Foreign Exchange Reserves and the Macro-economy in the GCC Countries

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Abstract

This research looks into the accumulation of foreign exchange reserves and the development of the macro-economy in the Gulf and Cooperation Council countries (GCC countries), namely, Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates. Using yearly data covering the period from 1996 through 2015, the empirical results show positive and significant relationships between foreign exchange reserves accumulation on one hand, and oil prices, GDP, the ratio of current account to GDP, and the ratio of broad money to GDP on the other hand. Moreover, the results point to negative and significant relationships between foreign exchange reserves accumulation on one hand, and real effective exchange rate, the ratio of debt to GDP, and call money rates on the other hand. However, the results show that the stockpile of foreign exchange reserves in the GCC countries is not sensitive to nominal effective exchange rates, neither to the ratio of imports to GDP, and nor to interest rates on the US Dollar. Furthermore, the study shows a robust and positive link between foreign exchange reserves and oil prices on the one hand and economic growth in these countries on the other hand.

Keywords: Foreign exchange reserves, Gulf Cooperation Council (GCC), Macro-economy, Panel least squares, Panel unit roots, Panel cointegration

JEL Classification Codes: F45, C33

1. Introduction

Foreign exchange reserves are viewed by economic policymakers as 'money in the bank' – the more, the better. Reserves are a fundamental pillar of the macroeconomic toolkit. In countries that implement fixed or partially fixed foreign exchange rate systems, they are used as a mean to keep the exchange rate at or near the official target or parity 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. Finally, foreign reserves reveal the financial strength of a country. "Foreign exchange reserves are particularly important in international trade because they facilitate international transactions and increase the speed in which trade deals are finalized. Additionally, these reserves could contribute to the efficiency of international supply chains" (Riasi & Aghdaie, 2013; Riasi, 2015).

The International Monetary Fund (IMF) defines foreign exchange reserves as the external stock of assets that a country's monetary authorities hold. They are composed of foreign banknotes, bank deposits in foreign currencies, and in foreign bonds, treasury bills, and other government securities.

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. China currently holds the world's largest foreign exchange reserves, amounting to 3.5 trillion of assets held in foreign currencies (mostly in US dollars). In the Middle East, Saudi Arabia holds the largest foreign exchange reserves in the region, and it ranks third worldwide (after China and Japan) in terms of accumulation of foreign exchange reserves (around USD 554 billion as of October 2016).

Besides being a good financial indicator of the strength and solvability of an economy we observe that the accumulation of foreign reserves in the six Gulf Cooperation Council (GCC) countries started to take a new path in 2004. Beginning at that date foreign exchange reserves held by the Saudi central bank remarkably soared. In the United Arab Emirates (UAE), foreign exchange reserves held by the Emirati Central Bank saw also 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, after 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 significant 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 afterwards.

Countries that implement a fixed exchange rate system opt to accumulate more foreign exchange reserves in an attempt to enable them to keep the exchange rate at or near official parity or target level by intervening sporadically in the market. In this regard a high stockpile of reserves is necessary to inspire confidence, reduce sovereign risk, and get good credit ratings for the external and internal debt of these countries. In return these countries obtain a lower borrowing rate.

GCC countries have pegged their domestic currencies to the US dollar given that their crude oil is exported in US dollars, 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 the GCC countries. By the end of the study, one main question will have been answered: What are the inter-relationships between foreign exchange reserves and the macro-economy in the GCC countries? The literature on the demand for foreign exchange reserves yields different results depending on the macroeconomic variables the period of estimation, and on the nature of the economies of the countries considered in the studies. Although 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, especially the US dollar. This study investigates the relationship between the demand for foreign exchange reserves in GCC countries and the opportunity cost of holding reserves. This opportunity cost is a crucial determinant of the demand for reserves. Furthermore, this study will evaluate the relationship between foreign exchange reserve accumulation and economic growth. Exchange rate devaluation induces export-led growth, in a classical beggar-thy-neighbor policy. In the aftermath of a financial crisis, we usually witness a remarkable stockpile of foreign exchange reserves. In addition, this study investigates the relationship between foreign exchange reserves and the real exchange rate. The last model estimated is the vulnerability equation, which dwells on the relation between foreign reserves and domestic and international indicators. Finally, this study will add a variable that other researchers have not considered when investigating the demand for foreign exchange reserves, and which is the price of crude oil.

The paper is organized as follows. In the next section, section 2, a survey of the literature is presented. The section has as many parts as there are theories of foreign exchange reserve behavior. In section 3 the data is described. Section 4 is the empirical part, with as money subsections as there are underlying theories. Section 5 provides for an interpretation of the results. Section 6 concludes, suggests policy recommendations and proposes an avenue for future research.

