HAIGAZIAN UNIVERISITY

FOREIGN EXCHANGE RESERVES AND THE MACRO-ECONOMY IN GCC COUNTRIES

BY

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A Thesis Submitted in Partial Fulfilment of the Requirements for the Degree of Masters in Business Administration with a Major in Finance to the Faculty of Business Administration & Economics at Haigazian University

Beirut, Lebanon

June 2017

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Date of Thesis Defence: June 8, 2017

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Acknowledgements

I would like to thank Dr Samih Azar for his assistance. He was always there to answer my questions. Without him, I would not have been able to complete my thesis.

I would also like to thank Dr Akram Tannir for his assistance and support.

Content:

Abstract

This research looks into foreign exchange reserves accumulation and macro-economic growth in GCC countries, namely Saudi Arabia, Bahrain, Qatar, Oman, Kuwait, and the United Arab Emirates. Using yearly covering the period from 1996 through 2015, the empirical results show positive relationships between foreign exchange reserves accumulation on one hand, and oil prices, GDP, current account to GDP, and broad money to GDP on the other hand. Moreover, the results point to negative relationships between foreign exchange reserves accumulation on one hand, and real effective exchange rate, debt to GDP, and call money rate on the other hand. However, the results show that the stockpile of foreign exchange reserves in GCC countries is less sensitive to nominal effective exchange rate, imports to GDP, and interest rates on US Dollar. Furthermore, and most importantly, the study shows that both foreign exchange reserves and oil prices appear to spur economic growth in these countries by raising GDP and GDP per capita.

I. Introduction

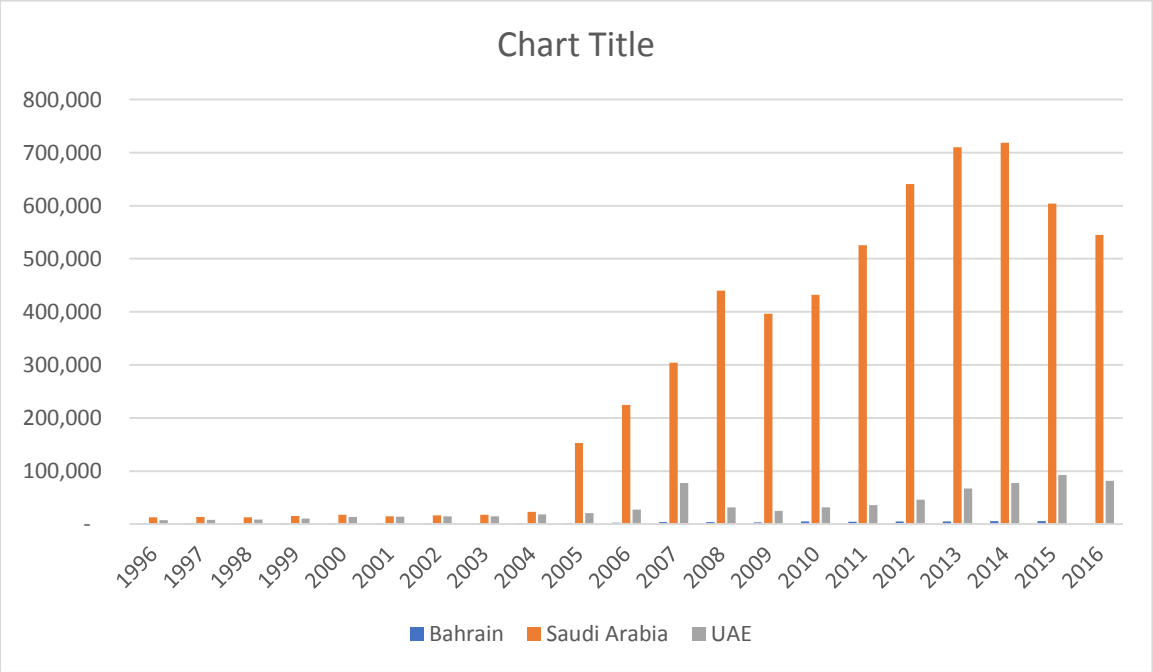
Foreign exchange reserves are viewed by economic policymakers as 'money in the bank' – the more, the better. Foreign exchange reserves are a fundamental pillar of the macroeconomic toolkit and make up foreign currency assets held by central banks of countries. In countries that implement fixed or partially fixed foreign exchange rate systems, they are used as a mean to keep exchange rate at or near the official target level. Beyond exchange rate stabilization, foreign exchange reserves are considered a key indicator of the strength of an economy, particularly of its exporting and importing industries. Regarding international trade, foreign exchange reserves are often a necessary requirement to finance imports of goods and services.

The International Monetary Fund (IMF) defines foreign exchange reserves as external stock of assets that a country's monetary authorities use to cover external payment imbalances or to influence the exchange rate of the domestic currency through intervention in exchange markets. Foreign exchange reserves (or forex reserves) include foreign banknotes, bank deposits, bonds, treasury bills, and other government securities. Colloquially, the term can also encompass gold reserves or IMF funds, but in this case it is referred to as 'international reserves'. Central banks hold foreign exchange reserves to:

- **Influence the exchange rate**. A country can target a certain exchange rate by accumulating large amount of reserves.
- **Act as a guarantor for liabilities such as external debt**. For example, if a country holds substantial foreign debt but at the same time accumulates foreign currency reserves, it is viewed as being able to pay off its debt. Whereas, a country with

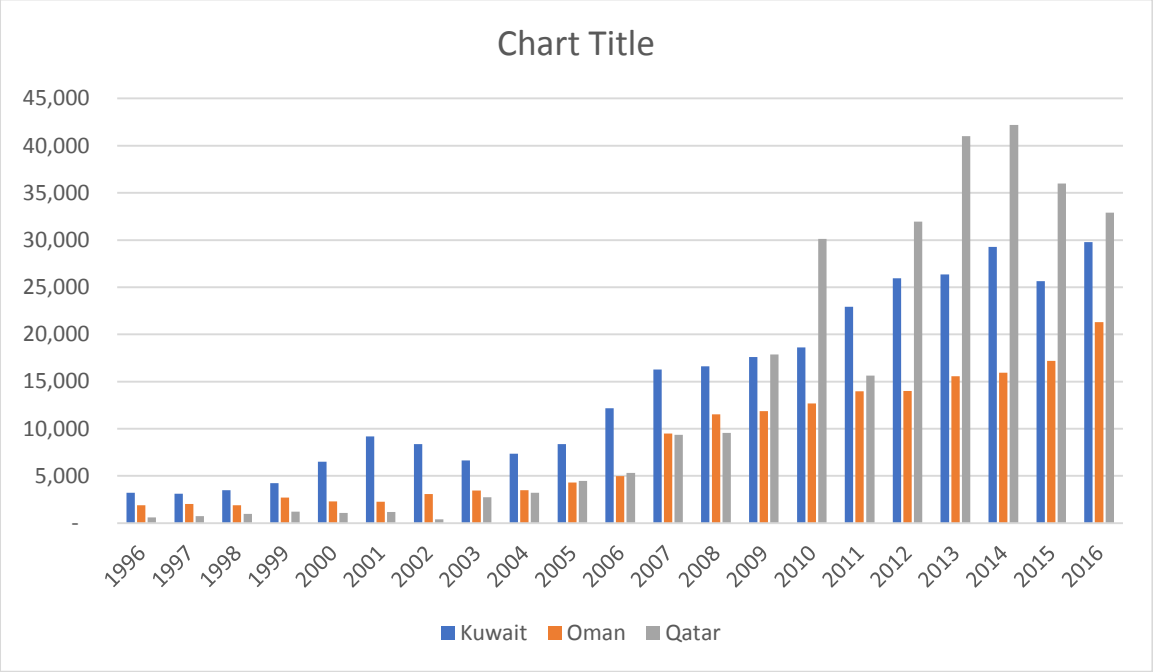
dwindling foreign currency reserves and high debt will have its credit worthiness deteriorated.

Regardless of the size of its economy, almost every single country holds significant amount of foreign exchange reserves, with more than half of the world's amount of foreign exchange reserves being held in the most traded global currency – the US Dollar. The British Pound Sterling (GBP), the Eurozone's Euro (EUR), the Chinese Yuan (CNY), and the Japanese Yen (JPY) are also other common foreign exchange currencies. China currently holds the world's largest foreign exchange reserves amounting to 3.5 trillion of assets held in foreign currencies (mostly in USD). In the Middle East Region, Saudi Arabia holds the largest foreign exchange reserves in the region, and it ranks third worldwide (after China and Japan) in terms of accumulation foreign exchange reserves (around USD 554 billion as of October 2016).



Graph 1: Foreign Exchange Reserves Accumulation in Bahrain, Saudi Arabia, UAE 1996 – 2016

(source: International Financial Statistics - IMF)



Graph 2: Foreign Exchange Reserves Accumulation in Kuwait, Oman, Qatar 1996 – 2016 (source: International Financial Statistics - IFS)

As I mentioned earlier, accumulation of foreign exchange reserves forms a good indicator of the strength of an economy. Looking at the graph included above, we observe that the accumulation of foreign exchange reserves in the six Gulf Cooperation Council (GCC) countries started to take a new level in 2004. Saudi Arabia, Bahrain, Kuwait, Qatar, Oman, and the United Arab Emirates (UAE) form the GCC countries. In 2004, foreign exchange reserves held by Saudi Arabian Monetary Authority (Saudi central bank) remarkably soared. In the UAE, foreign exchange reserves held by the Emirati Central Bank saw a rise in 2004, reaching its peak in 2007. Then, they decreased in the following year, only to rise again afterwards. In Kuwait, foreign exchange reserves held by the Kuwaiti Central Bank increased since 2004 until 2013, in which their amount dropped, only to increase again in the following year. In Oman, foreign exchange reserves held by the Omani Central Bank saw a remarkable surge in 2004 until 2007, their amount then slightly rose each year onwards. In

Qatar, foreign exchange reserves held by the Qatari Central Bank fluctuated after 2004, with their peak reached in 2014. Finally, in Bahrain, Foreign Exchange Reserves held by the Bahraini Central Bank also rose after 2004, but their amount experienced slight variations onwards.

Moreover, as I mentioned earlier in the introduction, countries that implement a fixed exchange rate system opt to accumulate foreign exchange reserves in an attempt to keep exchange rate at or near official target level.

Currency pegging is when a country fixes its domestic currency to another country's currency to control the value of its local currency. GCC countries have pegged their domestic currencies to the US Dollar given that their crude oil is exported in US Dollar, except for Kuwait, which has pegged its local currency to a basket of international currencies. This means that local currencies in GCC countries are controlled by the US Dollar; if the US Dollar rises, their currencies will rise, and if it falls, their currencies will fall too.

The aim of this study is to investigate the determinants of the demand for foreign exchange reserves in GCC countries. By the end of the study, one main question will have been answered:

What is the inter-relationship of foreign exchange reserves with the macro-economic variables?

II. Literature Review

A spurt of research studies has been carried out on demand for foreign exchange reserves. However, most of the research studies have focused on demand for foreign exchange reserves in emerging countries, particularly in Asian countries, with few considering

developed countries like Austria (Badinger 2002) and Israel (Ben-Bassat and Gottlieb, 1992). To my knowledge, research studies are yet to be conducted on demand for foreign exchange reserves in GCC countries. Bolbol and Fatheldin (2005) analyzed foreign reserves in Arab countries, with their study focusing on the Arab world as a whole, including of course the GCC region. However, this paper focuses on the demand for foreign reserves in the GCC area. The literature review on demand for foreign exchange reserves is of a great importance, provided that it allows comparison of results of the current study with that of previous ones. This literature review states why the demand for foreign exchange reserves has not much changed following the collapse of the Bretton Woods Agreement. Besides, it summarizes findings on the relationship between foreign reserve demand and the opportunity cost of holding the reserves, as well as on the relationship between foreign reserves and monetary base. Additionally, it presents a better understanding of the accumulation of foreign exchange reserves in Asian countries in the aftermath of the 1997 economic crisis. Furthermore, it provides an overview on whether the accumulation of foreign reserves leads to economic growth, as well as on how the foreign exchange reserves are influenced by the exchange rate.

The Mundell-Fleming Model and the IS-LM Model in Small Open Economy

GCC countries' currencies are pegged to the USD except for the Kuwaiti Dinar, which is pegged to an undisclosed weighted basket of international currencies, according to the FTSE Global Markets, a leading source of banking, finance, and industry news.

In May 1981, the GCC countries hammered out an agreement to regulate relations among them. Article No. 8 of chapter II of the agreement titled "The Unified Economic Agreement between the Countries of the Gulf Cooperation Council" states that each member state shall

grant citizens of other member states the same treatment as is granted to their citizens without any discrimination of differentiation in free movement of capital.

The Mundell-Fleming is an economic model developed by Robert Mundell and Marcus Fleming, presenting an extension to the IS-LM model. The latter tackles a closed economy, whereas the former deals with an open economy. Since GCC countries are small open economies, I consider the Mundell-Fleming model. The Mundell-Fleming model illustrates the relationship between the nominal exchange rate and an economy's output in the short run, unlike the IS-LM model, which portrays the relationship between interest rate and an economy's output. It argues that an economy cannot maintain a fixed exchange rate, free capital movement, and an independent monetary policy, in what is known to be the "Unholy Trinity" the "Irreconcilable Trinity", the "Inconsistent Trinity", or the "Mundell-Fleming Trinity".

Mundell-Fleming Model Under Fixed Exchange Rate Regime:

Changes in Global Interest Rate: When the global interest rate exceeds the local interest rate, hot money flows out. This results in a depreciation of the local currency, forcing the central bank to purchase local currency and sell some of its foreign currency to balance the outflow. This decrease in money supply shifts the LM curve to the left until the domestic interest rate and global interest rate are equal. The opposite is true when global interest rate decreases.

Monetary Policy Using Mundell-Fleming Model:

Under perfect capital mobility, a very small difference in interest rates in different countries would cause infinite capital flows that would bring about changes in balance of payments.

These changes in balance of payments will affect exchange rate between different national currencies which would eliminate interest rate differential. A monetary expansion in an economy with a fixed exchange rate system shifts the LM curve to the right. This leads to a lower domestic interest rates, an increase in capital outflows, and a deficit of the balance of payments, which causes a rise in demand in the foreign currency market and results in an increase in price of foreign currency. In order to keep the exchange rate constant, the central bank has to supply foreign currency. It sells some of its foreign currency reserves in the international market. The consequent reduction in the quantity of money shifts the LM curve back to its previous position. The monetary policy is ineffective under a fixed exchange rate system, provided that it fails to increase the level of real outputs and leads to a decline in the central bank's foreign currency reserves.

Fiscal Policy Using Mundell-Fleming Model:

On the other hand, an expansion in the fiscal policy under a fixed exchange rate regime shifts the IS curve to the right. Domestic interest rates are now higher, increasing capital inflows and causing appreciation of the local currency. The higher domestic rate of interest as compared to the world interest rate will cause capital inflows into the economy. These capital inflows will bring about appreciation in exchange rate of national currency. The surplus in the balance of payments tends to reduce the value of foreign currency. In order to keep the exchange rate fixed, the central bank has to accommodate the fiscal policy by buying its reserves. This shifts the LM curve to the right. Hence, the fiscal policy affects real output level.

The Demand for Foreign Exchange Reserves Before and After the Collapse of Bretton Woods Agreement

According to the Federal Reserve History, a getaway that provides historical materials that illustrate how the Federal Reserve has changed, in July 1944, delegates from 44 nations held a conference at Mount Washington Hotel in Bretton Woods, in New Hampshire, under the title, "The United Nations Monetary and Financial Conference". Participants in the conference hammered out an international monetary system that would ensure exchange rate stability, prevent competitive devaluations, and promote economic growth. However, the system dissolved between 1968 and 1971, particularly when the then US President Richard Nixon announced the suspension of the Dollar's convertibility into gold in August 1971. By March 1973, the world's major currencies started to float against each other.

Before March 1973, central banks of countries that took part in the Bretton Woods meeting were obliged to hold foreign reserves, bearing in mind that they were committed to interfere in foreign currency markets, if their currencies' rates were dragged out of predetermined range. The breakdown of the system was estimated to reduce central banks' intervention in foreign currency markets, and therefore, reduce their demand for foreign reserves. However, central banks continued to maintain stockpiles of reserves, leading researchers to conclude that central banks have not altered their demand for foreign reserves with the change of the exchange rate system (Batten – 1982; Bastourre et. al. – 2009).

The Intervention Model and The Asset Choice Model

Batten (1982) investigated the behavior of central banks regarding the demand for foreign exchange reserves within the framework of two models: the intervention model and the

asset-choice model. Batten (1982) defined the Intervention Model as "the standard model based on the derived demand for foreign exchange reserves for purposes of intervening in foreign exchange markets". His definition is derived from the fact that the model appeared in his literature review and was considered in previous studies on the demand for foreign exchange reserves. Meanwhile, The Asset-Choice Model, as defined by Batten (1982), is based on asset-choice behavior. He was the first to consider this model in examining the demand for foreign exchange reserves. In The Asset-Choice Model, foreign reserves are treated as one of several assets that appear in a bank's portfolio and are held for the general conduct of a monetary policy.

The Intervention Model identifies four major determinants:

- Variability of international payments and receipts
- Opportunity cost of holding reserves
- Scale variable measuring the size of international transactions
- Propensity to imports

Meanwhile, in The Asset-Choice Model, foreign reserves are treated as one type of asset in a central bank's portfolio held to enable it to set up a local monetary policy. To adequately conduct a monetary policy, the central bank's portfolio should contain at least three assets: foreign reserves, government securities, and claims on commercial banks.

Batten collected data from seven countries: Norway, Sweden, Denmark, Germany, France, the Netherlands, and Japan, between the first quarter of 1964 and the fourth quarter of 1979. It is worth mentioning that the change from the fixed exchange rate system to the floating exchange rate system took place in the second and third quarters of 1973.

Batten (1982) used two methods to compare the predictive abilities of the two models. The first method is the residual-variance criterion developed by Theil, while the second method is an extension of the Cox test developed by Pesaran and Deaton. The alternative models are analyzed one at a time, with each one assumed to be correct (null hypothesis) while observing the alternative. Batten concluded that when confronted with the data and the asset-choice model as an alternative, the intervention model must be rejected. Alternatively, the asset-choice model cannot be rejected. He argues that while that rejection of the intervention model for the floating rate period is not expected, it is interesting that the model is also rejected for fixed rate period, concluding that the asset-choice model offers a more general explanation of the central banks' demand for foreign reserves, which have changed with the change of the exchange rate system.

The results of Batten's study (1982) were supported by Bastourre et al. (2009). They referred to de facto exchange rate regime classification developed by Coudert and Doubert (2005) covering 136 countries. The classification is based on three steps. The first one includes estimation of a trend in the (monthly) nominal exchange rate in order to distinguish crawling peg from peg regimes. The second stage makes it possible to separate fixed regimes (pegs and crawling peg) from flexible ones (managed and pure floating), which is done by carrying out a comparison test of annual nominal exchange rate variance between each country and a benchmark group of floating currencies (Pound Sterling, Deutsche mark, and Yen) against the USD. Bastourre et al. (2009) showed that, other things constant, flexible regime's ratio of reserves to GDP is 6 percent higher than that of fixed regimes. They concluded that when countries experience intermediate stage of development and are exposed to capital mobility, reserve accumulation becomes key for a successful integration, meaning that flexible exchange rate systems complement reserve accumulation.

The literature on demand for foreign exchange reserves includes numerous research studies investigating the effect of opportunity cost on reserves holdings (Ben-Bassat, Gottlieb – 1992; Badinger – 2004; Prabheesh et al. – 2007; Bastourre et al. – 2009).

The opportunity cost of holding reserves is the difference between the yield on reserves and the marginal productivity forgone from an alternative investment in fixed capital (Ben-Bassat, Gottlieb – 1992). Collecting data from the Central Bank of Israel during the period extending from 1968 until 1988, Ben-Bassat and Gottlieb (1992) used the stochastic Buffer Stock model to show that opportunity cost plays a remarkable role in determining the demand for reserves. The Buffer Stock model is derived from the assumption that the role of the cash balance is to absorb unanticipated inflows or outflows, acting as a buffer. At the microeconomic level, appeal is made to the stochastic nature of inflows and outflows. At the macroeconomic level, the Buffer Stock model assumes that money is equivalent to fiat currency, a case in which an increase in money supply leads to a rise in spending and attempts to buy other assets. What makes the model distinguished is not that money can act as a buffer, but rather the fact that money stock is controlled exogenously and is independent of price levels and interest rates. Ben-Bassat Gottlieb (1992) concluded that there is a negative relationship between the demand for foreign exchange reserves and the opportunity cost of holding the reserves.

This is consistent with the results of a study carried out by Badinger (2004) for Austria, which he defined as a small open economy that pursued a fixed exchange rate vis-à-vis Deutsche mark during the period from which his data were collected (from 1985 to 1997). Performing ADF tests to his long-run reserve demand function, Badinger (2004) noted that when measured properly, opportunity cost of holding reserves is a crucial determinant of

demand for reserves, but indicates that the semi-elasticity of reserve demand is low in the case of Austria. His function included the following variables: real level of international reserves (including gold at official price), real imports goods and services, and the opportunity cost of holding reserves.

