37 different countries to study the significance of exchange rate exposure on the stock return generation process. They find that there is no unconditional relationship between stock returns and exchange rate exposure. However a conditional relationship does exist when the realized change in the exchange rate is used as conditioning variable. Furthermore, changes in the exchange rate have a direct correlation with the achieved return to exposure. The study established that the return effect is greater for organizations in developed economies as compared to those in developing ones, with the variation of return effect being in the range of 1.2 to 3.3% per unit of currency exposure. Even though there are issues that some of the individual time series are noisy and many exposures are not statistically significant, their research suggests that there are noticeable differences in the effect of exchange rate variation on the return of firms.

In order to determine the association between exchange rate and stock price index, data for six Asian economies were analyzed by Tsai (2012). Theory suggests that these two variables should be negatively correlated with each other. Tsai (2012) used a quantile regression model as the results obtained from conventional ordinary least squares estimation were not encouraging. It was found using this approach that the negative relation between the stock market and foreign exchange market is better defined when exchange rates are extremely high or low.

Using data for the period 1991 to 2011, Imam *et. al.* (2012) analyzed the association between the Australian/US dollar exchange rate and Australian and US stock indices. Using computational intelligence techniques they find that the exchange rate is best forecast using a linear forecast model rather than by using nonlinear or intelligent systems models.

By segregating export focused nations from import inclined ones, the association between the stock market and exchange rate was examined in a more practical manner by Ma *et. al.* (1990). The research established that increases in the exchange rate had opposite effects on the stock markets of export and import focused countries. For an export dominant country currency appreciation reduces its competitiveness in export markets and has a negative effect on the domestic stock market. For an import dominated country the currency appreciation lowers import costs and impacts positively on the domestic stock market. In passing it can be noted that the outcome of this particular study is consistent with the theoretical findings of the Mundell-Fleming model.

In order to examine the effect of financial liberalization in China on the relationship between exchange rate and stock market performance, Tian *et. al. (2010)* employ an autoregressive distribute lag (ARDL) cointegration strategy. They find existence after 1995 of a cointegration relationship between the Shanghai index and renminbi/US dollar exchange rate. It has to be remembered however that this period saw the introduction of a truly flexible managed floating exchange rate system. They further show that stock price is positively affected by the exchange rate and money supply. The shift towards a

more flexible exchange rate system saw the currency appreciate and resulted in “hot money” entering the country. This increased money supply, pushed stock markets higher and saw the currency appreciate even further.

In order to analyze the relationship between the (Chinese) Renminbi (RMB) real exchange rate and domestic stock market over the period January 1991 to June 2009, Zhao (2012) employs VAR and multivariate GARCH models. Although the study finds that a long term relationship between the exchange rate and stock market exists, it is found to be unstable.

In a few economies the presence of a relationship between the exchange rate and stock market relationship has been established. However for a number of other nations it has not yet been confirmed. An illustration of this follows from research carried out by Lean *et. al.* (2008). They test for cointegration and Granger causality using a sample comprising data from eight South East Asian countries over the time period January 1991 to June 2005. They find little evidence of cointegration. Only one country – South Korea – shows any sign of cointegration over the full sample period; and even there the relationship is very weak with a long run uni-directional Granger causality running from exchange rate to stock prices.

Through analysis of the banking sector, Chamberlain *et. al.* (1997) investigate the foreign exposure of a sample of US and Japanese banks. In particular they attempt to relate equity return to exchange rate using a comparative analysis. The results of the research carried out confirm the existence of such a relationship. Stock returns of a significant fraction of US companies move with the exchange rate whilst few of the Japanese companies do. In another study the association between the Japanese Yen with its domestic stock market was analyzed by He *et. al.* (1998). It was found that only 25% of the 171 Japanese multinationals considered, experienced economically significant positive effects from exchange rate exposure.

The existence of the above association was, however, not found by Barlov *et. al.* (1994). They found that contemporary changes in the US dollar had little explanatory power in explaining abnormal stock returns in their sample of 208 US firms.

Long run non-causality, unit-root, and cointegration tests were employed by Bhattacharya *et. al.* (2001) to analyze the association between the Indian stock market index and a number of macroeconomic variables over the ten year period 1990/91 to 2000/01. No causal relationship was found to exist between stock prices and the three macroeconomic variables (real effective exchange rate, foreign exchange reserves and value of the trade balance) used.

In order to analyze further the causal linkage between macroeconomic variables and the exchange rate, Ali *et. al.* (2010) investigates the case of Pakistan (for which little previous work had been undertaken). Federal Bureau of Statistics of Pakistan data for the stock exchange index, inflation, money supply, index of industrial production and exchange rate were collected for the period 1990 to 2008. The stock exchange index used was the Karachi stock exchange general prices index. A standard Augmented Dickey Fuller (ADF) unit root test was used to check for stationarity. Johansen's cointegration test was then applied to investigate for cointegration between the variables. Finally, Granger's causality test was used to investigate the nature of the causal relationship. The study found no evidence of a causal relationship between stock prices and the selected macroeconomic variables. It did, however, find a cointegration relationship between stock prices and the index of industrial production. It was concluded that macroeconomic variables cannot be used to predict stock prices

In analyzing the relationship between the exchange rate and stock market prices in the G7 nations, Nieh *et. al.* (2002) made two discoveries. First that there is no long run significant relationship between the two variables; second that the short run relationship was confirmed for one day and only then for a small number of the G7 countries considered.

The existence of a long run relationship between the exchange rate and stock market was not found when the same approach using a Granger causality test was carried out by Song *et. al.* (2007). The research revealed the presence of a short term relationship, and confirmed that in the short term, the exchange rate does influence stock market prices. However the converse does not hold true.

3.3 The Effect of Foreign Exchange on the Stock Market

This section considers the foreign exchange market and explains its effect on the stock market from a theoretical point of view. The main focus will be on the Mundell-Fleming model, where the stock market is represented by the goods market IS curve.

3.3.1 The Foreign Exchange Market

3.3.1.1 Size and Distribution

According to the results of a survey carried out by the BIS (Bank for International Settlements), foreign exchange market turnover experienced high rates of growth up to 1998. From 1998-2001 it declined as a result of the launch of the Euro that caused a majority of intra-European transactions to disappear.

Table 3.1: Foreign Exchange Market Growth (1995-2010)

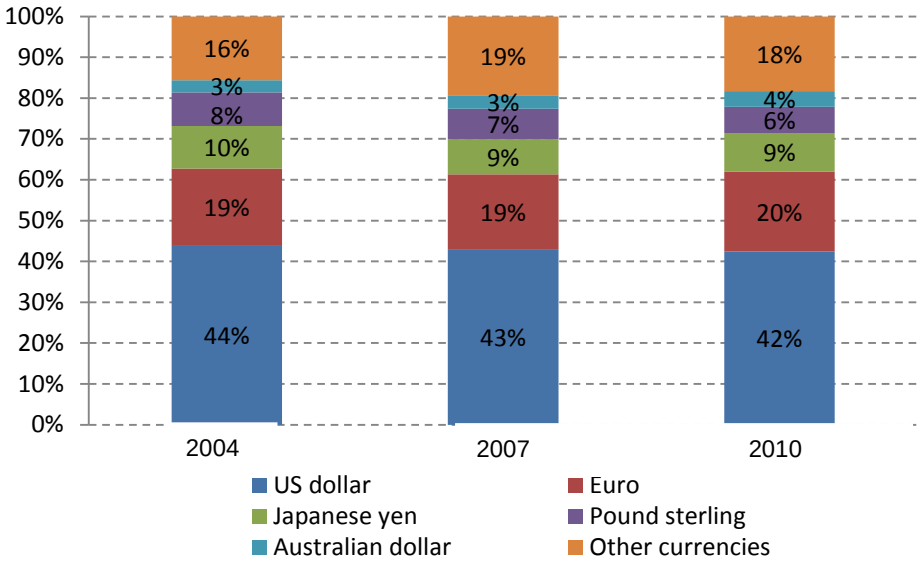
	1995	1998	2001	2004	2007	2010
Average daily turnover (US$ billion)	1,225	1,527	1,239	1,934	3,324	3,981
Annual Growth %		25%	-19%	56%	72%	20%

Source: http://www.bis.org/index.htm

Foreign exchange market (FEM) average daily turnover was US$ 1,225 billion in 1995 compared with US$ 1,934 billion in 2004 - an average annual growth of 6%. High rates of growth also occurred between 2004 and 2010 with the market almost doubling over the six year, period - resulting in an average annual growth of 18%.

Chart 3.1 below shows that the US dollar is still one of the most widely used international currencies with it accounting for more than 40% of total market size between 2004 and 2010, though the Euro became its main competitor after 2004, with a market share in excess of 19%.

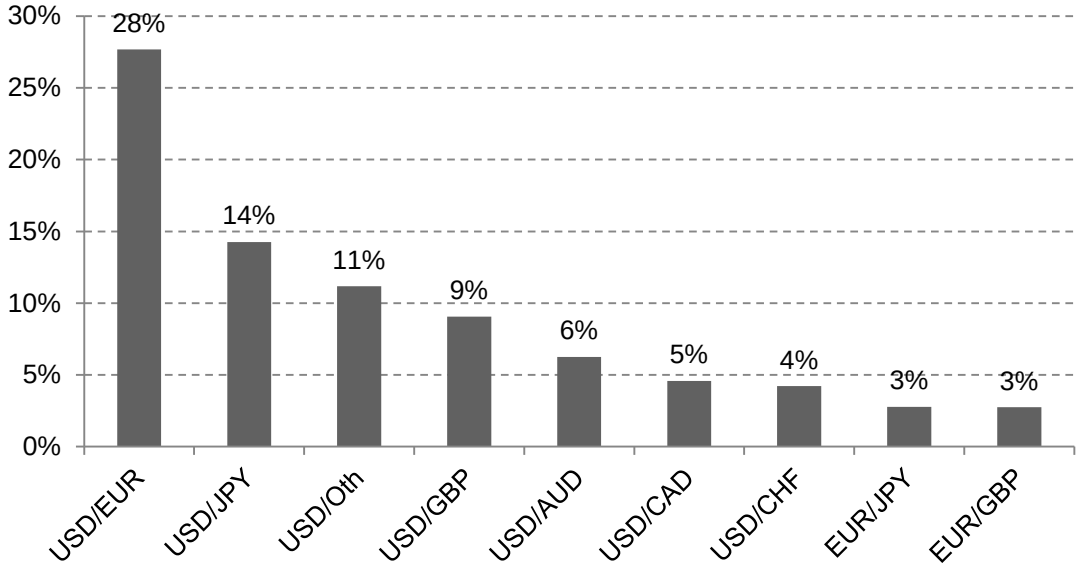
Chart 3.1: Market Share by Currency (2004-2010)



Source: http://www.bis.org/index.htm

In terms of global foreign exchange market turnover the US dollar remains the dominant currency with 28% of deals involving the USD/EUR and 14% of deals involving the USD/JPY in 2010.

Chart 3.2: Foreign Exchange Market Turnover by Currency Pairs (2010)



Source: http://www.bis.org/index.htm

3.3.1.2 Demand for Foreign Currency

According to IMF researches, there are many factors determining the demand for a foreign currency. The major of these are analyzed below:

3.3.1.2.1 Importation

The main objective of buying a foreign currency is to buy foreign goods and services. If this is the case then what are the reasons for buying goods and services from a foreign country? The obvious and textbook answer to this question is relative prices. If the prices of domestic goods are higher relative to foreign goods then there will be an incentive to purchase them abroad. This will increase the demand for foreign goods and services and increase the demand for foreign currencies. In addition, if people prefer foreign products more than the locally produced ones, then this will also increase the demand for foreign currency. Finally, an increase in individual incomes will increase demand for foreign currency since they will *cetiris paribus* demand more goods and services, some of which will be foreign.

3.3.1.2.2 Portfolio Investment

Portfolio investment means lending money to someone in another country. Lending here means either opening an account in a foreign country, or buying shares and bonds from this country. It is well known that this lending is highly related to interest rates. As foreign interest rates rise domestic money flows out. This will cause the demand for foreign exchange to increase, and *vice-versa*.

3.3.1.2.3 Foreign Direct Investment (FDI)

FDI involves owning and controlling a company or part of a company in a foreign country. If a local company wants to establish a company in a foreign country it has to pay for it in the currency of the foreign country. As a result, the demand for foreign currency will increase.

3.3.1.2.4 Expectations

The final reason for buying a foreign currency is to undertake currency speculation. If a domestic investor has an expectation that the exchange rate is going to change then profit opportunities arise. For instance if a trader believes that the Euro will strengthen

("appreciate") against the U.S. dollar, then the trader will buy Euros with U.S. dollars. If the exchange rate rises and the speculator thinks that the appreciation will taper off, the investor can buy U.S. dollars with the Euros that were purchased. The profit is made by through arbitrage - the difference between the currency exchange rates.

3.4 The Mundell-Fleming Model

The objective of the Mundell-Fleming model is the determination of equilibrium income, and deals with the response of income and interest rate to changes in economic policy and internal/external shocks that occur within the economy. The model extends the simple closed economy IS-LM model to an open economy setting. Equilibrium occurs at the intersection of the IS, LM, and FE curves where the goods market is represented by an IS curve (that encompasses the stock market), the money market is represented by the LM curve, and the foreign exchange market is represented by the FE curve.

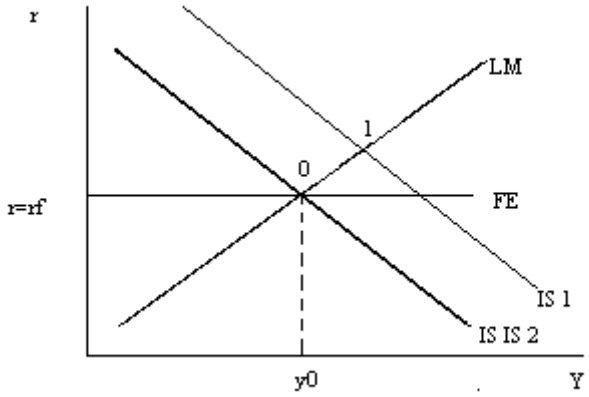
Dornbusch *et. al.* (2001) pp.172, defines it more precisely: "the analysis extending the standard IS-LM model to the open economy under perfect capital mobility has a special name, the Mundell-Fleming model".

3.4.1 The effects of fiscal policy in the Mundell-Fleming model

The effect of fiscal and monetary policy under a non-dollarization exchange rate system can be analyzed easily using the Mundell-Fleming model.

The effect of expansionary fiscal policy - increasing government spending (G) or decreasing taxes (T) - is shown in Chart 3.3.

Chart 3.3: Effects of Expansionary Fiscal Policy on Equilibrium Income



Source: Developed by the Author of the Thesis

Expansionary fiscal policy causes the IS curve to shift upward from IS to IS1. Following this there is an increase in the stock market index. At the point labeled “1” equilibrium between IS1 and LM is above the FE curve and means that the balance of payments is in surplus. At this point the domestic interest rate (r) has increased. This will induce investors to move their money into (domestic) banks. To do this they have to sell their own currency and buy the domestic currency. This then leads to an increase in the price of the domestic currency.

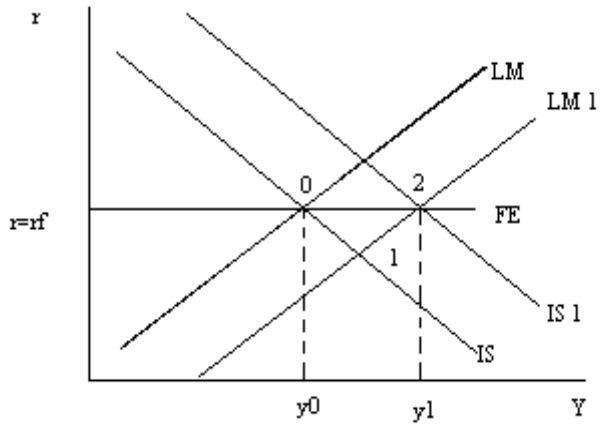
However, an appreciation of the local currency decreases profits for exporting firms as foreign demand for their products fall. In addition fluctuations in the exchange rate also affect the transactions exposure of these companies. It also affects the value of the firm’s future payable in foreign currency. This means that the country is less competitive in the market, and this causes IS1 to shift downward to IS2. In the final analysis equilibrium is unchanged which means that income (Y) and interest rate (r) remain constant.

The conclusion here is that an increase in fiscal policy causes the stock market to grow for a period of time. However, this growth causes the exchange rate to increase and this increase then affects the stock market causing it to fall until it returns to its previous position.

The impact of the exchange rate on the stock market depends on the importance of international trade and how much this trade contributes to the income of the economy. In the words of Pan *et. al.* (2002) pp. 6, “Countries that have a higher trade to GDP ratio, exchange rate fluctuations tend to exhibit significant influence on the equity market, regardless of the exchange rate arrangement system and the degree of capital control”.

3.4.2 The effects of monetary policy in the Mundell-Fleming model

Chart 3.4: Effects of a Fall in Money Supply on Equilibrium Income



Source: Developed by the Author of the Thesis

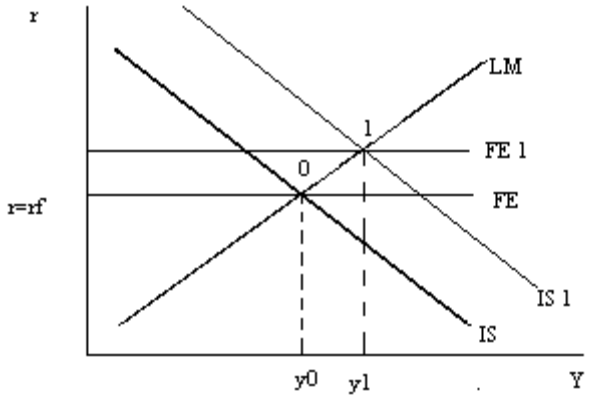
The LM curve moves to the right (from LM to LM1) since the money supply has been reduced. Equilibrium between IS and LM1 occurs below the FE curve. As a result there is a deficit on the balance of payments as the interest rate has fallen. This leads to depreciation in the nominal exchange rate and also the real exchange rate. At this point the economy becomes more competitive and the IS curve will shift upward to IS1. The new equilibrium is now at the point where IS1 intersects with LM1 and FE. In the final position, income (Y) rises whilst the interest rate (r) remains constant.

As a conclusion, monetary policy is useful in an open economy non-dollarization exchange rate regime as it can affect the level of output. However it is impotent in affecting the interest rate under perfect capital mobility.

3.4.3 The Effect of FE Curve Movement on Equilibrium Income

The movement of the FE curve is a result of shocks in the foreign sector such as appreciation/depreciation of the currency, or a change in foreign interest rates. An increase in the foreign interest rate will shift the FE curve upward to FE1. At the intersection between IS, LM and FE1 there is a deficit on the balance of payments. The size of this deficit is correlated with the increase in the foreign interest rate. The increase in the foreign interest rate encourages capital to leave the country. Hence, demand for local currency will fall and the currency will depreciate. This depreciation will make the country more competitive in export markets. So the goods market expands. The IS curve shifts to IS1 to intersect with LM and FE1. The final effect is that both interest rate (r) and income (Y) rise.

Chart 3.5: Effects of a Rise in the Foreign Rate of Interest



Source: Developed by the Author of the Thesis

From the above analysis, it is concluded that theoretically at least there is a relationship between stock market and exchange rate. However, this relationship differs from one country to another and depends on many external and internal factors.

3.5 Data

The objective of this chapter is to support the GCC economies in their possible future decision to move away from the dollarization regime. These economies are considered among the top oil exporters around the world where oil trading represents the bulk of

their international trading volume. Table 3.2 below shows the contribution of oil and gas to international trade for the GCC countries.

Table 3.2: Contribution of Oil and Gas Exports to International Trade in 2010

	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE
Net Oil and gas exports as % of international trade	**19%**	**34%**	**22%**	**53%**	**42%**	**28%**

Source: Joint Arab Economic Report, Arab Monetary Fund (AMF). April 2011

The table shows that the US dollar is the main currency used in international trade by the GCC countries (since oil and gas are priced in US dollars). Since the GCC economies except for Kuwait have been following a dollarization exchange regime for almost 30 years, it is not possible to directly measure the effects of change in their dollar exchange rates on domestic stock indices.

By selecting other economies where the US dollar is used as a major currency in international trade, support may be provided to the case of the GCC. If a relationship between the exchange rate and the stock market is found to exist in economies that are considered similar, then the analysis can be carried over to members of the GCC. It is then possible to observe the expected long-run effect of adopting an alternative exchange regime on the local stock markets of GCC member states.

The economies that have been selected for analysis in this chapter have the following characteristics:

- They have not been following a dollarization exchange regime over the last 10 years;
- They have a stock market index with long historical data;
- They use the US dollar as a main currency.

All European Union (EU) countries were excluded from the sample due to their high levels of intra-trading.

Table 3.3 below lists 12 economies considered in the initial shortlist for economies to be benchmarked against those from the GCC. An attempt was made to select major oil and gas producers and economies that are highly dependent on the US dollar in their trading.

Unfortunately, only three economies met this requirement. Many of the countries in the table lacked sufficient data to undertake the analysis.

Table 3.3: Initial List of Countries for Benchmark Selection

Country	Stock Market Data	Dollarization Regime	USD Dependent	Comments
Algeria	N	N	Y	Minimal Stock Market data
Australia	Y	N	N	Trading with USA represents 4.8%
Brazil	Y	N	Y	USA is the main trading partner
Ecuador	N	N	Y	Minimal Stock Market data - 2004 onward
Egypt	Y	N	N	Not USD dependent
Iran	N	N	Y	No market data
Iraq	N	N	Y	No market data
Japan	Y	Y	Y	Major oil importer; US is a major trading partner
Libya	N	Y	Y	No market data and dollarization
Nigeria	N	N	Y	No market data
Russia	Y	N	Y	Major gas exporter
Venzuela	Y	Y	Y	Dollarization regime and no data

Source: IMF, World Fact Book and World Trade Organization

Based on Table 3.3 above Japan, Russia and Brazil were selected for the following reasons:

Japan – one of the world's major oil importers that relies on the USA as a major international trading partner:

Japan is considered a major oil importer. Net oil imports account for 13.1% of its total trade according to table 3.4 and its assumptions. It is ranked as the 3rd largest oil importer after the US and EU according to the World Fact Book in 2012. 13.8% of its international trading is with the US. Hence, Japan depends heavily on the US dollar in its international trading. Accordingly it was selected to be used in the tests.

Russia – Among the world's major oil and natural gas exporters:

Russia is the 2nd largest oil exporter in the world, and net export value from oil represents 27% of its total international trade, according to the below table and its assumptions. In addition to exporting oil, Russia is also the largest natural gas exporter in the world (which is also priced in US dollars). As a result, and although Russia is not a major trading partner of the USA, its economy is very sensitive to the US dollar since its major trading commodities are priced and traded in US dollars.

Brazil – The USA is its main international trading partner:

Brazil is a major trading partner of the USA.13.1% of its international trade is with the USA.

Table 3.4: Oil and International Trading Data for the Selected Economies (2009)

	Japan	Russia	Brazil
Net oil export value in US$ billion*	(137)	134	(2)
Net oil export as % of international trading	-13.1%	27.0%	-0.6%
Oil export ranking	44	2	27
Oil Import ranking	3	87	20
Export from the USA % from total	16.42%	3.50%	10.50%
Import from the USA % from total	10.96%	4.46%	16.12%
Trading from USA as % of total trading	13.8%	3.9%	13.1%

Source: CIA Fact Book

* Based on an average price of US$ 75 per barrel of oil

3.6 Methodology

Two approaches can be used to analyze the relationship between the stock market and the exchange rate. The first, as previously outlined, is the theoretical approach that employs the Mundell-Fleming model.

The second approach uses quantitative (time series econometric) methods. The first step in examining this relationship is to test for stationarity of the original variables. After confirming that the data are stationary using Unite Root Test, Cointegration test is examined between the local stock market performance and the domestic currency/USD

in the selected countries (Japan, Russian and Brasil). The objective of this test is to assess whether a long-run relationship exists between the two variables. The presence of long-run relationship supports the effectiveness of monetary policies in affecting the market performance. Assuming that this relationship exists, an ECM test is implemented to check for short-run relationship. Otherwise, VAR test is applied. After completing the long-run and short-run relationship tests, a Granger Causality test is applied between the two variables (stock market index and domestic currency/USD) to investigate whether any of the two variables can be used to forecast the other variable.

One matter that should be taken into consideration is the number and length of lags used. If the chosen lag length is greater than that necessary it will cause inefficiency in estimation. A solution to this problem has been provided by Hsiao (1981) who developed a systematic autoregressive method for choosing the optimal lag length by using the mean square prediction error. The mean square prediction error is a combination between Granger causality test and Akaike's Final Predictive Error (FPE). Alternatively, a VAR test is implemented using between 2 and 4 lags.

In this thesis, unit root tests are used to examine stationarity of the logarithms of the selected stock market and exchange rate variables. If a time series is found to have a unit root then the first differences of that time series are stationary.

3.6.1 Unit Root Test

The unit root test is a test used to examine if a data series is stationary or non-stationary. It is important to check whether a series is stationary or not before using it in any regression model or for forecasting.

Stationary series are series of data for which the probability distribution underlying the data generating process is time invariant. In other words the probability distribution does not change over time. However it is impossible to test this strong definition of stationarity. Instead the test used check for "weak" stationarity. A stationary series has a constant mean and variance and a covariance that depends only on the length of time

separating the two values (and not the actual times at which the variables are observed.)

There are many ways for determining whether a time series is stationary or nonstationary. There are three main tests that can be used for this purpose - the Dickey-Fuller (DF) test, Augmented Dickey-Fuller (ADF) test, and Phillips-Perron (PP) test. In this study, the Augmented Dickey-Fuller (ADF) test will be used to examine if the series are stationary or not.

The basic idea behind the unit root test of stationary can be demonstrated by considering the equation of a simple first order autoregressive AR(1) process:

$$Y_t = \rho Y_{t-1} + \varepsilon_t \qquad (1)$$

Where ε_t is a white noise error term with mean 0 and constant variance σ^2.

Textbook analysis highlights that the process is stationary when $|\rho| < 1$ and nonstationary when $|\rho| = 1$

So to test for stationarity, a hypothesis test on the value of a single coefficient is examined. Normally, a transformation of the model in (1) is undertaken to make the analysis easier.

$$Y_t - Y_{t-1} = \rho Y_{t-1} - Y_{t-1} + \varepsilon_t \qquad (2)$$

$$\Delta Y_t = (1-\rho) Y_{t-1} + \varepsilon_t \qquad (3)$$

$$\Delta Y_t = \gamma Y_{t-1} + \varepsilon_t \qquad (4)$$

This allows to test the hypothesis in one of two ways.

$$H_0 : \rho = 1 \quad \Leftrightarrow \quad H_0 : \gamma = 0 \qquad (5a)$$

$$H_1 : \rho < 1 \quad \Leftrightarrow \quad H_1 : \gamma < 0 \qquad (5b)$$

Note that the null hypothesis is that the series is nonstationary. In other words, if the null hypothesis is not rejected, it is concluded that the data comes from a nonstationary process.

Of course the AR(1) model is a very simple representation.