2. Literature Review

A spurt of research studies has been carried out on the demand for foreign exchange reserves. However, most of the research has focused on the demand for foreign exchange reserves in emerging countries, particularly in Asian countries, with only a few considering developed ones. To our knowledge, research studies are yet to be conducted on the demand for foreign exchange reserves in the GCC countries. It is true that Bolbol and Fatheldin (2005) have analyzed foreign reserves in Arab countries. However their study focused on the Arab world as a whole, including of course the GCC region. This paper focuses on the demand for foreign reserves in the GCC area only. The demand for foreign exchange reserves has not much changed following the collapse of the Bretton Woods Agreement. This means that the policy on the accretion of reserves has not changed much since then, except that Asian countries have accumulated excess reserves in the aftermath of the 1997 Asian economic crisis. Finally an overview is carried out on whether the accumulation of foreign reserves is linked to economic growth, and on how foreign exchange reserves are influenced by the foreign exchange rate.

2.1 The Mundell-Fleming IS/LM Model in a Small Open Economy

The Mundell-Fleming model is an extension of the Keynesian IS/LM model to a small open economy, developed by Mundell and Fleming (Daniels and Van Hoose, 2014). Since GCC countries are small open economies, the Mundell-Fleming model is appropriate. One implication of the model is that an economy cannot maintain at the same time a fixed exchange rate, high capital mobility, and an independent monetary policy.

When the international interest rate exceeds the domestic interest rate, hot money flows out. This results in pressures to depreciate the local currency, forcing the central bank to purchase local currency and sell some of its foreign reserve currency to balance the outflow. The decrease in the monetary base of the domestic central bank and the domestic money supply shift the LM curve to the left until the domestic interest rate and the international interest rate become equal. The result is a higher local interest rate and an output contraction.

A monetary expansion shifts the LM curve to the right. This leads to lower domestic interest rates, an increase in capital outflows, and a deficit of the balance of payments, which cause a rise in demand for the 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. Thus monetary policy is ineffective under a fixed exchange rate system.

On the other hand, an expansion of fiscal policy under a fixed exchange rate regime shifts the IS curve up and to the right. Domestic interest rates are now higher, initiating capital inflows and causing pressures to appreciate the local currency. The surplus in the balance of payments tends to dampen the value of foreign currency. In order to keep the exchange rate fixed, the central bank has to accommodate the fiscal policy by buying reserves. This shifts the LM curve to the right because of the higher money supply. Hence, fiscal policy affects strongly the real output level and is therefore quite effective.

This analysis lets us conclude that the GCC countries should follow an expansionary fiscal policy, and a neutral monetary policy. In a different setting Lebanon has successfully adopted these measures and the peg of the Lebanese pound to the US dollar became quite stable. GCC countries should replicate Lebanon's policies.

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

In 1944, delegates from 44 nations held a conference in Bretton Woods, and conceived what has later to be called as the Bretton Woods Agreement. The participants agreed upon a new international monetary system that would ensure exchange rate stability, prevent competitive devaluations, and promote economic growth. This new order was based on a Dollar Standard. The US would fix their currency to the price of gold, and all other countries would fix their exchange rates on the US dollar. However, the system broke down in 1971 because of the accumulation of persistent US balance of payments deficits, and the severe outflow of gold from the US. By March 1973, The Bretton Woods agreement fell apart and the world's major currencies started to float de facto against each other.

Before March 1973, the central banks of the countries that took part in the Bretton Woods meeting, were obliged to hold enough foreign reserves to enable them to interfere in foreign currency markets if needed, to keep the national currency within a predetermined range. The breakdown of the system was expected 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 in the exchange rate system (Batten, 1982; Bastourre et. al., 2009). Among the theories that the academic literature has tried to validate are: the intervention, model, the asset choice model, the impact of a crisis, the growth model, and the foreign exchange rate model. We shall elaborate on each one of these determinants of foreign reserves.

2.3 The Intervention Model, The Asset Choice Model, and the Vulnerability Model

Batten (1982) investigated the behavior of central banks with the use of two models: the intervention model and the asset choice model. The first model gears foreign exchange reserves to the purveyance of official intervention. In contrast, 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 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.

The Intervention Model identifies four major determinants of foreign reserves:

- Variability of international payments and receipts
- Opportunity cost of holding reserves

- Scale variable measuring the size of international transactions
- Propensity to imports

Econometrically Batten rejected the intervention model. Alternatively, he could not reject the asset choice model. While the rejection of the intervention model for the floating rate period is as expected, it is surprising that the model is also rejected for the fixed rate period. During this period the burden of the adjustment was on countries with deficits. Countries with surpluses did not feel an urgent need to adjust.