However, Prabheesh et al. (2007) found different results in their study on demand for foreign exchange reserves in India. Their study collected quarterly data from January 1981 to January 2005 and grouped the determinants of demand for reserves into five categories: economic size, current account vulnerability, capital account vulnerability, exchange rate flexibility, and opportunity cost. It determined potential explanatory variables for each of these categories of determinants: population and per capita GDP for economic size; ratio of imports to GDP, ratio of trade to GDP, and ratio of current account deficit to GDP for current account vulnerability; ratio of capital account deficit to GDP, ratio of short-term external debt to GDP, and ratio of broad money to GDP for capital account vulnerability; standard deviation of exchange rate for exchange rate flexibility; and interest rate differential for opportunity cost. They expected that reserve holdings would rise with respect to economic size. They also assumed that a high ratio of imports to GDP, high trade to GDP, and high current account deficit to GDP might lead to high current account vulnerability, which would induce high reserve demand. They also estimated that a high ratio of capital account deficit to GDP, high-short term debt to GDP, and high broad money to GDP could be associated with higher capital account vulnerability, which may lead to a rise in reserve holdings. But, they estimated that greater exchange rate flexibility would increase the demand for reserves, and that a higher opportunity cost would lead to a reduction in reserve holdings, because alternative investments would become comparatively attractive. After proving that variables are non-stationary through ADF and PP tests, the study used Johansen

cointegration test. They initiated their test with the unrestricted Vector Auto Regressive model (VAR), incorporating five dummy variables (for the quarters 1990 Q3, 1990 Q4, 1991 Q1, 1991 Q2, and 1991 Q3). Using Akaike information criterion and Schwarz information criterion, the optimum number of lags for VAR was identified as two, where the residuals of the VAR were found to be uncorrelated and homoscedastic. Performing Eigen test statistics, they found evidence of one cointegrating vector, implying that there exists one set of cointegrating relationship among the five variables considered. This led to the findings that the impact of the ratio of broad money to GDP exhibits a higher influence on reserve movements. The effect of current account vulnerability variable indicated that a one percent increase in import to GDP results in more than two percent increase in reserve holdings. The interest rate differential entered the cointegrating vector significantly, but postulated a low impact compared to other variables. This led them to conclude that reserve accumulation of the Central Bank of India is less influenced by the opportunity cost of holding reserves.

In contrast, this is not the case in neighboring Pakistan (Jalil, Bokhari – 2008). Jalil and Bokhari (2008) found that the opportunity cost played a greater role in determining the level of reserves accumulation in Pakistan. Two costs incurred by the Central Bank of Pakistan were identified in their study: the opportunity cost of reserves and the adjustment cost, which the cost incurred every time reserves hit some lower bound. The adjustment cost is generally interpreted as the output or welfare lost due to costly price measures that are needed to generate sufficiently large external payments surplus necessary for reserve stockpiles when actual reserves hit some lower limit. A lower bound of zero was assumed in the study. They noted that the adjustment and opportunity costs are interrelated, meaning that a higher stock of reserves reduces the probability of having to adjust and thereby

reduces the expected cost of adjustment, but this cushion is acquired at the cost of higher foregone earnings. Due to the postulated stochastic process, reserve holdings are random, they highlighted, assuming that the optimal stock would be obtained by minimizing the sum of the expected value of both components of costs. Collecting data from period extending between June 1995 and June 2005, they used the stochastic buffer stock model that obtains the optimal reserves by minimizing the sum of the expected value of both components of cost. Jalil and Bokhari (2008) found that both adjustment and opportunity costs played a remarkable role in the accumulation of reserves in Pakistan with the opportunity cost being a more predominant determinant. Their results contradicted the hypothesis of increased capital mobility that is commonly set forth in explaining the precautionary motive for reserve holdings, claiming that could be attributed to the fact that the capital outflow in Pakistan is not as free as the capital inflow, and that a large part of the accumulated reserves is due to non-debt reserve inflows.

However, this was not verified in another recent study. Bastourre et al. (2009) asserted that the opportunity cost of holding reserves is an insignificant variable for investigating the accumulation of reserves by central banks. Bastourre et al. (2009) selected three variables from the literature on demand for reserves: opportunity cost of holding reserves, trade openness using imports plus exports as a proxy, and volatility of commercial transactions (trade volatility). They did not stick to the selected variables, but expanded the set to include three main issues: exchange rate regimes, development level and regional imitation. Data were collected from 136 countries. Using system GMM estimate, they argued that only trade openness is statistically significant to be a determinant variable of demand for reserves among the three selected variables from the literature, while the two other variables, the opportunity cost and trade volatility, are not relevant.

The Effect of the Asian Crisis on the Accumulation of Foreign Exchange Reserves

The literature on reserve accumulation in developing countries, particularly in the Far East, is rich (see for example Aizenman, Marion – 2002, Gosselin, Parent – 2005). Aizenman and Marion (2002) examined why reserves have seen accumulation in the aftermath of the 1997 Asian crisis, in Asian countries, and what drive these accumulations.

The Asian Financial Crisis is a major global crisis that struck the Asian economy before it destabilized the world economy at the end of the 1990s. The devastating crisis began in Thailand, where the local currency (Baht) was unpegged from the USD, initiating a series of currency devaluations and a massive capital flight. The crisis quickly spread to neighboring countries. Also called the Asian Contagion, the Asian economic crisis, which hit in 1997, badly damaged Indonesia, South Korea, and Thailand. Hong Kong, Laos, Malaysia, and the Philippines were also hurt by the slump, while Brunei, China, Singapore, Taiwan, and Vietnam were less damaged, although all suffered from a loss of demand and confidence throughout the region.

To estimate reserve holdings for a panel of developing countries and examine whether the estimation performs well in predicting reserves for the Asian emerging markets, Aizenman and Marion (2002) set up a standard estimating equation, in which reserve holdings depend on scale factors, international transactions volatility, and openness:

$$ln(Rit/Pit) = \alpha 0 + \alpha 1\, ln(POPit) + \alpha 2\, ln(GPCit) + \alpha 3\, ln(EXAit) + \alpha 4\, ln(IMYit) + \alpha 5\, ln(NEERit) + \varepsilon t$$

where:

R: actual holdings of reserves minus gold (valued in millions of USD and deflated by the US GDP deflator (P)

POP: total population of the country

GPC: real GDP per capita

EXA: volatility of real exports receipts

IMY: share of imports of goods and services in GDP

NEER: volatility of the nominal effective exchange rate

Aizenman and Marion (2002) estimated reserve holdings to be positively correlated with the country's population and standard of living, reserve holdings to be positively correlated with the volatility of a country's export receipts, reserve holdings to be positively correlated with the average propensity to import, and reserve holdings to be positively correlated with exchange rate volatility. They performed two regression analyses for a panel of 122 developing countries over the period cover 1980 through 1996 and found that the scale variables, population size, and real GDP per capita are positively correlated with reserve holdings. The volatility of real export receipts and the vulnerability to external shocks measured by openness are also positive and highly significant. Greater exchange rate variability significantly raises reserve holdings. Furthermore, the second regression illustrated that political measures can also affect reserve holdings, like political uncertainty and political corruption.

To illustrate results of the two regressions for smaller geographical regions, Aizenman and Marion (2002) computed the non-weighted average value of the coefficients of country dummies, which valued -0.2573, as well as one, two, and three standard deviations around

this average. They found that when reserve holdings are estimated without explanatory political variables, their results for the broad regions of Asia, Latin America, and Africa meet expectations. However, results for smaller regions in the Far East (China, Indonesia, Korea, Malaysia, the Philippines, and Thailand) and in Latin America (Argentina, Brazil, Chile, Colombia, Mexico, Peru, Uruguay, and Venezuela) showed that the average coefficient values were considerably more negative than the sample average. Consequently, the regression's explanatory variables over-predict reserve holdings for the subsets of countries in the 1986-1990 period. Aizenman and Marion (2002) then repeated the same exercise for estimates obtained from the second regression (with political measures). Results showed that the average values of the dummy coefficients for Latin America and Africa were close to the sample average (0.102), while that for Asia were more negative but within one standard deviation. For subsets of countries, results showed that the coefficient on the country dummy was more than two standard deviations below the average for Korea and Brazil, again suggesting that the explanatory variables including political factors were over-predicting reserve holdings for these important emerging countries.

Aizenman and Marion (2002) then used data for 1997-1999 to assess whether the two regressions predict out-of-sample for the Asian emerging markets. They found that for Korea, the second regression over-predicted reserve holdings for 1997, the year in which the Asian crisis hit. However, the regression under-predicted Korea's reserve holdings in both 1998 and 1999, meaning that the crisis increased Korea's optimal long-run demand for reserves. Elsewhere, in emerging Asian economies, the gap between the actual and predicted value of reserves over the 1997-1999 period is less dramatic in absolute terms. In the case of China, the second regression under-predicted China's reserve holdings in real terms in 1997 and 1998 but over-predicted holdings in 1999. The estimation results also

under-predicted Thailand's reserve holdings in all three years as well as the Philippines' holdings in the three-year period. However, the estimation over-predicted Malaysia's reserve holdings for all the three-year period.

Aizenman and Marion (2002) concluded that the standard estimating equation well predicted Asian reserve holdings in the period covering 1980-1996. They also showed that the explanatory variables over-predicted reserve holdings for some far eastern countries, but under-predicted reserve holdings for far eastern countries post 1996. They argued that the behavior changed since the Asian crisis struck. Aizenman and Marion (2002) further investigated the recent build-up of large international reserve holdings in a number of emerging countries. They estimated that the large stockpiles of reserves may represent precautionary holdings. They focused on two factors that motivate reserve stockpiles. The first was the need to smooth consumption and distortions to facilitate entry to global capital markets and overcome costly domestic tax collection. The second was a rise in the volatility of stocks and/or loss aversion after the 1997-1998 economic crisis. They further investigated why these factors do not induce other countries to hold precautionary balances. To assess the first factor, Aizenman and Marion (2002) assumed consumers were risk neutral (because they choose no precautionary saving in the conventional analysis), and analyzed international reserves in terms of a buffer stock model. The second factor was analyzed using a generalized expected utility framework that attached bigger weights to "bad" states of nature and smaller ones to "good" states. Aizenman and Marion (2002) concluded that the recent reserve stockpiles in the Far East is motivated by the economic crisis that struck in 1997. Countries faced with a rise in sovereign risk and high taxation costs associated with large inelastic fiscal liabilities seek to hold large precautionary reserve balances. When countries attach more weight to bad outcomes than to good ones, they also seek to hold

large reserve balances in the aftermath of a crisis, as some of them favor current consumption, experience political instability, or suffer from political corruption, and this results in lower effective return on holding reserves, hence come the humble stockpiles. Aizenman and Marion (2003) investigate both efficiency and political-

economy considerations play roles in determining a country's optimal holdings of international reserves, suggesting that in the absence of political-economy considerations, a country characterized by volatile output, inelastic demand for fiscal outlays, high tax collection costs and sovereign risk will want to accumulate both international reserves and external debt, which allows the country to smooth consumption when output is volatile. Aizenman and Marion (2003) consider in their study a two-period model of an emerging-market economy. The economy experiences productivity shocks that create a volatile tax base. It faces inelastic fiscal outlays and finds it costly to collect taxes. The economy can borrow internationally in the first period, but because there is some chance it will default in the second period, it faces a credit ceiling. Aizenman and Marion (2003) suggest that political instability and political corruption reduce the optimal size of buffer stocks. Their model described an economy where a higher chance of future looting by an opportunistic policy maker reduces the current demand for international reserves. They found that that the probability of leadership change and political corruption influenced the demand for reserves even after controlling for standard determinants and country fixed effects. Furthermore, their modeling suggests that international borrowing and international reserve accumulation are the simultaneous outcome of optimizing decisions.

Meanwhile, in his study on international reserves hoarding, Aizenman (2005) quantifies the relative importance of alternative views explaining international reserves accumulation, and models precautionary demand for international reserves, viewing it as self-insurance against costly output contractions induced by sudden stops and capital flight. Aizenman's model provides welfare evaluation of the costs and benefits of hoarding reserves, and the optimal size of precautionary demand. Aizenman (2005) adds in his research two sets of variables to previous econometric specifications. The first set deals with factors associated with mercantilist motives: lagged export growth and deviations from predicted purchasing power parity (PPP), while the second set of variables attempts to capture precautionary adjustment in the aftermath of unanticipated sudden-stop crises, using dummy variables. Specifically, two crucial events were the 1994 Mexican crisis and the 1997 East Asian crisis. Both happened at times of greater financial integration, promoted by relaxing capital controls. His research provides only a limited support for the mercantilist approach. While the variables associated with the mercantilist motive are statistically significant, their economic importance in accounting for reserves hoarding is close to zero and is dwarfed by other variables. In his study, Aizenman (2005) expected that reserves hoarding provoked by mercantilist concerns should be associated with higher export growth rate, and with deprecated real exchange rate relative to the fundamental PPP real exchange rate. His study covers Argentina, Brazil, Chile, China, Korea, and Mexico, over the period 1980 through 2000. Aizenman (2005) found that variables associated with trade openness and exposure to financial crises are both statistically and economically important in explaining reserves. In contrast, he suggested that variables associated with mercantilist concerns are statistically significant, but economically insignificant in accounting for the patterns of hoarding reserves, providing a model that shows that precautionary demand is consistent with high

levels of reserves. Aizenman (2005) revealed in his study that existing patterns of growing trade openness and greater exposure to financial shocks by emerging markets go a long way towards accounting for the observed hoarding of international reserves. He also suggested that international reserve stockpile in the aftermath of a crisis occurs only in countries falling in the affected regions.

The results found by Aizenman and Marion (2002) are endorsed by Bolbol and Fatheldin (2005). Bolbol and Fatheldin (2005) analyzed reserve holding in 17 Arab countries during the period covering 1980 through 2002. Bolbol and Fatheldin (2002) adopt a two-stage estimation methodology in their research and divide their all-countries sample into two groups over two periods of time: the GCC and Reform (Egypt, Jordan, Morocco and Tunisia) groups and the 1984 – 1992 and 1993 – 2002 periods. Bolbol and Fatheldin (2005) analyze reserve adequacy in Arab countries from the vantage of three reserve ratios: reserves to imports, reserves to short-term debt, and reserves to broad money. Bolbol and Fatheldin (2005) endorse the relationship between propensity to import and precautionary reserves suggested by Aizenman and Marion (2002). Bolbol and Fatheldin (2005) also find that a higher propensity to import mirrors great openness, and with it the need to hold more precautionary reserves.

Bolbol and Fatheldin (2005) also find results similar to those found by Aizenman and Marion (2002) regarding the relationship between population and per capita income on one hand and reserve holding on the other hand. While Aizenman and Marion (2002) conclude that population and per capita GDP positively influence the demand for reserves, Bolbol and

Fatheldin (2005) suggest a positive relationship between population size and per capita income on one hand and the demand for foreign reserves in Arab countries.

Regarding reserve hoarding in the aftermath of a crisis, Bolbol and Fatheldin (2005) agree with Aizenman and Marion (2002) regarding reserve stockpile in the aftermath of the Asian crisis, arguing that echoes from the Asian crisis have induced some Arab countries to stockpile foreign reserves.

Gosselin and Parent (2005) investigated how far the level of reserves in emerging-market economies from that given by standard macroeconomic determinants. To do so, Gosselin and Parent (2005) used Pedroni's (1999) panel cointegration tests as the basis for the estimation of a long-run reserve demand function in a panel of eight Asian emerging-market economies: China, India, Indonesia, Korea, Malaysia, the Philippines, Singapore, and Thailand. Their study highlighted the importance of studying these countries, as they claimed recent build-up in reserves is concentrated in this part of the world. Their data were obtained annually covering 1980 through 2003. Pedroni (1999) derived seven different Panel cointegration statistics, four of which were based on policy along the within-dimension (Panel v, p; Phillips-Perron), and augmented Dickey-Fuller (ADF), while the remaining were based on pooling along the between-dimension (group p, PP, and ADF Stats). They computed statistics by following steps suggested by Pedroni:

- They estimated the panel cointegration regression and collected the residuals.
- They differenced the original series for each member and computed residuals from the differenced regressions.
- They calculated the long-run variance using the Newey-West (1987) estimator

- Using the residuals of the original cointegrating regression, they estimated the appropriate auto-regression.

The explanatory variables in their study were obtained from the literature and were similar to those considered by Prabheesh et al. (2007), which are: population and per capita GDP for economic size; ratio of imports to GDP, ratio of trade to GDP, and ratio of current account deficit to GDP for current account vulnerability; ratio of capital account deficit to GDP, ratio of short-term external debt to GDP, and ratio of broad money to GDP for capital account vulnerability; standard deviation of exchange rate for exchange rate flexibility; and interest rate differential for opportunity cost. Gosselin and Parent (2005) first checked the order of integration of the variables using Im, Pesaran, and Shin (IPS 2003) panel unit root test, which assumes that all series are non-stationary under the null hypothesis. Lags of the dependent variable, which is the log of total reserves minus gold divided by nominal GDP (res), are introduced to allow for serial correlation in the errors. The IPS results rejected the null hypothesis of non-stationary for the exchange rate volatility and interest rate differentials, meaning that these two variables wouldn't be considered in the panel cointegration tests. Performing Pedroni (1999) cointegration tests, they found evidence that there is a positive coefficient on the ratio of imports to GDP. The volatility of export receipts also exhibits a positive coefficient. The potential for resident-based capital flight from the domestic currency seemed to play an important role in determining reserve holdings in emerging Asia, since the coefficient associated with the ratio of broad money to GDP rose by 0.78 percent in the past 1997-period. However, current account developments had less influence on reserve holdings in the aftermath of Asian contagion, as the coefficient associated with important propensity declined in the second subperiod.

Then Gosselin and Parent (2005) used the demand equation to probe the extent to which international reserves deviate from their usual economic determinants. They showed that in China, reserve balance was below values predicted by determinants. Elsewhere in Asia, reserve balances were slightly above values predicted by the determinants. The predicted values were obtained from the IMF.

Gosselin and Parent (2005) further examined the cointegrating vector by estimating a fixed-effects panel error-correction model for the percent change in the ratio of reserves to GDP, in order to evaluate the explanatory power of stationary variables that were initially dismissed from the cointegration analysis: exchange rate volatility and opportunity cost. In addition to these determinants, they considered changes in the variables of the cointegration space. An additional evidence of cointegration appeared in their results, with a strongly significant error-correction term of -0.56. Four lags of the dependent variable were needed to account for the autoregressive persistence of the series, and the residuals were white noise according to the Ljung-Box Q-statistics. At 56 percent per year, they noted that adjustment was fairly rapid. Aside from lagged values of the dependent variable, they unexpectedly found that none of the aforementioned variables were statistically significant. Gosselin and Parent (2005) concluded their model couldn't explain the very strong pace of reserve stockpiles in the two years that preceded their research, despite accounting for a structural break in the demand for reserves following the Asian economic crisis. They claimed that as long as historical relationships continue to hold, a slowdown in the pace of reserve accumulation is likely to occur, arguing that this brings negative risks for the USD. However, they claimed that substantial capital losses that central banks in Asia would incur if they were to drastically change their accumulation plan alleviate the risks of rapid depreciation of the USD induced by Asian central banks.

The Relationship between Foreign Exchange Reserves and Short-Run and Long-Run Growth

The literature on relationship between foreign exchange reserve accumulation and growth is large (see for example Polterovich, Popov – 2003). Polterovich and Popov (2003) probed the relationship between accumulation of foreign exchange reserves and growth in four Asian emerging countries, and estimated that the accumulation of foreign exchange reserves lowers values of exchange rates, which in turn induce export-led growth. Data for 100 countries were observed for the period covering 1960 through 1999. Analyzing foreign exchange reserves as a percentage of GDP, Polterovich and Popov (2003) found that figures varied dramatically throughout the mentioned period, suggesting the lack of a relationship between foreign exchange reserves and GDP.

Polterovich and Popov (2003) then examined the relationship between foreign exchange reserves (FER) accumulation and rates of long-term economic growth, assuming that there is a positive relationship between the two variables. They used standard growth regressions to show that the accumulation of reserves and policy-induced accumulation of FER matter for economic growth even if other factors are taken into consideration. Regression results showed that the investment/GDP ratios and growth are linked, but also suggested that reserve accumulation induce growth through greater involvement into foreign trade.

Furthermore, Polterovich and Popov (2003) investigated the relationship between FER accumulation and exchange rate undervaluation. The observed data showed that actual (official) exchange rates in less developed countries are usually below PPP levels, suggesting that the faster the accumulation of reserves, the more undervalued is the exchange rate as comparted to PPP, the lower are domestic prices as compared to prices of other countries

(US prices in their case, since the exchange rate of the local currency is measured against the USD). The data also suggested that the influence of policies set up by monetary authorities on the exchange rate is negligible: there is a negative relationship between the increase in FER and the exchange rate undervaluation as measured by the ratio of PPP exchange rate of local currency in USD to the official exchange rate.