More often test models of the following form are found

$$\Delta Y_t = \alpha + \gamma Y_{t-1} + \varepsilon_t \qquad (6)$$

or

$$\Delta Y_t = \alpha + \gamma Y_{t-1} + \lambda t + \varepsilon_t \qquad (7)$$

In these cases, testing for nonstationarity is carried out in exactly the same way as before. it is tested whether $\gamma = 0$ (or $\rho = 1$). If null hypothesis that $\gamma = 0$ is rejected, it is concluded that the data series is stationary!

Unfortunately, a standard t-test of $\gamma = 0$ cannot be used as the calculated t statistic no longer has a t distribution. If the null hypothesis is true, Y_t is nonstationarity and its variance increases as the sample size increases.

To recognize for this, the statistic is often called the τ (tau) statistic. This statistic is then compared to specially calculated critical values that were generated originally by Dickey and Fuller using Monte Carlo methods.

An important extension of the Dickey-Fuller tests allows for the possibility that the error term is autocorrelated. Such autocorrelation is likely to occur if the model does not have sufficient lag terms to capture the full dynamic nature of the data generating process. As a result the Augmented Dickey-Fuller Test (ADF) was born.

Using the model, for instance, described in (6), a further lagged terms are added to ensure that the residuals are not autocorrelated. This is equivalent to estimating:

$$\Delta Y_t = \alpha + \gamma Y_{t-1} + \sum_{s=1}^{m} a_s \Delta Y_{t-s} + \varepsilon_t \qquad (8)$$

The number of lagged terms can be determined by examining the autocorrelation function of the residuals or the significance of the coefficients of the estimated lag coefficients. The ADF test is simply a test of $\gamma = 0$ in (8). In the following analysis, use is made of the ADF test.

3.6.2 Cointegration

After confirming stationarity using an ADF unit root test, a cointegration test is then applied to investigate cointegration between the stock market index and domestic exchange rate (against the US dollar) for each of the selected countries - Japan, Russia and Brazil.

Cointegration means that despite two data series being individually nonstationary, a linear combination of the two may, in fact, be stationary. Cointegration of two or more time series suggests that there is a long-run equilibrium relationship between the two time series – that they share similar stochastic trends.

This can be defined more precisely. If Y_t and X_t are I(1) then expect their difference or any other linear combination of them such as $e_t = Y_t - \alpha - \beta X_t$ to be I(1) as well. However there is an important case when $e_t = Y_t - \alpha - \beta X_t$ is a stationary I(0) process. In this case it is concluded that Y_t and X_t are cointegrated. More generally, if Y_t and X_t are I(a) and $e_t = Y_t - \alpha - \beta X_t$ is I(b) then Y_t and X_t are integrated of order (a,b). The most common case occurs when $a = 1$ and $b = 0$.

The common test of whether two variables are cointegrated is to perform OLS regression estimation of $Y_t = \alpha - \beta X_t + e_t$ and test for stationarity of the residuals using Dickey-Fuller or Augmented Dickey-Fuller test as follows:

$$\Delta \hat{e}_t = \gamma \hat{e}_t + v_t \quad (9)$$

Where v_t is a white noise random error.

The hypotheses tested are:

$H_0 : \gamma = 0$. That is, e_t is I(1) and there is no cointegration.

$H_1 : \gamma < 0$. That is, e_t is I(0) and there is cointegration.

The critical values for the test are identical to those used in the DF test described earlier.

3.6.3 Vector Autoregression (VAR) and Vector Error Correction (VEC) Models

In the analysis above, it is assumed that one variable, say Y_t, is the dependent variable and the other, say X_t, is the independent variable. However unless there is good reason, it could be assumed that Y_t, is the independent variable and X_t, is the dependent variable. It can be further argued that the two variables X and Y are, in fact, simultaneously determined. With two variables the result is a bivariate system.

For instance the set of equations:

$$Y_t = \beta_{10} + \beta_{11} Y_{t-1} + \beta_{12} X_{t-1} + v_t^Y \quad (10a)$$

$$X_t = \beta_{20} + \beta_{21} Y_{t-1} + \beta_{22} X_{t-1} + v_t^X \quad (10b)$$

is known as a vector autoregressive VAR(1) model as it only involves the first lag of each variable and a random error.

Econometric theory confirms that to find that Y and X are stationary I(0) variables then simple ordinary least squares can be applied (OLS) to estimate each of the equations separately.

If Y and X are nonstationary I(1) and not cointegrated then it would be worked with first differences.

However if Y and X are I(1) and cointegrated then analysis should be modified to allow for it. The resulting model is known as a Vector Error Correction model (that is often abbreviated to VEC, VECM or more often ECM).

Estimation of an ECM, which is the main interest, is carried out straightforwardly using a two stage procedure due to Engle and Granger (date?).

Step 1:

Estimate $Y_t = \alpha - \beta X_t + e_t$ by OLS to obtain the residuals $\hat{e}_t$ where $\hat{e}_t = Y_t - \hat{\alpha} - \hat{\beta} X_t$

Step 2: Estimate the ECM equations using:

$$\Delta Y_t = \alpha_{10} + \alpha_{11}\hat{e}_{t-1} + v_t^Y \qquad (11a)$$

$$\Delta X_t = \alpha_{20} + \alpha_{21}\hat{e}_{t-1} + v_t^X \qquad (11b)$$

In the empirical work carried out a VAR model is applied to check the short-term relationship between each stock market index and its associated domestic exchange rate (against the US$).

3.6.4 Granger Causality Test

The study of causality is one of the most important objectives of empirical econometrics and the work carried out by Granger (1969) provides a comprehensive testing framework for investigating the relationship between the stock market index and the exchange rate.

Consider the following VAR model representation.

$$Y_t = \sum_{i=1}^{n} \alpha_i X_{t-i} + \sum_{i=1}^{n} \beta_i Y_{t-i} + \varepsilon_t^Y \qquad (12a)$$

$$X_t = \sum_{i=1}^{n} \phi_i X_{t-i} + \sum_{i=1}^{n} \varphi_i Y_{t-i} + \varepsilon_t^X \qquad (12b)$$

Where, for instance, Y_t is defined as the exchange rate, X_t is the stock market index and the white noise error terms ε_t^Y and ε_t^X are uncorrelated. This model confirms that the exchange rate is related to its own past history and the past history of the stock market index. Similarly, the stock market index is related to its own past history and the past history of the exchange rate. As there are two variables, this is a bivariate VAR (n) model.

A question that may be askd is the following: does the exchange rate cause the stock market index, or does stock market index cause the exchange rate? Using the model above, four cases are identified:

1. Unidirectional causality from X to Y is indicated if the estimated coefficients of the lagged X in equation 12a are statistically different from 0 as a group (i.e. $\sum_{i=1}^{n} \alpha_i \neq 0$) and the set of estimated coefficients on the lagged Y in equation 12b are not statistically different from 0 (i.e. $\sum_{i=1}^{n} \varphi_i = 0$)

2. Unidirectional causality from Y to X is indicated if the set of lagged X coefficients in equation 11a are not statistically different from 0 (i.e. $\sum_{i=1}^{n} \alpha_i = 0$)

and the set of coefficients on the lagged Y coefficients in equation 12b are not statistically different from 0 (i.e. $\sum_{i=1}^{n} \phi_i \neq 0$)

3. Bilateral causality occurs when the sets of Y and X coefficients are statistically significant from zero in both equations 12a, 12b.

4. Independence occurs when the sets of Y and X coefficients are not statistically significant in both equations 12a, 12b

So to test for Granger causality from X to Y (or *vice versa*) all what should be done is to run a simple F test. Equation 12a is estimated using least squares excluding the lagged X variables and obtain the restricted residual sum of squares. Then the regression is run again including the lagged terms to obtain the unrestricted residual sum of squares. The null hypothesis to be tested is $H_0 : \sum_{i=1}^{n} \alpha_i = 0$, that is, lagged X terms do not belong in the regression. The F statistic is calculated using the restricted and unrestricted residual sums of squares and test against a critical value obtained from table. If the computed value exceeds the critical value, the null hypothesis is rejected in which case the lagged X terms belong in the equation. In other words "X (Granger) causes Y".

Using a similar procedure, equation 12b is checked to find whether Y (Granger) causes X!

3.7 Empirical Work

This section presents the results of the tests that were carried out to investigate the relationship between the stock market index and domestic exchange rate for each of the selected countries.

The empirical work will start by applying a unit root test on the level and the first difference to check for stationarity. Checking for cointegration at the level then takes place. If the series are cointegrated, an error correction model is then estimated; if not a VAR model is estimated using the first difference. Finally, Granger causality testing is applied to examine the nature of causality.

The data series used are as follows:

- JPY/USD – the exchange rate between the Japanese Yen and US dollar
- RRB/USD – the exchange rate between the Russian Rouble and US dollar
- BRR/USD – the exchange rate between the Brazilian Real and US dollar
- NIKKEI – the Japanese [Tokyo] stock exchange index
- RTS the Russian [Moscow] stock exchange index
- BOVESPA - theBrazilian [Sao Paolo] stock exchange index

3.7.1 Results of the ADF Test

The starting point in the empirical work is to test for stationarity by applying an ADF test to the logarithm of each variable. The following shorthand notation is used:

$$LJU = \log(JPY/USD)$$

$$LRU = \log(RRB/USD)$$

$$LBU = \log(BRR/USD)$$

$$LNIK = \log(NIKKEI)$$

$$LRTS = \log(RTS)$$

$$LBOV = \log(BOVESPA)$$

The results of the ADF tests are provided in full in Appendix A1 Tables 1-6. A summary is provided in Table 3.5 below. Together they show that all the series except for LRU are nonstationary.

The calculated values of the τ (tau) statistic are all on the right hand side of the critical values except in the case of LRU. It means that in each case it is failed to reject the null hypothesis of nonstationarity.

Table 3.5: Summary of ADF Tests - Levels

Series	Value	5% critical value	1% critical value
LJU	-0.3457	-2.8804	-3.4736
LRU	-3.1788	-2.8804	-3.4736
LBU	-2.4807	-2.8804	-3.4736
LNIK	-2.0067	-2.8804	-3.4736
LRTS	-1.8808	-2.8804	-3.4736
LBOV	-1.3535	-2.8804	-3.4736

It is also possible to test stationarity of the log return instead. The following shorthand notation is used:

$$RJU = 100 \times (\log[JPY/USD_t] - \log[JPY/USD_{t-1}])$$

$$RRU = 100 \times (\log[RRB/USD_t] - \log[RRB/USD_{t-1}])$$

$$RBU = 100 \times (\log[BRR/USD_t] - \log[BRR/USD_{t-1}])$$

$$RNIK = 100 \times (\log[NIKKEI_t] - \log[NIKKEI_{t-1}])$$

$$RRTS = 100 \times (\log[RTS_t] - \log[RTS_{t-1}])$$

$$RBOV = 100 \times (\log[BOV_t] - \log[BOV_{t-1}])$$

The results of the ADF test are provided in full in Appendix A1 Tables 7-12. A summary is provided in Table 3.6 below. The calculated values of the τ (tau) statistic are all less than their 1% and 5% critical values. It means that the null hypothesis is rejected and all of these series are stationary.

Table 3.6: Summary of ADF Tests - Log Returns

Series	Value	5% critical value	1% critical value
RJU	-7.3799	-2.8805	-3.4739
RRU	-6.8876	-2.8805	-3.4739
RBU	-5.1545	-2.8805	-3.4739
RNIK	-5.2701	-2.8805	-3.4739
RRTS	-5.5216	-2.8805	-3.4739
RBOV	-5.7733	-2.8805	-3.4739

3.7.2 Cointegration Test Results

Cointegration tests were applied to confirm the presence of a relationship between LJU and LNIK; LRU and LRTS; LBU and LBOV. The full results are provided in Appendix A1 Tables 13-15. Analysis is carried out by considering the results of the Trace and Maximum Eigenvalue tests.

3.7.2.1 Trace Test

The trace test determines the number of cointegrating equations (r). The trace statistic that is used tests the null hypothesis of r cointegrating relationships against the alternative of k cointegrating relationships where k is the number of endogenous variables, for r=0,1,…,k-1. To complete the test the calculated trace statistic against its 5% critical value are compared.

First the logarithms of JPY/USD and NIKKEI index are considered. Table 3.7 shows that both trace statistics are less than their critical values. Put another way, the p value for the trace statistics are both insignificant at the 5% level of significance. It means that it is failed to reject the null hypothesis and conclude that there are no cointegrating equations between the two variables.

Table 3.7: Trace Test
Between Log(JPY/USD) and Log(NIKKEI) (1998-2011)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.032497	5.214631	15.49471	0.7856
At most 1	0.001269	0.193034	3.841466	0.6604

Trace test indicates no cointegration at the 0.05 level

Secondly the logarithms of RRB/USD and RTS index are considered. Table 3.8 shows that both trace statistics are greater than their critical values. Looking at the p values it is found that both trace statistics are significant at the 5% level. It means that the hypothesis is rejected and there is one cointegrating equation between the two variables.

Table 3.8: Trace Test
Between Log(RRB/USD) and Log(RTS) (1998-2011)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.095589	22.72512	15.49471	0.0034
At most 1 *	0.047853	7.453400	3.841466	0.0063

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

Finally, the case of the logarithms of BRR/USD and BOVESPA index is considered. Table 3.9 shows that only one of the trace statistics is significant at the 5% level. It means that the hypothesis is rejected and there is one cointegrating equation.

Table 3.9: Trace Test
Between Log(BRR/USD) and Log(BOVESPA) (1998-2011)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.146307	26.38660	15.49471	0.0008
At most 1	0.015294	2.342673	3.841466	0.1259

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

3.7.2.2 Maximum Eigenvalue Test

The Maximum Eigenvalue statistic tests the null hypothesis of r cointegration relationships against the alternative of r+1 cointegration relationships. To complete the test the calculated maximum eigenvalue statistic is compared against its 5% critical value.

First the logarithms of JPY/USD and NIKKEI index are considered. Table 3.10 shows that the maximum eigenvalue statistic is insignificant in both cases. The test concludes that there are no cointegrating equations between the two series.

Table 3.10: Maximum Eigenvalue Test
Between Log(JPY/USD) and Log(NIKKEI) (1998-2011)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.032497	5.021596	14.26460	0.7391
At most 1	0.001269	0.193034	3.841466	0.6604

Max-eigenvalue test indicates no cointegration at the 0.05 level

Secondly the logarithms of RRB/USD and RTS index are considered. Table 3.11 confirms the results of the trace test and suggest the presence of 2 cointegrating equations. The two maximum eigenvalue statistics both exceed their critical values. They are both significant at the 5% level. Accordingly, the hypothesis is rejected and there is one cointegrating equation.

Table 3.11: Maximum Eigenvalue Test
Between Log(RRB/USD) and Log(RTS) (1998-2011)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.095589	15.27172	14.26460	0.0345
At most 1 *	0.047853	7.453400	3.841466	0.0063

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

Finally, the case of the logarithms of BRR/USD and BOV index is considered. Table 3.12 confirms the results of the trace test. . Only in one case is the critical value exceeded. It indicates existence of 1 cointegrating equation.

Table 3.12: Maximum Eigenvalue Test
Between Log(BRR/USD) and Log(BOVESPA) (1998-2011)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.146307	24.04393	14.26460	0.0011
At most 1	0.015294	2.342673	3.841466	0.1259

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

3.7.3 Vector Autoregression Results

The objective of applying the VAR test is to check if there is any kind of relationship between the variables in the short-run. Accordingly, a VAR test was applied to the log of return of the JPY/USD and NIKKEI index, since there was no cointegration found. On the other hand, an Error Correction Model (ECM) was estimated for Russia and Brazil, due to the presence of cointegration. The full results of all the tests are shown in Appendix A1 Tables 16-24.

The VAR test was applied to the first difference of the JPY/USD exchange rate and NIKKEI index (at 4 lags). The results – Appendix A1 Tables 16-18 – show that there is no relationship between the two variables since the t-value at the four lags level is less than 2 for both RUJ and RNIK. The R square values for RJU and RNIK are 0.059 and 0.075 respectively. Both are extremely small and indicate that there is no relationship between the two variables. The same result is found when applying the test using 2 and 3 lags instead

In the case of the RRB/USD and RTS, an error correction model (ECM) was estimated. The results – Appendix A1 Tables 19-21 – show that there is a relationship only at 4 lags between the D(RRTS) and D(RRU(-1)), since the t-statistic value of 2.36 is greater than 2. However, the low R square values of 0.43 and 0.29, provide little support that

such a relationship exists. The same ECM model was restimated using 2 and 3 lags and a similar conclusion resulted.

An error correction model was also estimated for the log return of the BRR/USD and BOV. The results – Appendix A1 Tables 22-24 – show that there is no evidence of any relationship at either the 2 or 4 lags levels. However, at the 3 lags level there is support for the presence of a relationship since the t-statistic values between D(RBOV) & D(RBU(-1)), D(RBOV) & D(RBU(-2)) and D(RBU) & D(RBOV(-1)) are all greater than 2. The R-square value for D(RBU) is 0.56 and 0.45 for D(RBOV). Both of these are sufficiently large to suggest that it is not possible to reject the presence of this relationship. Accordingly, it is concluded that there is a short-run relationship between the BRR/USD and BOV at the 3 lags level.

3.7.4 Granger Causality Test Results

The result of Granger causality tests on the first differences suggests that their is no unidirectional causality in either direction. It indicates that there is no evidence, even in the short-run, of a relationship between the stock market and the foreign exchange market in Japan, Russia and Brazil (Appendix A1, Tables 25-27).

3.8 Conclusions

The current investigation examines the relationship between stock return and exchange rates in Japan, Russia and Brazil using monthly data for the period 1998 to 2011.

Theoretical analysis utilising a Mundell-Fleming model and a large amount of empirical evidence provides support for this relationship. However, this relationship is not constant in all economies and it may exist in some countries and disappear in others.

The findings of the statistical research carried out in this chapter suggest that in the case of Japan there is little evidence in support of a short or long-run relationship between the JPY/USD exchange rate and NIKKEI index. On the other hand, cointegration tests show that there is a long-run relationship between the RRB/USD & RTS and BRR/USD & BOV. However, Granger Causality testing does not support the

hypothesis that any unidirectional causalty between the variables is present. This indicates that these variables are moving in the same direction in the long-run. It also means that it is not possible to predict either of these variables (using historical data) knowing the movement of the other. In addition, the results obtained from estimation of the error correction models show that there is a short-run relationship between stock market return and foreign exchange market in both Russia and Brazil. However, this relationship is not constant and is of little use in forecasting one of the variables using the other, even in the short-run.

In order to confirm that the outcomes are not due to sample selection the analysis was then performed on two half-samples. The full results for the two half samples are contained in Appendices A2 and A3 respectively.

Since Russia is a major oil exporter and Brazil is an economy that depends heavily on the US as a trading partner they share a similarity to the GCC. Based on the outcome of this chapter, the following advice is provided to the GCC economies (assuming they move to a non-dollarization regime in the future):

- GCC countries' domestic currency/US dollar exchange rate and domestic stock index are expected to move in the same direction;
- GCC economies, assuming they decide to unpeg their currencies should consider a gradual move, since a shock to the domestic exchange rate may cause a shock to their stock markets and indirectly to the whole economy; and
- Monetary policy, which does not exist at the moment due to the dollarization regime, may influence stock market movement in the long-run, assuming it is used in the objective of appreciating/depreciating the currency against the US dollar.

CHAPTER FOUR

GCC CURRENCY UNION: LEARNING FROM THE EURO EXPERIENCE

4.1 Introduction

Recent political events in the Middle East have brought into question the need for better economic cooperation between members of the Gulf Cooperation Council (GCC). This need was discussed as part of a wider call for a more advanced economic, political and military union at the Bahrain summit of GCC leaders in December 2012. The proposed GCC currency union that was to have been launched in 2010 has still not been achieved. This chapter evaluates the current position and the likelihood and readiness of GCC countries to form a currency union.

The foundations for complete economic union were laid down at the second meeting of the GCC Supreme Council. At the meeting an economic agreement was agreed upon by the GCC member states. In order to accomplish coordination, integration and collaboration among GCC member states on a number of different economic issues, a set of broad outlines were established. A free trade area, customs and economic union and a common market for member states are some of the steps that have been proposed (and in some cases taken) by the Council to achieve total economic integration across the region.

In 1983, the first foundations for economic integration were laid down with the creation of a free trade zone. In 1999, the setting up of a customs union marked the second stage of economic integration with acceptance of a schedule for it to be operational by 2005 accepted. Adoption of a common peg for a number of GCC member states currencies followed acceptance of it by GCC leaders attending the 2000 Bahrain summit meeting. It was seen by many as the first step in the creation of the single currency. This was seen as a necessary foundation for accomplishing complete economic integration.

According to the AMF, a uniform customs tariff of 5% targeted for 2003 by the GCC nations in 2001 was achieved in 2005.

As a move towards adoption of the common currency in 2010 it was also agreed that member states would peg their currencies to the US dollar. Various reasons, both internal and external, resulted in this target being missed.

Oman announced in December 2006[5] that it would not be able to meet the target date. Following the announcement that the central bank for the monetary union would be located in Riyadh and not in Abu Dhabi, the UAE announced in May 2009 that they would be withdrawing from the monetary union project. If realized, the GCC monetary union will be the second largest supranational monetary union in the world, as measured by GDP of the common-currency area.

Table 4.1: GCC Chronology

Year	Achievement
1981	Formation of the GCC
1981	Adoption of an Economic Agreement
1983	Launch a Free Trade Zone
1999	Decision made to form a Custom Union
2000	Agreement to adopt a common peg and CU
2001	Agreement to form a Joint Custom Tariff
2003	Implementation of Joint Custom Tariff
2005	Formation of Custom Union
2010	Deadline to form a Currency Union (not achieved)

Source: Different publications by Arab Monetary Fund

Although the authorities in the GCC are working towards the diversification of industry, they still rely on the oil sector to a significant extent, with oil and gas contributing around

[5] Emirates Centre for Strategic Studies and Research (January 2007),

39% of total GDP (of US$ 848 billion) in 2009[6]. If the interdependence of other industries with oil and gas are taken into consideration then this figure would be far higher than 39%. About 80% of public expenditures are financed by income emanating from the oil sector. With the GCC owning 42% of worldwide oil assets and 23% of established gas assets[7], the member states of the GCC are crucial to the global economy.

The population of the region in 2011 was approximately 40 million and average GDP per capital was around USD 24,000. Biggest among the GCC countries in terms of GDP, size and population, is Saudi Arabia. Its population alone accounts for almost 70% of the total population of the region. In terms of wealth per capita, Qatar and UAE are ranked among the top, while Bahrain and Oman are at the bottom. The situation of Bahrain and Oman is worse than meets the eye as they have small oil reserves that are expected to run out in the next twenty years. If the GCC is compared to the EU, then Bahrain and Oman can be compared to the likes of Greece and Portugal. Kuwait, Saudi Arabia and UAE on the other hand have large oil reserves that will provide streams of revenue well into the next century. Imports into the GCC are mainly from the EU, while export markets (for oil and gas) are generally located in South and East Asia. Even though GCC economies are quite transparent, with the minimum ratio being 60% of trade to GDP, but still the figures for intra-trade at 6% of the total trade was quite low in 2010, and this figure can climb up to 17% if oil trading[8] is not included in the figures.

In the 20 year period up to 2006 GCC inflation was kept well under control at 5%. Since 2006 it has climbed up to 10%. The initial low inflation rate can be attributed to the restricted ability to use monetary policy and pegging of currencies to the dollar. Ample foreign currency assets have been the key reason behind the almost constant fiscal policy. According to Marzovilla *et. al. (*2010), the currencies of 5 GCC member states

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[6] Arab Monetary Fund, Economic Statistics Bulletin of Arab Countries 2011

[7]European Central Bank, 2005. International Business & Economics Research Journal – November 2007 Volume 6, pp 11-43

[8]International Trade Statistics 2010

were pegged to the dollar. Only in Kuwait did this different, where it was pegged to a basket of currencies. As a result GCC exchange rates have been relatively stable and most of the GCC member states have been confronted with similar problems in reacting to economic shocks as they share very similar economic backgrounds.

The presence of ample foreign exchange assets has also safeguarded the exchange rate. Accordingly, GCC member countries also have similar interest rates structures as well. The role of monetary policy has been restricted due to both these factors. As a result there has been a dependence on fiscal policy. Within the GCC nations, *de facto* monetary policy harmonization has been made possible through exchange, interest and inflation rate constancy.

Asymmetrical performance has been showcased by public debt among the GCC nations, even though the economic constitution is almost same. Disparity in the magnitude and elements of public expenditures and income, in the acceptance of fiscal policy, and in the amount of prior shortfall or excess, are some of the reasons which can be seen to be responsible for the asymmetrical debt performance. The ratio of public debt to GDP in Saudi Arabia was 55% in 2010, while that for Bahrain and Qatar was 50%. Oman and UAE by comparison fared quite well with the ratio being around 30%[9].

The foreign oil market plays a significant role in the budgets of many GCC member states. As oil prices (and revenues) have declined, the authorities have had to reduce their expenditure and use money out of their foreign exchange reserves.

The lack of progress in adopting currency union has occurred for two main reasons. First is the tension in the Middle East, particularly between Iran and GCC nations; and the aftermath of the Arab Spring. Second is the evidence of problems affecting the European Union. After observing the problems affecting the European Union and the Euro, GCC member states have been trying to decide whether currency union is still a

[9] www.cia.gov/library/ - 2012 data

good idea. Each nation needs to believe that it has a part to play and that it still has a degree of sovereignty over its own affairs. Comparing the GCC and the EU, it can be seen that Bahrain and Oman are likely to behave in a similar way to Spain, Italy, Portugal or Greece. Economies such as Kuwait, Qatar and the UAE are likely to more be self-reliant. And just like the case of Greece and the EU it will be the case that there will be economies amongst the GCC nations that will need the support of the others (in the GCC). Saudi Arabia may well have to play the part played by Germany in the EU in coming to the rescue of distressed GCC economies. Will they be prepared to take on that role; and will the other member states be happy with it?

Total integration of product and factor markets, according to the GCC nations, can be accomplished if transaction costs and doubts arising due to the presence of separate currencies are eradicated. This would pave the path for a common currency and accomplish monetary assimilation (Laabas *et. al.* 2002).

The economic gains from adopting a single currency over a large geographical region have been extensively investigated. The theory of optimal currency areas (OCA) developed by Mundell (1961), McKinnon (1963) and Kenen (1969) amongst others, sets out the conditions needed to guarantee success. The theory is often used to argue whether or not a group of countries are ready to form a currency union. Currency union is seen as one of the final stages of economic integration.

The way in which the member nations behave towards each other with regards to labor (and also capital) market regulation is critical in determining labor mobility and price and wage flexibility. These are crucial requirements for an OCA. Also important are redistribution systems so that all members of the OCA feel equally treated. In theory, this is achieved using tax systems. However it rarely works in practice and breakdowns in currency unions frequently occur because the “richer” nations are not prepared to hand over monies to the “poorer” nations. This leads to resentment between members. It is often the case that this resentment arises because one country’s economy is

stronger and at a different point in the business cycle. The case of Greece in the European Union is a case in point with many of its partners refusing to help.

The degree to which an OCA is acceptable is that it enables fixing of exchange rates. This facilitates trade and investment as any ambiguity over the exchange rates is eliminated.

Analysis of the prerequisites needed for currency union and the investigation of how ready member states of GCC members are to undertake currency union are the main purpose of this chapter. Extensive use will be made of evidence from the European Union. Learning from the Euro zone will reduce costly mistakes being made. Two approaches are taken. A formal statistical approach is undertaken using a model based on Generalised Purchasing Power Parity (G-PPP) theory. A second, informal approach is also carried out. In both cases, recommendations based on the analysis of published statistical data are presented.