The results of Batten's study were supported by Bastourre et al. (2009). Bastourre et al. showed that, ceteris paribus, flexible regime's ratio of reserves to GDP is 6 percent higher than that of fixed regimes. They concluded that when countries experience an intermediate stage of development and are exposed to high capital mobility, reserve accumulation becomes a key for a successful integration. In this regard flexible exchange rate systems complement reserve accumulation.

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

Ben-Bassat Gottlieb (1992) found a negative relationship between the demand for foreign exchange reserves and the opportunity cost of holding these reserves. This is consistent with the results of a study carried out by Badinger (2004) for Austria. Badinger noted that the opportunity cost of holding reserves is a crucial determinant of the demand for reserves. His function included the following variables: real level of international reserves, real imports of goods and services, and the opportunity cost of holding reserves.

By contrast, Prabheesh et al. (2007) found somewhat different results for India. They grouped the determinants of demand for reserves into five categories: economic size, current account vulnerability, capital account vulnerability, exchange rate flexibility, and opportunity cost. Potential explanatory variables for each of these categories of determinants are identified as follows: the population and per capita GDP for economic size; the ratio of imports to GDP, the ratio of trade to GDP, and the ratio of current account deficit to GDP for current account vulnerability; the ratio of capital account deficit to GDP, the ratio of short-term external debt to GDP, and the ratio of broad money to GDP for capital account vulnerability; the standard deviation of exchange rate for exchange rate flexibility; and the interest rate differential for the opportunity cost. They expected that reserve holdings would rise with respect to economic size. They also expected 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 higher reserve demand. Additionally they expected 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 expected 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 more attractive. Prabheesh et al. found that the impact of the ratio of broad money to GDP exhibits a high influence on reserve movements. The effect of current account vulnerability variable was significant and proportional. The interest rate differential, although statistically significant, had a low impact compared to other variables. This led these authors to the conclusion that reserve accumulation of the Central Bank of India is little guided by the opportunity cost of holding reserves.

This is not the case in Pakistan (Jalil and Bokhari, 2008). Jalil and Bokhari 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. This cost is incurred every time reserves hit the lower bound of zero. Jalil and Bokhari found that both the adjustment and opportunity costs played a notable role in the accumulation of reserves in Pakistan with the opportunity cost being a more predominant determinant.

Nonetheless, this was challenged in another more 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. selected three variables from the literature on demand for reserves: opportunity cost of holding reserves, trade openness using the addition of imports to exports as a proxy, and volatility of commercial transactions (trade volatility). They did not stick to these pre-selected variables, but expanded the set to include three main variables: the exchange rate regime, the development level and the regional position. They found that only trade openness is statistically significant as a variable for the demand for reserves among the three selected variables from the literature, while the other two variables, the opportunity cost and trade volatility, are not relevant.

To conclude, the empirical academic literature is divided between those who find the opportunity cost of holding reserves as a significant and negatively related variable for the demand for reserves, and those that find otherwise. This paper will present evidence that, for the GCC countries, the opportunity cost is significant while the US dollar interest rate is not. This means that the researcher should not take the differential cost as the independent variable, but each cost separately.

2.4 The Effect of a Crisis on the Accumulation of Foreign Exchange Reserves

The literature on reserve accumulation in the Far East is rich, especially after the Asian Financial crisis. See, for example, Aizenman and Marion, 2003; and Gosselin and Parent, 2005. This crisis was 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 was unpegged from the US dollar, initiating a series of currency devaluations and massive capital flights, commensurate with trade wars. The crisis quickly spread to neighboring countries.

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 (2003) set up a standard estimating equation, in which reserve holdings depend on scale factors, international transactions volatility, and openness. Aizenman and Marion postulated that reserve holdings are positively correlated with the country's population and standard of living, are positively correlated with the volatility of a country's export receipts, are positively correlated with the average propensity to import, and are positively correlated with exchange rate volatility. They found that the scale variables, population size, and real GDP per capita are indeed positively correlated with reserve holdings. The volatility of real export receipts and the vulnerability to external shocks measured by openness are found to be also positive and highly significant. Greater exchange rate variability significantly raises the demand for reserve holdings.

Aizenman and Marion further investigated the recent build-up of large international reserve holdings in a number of emerging countries, besides the Far East. They postulated that the large stockpiles of reserves are for precautionary needs. They focused on two factors that motivate precautionary reserves. The first was the need to smooth consumption and to eliminate 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. Aizenman and Marion (2004) were able to find evidence that the recent reserve stockpiles in the Far East are motivated by the economic crisis that struck in 1997. Countries faced with a rise in sovereign risk and high taxation costs seek to hold large precautionary reserves. When countries attach more weight to bad outcomes than to good ones, they also seek to hold large reserves in the aftermath of a crisis, as some of them favor current consumption, experience political instability, or suffer from political corruption.