Additionally, Polterovich and Popov (2003) assessed the relationship between FER accumulation and investment/GDP ratios, estimating that reserve accumulation leads to devaluation and results in higher relative prices of tradable goods (as compared to wages and prices of non-tradable goods) and higher profits, this would result in higher savings and investment/GDP ratios. Performing regression of the average share of investment in GDP on the IRCG index of investment climate, and the increase in foreign exchange reserves for the period 1060-1999 and 1975-1999, they found that FER required level and FER-induces level impact the ratio of investment to GDP for both periods.

Moreover, Poterovich and Popov (2003) probed the relationship among FER accumulation, currency undervaluation, and trade and investment. They argued that FER accumulation boosts not only investment/GDP ratios, but also share of exports and trade in GDP. Trade/GDP are positively related to the accumulation of reserves but negatively related to the ratio of domestic to US prices.

Polterovich and Popov (2003) also wanted to investigate the relationship between foreign direct investment and FER accumulation. They estimated that the pump of foreign direct investment is related to FER accumulation, suggesting that the flow of foreign direct investments underprices the exchange rate making domestic assets seem cheap in foreign currencies. They further suggested that the ability of authorities to accumulate reserves for

a considerable period of time mirrors government credibility and policy consistency. Performing regression analysis, they found evidence that the inflow of foreign direct investments in 1980-1999 is not correlated with the investment climate index but is strongly correlated with FER stockpiles in the preceding period (1960-1980) and the following period (1980-1999).

Polterovich and Popov (2003) concluded that FER accumulation is not significant for economic growth, arguing that countries accumulating reserves fail to raise their investment/GDP ratios due to high capital flight resulting from poor investment climate. However, they found that FER accumulation is a powerful macroeconomic mechanism of raising long-term growth rates. The FER stockpiles bring about the undervalued exchange rate, the increase in reserves and profits of the exports sector, and boost investment and export-led growth.

The Relationship between Foreign Exchange Reserves and Real and Nominal Exchange Rates

The literature on demand for foreign exchange reserves also includes a myriad of research studies on the relationship between foreign exchange reserves and exchange rate (see for example Narayan, Smyth – 2006; Bayat et. al. – 2014). In the long-run, the real exchange rate bears a significant positive effect on foreign exchange reserves (Narayan, Smyth – 2006). Narayan and Smyth (2006) defined the real effective exchange rate as the trade-weighted real effective exchange rate for the Chinese RMB vis-à-vis its major trading partner currencies as the ratio of the price of non-tradable goods over the price of trade-weighted goods. Narayan and Smyth (2006) used a multivariate model to investigate the dynamic relationship between real effective exchange rate, real China-USA interest rate differential

and foreign reserves in China. Data were collected from the period covering January 1980 through July 2002. Narayan and Smyth (2006) performed Augmented Dickey-Fuller unit root test for each variable without allowing for structural breaks in order to determine the variable's order of integration. Their results suggested that the real exchange and foreign exchange reserves are integrated of order one or I(1), whereas the real interest the real interest rate differential is integrated of order zero or I(0). Narayan and Smyth then developed two models, allowing for structural breaks, with one model allowing for one break and in the intercept of the trend while the second allowing for a change in both the intercept and slope of the trend. The null hypothesis implied that there was unit root, while the alternative hypothesis implied that the breakpoint of the model's equation was stationary. Narayan and Smyth (2006) failed to reject the null hypothesis of a unit root, and the two models suggested the same breakpoints for foreign reserves and interest rates and that the breakpoints of exchange rate are within a few months of each other. The break in the intercept of the trend is significant in the first model for each variable, while the break in in the slope of the trend was significant in the second model for the exchange rate. Narayan and Smyth (2006) then applied Lumasdaine and Papell (1997) test, which proposes a unit root test extending the two models to allow for two structural breaks. One model allowed for two breaks in the intercept of the trend while other allowed for two breaks in the intercept and slope of the trend. Again, they failed to reject the unit root null hypothesis for any of the variables.

Narayan and Smyth (2006) then used the bounds testing approach to cointegration. To implement the bound tests, they considered a vector of variables *Zt*, where *Zt = (Yt, Xt), Yt* is the dependent variable and *Xt* is a vector of regressors. The data generating process of *Zt* is a *p*-order vector auto-regression. To test for cointegration, ΔYt is modelled as a conditional

unrestricted error-correction mechanism (UECM). Lagged values of Δ*yt* and current and lagged values of Δ*xt* are used to model the short-run dynamic structure. The bounds testing procedure tests for the absence of any level relationship between *yt* and *xt* is through exclusion of the lagged levels variables *yt*-1 and *xt*-1. Because they employed monthly data, the ARDL model is based on an ARDL(12, 12, 12) error correction version. They found that the calculated F statistic (8.283) when the log of the real official foreign exchange reserves is the dependent variable exceeds the upper band critical value of 7.52 while the computed F statistics when the log of the real effective exchange rate is the dependent variable (2.229) and when the real interest rate differential between China and the US is the dependent variable (1.443) are lower than the lower band critical value of 6.34 at the 1 percent level. The results implied that that there is a unique long-run relationship among variables, when the real foreign exchange reserves variable is dependent. In the long-run, the real exchange rate has a statistically significant positive effect on foreign exchange reserves. The positive sign on the real exchange rate suggested that an increase in price of tradable goods will depreciate the real exchange rate, which consequently leads to expansion in exports, and therefore, a rise in foreign reserves.

Bayat et al. (2014) examined the asymmetric relationship between foreign exchange reserves and nominal – real exchange rate in the Turkish economy. Bayat et. al. (2014) employed monthly data covering January 2003 through January 2014. Testing unit root properties of the variables, they applied ADF test. Results showed that variables are integrated of order one or I(1). Then, they applied Hansen-Seo (2002) non-linear cointegration test. To investigate whether there is an asymmetric relationship among the

variables, Bayat et al. (2014) applied Dicks-Panchenko (2006) non-linear Granger Causality test and found no causality for both raw data and residuals between nominal-real exchange rate and foreign exchange reserves. However, they found that there is a causal relationship from foreign exchange reserves to nominal and real exchange rate for raw data (positive relationship). Finally, Bayat et. al. (2014) applied Breitung and Candelon (2006) frequency domain causality analysis to examine short, medium, and long term causality. Their results showed that foreign exchange reserves do not influence nominal and real exchange rate in Turkey at any period, but there is a causality running from nominal exchange rate to foreign exchange reserves in the short run (positive relationship), and a causality running from real exchange rate to foreign exchange reserves in short and long run (positive relationship).

The Relationship between Foreign Exchange Reserves and Money Creation

The literature on demand for foreign exchange reserves in Middle Eastern countries with a fixed exchange rate system includes a recent study on the relationship between foreign exchange reserves and monetary base in Lebanon (Azar – 2014). In his study, Azar (2014) also looked into the relationship between foreign exchange reserves and monetary base on one hand, and the broad money supply (M2) on the other hand in Lebanon, where the local currency is pegged to the USD. Azar (2014) obtained data from the period covering January 1993 through November 2013. Using Elliott et. al.'s unit root test (1996), Azar (2014) tested for stationarity of six logged variables: coincident indicator, monetary base, claims of commercial banks in Lebanese pounds on the private sector, foreign exchange reserves of the central bank in USD, foreign exchange reserves of the central bank in Lebanese pounds, and money supply (M2). Azar (2014) used error-correction model to conduct regressions of the logged foreign exchange reserves on the logged monetary base. Azar (2014) pointed out

that in the long run, as the amount of foreign exchange reserves rises by 1 percent, monetary base rises by one percent. Azar (2014) then carried out regressions on the change in logs of the money supply (M2). Results showed that there is a short run relationship between growth rates of the monetary base and the coincident indicator with the growth rate in M2. This implies that the consumer and business confidence significantly influence money creation. Azar (2014) then included, in the same regression, the three lagged log-level variables, indicating that there is a significant long run cointegration relation between the coincident indicator and M2, but not between monetary base and M2. The same regressions were then conducted but with the lagged cointegration residual replacing the lagged log-level variables. Results pointed out that the relationship between foreign exchange reserves and the coincident indicator on one hand, and the money supply on the other hand is significant. Azar (2014) concluded that foreign exchange reserves directly influence the money supply without the intermediation of the monetary base, giving evidence that the expansion of M2 responds positively and significantly to consumer and business confidence.

Theory

The literature on the demand for foreign exchange reserves yields several results depending on the macroeconomic variables considered and the nature of economies of countries considered in the studies. While Batten (1982) and Bastourre et al. (2009) found that the demand for foreign exchange reserves changed upon the introduction of the floating exchange rate regime, this is not the case in GCC countries, whose local currencies have always been pegged to international currencies meaning that the exchange rate system in GCC countries has always been fixed, with USD being the major currency that GCC

countries' currencies are pegged to (except for the Kuwaiti Dinar which is pegged to a basket of international currencies). This study will investigate the relationship between the demand for foreign exchange reserves in GCC countries and the opportunity cost of holding reserves, a variable that was studied in each of the following studies: Ben-Bassat, Gottlieb (1992); Badinger (2004); Prabheesh et. al. (2007); and Bastourre et al. (2009). I estimate results to be similar to those found by Badinger (2004), who showed that the opportunity cost of holding reserves is a crucial determinant of the demand for reserves, bearing in mind that Austria, the country that he considered in his study, is considered a small open economy and had a fixed exchange rate vis-à-vis the Deutschemark during the period from which the data in his study was collected. Since GCC countries are classified as small open economies with fixed exchange rate system, I estimate opportunity cost to be a major determinant of the demand for reserves in the Gulf countries. Furthermore, this study will look into the relationship between foreign exchange reserve accumulation and economic growth. Polterovich and Popov (2003) investigated this issue and concluded that a foreign exchange reserve stockpile leads to exchange rate devaluation, which in turns induces export-led growth. Abdulaziz bin Hamad al-Ageel, secretary-general of the Gulf Organization for Industrial Consulting (GOIC), declared in 2015 that foreign direct investments in GCC countries skyrocketed in the past 15 years. Since, foreign exchange reserves are a major attractor for foreign direct investments, there should be a positive relationship between foreign exchange reserves and economic growth. Aizenman and Marion (2002) showed that countries that strongly favor current consumption, experience political instability, or suffer from political corruption face a lower effective return on holding reserves and will acquire lower stockpiles in the aftermath of a crisis, implicitly referring to the 1997 Asian economic crisis. This study will investigate foreign exchange reserve accumulation in GCC countries

following the 2008 economic crisis, which heavily influenced economies of these countries. There should be a remarkable stockpile in foreign exchange reserves in the aftermath of the crisis. Besides that, this study investigates the relationship between foreign exchange reserves and real exchange rate. Narayan and Smith (2006) found that in China, the real exchange rate bears a significant positive effect on foreign exchange reserves in the long run, a finding supported by Bayat et al. (2014). This study will investigate whether this real exchange rate have a positive effect on the demand foreign exchange reserves in GCC countries. Azar (2014) found evidence that a 1 percent rise in foreign exchange reserves leads to a 1 percent increase in monetary base in a study conducted over Lebanon, an open economy with a USD-pegged local currency and perfect capital mobility. Finally, this study will add another variable that other researchers have not considered when investigating the demand for foreign exchange reserves – the price of crude oil. The six GCC countries are oil-exporting countries, having one of the highest proven reserves of oil worldwide. The study will investigate the relationship between oil prices and the demand for foreign exchange reserves in GCC countries. Since foreign direct investments are proved to be positively correlated with accumulation of direct foreign investments (Polterovich and Popov - 2003), and oil reserves in GCC are major attractors of direct foreign investments, I estimate that oil reserves are positively correlated with the accumulation of reserves. However, since prices of oil are not directly related to foreign direct investments and that foreign direct investments are pumped into oil-producing countries regardless of the current price of oil, provided that investments are managed by geo-political factors, I estimate that there is no relationship between foreign exchange reserve accumulation and oil prices.

Summary of the Econometric Procedures in the Literature Review

The following is a summary of the models covered in the literature. Batten (1982) investigated the behavior of central banks regarding the demand for foreign exchange reserves within the framework of two models: the intervention model and the asset-choice model. Batten (1982) used two methods to compare the predictive abilities of the two models: the residual-variance criterion developed by Theil and an extension of the Cox test developed by Pesaran and Deaton. Ben-Bassat and Gottlieb (1992) used the Stochastic Buffer Stock model to investigate the effect of the opportunity cost on demand for reserves. Aizenman and Marion (2002) examined determinants of reserve accumulation through two regression analyses. Gosselin and Parent (2005) used Pedroni's (1999) panel cointegration tests to estimate a long-run reserve demand function, as well as error-correction model to evaluate explanatory power of stationary variables initially dismissed in their study. Polterovich and Popov (2003) used standard growth regressions to investigate the relationship between reserve accumulation and growth. Prabheesh et. al. (2007) applied ADF and PP tests to test stationarity of variables, and then they implemented the Johannsen cointegration test, which was initiated through the unrestricted Vector Auto Regressive model (VAR), followed by Eigen test statistics. Like Ben-Bassat and Gottlieb, Jalil and Bokhari (2008) also implemented the Stochastic Buffer Stock model to examine the role of opportunity cost. To investigate the determinants of the demand for foreign reserves, Bastourre et. al. (2009) used GMM estimate. Narayan and Smyth (2006) used a multivariate model to investigate the dynamic relationship between real effective exchange rate, real interest rate differential, and foreign reserves. They developed two models, allowing for structural breaks. They applied Lumasdaine and Pepell test (1997) and used bounds testing approach to cointegration. Addiotionally, Bayat et. al. applied Dicks-Panchenko (2006) non-linear Granger Causality test to examine a causality between nominal-real exchange rate

and foreign exchange reserves. They also applied Breitug and Candelon (2006) frequency domain causality analyses to examine short, medium, and long-term causality. Finally, Azar (2014) first used a modified Dickey-Fuller of Elliott et al. (1996) to test for stationarity of variables, before using error-correction model to conduct regressions of the logged foreign exchange on the logged monetary base.

III. Data

Since the data of some of the independent variables to be examined in this study, Government Debt to GDP Ratio, GDP Per Capita, and Ratio of Imports to GDP, are available only on annual basis, all data of all variables are collected on an annual basis. Data is collected for the six GCC countries covering the period from 1996 through 2015, a period covering the 2007 – 2008 economic crisis and the devastating drop in oil prices that occurred at the end of 2013.

Data are collected from various sources. Oil prices are obtained from the Energy Information Administration. The interest rates on US Dollar are collected from website of the Federal Reserve of St Louis. Annual GDP rate, Call Money Rate, GDP per Capita, Net Current Account to GDP, Ratio of Broad Money to GDP for every GCC country were gathered from the website of the International Monetary Fund (IMF). Data on Ratio of Current Account to GDP, Ratio of Imports to GDP, Ratio of Trade to GDP, Real Effective Exchange Rate, and Nominal Effective Exchange Rate for all countries were obtained from Trading Economics (tradingeconomics.com). Values of Foreign Exchange Reserves for all Gulf countries were obtained from the website of the World Bank (worldbank.org).

GCC countries fall in the list of countries that have small open economies with pegged exchange rate system. Therefore, the opportunity cost of holding reserves in these countries is expected to be a crucial determinant for the demand for foreign exchange reserves (Badinger 2004). Additionally, higher foreign exchange reserves induce more foreign-direct investments, which lead to higher growth. As a result, it is estimated that there is a positive relationship between foreign exchange reserves and economic growth. Foreign exchange reserves surge in the aftermath of a crisis (Aizenman and Marion 2002). Therefore, foreign exchange reserves are expected to have stockpiled following the 2007 – 2008 economic crisis, which left GCC countries' economies in struggle. Furthermore, the six GCC countries are major oil producers, having one of the highest proven reserves of oil worldwide. This study will add another variable that other researchers have not considered when investigating the demand for foreign exchange reserves – the price of crude oil. Since prices of oil are not directly related to foreign direct investments, which are induced by higher forex reserves, and that foreign direct investments are pumped into oil-producing countries regardless of the current price of oil, provided that investments are managed by geo-political factors, I estimate that there is no relationship between foreign exchange reserve accumulation and oil prices.

Below is a table that summarizes the entire dependent and independent variables with their symbols appearing in all tables:

Symbol	Variable Description
YCAP	GDP per Capita
IUSD	Interest Rate on US Dollar
TRADE	Ratio of Trade to GDP
RESERVE	Total Reserves (including gold reserves, special drawing rights, and IMF funds)
REAL	Real Effective Exchange Rate
OIL	Price of Crude Oil
NEFFRATE	Nominal Effective Exchange Rate
INT	Call Money Rate
MONEY	Broad Money to GDP
IMPORTS	Ratio of Imports to GDP
GDP	Gross Domestic Product
FOREX	Value of Foreign Exchange Reserves
DEBT	Government Debt to GDP
RESGDP	Ratio of Reserves to GDP
CA	Current Account to GDP

Table: 1

IV. Methodology

As a first step of the analysis, it is important to test for the existence of unit roots in such time series data. Most economic data are characterized by seasonality and their statistical properties, such as mean, variance, and correlation, are not constant through time. Therefore, such data need to be transformed and differenced to become stationary, otherwise regression analysis cannot be conducted. The first difference of a time series is the series of changes from one period to another, and all economic variables need to be differenced to become stationary. All the dependent and independent variables are in natural logarithm, except for Current Account to GDP (CA). Additionally, the first difference is applied on the log variables.

Four unit root tests are implemented for the log variables: Levin, Lin, and Chu; Im, Pesaran, and Sin W-Stat; Augmented Dickey-Fuller (ADF) – Fisher Chi-square; and Phillips-Perron (PP) – Fisher Chi-square. As for the Capital Account to GDP, a fifth test is implemented in addition to the four tests: Breitung t-stat. The probabilities for Fisher tests are computed using an asymptomatic Chi-square distribution, while other tests assume asymptomatic normality. Levin, Lin, and Chu and Breitung t-stat are implemented with common unit root process, whereas Im, Pesaran, and Shin W-stat; ADF – Fisher Chi-square; and PP – Chi-square are carried out with individual unit root process.

The results obtained are reported in the following tables:

X	Log(x) Common Unit Root Levin, Lin & Chu t*	Log(x) Individual Unit Root A: Im Pesaran & Shin W-Stat B: ADF-Fisher Chi-Sq C: PP Fisher Chi-Sq	ΔLog(x) Common Unit Root Levin, Lin * Chu t*	ΔLog(x) Individual Unit Root A: Im, Pesaran & Shin W-Stat B: ADF – Fisher Chi-Square C: PP Fisher Chi-Sq
YCAP	0.0669	A = 0.7595 B = 0.9079 C = 0.8953	0.0000	A = 0.0000 B = 0.0000 C = 0.0000
TRADE	0.600	A = 0.1965 B = 0.1957 C = 0.2625	0.0000	A = 0.0000 B = 0.0000 C = 0.0000
RESERVE	0.2712	A = 0.9900 B = 0.9986 C = 0.9995	0.0000	A = 0.0000 B = 0.0000 C = 0.0000
REAL	0.1085	A = 0.3528 B = 0.4542 C = 0.6849	0.0000	A = 0.0000 B = 0.0003 C = 0.0042
OIL	0.1973	A = 0.5373 B = 0.7957 C = 0.8558	0.0000	A = 0.0000 B = 0.0000 C = 0.0000
NEFFRATE	0.0016	A = 0.0076 B = 0.0188 C = 0.2884	0.0413	A = 0.0304 B = 0.0496 C = 0.0334
INT	0.3477	A = 0.3812 B = 0.2795 C = 0.9427	0.0000	A = 0.0000 B = 0.0000 C = 0.0000
MONEY	0.6148	A = 0.5353 B = 0.6813 C = 0.6818	0.0000	A = 0.0000 B = 0.0000 C = 0.0000
IMPORTS	0.2780	A = 0.5408 B = 0.5632 C = 0.5872	0.0000	A = 0.0000 B = 0.0000 C = 0.0000
GDP	0.0978	A = 0.9517 B = 0.9931 C = 0.9929	0.0000	A = 0.0000 B = 0.0000 C = 0.0000
FOREX	0.2379	A = 0.9794 B = 0.9979 C = 0.9994	0.0000	A = 0.0000 B = 0.0000 C = 0.0000
DEBT	0.1466	A = 0.6140 B = 0.7644 C = 0.9464	0.0068	A = 0.0108 B = 0.0267 C = 0.0281
OIL	0.1973	A = 0.5373 B = 0.7957 C = 0.8558	0.0000	A = 0.0000 B = 0.0000 C = 0.0000
IUSD	0.0021	A = 0.0326 B = 0.0791 C = 0.4053	0.0000	A = 0.0000 B = 0.0000 C = 0.0000

RESGDP	0.0594	A = 0.0844 B = 0.1115 C = 0.1269	0.0000	A = 0.0000 B = 0.0000 C = 0.0000

Table: 2 Unit Root Test Sample period: 1996 to 2015

X	**Common Unit Root** **A: Levin, Lin & Chin t*** **B: Breitung t-Stat**	**Individual Unit Root** **A: Im, Pesaran & Shin W-Stat** **B: ADF-Fisher Chi Sq** **C: PP-Fisher Chi-Sq**	**Δlog(x) Common Unit Root** **A: Levin, Lin & Chin t*** **B: Breitung t-Stat**	**Δlog(x) Individual Un. Rt A: Im, Pesaran & Shin W-Stat** **B: ADF-Fisher Chi Sq** **C: PP-Fisher Chi-Sq**
CA	A = 0.1433 B = 0.9880	A = 0.0530 B = 0.0156 C = 0.8802	A = 0.0000 B = 0.0000	A = 0.0000 B = 0.0000 C = 0.0000

Table 3: Sample period: 1996 to 2015

In table 2, the null hypothesis is not rejected, therefore the variable CA is non-stationary. But after differencing the variable, the null appears to be rejected, therefore the variable CA is stationary in first-difference.