The contents of this chapter can be summarized as follows:

- A literature review defining the concept of an optimal currency area (OCA) and analysis of the criteria needed for successful implementation of it
- Explanation of the methodology that underlies the statistical analysis
- Comparison of intra-trading in the GCC with that in the Euro zone
- GCC and OCA: a formal statistical approach using Generalised Purchasing Power Parity (G-PPP) theory
- GCC and OCA: an informal approach using published statistical data and observation of other attempts at currency union to evaluate the readiness of GCC member states as a group to form an OCA.
- Discussion of the impact of the Euro on the likelihood of adoption of currency union in the GCC
- A recommendation on the way forward for the GCC.

4.2 Literature Review

Monetary or currency union are all synonymous with OCA. Monetary amalgamation, one currency, and a common central bank responsible for the management of the foreign exchange reserve pool and governing the union's monetary policy, are some of the features of an OCA.

Mundell (1961) was one of the first researchers to look at optimal currency areas. His seminal paper in the American Economic Review laid out much of the theory now taken for granted by economists. McKinnon (1963) was the second paper, while the last paper of the series was by Kenen (1969). The attributes which the probable partners of a monetary union must have, for the purpose of making it possible to create a nationwide customized monetary policy and the modifications to the exchange rate of the national currency, are pointed out by these two authors.

An OCA is desirable in that it allows exchange rates to be fixed. This reduces some of the uncertainties affecting trade and investment. Laabas *et. al.* (2002) also argues that it reduces the transaction charges associated with maintaining multiple exchange rates. Costs of monitoring exchange rate movements, costs of obtaining data needed to forecast changes in the exchange rate, costs associated with currency conversion and costs associated with managing reserves for intra-regional trade are all reduced. Additional benefits achieved from OCA are the creation of economies of scale by liberating unused reserves, and increasing the part played by money as a means of unit of account and payment. Willet (2001) also suggests that the role that speculators have on influencing price is also controlled as a result of formation of an OCA

Pisani-Ferry (2012) believes that the authority and reliability of monetary policy, particularly in nations that are inflation prone, can be aided by membership of an OCA. By linking monetary policy to a low inflation anchor currency, the trustworthiness of monetary policy can be increased. An illustration of this occurred during the 1970s when Italy, Spain and Portugal which had high inflation rates, wanted to anchor their exchanges to that of Germany, which had the image of being able to fight inflation. In

this scenario, weaker economies take up a common currency, peg their currencies to another stronger currency and gain the reliability of a fixed exchange rate system. However they lose the authority to modify their exchange rate. They concede that to the authorities of the stronger currency.

The growth of bilateral trade between members is one of the major advantages of currency union. Rose (2000) suggests that under currency union, bilateral trade among member nations can increase threefold. Yeyati (2001) using a gravity model based on Rose (2000) found similar results. Of perhaps more interest is the finding that the link between a common currency and bilateral trade flows is significantly stronger for common currency pairs comprising unilaterally dollarized countries than for members of a multilateral currency union. However, Tenreyro (2001) argues that the magnitude of gain from currency union has been overstated. Sample selection (endogeneity) issues and omitted variable problems has result in flawed econometric estimation. Correcting for them, Tenreyro (2001) finds that that the enhancement effect is much reduced.. Data from Eurostat shows that intra-trading in the EU has gone up more than twice in the past decade. This establishes the fact that Rose (2000) was justified in his assessment.

The loss of control over monetary and exchange rate policy is one of the main drawbacks when forming an OCA. However, this particular element is not given that much attention as research has not been able to identify any negative influence on fluctuations in the exchange rate.

The role of stabilizer which is quite significant in the economic modification is played by the instruments of monetary and exchange rate. Nations tend to do away with such significant policy tools, which leads to vital job and output losses, when they are occupied with hand-tying institutional planning like that of OCA.

In the case of countries that rely on fiscal income, the price of policy freedom can be quite high, especially for nations with weak tax mechanisms. The cost of synchronizing policies is one of the most likely reasons for currency union breakdown. Levying

sanctions on violating nations is also expensive and difficult to achieve. An OCA agreement can help ensure that member nations do not move outside or break the rules.

Various lapses in the discussion above on the OCA theory have been pointed out by Corden (1972). It is definitely true that price stability results from monetary integration, and that openness of the economy further enhances it. However an insulating role is played by the exchange rates. The earlier discussions presumed that the international prices and micro-oriented supply and demand movements were stagnant. However, they were shocks starting off in the foreign land and are macro type movements of exchange rate that are in a position to alienate the local currency from international shocks, enhancing the liquidity. As such the advantages to be acquired from monetary amalgamation are reliant on the suppositions done with regards to the disturbances to the system. These disturbances are structural micro shocks to the domestic economy. As per Corden, McKinnon's argument for monetary amalgamation is relevant. The expenses of monetary amalgamation are likely to go up for greater openness, where they stand for international macro movements in expenses and prices.

Ishiyama (1975) has, however argued that OCA theory is mainly an academic dialogue that has so far provided little contribution to exchange rate policy and monetary reform issues in the real world.

The points raised by Mundell (1961) regarding the function of money illusion in finding out the efficiency of changes of exchange rate in keeping the internal balance, are simplified by Corden (1972). The said function of flexible exchange rates relies on the presumptions of actual wage flexibility and the money wage inflexibility. In the case of an exceptionally open economy, the real-wage flexibility might not be existing, and in such a situation the theory of money illusion becomes unacceptable to a large extent, which brings down the usefulness of exchange rate in managing the price control.

The expenses and advantages to the nation from various big aspects, which are of definite significance, are elaborated in detail by Tower *et. al.* (1976). The relative advantages of a flexible exchange rate regime, in comparison with the fixed exchange rate regime of an OCA are summarized using a graphical synthesis. It is shown that as openness increases the advantages from OCA also increase indicating that the two are directly related. The flexible exchange rate system and currency area determinants are varied and connect with the factors elaborated in the past. These factors include disturbance origination and size, efficacy of correction brought in by monetary policy, mobility of labor and capital, and elasticity of price.

The above discussion has pointed out some of the advantages that currency union and/or optimum currency areas provide. The more important question concerns the requirements needed for formation of a currency union or optimum currency area. This analysis turns to discussion of the following criteria:

- Factor mobility
- Price and wage flexibility
- Openness
- Sources of external shocks
- Product diversification
- Production structures
- Inflation convergence

A significant role is also played by political elements in the success of a single currency area

Agenor *et. al.* (2011) shows how within and cross-country capital market imperfections affect the welfare of forming a currency union. The study is based on the situation of a bank-only world, where the banks compete in Cournot fashion and where the expense of monitoring and state verification is high. The best possible number of banks before becoming a part of the union, and the credit market stability are found out in the first

part, while the advantages of becoming a part of currency union are debated in the next part.

Lee *et. al.* (2012) considers the empirical desirability to East Asian nations of monetary union. The advantage of monetary union is that it provides exchange rate stability and credibility across the region. A particular qualification for formation of an OCA is that there should be symmetry in macroeconomic disturbances. It is found that the East Asian nations satisfy this. Using an approach based on a Bayesian State-Space based methodology they are the able to evaluate the suitability of monetary union. An economic model in which output is affected by three types of shock (international, regional and country specific) is used. The basis for a common regional currency will emerge from the significance of common regional shock. Regional and country specific cycles can be analysed along with the global business cycle, in this particular model. The significance of the shock's disintegration is that analyzing a subset of nations can make a person suppose that the examined co-movement is specific to the subset of nations only, whereas the same might hold true for a bigger number of economies as well. For the purpose of taking decisions on policies, it is significant to comprehend the origin of movements in the global economy. The situation for creation of monetary union is ripe in East Asia, as the region factor role is going up, while that of country specific one is coming down. The expense of doing away with country specific currency and moving towards monetary union in the region of East Asia could be quite high, as the country specific factor still as a notable share and cannot be ignored.

4.3 Methodology

The first approach used for assessing the viability of forming an OCA is through the use of Generalized Purchasing Power Parity (G-PPP) theory. This econometric time series based approach was first developed by Enders *et. al.* (1994). The main idea behind the approach starts from the fact that real exchange rates of countries that are potential candidates for currency union are non-stationary. This is due to the fact that macroeconomic variables that determine real exchange rates are also non-stationary. For countries to qualify for a successful currency area, they should experience convergence and symmetrical shocks to their fundamentals. The latter should move

together and be sufficiently interrelated so that the real exchange rates have common stochastic trends. Therefore, the theory advocates that real exchange rates within a currency area should be cointegrated. This means that bilateral real exchange rates of countries in the currency area should have at least one linear combination that is stationary.

The G-PPP test consists of finding whether there are cointegrating vectors between the exchange rates of the members of the currency union. Put slightly differently, this chapter needs to test whether an equilibrium relationship exists between the different bilateral real exchange rates. It implies, for instance that:

$$RER_{12t} = \alpha_0 + \beta_{13} RER_{13t} + \ldots + \beta_{1n} RER_{1nt} + \varepsilon_t \qquad (1)$$

Where RER_{1it} is the real exchange rate between the base country and country i in period t; α_0 is a constant term; β_{ij} are the parameters of the cointegrating vector and represent linkages among the economies of the currency area, and ε_t is a white noise disturbance term.

The real exchange rate series are constructed using two alternative base countries namely the Kingdom of Saudi Arabia (KSA) and the United States of America (USA). The choice of KSA as a base country is obvious given the economic importance of the Saudi economy to the GCC. It may also represent the dominant country in forming a successful currency area. However, the choice of the USA is also important and is chosen as the US dollar is closely related with all of the GCC member state currencies

The real exchange rates used are defined as follows:

$$RER_t = \frac{S_t P_t^*}{P_t} \qquad (2)$$

where S_t is the nominal exchange rate expressed as the number of national currency units exchanging for one unit of the currency of the base country. P_t^* and P_t are the consumer price index in the base and home country respectively.

The second approach is an informal one. This approach is based on defining the criteria that allow a country or group of countries to form an OCA. This approach analyses published statistics for the GCC economies and provides subjective recommendations on the way forward by evaluating the similarities and differences between them. The literature review above defined the different criteria that should be considered prior to forming a currency union. The following criteria are considered here:

1. Trade openness
2. Factor mobility
3. Commodity diversification
4. Similarity of production structure
5. Price and wage flexibility
6. Similarity of inflation rates
7. Political factors

4.4 European Economic Community vs. GCC Economic Community

Since intra-trading is one of the main factors in defining whether a group of economies are ready to form a currency union it is important to review the GCC Economic Community (GCCEC) and compare it with the European Economic Community (EEC).

The EEC has already gone through the process of monetary union. As a result it can be used as a benchmark.

The GCC countries in considering economic and monetary union initially compared themselves with member nations of the European Economic Community. The Arab Economic Community (AEC) was established in 1964 with the main objective of liberating intra-Arab trade. A secondary objective was to liberate labor and capital

markets. However, as the AEC did not include all the Arab countries it lacked the ability to achieve its objectives. This was mainly due to the huge gap in financial and legal infrastructure existing between the different economies. Accordingly, the 1964 experience was not a success for most of the Arab Countries[10].

In 1974, after revising oil prices and observing large increases in oil revenues, the Arab countries changed to a different approach based on economic cooperation. As a result various joint projects were undertaken between the Arab countries. The funding for these projects came mainly from the GCC with labor coming from all of the Arab countries. However these projects failed to deliver what was required. During the 1980's the move toward political as well as economic union came with the creation of the GCC[11]. Although political factors were the main driver for the establishment of the GCC, it was the economic development of GCC member nations, especially in terms of financial and legal infrastructure, that would be responsible for its success, at least when compared with previous experiences.

The success of the EEC has forced the rest of the world, including the GCC, to reconsider the wisdom of undertaking economic and monetary union. The EEC experience is considered the best example of a fully functioning economic and monetary union since the Second World War and accordingly it will be uses as a basis for comparison.

4.4.1 European Economic Community

As a start, this chapter analyses the historical background behind formation of the European currency union. The euro became the common currency of the 11 Member States of the European Union (EU) in 1999 – Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxemburg, The Netherlands, Portugal, and Spain - to be joined by Greece in 2000. The 12 were joined by Slovenia on January 1, 2007, Malta

[10] Arab Monetary Fund – Abu Dhabi, UAE – Different publications

[11] Arab Monetary Fund – Abu Dhabi, UAE – Different publications

and Cyprus on January 1, 2008, and Slovakia on January 1, 2009. Estonia was included as the 17th member of the Eurozone on January 1, 2011, and was admitted to it in September 2010. Following Slovenia and Slovakia, Estonia is the third former Communist state to join the Euro regime. It is, however, the first former Soviet republic to earn this honor. The remaining East European countries that were provided with EU membership by the Treaty of Rome in 2004 will become full members of the Eurozone after a process of scrutiny. Each must satisfy the terms of the Maastricht Treaty of 1992. Denmark, Sweden, and the United Kingdom, three of the original EU-15 countries, continue to be outside the Eurozone. However, Sweden and Denmark have limited exchange rate fluctuations with the euro. The United Kingdom has a different story. Its economic structure and its relatively small share of world GDP have become an issue. The declining share of the United Kingdom's pound sterling as an international reserve currency warrants much critical evaluation.[12]

The modern European Union was formed initially on the basis of economic needs and was the vision of Robert Schumann and Jean Monnet. This vision led to the formation of the EEC - European Economic Community (or Common Market) in 1958. Through the Treaty of Rome. In 1993 came the European Community with the Maastricht Treaty; and in 2009 the European Union with the Lisbon Treaty. The European Union (EU) now is now involved in a wide range of political as well as economic matters[13].

The EU is considered the most developed economic community in the world and it has managed to promote intra-trading between its members to such a level that it now represents the bulk of trading for these economies. It is also by far the largest when compared to other economic communities. Intra-trading activities represented around 66% of total foreign trading of the EU in 2008. The EU is currently considered the largest exporter in the world accounting for 15.9% of total international exports in 2009.

[12] http://en.wikipedia.org/wiki/European_Economic_Community

[13] http://europa.eu/index_en.htm

At the same time, it was also the largest importer accounting for 18.3% of total international imports according to the WTO.

Table 4.2: Intra-Trading Activities for Selected Economic Communities (2009)

Economic Community	Intra-Exports as a % of Total Exports	Intra-Imports as a % of Total Imports
European Union	67.40%	63.50%
GCC	6.00%	6.20%
Arab Economic Community	8.30%	11.10%
MERCOSUR	15.10%	17.10%
ASEAN	25.50%	24.40%

Source: International Trade Statistics 2010

At the same time, and in order to maximize intra-trading between EU member states, the EU imposed stringent restrictions on the quality of industrial and agriculture products imported from outside the EU. According to the World Bank GEP 2005, this increased intra-trading between the EU member states by reducing international trading with non-EU countries. However, the EU has been forced to reduce these under the pretense that by so doing it is liberating international trade. This has been none more than in agricultural products that affect the wellbeing of small and medium economies, and the developing countries in particular.

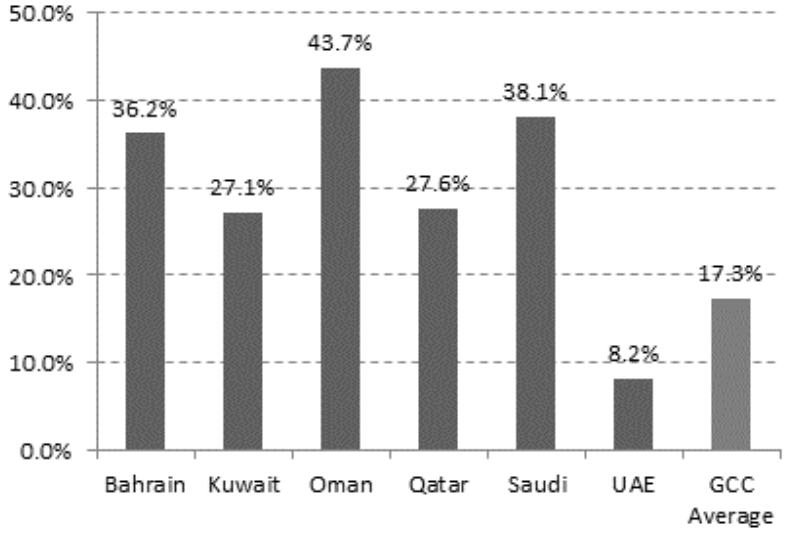
4.4.2 GCC Economic Community

Economic integration between a group of countries is achieved after a number of steps have taken place. The first and initial step is the creation of a free trade zone. This liberates trade between members of the group and those outside the group. To achieve it requires the removal of customs duties and tariffs levied on goods and services levied especially on those within fellow members of the group. The free trade zone is usually followed by creation of an economic community.

4.4.2.1 Movement of products and output;

Although the value of intra-trading between GCC member states increased five-fold between 1982 and 2009 its share in intra-trading remained at 6% for most of the period. However, over the same period, non-oil intra-exports between the GCC almost tripled in size compared to intra-exports of oil. Chart 4.1 below shows this relationship for 2009[14].

Chart 4.1: GCC Non-oil Intra-Exports as a % of Total Exports (2009)

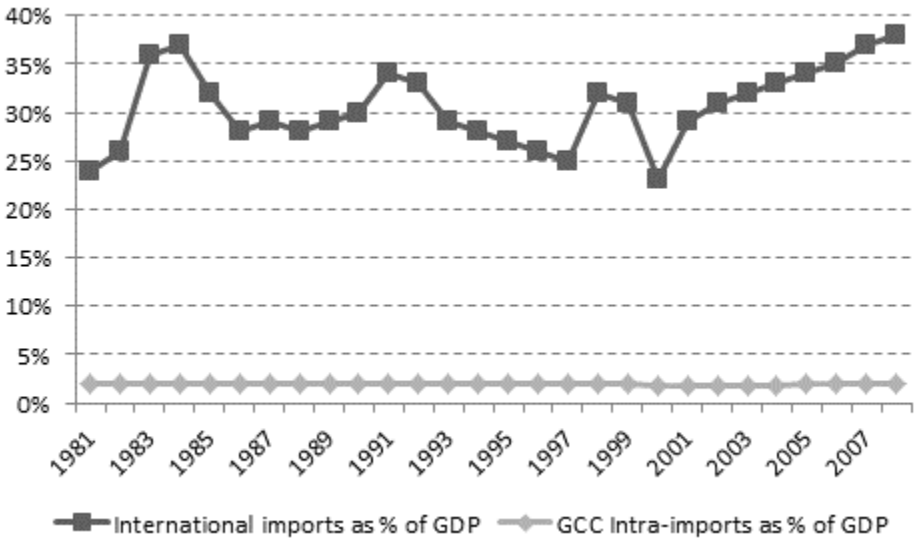


Source: UNSTATS 2010

Another indication of the development of intra-trading within the GCC can be obtained by looking at import penetration. Chart 4.2 shows total imports as a percentage of GDP over the period 1981-2008. The chart shows that the ratio was consistently in excess of 20% from 1981 to 2003; and rose steadily beyond that level during the boom period 2003 to 2008. However, intra-import trade between GCC member states has remained fixed at 2-3% for the last 30 years.

[14] IMF, Direction of Trade statistics and Arab Economic Report

Chart 4.2: Comparison of GCC International Imports as a % of GDP and GCC Intra-imports as a % of GDP (1981 - 2008)



Source: IMF, Direction of Trade statistics. Arab Economic Report

4.4.2.2 Movement of services

Restriction on the movement of services has been reduced to some extent by allowing banks, financial institutions and other organizations of one GCC member state to operate in another GCC member state without facing severe restriction. However, the licensing needed by GCC nationals to operate in another GCC nation has increased rapidly during the last few years with government and other discretionary measures (such as negative lists that limit investment by companies across the member states of the GCC) becoming more prevalent.

At the same time, policies concerned with nationalization and reducing public sector monopoly have improved the competition environment in the GCC. This has also encouraged intra-investment between the GCC countries in sectors, such as telecommunication, education, infrastructure and healthcare.

4.4.2.3 Movement of capital

Capital movement between GCC member states has not been an issue over the last few decades. The GCC has, however, been required through international regulation, to

enforce more stringent rules on those moving capital. This has taken place in an attempt to reduce money laundering which has affected a number of GCC member states during the last few years. In addition one of the major items on the radar of the GCC economic council for the last ten years has been the movement of foreign capital between the GCC member states. Agreement on a single framework for regulation of foreign investment in the GCC has been a top priority.

4.4.2.4 Movement of labor

Although there is no restriction on the movement of GCC nationals between GCC member states, the movement of labor within the GCC is still one of the most awkward issues in moving towards an efficient economic community. All the GCC countries are heavily dependent on foreign workers. Foreign workers represent around 32% of the labor force in Saudi Arabia[15]; and almost 85% in the UAE[16]. Liberating the movement of labor within the GCC requires the consideration of foreign workers as well as GCC nationals. At the same time there is a major difficulty in that GCC member states vary widely in terms of their labor law, pension fund and social security arrangements. It all indicates that serious work still has to be done to achieve unrestricted, free movement of labor within the GCC.

The objective of the above analysis has been to evaluate the basic requirements needed to reach full economic integration. By looking at what the GCC has achieved to date it is concluded that the GCC has already achieved a lot. However it is still a long way away from delivering what is required.

The trading structure of the GCC, where oil and gas exports to industrialised countries outside the GCC, represents the bulk of exports has forced the GCC to rely heavily on imports for most of their needs and especially for heavy industrial products. Accordingly, intra-trading between member states of the GCC remains limited and a long way away from reaching the standards attained by the EU.

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[15] en.wikipedia.org/wiki/Demographics_of_Saudi_Arabia

[16] http://en.wikipedia.org/wiki/Expatriates_in_the_United_Arab_Emirates

Some of the GCC member states have worked hard since its inception to diversify their export portfolios. Some have actually managed to achieve it in a limited way by adding petrochemicals, aluminum, steel and cement to their export portfolios, as per the AMF.

By the beginning of this century, the GCC leaders had taken a series of major decisions towards moving to full economic integration and economic union taking into consideration the establishments of major Economic Union as a main driver toward the formation of a union that will include the GCC.

These major decisions can be summarised as follows:

- The proposed formation of a customs union in 2003, which has since been achieved. It is currently working properly in terms of allowing the management of trade between the GCC and international market;
- Another decision was to form the GCC Economic Community in 2008. The legal establishment of the community has been delivered, but the expected outcome from it is still a long way off. A clear example of this is that the ratio of GCC intra-trading to total international trading is still below 10% as per table 4.2. Compare that with the EU where the ratio is in excess of 60%.The GCC Economic Community still has a long way to go to reach what is required.
- Full currency union by 2010. To date it has not been achieved, and still requires further serious work if it is to be achieved.

4.4.3 Comparison of the EEC experience with the GCCEC experience

There are major differences between the EEC and GCCEC in terms of reasons behind the formation of the two communities, methods for liberating intra-trading between the member countries, the legal framework and managing the integration.

The major points of comparison that need to be discussed in this chapter are the following:

4.4.3.1 Reasons behind the formation of the Economic Community

The EEC, founded in 1957 was based on economic drivers and designed to achieve political stability in Europe. It had started with creation of the European Steel and Coal Community in 1951. This saw an alliance between German and French coal and steel producers. The member states granted powers to the authorities in charge to prevent the resources of the two countries being used to manufacture military products and weapons of mass destruction[17]. On the other hand, the objective of forming the GCC was based on pure political drivers in order to achieve economic objectives. Taking into consideration the political situation in the Middle East, the rationale behind formation of the GCCEC was to gain strength in the wake of the Arab spring and GCC-Iran conflict. In both cases the motivation was always political, but in the case of the EEC the economic integration that followed saw the growth of product diversification while in the case of the GCCEC diversification and integration of products has not occurred.

The above indicates that the EEC was established to become a successful experience after achieving political stability in Europe, taking into consideration the integration between the member countries. In contrast, the GCCEC is taking a risk by assuming that the political needs of its member states will lead to economic integration.

4.4.3.2 Differences in intra-trading structure

The EEC's main objective was to free the movement of goods between its member states. This was an eminently achievable target as intra-trading between member states prior to the formation of the EEC was already heavily dependent on intra-industry trading. The objective then of forming the European Custom Union (ECU) was to facilitate the (free) movement of goods between member states – which is one of the prime motives for establishment of a customs union! On the other hand the GCC member states took the decision to try and free the movement of goods and services between member states in order to encourage the development of the industrial sector. Hopefully, increases in intra-trading would lead to further diversification. Revenues

[17] http://www.econlib.org/library/Enc1/EuropeanEconomicCommunity.html

would no longer depend on the export of oil and gas. Intra-trading between GCC member states was minimal at that time and even after the formation of the GCC Custom Union in 2003, intra-trading between GCC member states failed to grow much. This experience has not been comparable to the European case. This indicates that the GCC member states have failed to reduce their dependence on oil production and diversify by expanding production elsewhere.

As highlighted above, the European experience is not the only benchmark to be used as a basis of analysis in measuring the benefits of union. Freeing the movement of goods is a very important indicator to the success of any union, but it is not the only factor that should be taken into consideration in deciding whether it is successful or not. For the GCC and taking into consideration the economic structure of its member states, it is better that they focus on freeing services, labor and financial markets without waiting for policy changes affecting the goods market to bear fruit.

4.4.3.3 Economic Integration management and regulations

This is one of the major factors differentiating the European experience from the GCC experience. In both cases, the nations involved have shown serious commitment to economic community, integration, economic and even currency union. In the European case, that commitment was translated into action by the Treaty of Rome in 1957 that saw the creation of various supervising authorities. The objective of establishing these authorities was not only to manage and enhance cooperation between member states but also to convert these supervising authorities into supranational institutions. It indicates that the power invested in these authorities exceeds the national power of the member states. For example, the European Union includes execution, political and jurisdiction authorities as represented by the European Commission, European Council and European Court of Justice. These authorities have played a major role in allowing the EEC and EU to achieve full economic integration.

On the other hand, GCC member states have not relinquished their powers. There is no single independent entity that acts as a supranational institution. The GCC member states have only ceded negotiation rights to the GCC to negotiate on their behalf. This

then reflects the main difference between the GCC experience and EU experience. In both cases it has been the differences in legislation that have led to this

If the GCC is keen to achieve its economic and political objectives through economic union and progress to the stage of launching a single currency then it will need to form independent authorities that can enforce decisions made by them on all GCC member states. These authorities will also have to be provided with realistic, achievable targets that enforceable action can deliver. Only then will it be able to reach and achieve the objective of the economic and political union.

4.4.3.4 Political conditions during the formation of the Economic Community

The political power of the European Union has helped it enforce tough sanctions on all member states attempting to conduct trade outside its jurisdiction. The sanctions available are designed to encourage intra-trading between member states. For example, the EU has imposed stringent conditions on agricultural products imported from outside the EU, and especially from the developing countries. This has led EU member states to rely heavily on, and expand their intra-trading with other members of the EU rather than with the rest of the world.

4.5 Empirical Work

There has not been much movement in GCC member states exchange rates over the last thirty years as they have largely operated under fixed exchange rate systems pegged to the US dollar. Fluctuations in the currencies of a majority of GCC member states have not occurred. For instance, the Bahraini Dinar has remained stagnant since 1981 at 0.377 BD to the US dollar. By way of a comparison, the Kuwaiti Dinar, fixed to a basket of currencies, has seen some movement but only then over a very small range.

Testing whether the exchange rates of GCC member states have fluctuated significantly can be achieved using the General Purchasing Parity Power (G-PPP) methodology described earlier. Chart 4.3 shows real exchange rates for GCC member states over the period 1960-2010. The augmented Dickey-Fuller (ADF) tests are presented in

Table 4.3 for both nominal and real exchange rates. They show that on applying the test to the first differences of nominal and real exchange rates, it is rejected at 5% level. Hence the two series are integrated at order one.

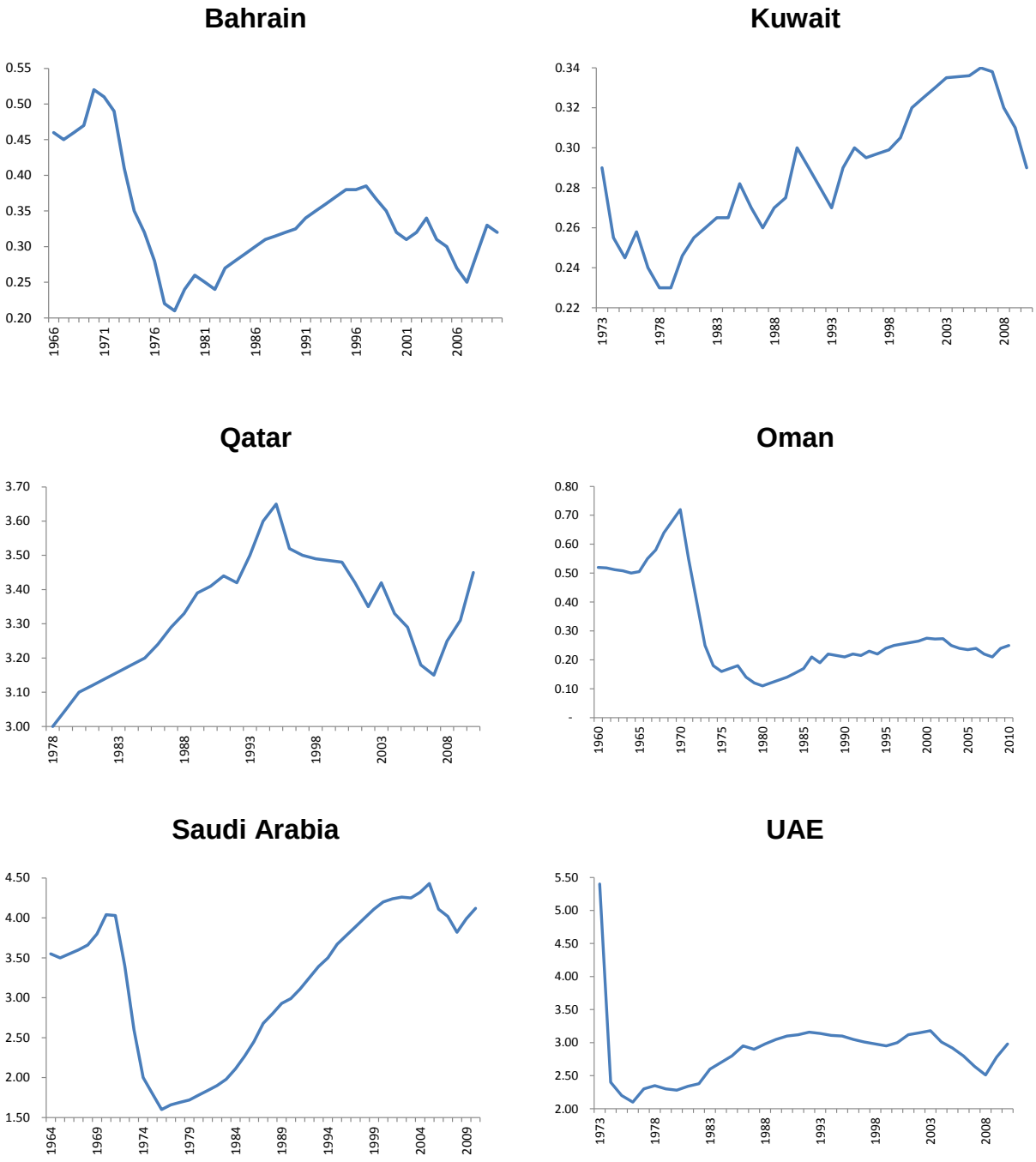
On applying the ADF stationarity test to a bigger sample size, it is found out that the GCC nominal rates are fluctuating, although from 1980s onwards there appears that the GCC nominal exchange rates are constant. It can be attributed to the movement in nominal exchange rates before the 1980s. In comparison to the US dollar, the fluctuation of GCC currencies is quite less with regards to the SAR. In comparison to the nominal exchange rates, the real exchange rates determined for both the base economies i.e. USA and KSA, demonstrate greater fluctuation.

Table 4.3: ADF Stationarity Tests of GCC Exchange Rates

Country	Base Country USA				Base Country KSA			
	Nominal		Real		Nominal		Real	
	Level	1st Difference	Level	1st Difference	Level	1st Difference	Level	1st Difference
Bahrain	(0.98)	(3.62)	(0.51)	(2.88)	(0.32)	(2.72)	(0.65)	(4.12)
Kuwait	(0.72)	(3.98)	0.75	(4.92)	0.12	(5.21)	(0.59)	(3.31)
Oman	0.14	(3.38)	(1.02)	(3.29)	1.33	(4.21)	(0.41)	(6.52)
Qatar	(1.40)	(3.44)	0.82	(2.77)	(0.62)	(2.44)	(0.19)	(1.98)
KSA	(0.69)	(3.52)	(1.30)	(2.08)	-	-	-	-
UAE	(1.56)	(3.72)	1.44	(3.66)	(0.61)	(3.12)	(0.51)	(3.12)

Source: Computed using Eviews

Chart 4.3: GCC Real Exchange Rate to the US$ (1960–2010)



Source: Nominal GDP from Arab Monetary Fund statistics – Real GDP calculated by the author

Having established stationarity or nonstationarity, cointegration analysis is then carried out. The procedure used is similar to that used in Chapter 3 above.

In determining the parameters of the cointegration relationships, the lag length of the VAR or Vector Autoregressive model fundamental to the long-run relationship exhibited by equation (1) in the methodology needs to be determined. Testing with higher order VAR models could not be carried out because of the small sample size and data availability problems. It was found that a VAR (1) appears most appropriate.

Table 4.4 provides a summary of relevant cointegration test results. The presence of three cointegrating vectors is confirmed by the trace test. If the maximum eigenvalue statistic (λ) is used instead then four cointegrating vectors are confirmed. This disparity (or conflict) between test results is not unknown. The hypothesis that there are three cointegrating vectors or less is accepted (since the tests were carried out at a significance level of 90%.)

Table 4.4: Testing for Cointegration

		Trace						
H0	H1	Stat.	90% CV	H0	H1	Stat.	90% CV	λ
r = 0	r > 0	194.40	96.20	r = 0	r = 1	100.43	25.25	0.995
r ≤ 1	r > 1	93.97	70.94	r = 1	r = 2	39.23	21.52	0.876
r ≤ 2	r > 2	54.74	49.41	r = 2	r = 3	25.23	17.85	0.739
r ≤ 3	r > 3	29.50	31.56	r = 3	r = 4	16.13	13.95	0.576
r ≤ 4	r > 4	13.37	17.61	r = 4	r = 5	8.42	10.19	0.361
r ≤ 5	r > 5	5.00	7.50	r = 5	r = 6	5.00	7.50	0.231

Based on the above results, there are two cointegrating vectors. The estimates of the cointegrating vectors (β) and the associated adjustment coefficients vectors (α) are presented in Table 4.5 below.

Table 4.5: Cointegration and Adjustment Vectors*

	Constant	Bahrain	Kuwait	Oman	Qatar	KSA	UAE
β_1	-1.593	-0.453	-1.593	-1.593	-1.593	-1.593	-1.593
α_1	-	-0.277	-0.164	-0.006	-0.118	-0.415	-0.057
		-7.656	-2.258	-0.024	-4.201	-13.217	-1.113
$\beta 2$	1.865	-0.304	1.550	-0.573	-0.639	1.000	-1.455
$\alpha 2$	-	-0.056	-0.047	0.620	0.010	0.129	0.171
		-1.808	-0.752	3.090	0.393	4.789	3.842

* The cointegration vectors are normalized so that Saudi Arabia's exchange rate is the reference.
T-values are highlighted in grey

While the β coefficients may be interpreted as long-term elasticity, the α's are adjustment coefficients indicating the speed of adjustment toward long-term equilibrium.

Overall, the presence of cointegrating relationships is a formal proof that G-PPP holds and that member states of the GCC meet the requirements necessary for formation of a currency union. However, cointegration is a statistical concept and it is often very difficult to provide a sound economic interpretation to all of the cointegrating relationships. In the above case, the first cointegrating vector on the grounds that all adjustment coefficients have the appropriate negative sign. The exchange rates of all GCC member states except Oman enter this cointegrating relationship significantly. The zero restriction Likelihood Ratio test for the Omani exchange rate could not be rejected at the 95% level. This may reflect the fact that Oman is the least favorable candidate for currency union. This interpretation is compatible with the relatively low correlation between the macroeconomic fundamentals of Oman and those of the other GCC member states.

Furthermore, the α's for Oman and the UAE are very small and show that there is a slow adjustment to equilibrium in the sense that deviations from G-PPP can persist for a relatively long period of time. Differences in the adjustment speed may also reflect differences in country circumstances that would call for different policy measures. From this perspective, Oman and UAE may be considered less homogeneous than the rest of the GCC member states.

It should be noted that many G-PPP-based tests in the literature reject the OCA hypothesis. This occurs despite having stronger correlations between forcing variables than those observed in the case of GCC.

4.6 CC Countries and OCA

There are many reasons for the formation of an OCA. An OCA provides the member states under that OCA a number of advantages. But are member states of the GCC ready for it? The analysis below provides some of the answers.

4.6.1 Trade openness

The GCC member states are considered among some of the largest oil exporters in the world. At the same time, all GCC member states are heavily reliant on imported goods and services, due to the limited availability of domestic produced substitutes, and inability or unwillingness of consumers to pay the higher prices needed to purchase them. This has resulted in member states of the GCC being among some of the most open economies around the world. Table 4.6 shows more detail. As discussed earlier in this chapter, market openness is one of the most important criteria in determining whether a country or a group of countries are ready to form an OCA. Accordingly, and since most of the GCC member states are ranked at the top end of the scale, it is concluded that it is favorable for these countries to enter into currency union.

Table 4.6: GCC Market Openness and Benchmarks (1980-2010)

Year	Bahrain	Kuwait	Oman	Qatar	Saudi	UAE	USA	Germany	France
1980	226.5	90.0	84.6	90.9	89.0	96.1			
1985	169.0	75.6	77.1	68.9	52.7	69.3			
1990	164.2	56.5	67.7	70.0	65.5	83.3			
1995	131.9	77.5	68.7	84.5	61.1	85.4			
2000	109.4	72.5	70.0	74.2	55.5	87.0			
2005	95.6	69.4	69.0	71.0	68.3	81.2			
2010	73.6	67.7	67.7	69.0	64.1	67.3	78.0	71.1	64.2
Average	138.6	72.7	72.1	75.5	65.2	81.4			
2010 Ranking	12	43	44	39	65	47	8	23	62

Source: World Bank, World Development Indicators 2011 & Global Finance Magazine 2010

4.6.2 Factor mobility

Factor mobility as discussed earlier consists of adjusting and removing restrictions on factor markets – especially capital and labor – so that they work more efficiently. Much of the legal framework is in place for the capital market. The labor market is, however, more problematic. Implementation of regulations and creation of the appropriate authorities/infrastructure within GCC member states has largely been neglected.

One concern is that factor mobility is considered one of the most important factors defining whether or not an OCA is achievable. If it is not possible to reform factor markets sufficiently then it may stop any idea of currency union dead in its tracks. What can be said is that there is still a long way to go for the GCC member states in order to satisfy the conditions needed to form and join a currency union.

4.6.3 Commodity diversification

Although most of the GCC member states have been trying hard over the last ten years to diversify their export portfolios, oil and gas still represent the bulk of exports for most of them. On average around 70% of the exports of these economies are oil related. Saudi Arabia has worked to encourage its manufacturing sector; the UAE has become a leisure and hospitality center (especially after the 2008 crisis.) However, oil is still the dominant commodity. Table 4.7 below shows that export concentration is still very high when compared with the rest of the world.

Table 4.7: Export Concentration Indices (1995 & 2010)

Country	1995	2010
Bahrain	0.629	0.559
Kuwait	0.940	0.826
Oman	0.765	0.642
Qatar	0.731	0.796
Saudi Arabia	0.743	0.824
United Arab Emirates	0.619	0.583
Turkey	0.112	0.103
Brasil	0.088	0.093
Korea	0.148	0.124

Source: UNCTAD (1999) & Arab Monetary Fund (2011)

4.6.4 Similarity of production structure

In general, the GCC member states have an almost identical production structure where oil and gas dominate. The non-oil sector is limited to trade and financial services. GDP distribution by sector is detailed in Table 4.8 below and shows the degree of similarity in economic activity between GCC member states. Since these economies are dominated by oil, a shock in the price of oil will result in similar outcomes across all of the GCC member states. As a result almost identical (common) policy reactions will follow. This, actually, is a factor working in favor of currency union for the GCC member states, as it encourages formation of an overarching financial regulator and Central Bank to manage overall policy. The GCC is well placed in this regard as the GCC central bank was established in Riyadh in 2010. However it is not yet effective in terms of setting and controlling monetary policy.

Table 4.8: GDP Components By Sector (2009)

GDP components	Bahrain	Kuwait	Oman	Qatar	Saudi	UAE
Agriculture and fishing	0.4	0.2	1.4	0.1	3.1	1.1
Mining and quarrying	21.6	45.5	41.3	46.7	43.0	23.5
Manufacturing	16.0	5.4	10.3	8.0	10.7	14.9
Electricity, gas and water	1.2	1.3	1.2	1.1	1.0	1.8
Construction	5.3	1.9	6.8	7.3	5.1	8.0
Wholesale and retail trade, restaurants and hotels	10.8	4.4	10.2	6.8	6.1	21.4
Transport, storage and communication	7.5	8.4	6.1	6.4	4.1	6.3
Financial institutions	13.2	9.9	2.3	4.8	3.1	5.4
Real estate and business services	6.7	6.2	5.2	5.0	4.7	10.2
Community social and Government services	12.3	13.4	7.3	12.6	16.6	5.1
Other services	4.9	3.4	7.8	1.2	2.5	2.2
TOTAL	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: Arab Monetary Fund, Economic Statistics Bulletin of Arab Countries 2011

4.6.5 Price and wage flexibility

One of the main reasons for the GCC member states countries to consider a more flexible exchange regime is the lack of useful monetary tools under the current pegged regime. During the period between 2004 and 2008 the only way for the GCC governments to respond to rapid inflation, caused by excess liquidity resulting from increases in oil prices, was to increase the wages of public sector employees. Accordingly, wages in the public sector doubled, possibly tripled, between 2004 and 2008. The private sector was then forced to follow suit in order to stay competitive. Since the 2008 crisis most private sector companies have cut their costs. They also responded to changes in their markets. However the public sector did not react in the same way and a large gap between the wages paid to workers in the two sectors developed. In general, it is concluded that the GCC member states do not systematically adjust prices and wages in response to external shocks, especially oil prices. The adjustment is mainly related to the way the shocks affect the private sector

4.6.6 Similarity of inflation rates

In general and taking into consideration the similarity between GCC member states it is obvious that oil prices have a direct impact on the rate of inflation. Inflation rates pick up when oil prices rise; and decrease when oil prices fall. However, the internal economic policies within the GCC countries affect the speed with which oil price changes affect inflation. This is clear from analysis of Table 4.9 below.

Table 4.9: GCC Inflation Correlation Coefficients (2000–2010)

	Bahrain	Kuwait	Oman	Qatar	Saudi	UAE
Bahrain	1.00	0.70	(0.12)	0.55	0.78	0.51
Kuwait		1.00	0.70	0.56	0.51	0.92
Oman			1.00	0.16	0.38	0.95
Qatar				1.00	0.49	0.84
Saudi					1.00	0.58
UAE						1.00

Source: Computed by the author using excel. Raw data sourced from Economic Statistics Bulletin for Arab Countries, Arab Monetary Fund (2011)

4.6.7 Political factors

Taking into consideration the current political status of the Middle East in general and the GCC in particular, the leaders of the GCC member states are definitely moving toward a more inclusive economic and political integration. This was clearly stated by King Abdullah of Saudi Arabia during the GCC committee meeting in 2012. He confirmed the commitment towards full integration at both an economic and political level; and called on the leaders of GCC member states to consider a union rather than a cooperative council in order to prevent external threats on the GCC, especially from neighboring Iran. The leaders of the GCC believe that the road map that was set out in 2003 to reach economic integration is working well, since the necessary legal and structural framework is in place. However, it seems that there is still a long way to go in order to achieve what is required.

Assuming that the above seven factors are considered as an informal test for the eligibility of GCC member states to form a currency union, the current status can be summarized as follows:

Table 4.10: Eligibility for Currency Union

Eligibility Criteria for Currency Union	Decision
Trade openness	Eligible
Factor mobility	Not eligible
Commodity diversification	Not eligible
Similarity of production structure	Eligible
Price and wage flexibility	Not eligible
Similarity of inflation rates	Not eligible
Political factors	Eligible

Table 4.10 above provides sufficient evidence to show that GCC member states are still not ready to move to a currency union.

4.7 Conclusions

In the formal, empirical approach using time series econometric methods, it is found that G-PPP holds for the case of the GCC. This rather unconventional result can be rationalized putting aside data limitations and modeling difficulties, by the fact that GCC represent a rare case where exchange rates are stable and anchored strongly to the US dollar and inflation rates are relatively similar. This result, however, does not prevent forcing variables from drifting apart and should not be interpreted as a sign of convergence among the economies of the GCC. The success of GCC monetary union requires greater policy coordination and synchronization to be undertaken, and further steps taken to create a single market where all restrictions on the movement of goods and factors of production are removed.

At the same time, the informal approach suggests that the GCC countries are not yet ready to form a currency union or become an OCA. As highlighted above, being unable to liberate the movements of good, services, labor and capital might be a major obstacle to the creation of a lasting currency union.

In the case of the European Union, which is still the best benchmark for other future economic unions, the resulting economic performance of some of the EU countries such as Greece, Spain and Portugal post 2008 was largely the result of insufficient monitoring and supervision by the authorities in charge. Although the infrastructure for the supervisory and monitoring authorities was in place and considered effective, the performance of some of the economies within the EU has threatened the very existence of it!

This having been said, it will be quite risky for the GCC countries to go ahead and form a currency union or OCA without having the required framework and authorities to monitor, supervise and enforce the mutual and common requirements of all the states making up the union. Some economists believe that since Saudi Arabia is the leading economy by far when compared to the other member states, it will be able to bail out the poorer performing members of the GCC. This could be close to reality, but it may

not be sustainable and it may prevent healthy relationships between member states developing.

Accordingly, and based on all the above, it is recommended that the GCC countries improve their infrastructure prior to consideration of the final step of full union.

CHAPTER FIVE

CONCLUSIONS

5.1 Introduction

The objective of this research was to provide an initial recommendation to the GCC member states on alternative regime policies that could be adopted, taking into account the effects that changing the dollarization regime would have on the private sector. Another aim of this research was to evaluate the eligibility of GCC member states to form an OCA and assess their preparedness in respect of the single currency that was due to have been launched in 2010.

At the start, an overview of each of the economies of the GCC member states and a comparison to other nations was presented to make the research more attractive to readers not familiar with the Middle East and the GCC in particular.

The research has also provided taxonomy of the different exchange regimes as categorized by the IMF. It carefully distinguished between *de facto* and *de jure* exchange rate regimes.

The research has provided answers to the initial questions asked by using both formal statistical approaches and informal statistical approaches. The outcome of these questions is summarized in this chapter.

5.2 Summary and Recommendations of the Research

The chapters of this thesis provide answers to each of the questions asked earlier. In Chapter 2, the question was whether member states of the GCC should move to a different exchange rate regime. A logit model was constructed to provide recommendations based on two different snapshots in time. The view of Velasco (2000) that a dollarization regime may not necessarily be the most suitable for all developing nations is validated. Also, the view of Duttagupta *et. al.* (2005) confirmed that assuming technical knowhow and infrastructure are available, a decision to float is recommended. Hoffman (2007) view as well was proved that a floating regime is better to manage

external shocks. This was clear following the 2008 financial crisis and its effects on the GCC.

On the other hand, views like Hausmann *et. al*. (1999), Ghosh *et. al.* (1996), Burnside *et. al.* (2001) and Caramazza *et. al.* (1998) that support a fixed regime for small economies in order to manage inflation and be under the umbrella of a major currency, with no monetary tools, are rejected in this research. It is essential that the exchange regime used by economies with special characteristics, such as the member states of the GCC, are evaluated differently. This is exactly what Chapter 2 delivered.

In Chapter 3 standard time series methodology was adopted. However it was very challenging as there has been very little published research looking into the relationship between the stock market and exchange rate for the Gulf nations. Even though the selection of economies to be tested and used as benchmarks was done in a way that can be challenged as being subjective, the main finding is that variations in the exchange rate affect the stock market. In the short run, the effect is minimal, and in the long run the effects are manageable. This outcome was in accordance with Frankel et. al. (2007), Tian et. al. (2010) and Dornbush et. al. (1980). On the other hand, the outcome didn't comply with other researchers such as Bartram et. al. (2012), Nieh et. al. (2002) and Tsai (2012) who are of the view that this relation between the stock market and exchange rate doesn't exist

In Chapter 4, a contradiction between the two approaches was found. A formal statistical approach using General Purchasing Power Parity (G-PPP) theory provides the recommendation that the GCC member states should form an optimal currency area (OCA). This move is supported by researchers like Laabas et. al. (2002), Rose (2000) and Pisani-Ferry (2012) who believe that a single currency union will increase intra-trading, liberate reserves, and increase the trust of the union economies. On the other hand, the informal approach based on the work of Mundell (1961) looks at the conditions necessary to achieve the OCA and reaches the reverse conclusion.

Assuming that the outcome of the research needs to be summarized in a few lines for senior officials and decision makers in the GCC, the following can be concluded:

1. The GCC current dollarization regime policy has to be reconsidered, as it is the least efficient exchange rate regime currently available to GCC member states.
2. There are many alternative exchange rate regimes available that should be considered. It is not necessary to accept either extremes - fixed or floating.
3. Further investigations will be required for all types of intermediate floating and fully floating regime to evaluate which is the most appropriate for GCC member states.
4. The possibility of currency union will need to be taken into account when evaluating plans relating to the choice of a future exchange rate regime.
5. Assuming a more flexible regime is adopted, domestic exchange rates of GCC member states are expected to change. This change will have a minimal short-run and positive long-run effect on local stock markets.
6. It is very important to manage properly announcements of decisions relating to the adoption of a different exchange rate regime. After 30 years of using the same fixed exchange rate regime such announcements can have unexpected effects. Instability may result in the flight of capital which is damaging. This will have a negative influence on GCC member states' economies in the long-run.
7. The political motivation to form a currency union has to provide economic benefits to the member states of the GCC in order for it to be successful and sustainable.
8. It is essential to have the required infrastructure in place before forming a currency union rather than rushing into it and having to set it up afterwards.
9. The Euro experience is still a fresh experience that has been into different economic cycles. Unnecessary failures and mistakes in the future can be avoided by digging into the details of the Euro experience.
10. The benefits of currency union are expected to differ across member states. This may cause problems if a feeling of unfairness arises. However, the long-run

political and economic outcomes from currency union are well worth the sacrifices that member states may suffer at the start.

5.3 Limitation of the Study

The limitations of this research can be summarized as follows:

1. Political influence in determining the choice of exchange rate regime of a developing economy can play a significant role. In some cases the economic benefits from adoption of a new exchange regime are very clear. However the political repercussions from taking such a decision may be unbearable.
2. One of the main obstacles in this research was data availability for the GCC member states. As many of the member states are developing economies, with minimal track record in historical data, and may lack the means to arrange the efficient collection and validation of data, reliability of data become an issue. Whilst official government sources were uses at all times, the researcher also had to use data from non-governmental sources as well. This may have an impact on the findings reported in this research.
3. The limited options available for benchmarking other economies with the GCC in Chapter 3 gave a preference to economies that may not be considered ideal. The initial objective was to have developing economies with similar characteristics to the GCC economies, especially in terms of being heavily dependent on oil as a source of income. However, none of these economies managed to meet the requirements to be among the benchmark countries.
4. The recommendation made in the Chapter 4 is heavily dependent on the informal approach rather than the formal empirical work. This might create confusion to the reader of this research if he/she is not familiar with the economic (and political) landscape of the Middle East and the GCC member states in particular.

5.4 Contribution to Knowledge

Each chapter in this research, other than the introduction and conclusion, is considered by itself a contribution to knowledge. In the same time, some additions and/or alternatives are recommended for further studies in relation to the same subject.

In Chapter Two, a statistical approach is developed using basic economic indicators to determine whether the existing exchange rate regime of an economy is optimal or not. The equation used in this Chapter allows any economy, even from outside the sample, to test whether they should follow a fixed or a floating regime. This equation is changeable on yearly basis and accordingly the outcome might change subject to the significant variables and their coefficients. The technique and methodology used in this Chapter, in terms of linking some economic indicators to the exchange regime decision, are original and used for the first time in a research or a publication.

This approach assumes that the country or group of countries tested make their decisions on choice of optimal exchange rate regime by assuming that the rest of the sampled countries are following their optimal regimes. The limitation of this approach is that it takes into consideration large and influential economies in the sample as well as some very small ones. Whilst the sample is still random, this may influence results since no weighting is considered for any of the countries based on economy size.

Chapter Three has tested the relationship between the nominal exchange rate and the domestic stock market indices in GCC member states, although the nominal exchange rate is pegged to the USD for more than 30 years. A comparison approach has been adopted in this Chapter with economies that have similar economic criteria with the GCC in order to conclude on the relationship for the GCC.

In Chapter Four, the contribution to knowledge comes in the form of a recommendation whether the GCC countries should enter formal currency union or not. Investigation of whether prerequisites for currency union are satisfied and analysis of how well placed the GCC member nations are undertaken. The contribution to knowledge in this Chapter was developed by using the G-PPP approach in economies that are adopting “dollarization” regime since the early 1980’s. This approach was used for the first time in this research for economies with no fluctuation in nominal exchange rate.

For further studies in relation to the same subject, a further expansion in the number of economic indicators used is recommended. In this research, six economic indicators were used to praise the exchange regime, where three indicators were significant in each snapshot. The used approach was helpful and managed to recommend an initial strategy for the research. However, assuming additional indicators that are reflective of wealth and openness are used, a better granular recommendation can be concluded from the research.

Also and for further studies in the future, it will be recommended to limit the sample selections in Chapter Two to countries with similar economic criteria rather than increasing the number of the sampled countries and randomly select the sample. For sure, further data availability is recommended at an early stage.

In Chapter Three, it is recommended for further studies to evaluate the relationship between real exchange rate and the stock market in the GCC, rather than evaluating this relationship in other economies with similar criteria with the GCC. The risks associated with this recommendation are related to data accuracy when calculating real exchange rate for the GCC economies, especially that historical inflation data are scattered for the GCC countries, and discrepancies have appeared when collecting these data.