In table 1, the null is rejected for all the variables, therefore, all the variables are non-stationary. After differencing the variables using individual root tests, the null appears to be rejected, and therefore, all variables are now stationary. Individual unit root is used to change the unit root test according to each country. The difference between individual unit root and common unit root is that in the common unit root all countries have one root.

In order to examine whether there is a cointegration relationship among independent variables, Johansen Cointegration Test is conducted on the non-differenced variables. For each model, the test is conducted on the variables included in it. For every model, the test is carried out twice; for the case of FOREX and for the case of RESERVE.

V. Empirical Results

This section of the study portrays the empirical results found for all GCC countries. The following section interprets the results obtained in the tables. In the following section, the letter "L" that precedes every variable stands for the logarithm of that variable.

A. Intervention Model

The intervention model is derived from a study conducted by Batten (1982), who defined it as "the standard model based on the derived demand for foreign exchange reserves for purposes of intervening in foreign exchange markets". Table 4 portrays the results of the panel least square method with FOREX (values of foreign exchange reserves for GCC countries from 1996 until 2015) being the dependent variable.

Variable	Coefficient	Std. Error	t-Statistics	Probability
C	-168.1688	82.34355	-2.042282	0.0435
LREAL	75.38193	35.92732	2.098179	0.0382
$LREAL^2$	-8.048316	3.882517	-2.072963	0.0405
LOIL	1.130038	0.154688	7.305269	0.0000
LNEFFRATE	-0.671235	1.223581	-0.548583	0.5844
Adjusted R-squared	0.798446			
Schwarz criterion	2.509473			

Table 4: Panel Least Square with LFOREX as Dependent Variable

In Table 4, log REAL squared is considered since intervention by the central bank in the foreign exchange market is high when there is high exchange rate volatility, which causes foreign exchange reserves to fall. Central banks intervene in the foreign exchange market to reduce exchange rate volatility. The actual P-Value of LNEFFRATE (log nominal effective

exchange rate) is higher than the significance level of 5 percent, therefore the nominal effective exchange rate insignificantly affects foreign exchange reserves. P-values of the other independent variables (LREAL, $LREAL^2$, LOIL) are less than the significance level of 5 percent, meaning that the variables significantly affect the demand for forex reserves.

To further investigate the matter, the insignificant variable is removed, and another regression analysis is conducted on the significant variables. Table 5 shows results of the second regression analysis including only the significant variables.

Variable	Coefficient	Std. Error	t-Statistics	Probability
C	-166.5836	82.03329	-2.030683	0.0447
LREAL	73.45642	35.64268	2.060912	0.0416
$LREAL^2$	-7.859218	3.854988	-2.038714	0.0439
LOIL	1.167601	0.138270	8.444348	0.0000
Adjusted R-squared	0.799715			
Schwarz criterion	2.472309			

Table5: Panel Least Square considering significant variables

P-values of all independent variables (LREAL, $LREAL^2$, LOIL) are lower than the significance level of 5 percent, meaning that real effective exchange rate and oil significantly affect the demand for forex reserves. It is understood that, ceteris paribus, a 1 percent increase in volatility of real effective exchange rate in GCC countries lowers forex reserves by 7.8592. It is also concluded that a 1 percent increase oil prices surges forex reserves by 1.1676 percent, ceteris paribus. After omitting the insignificant variables from the second regression analysis, the value of the Schwarz criterion falls from 2.5094 to 2.4723, meaning that omitting insignificant variables improves Schwarz criterion.

To further investigate whether similar results are obtained when values of gold and SDR holdings are considered alongside values of foreign exchange reserves as the dependent

variable, another regression analysis is conducted, this time with LRESERVE (log of international reserves) being the dependent variable. Table 6 portrays the results.

Variable	Coefficient	Std. Error	t-Statistics	Probability
C	-168.23388	79.96505	-2.103904	0.0377
LREAL	75.29026	34.88955	2.157960	0.0331
LNEFFRATE	-0.5832243	1.188238	-0.490847	0.6245
$LREAL^2$	-8.038729	3.770370	-2.132080	0.0352
LOIL	1.111954	0.150220	7.402172	0.0000
Adjusted R-squared	0.821746			
Schwarz criterion	2.450852			

Table 6: Least Panel Square with LRESERVE as Dependent Variable

Similarly, the P-value of LNEFFRATE is higher than the significance level of 5 percent, meaning that NEFFRATE insignificantly affects demand for foreign exchange reserves, even when total reserves minus gold, SDR holdings, reserve position in the fund, foreign exchange reserves, and gold are considered as dependent variable.

To further investigate the results, the insignificant variable (NEFFRATE) is omitted, and a regression analysis is carried out on the significant variables. Table 7 portrays the results.

Variable	Coefficient	Std. Error	t-Statistics	Probability
C	-166.8614	79.64207	-2.095141	0.0384
LREAL	73.61716	34.60372	2.127435	0.0356
$LREAL^2$	-7.874420	3.742618	-2.103987	0.0376
LOIL	1.144593	0.134240	8.526486	0.0000
Adjusted R-squared	0.808480			
Schwarz criterion	2.413144			

Table 7: Panel Least Square Method for Significant Variables

The P-values of the variables (LREAL, LREA^{2,} LOIL) are lower than the significance level of five percent. Therefore, real effective exchange rate and oil prices significantly affect the demand for foreign exchange reserves in GCC countries. It is understood that a 1 percent rise in real effective exchange rate pulls down international reserves by 7.8744 percent, ceteris paribus. It is also concluded that a 1 percent increase in oil prices raises international reserves by 1.1445 percent. The results are almost the same in both cases (foreign exchange reserves and international reserves). The value of the Schwarz criterion falls from 2.4508 to 2.4131 after carrying out the second regression analysis without the insignificant variables, meaning that omitting the insignificant variables improves the value of the Schwarz criterion.

Now the independent variables considered in the Intervention Model are tested for cointegration. Table 8 portrays results of the cointegration tests.

Dep. Variable / **Indep Variable**	LRESERVE	LFOREX
LREAL	4,984.266* 858.711** 5.80435***	5,003.105* 863.926** 5.79113***
LREAL^2	-534.1881* 92.6262** -5.76714***	-536.0890* 93.1844** 5.75299***
LOIL	-8.175413* 3.41108** -2.39672***	-8.035250* 3.43152** -2.34160***

: Coefficient; **: Standard Error; *: t-Statistic*

Table 8: Cointegration Test for Intervention Model, LFOREX & LRESERVE

The t-Statistics values of the independent variables in both cases (RESERVE and FOREX) are less than the significance level of 2 percent. However, coefficient values in both cases are surprisingly very high.

After comparing the first and second lag of the Schwarz Criterion, Trace and Maximum Eigenvalue tests are conducted and the results are shown in Table 9.

LRESERVE				**LFOREX**			
Trace		**Maximum Eigenvalue**		**Trace**		**Maximum Eigenvalue**	
Hypoth. No of CE	**Prob.**	**Hypoth. No of CEs**	**Prob.**	**Hypoth. No of CE**	**Prob.**	**Hypth. No of CE**	**Prob**
None*	0.0002	None*	0.0069	None*	0.0002	None*	0.0065
At most 1	0.0096	At most 1	0.1095	At most 1	0.0103	At most 1	0.1191
At most 2	0.0294	At most 2	0.0219	At most 2	0.0287	At most 2	0.0221
At most 3	0.4703	At most 3	0.4703	At most 3	0.4355	At most 3	0.4355

Table 9: Trace and Maximum Eigenvalue tests of both LFOREX and LRESERVE

The p-values of non-hypothesized CE, Hypothesized at most 1 CE, and Hypothesized 2 CEs in the trace test for each of FOREX and RESERVE are less than the significance level of 5 percent, indicating that the null hypotheses for no cointegration is rejected. This implies that the Trace test indicated three cointegration vectors. Meanwhile, the p-value of non-hypothesized CE in the Maximum Eigen Value test conducted for both RESERVE and FOREX is less than the 5 percent significance level, and therefore the null hypothesis for no cointegration is rejected. The Maximum Eigenvalue test indicated one cointegration vector.

Other types of cointegration tests are conducted on the significant dependent variables – Pedroni Residual Cointegration Test and Johansen Fisher Panel Cointegration Test. Tables 10 and 11 portray the results for each case (RESERVE and FOREX).

			Weighted	
	Statistics	Probability	Statistics	Probability
Panel PP Statistic	-2.716653	0.0033	-2.582972	0.0049
Group PP-Stat	-4.006995	0.0000		
Hypothesized No of CE	Fisher Stat. (Trace)	Probability	Fisher Stat. (Max. Eigen)	Probability
None	35.96	0.0003	27.73	0.0061

Table 10: Pedroni Residual Cointegration Test, with LRESERVE as Dependent Variable

			Weighted	
	Statistics	Probability	Statistics	Probability
Panel PP Statistic	-2.294662	0.0109	-1.967824	0.0245
Group PP-Stat	-2.955821	0.0016		
Hypothesized No of CE	Fisher Stat. (Trace)	Probability	Fisher Stat. (Max. Eigen)	Probability
None	34.89	0.0005	28.67	0.0044

Table 11: Johansen Fisher Panel Cointegration, with LFOREX as Dependent Variable

The p-values are less than the significance level of 5 percent in both cases (FOREX and RESERVES), meaning that the null hypothesis of no cointegration is rejected. This implies that there is cointegration among the independent variables in the Intervention Model.

B. Asset Choice Model

The Asset-Choice Model, which is also derived from Batten (1982), is considered. According to Batten (1982), the Asset-Choice Model is based on asset-choice behavior. In this model, foreign reserves are treated as one of several assets that appear in a bank's portfolio and are held for the general conduct of a monetary policy. I will use two methods to predict the abilities of this model, just like I did when examining the Intervention Model: the dependent variable includes foreign exchange reserve values in the first method (FOREX), and values of international reserves (RESERVE). Table 12 portrays the results of regression analysis with FOREX as dependent variable.

Variable	Coefficient	Std. Error	t-Statistic	Probability
C	-22.62938	2.318639	-9.759769	0.0000
LGDP	1.197143	0.051322	23.32624	0.0000
LINT	-0.155322	0.054816	-2.833530	0.0054
LIUSD	0.004194	0.057090	0.073464	0.9416
LREAL	0.357968	0.383335	0.933826	0.3524
LOIL	0.135937	0.087134	1.560095	0.1215
Adjusted R-squared	0.878812			

Table 12: Panel EGLS (Cross-section random effects) with LFOREX as Dependent Variable

The P-values of LGDP and LINT are less than the significance level of 5 percent, meaning that GDP and call money rate significantly affect the demand for forex reserves. Meanwhile, the P-values of LIUSD, LREAL, and LOIL are higher than the significance level of 5 percent, meaning that interest rate on USD, real effective exchange rate, and oil price insignificantly affect the demand for forex reserves in GCC countries. Another regression analysis is conducted on the significant variables. However, before proceeding with the regression, a Wald Test is carried out on the coefficients of the insignificant variables to see if the omission of the variables is valid. The Wald Test

investigates whether all the coefficients on the excluded insignificant variables are all jointly zero. Table 13 shows the results of the Wald Test.

Test Statistic	Value	df	Probability
F-statistic	1.005056	(3, 114)	0.3933
Chi-square	3.015168	3	0.3893

Table 13: Wald Test

Since the results obtained fail to reject the null hypothesis at the 1 percent significance level, all the insignificant variables are omitted, and a new regression is carried out using only the significant independent variables. Table 14 shows results of the second regression analysis.

Variable	Coefficient	Std. Error	t-Statistic	Probability
C	-22.63742	1.420972	-15.93093	0.0000
LGDP	1.284717	0.056122	22.89131	0.0000
LINT	-0.165048	0.060672	-2.720345	0.0075
Adjusted R-squared	0.842233			

Table 14: Panel EGLS (Cross-Section Random Effects) on Significant Independent Variables

As portrayed in Table 14, P-values of the second regression analysis are still below the significance level of 5 percent, meaning that the independent variables still significantly affect the demand for foreign exchange reserves. This implies that, ceteris paribus, a 1 percent increase in GDP will raise forex reserves by 1.2847 percent. It is also concluded that a 1 percent increase in call money rate will lower forex reserves by 0.165 percent.

Now I will reconduct the same process, but this the dependent variable does not only include the value of reserves in GCC country, but also values of SDR Holdings, reserve

position in the fund, total reserves minus gold, and gold (RESERVE). Table 15 portrays the results of the regression analysis using RESERVE as dependent variable.

Variable	Coefficient	Std. Error	t-Statistics	Probability
C	-21.31725	2.359481	-9.034719	0.0000
LGDP	1.192609	0.056713	21.02897	0.0000
LINT	-0.157744	0.056124	-2.810609	0.0058
LIUSD	-0.007802	0.055897	-0.139576	0.8892
LREAL	0.140348	0.383933	0.365553	0.7154
LOIL	0.101276	0.086397	1.172208	0.2436
Adjusted R-squared	0.872673			

Table 15: Panel EGLS (Cross-Section Random Effects) with LRESERVE as Dependent Variable

Similarly, P-values of LGDP and LINT are less than the significance level of 5 percent, meaning that GDP and call money rate significantly affect the demand for forex reserves in GCC countries. Meanwhile, the P-values of LIUSD, LREAL, and LOIL, are higher than the significance level of 5 percent, meaning that interest rate on US Dollar, real effective exchange rate, and oil price insignificantly affect the demand for forex reserves in GCC countries. As done in the first method, a second regression analysis is carried out this time only on the significant variables. But before, a Wald Test is conducted on the coefficients of the insignificant variables to see if the omission of the variables is valid. Table 40 portrays the results of the Wald Test.

Test Statistic	Value	df	Probability
F – statistic	0.509027	(3, 114)	0.6768
Chi – square	1.527080	3	0.6760

Table 16: Results of Wald Test

Looking at the results of Table 16, the results obtained fail to reject the null hypothesis at the 1 percent significance level. All the insignificant variables are omitted and a new regression analysis on the significant variables is carried out. Table 17 portrays the results of the second regression analysis.

Variable	Coefficient	Std. Error	t-Statistics	Probability
C	-22.5362	1.516892	-14.85683	0.0000
LGDP	1.282630	0.060069	21.35271	0.0000
LINT	-0.159130	0.062809	-2.533563	0.0127
Adjusted R-squared		0.925898		
Schwarz criterion		1.432664		

Table 17: Panel EGLS (Cross-Section Random Effects) Including Significant Independent Variables

Results of the second regression analysis conducted on the significant independent variables show that P-values of LGDP and LINT are still below the significance level of 5 percent, which means that GDP and call money rate still prove to significantly affect the demand of foreign exchange reserves in GCC countries. It is understood from the results that, ceteris paribus, a 1 percent surge in GDP raises forex reserves by 1.2826 percent. It is also concluded that a 1 percent increase in call money rate lowers forex reserves by 0.165 percent and international reserves by 0.1591 percent. The findings show very close results between foreign exchange and international reserves.

Now I apply cointegration test on the independent variables considered in the Asset-Choice Model (GDP and Call Money Rate). The results of the cointegration tests in the case of RESRVE and the Case of FOREX are portrayed in Table 18.

Dep. Variable / Indep Variable	LRESERVE	LFOREX
LGDP	1.529328* 0.30183** 5.06691***	1.467566* 0.23279** 6.30432***
LINT	-1.550696* 0.38612** -4.01605***	-1.211627* 0.29732** -4.07515***

*Table 18 *: Coefficient; **: Standard Error; ***: t-Statistic*

The t-statistics values for both LGDP and LINT in the case of RESERVE are higher than the significance level of 2 percent, similarly in the case of FOREX, which means that there is no cointegration among the independent variables. After comparing the first and second lag of the Schwarz Criterion, Trace and Maximum Eigenvalue tests are carried out. The results of the test are shown in Table 19.

LRESERVE				**LFOREX**			
Trace		**Maximum Eigenvalue**		**Trace**		**Maximum Eigenvalue**	
Hypoth. No of CE	**Prob.**	**Hypoth. No of CEs**	**Prob.**	**Hypoth. No of CE**	**Prob.**	**Hypth. No of CE**	**Prob**
None*	0.0756	None*	0.3077	None*	0.0616	None*	0.2702
At most 1	0.0990	At most 1	0.3013	At most 1	0.0908	At most 1	0.3088
At most 2	0.0313	At most 2	0.0313	At most 2	0.0255	At most 2	0.0255

Table 19: Trace and Maximum Eigenvalue Tests for both FOREX and RESERVE

The p-values in both Trace and Maximum Eigenvalue tests for RESERVE and FOREX are higher than the significance level of 5 percent, meaning that the null hypothesis for no cointegration is not rejected. Since the results indicate that there is no cointegration among the independent variables, we take the first difference using Panel Least Squares for both RESERVE and FOREX. The results are portrayed in tables 20 through 23.

Variable	Coefficient	Std. Error	t-Statistics	Probability
C	0.116077	0.031103	3.732043	0.0003
D(LGDP)	0.287477	0.182901	1.571758	0.1190
D(LINT)	0.037731	0.065517	0.575891	0.5659
Cross-section fixed (dummy variables)				
Adjusted R-squared	-0.003905			
Schwarz criterion	0.519872			

Table 20: Dep. Variable: LRESERVE, with Cross-section fixed (dummy variables)

Variable	Coefficient	Std. Error	t-Statistics	Probability
C	0.113667	0.030602	3.714416	0.0003
D(LGDP)	0.313251	0.177530	1.764498	0.0804
D(LINT)	0.036076	0.064777	0.556924	0.5787
Adjusted R-squared	0.017108			
Schwarz criterion	0.337081			

Table 21: Dep. Variable: LRESERVE without cross-section fixed (dummy variables)

The p-values in tables 20 and 21 are higher than the significance level of 5 percent, which means that there neither long-run nor short-run relationships among the variables.

Variable	Coefficient	Std. Error	t-Statistics	Probability
C	0.112080	0.032495	3.449169	0.0008
D(LGDP)	0.359940	0.191087	1.883644	0.0624
D(LINT)	0.047722	0.068449	0.697190	0.4872
Cross-section fixed (dummy variables)				
Adjusted R-squared	0.008772			
Schwarz criterion	0.607435			

Table22: Dep. Variable: LFOREX, with cross-section fixed (dummy variables)

Variable	Coefficient	Std. Error	t-Statistics	Probability
C	0.109757	0.031956	3.434620	0.0008
D(LGDP)	0.384767	0.185387	2.075476	0.0403
D(LINT)	0.046087	0.067644	0.681318	0.4971
Adjusted R-squared	0.030436			
Schwarz criterion	0.423700			

Table 23: Dep. Variable: LFOREX, without cross-section (dummy variables)

The p-values of D(LINT) in both cases are higher than the significance level of 5 percent, which implies the lack of a long-run and short-run relationships among the variables.

Other types of cointegration tests are conducted on the significant dependent variables – Pedroni Residual Cointegration Test and Johansen Fisher Panel Cointegration Test. Tables 24 and 25 portray the results for each case (RESERVE and FOREX).

			Weighted	
	Statistics	Probability	Statistics	Probability
Panel PP Statistic	-2.100757	0.0178	-2.260399	0.0119
Group PP-Stat	-1.598097	0.0550		
Hypothesized No of CE	Fisher Stat. (Trace)	Probability	Fisher Stat. (Max. Eigen)	Probability
None	45.11	0.0000	30.90	0.0020

Table 24: Pedroni Residual Cointegration Test, with LRESERVE as Dependent Variable

			Weighted	
	Statistics	Probability	Statistics	Probability
Panel PP Statistic	-2.622464	0.0044	-2.573102	0.0050
Group PP-Stat	-4.585242	0.0000		
Hypothesized No of CE	Fisher Stat. (Trace)	Probability	Fisher Stat. (Max. Eigen)	Probability
None	44.92	0.0000	31.16	0.0019

Table 25: Johansen Fisher Panel Cointegration, with LFOREX as Dependent Variable

The p-values are less than the significance level of 5 percent in both cases (FOREX and RESERVES), meaning that the null hypothesis of no cointegration is rejected. This implies that there is cointegration among the independent variables in the Asset Choice Model.