Overall, this research provides general recommendations for the GCC economies on the way forward, without the absolute confirmation that unpegging the currency and/ or the currency union decision is the sole option available. Accordingly and for further studies in the future, further qualitative meetings with decision makers in the GCC are recommended.

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APPENDICES

Appendix (A1)

Full Sample

Table A1.1: Unit Root Test - Log of JPY/USD (1998-2011)

Null Hypothesis: LJU has a unit root

Exogenous: Constant

Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.345763	0.9139
Test critical values:	1% level	-3.473672	
	5% level	-2.880463	
	10% level	-2.576939	

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

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(LJU)

Method: Least Squares

Date: 08/27/11 Time: 03:22

Sample (adjusted): 1998M12 2011M07

Included observations: 152 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LJU(-1)	-0.007127	0.020612	-0.345763	0.7300
D(LJU(-1))	-0.034113	0.083381	-0.409123	0.6830
D(LJU(-2))	0.123259	0.076259	1.616335	0.1082
D(LJU(-3))	0.047220	0.075347	0.626705	0.5318
D(LJU(-4))	-0.121083	0.075281	-1.608421	0.1099
C	-0.030391	0.096737	-0.314157	0.7539

R-squared	0.038062	Mean dependent var	0.003060
Adjusted R-squared	0.005119	S.D. dependent var	0.029258
S.E. of regression	0.029183	Akaike info criterion	-4.191753
Sum squared resid	0.124345	Schwarz criterion	-4.072389
Log likelihood	324.5732	Hannan-Quinn criter.	-4.143263
F-statistic	1.155383	Durbin-Watson stat	1.948895
Prob(F-statistic)	0.334076		

Table A1.2: Unit Root Test - Log of RRB/USD (1998-2011)

Null Hypothesis: LRU has a unit root

Exogenous: Constant

Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.178866	0.0232
Test critical values:	1% level	-3.473672	
	5% level	-2.880463	
	10% level	-2.576939	

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

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(LRU)

Method: Least Squares

Date: 08/27/11 Time: 04:16

Sample (adjusted): 1998M12 2011M07

Included observations: 152 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LRU(-1)	-0.063895	0.020100	-3.178866	0.0018
D(LRU(-1))	0.382991	0.079640	4.809046	0.0000
D(LRU(-2))	-0.089189	0.075089	-1.187776	0.2369
D(LRU(-3))	0.153988	0.052819	2.915403	0.0041
D(LRU(-4))	-0.001854	0.044952	-0.041254	0.9671
C	-0.214112	0.067277	-3.182536	0.0018

R-squared	0.366381	Mean dependent var	-0.002659
Adjusted R-squared	0.344682	S.D. dependent var	0.027756
S.E. of regression	0.022469	Akaike info criterion	-4.714672
Sum squared resid	0.073710	Schwarz criterion	-4.595308
Log likelihood	364.3151	Hannan-Quinn criter.	-4.666182
F-statistic	16.88446	Durbin-Watson stat	2.006723
Prob(F-statistic)	0.000000		

Table A1.3: Unit Root Test - Log of BRR/USD (1998-2011)

Null Hypothesis: LBU has a unit root

Exogenous: Constant

Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.480715	0.1222
Test critical values:	1% level	-3.473672	
	5% level	-2.880463	
	10% level	-2.576939	

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

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(LBU)

Method: Least Squares

Date: 08/27/11 Time: 03:50

Sample (adjusted): 1998M12 2011M07

Included observations: 152 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LBU(-1)	-0.060846	0.024528	-2.480715	0.0142
D(LBU(-1))	0.000562	0.081417	0.006898	0.9945
D(LBU(-2))	0.026438	0.081318	0.325113	0.7456
D(LBU(-3))	-0.014616	0.081328	-0.179710	0.8576
D(LBU(-4))	0.061451	0.081314	0.755725	0.4510
C	-0.048412	0.019641	-2.464840	0.0149

R-squared	0.044135	Mean dependent var	-0.001701
Adjusted R-squared	0.011400	S.D. dependent var	0.068893
S.E. of regression	0.068499	Akaike info criterion	-2.485320
Sum squared resid	0.685050	Schwarz criterion	-2.365956
Log likelihood	194.8843	Hannan-Quinn criter.	-2.436830
F-statistic	1.348247	Durbin-Watson stat	2.006155
Prob(F-statistic)	0.247390		

Table A1.4: Unit Root Test - Log of NIKKEI (1998-2011)

Null Hypothesis: LNIK has a unit root

Exogenous: Constant

Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.006721	0.2838
Test critical values:	1% level	-3.473672	
	5% level	-2.880463	
	10% level	-2.576939	

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

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(LNIK)

Method: Least Squares

Date: 08/27/11 Time: 03:53

Sample (adjusted): 1998M12 2011M07

Included observations: 152 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNIK(-1)	-0.039475	0.019671	-2.006721	0.0466
D(LNIK(-1))	0.114414	0.081042	1.411784	0.1601
D(LNIK(-2))	0.076940	0.081484	0.944240	0.3466
D(LNIK(-3))	0.127446	0.081535	1.563082	0.1202
D(LNIK(-4))	0.028412	0.080000	0.355153	0.7230
C	0.369901	0.185454	1.994565	0.0480

R-squared	0.055237	Mean dependent var	-0.002727
Adjusted R-squared	0.022882	S.D. dependent var	0.058960
S.E. of regression	0.058281	Akaike info criterion	-2.808399
Sum squared resid	0.495919	Schwarz criterion	-2.689035
Log likelihood	219.4383	Hannan-Quinn criter.	-2.759909
F-statistic	1.707226	Durbin-Watson stat	1.956912
Prob(F-statistic)	0.136480		

Table A1.5: Unit Root Test - Log of RTS (1998-2011)

Null Hypothesis: LRTS has a unit root

Exogenous: Constant

Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.880832	0.3406
Test critical values:	1% level	-3.473672	
	5% level	-2.880463	
	10% level	-2.576939	

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

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(LRTS)

Method: Least Squares

Date: 08/27/11 Time: 03:53

Sample (adjusted): 1998M12 2011M07

Included observations: 152 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LRTS(-1)	-0.017721	0.009422	-1.880832	0.0620
D(LRTS(-1))	0.228311	0.081073	2.816129	0.0055
D(LRTS(-2))	-0.043031	0.082319	-0.522738	0.6019
D(LRTS(-3))	0.009442	0.079903	0.118171	0.9061
D(LRTS(-4))	0.100566	0.069478	1.447455	0.1499
C	0.129154	0.061204	2.110230	0.0365
R-squared	0.086550	Mean dependent var		0.021803
Adjusted R-squared	0.055268	S.D. dependent var		0.119135
S.E. of regression	0.115796	Akaike info criterion		-1.435304
Sum squared resid	1.957664	Schwarz criterion		-1.315940
Log likelihood	115.0831	Hannan-Quinn criter.		-1.386814
F-statistic	2.766722	Durbin-Watson stat		1.943933
Prob(F-statistic)	0.020301			

Table A1.6: Unit Root Test- Log of BOVESPA (1998-2011)

Null Hypothesis: LBOV has a unit root

Exogenous: Constant

Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.353532	0.6036
Test critical values:	1% level	-3.473672	
	5% level	-2.880463	
	10% level	-2.576939	

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

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(LBOV)

Method: Least Squares

Date: 08/27/11 Time: 03:54

Sample (adjusted): 1998M12 2011M07

Included observations: 152 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LBOV(-1)	-0.013327	0.009846	-1.353532	0.1780
D(LBOV(-1))	0.067693	0.080615	0.839713	0.4024
D(LBOV(-2))	0.037876	0.080528	0.470344	0.6388
D(LBOV(-3))	0.011216	0.080602	0.139153	0.8895
D(LBOV(-4))	0.119348	0.072353	1.649531	0.1012
C	0.145238	0.100461	1.445714	0.1504
R-squared	0.033758	Mean dependent var		0.012626
Adjusted R-squared	0.000668	S.D. dependent var		0.083021
S.E. of regression	0.082994	Akaike info criterion		-2.101429
Sum squared resid	1.005643	Schwarz criterion		-1.982065
Log likelihood	165.7086	Hannan-Quinn criter.		-2.052939
F-statistic	1.020183	Durbin-Watson stat		1.839600
Prob(F-statistic)	0.408000			

Table A1.7: Unit Root Test - Log of return on JPY/USD (1998-2011)

Null Hypothesis: RJU has a unit root

Exogenous: Constant

Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.379902	0.0000
Test critical values:	1% level	-3.473967	
	5% level	-2.880591	
	10% level	-2.577008	

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

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(RJU)

Method: Least Squares

Date: 08/27/11 Time: 03:56

Sample (adjusted): 1999M01 2011M07

Included observations: 151 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RJU(-1)	-1.236938	0.167609	-7.379902	0.0000
D(RJU(-1))	0.200227	0.146751	1.364400	0.1746
D(RJU(-2))	0.253366	0.125294	2.022179	0.0450
D(RJU(-3))	0.285500	0.105004	2.718941	0.0073
D(RJU(-4))	0.155920	0.072948	2.137423	0.0342
C	0.343062	0.236400	1.451192	0.1489
R-squared	0.544302	Mean dependent var		-0.027137
Adjusted R-squared	0.528589	S.D. dependent var		4.121573
S.E. of regression	2.829848	Akaike info criterion		4.957247
Sum squared resid	1161.165	Schwarz criterion		5.077139
Log likelihood	-368.2721	Hannan-Quinn criter.		5.005953
F-statistic	34.63868	Durbin-Watson stat		1.980054
Prob(F-statistic)	0.000000			

Table A1.8: Unit Root Test - Log of return on RRB/USD (1998-2011)

Null Hypothesis: RRU has a unit root

Exogenous: Constant

Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.887600	0.0000
Test critical values:	1% level	-3.473967	
	5% level	-2.880591	
	10% level	-2.577008	

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

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(RRU)

Method: Least Squares

Date: 08/27/11 Time: 03:56

Sample (adjusted): 1999M01 2011M07

Included observations: 151 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RRU(-1)	-0.603014	0.087551	-6.887600	0.0000
D(RRU(-1))	-0.022430	0.086045	-0.260675	0.7947
D(RRU(-2))	-0.057902	0.079403	-0.729215	0.4670
D(RRU(-3))	-0.007956	0.047583	-0.167211	0.8674
D(RRU(-4))	0.004694	0.045020	0.104270	0.9171
C	-0.052277	0.189915	-0.275265	0.7835
R-squared	0.375611	Mean dependent var		0.109709
Adjusted R-squared	0.354080	S.D. dependent var		2.855178
S.E. of regression	2.294683	Akaike info criterion		4.537990
Sum squared resid	763.5074	Schwarz criterion		4.657882
Log likelihood	-336.6183	Hannan-Quinn criter.		4.586697
F-statistic	17.44538	Durbin-Watson stat		2.015972
Prob(F-statistic)	0.000000			

Table A1.9: Unit Root Test - Log of return on BRR/USD (1998-2011)

Null Hypothesis: RBU has a unit root

Exogenous: Constant

Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.154574	0.0000
Test critical values:	1% level	-3.473967	
	5% level	-2.880591	
	10% level	-2.577008	

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

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(RBU)

Method: Least Squares

Date: 08/27/11 Time: 03:57

Sample (adjusted): 1999M01 2011M07

Included observations: 151 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RBU(-1)	-0.972941	0.188753	-5.154574	0.0000
D(RBU(-1))	-0.048493	0.169480	-0.286129	0.7752
D(RBU(-2))	-0.039801	0.145472	-0.273602	0.7848
D(RBU(-3))	-0.073581	0.118717	-0.619805	0.5364
D(RBU(-4))	-0.027378	0.083125	-0.329357	0.7424
C	-0.159263	0.572061	-0.278402	0.7811
R-squared	0.513139	Mean dependent var		0.007042
Adjusted R-squared	0.496350	S.D. dependent var		9.883485
S.E. of regression	7.014139	Akaike info criterion		6.772657
Sum squared resid	7133.731	Schwarz criterion		6.892549
Log likelihood	-505.3356	Hannan-Quinn criter.		6.821363
F-statistic	30.56522	Durbin-Watson stat		1.608065
Prob(F-statistic)	0.000000			

Table A1.10: Unit Root Test - Log of return on NIKKEI (1998-2011)

Null Hypothesis: RNIK has a unit root

Exogenous: Constant

Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.270030	0.0000
Test critical values:	1% level	-3.473967	
	5% level	-2.880591	
	10% level	-2.577008	

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

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(RNIK)

Method: Least Squares

Date: 08/27/11 Time: 03:57

Sample (adjusted): 1999M01 2011M07

Included observations: 151 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RNIK(-1)	-0.806427	0.153021	-5.270030	0.0000
D(RNIK(-1))	-0.077452	0.142277	-0.544374	0.5870
D(RNIK(-2))	-0.011636	0.128240	-0.090734	0.9278
D(RNIK(-3))	0.091593	0.107722	0.850278	0.3966
D(RNIK(-4))	0.083387	0.080162	1.040240	0.3000
C	-0.184652	0.479369	-0.385199	0.7007
R-squared	0.450605	Mean dependent var		0.049186
Adjusted R-squared	0.431660	S.D. dependent var		7.788661
S.E. of regression	5.871741	Akaike info criterion		6.417103
Sum squared resid	4999.214	Schwarz criterion		6.536995
Log likelihood	-478.4913	Hannan-Quinn criter.		6.465810
F-statistic	23.78532	Durbin-Watson stat		2.005137
Prob(F-statistic)	0.000000			

Table A1.11: Unit Root Test - Log of return on RTS (1998-2011)

Null Hypothesis: RRTS has a unit root

Exogenous: Constant

Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.521636	0.0000
Test critical values:	1% level	-3.473967	
	5% level	-2.880591	
	10% level	-2.577008	

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

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(RRTS)

Method: Least Squares

Date: 08/27/11 Time: 03:57

Sample (adjusted): 1999M01 2011M07

Included observations: 151 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RRTS(-1)	-0.796750	0.144296	-5.521636	0.0000
D(RRTS(-1))	0.051934	0.134567	0.385933	0.7001
D(RRTS(-2))	0.034289	0.115883	0.295894	0.7677
D(RRTS(-3))	0.006817	0.088630	0.076912	0.9388
D(RRTS(-4))	0.064259	0.069775	0.920951	0.3586
C	1.856889	0.998411	1.859844	0.0649
R-squared	0.388055	Mean dependent var		0.147623
Adjusted R-squared	0.366953	S.D. dependent var		14.58767
S.E. of regression	11.60657	Akaike info criterion		7.779944
Sum squared resid	19533.32	Schwarz criterion		7.899836
Log likelihood	-581.3858	Hannan-Quinn criter.		7.828651
F-statistic	18.38984	Durbin-Watson stat		2.037040
Prob(F-statistic)	0.000000			

Table A1.12: Unit Root Test - Log of return on BOVESPA (1998-2011)

Null Hypothesis: RBOV has a unit root

Exogenous: Constant

Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.773373	0.0000
Test critical values:	1% level	-3.473967	
	5% level	-2.880591	
	10% level	-2.577008	

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

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(RBOV)

Method: Least Squares

Date: 08/27/11 Time: 03:58

Sample (adjusted): 1999M01 2011M07

Included observations: 151 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RBOV(-1)	-0.917383	0.158899	-5.773373	0.0000
D(RBOV(-1))	0.039554	0.147031	0.269019	0.7883
D(RBOV(-2))	0.079202	0.125824	0.629469	0.5300
D(RBOV(-3))	0.095119	0.102619	0.926919	0.3555
D(RBOV(-4))	0.109495	0.070714	1.548432	0.1237
C	1.298815	0.695216	1.868218	0.0637

R-squared	0.470178	Mean dependent var	0.120338
Adjusted R-squared	0.451908	S.D. dependent var	10.90423
S.E. of regression	8.072753	Akaike info criterion	7.053790
Sum squared resid	9449.554	Schwarz criterion	7.173682
Log likelihood	-526.5612	Hannan-Quinn criter.	7.102497
F-statistic	25.73537	Durbin-Watson stat	1.900074
Prob(F-statistic)	0.000000		

Table A1.13: Cointegration test - Log of JPY/USD and Log of NIKKEI (1998-2011)

Date: 08/27/11 Time: 19:10
Sample (adjusted): 1998M12 2011M07
Included observations: 152 after adjustments
Trend assumption: Linear deterministic trend
Series: LJU LNIK
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.032497	5.214631	15.49471	0.7856
At most 1	0.001269	0.193034	3.841466	0.6604

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.032497	5.021596	14.26460	0.7391
At most 1	0.001269	0.193034	3.841466	0.6604

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

LJU	LNIK
1.289781	4.345787
9.214638	0.974802

Unrestricted Adjustment Coefficients (alpha):

D(LJU)	-0.000638	-0.001000

D(LNIK)	-0.009333	0.000807

1 Cointegrating Equation(s): Log likelihood 556.2193

Normalized cointegrating coefficients (standard error in parentheses)

LJU	LNIK
1.000000	3.369398
	(1.47994)

Adjustment coefficients (standard error in parentheses)

D(LJU)	-0.000823
	(0.00306)
D(LNIK)	-0.012037
	(0.00603)

Table A1.14: Cointegration test - Log of RRB/USD and Log of RTS (1998-2011)

Date: 08/27/11 Time: 19:15
Sample (adjusted): 1998M12 2011M07
Included observations: 152 after adjustments
Trend assumption: Linear deterministic trend
Series: LRU LRTS
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.095589	22.72512	15.49471	0.0034
At most 1 *	0.047853	7.453400	3.841466	0.0063

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**

None *	0.095589	15.27172	14.26460	0.0345
At most 1 *	0.047853	7.453400	3.841466	0.0063

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

LRU	LRTS
-10.56792	0.587386
-4.114159	-1.036753

Unrestricted Adjustment Coefficients (alpha):

D(LRU)	0.006766	-0.000266
D(LRTS)	0.014944	0.022374

1 Cointegrating Equation(s): Log likelihood 499.8572

Normalized cointegrating coefficients (standard error in parentheses)

LRU	LRTS
1.000000	-0.055582
	(0.02880)

Adjustment coefficients (standard error in parentheses)

D(LRU)	-0.071502
	(0.01849)
D(LRTS)	-0.157926
	(0.09945)

Table A1.15: Cointegration test - Log of BRR/USD and Log of BOVESPA (1998-2011)

Date: 08/27/11 Time: 19:19
Sample (adjusted): 1998M12 2011M07
Included observations: 152 after adjustments
Trend assumption: Linear deterministic trend
Series: LBU LBOV
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.146307	26.38660	15.49471	0.0008
At most 1	0.015294	2.342673	3.841466	0.1259

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.146307	24.04393	14.26460	0.0011
At most 1	0.015294	2.342673	3.841466	0.1259

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

LBU	LBOV
-4.209546	1.593946
2.743507	0.880326

Unrestricted Adjustment Coefficients (alpha):

D(LBU)	0.024622	-0.000862

D(LBOV)	0.007464	-0.009683

1 Cointegrating Equation(s): Log likelihood 388.9437

Normalized cointegrating coefficients (standard error in parentheses)

LBU	LBOV
1.000000	-0.378650
	(0.07742)

Adjustment coefficients (standard error in parentheses)

D(LBU)	-0.103649
	(0.02115)
D(LBOV)	-0.031419
	(0.02838)

Table A1.16: VAR test (4 lags) - Log of Return of JPY/USD and NIKKEI (1998-2011)

Vector Autoregression Estimates
Date: 08/28/11 Time: 03:19
Sample (adjusted): 1998M12 2011M07
Included observations: 152 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	RJU	RNIK
RJU(-1)	-0.009443	-0.096124
	(0.08576)	(0.17137)
	[-0.11011]	[-0.56091]
RJU(-2)	0.109864	-0.206109
	(0.07801)	(0.15589)
	[1.40828]	[-1.32217]
RJU(-3)	0.055480	0.296710
	(0.07677)	(0.15340)
	[0.72268]	[1.93421]
RJU(-4)	-0.130194	-0.154679
	(0.07806)	(0.15598)
	[-1.66783]	[-0.99163]

RNIK(-1)	0.048880	0.116011
	(0.04283)	(0.08559)
	[1.14112]	[1.35539]
RNIK(-2)	-0.050030	0.021992
	(0.04206)	(0.08405)
	[-1.18938]	[0.26165]
RNIK(-3)	0.018164	0.151964
	(0.04190)	(0.08373)
	[0.43346]	[1.81484]
RNIK(-4)	0.030381	-0.036809
	(0.04151)	(0.08295)
	[0.73189]	[-0.44376]
C	0.312346	-0.180338
	(0.24177)	(0.48311)
	[1.29191]	[-0.37329]
R-squared	0.059615	0.075339
Adj. R-squared	0.007006	0.023609
Sum sq. resids	1215.587	4853.674
S.E. equation	2.915580	5.825957
F-statistic	1.133174	1.456400
Log likelihood	-373.6904	-478.9131
Akaike AIC	5.035400	6.419909
Schwarz SC	5.214446	6.598954
Mean dependent	0.306009	-0.272710
S.D. dependent	2.925848	5.895973

Determinant resid covariance (dof adj.)	265.4324
Determinant resid covariance	234.9302
Log likelihood	-846.2632
Akaike information criterion	11.37188
Schwarz criterion	11.72998

Table A1.17: VAR test (3 lags) - Log of Return of JPY/USD and NIKKEI (1998-2011)

Vector Autoregression Estimates
Date: 09/01/11 Time: 00:28
Sample (adjusted): 1998M11 2011M07
Included observations: 153 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	RJU	RNIK
RJU(-1)	-0.077228	0.030853
	(0.07884)	(0.15682)
	[-0.97961]	[0.19674]
RJU(-2)	0.072014	-0.161004
	(0.07745)	(0.15406)
	[0.92987]	[-1.04510]
RJU(-3)	0.070209	0.285266
	(0.07765)	(0.15446)
	[0.90418]	[1.84682]
RNIK(-1)	0.031489	0.124323
	(0.04212)	(0.08379)
	[0.74753]	[1.48367]
RNIK(-2)	-0.039122	0.021807
	(0.04237)	(0.08428)
	[-0.92339]	[0.25874]
RNIK(-3)	0.034766	0.119246
	(0.04156)	(0.08267)
	[0.83658]	[1.44249]
C	0.251412	-0.197715
	(0.24376)	(0.48489)
	[1.03140]	[-0.40775]
R-squared	0.035410	0.054060
Adj. R-squared	-0.004230	0.015186
Sum sq. resids	1276.486	5051.141
S.E. equation	2.956865	5.881909

F-statistic	0.893283	1.390646
Log likelihood	-379.3868	-484.6129
Akaike AIC	5.050808	6.426312
Schwarz SC	5.189456	6.564959
Mean dependent	0.269678	-0.210268
S.D. dependent	2.950631	5.927086

Determinant resid covariance (dof adj.)	277.6760
Determinant resid covariance	252.8490
Log likelihood	-857.4538
Akaike information criterion	11.39155
Schwarz criterion	11.66885

Table A1.18: VAR test (2 lags) - Log of Return of JPY/USD and NIKKEI (1998-2011)

Vector Autoregression Estimates
Date: 09/01/11 Time: 00:29
Sample (adjusted): 1998M10 2011M07
Included observations: 154 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	RJU	RNIK
RJU(-1)	-0.037024	0.025252
	(0.08317)	(0.15480)
	[-0.44519]	[0.16313]
RJU(-2)	0.059158	-0.169408
	(0.08305)	(0.15458)
	[0.71232]	[-1.09591]
RNIK(-1)	0.026247	0.113184
	(0.04513)	(0.08399)
	[0.58164]	[1.34753]
RNIK(-2)	-0.076036	0.029556
	(0.04422)	(0.08232)
	[-1.71933]	[0.35906]
C	0.340495	-0.110611
	(0.25988)	(0.48371)

	[1.31022]	[-0.22867]
R-squared	0.031569	0.024120
Adj. R-squared	0.005571	-0.002079
Sum sq. resids	1504.665	5212.873
S.E. equation	3.177802	5.914873
F-statistic	1.214290	0.920659
Log likelihood	-394.0282	-489.7054
Akaike AIC	5.182185	6.424746
Schwarz SC	5.280787	6.523348
Mean dependent	0.368557	-0.201289
S.D. dependent	3.186691	5.908736

Determinant resid covariance (dof adj.)	334.2097
Determinant resid covariance	312.8601
Log likelihood	-879.4563
Akaike information criterion	11.55138
Schwarz criterion	11.74859

Table A1.19: Vector ECM (4 lags) - Log of Return of RRB/USD and RTS (1998-2011)

Vector Error Correction Estimates
Date: 09/01/11 Time: 00:31
Sample (adjusted): 1999M01 2011M07
Included observations: 151 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1	
RRU(-1)	1.000000	
RRTS(-1)	-0.125979	
	(0.03870)	
	[-3.25501]	
C	0.548476	
Error Correction:	D(RRU)	D(RRTS)
CointEq1	-0.735512	-1.294846
	(0.09962)	(0.56629)

	[-7.38346]	[-2.28652]
D(RRU(-1))	0.022575	1.239677
	(0.09232)	(0.52481)
	[0.24453]	[2.36213]
D(RRU(-2))	-0.070471	0.474591
	(0.08116)	(0.46137)
	[-0.86831]	[1.02866]
D(RRU(-3))	-0.088738	-0.009714
	(0.05508)	(0.31310)
	[-1.61117]	[-0.03103]
D(RRU(-4))	-0.059302	-0.133762
	(0.05002)	(0.28436)
	[-1.18553]	[-0.47040]
D(RRTS(-1))	-0.076602	-0.747622
	(0.01906)	(0.10835)
	[-4.01924]	[-6.90036]
D(RRTS(-2))	-0.046426	-0.546332
	(0.01915)	(0.10884)
	[-2.42488]	[-5.01963]
D(RRTS(-3))	-0.000955	-0.351586
	(0.01776)	(0.10098)
	[-0.05376]	[-3.48157]
D(RRTS(-4))	0.005231	-0.138588
	(0.01532)	(0.08709)
	[0.34146]	[-1.59128]
C	0.134226	0.047714
	(0.18292)	(1.03983)
	[0.73381]	[0.04589]
R-squared	0.429611	0.293861
Adj. R-squared	0.393204	0.248788
Sum sq. resids	697.4750	22539.98
S.E. equation	2.224102	12.64350

F-statistic	11.79999	6.519713
Log likelihood	-329.7888	-592.1950
Akaike AIC	4.500514	7.976093
Schwarz SC	4.700334	8.175913
Mean dependent	0.109709	0.147623
S.D. dependent	2.855178	14.58767

Determinant resid covariance (dof adj.)	709.2161
Determinant resid covariance	618.3907
Log likelihood	-913.7670
Akaike information criterion	12.39427
Schwarz criterion	12.83387

Table A1.20: Vector ECM (3 lags) - Log of Return of RRB/USD and RTS (1998-2011)

Vector Error Correction Estimates
Date: 09/01/11 Time: 00:32
Sample (adjusted): 1998M12 2011M07
Included observations: 152 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
RRU(-1)	1.000000
RRTS(-1)	-0.253400
	(0.04029)
	[-6.28893]
C	0.921847

Error Correction:	D(RRU)	D(RRTS)
CointEq1	-0.567756	0.357299
	(0.08464)	(0.46964)
	[-6.70786]	[0.76079]
D(RRU(-1))	-0.110616	0.243202
	(0.08066)	(0.44758)
	[-1.37132]	[0.54337]

D(RRU(-2))	-0.196878	-0.073353
	(0.05422)	(0.30086)
	[-3.63102]	[-0.24381]
D(RRU(-3))	-0.078076	-0.020884
	(0.05162)	(0.28642)
	[-1.51252]	[-0.07291]
D(RRTS(-1))	-0.109137	-0.502945
	(0.02149)	(0.11921)
	[-5.07963]	[-4.21882]
D(RRTS(-2))	-0.068040	-0.341614
	(0.01923)	(0.10672)
	[-3.53769]	[-3.20111]
D(RRTS(-3))	-0.018538	-0.200042
	(0.01616)	(0.08967)
	[-1.14713]	[-2.23089]
C	0.166104	-0.005486
	(0.18861)	(1.04654)
	[0.88067]	[-0.00524]
R-squared	0.390209	0.298819
Adj. R-squared	0.360566	0.264734
Sum sq. resids	765.1679	23557.91
S.E. equation	2.305139	12.79049
F-statistic	13.16377	8.766838
Log likelihood	-338.5110	-598.9722
Akaike AIC	4.559355	7.986477
Schwarz SC	4.718507	8.145628
Mean dependent	0.072372	-0.122720
S.D. dependent	2.882699	14.91643

Determinant resid covariance (dof adj.)	713.3664
Determinant resid covariance	640.2513
Log likelihood	-922.4587
Akaike information criterion	12.37446
Schwarz criterion	12.73255

Table A1.21: Vector ECM (2 lags) - Log of Return of RRB/USD and RTS (1998-2011)

Vector Error Correction Estimates
Date: 09/01/11 Time: 00:33
Sample (adjusted): 1998M11 2011M07
Included observations: 153 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
RRU(-1)	1.000000
RRTS(-1)	-0.328348
	(0.04101)
	[-8.00744]
C	1.172775

Error Correction:	D(RRU)	D(RRTS)
CointEq1	-0.392889	1.069378
	(0.06433)	(0.34311)
	[-6.10760]	[3.11668]
D(RRU(-1))	-0.099236	0.447554
	(0.05435)	(0.28989)
	[-1.82588]	[1.54387]
D(RRU(-2))	-0.193852	-0.202293
	(0.05075)	(0.27069)
	[-3.81975]	[-0.74732]
D(RRTS(-1))	-0.090375	-0.273500
	(0.01955)	(0.10430)
	[-4.62175]	[-2.62228]
D(RRTS(-2))	-0.050596	-0.130762
	(0.01657)	(0.08838)
	[-3.05338]	[-1.47946]
C	0.169808	-0.101886
	(0.19485)	(1.03930)

	[0.87148]	[-0.09803]
R-squared	0.345687	0.286157
Adj. R-squared	0.323432	0.261877
Sum sq. resids	843.7536	24004.57
S.E. equation	2.395792	12.77875
F-statistic	15.53264	11.78553
Log likelihood	-347.7154	-603.8481
Akaike AIC	4.623731	7.971870
Schwarz SC	4.742572	8.090711
Mean dependent	0.033732	-0.158494
S.D. dependent	2.912684	14.87387
Determinant resid covariance (dof adj.)		733.5029
Determinant resid covariance		677.1013
Log likelihood		-932.8085
Akaike information criterion		12.37658
Schwarz criterion		12.65388

Table A1.22: Vector ECM (4 lags) - Log of Return of BRR/USD and BOVESPA (1998-2011)

Vector Error Correction Estimates
Date: 09/01/11 Time: 00:34
Sample (adjusted): 1999M01 2011M07
Included observations: 151 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1	
RBU(-1)	1.000000	
RBOV(-1)	-0.977237	
	(0.13236)	
	[-7.38320]	
C	1.454495	
Error Correction:	D(RBU)	D(RBOV)
CointEq1	-0.648873	0.533066
	(0.15267)	(0.19412)

	[-4.25029]	[2.74608]
D(RBU(-1))	-0.428258	-0.577997
	(0.14556)	(0.18509)
	[-2.94205]	[-3.12279]
D(RBU(-2))	-0.294223	-0.511306
	(0.13390)	(0.17026)
	[-2.19731]	[-3.00308]
D(RBU(-3))	-0.195866	-0.445913
	(0.11257)	(0.14313)
	[-1.74003]	[-3.11543]
D(RBU(-4))	-0.088077	-0.242179
	(0.07888)	(0.10030)
	[-1.11656]	[-2.41453]
D(RBOV(-1))	-0.296535	-0.206831
	(0.14495)	(0.18431)
	[-2.04580]	[-1.12221]
D(RBOV(-2))	-0.215537	-0.048289
	(0.12635)	(0.16066)
	[-1.70583]	[-0.30056]
D(RBOV(-3))	-0.237214	0.054604
	(0.10183)	(0.12948)
	[-2.32951]	[0.42172]
D(RBOV(-4))	-0.197418	0.115222
	(0.06608)	(0.08402)
	[-2.98779]	[1.37142]
C	0.019864	0.071798
	(0.55659)	(0.70772)
	[0.03569]	[0.10145]
R-squared	0.551138	0.403791
Adj. R-squared	0.522487	0.365735
Sum sq. resids	6576.946	10633.59
S.E. equation	6.829715	8.684210

F-statistic	19.23642	10.61049
Log likelihood	-499.2002	-535.4739
Akaike AIC	6.744373	7.224820
Schwarz SC	6.944193	7.424640
Mean dependent	0.007042	0.120338
S.D. dependent	9.883485	10.90423

Determinant resid covariance (dof adj.)	2778.745
Determinant resid covariance	2422.887
Log likelihood	-1016.869
Akaike information criterion	13.75986
Schwarz criterion	14.19946

Table A1.23: Vector ECM (3 lags) - Log of Return of BRR/USD and BOVESPA (1998-2011)

Vector Error Correction Estimates
Date: 09/01/11 Time: 00:34
Sample (adjusted): 1998M12 2011M07
Included observations: 152 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
RBU(-1)	1.000000
RBOV(-1)	-0.060731
	(0.11983)
	[-0.50680]
C	0.264602

Error Correction:	D(RBU)	D(RBOV)
CointEq1	-0.955560	-0.823658
	(0.17127)	(0.22162)
	[-5.57934]	[-3.71656]
D(RBU(-1))	-0.146322	0.582102
	(0.15317)	(0.19820)
	[-0.95527]	[2.93689]

D(RBU(-2))	-0.074490	0.368996
	(0.12598)	(0.16302)
	[-0.59126]	[2.26347]
D(RBU(-3))	-0.055304	0.115066
	(0.08435)	(0.10915)
	[-0.65563]	[1.05420]
D(RBOV(-1))	0.166885	-0.799281
	(0.06270)	(0.08113)
	[2.66175]	[-9.85186]
D(RBOV(-2))	0.122928	-0.541261
	(0.07253)	(0.09386)
	[1.69482]	[-5.76698]
D(RBOV(-3))	0.016929	-0.298148
	(0.05684)	(0.07355)
	[0.29783]	[-4.05363]
C	0.020280	-0.160107
	(0.54538)	(0.70572)
	[0.03718]	[-0.22687]
R-squared	0.556047	0.449906
Adj. R-squared	0.534466	0.423165
Sum sq. resids	6505.020	10892.09
S.E. equation	6.721142	8.697096
F-statistic	25.76551	16.82476
Log likelihood	-501.1688	-540.3439
Akaike AIC	6.699589	7.215051
Schwarz SC	6.858741	7.374203
Mean dependent	0.007352	-0.172264
S.D. dependent	9.850705	11.45113

Determinant resid covariance (dof adj.)	3144.747
Determinant resid covariance	2822.433
Log likelihood	-1035.204
Akaike information criterion	13.85795
Schwarz criterion	14.21604

Table A1.24: Vector ECM (2 lags) - Log of Return of BRR/USD and BOVESPA (1998-2011)

Vector Error Correction Estimates
Date: 09/01/11 Time: 00:35
Sample (adjusted): 1998M11 2011M07
Included observations: 153 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
RBU(-1)	1.000000
RBOV(-1)	-0.415112
	(0.09048)
	[-4.58790]
C	0.790344

Error Correction:	D(RBU)	D(RBOV)
CointEq1	-1.109809	-0.101683
	(0.15940)	(0.23375)
	[-6.96231]	[-0.43500]
D(RBU(-1))	-0.046109	-0.076326
	(0.12619)	(0.18505)
	[-0.36540]	[-0.41246]
D(RBU(-2))	-0.019851	-0.102188
	(0.08216)	(0.12048)
	[-0.24162]	[-0.84815]
D(RBOV(-1))	-0.111899	-0.596719
	(0.07676)	(0.11256)
	[-1.45783]	[-5.30134]
D(RBOV(-2))	-0.021324	-0.185378
	(0.05864)	(0.08599)
	[-0.36366]	[-2.15590]
C	0.010647	-0.043424
	(0.54119)	(0.79362)

	[0.01967]	[-0.05472]
R-squared	0.550837	0.291981
Adj. R-squared	0.535560	0.267899
Sum sq. resids	6581.353	14152.79
S.E. equation	6.691122	9.812110
F-statistic	36.05514	12.12431
Log likelihood	-504.8568	-563.4306
Akaike AIC	6.677866	7.443538
Schwarz SC	6.796707	7.562378
Mean dependent	0.007168	-0.082142
S.D. dependent	9.818248	11.46771
Determinant resid covariance (dof adj.)		3753.503
Determinant resid covariance		3464.883
Log likelihood		-1057.703
Akaike information criterion		14.00919
Schwarz criterion		14.28649

Table A1.25: Granger Causality Test - Log of Return of JPY/USD and NIKKEI (1998-2011)

Pairwise Granger Causality Tests
Date: 08/28/11 Time: 03:28
Sample: 1998M07 2011M07
Lags: 4

Null Hypothesis:	Obs	F-Statistic	Prob.
RNIK does not Granger Cause RJU	152	0.84932	0.4962
RJU does not Granger Cause RNIK		1.78466	0.1351

Table A1.26: Granger Causality Test - Log of Return of RRB/USD and RTS (1998-2011)

Pairwise Granger Causality Tests
Date: 08/28/11 Time: 03:29
Sample: 1998M07 2011M07
Lags: 4

Null Hypothesis:	Obs	F-Statistic	Prob.
RRTS does not Granger Cause RRU	152	2.83750	0.0266
RRU does not Granger Cause RRTS		1.10039	0.3588

Table A1.27: Granger Causality Test - Log of Return of BRR/USD and BOVESPA (1998-2011)

Pairwise Granger Causality Tests
Date: 08/28/11 Time: 03:30
Sample: 1998M07 2011M07
Lags: 4

Null Hypothesis:	Obs	F-Statistic	Prob.
RBOV does not Granger Cause RBU	152	4.30262	0.0026
RBU does not Granger Cause RBOV		1.02790	0.3950

Appendix (A2)

Sample (07:1998 – 01:2005)

Table A2.1: Unit Root Test - Log of JPY/USD (1998-2011)

Null Hypothesis: LJU has a unit root
Exogenous: Constant
Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.849012	0.3544
Test critical values:	1% level	-3.521579	
	5% level	-2.901217	
	10% level	-2.587981	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LJU)
Method: Least Squares
Date: 04/24/13 Time: 19:17
Sample (adjusted): 1998M12 2005M01
Included observations: 74 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LJU(-1)	-0.097113	0.052521	-1.849012	0.0688
D(LJU(-1))	0.001365	0.118165	0.011556	0.9908
D(LJU(-2))	0.203584	0.099114	2.054042	0.0438
D(LJU(-3))	0.175445	0.096845	1.811605	0.0745
D(LJU(-4))	-0.146443	0.099067	-1.478225	0.1440
C	-0.459461	0.249514	-1.841423	0.0699

R-squared	0.155973	Mean dependent var	0.002332
Adjusted R-squared	0.093912	S.D. dependent var	0.029992
S.E. of regression	0.028549	Akaike info criterion	-4.196769
Sum squared resid	0.055424	Schwarz criterion	-4.009953
Log likelihood	161.2805	Hannan-Quinn criter.	-4.122246
F-statistic	2.513223	Durbin-Watson stat	1.954644
Prob(F-statistic)	0.037939		

Table A2.2: Unit Root Test - Log of RRB/USD (1998-2005)

Null Hypothesis: LRU has a unit root
Exogenous: Constant
Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.657871	0.4483
Test critical values:	1% level	-3.521579	
	5% level	-2.901217	
	10% level	-2.587981	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LRU)
Method: Least Squares
Date: 04/24/13 Time: 19:19
Sample (adjusted): 1998M12 2005M01
Included observations: 74 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LRU(-1)	-0.043709	0.026365	-1.657871	0.1020
D(LRU(-1))	0.066365	0.116427	0.570012	0.5705
D(LRU(-2))	-0.008816	0.082360	-0.107046	0.9151
D(LRU(-3))	0.190350	0.042757	4.451912	0.0000
D(LRU(-4))	0.062993	0.044860	1.404214	0.1648
C	-0.147661	0.088949	-1.660066	0.1015

R-squared	0.666694	Mean dependent var	-0.005647
Adjusted R-squared	0.642186	S.D. dependent var	0.024464
S.E. of regression	0.014634	Akaike info criterion	-5.533401
Sum squared resid	0.014561	Schwarz criterion	-5.346585
Log likelihood	210.7358	Hannan-Quinn criter.	-5.458878
F-statistic	27.20332	Durbin-Watson stat	1.805802
Prob(F-statistic)	0.000000		

Table A2.3: Unit Root Test - Log of BRR/USD (1998-2005)

Null Hypothesis: LBU has a unit root
Exogenous: Constant
Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.664113	0.0852
Test critical values:	1% level	-3.521579	
	5% level	-2.901217	
	10% level	-2.587981	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LBU)
Method: Least Squares
Date: 04/24/13 Time: 19:19
Sample (adjusted): 1998M12 2005M01
Included observations: 74 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LBU(-1)	-0.103238	0.038751	-2.664113	0.0096
D(LBU(-1))	-0.078776	0.115551	-0.681740	0.4977
D(LBU(-2))	-0.065323	0.115915	-0.563547	0.5749
D(LBU(-3))	-0.063384	0.116331	-0.544859	0.5876
D(LBU(-4))	0.009038	0.116089	0.077853	0.9382
C	-0.102709	0.035344	-2.906019	0.0049

R-squared	0.107747	Mean dependent var	-0.010534
Adjusted R-squared	0.042140	S.D. dependent var	0.088660
S.E. of regression	0.086772	Akaike info criterion	-1.973459
Sum squared resid	0.511999	Schwarz criterion	-1.786643
Log likelihood	79.01798	Hannan-Quinn criter.	-1.898936
F-statistic	1.642314	Durbin-Watson stat	2.010204
Prob(F-statistic)	0.160682		

Table A2.4: Unit Root Test - Log of NIKKEI (1998-2005)

Null Hypothesis: LNIK has a unit root
Exogenous: Constant
Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.260283	0.6439
Test critical values:	1% level	-3.521579	
	5% level	-2.901217	
	10% level	-2.587981	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNIK)
Method: Least Squares
Date: 04/24/13 Time: 19:20
Sample (adjusted): 1998M12 2005M01
Included observations: 74 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNIK(-1)	-0.033121	0.026280	-1.260283	0.2119
D(LNIK(-1))	0.027156	0.116842	0.232415	0.8169
D(LNIK(-2))	0.156230	0.117592	1.328577	0.1884
D(LNIK(-3))	0.110867	0.117616	0.942624	0.3492
D(LNIK(-4))	-0.056469	0.112318	-0.502760	0.6168
C	0.309073	0.247917	1.246677	0.2168

R-squared	0.055394	Mean dependent var	-0.003618
Adjusted R-squared	-0.014062	S.D. dependent var	0.055246
S.E. of regression	0.055633	Akaike info criterion	-2.862483
Sum squared resid	0.210460	Schwarz criterion	-2.675667
Log likelihood	111.9119	Hannan-Quinn criter.	-2.787960
F-statistic	0.797540	Durbin-Watson stat	1.882783
Prob(F-statistic)	0.555260		

Table A2.5: Unit Root Test - Log of RTS (1998-2005)

Null Hypothesis: LRTS has a unit root
Exogenous: Constant
Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.600473	0.4773
Test critical values:	1% level	-3.521579	
	5% level	-2.901217	
	10% level	-2.587981	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LRTS)
Method: Least Squares
Date: 04/24/13 Time: 19:21
Sample (adjusted): 1998M12 2005M01
Included observations: 74 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LRTS(-1)	-0.034604	0.021621	-1.600473	0.1141
D(LRTS(-1))	0.079278	0.118005	0.671818	0.5040
D(LRTS(-2))	-0.154958	0.117577	-1.317932	0.1919
D(LRTS(-3))	-0.088832	0.109238	-0.813194	0.4189
D(LRTS(-4))	0.119613	0.092841	1.288365	0.2020
C	0.224928	0.120757	1.862650	0.0668

R-squared	0.100504	Mean dependent var	0.029567
Adjusted R-squared	0.034365	S.D. dependent var	0.126995
S.E. of regression	0.124794	Akaike info criterion	-1.246695
Sum squared resid	1.059006	Schwarz criterion	-1.059879
Log likelihood	52.12773	Hannan-Quinn criter.	-1.172172
F-statistic	1.519586	Durbin-Watson stat	1.952740
Prob(F-statistic)	0.195295		

Table A2.6: Unit Root Test- Log of BOVESPA (1998-2005)

Null Hypothesis: LBOV has a unit root
Exogenous: Constant
Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.606645	0.4742
Test critical values:	1% level	-3.521579	
	5% level	-2.901217	
	10% level	-2.587981	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LBOV)
Method: Least Squares
Date: 04/24/13 Time: 19:21
Sample (adjusted): 1998M12 2005M01
Included observations: 74 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LBOV(-1)	-0.064296	0.040019	-1.606645	0.1128
D(LBOV(-1))	0.046841	0.118723	0.394543	0.6944
D(LBOV(-2))	0.034149	0.116325	0.293566	0.7700
D(LBOV(-3))	-0.015412	0.116415	-0.132392	0.8951
D(LBOV(-4))	0.153950	0.101944	1.510147	0.1356
C	0.625830	0.381620	1.639928	0.1056

R-squared	0.056540	Mean dependent var	0.014016
Adjusted R-squared	-0.012832	S.D. dependent var	0.095412
S.E. of regression	0.096023	Akaike info criterion	-1.770861
Sum squared resid	0.626983	Schwarz criterion	-1.584045
Log likelihood	71.52186	Hannan-Quinn criter.	-1.696338
F-statistic	0.815032	Durbin-Watson stat	1.794860
Prob(F-statistic)	0.543118		

Table A2.7: Unit Root Test - Log of return on JPY/USD (1998-2005)

Null Hypothesis: RJU has a unit root
Exogenous: Constant
Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.575103	0.0000
Test critical values:	1% level	-3.522887	
	5% level	-2.901779	
	10% level	-2.588280	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RJU)
Method: Least Squares
Date: 04/24/13 Time: 19:23
Sample (adjusted): 1999M01 2005M01
Included observations: 73 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RJU(-1)	-1.213838	0.217725	-5.575103	0.0000
D(RJU(-1))	0.152949	0.191406	0.799083	0.4271
D(RJU(-2))	0.246452	0.164954	1.494065	0.1399
D(RJU(-3))	0.375731	0.140315	2.677774	0.0093
D(RJU(-4))	0.184741	0.097265	1.899344	0.0618
C	0.211490	0.331975	0.637066	0.5263

R-squared	0.597707	Mean dependent var	-0.130832
Adjusted R-squared	0.567685	S.D. dependent var	4.230028
S.E. of regression	2.781272	Akaike info criterion	4.962311
Sum squared resid	518.2769	Schwarz criterion	5.150568
Log likelihood	-175.1243	Hannan-Quinn criter.	5.037334
F-statistic	19.90903	Durbin-Watson stat	1.954574
Prob(F-statistic)	0.000000		

Table A2.8: Unit Root Test - Log of return on RRB/USD (1998-2005)

Null Hypothesis: RRU has a unit root
Exogenous: Constant
Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.964808	0.0027
Test critical values:	1% level	-3.522887	
	5% level	-2.901779	
	10% level	-2.588280	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RRU)
Method: Least Squares
Date: 04/24/13 Time: 19:24
Sample (adjusted): 1999M01 2005M01
Included observations: 73 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RRU(-1)	-0.430841	0.108666	-3.964808	0.0002
D(RRU(-1))	-0.400865	0.097059	-4.130118	0.0001
D(RRU(-2))	-0.079188	0.088763	-0.892127	0.3755
D(RRU(-3))	0.021638	0.049485	0.437274	0.6633
D(RRU(-4))	0.137710	0.041790	3.295276	0.0016
C	-0.074298	0.169388	-0.438626	0.6623

R-squared	0.654427	Mean dependent var	0.198009
Adjusted R-squared	0.628637	S.D. dependent var	2.250990
S.E. of regression	1.371743	Akaike info criterion	3.548658
Sum squared resid	126.0724	Schwarz criterion	3.736915
Log likelihood	-123.5260	Hannan-Quinn criter.	3.623681
F-statistic	25.37612	Durbin-Watson stat	1.920459
Prob(F-statistic)	0.000000		

Table A2.9: Unit Root Test - Log of return on BRR/USD (1998-2005)

Null Hypothesis: RBU has a unit root
Exogenous: Constant
Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.882054	0.0035
Test critical values:	1% level	-3.522887	
	5% level	-2.901779	
	10% level	-2.588280	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RBU)
Method: Least Squares
Date: 04/24/13 Time: 19:25
Sample (adjusted): 1999M01 2005M01
Included observations: 73 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RBU(-1)	-1.216687	0.313413	-3.882054	0.0002
D(RBU(-1))	0.128205	0.277236	0.462439	0.6453
D(RBU(-2))	0.059049	0.232791	0.253658	0.8005
D(RBU(-3))	-0.003920	0.182715	-0.021455	0.9829
D(RBU(-4))	0.010256	0.123114	0.083306	0.9339
C	-1.305353	1.137262	-1.147803	0.2551

R-squared	0.543658	Mean dependent var	0.027894
Adjusted R-squared	0.509602	S.D. dependent var	13.11739
S.E. of regression	9.185897	Akaike info criterion	7.351833
Sum squared resid	5653.507	Schwarz criterion	7.540089
Log likelihood	-262.3419	Hannan-Quinn criter.	7.426856
F-statistic	15.96393	Durbin-Watson stat	1.506630
Prob(F-statistic)	0.000000		

Table A2.10: Unit Root Test - Log of return on NIKKEI (1998-2005)

Null Hypothesis: RNIK has a unit root
Exogenous: Constant
Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.375234	0.0151
Test critical values:	1% level	-3.522887	
	5% level	-2.901779	
	10% level	-2.588280	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RNIK)
Method: Least Squares
Date: 04/24/13 Time: 19:25
Sample (adjusted): 1999M01 2005M01
Included observations: 73 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RNIK(-1)	-0.785462	0.232713	-3.375234	0.0012
D(RNIK(-1))	-0.152720	0.211784	-0.721116	0.4733
D(RNIK(-2))	-0.003653	0.188643	-0.019365	0.9846
D(RNIK(-3))	0.059027	0.157311	0.375225	0.7087
D(RNIK(-4))	-0.071865	0.111883	-0.642322	0.5229
C	-0.191061	0.656427	-0.291062	0.7719

R-squared	0.501526	Mean dependent var	0.087263
Adjusted R-squared	0.464327	S.D. dependent var	7.591742
S.E. of regression	5.556373	Akaike info criterion	6.346385
Sum squared resid	2068.510	Schwarz criterion	6.534642
Log likelihood	-225.6431	Hannan-Quinn criter.	6.421409
F-statistic	13.48206	Durbin-Watson stat	1.956459
Prob(F-statistic)	0.000000		

Table A2.11: Unit Root Test - Log of return on RTS (1998-2005)

Null Hypothesis: RRTS has a unit root
Exogenous: Constant
Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.769023	0.0002
Test critical values:	1% level	-3.522887	
	5% level	-2.901779	
	10% level	-2.588280	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RRTS)
Method: Least Squares
Date: 04/24/13 Time: 19:26
Sample (adjusted): 1999M01 2005M01
Included observations: 73 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RRTS(-1)	-1.269317	0.266159	-4.769023	0.0000
D(RRTS(-1))	0.364508	0.234060	1.557329	0.1241
D(RRTS(-2))	0.211567	0.187247	1.129884	0.2626
D(RRTS(-3))	0.042462	0.128065	0.331568	0.7413
D(RRTS(-4))	0.077341	0.093223	0.829641	0.4097
C	4.147319	1.684639	2.461845	0.0164

R-squared	0.492817	Mean dependent var	0.314675
Adjusted R-squared	0.454967	S.D. dependent var	16.95054
S.E. of regression	12.51396	Akaike info criterion	7.970184
Sum squared resid	10492.15	Schwarz criterion	8.158441
Log likelihood	-284.9117	Hannan-Quinn criter.	8.045207
F-statistic	13.02044	Durbin-Watson stat	2.072701
Prob(F-statistic)	0.000000		

Table A2.12: Unit Root Test - Log of return on BOVESPA (1998-2005)

Null Hypothesis: RBOV has a unit root
Exogenous: Constant
Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.428737	0.0006
Test critical values:	1% level	-3.522887	
	5% level	-2.901779	
	10% level	-2.588280	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RBOV)
Method: Least Squares
Date: 04/24/13 Time: 19:26
Sample (adjusted): 1999M01 2005M01
Included observations: 73 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RBOV(-1)	-1.091511	0.246461	-4.428737	0.0000
D(RBOV(-1))	0.174287	0.224330	0.776920	0.4399
D(RBOV(-2))	0.180704	0.186132	0.970838	0.3351
D(RBOV(-3))	0.143189	0.147741	0.969188	0.3359
D(RBOV(-4))	0.114762	0.097452	1.177627	0.2431
C	1.846534	1.160017	1.591816	0.1161

R-squared	0.503262	Mean dependent var	0.229752
Adjusted R-squared	0.466192	S.D. dependent var	12.75717
S.E. of regression	9.320666	Akaike info criterion	7.380962
Sum squared resid	5820.613	Schwarz criterion	7.569219
Log likelihood	-263.4051	Hannan-Quinn criter.	7.455986
F-statistic	13.57600	Durbin-Watson stat	1.814982
Prob(F-statistic)	0.000000		

Table A2.13: Cointegration test - Log of JPY/USD and Log of NIKKEI (1998-2005)

Date: 04/24/13 Time: 19:29
Sample (adjusted): 1998M12 2005M01
Included observations: 74 after adjustments
Trend assumption: Linear deterministic trend
Series: LJU LNIK
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.071506	7.701615	15.49471	0.4978
At most 1	0.029442	2.211424	3.841466	0.1370

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.071506	5.490190	14.26460	0.6791
At most 1	0.029442	2.211424	3.841466	0.1370

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

LJU	LNIK
-17.76356	2.733904
-2.875570	-3.693372

Unrestricted Adjustment Coefficients (alpha):

D(LJU)	0.006158	0.002313
D(LNIK)	-0.006475	0.007382

1 Cointegrating Equation(s): Log likelihood 283.5401

Normalized cointegrating coefficients (standard error in parentheses)

LJU	LNIK
1.000000	-0.153905
	(0.10353)

Adjustment coefficients (standard error in parentheses)

D(LJU)	-0.109383
	(0.05765)

D(LNIK)	0.115020
	(0.10867)