C. Current and Capital Account Vulnerability

Another model to be considered in this study is the vulnerability model, which includes capital account and current account vulnerability, derived from Prabheesh et al. (2007). It is expected that high ratio of imports to GDP and high trade to GDP might lead to high current account vulnerability, which would induce high reserve demand. It is also estimated that a high ratio of current account deficit to GDP, high-short term debt to GDP, and high broad money to GDP could be associated with higher capital account vulnerability, which may lead to a rise in reserve holdings. First a regression analysis is conducted with RESERVE being the dependent variable. Table 26 portrays the results.

Variable	Coefficient	Std. Error	t-Statistic	Probability
C	-18.54687	2.431263	-7.628489	0.0000
LOG(DEBT)	-0.387824	0.049372	-7.855160	0.0000
LOG(GDP)	0.998802	0.094913	10.52331	0.0000
LOG(IMPORTS)	0.064016	0.234443	0.273054	0.7853
LINT	-0.025373	0.057729	-0.439525	0.6612
LIUSD	0.034255	0.052138	0.657009	0.5126
LMONEY	1.562237	0.325006	4.806802	0.0000
LOIL	-0.072226	0.094663	-0.762980	0.4472
LREAL	-0.486911	0.358111	-1.359666	0.1768
CA	0.010744	0.004290	2.504097	0.0138
Adjusted R-squared	0.956838			
Schwarz Criterion	1.106918			

Table 26: Panel Least Square with LRESERVE Being Dependent Variable

The p-values of LOG(DEBT), LOG(GDP), LMONEY, and CA are lower than the significance level of 5 percent, meaning that debt ratio to GDP, GDP per capita, broad money to GDP, and current account to GDP ratio significantly affect the demand for reserves in GCC countries. However, since P-values of LOG(IMPORTS), LINT, LIUSD, LOIL, and LREAL are higher than the significance level of 5 percent, it is concluded that ratio of imports to GDP, call money rate, interest rate on USD, oil price, and real effective exchange rate insignificantly affect the demand for forex reserves in GCC countries. A second regression analysis is carried out this time only on the significant variables. But before, a Wald Test is conducted on the coefficients of the insignificant variables to see if the omission of the variables is valid. Table 27 shows the results of the Wald Test.

Test Statistic	Value	df	Probability
F-statistic	0.598402	(5, 105)	0.7012
Chi-square	2.992008	5	0.7012

Table 27: Wald Test Results

The Wald Test results portrayed in Table 28 fail to reject the null hypothesis at the 1 percent significance level. All the insignificant variables are omitted and a new regression analysis on the significant variables is carried out. Table 29 portrays the results of the second regression analysis conducted on the significant variables.

Variable	Coefficient	Std. Error	t-Statistic	Probability
C	-19.14029	1.324954	-14.44600	0.0000
LOG(DEBT)	-0.401388	0.044560	-9.007725	0.0000
LOG(GDP)	0.934989	0.067736	13.80334	0.0000
LMONEY	1.550535	0.231100	6.709411	0.0000
CA	0.009572	0.003993	2.397100	0.0182
Adjusted R-squared	0.957626			
Schwarz Criterion	0.935536			

Table 29: Panel Least Squares on Significant Variables with LRESERVE as Dependent Variable

The p-values of all the independent variables are still less that the significance level of 5 percent. It is understood that, ceteris paribus, a 1 percent in increase in debt ratio in GCC countries lowers the international reserves by 0.4013 percent. Additionally, a 1 percent increase in GDP surges international reserves by nearly 1 percent. A 1 percent increase in broad money to GDP increases international reserves by 1.5505 percent and that a 1 percent increase in current account to GDP raises international reserves by 0.0095 percent. The omission of the insignificant variables has improved the Schwarz criterion as its value fell from 1.1069 to 0.9355.

The same procedure is repeated but this time with FOREX being the dependent variable. Results of the first regression are shown in Table 30.

Variable	Coefficient	Std. Error	t-Statistic	Probability
C	-19.39943	2.558611	-7.582017	0.0000
LOG(DEBT)	-0.404119	0.051958	-7.777907	0.0000
LOG(GDP)	1.032856	0.99885	10.34047	0.0000
LOG(IMPORTS)	0.108024	0.246723	-0.336900	0.6624
LINT	-0.020468	0.060753	0.857872	0.7369
LIUSD	0.047070	0.054868	-0.857872	0.3929
LOIL	-0.086176	0.099622	-0.865031	0.3890
LREAL	-0.505383	0.376868	-1.341008	0.1828
LMONEY	1.551641	0.342029	4.536575	0.0000
CA	0.011197	0.004515	2.479839	0.0147
Adjusted R-squared	0.952882			
Schwarz Criterion	1.209025			

Table 30: Panel Least Squares with FOREX as Dependent Variable

Similarly to results of the previous regression analysis when LRESERVE was the dependent variable, the P-values of LOG(DEBT), LOG(GDP), LMONEY, and CA are less than the significance level of 5 percent. This implies that debt ratio, GDP, broad money to GDP, and current account ratio to GDP significantly affect the demand for forex reserves in GDP. The P-values of LOG(IMPORTS), LINT, LIUSD, LOIL, and LREAL are higher than the significance level of 5 percent, meaning that ratio of imports to GDP, call money rate, interest rate on USD, oil price, and real effective exchange rate insignificantly affect the demand for forex reserves in GCC countries. Again, a second regression analysis is carried out this time only on the significant variables. But before, a Wald Test is conducted on the coefficients of the insignificant variables to see if the omission of the variables is valid. Table 31 shows the results of the Wald Test.

Test Statistic	Value	df	Probability
F-statistic	0.717676	(5, 105)	0.6116
Chi-square	3.588380	5	0.6101

Table 31: Wald Test Results

The Wald Test results portrayed in Table 31 fail to reject the null hypothesis at the 5 percent significance level. All the insignificant variables are omitted and a new regression analysis on the significant variables is carried out. Table 32 portrays the results of the second regression analysis conducted on the significant variables.

Variable	Coefficient	Std. Error	t-Statistic	Probability
C	-19.48881	1.398199	-13.93851	0.0000
LOG(DEBT)	-0.417961	0.047024	-8.888279	0.0000
LOG(GDP)	0.949538	0.071481	13.28379	0.0000
LMONEY	1.544871	0.243875	6.334672	0.0000
CA	0.009798	0.004214	2.325279	0.0219
Adjusted R-squared	0.953487			
Schwarz Criterion	1.043151			

Table 32: Panel Least Squares on Significant Variables with LFOREX as Dependent Variable

The p-values of all independent variables are less than the significance level of 5 percent. It can be deduced that a 1 percent increase in debt ratio to GDP in GCC countries lowers forex reserves by 0.4179 percent, ceteris paribus. It can also be concluded that a 1 percent increase in GDP increases forex reserves by nearly 1 percent. Additionally, a 1 percent increase in broad money to GDP raises forex reserves by 1.5448 percent and that a 1 percent increase in current account to GDP surges forex reserves by 0.0097 or 0.01 percent. Furthermore, the omission of the insignificant variables improved the value of the Schwarz criterion, which fell from 1.2090 in the first regression analysis to 1.0431 in the second. The results are very similar to the case when LRESERVE was the dependent variable.

To test for cointegration among the variables in this model, first a Johansen Cointegration Test is conducted. Table 33 portrays the results of the test.

Dep. Variable / Indep Variable	LRESERVE	LFOREX
LOGDEBT	-0.747172* 0.26601** -2.80880***	-0.702125* 0.25119** -2.79517***
LOGGDP	1.272982* 0.19999** 6.36533***	1.28004* 0.18893** 6.77517***
LMONEY	3.284426* 0.89274** 3.67904***	3.064059* 0.84349** 3.63261***
CA	-0.129159* 0.02096** -6.16131***	-0.122618* 0.01980** -6.19308***

: Coefficient; **: Standard Error; *: t-Statistic*

Table 32: Cointegration Test for Vulnerability Model for both LRESERVE and LFOREX

After comparing the first lag and the second lag of the Schwarz Criterion, results of the Trace and Maximum Eigenvalue of Johansen Cointegration Test are reported in Table 33.

LRESERVE				**LFOREX**			
Trace		**Maximum Eigenvalue**		**Trace**		**Maximum Eigenvalue**	
Hypoth. No of CE	**Prob.**	**Hypoth. No of CEs**	**Prob.**	**Hypoth. No of CE**	**Prob.**	**Hypth. No of CE**	**Prob**
None*	0.0119	None*	0.0219	None*	0.0117	None*	0.0213
At most 1	0.2147	At most 1	0.4906	At most 1	0.2148	At most 1	0.5002
At most 2	0.2893	At most 2	0.3889	At most 2	0.2833	At most 2	0.4111
At most 3	0.4183	At most 3	0.7493	At most 3	0.3821	At most 3	0.6977
At most 4	0.0609	At most 4	0.0609	At most 4	0.0623	At most 4	0.0623

Table 33: Trace & Maximum Eigenvalue for both LRESERVE and LFOREX

The p-values of non-hypothesized CE in both Trace and Maximum Eigenvalue tests for the two cases are below the significance level of five percent, indicating the rejection of the null

hypothesis that there is no cointegration. This means that there is one cointegration vector among the independent variables.

To further look for cointegration among the variables, another tests are conducted – Pedroni Residual Cointegration Test and Fisher Panel Cointegration Test. Tables 34 and 35 portray the results of the tests.

			Weighted	
	Statistics	Probability	Statistics	Probability
Panel PP Statistic	-2.578049	0.0050	-5.154166	0.0000
Group PP-Stat	-6.000137	0.0000		
Hypothesized No of CE	Fisher Stat. (Trace)	Probability	Fisher Stat. (Max. Eigen)	Probability
None	243.6	0.0000	144.6	0.0000

Table 34: Pedroni Residual Cointegration Test, with RESERVE as Dependent Variable

			Weighted	
	Statistics	Probability	Statistics	Probability
Panel PP Statistic	-0.953746	0.1701	-3.401658	0.0003
Group PP-Stat	-5.120625	0.0000		
Hypothesized No of CE	Fisher Stat. (Trace)	Probability	Fisher Stat. (Max. Eigen)	Probability
None	232.4	0.0000	136.1	0.0000

Table 35: Johansen Fisher Panel Cointegration, with LFOREX as Dependent Variable

The p-values are in both tests are less than the significance level of 5 percent, meaning that the null hypothesis of no cointegration is rejected. This indicates the presence of cointegration among the variables.

D. Real Growth Model

D1. Relationship between Foreign Exchange Reserves and GDP

In this section, I will look into the relationship between foreign exchange reserve accumulation and growth, as investigated by Polterovich and Popov (2003). First, I will examine the relationship between foreign exchange reserves and GDP. A regression analysis is conducted with GDP being the dependent variable and LFOREX being the independent variable. Provided that oil price is being added to every test conducted in this study, the following regression also includes the price of oil. Table 36 portrays the results.

Variable	Coefficient	Std. Error	t-Statistic	Probability
C	19.41399	0.214514	90.50216	0.0000
LFOREX	0.449041	0.034803	12.90249	0.0000
LOIL	0.359959	0.060774	5.922936	0.0000
Adjusted R-squared	0.953329			
Schwarz Criterion	0.482436			

Table 36: Panel Least Squares with LGDP as Dependent Variable, LFOREX Ind. Var.

The P-values of LFOREX and LOIL are less than the significance level of 5 percent, meaning that forex exchange reserves and oil prices significantly affect GDP. Ceteris paribus, a 1 percent increase in forex reserves raises GDP in GCC countries by 0.449 percent. Additionally, a 1 percent increase in oil price brings GDP up by 0.3599 percent. Another

regression is carried out to see if similar results are obtained when LRESERVES are replaced with LFOREX. Table 36 portrays the results.

Variable	Coefficient	Std. Error	t-Statistics	Probability
C	19.27558	0.218177	88.34825	0.0000
LRESERVE	0.465824	0.035304	13.19481	0.0000
LOIL	0.348675	0.060302	5.782158	0.0000
Adjusted R-squared	0.954573			
Schwarz Criterion	0.455409			

Table 37: Panel Least Squares, with LGDP as Dependent Variable, LRESEVE as Ind. Var.

Similarly, the p-values of LRESERVE and LOIL are less than the significance level of 5 percent, meaning that total reserves (including everything) and oil prices significantly affect the GDP of GCC countries. A 1 percent increase in international reserves raises GDP by 0.4658 percent. Additionally, a 1 percent rise in oil prices surges GDP by 0.3486 percent. The results are very close to the case when LFOREX was used.

Now I will test whether there is cointegration among the variables considered in the Real Growth and Intervention Model (GDP). In this model, GDP is the dependent variable, and foreign exchange reserves and oil prices are the independent variables. We have two cases, in the first FOREX is the dependent variable, while in the second, RESERVE is the independent variable. Table 38 portrays results of Johansen Cointegration test for both cases.

Dep. Var. / Indep Variable	LGDP	LGDP	Dep Var. / Indep. Var.
LRESERVE	0.737592* 0.51246** 1.43933***	0.755144* 0.53707** 1.40605***	**LFOREX**
LOIL	-4.108221* 1.30928** -3.13778***	-4.347816* 1.38003** -3.15053***	**LOIL**

Table 38: Johansen Cointegration, GDP is Dep. Var; LFOREX and LRESERVE are Indep. Var.

: Coefficient; **: Standard Error; *: t-Statistic*

The t-statistics values of LFOREX and LRESERVE are higher than the significance level of 2 percent, meaning that both RESERVE and FOREX are insignificant. After comparing the first and second lag of the Schwarz Criterion, Trace and Maximum Eigenvalue tests are carried out. The results of the test are shown in Table 39.

LGDP				**LGDP**			
Trace		**Maximum Eigenvalue**		**Trace**		**Maximum Eigenvalue**	
Hypoth. No of CE	**Prob.**	**Hypoth. No of CEs**	**Prob.**	**Hypoth. No of CE**	**Prob.**	**Hypth. No of CE**	**Prob**
None*	0.1333	None*	0.3042	None*	0.1232	None*	0.3062
At most 1	0.2076	At most 1	0.2949	At most 1	0.1863	At most 1	0.2704
At most 2	0.1409	At most 2	0.1409	At most 2	0.1347	At most 2	0.1347

Table 39: Trace and Maximum Eigen Value Tests. In the case on the left, LRESEVE is the independent variable, while in the case on the right, LFOREX is the independent variable.

The p-values appearing in both Trace and Maximum Eigenvalue tests in both cases are higher than the significance level of 5 percent, meaning that the null hypotheses for no cointegration fails to be rejected. This implies that there is no cointegration among the variables in the Real Growth and Integration Model (GDP). Since the results indicate that there is no cointegration among the independent variables, we take the first difference

using Panel Least Squares for both RESERVE and FOREX. The results are portrayed in tables 40 through 43.

Variable	Coefficient	Std. Error	t-Statistics	Probability
C	0.079286	0.015630	5.072657	0.0000
D(LRESERVE)	0.080270	0.053711	1.494482	0.1380
D(LOIL)	0.016615	0.036480	0.455451	0.6497
Cross-section fixed (dummy variables)				
Adjusted R-squared	0.003367			
Schwarz criterion	-0.734980			

Table 40: LRESERVE is the independent variable; with cross-section fixed (dummy Variables)

Variable	Coefficient	Std. Error	t-Statistics	Probability
C	0.078087	0.015477	5.045328	0.0000
D(LRESERVE)	0.089043	0.052512	1.695663	0.0928
D(LOIL)	0.014771	0.036195	0.408100	0.6840
Adjusted R-squared	0.015838			
Schwarz criterion	-0.909210			

Table 41: LRESERVE is the independent variable; no cross-section fixed (dummy variables)

Variable	Coefficient	Std. Error	t-Statistics	Probability
C	0.077226	0.015414	5.010074	0.0000
DL(FOREX)	0.093826	0.050577	1.855839	0.0663
D(LOIL)	0.013579	0.036126	0.375880	0.7078
Cross-section fixed (dummy variables)				
Adjusted R-squared	0.014391			
Schwarz criterion	-0.746104			

Table 42: LFOREX is the independent variable; with cross-section fixed (dummy Variables

Variable	Coefficient	Std. Error	t-Statistics	Probability
C	0.076148	0.015263	4.989124	0.0000
D(LFOREX)	0.101628	0.049452	2.055080	0.0422
D(LOIL)	0.011933	0.035839	0.332952	0.7398
Adjusted R-squared	0.027353			
Schwarz criterion	-0.920979			

Table 43: LFOREX is the independent variable; no cross-section fixed (dummy variables)

The P-values in both cases are higher than the significance level of 5 percent. This implies that there is neither a long-run relationship nor a short-run relationship between oil price and GDP. Additionally, the p-values of the first difference of LRESERVE in both cases are higher than the significance level of 5 percent, implying that there is neither a long-run nor a short-run relationship between international reserves and GDP.

To further investigate whether there is cointegration among the variables, other types of cointegration tests are conducted: Pedroni Residual Cointegration Test and Johansen Fisher Panel Cointegration Test. Tables 44 and 45 portray the results.

			Weighted	
	Statistics	Probability	Statistics	Probability
Panel PP Statistic	-4.778671	0.0000	-4.941852	0.0000
Group PP-Stat	-5.318918	0.0000		
Hypothesized No of CE	Fisher Stat. (Trace)	Probability	Fisher Stat. (Max. Eigen)	Probability
None	28.33	0.0049	22.34	0.0339

Table 44: Fisher Panel Cointegration Test, with LRESERVE as Independent Variable, GDP as Dep. Var.

			Weighted	
	Statistics	Probability	Statistics	Probability
Panel PP Statistic	-4.736213	0.0000	-4.930779	0.0000
Group PP-Stat	-5.339231	0.0000		
Hypothesized No of CE	Fisher Stat. (Trace)	Probability	Fisher Stat. (Max. Eigen)	Probability
None	28.50	0.0047	21.89	0.0387

Table 45: Pedroni Residual Cointegration, with LFOREX as Independent Variable, GDP as Dep. Variable

D2. Relationship between Forex Reserves and Per Capita GDP

Next, I will look into the relationship between foreign exchange reserve and per capita GDP. A regression analysis is conducted with GDP per Capita being the dependent variable and foreign exchange reserves being the independent variable. Oil price variable is also included in the test. Table 46 shows the results.

Variable	Coefficient	Std. Error	t-Statistic	Probability
C	6.926018	0.135686	51.04436	0.0000
LFOREX	0.246504	0.022014	11.19777	0.0000
LOIL	0.214966	0.038441	5.592087	0.0000
Adjusted R-squared	0.932060			
Schwarz Criterion	-0.433625			

Table 46: Panel Least Squares with YCAP as Dependent Variable, LFOREX as Ind. Var.

The p-values of LFOREX and LOIl are less than the significance level of 5 percent, which means that foreign exchange reserves and oil price significantly affect GDP per capita. Ceteris paribus, a 1 percent increase in foreign exchange reserves raises GDP per capita by

0.2465 percent. Furthermore, a 1 percent increase in oil prices raises GDP per capita by 0.2149 percent. Another regression analysis is carried out to test whether similar results are obtained when RESERVE is replaced with FOREX. The results are portrayed in Table 47.

Variable	Coefficient	Std. Error	t-Statistic	Probability
C	6.863229	0.140304	48.91680	0.0000
LRESERVE	0.252767	0.022703	11.13374	0.0000
LOIL	0.212593	0.038779	5.482228	0.0000
Adjusted R-squared	0.931649			
Schwarz Criterion	-0.427583			

Table 47: Panel Least Squares with YCAP as Dependent Variable, LRESERVE as Indep. Var.

Similarly, the p-values of LRESEVE and LOIL are less than the significance of 5 percent level, meaning that international reserves and oil prices significantly affect growth. A 1 percent increase in total international reserves increases GDP per capita by 0.2527 percent. Additionally, a 1 percent increase in oil prices surges GDP per capita by 0.2125 percent. The results are very similar to those yielded when LFOREX was used.

Now I will test for cointegration among variables considered in the Real Growth and Intervention Model (GDP per Capita). In this model, The GDP per Capita is the dependent variable, while the independent variables are foreign exchange reserves and oil prices. Like in every model, two cases are considered, one with forex exchange reserves and one with international reserves. In this model, RESEREVE is the independent variable in the first case, while FOREX is the independent variable in the second case. Table 48 shows results of the Vector Error Correction Estimates for both cases.

Dep. Var. / Indep Variable	LYCAP	LYCAP	Dep Var. / Indep. Var.
LRESERVE	-0.586557* 2.51520** -0.23321***	-0.596555* 2.64029** -0.22594***	**LFOREX**
LOIL	-19.68999* 6.34941** -3.10107***	-20.67767* 6.70384** -3.08445**	**LOIL**

Table 48: Johansen Cointegration Test, the left side of the table shows results of the case when LRESERVE is independent variable, while the right side of the table shows the case when LFOREX is the independent variable

: Coefficient; **: Standard Error; *: t-Statistic*

The values of the t-statistics of LRESERVE, LOIL, and LFOREX are higher than the significance level of 2 percent, meaning that the null hypothesis for no cointegration fails to be rejected. After comparing the first and second lag of the Schwarz Criterion, Trace and Maximum Eigenvalue tests are carried out. The results of the test are shown in Table 49.