Table A2.14: Cointegration test - Log of RRB/USD and Log of RTS (1998-2005)

Date: 04/24/13 Time: 19:31
Sample (adjusted): 1998M12 2005M01
Included observations: 74 after adjustments
Trend assumption: Linear deterministic trend
Series: LRU LRTS
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.065124	7.223607	15.49471	0.5518
At most 1	0.029821	2.240309	3.841466	0.1345

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.065124	4.983297	14.26460	0.7439
At most 1	0.029821	2.240309	3.841466	0.1345

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

LRU	LRTS
-4.214816	1.639330
-18.28324	-1.730247

Unrestricted Adjustment Coefficients (alpha):

D(LRU)	0.003120	0.001139
D(LRTS)	-0.010523	0.018742

1 Cointegrating Equation(s): Log likelihood 268.9369

Normalized cointegrating coefficients (standard error in parentheses)

LRU	LRTS
1.000000	-0.388945

	(0.22317)

Adjustment coefficients (standard error in parentheses)

D(LRU)	-0.013150
	(0.00713)
D(LRTS)	0.044353
	(0.06092)

Table A2.15: Cointegration test - Log of BRR/USD and Log of BOVESPA (1998-2005)

Date: 04/24/13 Time: 19:31
Sample (adjusted): 1998M12 2005M01
Included observations: 74 after adjustments
Trend assumption: Linear deterministic trend
Series: LBU LBOV
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.136431	13.85264	15.49471	0.0871
At most 1	0.039707	2.998223	3.841466	0.0834

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.136431	10.85442	14.26460	0.1616
At most 1	0.039707	2.998223	3.841466	0.0834

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

LBU	LBOV
-2.944568	2.119129
-2.800958	-3.437114

Unrestricted Adjustment Coefficients (alpha):

D(LBU)	0.029029	0.003296
D(LBOV)	0.002173	0.018210

1 Cointegrating Equation(s): Log likelihood 161.7098

Normalized cointegrating coefficients (standard error in parentheses)

LBU	LBOV
1.000000	-0.719674
	(0.42197)

Adjustment coefficients (standard error in parentheses)

D(LBU)	-0.085478
	(0.02756)
D(LBOV)	-0.006400
	(0.03370)

Table A2.16: VAR test (4 lags) - Log of Return of JPY/USD and NIKKEI (1998-2005)

Vector Autoregression Estimates
Date: 04/24/13 Time: 19:34
Sample (adjusted): 1998M12 2005M01
Included observations: 74 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	RJU	RNIK
RJU(-1)	-0.081263	-0.288345
	(0.11843)	(0.21912)
	[-0.68616]	[-1.31593]
RJU(-2)	0.170526	-0.332870
	(0.09849)	(0.18223)
	[1.73135]	[-1.82667]
RJU(-3)	0.167534	0.471500
	(0.09603)	(0.17767)
	[1.74460]	[2.65378]
RJU(-4)	-0.243741	-0.103167
	(0.10407)	(0.19255)
	[-2.34202]	[-0.53579]
RNIK(-1)	0.127106	0.094283
	(0.06327)	(0.11706)
	[2.00894]	[0.80543]
RNIK(-2)	-0.015359	0.148590
	(0.06219)	(0.11505)
	[-0.24698]	[1.29148]
RNIK(-3)	0.063858	0.099233
	(0.06008)	(0.11116)
	[1.06290]	[0.89274]
RNIK(-4)	0.055610	-0.066743
	(0.05832)	(0.10790)
	[0.95350]	[-0.61854]

C	0.282640	-0.276260
	(0.34078)	(0.63050)
	[0.82938]	[-0.43816]
R-squared	0.197717	0.190596
Adj. R-squared	0.098975	0.090977
Sum sq. resids	526.8276	1803.372
S.E. equation	2.846935	5.267275
F-statistic	2.002352	1.913248
Log likelihood	-177.6254	-223.1553
Akaike AIC	5.043928	6.274469
Schwarz SC	5.324153	6.554693
Mean dependent	0.233165	-0.361814
S.D. dependent	2.999225	5.524570

Determinant resid covariance (dof adj.)	224.8037
Determinant resid covariance	173.4469
Log likelihood	-400.7702
Akaike information criterion	11.31811
Schwarz criterion	11.87856

Table A2.17: VAR test (3 lags) - Log of Return of JPY/USD and NIKKEI (1998-2005)

Vector Autoregression Estimates
Date: 04/24/13 Time: 19:35
Sample (adjusted): 1998M11 2005M01
Included observations: 75 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	RJU	RNIK
RJU(-1)	-0.178996	-0.032746
	(0.09895)	(0.18440)
	[-1.80889]	[-0.17758]
RJU(-2)	0.102760	-0.222022
	(0.09654)	(0.17990)
	[1.06446]	[-1.23417]
RJU(-3)	0.182961	0.468245
	(0.09867)	(0.18387)
	[1.85427]	[2.54658]
RNIK(-1)	0.083188	0.081702
	(0.06225)	(0.11600)
	[1.33634]	[0.70430]
RNIK(-2)	0.031402	0.108559
	(0.06131)	(0.11426)
	[0.51216]	[0.95015]
RNIK(-3)	0.085337	0.009945
	(0.05916)	(0.11025)
	[1.44236]	[0.09020]

C	0.182885	-0.255119
	(0.34820)	(0.64887)
	[0.52523]	[-0.39317]
R-squared	0.148209	0.124830
Adj. R-squared	0.073051	0.047609
Sum sq. resids	584.6302	2030.191
S.E. equation	2.932150	5.464042
F-statistic	1.971971	1.616532
Log likelihood	-183.4263	-230.1103
Akaike AIC	5.078035	6.322941
Schwarz SC	5.294334	6.539240
Mean dependent	0.160020	-0.233244
S.D. dependent	3.045498	5.598947

Determinant resid covariance (dof adj.)	256.6630
Determinant resid covariance	210.9884
Log likelihood	-413.5334
Akaike information criterion	11.40089
Schwarz criterion	11.83349

Table A2.18: VAR test (2 lags) - Log of Return of JPY/USD and NIKKEI (1998-2005)

Vector Autoregression Estimates
Date: 04/24/13 Time: 19:36
Sample (adjusted): 1998M10 2005M01
Included observations: 76 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	RJU	RNIK
RJU(-1)	-0.078099	0.043023
	(0.11597)	(0.18402)
	[-0.67343]	[0.23379]
RJU(-2)	0.113869	-0.249384
	(0.11602)	(0.18409)
	[0.98148]	[-1.35468]
RNIK(-1)	0.042014	0.029070
	(0.07326)	(0.11625)
	[0.57347]	[0.25007]
RNIK(-2)	-0.056773	0.099653
	(0.07056)	(0.11195)
	[-0.80466]	[0.89013]
C	0.326137	-0.060684
	(0.41521)	(0.65884)
	[0.78547]	[-0.09211]
R-squared	0.033550	0.037372
Adj. R-squared	-0.020897	-0.016861
Sum sq. resids	887.6696	2234.951

S.E. equation	3.535872	5.610542
F-statistic	0.616194	0.689102
Log likelihood	-201.2382	-236.3265
Akaike AIC	5.427322	6.350697
Schwarz SC	5.580660	6.504035
Mean dependent	0.361823	-0.214746
S.D. dependent	3.499496	5.563833

Determinant resid covariance (dof adj.)	390.6773
Determinant resid covariance	340.9634
Log likelihood	-437.2861
Akaike information criterion	11.77069
Schwarz criterion	12.07736

Table A2.19: Vector ECM (4 lags) - Log of Return of RRB/USD and RTS (1998-2005)

Vector Autoregression Estimates
Date: 04/24/13 Time: 19:36
Sample (adjusted): 1998M12 2005M01
Included observations: 74 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	RRU	RRTS
RRU(-1)	0.053544	-0.551364
	(0.12059)	(1.00796)
	[0.44400]	[-0.54701]
RRU(-2)	0.077058	-1.522938
	(0.08784)	(0.73417)
	[0.87727]	[-2.07437]
RRU(-3)	0.183607	0.073042
	(0.04544)	(0.37982)
	[4.04038]	[0.19231]
RRU(-4)	0.078029	0.533839
	(0.04706)	(0.39332)
	[1.65814]	[1.35726]
RRTS(-1)	0.007785	0.073341
	(0.01444)	(0.12067)
	[0.53923]	[0.60779]
RRTS(-2)	0.003358	-0.098494
	(0.01438)	(0.12016)
	[0.23360]	[-0.81972]
RRTS(-3)	0.023908	-0.149183
	(0.01404)	(0.11732)
	[1.70331]	[-1.27163]
RRTS(-4)	0.010644	0.029432
	(0.01350)	(0.11285)

	[0.78831]	[0.26080]
C	-0.176534	3.163887
	(0.20456)	(1.70971)
	[-0.86301]	[1.85054]
R-squared	0.673165	0.152737
Adj. R-squared	0.632939	0.048458
Sum sq. resids	142.7878	9975.107
S.E. equation	1.482139	12.38803
F-statistic	16.73463	1.464701
Log likelihood	-129.3214	-286.4414
Akaike AIC	3.738415	7.984903
Schwarz SC	4.018639	8.265127
Mean dependent	-0.564667	2.956705
S.D. dependent	2.446357	12.69955
Determinant resid covariance (dof adj.)		331.3119
Determinant resid covariance		255.6232
Log likelihood		-415.1200
Akaike information criterion		11.70595
Schwarz criterion		12.26639

Table A2.20: Vector ECM (3 lags) - Log of Return of RRB/USD and RTS (1998-2005)

Vector Autoregression Estimates
Date: 04/24/13 Time: 19:37
Sample (adjusted): 1998M11 2005M01
Included observations: 75 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	RRU	RRTS
RRU(-1)	0.279187	-0.168104
	(0.08250)	(0.68229)
	[3.38403]	[-0.24638]
RRU(-2)	-0.044096	-0.594545
	(0.04548)	(0.37615)
	[-0.96949]	[-1.58059]
RRU(-3)	0.226620	0.421745
	(0.03949)	(0.32655)
	[5.73923]	[1.29151]
RRTS(-1)	0.005732	0.085769
	(0.01466)	(0.12122)
	[0.39107]	[0.70755]
RRTS(-2)	-0.004936	-0.142622
	(0.01418)	(0.11728)
	[-0.34805]	[-1.21610]

RRTS(-3)	0.017697	-0.092041
	(0.01356)	(0.11218)
	[1.30469]	[-0.82050]
C	-0.128011	3.425131
	(0.20044)	(1.65764)
	[-0.63865]	[2.06627]
R-squared	0.700579	0.114405
Adj. R-squared	0.674160	0.036264
Sum sq. resids	156.9200	10732.26
S.E. equation	1.519094	12.56293
F-statistic	26.51755	1.464085
Log likelihood	-134.1047	-292.5524
Akaike AIC	3.762791	7.988065
Schwarz SC	3.979090	8.204364
Mean dependent	-0.690013	3.206159
S.D. dependent	2.661230	12.79711
Determinant resid covariance (dof adj.)		357.9602
Determinant resid covariance		294.2592
Log likelihood		-426.0081
Akaike information criterion		11.73355
Schwarz criterion		12.16615

Table A2.21: Vector ECM (2 lags) - Log of Return of RRB/USD and RTS (1998-2005)

Vector Autoregression Estimates
Date: 04/24/13 Time: 19:38
Sample (adjusted): 1998M10 2005M01
Included observations: 76 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	RRU	RRTS
RRU(-1)	0.091798	0.116457
	(0.06558)	(0.36728)
	[1.39972]	[0.31708]
RRU(-2)	0.178515	-0.375200
	(0.05228)	(0.29278)
	[3.41461]	[-1.28151]
RRTS(-1)	-0.036271	0.061137
	(0.02017)	(0.11295)
	[-1.79835]	[0.54127]
RRTS(-2)	-0.043405	-0.171067
	(0.01882)	(0.10540)
	[-2.30634]	[-1.62309]
C	-0.070651	3.082410
	(0.28217)	(1.58019)
	[-0.25039]	[1.95066]

R-squared	0.344545	0.132147
Adj. R-squared	0.307618	0.083254
Sum sq. resids	351.1460	11012.84
S.E. equation	2.223897	12.45433
F-statistic	9.330440	2.702770
Log likelihood	-165.9971	-296.9305
Akaike AIC	4.499925	7.945540
Schwarz SC	4.653263	8.098878
Mean dependent	-0.735222	3.522680
S.D. dependent	2.672649	13.00756

Determinant resid covariance (dof adj.)	748.4723
Determinant resid covariance	653.2287
Log likelihood	-461.9919
Akaike information criterion	12.42084
Schwarz criterion	12.72751

Table A2.22: Vector ECM (4 lags) - Log of Return of BRR/USD and BOVESPA (1998-2005)

Vector Autoregression Estimates
Date: 04/24/13 Time: 19:39
Sample (adjusted): 1998M12 2005M01
Included observations: 74 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	RBU	RBOV
RBU(-1)	-0.179989	-0.163934
	(0.12753)	(0.14542)
	[-1.41131]	[-1.12734]
RBU(-2)	0.024932	-0.079560
	(0.12995)	(0.14818)
	[0.19186]	[-0.53693]
RBU(-3)	-0.043697	-0.190077
	(0.12683)	(0.14462)
	[-0.34453]	[-1.31435]
RBU(-4)	0.025357	-0.076818
	(0.11908)	(0.13578)
	[0.21293]	[-0.56574]
RBOV(-1)	0.367759	0.039769
	(0.10940)	(0.12474)
	[3.36159]	[0.31881]
RBOV(-2)	-0.033516	0.058323
	(0.11614)	(0.13242)
	[-0.28859]	[0.44044]
RBOV(-3)	-0.103484	0.012355

	(0.11641)	(0.13273)
	[-0.88898]	[0.09309]
RBOV(-4)	0.064419	0.160606
	(0.09585)	(0.10929)
	[0.67205]	[1.46948]
C	-1.723419	0.448391
	(1.14858)	(1.30963)
	[-1.50048]	[0.34238]
R-squared	0.168186	0.066209
Adj. R-squared	0.065808	-0.048719
Sum sq. resids	4773.175	6205.579
S.E. equation	8.569333	9.770898
F-statistic	1.642804	0.576093
Log likelihood	-259.1694	-268.8796
Akaike AIC	7.247822	7.510259
Schwarz SC	7.528046	7.790483
Mean dependent	-1.053419	1.401583
S.D. dependent	8.866027	9.541243

Determinant resid covariance (dof adj.)	6505.668
Determinant resid covariance	5019.439
Log likelihood	-525.2826
Akaike information criterion	14.68331
Schwarz criterion	15.24376

Table A2.23: Vector ECM (3 lags) - Log of Return of BRR/USD and BOVESPA (1998-2005)

Vector Autoregression Estimates
Date: 04/24/13 Time: 19:39
Sample (adjusted): 1998M11 2005M01
Included observations: 75 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	RBU	RBOV
RBU(-1)	-0.183129	-0.181271
	(0.12538)	(0.14694)
	[-1.46061]	[-1.23364]
RBU(-2)	-0.001116	-0.037773
	(0.12456)	(0.14598)
	[-0.00896]	[-0.25877]
RBU(-3)	-0.035926	-0.084250
	(0.11693)	(0.13703)
	[-0.30725]	[-0.61481]
RBOV(-1)	0.348528	0.040710
	(0.10614)	(0.12439)
	[3.28377]	[0.32728]

RBOV(-2)	-0.027374	0.063882
	(0.11421)	(0.13385)
	[-0.23969]	[0.47727]
RBOV(-3)	-0.065103	-0.114029
	(0.09342)	(0.10949)
	[-0.69689]	[-1.04150]
C	-1.814621	1.241266
	(1.08266)	(1.26884)
	[-1.67608]	[0.97827]
R-squared	0.154957	0.048105
Adj. R-squared	0.080395	-0.035886
Sum sq. resids	4849.206	6660.471
S.E. equation	8.444635	9.896874
F-statistic	2.078218	0.572742
Log likelihood	-262.7610	-274.6625
Akaike AIC	7.193626	7.511001
Schwarz SC	7.409925	7.727300
Mean dependent	-1.048286	1.653240
S.D. dependent	8.806030	9.723936

Determinant resid covariance (dof adj.)	6531.151
Determinant resid covariance	5368.897
Log likelihood	-534.9049
Akaike information criterion	14.63747
Schwarz criterion	15.07006

Table A2.24: Vector ECM (2 lags) - Log of Return of BRR/USD and BOVESPA (1998-2005)

Vector Autoregression Estimates
Date: 04/24/13 Time: 19:40
Sample (adjusted): 1998M10 2005M01
Included observations: 76 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	RBU	RBOV
RBU(-1)	-0.180246	-0.148659
	(0.12026)	(0.14272)
	[-1.49877]	[-1.04161]
RBU(-2)	-0.024773	-0.057018
	(0.11464)	(0.13605)
	[-0.21609]	[-0.41909]
RBOV(-1)	0.347644	0.035625
	(0.10425)	(0.12371)
	[3.33483]	[0.28796]
RBOV(-2)	-0.016244	0.021016

	(0.09174)	(0.10887)
	[-0.17708]	[0.19304]
C	-1.885051	1.407031
	(1.01004)	(1.19866)
	[-1.86631]	[1.17383]
R-squared	0.145768	0.016793
Adj. R-squared	0.097642	-0.038599
Sum sq. resids	4902.074	6903.880
S.E. equation	8.309229	9.860920
F-statistic	3.028899	0.303167
Log likelihood	-266.1732	-279.1853
Akaike AIC	7.136136	7.478561
Schwarz SC	7.289474	7.631899
Mean dependent	-1.043013	1.719110
S.D. dependent	8.747247	9.675947
Determinant resid covariance (dof adj.)		6240.751
Determinant resid covariance		5446.611
Log likelihood		-542.5831
Akaike information criterion		14.54166
Schwarz criterion		14.84834

Table A2.25: Granger Causality Test - Log of Return of JPY/USD and NIKKEI (1998-2005)

Pairwise Granger Causality Tests
Date: 04/24/13 Time: 19:41
Sample: 1998M07 2005M01
Lags: 4

Null Hypothesis:	Obs	F-Statistic	Prob.
RRU does not Granger Cause RRTS	74	1.65165	0.1720
RRTS does not Granger Cause RRU		0.99156	0.4185

Table A2.26: Granger Causality Test - Log of Return of RRB/USD and RTS (1998-2005)

Pairwise Granger Causality Tests
Date: 04/24/13 Time: 19:42
Sample: 1998M07 2005M01
Lags: 4

Null Hypothesis:	Obs	F-Statistic	Prob.
RRU does not Granger Cause RRTS	74	1.65165	0.1720
RRTS does not Granger Cause RRU		0.99156	0.4185

Table A2.27: Granger Causality Test - Log of Return of BRR/USD and BOVESPA (1998-2005)

Pairwise Granger Causality Tests
Date: 04/24/13 Time: 19:42
Sample: 1998M07 2005M01
Lags: 4

Null Hypothesis:	Obs	F-Statistic	Prob.
RBU does not Granger Cause RBOV	74	0.79150	0.5349
RBOV does not Granger Cause RBU		3.00003	0.0246

Appendix (A3)

Sample (02:2005 – 07:2011)

Table A3.1: Unit Root Test - Log of JPY/USD (2005-2011)

Null Hypothesis: LJU has a unit root
Exogenous: Constant
Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.357252	0.9798
Test critical values:	1% level	-3.516676	
	5% level	-2.899115	
	10% level	-2.586866	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LJU)
Method: Least Squares
Date: 04/24/13 Time: 19:51
Sample: 2005M02 2011M07
Included observations: 78

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LJU(-1)	0.009929	0.027791	0.357252	0.7219
D(LJU(-1))	-0.010770	0.122663	-0.087800	0.9303
D(LJU(-2))	0.049644	0.121076	0.410023	0.6830
D(LJU(-3))	-0.116120	0.120399	-0.964458	0.3380
D(LJU(-4))	-0.037250	0.120064	-0.310253	0.7573
C	0.050089	0.128925	0.388512	0.6988

R-squared	0.017204	Mean dependent var	0.003751
Adjusted R-squared	-0.051045	S.D. dependent var	0.028722
S.E. of regression	0.029446	Akaike info criterion	-4.138705
Sum squared resid	0.062429	Schwarz criterion	-3.957419
Log likelihood	167.4095	Hannan-Quinn criter.	-4.066133
F-statistic	0.252081	Durbin-Watson stat	1.987702
Prob(F-statistic)	0.937454		

Table A3.2: Unit Root Test - Log of RRB/USD (2005-2011)

Null Hypothesis: LRU has a unit root
Exogenous: Constant
Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.108105	0.2422
Test critical values:	1% level	-3.516676	
	5% level	-2.899115	
	10% level	-2.586866	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LRU)
Method: Least Squares
Date: 04/24/13 Time: 19:51
Sample: 2005M02 2011M07
Included observations: 78

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LRU(-1)	-0.076615	0.036343	-2.108105	0.0385
D(LRU(-1))	0.462331	0.114529	4.036802	0.0001
D(LRU(-2))	-0.070643	0.126716	-0.557496	0.5789
D(LRU(-3))	0.054457	0.127064	0.428583	0.6695
D(LRU(-4))	0.048452	0.119601	0.405115	0.6866
C	-0.255019	0.121114	-2.105612	0.0387

R-squared	0.217834	Mean dependent var	0.000176
Adjusted R-squared	0.163517	S.D. dependent var	0.030442
S.E. of regression	0.027842	Akaike info criterion	-4.250742
Sum squared resid	0.055813	Schwarz criterion	-4.069457
Log likelihood	171.7789	Hannan-Quinn criter.	-4.178170
F-statistic	4.010408	Durbin-Watson stat	2.004614
Prob(F-statistic)	0.002887		

Table A3.3: Unit Root Test - Log of BRR/USD (2005-2011)

Null Hypothesis: LBU has a unit root
Exogenous: Constant
Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.885118	0.3376
Test critical values:	1% level	-3.516676	
	5% level	-2.899115	
	10% level	-2.586866	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LBU)
Method: Least Squares
Date: 04/24/13 Time: 19:52
Sample: 2005M02 2011M07
Included observations: 78

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LBU(-1)	-0.062441	0.033123	-1.885118	0.0634
D(LBU(-1))	0.154322	0.115344	1.337922	0.1851
D(LBU(-2))	0.219015	0.115534	1.895670	0.0620
D(LBU(-3))	-0.094174	0.115596	-0.814682	0.4179
D(LBU(-4))	0.042166	0.115320	0.365643	0.7157
C	-0.037596	0.023164	-1.623049	0.1089

R-squared	0.113186	Mean dependent var	0.006679
Adjusted R-squared	0.051602	S.D. dependent var	0.041341
S.E. of regression	0.040261	Akaike info criterion	-3.513078
Sum squared resid	0.116707	Schwarz criterion	-3.331793
Log likelihood	143.0100	Hannan-Quinn criter.	-3.440506
F-statistic	1.837906	Durbin-Watson stat	2.012439
Prob(F-statistic)	0.116226		

Table A3.4: Unit Root Test - Log of NIKKI (2005-2011)

Null Hypothesis: LNIK has a unit root
Exogenous: Constant
Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.555877	0.5002
Test critical values:	1% level	-3.516676	
	5% level	-2.899115	
	10% level	-2.586866	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNIK)
Method: Least Squares
Date: 04/24/13 Time: 19:53
Sample: 2005M02 2011M07
Included observations: 78

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNIK(-1)	-0.046622	0.029965	-1.555877	0.1241
D(LNIK(-1))	0.187590	0.116186	1.614572	0.1108
D(LNIK(-2))	0.009995	0.117173	0.085297	0.9323
D(LNIK(-3))	0.150528	0.117063	1.285878	0.2026
D(LNIK(-4))	0.086425	0.117481	0.735647	0.4643
C	0.437756	0.282310	1.550622	0.1254

R-squared	0.083869	Mean dependent var	-0.001882
Adjusted R-squared	0.020249	S.D. dependent var	0.062626
S.E. of regression	0.061989	Akaike info criterion	-2.649920
Sum squared resid	0.276669	Schwarz criterion	-2.468635
Log likelihood	109.3469	Hannan-Quinn criter.	-2.577348
F-statistic	1.318274	Durbin-Watson stat	1.959239
Prob(F-statistic)	0.266050		

Table A3.5: Unit Root Test - Log of RTS (2005-2011)

Null Hypothesis: LRTS has a unit root
Exogenous: Constant
Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.541026	0.1099
Test critical values:	1% level	-3.516676	
	5% level	-2.899115	
	10% level	-2.586866	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LRTS)
Method: Least Squares
Date: 04/24/13 Time: 19:53
Sample: 2005M02 2011M07
Included observations: 78

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LRTS(-1)	-0.076983	0.030296	-2.541026	0.0132
D(LRTS(-1))	0.354406	0.112453	3.151597	0.0024
D(LRTS(-2))	0.116822	0.119654	0.976331	0.3322
D(LRTS(-3))	0.131052	0.120751	1.085306	0.2814
D(LRTS(-4))	-0.027821	0.115527	-0.240821	0.8104
C	0.561963	0.218321	2.574019	0.0121

R-squared	0.256803	Mean dependent var	0.014438
Adjusted R-squared	0.205192	S.D. dependent var	0.111491
S.E. of regression	0.099396	Akaike info criterion	-1.705597
Sum squared resid	0.711335	Schwarz criterion	-1.524311
Log likelihood	72.51827	Hannan-Quinn criter.	-1.633025
F-statistic	4.975760	Durbin-Watson stat	1.992285
Prob(F-statistic)	0.000572		

Table A3.6: Unit Root Test- Log of BOVESPA (2005-2011)

Null Hypothesis: LBOV has a unit root
Exogenous: Constant
Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.296322	0.1757
Test critical values:	1% level	-3.516676	
	5% level	-2.899115	
	10% level	-2.586866	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LBOV)
Method: Least Squares
Date: 04/24/13 Time: 19:54
Sample: 2005M02 2011M07
Included observations: 78

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LBOV(-1)	-0.055337	0.024098	-2.296322	0.0246
D(LBOV(-1))	0.164066	0.112790	1.454611	0.1501
D(LBOV(-2))	0.072335	0.113894	0.635108	0.5274
D(LBOV(-3))	0.098721	0.113125	0.872675	0.3857
D(LBOV(-4))	0.074594	0.112874	0.660859	0.5108
C	0.603103	0.259804	2.321379	0.0231

R-squared	0.118473	Mean dependent var	0.011308
Adjusted R-squared	0.057256	S.D. dependent var	0.069874
S.E. of regression	0.067844	Akaike info criterion	-2.469407
Sum squared resid	0.331403	Schwarz criterion	-2.288121
Log likelihood	102.3069	Hannan-Quinn criter.	-2.396835
F-statistic	1.935290	Durbin-Watson stat	1.870517
Prob(F-statistic)	0.098956		

Table A3.7: Unit Root Test - Log of return on JPY/USD (2005-2011)

Null Hypothesis: RJU has a unit root
Exogenous: Constant
Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.663971	0.0003
Test critical values:	1% level	-3.516676	
	5% level	-2.899115	
	10% level	-2.586866	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RJU)
Method: Least Squares
Date: 04/24/13 Time: 19:54
Sample: 2005M02 2011M07
Included observations: 78

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RJU(-1)	-1.241998	0.266296	-4.663971	0.0000
D(RJU(-1))	0.238653	0.233568	1.021772	0.3103
D(RJU(-2))	0.278211	0.196548	1.415485	0.1612
D(RJU(-3))	0.178271	0.163665	1.089239	0.2797
D(RJU(-4))	0.151538	0.116587	1.299788	0.1978
C	0.464755	0.341917	1.359263	0.1783