LYCAP				**LYCAP**			
Trace		**Maximum Eigenvalue**		**Trace**		**Maximum Eigenvalue**	
Hypoth. No of CE	**Prob.**	**Hypoth. No of CEs**	**Prob.**	**Hypoth. No of CE**	**Prob.**	**Hypth. No of CE**	**Prob**
None*	0.5806	None*	0.2331	None*	0.5796	None*	0.2357
At most 1	0.9957	At most 1	0.9931	At most 1	0.9950	At most 1	0.9925
At most 2	0.8126	At most 2	0.8126	At most 2	0.7698	At most 2	0.7698

Table 49: Trace and Maximum Eigenvalue tests. Results on the left side portray the case when LRESERVE is the independent variable, while the results on the right side reflect the case when LFOREX is the independent variable.

The p-values of both Trace and Maximum Eigenvalue tests in both cases are higher than the significance level of 5 percent, meaning that the null hypotheses of no cointegration fails o be rejected. Now I take the first difference of the variables using Panel Least Square method

to look into the existence of long run and short run relationships among the variable. The results are portrayed in tables 50 through 53.

Variable	Coefficient	Std. Error	t-Statistics	Probability
C	0.030504	0.015284	1.995769	0.0485
D(LRESERVE)	0.075207	0.052522	1.431904	0.1551
D(LOIL)	0.005425	0.035673	0.152089	0.8794
Cross-section fixed (dummy variables)				
Adjusted R-squared	-0.022405			
Schwarz criterion	-0.779737			

Table 50: LRESERVE is the Independent Variable; with Cross-section fixed (dummy variables)

Variable	Coefficient	Std. Error	t-Statistics	Probability
C	0.029634	0.014998	1.975907	0.0506
D(LRESERVE)	0.081566	0.050887	1.602891	0.1118
D(LOIL)	0.004089	0.035075	0.116586	0.9074
Adjusted R-squared	0.008537			
Schwarz criterion	-0.972105			

Table 51: LRESERVE is the independent variable; without cross-section fixed (dummy variables

Variable	Coefficient	Std. Error	t-Statistics	Probability
C	0.028322	0.015071	1.879286	0.0630
D(LFOREX)	0.089757	0.049449	1.815136	0.0723
D(LOIL)	0.002196	0.035321	0.062181	0.9505
Cross-section fixed (dummy variables)				
Adjusted R-squared	-0.010764			
Schwarz criterion	-0.791187			

Table 52: LFOREX is the Independent Variable; with Cross-section fixed (dummy variables)

Variable	Coefficient	Std. Error	t-Statistics	Probability
C	0.027564	0.014788	1.863907	0.0650
D(LFOREX)	0.095221	0.047914	1.987340	0.0493
D(LOIL)	0.001038	0.034274	0.029888	0.9762
Adjusted R-squared	0.020442			
Schwarz criterion	-0.984185			

Table 53: LFOREX is the independent variable; without cross-section fixed (dummy variables

Looking at the results portrayed in the four tables above, the p-values of the first difference of LOIL is higher than the significance level of 5 percent, meaning that there is neither a long-run relationship nor a short-run one between oil price and GDP per Capita. Additionally, the p-values of first difference of RESERVE is higher than the significance level of 5 percent, meaning that that there is no relationship between international reserves and GDP per capita neither on the long run nor on the short run. Additionally, the p-values of the first difference of LFOREX are higher than the significance level of 5 percent, which indicates the lack of long and short-run relationships between foreign exchange reserves and per capita GDP.

To further investigate the presence of cointegration among the variables, Johansen Fisher Panel Cointegration and Pedroni Residual Cointegration tests are carried out. Tables 54 and 55 portray the results of the tests.

			Weighted	
	Statistics	Probability	Statistics	Probability
Panel PP Statistic	-5.561675	0.0000	-5.154207	0.0000
Group PP-Stat	-5.421652	0.0000		
Hypothesized No of CE	Fisher Stat. (Trace)	Probability	Fisher Stat. (Max. Eigen)	Probability
None	24.39	0.0180	18.01	0.1154

Table 54: Johansen Fisher Panel Cointegration Test, with FOREX as Independent Variable, YCAP as Dep. Var.

			Weighted	
	Statistics	Probability	Statistics	Probability
Panel PP Statistic	-5.676617	0.0000	-5.049149	0.0000
Group PP-Stat	-5.400594	0.0000		
Hypothesized No of CE	Fisher Stat. (Trace)	Probability	Fisher Stat. (Max. Eigen)	Probability
None	25.27	0.0136	18.26	0.1080

Table 55: Pedroni Residual Cointegration, with LRESERVE as Independent Variable, YCAP as Dep. Variable

The p-values are less than the significance level of 5-percent, which means that the null of no cointegration fails to be rejected.

E. Relationship between Foreign Exchange Reserves and Money Creation (Money Supply)

Finally, I will investigate the relationship between foreign exchange reserve accumulation and money supply. This model has been derived from Azar (2014). In his study, Azar (2014) found that there is a significant relationship between foreign exchange reserve accumulation and money supply in Lebanon, so this section examines whether the case is the same in the six GCC countries. A regression analysis is conducted with broad money supply being the dependent variable and foreign exchange reserves being the independent variable. Two regression analyses are conducted with the first considering value of foreign exchange reserves and the second considering total reserves including everything (international reserves). Like in every model implemented in this study, the independent variable 'oil price' is included in the regression analyses. The results of the first regression are shown in Table 56.

Variable	Coefficient	Std. Error	t-Statistic	Probability
C	3.393467	0.139600	24.30858	0.0000
LFOREX	0.097228	0.022649	4.292881	0.0000
LOIL	-0.077505	0.039550	-1.959691	0.0525
Adjusted R-squared	0.647563			
Schwarz Criterion	-0.376759			

Table 56: Panel Least Squares with Broad Money Supply as Dep. Var. and LFOREX as Ind. Var.

The P-value of LFOREX is less than the significance level of 5 percent, meaning that foreign exchange reserve accumulation significantly affects broad money supply. However, the P-value of LOIL is slightly higher than the significance level of 5 percent, meaning that oil price

insignificantly affects broad money supply. Another regression analysis is carried out, but this time LFOREX is replaced with LRESERVE. Table 57 portrays the results.

Variable	Coefficient	Std. Error	t-Statistic	Probability
C	3.348869	0.142905	23.43430	0.0000
LRESERVE	0.104133	0.023124	4.503334	0.0000
LOIL	-0.084186	0.039497	-2.131442	0.0352
Adjusted R-squared	0.652495			
Schwarz Criterion	-0.390852			

Table 57: Panel Least Squares with Broad Money Supply as Dep Var and LRESERVE as Independent Variable.

The p-values of LRESERVE and LOIL are lower than the significance level of 5 percent, implying that international reserves and oil price significantly affect broad money supply, but with the variable oil price being marginally significant (0.0352). The results are very similar to those yielded when LFOREX was considered.

Finally, I will test whether there is cointegration among the variables considered in the Relationship to Money Creation with Money Supply model. In this model, Broad Money to GDP is the dependent variable, and oil prices and reserves are the independent variables. Similar to other models considered in this study, there are two cases. In the first case RESERVE is the independent variable, while in the second, FOREX is the independent variable. First I conduct Vector Error Correction Estimates. Table 58 portrays the results of the Johansen Cointegration test for the two cases (RESERVE and FOREX).

Dep. Var. / Indep Variable	LMONEY	LMONEY	Dep Var. / Indep. Var.
LRESERVE	0.015520* 0.10247** 0.15146***	0.017649* 0.10260** 0.17201***	**LFOREX**
LOIL	0.907982* 0.25698** 3.53329***	0.903907* 0.25873** 3.49360***	**LOIL**

Table 58: Johansen Cointegration, the left side portrays results when LRESERVE is independent variable; the right side portrays results when LFOREX is the independent variable

The values of the t-statistics in Table 58 are higher than the significance level of 2 percent. After comparing the first and second lag of the Schwarz Criterion, Trace and Maximum Eigenvalue tests are carried out. The results of the tests for both cases (RESERVE and FOREX) are reported in Table 59.

LMONEY				**LMONEY**			
Trace		**Maximum Eigenvalue**		**Trace**		**Maximum Eigenvalue**	
Hypoth. No of CE	**Prob.**	**Hypoth. No of CEs**	**Prob.**	**Hypoth. No of CE**	**Prob.**	**Hypth. No of CE**	**Prob**
None*	0.0733	None*	0.0693	None*	0.0718	None*	0.0703
At most 1	0.4419	At most 1	0.3695	At most 1	0.4287	At most 1	0.3622
At most 2	0.7166	At most 2	0.7166	At most 2	0.6662	At most 2	0.6662

Table 59: Trace and Maximum Eigenvalue tests. Results on the left side show the case when LRESERVE is the independent variable, while the results on the right side reflect the case when LFOREX is the independent variable.

The p-values of both the Trace and the Maximum Eigenvalue tests in both cases (RESERVE and FOREX) are higher than the significance level of 5 percent, meaning that the null hypotheses for no cointegration are accepted. This implies that there is no cointegration among the variables. To test for long-run and short-run relationships among the variables,

the first difference of the log of the variables is conducted through Panel Least Squares method. Tables 60 through 63 portray the results of the tests.

Variable	Coefficient	Std. Error	t-Statistics	Probability
C	0.026769	0.014530	1.842263	0.0682
D(LRESERVE)	0.005318	0.049932	0.106500	0.9154
D(LOIL)	-0.015525	0.033914	-0.457781	0.6480
Cross-section fixed (dummy variables)				
Adjusted R-squared	-0.051482			
Schwarz criterion	-0.880873			

Table 60: LRESERVE is the Independent Variable; with Cross-section fixed (dummy variables)

Variable	Coefficient	Std. Error	t-Statistics	Probability
C	0.026727	0.014233	1.877885	0.0630
D(LRESERVE)	0.005622	0.048291	0.116418	0.9075
D(LOIL)	-0.015589	0.033285	-0.468340	0.6405
Adjusted R-squared	-0.016003			
Schwarz criterion	-1.076835			

Table 61: LRESERVE is the independent variable; without cross-section fixed (dummy variables

Variable	Coefficient	Std. Error	t-Statistics	Probability
C	0.029357	0.014405	2.037936	0.0440
D(LFOREX)	-0.013403	0.047265	-0.283565	0.7773
D(LOIL)	-0.011566	0.033761	-0.342581	0.7326
Cross-section fixed (dummy variables)				
Adjusted R-squared	-0.050798			
Schwarz criterion	-0.881525			

Table 62: LFOREX is the Independent Variable; with Cross-section fixed (dummy variables)

Variable	Coefficient	Std. Error	t-Statistics	Probability
C	0.029237	0.014115	2.071400	0.0406
D(LFOREX)	-0.012542	0.045732	-0.274256	0.7844
D(LOIL)	-0.011748	0.033143	-0.354480	0.7237
Adjusted R-squared	-0.015439			
Schwarz criterion	-1.077390			

Table 63: LFOREX is the independent variable; without cross-section fixed (dummy variables

Looking at the results shown in the tables above, the p-values of the first difference of LFOREX and LOIL are higher than the significance level of 5 percent. This implies that there is neither a long-run relationship nor a short-run one between reserves (both international and foreign exchange) and broad money to GDP. The results also point to a lack of long-run and short-run relationships between oil prices and broad money to GDP.

To further look into the presence of cointegration among the variables, Johansen Fisher Panel Cointegration and Pedroni Residual Cointegration tests are conducted. Tables 64 and 65 portray the results of the tests.

			Weighted	
	Statistics	Probability	Statistics	Probability
Panel PP Statistic	-6.344688	0.0000	-5.889611	0.0000
Group PP-Stat	-7.208514	0.0000		
Hypothesized No of CE	Fisher Stat. (Trace)	Probability	Fisher Stat. (Max. Eigen)	Probability
None	31.92	0.0014	35.96	0.0003

Table 64: Johansen Fisher Panel Cointegration Test, with LRESERVE as Independent Variable, MONEY as Dep. Var.

			Weighted	
	Statistics	Probability	Statistics	Probability
Panel PP Statistic	-6.134943	0.0000	-5.774885	0.0000
Group PP-Stat	-7.036967	0.0000		
Hypothesized No of CE	Fisher Stat. (Trace)	Probability	Fisher Stat. (Max. Eigen)	Probability
None	31.28	0.0018	35.51	0.0004

Table 65: Pedroni Residual Cointegration, with LFOREX as Independent Variable, MONEY as Dep. Variable

The p-values are less than the significance level of 5 percent, meaning that the null hypothesis for no cointegration fails to be rejected. This implies that there is no cointegration among the variables in this model.

VI. Interpretation

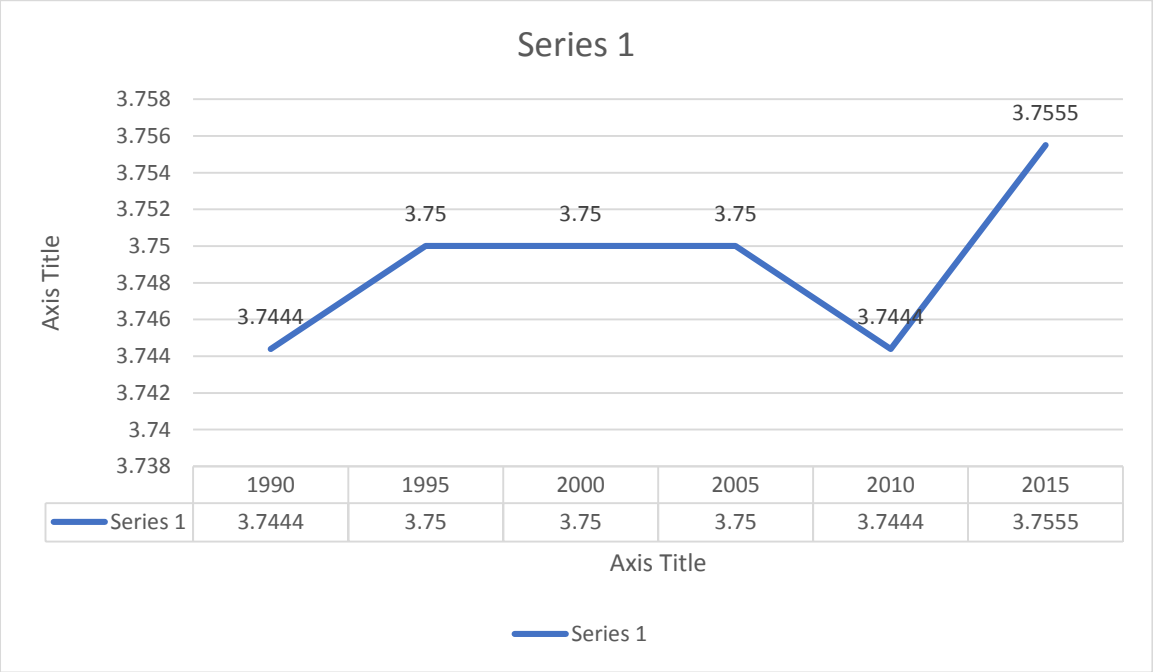
A. Intervention Model

Central banks of countries whose currencies are pegged stockpile foreign exchange reserves to keep their exchange rate stable. When the real effective exchange rate appreciates, central banks tend to hold larger amounts of foreign exchange reserves. Currencies in Gulf countries are pegged to the US Dollar, as mentioned earlier, with the Kuwaiti Dinar being pegged to a basket of international currencies. When GCC countries stockpile US Dollar, its value is raised compared to each GCC currency. This will make Gulf exports cheaper than American goods, therefore, giving sales of GCC goods a boost. The Intervention Model

considered in this study shows that a rise in real effective exchange rate prompts GCC countries to hold higher reserves. When exchange rate volatility is high, central banks intervene by selling some of its foreign currency in a bid to reduce foreign exchange rate volatility. This explains the negative relationship between foreign exchange reserves and the square log of the real effective exchange rate shown in the regression analysis. Regarding the price of oil, which is also considered in the model, the analysis shows a positive relationship between the accumulation of foreign exchange reserves and the price of oil in GCC countries. The results are almost the same in the case of international reserves. The six GCC countries are major oil-exporting countries, where crude oil is the main export good. Therefore, the positive relationship between forex reserves and crude oil prices can be attributed to the rise in petrodollar, or revenues generated from the sales of crude oil, which is traded internationally in US Dollar, when oil prices are high. The graph depicting the annual variation of the natural logarithm of the foreign exchange reserves in GCC countries shows that GCC countries have been liquidating their foreign exchange reserves following the recent drop in oil prices, which started to take place in 2013. This is in line with the finding of the Intervention Model regarding the relationship between oil prices and foreign reserves accumulation. The graph shows that Saudi Arabia, the world's largest oil-exporting country and the largest GCC country in terms foreign exchange reserves, has lost more than 100,000 million USD of foreign exchange reserves since oil prices started to heavily fall in mid-2013.

However, the results of the regression analysis show that the nominal effective exchange rate insignificantly affect foreign exchange or international reserves in GCC countries. The finding is not surprising. As I mentioned earlier, GCC countries implement a fixed exchange rate system, with the local currency in each GCC country being pegged to the US Dollar,

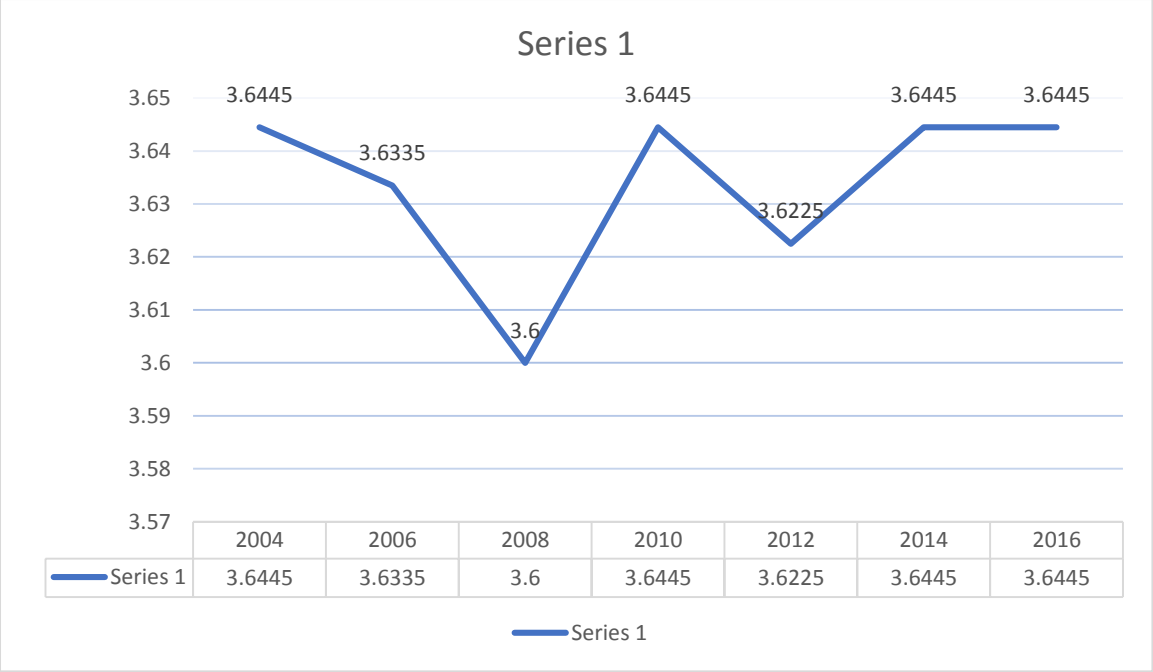
except for the Kuwaiti Dinar, which is pegged to a basket of international currencies. This implies that that there is a slight variability in the nominal effective exchange rate in each country, despite the fact that real effective exchange rates are more volatile. When a variable slightly varies, it exhibits little explanatory power, hence the nominal effective exchange rate in GCC countries appears to be less sensitive to foreign exchange or international reserves.



Graph 3: Saudi Riyal vis-à-vis US Dollar 1990 – 2016

Source: Trading Economics

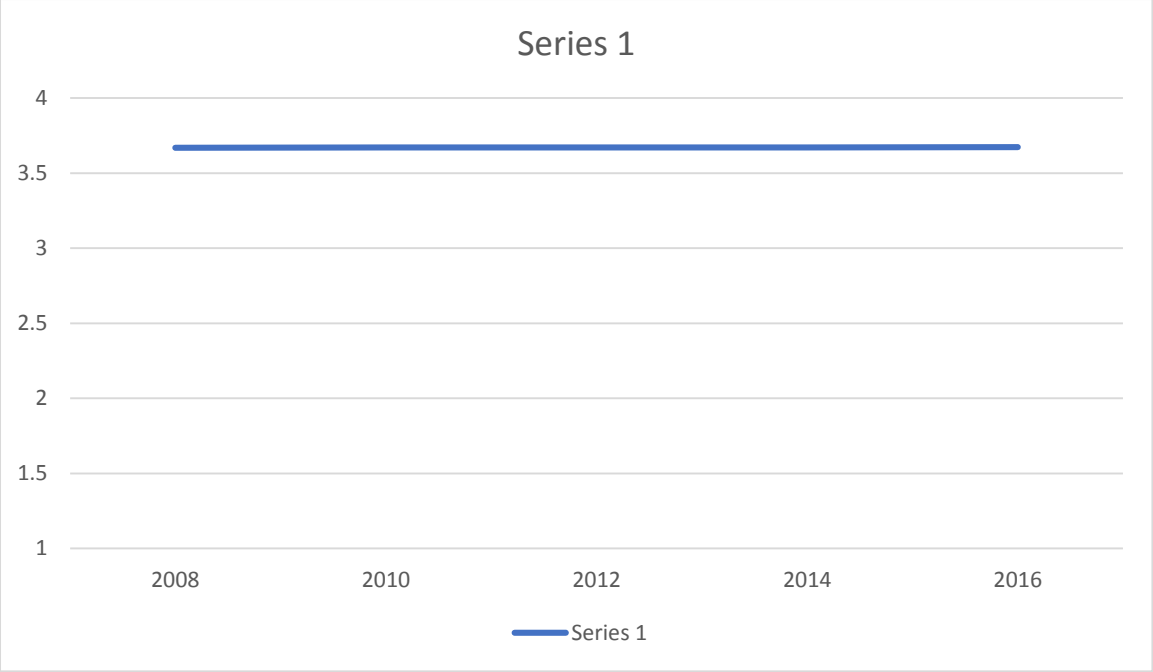
The above graph shows that fluctuation of the Saudi Riyal vis-à-vis the US Dollar. The graph shows that the value of 1 US Dollar has been slightly fluctuating around 3.75 Saudi Riyals, meaning that the local currency in Saudi Arabia is quasi-stable.



Graph 4: USD vis-à-vis Qatari Riyal 2004 – 2017

(Source: Trading Economics)

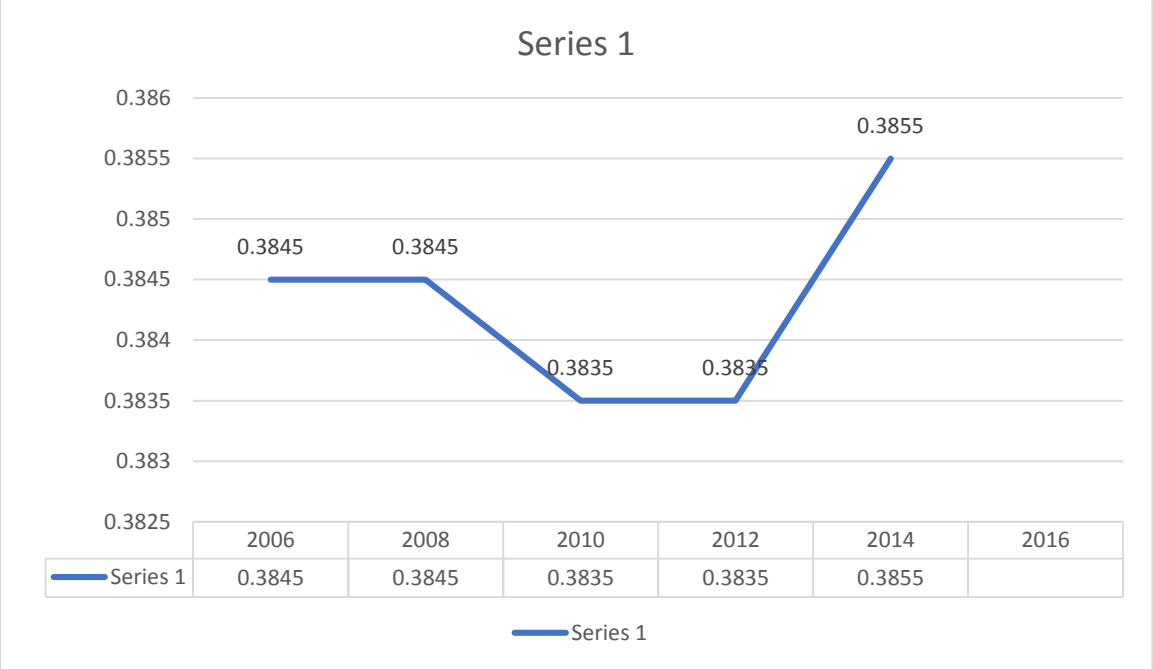
The graph above shows the evolution of the USD vis-à-vis Qatari Riyal. The value of 1 US Dollar fluctuates around 3.6 Qatari Riyal.



Graph 5: USD vis-à-vis Emirati Dirham 2008 – 2017

Source: Trading Economics

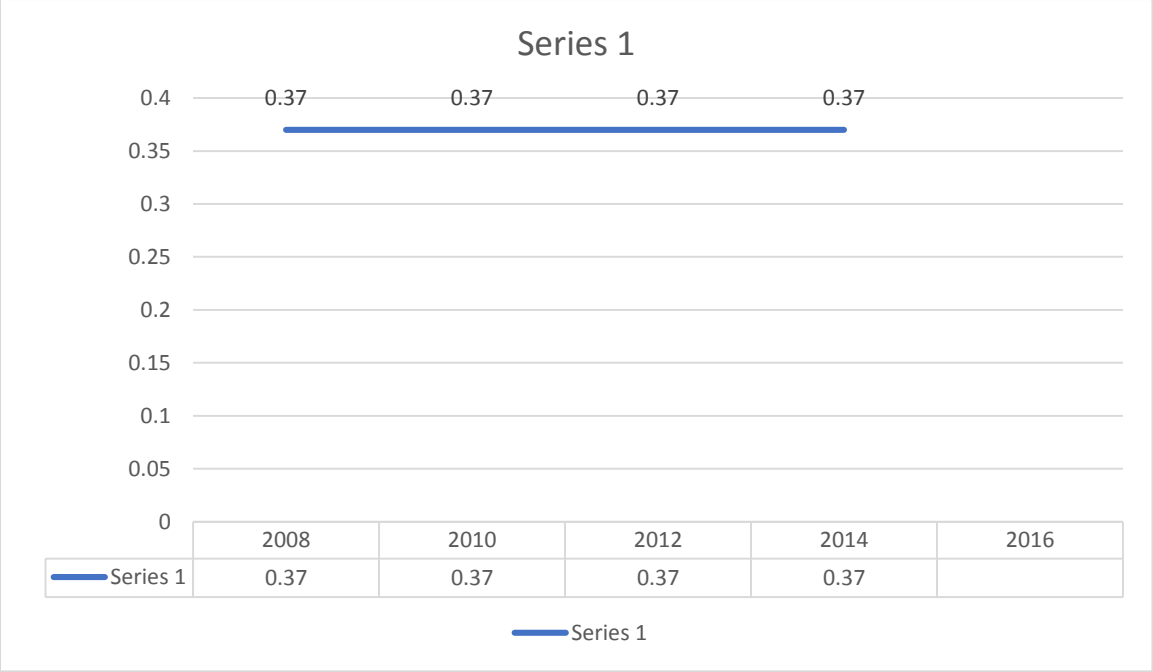
The graph above shows the evolution of the Emirati Dirham over the past 10 years. The value of 1 US Dollar slightly fluctuates around 3.67 Emirati Dirhams.



Graph 6: USD vis-à-vis Omani Rial

Source: Trading Economics

The graph above shows the evolution of the Omani Rial over the past 10 years. The value of 1 US Dollar slightly fluctuates around 0.38 Omani Rial.



Graph 7:USD vis-à-vis Bahraini Dinar 2006-2016

Source: Trading Economics

The graph above shows the evolution of the Bahraini Dinar over the past 10 years. The value of 1 US Dollar was sharply stable at 0.37 Bahraini Dinar until 2016, before it slightly rose to slightly above 0.376 Dinar.

B. Asset Choice Model

The country's exporters deposit foreign currencies into their local banks who then transfer them to the central bank. Exporters are paid by their trading partners in US Dollar, Euro, or other currencies. The exporters exchange them for the local currency they can use to pay their workers and local suppliers. GCC countries are the world's largest countries in terms of oil reserves, bearing in mind that Gulf countries have estimated net oil exports of 18.2 million barrel per day of oil as of 2016, meaning that most of the world's oil reserves are concentrated in the Arabian Gulf region. However, GCC economies do not only rely on crude

oil exports. According to the IMF, Saudi Arabia exports, in addition to crude oil and other oil derivatives, plastics (7 percent of exports), organic chemicals (3.7 percent of exports), ships and boats (1.1 percent of exports), aluminum (0.9 percent of exports), machinery (0.8 percent of exports), dairy and eggs (0.6 percent of exports), vehicles (0.5 percent of exports), and precious metals (0.5 percent of exports). In addition to refined oil and petroleum products, Kuwait exports fertilizers, while Bahrain Exports aluminum and textile. Meanwhile, in the UAE, natural gas accounts for 40 percent of the country's exports. Additionally, Qatar's exports include, in addition to petroleum products, liquified natural gas, steel, and fertilizers, whereas Oman's exports include fish, textile, and metals. Since international export transactions are carried out in international currencies, mainly US Dollar and Euro, exports, which raise countries' GDP, bring in foreign currencies into central banks. This explains the positive relationship between GDP and foreign exchange reserves found in the Asset-Choice model, which notes that a 1 percent increase in GDP will raise forex reserves by slightly more than 1 percent. The results are almost the same in the case of international reserves, whereby a 1 percent increase in GDP raises international reserves by slightly more than 1 percent.

Furthermore, the Asset-Choice model yields another finding, which points to a negative relationship between foreign exchange reserves and call money rate. According to the regression analysis' results, a 1 percent increase in call money rate will lower foreign exchange reserves by 0.16 percent. The results are exactly the same in the case of international reserves. Call money rate is the interest rate imposed on a type of short-term loan that banks give to brokers who in turn lend the money in domestic currency to investors to fund margin accounts, brokerage accounts in which the broker lends the customer cash to purchase securities. Since foreign exchange reserves and international

reserves are denominated in foreign exchange, higher call money rates discourage the accumulation of foreign exchange reserves and international reserves. This explains the negative relationship between foreign exchange reserves or international reserves and call money rate. In this case, call money rate exhibits the opportunity cost of holding foreign exchange or international reserves.

Meanwhile the interest rate on US Dollar appears to insignificantly affect foreign exchange reserve or international reserve accumulation in GCC countries. The interest rate differential (IRD) is a differential measuring the gap in interest rates between two similar interest-bearing assets. Prabheesh et. al. (2007) used in their study on the demand for foreign exchange reserves in India the IRD as an independent variable that determines the opportunity cost of holding reserves. Prabheesh et al (2007) found that IRD, which is equal to [(1+ Indian Call money rate) / (1+ US Fed rate)], is less sensitive to the demand for foreign exchange reserves in India, which means that the interest rate on US Dollar is also less sensitive to the demand for foreign exchange reserves in India. They implied that the accumulation of reserves by the Indian central bank is less sensitive to the return of holding the reserves. Regarding GCC countries, the results imply that the accumulation of foreign exchange or international reserves by central banks of GCC countries is less sensitive to the return of holding reserves. This can be ascribed to the fact that interest rates in GCC countries are mainly determined outside the system.

C. Current and Capital Account Vulnerability Model

When this model is considered, it appears that foreign exchange reserves in GCC countries are sensitive to multiple independent variables. The model shows that a one percent increase in debt-to-GDP ratio lowers foreign exchange reserves by 1.5 percent. In the case of international reserves, a one percent increase in debt-to-GDP ratio lowers international reserves by around 0.5 percent. A high debt-to-GDP ratio may make it more difficult for a country to pay external debts, and may lead creditors to seek higher interest rates when lending. Debt is usually accumulated in US Dollar, so when the debt-to-GDP ratio rises, creditors will freak out because more debt is being incurred, which implies that more foreign money will be fly out when debt is to be paid off. This, in turn, will lead to less foreign exchange or international reserve accumulation. This explains the negative relationship between debt-to-GDP ratio and foreign exchange or international reserves.

Like the Asset-Choice Model, the Current and Capital Account Vulnerability also points to a positive relationship between foreign exchange reserves and GDP in GCC countries. A one percent increase in GDP leads to a one percent rise in foreign exchange reserves in these countries, whose GDPs heavily rely on the export of petroleum products. The results are the same when international reserves are considered. The sales of petroleum products in Saudi Arabia contribute to 55 percent of the kingdom's GDP. In Kuwait, the sales of refined oil products account for 60.5 percent of the country's GDP, while in Bahrain industry accounts for 40.7 percent of the country's GDP. In the remaining three GCC countries, industry accounts for 58.8 percent of Qatar's GDP, 65.1 percent of Oman's GDP, and 56.1 percent of the UAE's GDP. Industry in GCC countries help exporters contribute to higher foreign money

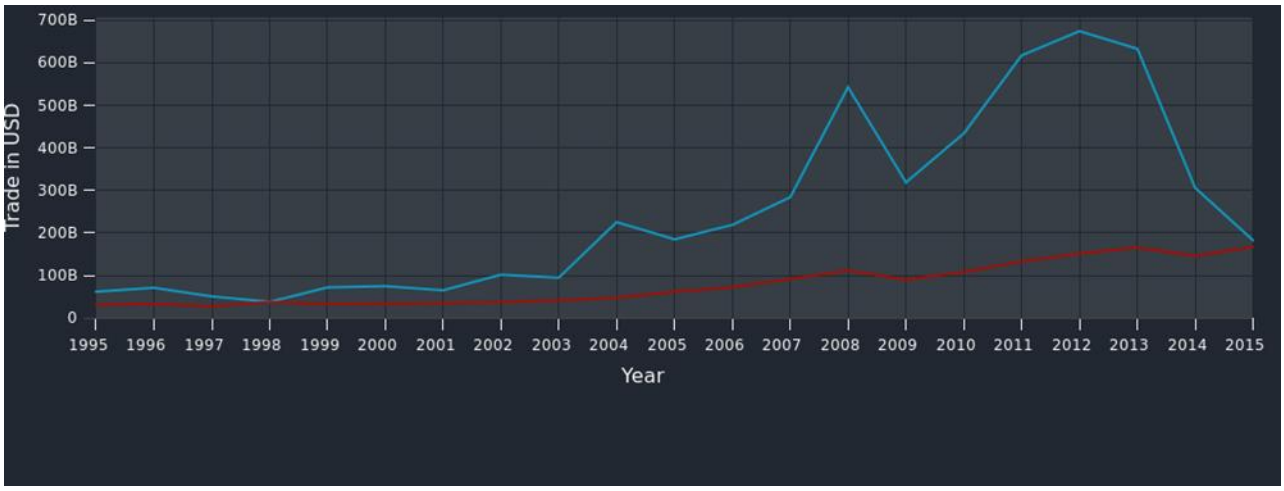
inflow by exporting goods and commodities to the world, and therefore to higher foreign exchange reserves.

Additionally, the model exhibits a positive relationship between broad money to GDP and foreign exchange reserves in GCC countries. This could be associated with higher capital account vulnerability and this may lead to a rise in reserve holdings. The impact of ratio of broad money to GDP exhibits a higher influence on reserve movements.

Finally, the model exhibits a positive relationship between current account to GDP and foreign exchange reserves in GCC countries. However, the effect is little, as a one percent increase in current account to GDP raises foreign exchange reserves by 0.0095 percent. The results are exactly the same when international reserves are considered. The Current account balance as a percent of GDP provides an indication on the level of international competitiveness of a country. As the current account balance to GDP rises, it means that an economy tends to depend more on export revenues, which leads to a higher inflow of foreign money. This leads to a higher foreign exchange reserve stockpiles. This explains the positive relationship between foreign exchange reserves and current account to GDP in GCC countries.

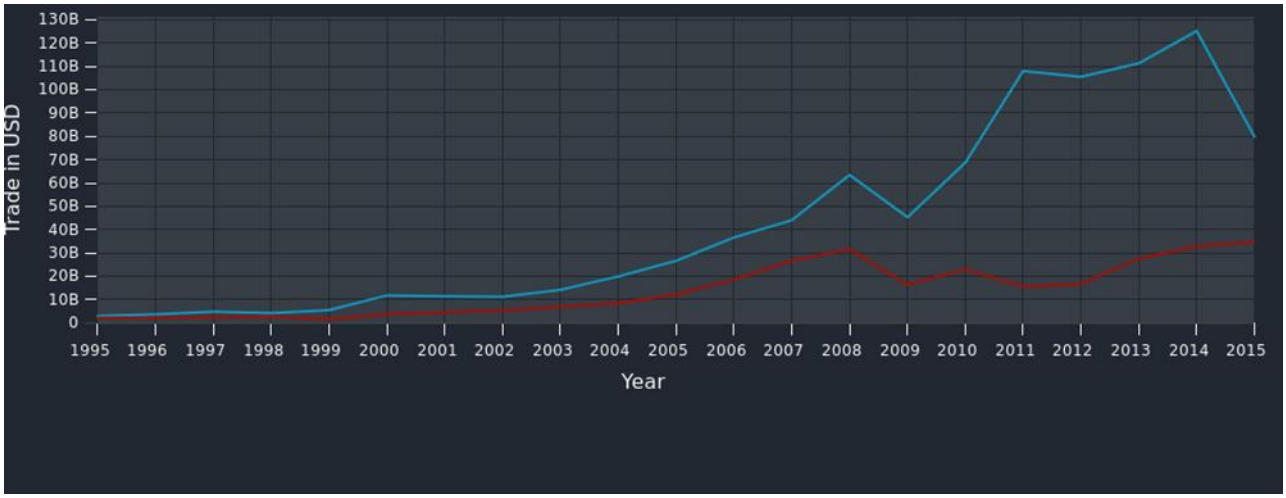
Meanwhile, imports-to-GDP ratio appears to insignificantly affect foreign exchange or international reserves accumulation in GCC countries. This can be attributed to the fact that the volume of exports in GCC countries has been higher than the volume of imports in the past two decades, or specifically over the period from which the data have been retrieved. As of 2015 Saudi Arabia had a positive trade balance of USD15.6B in net exports, compared to their trade balance in 1995 of USD30.5B in net exports. As a result, central banks in these

countries have been accumulating foreign money at an average higher than the amount of foreign money being paid for imports.



Graph 8: Imports Vs Exports in Saudi Arabia 1995 – 2015

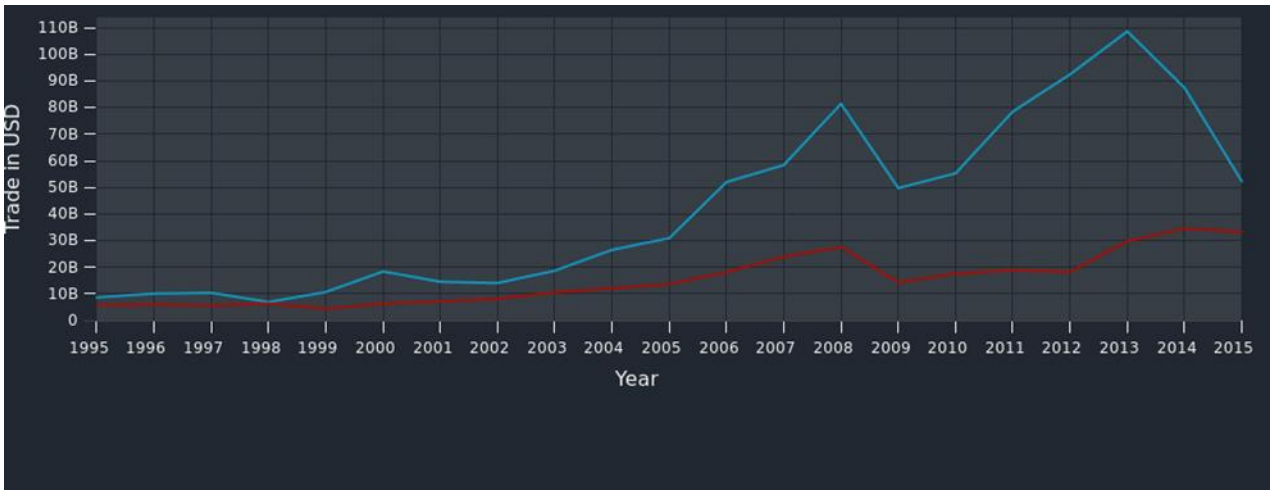
Source: Atlas Media



Graph 9: Imports Vs Exports in Qatar 1995 – 2015

Source: Atlas Media

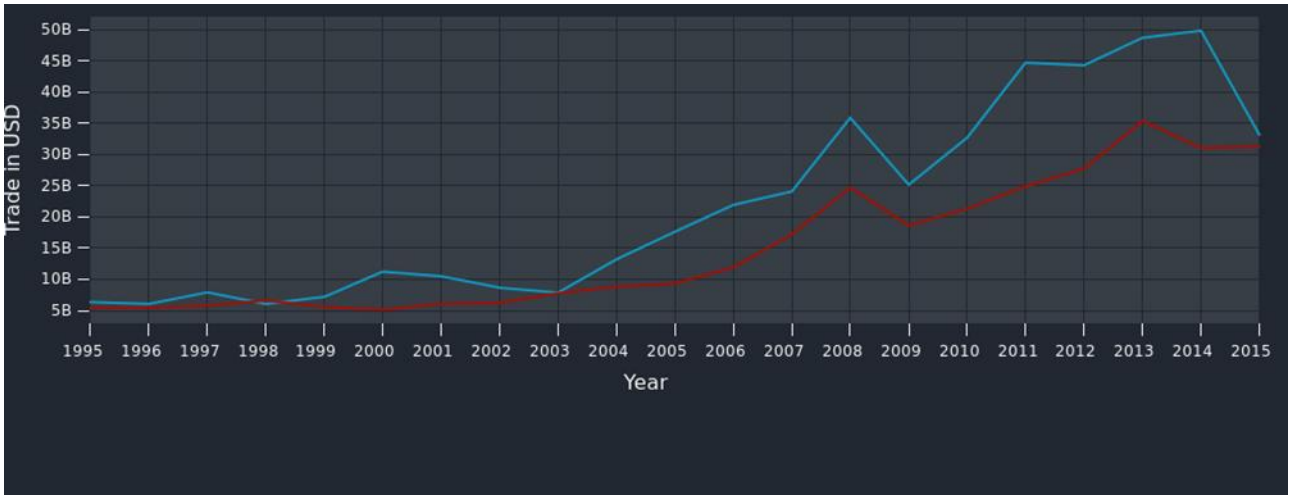
As of 2015 Qatar had a positive trade balance of USD45.2B in net exports, compared to its trade balance in 1995 of USD804M in net exports.