R-squared	0.514367	Mean dependent var	0.069911
Adjusted R-squared	0.480642	S.D. dependent var	4.042436
S.E. of regression	2.913241	Akaike info criterion	5.050213
Sum squared resid	611.0622	Schwarz criterion	5.231498
Log likelihood	-190.9583	Hannan-Quinn criter.	5.122785
F-statistic	15.25200	Durbin-Watson stat	1.998604
Prob(F-statistic)	0.000000		

Table A3.8: Unit Root Test - Log of return on RRB/USD (2005-2011)

Null Hypothesis: RRU has a unit root
Exogenous: Constant
Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.092299	0.0312
Test critical values:	1% level	-3.516676	
	5% level	-2.899115	
	10% level	-2.586866	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RRU)
Method: Least Squares
Date: 04/24/13 Time: 19:55
Sample: 2005M02 2011M07
Included observations: 78

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RRU(-1)	-0.570330	0.184435	-3.092299	0.0028
D(RRU(-1))	0.015296	0.171741	0.089064	0.9293
D(RRU(-2))	-0.102477	0.154198	-0.664577	0.5084
D(RRU(-3))	-0.061505	0.134608	-0.456921	0.6491
D(RRU(-4))	-0.135146	0.118752	-1.138050	0.2589
C	0.020412	0.322024	0.063386	0.9496

R-squared	0.320673	Mean dependent var	0.027070
Adjusted R-squared	0.273498	S.D. dependent var	3.335920
S.E. of regression	2.843374	Akaike info criterion	5.001664
Sum squared resid	582.1040	Schwarz criterion	5.182949
Log likelihood	-189.0649	Hannan-Quinn criter.	5.074235
F-statistic	6.797462	Durbin-Watson stat	1.963231
Prob(F-statistic)	0.000030		

Table A3.9: Unit Root Test - Log of return on BRR/USD (2005-2011)

Null Hypothesis: RBU has a unit root
Exogenous: Constant
Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.255619	0.0205
Test critical values:	1% level	-3.516676	
	5% level	-2.899115	
	10% level	-2.586866	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RBU)
Method: Least Squares
Date: 04/24/13 Time: 19:55
Sample: 2005M02 2011M07
Included observations: 78

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RBU(-1)	-0.689084	0.211660	-3.255619	0.0017
D(RBU(-1))	-0.174451	0.193613	-0.901026	0.3706
D(RBU(-2))	0.039522	0.171175	0.230885	0.8181
D(RBU(-3))	-0.102197	0.154092	-0.663219	0.5093
D(RBU(-4))	-0.098378	0.116808	-0.842224	0.4025
C	0.460450	0.488711	0.942172	0.3493

R-squared	0.464272	Mean dependent var	-0.012473
Adjusted R-squared	0.427069	S.D. dependent var	5.422042
S.E. of regression	4.104064	Akaike info criterion	5.735636
Sum squared resid	1212.721	Schwarz criterion	5.916921
Log likelihood	-217.6898	Hannan-Quinn criter.	5.808208
F-statistic	12.47932	Durbin-Watson stat	1.946224
Prob(F-statistic)	0.000000		

Table A3.10: Unit Root Test - Log of return on NIKKEI (2005-2011)

Null Hypothesis: RNIK has a unit root
Exogenous: Constant
Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.008864	0.0023
Test critical values:	1% level	-3.516676	
	5% level	-2.899115	
	10% level	-2.586866	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RNIK)
Method: Least Squares
Date: 04/24/13 Time: 19:56
Sample: 2005M02 2011M07
Included observations: 78

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RNIK(-1)	-0.820798	0.204746	-4.008864	0.0001
D(RNIK(-1))	0.004306	0.193638	0.022239	0.9823
D(RNIK(-2))	0.017356	0.176550	0.098306	0.9220
D(RNIK(-3))	0.138033	0.148649	0.928580	0.3562
D(RNIK(-4))	0.229744	0.115686	1.985937	0.0508
C	-0.135560	0.695437	-0.194928	0.8460

R-squared	0.452239	Mean dependent var	0.013550
Adjusted R-squared	0.414200	S.D. dependent var	8.017508
S.E. of regression	6.136407	Akaike info criterion	6.540159
Sum squared resid	2711.196	Schwarz criterion	6.721445
Log likelihood	-249.0662	Hannan-Quinn criter.	6.612731
F-statistic	11.88882	Durbin-Watson stat	2.074870
Prob(F-statistic)	0.000000		

Table A3.11: Unit Root Test - Log of return on RTS (2005-2011)

Null Hypothesis: RRTS has a unit root
Exogenous: Constant
Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.699657	0.0059
Test critical values:	1% level	-3.516676	
	5% level	-2.899115	
	10% level	-2.586866	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RRTS)
Method: Least Squares
Date: 04/24/13 Time: 19:56
Sample: 2005M02 2011M07
Included observations: 78

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RRTS(-1)	-0.607189	0.164120	-3.699657	0.0004
D(RRTS(-1))	-0.033558	0.160246	-0.209417	0.8347
D(RRTS(-2))	0.070860	0.151808	0.466774	0.6421
D(RRTS(-3))	0.166843	0.137636	1.212205	0.2294
D(RRTS(-4))	0.109876	0.116812	0.940622	0.3500
C	0.894070	1.192750	0.749587	0.4559

R-squared	0.318089	Mean dependent var	-0.008721
Adjusted R-squared	0.270734	S.D. dependent var	12.07605
S.E. of regression	10.31259	Akaike info criterion	7.578412
Sum squared resid	7657.171	Schwarz criterion	7.759698
Log likelihood	-289.5581	Hannan-Quinn criter.	7.650984
F-statistic	6.717121	Durbin-Watson stat	2.012921
Prob(F-statistic)	0.000035		

Table A3.12: Unit Root Test - Log of return on BOVESPA (2005-2011)

Null Hypothesis: RBOV has a unit root
Exogenous: Constant
Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.439079	0.0124
Test critical values:	1% level	-3.516676	
	5% level	-2.899115	
	10% level	-2.586866	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RBOV)
Method: Least Squares
Date: 04/24/13 Time: 19:57
Sample: 2005M02 2011M07
Included observations: 78

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RBOV(-1)	-0.711942	0.207015	-3.439079	0.0010
D(RBOV(-1))	-0.117867	0.196254	-0.600585	0.5500
D(RBOV(-2))	-0.045458	0.178710	-0.254365	0.7999
D(RBOV(-3))	0.049038	0.152249	0.322087	0.7483
D(RBOV(-4))	0.118770	0.115884	1.024899	0.3088
C	0.794273	0.834469	0.951831	0.3444

R-squared	0.426813	Mean dependent var	0.017938
Adjusted R-squared	0.387009	S.D. dependent var	8.912252
S.E. of regression	6.977737	Akaike info criterion	6.797130
Sum squared resid	3505.594	Schwarz criterion	6.978415
Log likelihood	-259.0881	Hannan-Quinn criter.	6.869702
F-statistic	10.72271	Durbin-Watson stat	1.898143
Prob(F-statistic)	0.000000		

Table A3.13: Cointegration test - Log of JPY/USD and Log of NIKKEI (2005-2011)

Date: 04/24/13 Time: 19:57
Sample: 2005M02 2011M07
Included observations: 78
Trend assumption: Linear deterministic trend
Series: LJU LNIK
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.075670	6.737056	15.49471	0.6084
At most 1	0.007656	0.599503	3.841466	0.4388

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.075670	6.137553	14.26460	0.5956
At most 1	0.007656	0.599503	3.841466	0.4388

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

LJU	LNIK
11.04689	8.224346
12.92074	2.986327

Unrestricted Adjustment Coefficients (alpha):

D(LJU)	0.002013	0.002278
D(LNIK)	-0.015470	-0.001888

1 Cointegrating Equation(s): Log likelihood 299.6961

Normalized cointegrating coefficients (standard error in parentheses)

LJU	LNIK
1.000000	0.744494
	(0.16538)

Adjustment coefficients (standard error in parentheses)

D(LJU)	0.022236
	(0.03612)

D(LNIK)	-0.170893
	(0.07798)

Table A3.14: Cointegration test - Log of RRB/USD and Log of RTS (2005-2011)

Date: 04/24/13 Time: 19:58
Sample: 2005M02 2011M07
Included observations: 78
Trend assumption: Linear deterministic trend
Series: LRU LRTS
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.149140	14.41114	15.49471	0.0723
At most 1	0.022982	1.813544	3.841466	0.1781

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.149140	12.59760	14.26460	0.0902
At most 1	0.022982	1.813544	3.841466	0.1781

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

LRU	LRTS
1.628405	2.941352
15.22006	-1.983941

Unrestricted Adjustment Coefficients (alpha):

D(LRU)	0.005026	-0.002959
D(LRTS)	-0.015849	-0.012554

1 Cointegrating Equation(s): Log likelihood 274.5593

Normalized cointegrating coefficients (standard error in parentheses)

LRU	LRTS
1.000000	1.806278

	(0.55777)

Adjustment coefficients (standard error in parentheses)

D(LRU)	0.008184
	(0.00453)
D(LRTS)	-0.025809
	(0.01798)

Table A3.15: Cointegration test - Log of BRR/USD and Log of BOVESPA (2005-2011)

Date: 04/24/13 Time: 19:59
Sample: 2005M02 2011M07
Included observations: 78
Trend assumption: Linear deterministic trend
Series: LBU LBOV
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.130943	14.95165	15.49471	0.0602
At most 1 *	0.050046	4.004616	3.841466	0.0454

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.130943	10.94703	14.26460	0.1569
At most 1 *	0.050046	4.004616	3.841466	0.0454

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

LBU	LBOV
-25.27864	8.419024
17.19729	-9.544874

Unrestricted Adjustment Coefficients (alpha):

D(LBU)	0.011250	-0.004622
D(LBOV)	0.022789	0.004673

1 Cointegrating Equation(s): Log likelihood 270.8178

Normalized cointegrating coefficients (standard error in parentheses)

LBU	LBOV
1.000000	-0.333049
	(0.03901)

Adjustment coefficients (standard error in parentheses)

D(LBU)	-0.284374
	(0.10910)
D(LBOV)	-0.576085
	(0.19103)

Table A3.16: VAR test (4 lags) - Log of Return of JPY/USD and NIKKEI (2005-2011)

Vector Autoregression Estimates
Date: 04/24/13 Time: 20:00
Sample: 2005M02 2011M07
Included observations: 78
Standard errors in ( ) & t-statistics in [ ]

	RJU	RNIK
RJU(-1)	0.007432	0.259069
	(0.15127)	(0.33698)
	[0.04913]	[0.76879]
RJU(-2)	-0.044465	-0.116991
	(0.14787)	(0.32939)
	[-0.30071]	[-0.35517]
RJU(-3)	-0.219044	0.058730
	(0.14050)	(0.31298)
	[-1.55904]	[0.18765]
RJU(-4)	0.041044	0.095129
	(0.14078)	(0.31362)
	[0.29154]	[0.30333]
RNIK(-1)	0.017883	0.243254
	(0.06718)	(0.14964)
	[0.26621]	[1.62557]
RNIK(-2)	-0.110115	-0.064770
	(0.06784)	(0.15112)
	[-1.62319]	[-0.42861]
RNIK(-3)	-0.081931	0.174808
	(0.06968)	(0.15523)
	[-1.17576]	[1.12614]
RNIK(-4)	0.064175	0.055699
	(0.06782)	(0.15107)
	[0.94627]	[0.36868]

C	0.432018	-0.219921
	(0.33810)	(0.75317)
	[1.27777]	[-0.29200]
R-squared	0.102221	0.062921
Adj. R-squared	-0.001870	-0.045726
Sum sq. resids	570.2896	2829.949
S.E. equation	2.874903	6.404198
F-statistic	0.982039	0.579132
Log likelihood	-188.2652	-250.7381
Akaike AIC	5.058082	6.659951
Schwarz SC	5.330010	6.931879
Mean dependent	0.375118	-0.188176
S.D. dependent	2.872219	6.262616

Determinant resid covariance (dof adj.)	217.9578
Determinant resid covariance	170.5617
Log likelihood	-421.7792
Akaike information criterion	11.27639
Schwarz criterion	11.82025

Table A3.17: VAR test (3 lags) - Log of Return of JPY/USD and NIKKEI (2005-2011)

Vector Autoregression Estimates
Date: 04/24/13 Time: 20:01
Sample: 2005M02 2011M07
Included observations: 78
Standard errors in ( ) & t-statistics in [ ]

	RJU	RNIK
RJU(-1)	0.009419	0.243611
	(0.14615)	(0.32365)
	[0.06445]	[0.75271]
RJU(-2)	-0.090712	-0.152471
	(0.13915)	(0.30814)
	[-0.65192]	[-0.49481]
RJU(-3)	-0.196475	0.074510
	(0.13761)	(0.30474)
	[-1.42778]	[0.24451]
RNIK(-1)	0.026934	0.244712
	(0.06524)	(0.14447)
	[0.41285]	[1.69386]
RNIK(-2)	-0.124262	-0.074936
	(0.06582)	(0.14576)
	[-1.88788]	[-0.51410]
RNIK(-3)	-0.063130	0.186960
	(0.06647)	(0.14719)
	[-0.94978]	[1.27016]

C	0.445992	-0.182349
	(0.33064)	(0.73220)
	[1.34889]	[-0.24904]
R-squared	0.089579	0.060880
Adj. R-squared	0.012642	-0.018483
Sum sq. resids	578.3197	2836.114
S.E. equation	2.854006	6.320226
F-statistic	1.164322	0.767109
Log likelihood	-188.8105	-250.8230
Akaike AIC	5.020782	6.610845
Schwarz SC	5.232282	6.822345
Mean dependent	0.375118	-0.188176
S.D. dependent	2.872219	6.262616

Determinant resid covariance (dof adj.)	212.8109
Determinant resid covariance	176.3280
Log likelihood	-423.0759
Akaike information criterion	11.20707
Schwarz criterion	11.63007

Table A3.18: VAR test (2 lags) - Log of Return of JPY/USD and NIKKEI (2005-2011)

Vector Autoregression Estimates
Date: 04/24/13 Time: 20:01
Sample: 2005M02 2011M07
Included observations: 78
Standard errors in ( ) & t-statistics in [ ]

	RJU	RNIK
RJU(-1)	0.046329	0.109796
	(0.13896)	(0.30741)
	[0.33341]	[0.35717]
RJU(-2)	-0.103222	-0.090404
	(0.13771)	(0.30466)
	[-0.74953]	[-0.29674]
RNIK(-1)	0.039492	0.209142
	(0.06400)	(0.14158)
	[0.61706]	[1.47717]
RNIK(-2)	-0.136296	-0.020946
	(0.06338)	(0.14022)
	[-2.15040]	[-0.14938]
C	0.379599	-0.155375
	(0.32753)	(0.72456)
	[1.15899]	[-0.21444]
R-squared	0.062994	0.035438
Adj. R-squared	0.011651	-0.017415
Sum sq. resids	595.2076	2912.947
S.E. equation	2.855439	6.316912

F-statistic	1.226920	0.670501
Log likelihood	-189.9331	-251.8655
Akaike AIC	4.998284	6.586294
Schwarz SC	5.149355	6.737365
Mean dependent	0.375118	-0.188176
S.D. dependent	2.872219	6.262616

Determinant resid covariance (dof adj.)	215.7787
Determinant resid covariance	189.0014
Log likelihood	-425.7828
Akaike information criterion	11.17392
Schwarz criterion	11.47606

Table A3.19: Vector ECM (4 lags) - Log of Return of RRB/USD and RTS (2005-2011)

Vector Autoregression Estimates
Date: 04/24/13 Time: 20:02
Sample: 2005M02 2011M07
Included observations: 78
Standard errors in ( ) & t-statistics in [ ]

	RRU	RRTS
RRU(-1)	0.131860	-0.279382
	(0.13653)	(0.53783)
	[0.96579]	[-0.51946]
RRU(-2)	-0.347266	-0.803451
	(0.13403)	(0.52797)
	[-2.59098]	[-1.52176]
RRU(-3)	-0.207950	-0.745371
	(0.13439)	(0.52940)
	[-1.54737]	[-1.40797]
RRU(-4)	-0.130988	-1.043414
	(0.13488)	(0.53134)
	[-0.97112]	[-1.96374]
RRTS(-1)	0.024874	0.294698
	(0.03423)	(0.13486)
	[0.72660]	[2.18526]
RRTS(-2)	0.090311	0.200362
	(0.03514)	(0.13841)
	[2.57033]	[1.44759]
RRTS(-3)	0.102211	0.252009
	(0.03638)	(0.14332)
	[2.80929]	[1.75833]
RRTS(-4)	0.066308	0.183252
	(0.03890)	(0.15323)
	[1.70462]	[1.19591]

C	-0.371133	0.181130
	(0.29509)	(1.16245)
	[-1.25768]	[0.15582]
R-squared	0.398309	0.303911
Adj. R-squared	0.328548	0.223205
Sum sq. resids	429.3449	6662.470
S.E. equation	2.494472	9.826369
F-statistic	5.709598	3.765664
Log likelihood	-177.1937	-284.1311
Akaike AIC	4.774198	7.516183
Schwarz SC	5.046126	7.788111
Mean dependent	0.017589	1.443793
S.D. dependent	3.044185	11.14910

Determinant resid covariance (dof adj.)	451.0849
Determinant resid covariance	352.9940
Log likelihood	-450.1460
Akaike information criterion	12.00374
Schwarz criterion	12.54760

Table A3.20: Vector ECM (3 lags) - Log of Return of RRB/USD and RTS (2005-2011)

Vector Autoregression Estimates
Date: 04/24/13 Time: 20:02
Sample: 2005M02 2011M07
Included observations: 78
Standard errors in ( ) & t-statistics in [ ]

	RRU	RRTS
RRU(-1)	0.197639	-0.178955
	(0.13142)	(0.52108)
	[1.50386]	[-0.34343]
RRU(-2)	-0.296363	-0.589250
	(0.13083)	(0.51873)
	[-2.26524]	[-1.13594]
RRU(-3)	-0.208050	-1.034837
	(0.12742)	(0.50521)
	[-1.63279]	[-2.04833]
RRTS(-1)	0.026877	0.338286
	(0.03390)	(0.13441)
	[0.79283]	[2.51680]
RRTS(-2)	0.088164	0.196713
	(0.03534)	(0.14011)
	[2.49485]	[1.40395]
RRTS(-3)	0.108698	0.259985

	(0.03639)	(0.14430)
	[2.98678]	[1.80175]
C	-0.284729	0.368487
	(0.29256)	(1.15996)
	[-0.97325]	[0.31767]
R-squared	0.372873	0.265003
Adj. R-squared	0.319876	0.202890
Sum sq. resids	447.4951	7034.877
S.E. equation	2.510527	9.954033
F-statistic	7.035783	4.266498
Log likelihood	-178.8085	-286.2523
Akaike AIC	4.764321	7.519291
Schwarz SC	4.975821	7.730790
Mean dependent	0.017589	1.443793
S.D. dependent	3.044185	11.14910
Determinant resid covariance (dof adj.)		467.2715
Determinant resid covariance		387.1656
Log likelihood		-453.7497
Akaike information criterion		11.99358
Schwarz criterion		12.41658

Table A3.21: Vector ECM (2 lags) - Log of Return of RRB/USD and RTS (2005-2011)

Vector Autoregression Estimates
Date: 04/24/13 Time: 20:03
Sample: 2005M02 2011M07
Included observations: 78
Standard errors in ( ) & t-statistics in [ ]

	RRU	RRTS
RRU(-1)	0.312378	0.135050
	(0.13116)	(0.50620)
	[2.38165]	[0.26679]
RRU(-2)	-0.330767	-0.896288
	(0.12845)	(0.49575)
	[-2.57504]	[-1.80796]
RRTS(-1)	0.027269	0.349103
	(0.03542)	(0.13670)
	[0.76991]	[2.55385]
RRTS(-2)	0.112895	0.249029
	(0.03594)	(0.13871)
	[3.14107]	[1.79529]
C	-0.175997	0.593040
	(0.30373)	(1.17222)
	[-0.57945]	[0.50591]

R-squared	0.293884	0.215888
Adj. R-squared	0.255193	0.172923
Sum sq. resids	503.8588	7504.967
S.E. equation	2.627199	10.13942
F-statistic	7.595612	5.024739
Log likelihood	-183.4351	-288.7751
Akaike AIC	4.831669	7.532694
Schwarz SC	4.982740	7.683765
Mean dependent	0.017589	1.443793
S.D. dependent	3.044185	11.14910

Determinant resid covariance (dof adj.)	514.2817
Determinant resid covariance	450.4614
Log likelihood	-459.6550
Akaike information criterion	12.04244
Schwarz criterion	12.34458

Table A3.22: Vector ECM (4 lags) - Log of Return of BRR/USD and BOVESPA (2005-2011)

Vector Autoregression Estimates
Date: 04/24/13 Time: 20:04
Sample: 2005M02 2011M07
Included observations: 78
Standard errors in ( ) & t-statistics in [ ]

	RBU	RBOV
RBU(-1)	-0.059529	-0.108348
	(0.15313)	(0.27220)
	[-0.38875]	[-0.39804]
RBU(-2)	-0.022339	-0.205264
	(0.14841)	(0.26381)
	[-0.15053]	[-0.77808]
RBU(-3)	-0.256674	-0.073640
	(0.14038)	(0.24954)
	[-1.82846]	[-0.29511]
RBU(-4)	-0.006830	-0.342974
	(0.14572)	(0.25903)
	[-0.04687]	[-1.32406]
RBOV(-1)	0.102451	0.197327
	(0.08403)	(0.14937)
	[1.21921]	[1.32103]
RBOV(-2)	0.177699	0.128922
	(0.08444)	(0.15010)
	[2.10453]	[0.85894]
RBOV(-3)	0.152235	0.152064
	(0.08595)	(0.15279)

	[1.77114]	[0.99525]
RBOV(-4)	0.022728	0.216778
	(0.08871)	(0.15770)
	[0.25619]	[1.37464]
C	0.358697	0.769131
	(0.47222)	(0.83942)
	[0.75959]	[0.91626]
R-squared	0.174221	0.086565
Adj. R-squared	0.078479	-0.019340
Sum sq. resids	1086.743	3433.982
S.E. equation	3.968614	7.054633
F-statistic	1.819683	0.817382
Log likelihood	-213.4122	-258.2831
Akaike AIC	5.702878	6.853413
Schwarz SC	5.974806	7.125341
Mean dependent	0.667904	1.130780
S.D. dependent	4.134149	6.987388
Determinant resid covariance (dof adj.)		486.1090
Determinant resid covariance		380.4018
Log likelihood		-453.0623
Akaike information criterion		12.07852
Schwarz criterion		12.62238

Table A3.23: Vector ECM (3 lags) - Log of Return of BRR/USD and BOVESPA (2005-2011)

Vector Autoregression Estimates
Date: 04/24/13 Time: 20:04
Sample: 2005M02 2011M07
Included observations: 78
Standard errors in ( ) & t-statistics in [ ]

	RBU	RBOV
RBU(-1)	-0.055060	0.000269
	(0.14517)	(0.26211)
	[-0.37927]	[0.00103]
RBU(-2)	-0.008422	-0.150403
	(0.13811)	(0.24936)
	[-0.06098]	[-0.60316]
RBU(-3)	-0.250537	-0.046238
	(0.13685)	(0.24708)
	[-1.83073]	[-0.18713]
RBOV(-1)	0.102913	0.170533
	(0.08173)	(0.14757)
	[1.25912]	[1.15560]

RBOV(-2)	0.173384	0.116556
	(0.08180)	(0.14769)
	[2.11962]	[0.78920]
RBOV(-3)	0.151235	0.124851
	(0.08412)	(0.15188)
	[1.79787]	[0.82206]
C	0.373969	0.770581
	(0.46122)	(0.83273)
	[0.81082]	[0.92536]
R-squared	0.173211	0.056530
Adj. R-squared	0.103342	-0.023200
Sum sq. resids	1088.071	3546.896
S.E. equation	3.914710	7.067976
F-statistic	2.479071	0.709022
Log likelihood	-213.4599	-259.5449
Akaike AIC	5.652818	6.834484
Schwarz SC	5.864317	7.045983
Mean dependent	0.667904	1.130780
S.D. dependent	4.134149	6.987388

Determinant resid covariance (dof adj.)	480.8312
Determinant resid covariance	398.4007
Log likelihood	-454.8653
Akaike information criterion	12.02219
Schwarz criterion	12.44519

Table A3.24: Vector ECM (2 lags) - Log of Return of BRR/USD and BOVESPA (2005-2011)

Vector Autoregression Estimates
Date: 04/24/13 Time: 20:05
Sample: 2005M02 2011M07
Included observations: 78
Standard errors in ( ) & t-statistics in [ ]

	RBU	RBOV
RBU(-1)	-0.028663	0.071024
	(0.13918)	(0.24556)
	[-0.20594]	[0.28923]
RBU(-2)	0.013464	-0.116780
	(0.13852)	(0.24440)
	[0.09720]	[-0.47782]
RBOV(-1)	0.104303	0.152770
	(0.08160)	(0.14398)
	[1.27815]	[1.06104]
RBOV(-2)	0.166449	0.116443
	(0.08290)	(0.14627)

	[2.00786]	[0.79610]
C	0.360439	0.852377
	(0.46257)	(0.81615)
	[0.77921]	[1.04438]
R-squared	0.124518	0.045933
Adj. R-squared	0.076546	-0.006345
Sum sq. resids	1152.153	3586.735
S.E. equation	3.972772	7.009519
F-statistic	2.595656	0.878638
Log likelihood	-215.6917	-259.9805
Akaike AIC	5.658761	6.794371
Schwarz SC	5.809832	6.945442
Mean dependent	0.667904	1.130780
S.D. dependent	4.134149	6.987388

Determinant resid covariance (dof adj.)	491.7648
Determinant resid covariance	430.7388
Log likelihood	-457.9090
Akaike information criterion	11.99767
Schwarz criterion	12.29981

Table A3.25: Granger Causality Test - Log of Return of JPY/USD and NIKKEI (2005-2011)

Pairwise Granger Causality Tests
Date: 04/24/13 Time: 20:05
Sample: 2005M02 2011M07
Lags: 4

Null Hypothesis:	Obs	F-Statistic	Prob.
RJU does not Granger Cause RNIK	78	0.18139	0.9473
RNIK does not Granger Cause RJU		1.66698	0.1676

Table A3.26: Granger Causality Test - Log of Return of RRB/USD and RTS (2005-2011)

Pairwise Granger Causality Tests
Date: 04/24/13 Time: 20:06
Sample: 2005M02 2011M07
Lags: 4

Null Hypothesis:	Obs	F-Statistic	Prob.
RRU does not Granger Cause RRTS	78	2.81904	0.0315
RRTS does not Granger Cause RRU		6.55818	0.0002

Table A3.27: Granger Causality Test - Log of Return of BRR/USD and BOVESPA (2005-2011)

Pairwise Granger Causality Tests
Date: 04/24/13 Time: 20:07
Sample: 2005M02 2011M07
Lags: 4

Null Hypothesis:	Obs	F-Statistic	Prob.
RBU does not Granger Cause RBOV	78	0.61664	0.6521
RBOV does not Granger Cause RBU		2.18931	0.0792