Graph 10: Imports Vs Exports in Kuwait 1995 – 2015

Source: Atlas Media

As of 2015 Kuwait had a positive trade balance of USD19B in net exports, compared to its trade balance in 1995 of USD2.92B in net exports.



Graph 11: Imports Vs Exports in Oman 1995 – 2015

Source: Atlas Media

As of 2015 Oman had a positive trade balance of USD$1.91B in net exports, compared to their its balance in 1995 of USD885M in net exports.

D. Real Growth Model

D1. Relationship between Foreign Exchange Reserves and GDP

In previous models, I have examined the positive relationship between foreign exchange reserves and GDP when foreign exchange reserves are considered as the independent variable. However, in this model, which was considered by Polterovich and Popov (2003), GDP is considered as the dependent variable, while foreign exchange reserves are the independent variable. Another independent variable was added – the price of oil. The model exhibits also a positive relationship between foreign exchange reserves and GDP. The model suggests that the accumulation of reserves creates a stimulus for growth through greater involvement into foreign trade, which in turn produces externalities – higher capital productivity. Saudi Arabia, the largest GCC country in terms of foreign exchange reserve

accumulation, for instance, stockpiled the largest amount of foreign exchange reserves ever in its history in 2013 and 2014 (see graph shows annual variation of the natural logarithm of the foreign exchange reserves in GCC countries). Below is a bar graph that shows the annual GDP of Saudi Arabia over the past 10 years. It is understood that Saudi Arabia reported the highest GDP values in 2013 and 2014, at the time when it also reported the highest amount of foreign exchange reserves (USD710,485 million and USD718,921 million respectively). This is in line with the interpretation for the results of the regression.

Graph 12: Annual GDP of Saudi Arabia

Source: Trading Economics

Regarding the price oil, the results of the regression also point to a positive relationship between oil prices and GDP in GCC countries. A 1 percent increase in oil price brings GDP up by nearly 0.4 percent. The results are not surprising, because an increase in oil prices will lead to higher revenues on oil, which in turn leads to an increase in real GDP. This strictly applies to GCC countries, which are major oil-exporting countries and where

revenues on oil account for a large portion of GDPs. This explains the positive relationship between oil prices and GDP.

D2. The Relationship between Foreign Exchange Reserves and Per Capita GDP

In this section of the Real Growth and Intervention Model, GDP per capita has been considered the dependent variable, while oil price and forex reserves are considered independent variables. The model also points to a positive relationship between foreign exchange reserves and GDP per capita. The regression analysis shows that a 1 percent increase in foreign exchange reserves raises GDP per capita by nearly 0.3 percent. Polterovich and Popov (2003) found that GDP from external trade depends on the level of development (GDP per capita) and on a country size – smaller countries are more engaged in the international trade and the share of trade in GDP of these countries grows faster. This suggests that higher GDP per capita leads to higher share of trade in GDP, which in turn leads to more foreign exchange reserves. Saudi Arabia is referred to again as an example. The figure below shows GDP per Capita per annum in Saudi Arabia.

Graph 13: Annual GDP per Capita Saudi Arabia

Source: Trading Economics

The bar graph shows high amount of GDP per capita in Saudi Arabia in 2013 and 2014 (USD21,030 and USD21,312 respectively). This is correlated with the highest values of foreign exchange reserves reported in Saudi Arabia's history in 2013 and 2014 (USD710,485 million and USD718,921 million respectively). This is in line with my finding that an increase in GDP per capita leads to more foreign exchange reserve accumulation.

E. Relationship Between Foreign Exchange Reserves and Money Creation (Money Supply)

The regression analysis of the model points to a positive relationship between foreign exchange reserves and broad money supply. A 1 percent increase in foreign exchange reserves raises broad money supply by around 0.09 percent. The results are similar in the case of international reserves, whereby a one percent increase in international reserves

raises broad money supply by around 0.1 percent. The results support the finding of Azar (2014) who found in his study on Lebanon a positive relationship between foreign exchange reserves and money supply (M2). The results found in this study came as expected, since GCC countries, like Lebanon, have their currencies pegged to the US Dollar. GCC countries also enjoy open economies with a perfect capital mobility. Therefore, it is understood that foreign reserves, whether only taken as foreign exchange reserves or expanded to become international reserves, directly impact broad money supply.

To sum up, the analysis shows a negative relationship between foreign exchange or international reserves and real effective exchange rate. However, foreign exchange or international reserves appear to be less sensitive to nominal effective exchange rate. The analysis also shows a positive relationship between oil prices and foreign exchange or international reserves. Additionally, the analysis proves that GDP significantly affects the accumulation of foreign exchange or international reserves in GCC countries, whereby a 1 percent increase in GDP raises foreign exchange or international reserves by 1 percent. Debt-to-GDP appears to lower the accumulation of foreign exchange or international reserves, while current account to GDP and broad money to GDP ratios appear to raise the accumulation of reserves in these countries, as imports to GDP appear to insignificantly affects reserves accumulation. Despite the negative relationship between call money rate and reserves accumulation, reserves accumulation in GCC countries appears to be less sensitive to the interest rate on US Dollar. When studying growth in GCC countries, both foreign exchange or international reserves and oil prices appear to spur economic growth in these countries. Furthermore, foreign exchange or international reserves appear to cause a rise in GDP per capita.

VII. Conclusion & Implications

The primary purpose of this study has been to examine the determinants of foreign exchange reserves in GCC countries. The paper also aims to look into whether foreign exchange reserves accumulation affects real growth in these countries. It is conducted based on multiple research studies carried out on different countries and regions of the world. Five models are considered in this research. First, the Intervention Model is derived from a study conducted by Batten (1982), who defined it as "the standard model based on the derived demand for foreign exchange reserves for purposes of intervening in foreign exchange markets". Second, the Asset-Choice Model, which is also derived from Batten (1982), is considered. According to Batten (1982), the Asset-Choice Model is based on asset-choice behavior. In this model, foreign reserves are treated as one of several assets that appear in a bank's portfolio and are held for the general conduct of a monetary policy. Third, the study refers to the vulnerability model, which includes capital account and current account vulnerability, derived from Prabheesh et al. (2007). Additionally, the paper refers to the Real Growth Model derived from a study carried out by by Polterovich and Popov (2003). Finally, the paper refers to the Money Creation Model derived from Azar (2014). The paper also examines whether the price of oil plays a role in foreign exchange reserves accumulation in major oil-exporting countries, like countries of the Gulf Cooperation Council. The results of the study provide an answer to the paper's main question: What is the interrelationship of foreign exchange reserves or international reserves with the macro-economic variables?

Annual data covering the period 1996 through 2015 were used in the study. A Unit Root test is carried out at the beginning, where the variables appear to be non-stationary in the level. After proving that the variables are stationary at the first difference, regression analysis has been conducted to determine the significant variables. Then Johansen Cointegration Test has been conducted to test whether there is cointegration among the variables. For every model, two regression analyses and two Johansen Cointegration Tests are conducted, with the first having foreign exchange reserves, while the second including international reserves. In every model, the results yielded from both foreign exchange reserves and international reserves are very similar. In the Intervention Model, the real effective exchange rate and the price of oil appear to significantly affect foreign exchange or international reserves accumulation in GCC countries. The nominal effective exchange rate, however, appears to insignificantly affect reserves accumulation in these countries, apparently due to the slight variations in the nominal effective exchange rates in these countries. Johansen Cointegration Test shows that there is cointegration among the independent variables considered in the model. In the Asset Choice Model, GDP and call money rate appear to significantly affect the stockpile of foreign exchange or international reserves in GCC countries, unlike the interest rate on US Dollar, real effective exchange rate and oil prices, which are found to insignificantly affect the demand for reserves in these countries. When Johansen Cointegration Test is carried out, it is found that there is no cointegration among the variables. In the Current and Capital Account Vulnerability Model, it is found that debt-to-GDP, GDP, broad money to GDP, and current account to GDP significantly affect the demand for foreign exchange and international reserves in GCC countries. Import to GDP, call money rate, interest rate on US Dollar, oil prices, and real effective exchange rate, however, are found to have insignificant effects on foreign

exchange or international reserves in these countries. Johansen Cointegration tests show the presence of cointegration among the independent variables. In the Real Growth Model, I examined how foreign exchange or international reserves impact real growth, but this time with foreign exchange reserves and international reserves being among the independent variables in two separate cases. It is found that both foreign exchange and international reserves, as well as oil prices, significantly affect GDP and GDP per capita. Finally, the study has investigated the relationship between foreign reserves and money creation (money supply), with also this time foreign exchange reserves and international reserves being among the independent variables in two separate cases. It is found that there is a positive relationship between foreign exchange reserves and broad money supply one hand, and between international reserves and broad money supply on the other hand. However, oil prices appear to insignificantly affect the broad money supply. Johansen Cointegration tests point to a lack of cointegration among the variables.

The variables considered in this study have been derived from the literature review on the determinants of foreign exchange reserves. It also considers a variable that was not previously considered when examining the demand for foreign exchange reserves – the price of oil. The study shows that when considered with the real effective exchange rate and the nominal effective exchange rate, oil prices significantly affect foreign exchange or international reserves accumulation in GCC countries. Additionally, the results show that oil prices significantly affect GDP and GDP per capita, pointing to a positive relationship between oil prices and GDP on one hand, and between oil prices and GDP per capita on the other hand.

The results obtained when foreign exchange reserves are considered are almost similar to results obtained when international reserves are considered. For instance, a one percent increase in GDP raises forex reserves by 1.2847 percent, and international reserves by 1.2826 percent.

Implications:

Authorities in GCC countries need to take into consideration the study for the following reasons:

1- To determine the interrelationship between foreign exchange reserves and the macro-economic variables.
2- The research study has identified the significant variables that affect and are affected by foreign exchange reserves. For example, the results point to a negative correlation between call money rate and foreign exchange or international reserves. This implies that authorities in a particular GCC country can change domestic rates in a bid to induce foreign exchange or international reserve accumulation.
3- If concerned authorities in GCC countries are already aware of the factors that affect foreign exchange or international reserves, this paper goes further to provide the quantitative relationship of the variables.

VIII. Recommendations

Following the devastating fall in oil prices due to oversupply of crude oil in international markets, OPEC member states and non-OPEC oil-exporting countries have hammered out a six-month agreement in November 2016 on oil production cuts, in a bid to lower oversupply in the market, and therefore pull up prices of oil. This means that exports of GCC countries, of which four are OPEC member states, must have fallen since that period. At the end of May 2017, OPEC and non-OPEC countries agreed to extend the oil output cuts deal by nine months. This means that exports of GCC countries, which are dominated by crude oil and oil derivatives, will continue to fall for another nine months. As the Real Growth model unveils a positive relationship between foreign exchange reserves accumulation and GDP, which is brought up by exports, GCC countries must focus on exports of other commodities. GCC countries have long relied on the exports of crude oil and oil derivatives to spur economic growth, but with the recent fall of oil prices, these countries must generate income from other sources to maintain growth. This can include boosting non-oil industries, as these countries are home to highly-skilled professionals from different nationalities, so they can benefit from human resources to develop non-oil industries. Another reason for developing non-oil exports is to maintain a surplus in the balance of trade. The graphs depicting imports and exports in GCC countries show that exports have been higher than imports over the period that the study covers, and the Current and Capital Account Vulnerability model shows that imports appear to be less sensitive to foreign exchange or international reserves accumulation, due to the fact that exports have been higher than imports. But with retreat in oil exports following the implementation of the oil output cuts agreement, GCC countries must develop their non-oil industries to keep their exports higher than imports. As the study

points to a positive association between foreign exchange reserves accumulation and GDP, higher reserves make the market more stable, which in turn enhances economic development. Therefore, it is desirable that GCC countries increase and diversify their amount of foreign reserves. Meanwhile, the Intervention Model highlights a negative relationship between exchange rate volatility and intervention by GCC central banks. Therefore, it is recommended that GCC countries hold enough reserves to face instability of external markets by building up reserves if indeed they care about volatility of foreign exchange rates. Additionally, the Asset Choice model shows that the interest rate on US Dollar appears to insignificantly affect foreign exchange reserve or international reserve accumulation in GCC countries. However, the model shows the existence of negative relationship between call money rate and foreign exchange or international reserves accumulation. This implies that a policy of lowering domestic interest rates may serve to induce more reserves.

IX. Limitations

This study has been faced with few limitations. To start with, it was a little bit hard to collect data of the designated independent variables from the same source. Even data related to the same independent variable were not all collected from the same source. For instance, yearly data for few of the independent variables were not consecutively available from the same source, as some of the websites omitted sections of the yearly data falling within the duration period that the study covers (1996 – 2015). In this case, I had to look for graphs

from other sources depicting the targeted figures for the missing period. Moreover, yearly data were considered in the study instead of monthly data, because it was very difficult to find monthly data for all the selected independent variables. Data with higher frequency capture more precise interactions between the dependent variable and the independent variables than data with lower frequency, but in the case of GCC countries, data for most of the selected independent variables are available only per annum. Furthermore, all GCC countries are small open economies, with free capital mobility, and pegged exchange rate systems. Most of them produce similar amount of crude oil, have similar export and import volumes, similar population size, and similar foreign exchange reserves accumulation. In this case, the study could have conducted the regression analysis not on all the GCC countries, but on just some of them, and later generalized the results. Finally, the value of foreign exchange reserves must have been deflated by GDP deflator before the regression analysis was carried out to obtain more precise results.

X. References

References

(n.d.).

Abdul Jalil, S. B. (2008). The Optimal Demand for Foreign Exchange Reserves in Pakistan. *International Journal of Applied Econometrics and Quantitative Studies*, 16.

Ali A. Bolbol, A. M. (2005). *Analysis of Foreign Reserves in Arab Countries 1980 - 2002.* Abu Dhabi: Arab Monetary Fund (AMF).

Avraham Ben-Bassat, D. G. (1992). *On the Effect of Opportunity Cost on International Reserve Holdings.* Bank of Israel.

Azar, S. (2014). *Foreign Reserve Accretion and Money Supply Creation: Lebanon's Experience under an Adjustable Peg.* Beirut .

B., A. D. (2016). *Asian Financial Crisis.* Encyclopaedia Britannica.

Badinger, H. (2002). *Austia's Demand for International Reserves and Monetary Disequilibrium: The Case of a Small Open Economy with a Fixed Exchange Rate Regime.* Vienna: Vienna Univrersity of Economics and Business Administration.

Bahraini Dinar 1988-2017. (n.d.). Retrieved from Trading Economics : https://tradingeconomics.com/bahrain/currency

Batten, D. S. (1982). *Central Bank's Demand for Foreign Reserves Under Fixed and Floating Exchange Rates* .

Brugger, S. (n.d.). *Instituto Mexicano de Gobernanza Medioambiental* . Retrieved from Instituto Mexicano de Gobernanza Medioambiental : http://gobernanzamedioambiental.org/brugger/Mundell%E2%80%93Fleming%20model.pdf

Canales Kriljenko, J. I., Guimarães, R. P., & Karacadag, C. (2003). *Official Intervention in the Foreign Exchange Market: Elements of Best Practice.* International Monetary Fund.

Diego Bastourre, J. C. (2009). *What is Driving Reserve Accumulation? A Dynamic Panel Data Approach.* Review of International Economics.

Energy Information Administration. (2017, March 15). Retrieved from Energy Information Administration: https://www.eia.gov

Federal Reserve of St Louis . (2017, March 15). Retrieved from Federal Reserve of St Louis : https://fred.stlouisfed.org/

Ghizoni, S. K. (2013, November 22). *Establishment of the Bretton Woods System.* Retrieved from Federal Reserve Histyory : http://www.federalreservehistory.org/Home/Legal

International Financial Statistics . (2017, March 10). Retrieved from International Monetary Fund (IMF): www.imf.org/en/Data

International Monetary Fund. (n.d.). Retrieved from International Monetary Fund: www.imf.org

jee, S. M. (2015). *Economics Discussion.* Undisclosed : Economics Discussion.

Joshua Aizenman, J. L. (2005). International Reserves: Precautionary versus Mercantilist Views, Theory and Evidence.

Joshua Aizenman, N. M. (2002). *The High Demand for International Reserves in the Far East: What's Going On?* Cambridge: National Bureau of Economic Research. Retrieved from www.nber.org/papers/w9266

Joshua Aizenman, N. M. (2003, January 11). International Reserve Holdings with Sovereign Risk and Costly Tax Collection.

Kuwaiti Dinar 2015-2017. (n.d.). Retrieved from Trading Economics : https://tradingeconomics.com/kuwait/currency

OEC - Bahrain (BHR) Exports, Imports, and Trade Partners. (n.d.). Retrieved from Atlas Media : http://atlas.media.mit.edu/en/profile/country/bhr/

OEC - Kuwait (KWT) Exports, Imports, and Trade Partners. (n.d.). Retrieved from Atlas Media : http://atlas.media.mit.edu/en/profile/country/kwt/

OEC - Oman (OMN) Exports, Imports, and Trade Partners. (n.d.). Retrieved from Atlas Media : http://atlas.media.mit.edu/en/profile/country/omn/

OEC - Qatar (QAT) Exports, Imports, and Trade Partners. (n.d.). Retrieved from Atlas Media : http://atlas.media.mit.edu/en/profile/country/qat/

OEC - United Arab Emirates (ARE) Exports, Imports, and Trade Partners. (n.d.). Retrieved from Atlas Media : http://atlas.media.mit.edu/en/profile/country/are/

Omani Rial 2005-2017 . (n.d.). Retrieved from Trading Economics: https://tradingeconomics.com/oman/currency

Parent, M.-A. G. (2005). *An Empirical Analysis of Foreign Exchange Reserves in Emerging Asia.* Ottawa: Bank of Canada.

Paresh Kumar Narayan, R. S. (2006). *The Dynamic Relationship Between Real Exchange Rates, Real Interest Rates, and Foreign Exchange Reserves: Empirical Evidence from China.* Taylor & Francis.

Prabheesh K P*, M. D. (2007). *Demand for Foreign Exchange Reserves in India: A Cointegration Approach.* South Asian Journal of Management .

Qatari Riyal 2003-2017. (n.d.). Retrieved from Trading Economics : https://tradingeconomics.com/qatar/currency

Russell Green, T. T. (2007). *Are High Foreign Exchange Reserves in Emerging Markets a Blessing or a Burden?* Washington D.C.: US Department of the Treasury: Office of International Affairs.

Saudi Arabia OEC Imports and Exports . (n.d.). Retrieved from Atlas Media : http://atlas.media.mit.edu/en/profile/country/sau/

Saudi Arabia Riyal 1988-2017. (n.d.). Retrieved from Trading Economics : https://tradingeconomics.com/saudi-arabia/currency

Tayfur Bayat, S. K. (2014). *Exchange Rates and Foreign Exchange Reserves in Turkey: Nonlinear and Frequency Domain Causality Approach.*

The World Bank. (2017, March 15). Retrieved from The World Bank: www.worldbank.org

Trading Economics . (2017, March 15). Retrieved from Trading Economics : https://tradingeconomics.com/

UAE Dirham 1988-2017 . (n.d.). Retrieved from Trading Economics : https://tradingeconomics.com/united-arab-emirates/currency

Victor Polterovich, V. P. (2003). *Accumulation of Foreign Exchange Reserves and Long Term Growth .* Moscow : New Economic School of Moscow.