Aizenman and Lee (2007) 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 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. 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. Their research provided 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. Variables associated with trade openness and exposure to financial crises are both statistically and economically important in explaining reserves. Aizenman and Lee concluded in their 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. They also argued that the international reserve accretion in the aftermath of a crisis occurs only in the countries falling in the affected regions.

The results found by Aizenman and Marion (2003) are endorsed by Bolbol and Fatheldin (2005). Bolbol and Fatheldin analyzed reserve holding in 17 Arab countries during the period covering 1980 through 2002. They adopted a two-stage estimation methodology in their research and divided their 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. They 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 verify the relationship between propensity to import and precautionary reserves suggested by Aizenman and Marion (2003). Bolbol and Fatheldin also find that a higher propensity to import mirrors greater openness, and with it the need to hold more precautionary reserves. They also found results similar to those found by Aizenman and Marion (2002) regarding the relationship between population and per capita income on one hand and reserve holdings on the other hand. Both

Aizenman and Marion (2002) and Bolbol and Fatheldin (2005) conclude that population and per capita GDP have a positive influence on the demand for reserves. Regarding reserve hoarding in the aftermath of a crisis, Bolbol and Fatheldin agree with Aizenman and Marion regarding reserve accretion in the aftermath of the Asian crisis, arguing that echoes from the Asian crisis have induced some Arab countries to increase foreign reserves.

Gosselin and Parent (2005) investigated how far the level of reserves in emerging-market economies should diverge from that given by standard macroeconomic determinants. To do so, they used 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. They claimed that the recent build-up in reserves is concentrated in this part of the world. The explanatory variables in their study were: 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 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 significantly in the post-1997 period. However, current account balances had less influence on reserve holdings even in the aftermath of the Asian crisis.

2.5 The Relationship between Foreign Exchange Reserves and Growth

The literature on the relationship between foreign exchange reserve accumulation and growth is large (see, for example, Polterovich and Popov, 2003). Polterovich and Popov probed the relationship between 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 induces export-led growth, in a classical beggar-thy-neighbor policy. 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 found that figures varied dramatically throughout the mentioned period, suggesting the lack of a relationship between foreign exchange reserves and GDP.

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

Furthermore, Polterovich and Popov investigated the relationship between foreign reserves accumulation and exchange rate undervaluation. They found that there is a negative relationship between the increase in reserves and the exchange rate undervaluation as measured by the ratio of PPP exchange rate to the official exchange rate.

Polterovich and Popov concluded that reserve 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 a poor investment climate. However, they found that reserve accumulation is a powerful macroeconomic mechanism for raising long-term growth rates. The reserves produce an undervalued exchange rate, and more profits from the exports sector, all of which boost investment and export-led growth.

It is important to remark that many authors have included aggregate income, or aggregate income per capita, in the list of the explanatory variables in the regressions that account for vulnerability. For example some authors have insisted that aggregate income is the scale variable that is needed in regressions of vulnerability. See section **2.3** above. In this section only the studies on the bilateral movement between reserves and output are considered.

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

The literature on the demand for foreign exchange reserves also includes a myriad of research studies on the relationship between foreign exchange reserves and foreign exchange rates. See, for example, Narayan and Smyth, 2006, and Bayat et al., 2014. In the long-run, the real exchange rate bears a significant positive effect on foreign exchange reserves (Naraya and Smyth, 2006). The results of the latter study show that the real effective exchange rate and foreign exchange reserves are both integrated of order one or I(1), whereas the real interest rate differential is integrated of order zero or I(0). Narayan and Smyth then used the bounds testing approach to cointegration. The bounds testing procedure tests for the absence of any level relationship. 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 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 the dependent variable. Thus in the long-run, the real exchange rate has a statistically significant positive effect on foreign exchange reserves.

Bayat et al. (2014) examined the asymmetric relationship between foreign exchange reserves and nominal and real exchange rate in the Turkish economy. They employed monthly data covering January 2003 through January 2014. However, they found that there was a causal positive relationship from foreign exchange reserves to nominal and real exchange rate for raw data. Their results showed that foreign exchange reserves do not influence nominal and real exchange rates in Turkey at any period, but there is a positive causality running from nominal exchange rate to foreign exchange reserves in the short run and a positive causality running from real exchange rate to foreign exchange reserves in both the short and the long run.

3. Data

All data of all the 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 the US Dollar are collected from the website of the Federal Reserve of St Louis. Annual GDP, call money rates, GDP per capita, ratio of broad money to GDP were gathered from the website of the International Monetary Fund (IMF). Data on the ratio of current account to GDP, the ratio of imports to GDP, the ratio of trade to GDP, the real effective exchange rate, and the nominal effective exchange rate for all countries were obtained from Trading Economics (tradingeconomics.com). The values for foreign exchange reserves were obtained from the website of the World Bank (worldbank.org). Below is Table 1 that summarizes the entire list of variables with their symbols attached. When an "L" is appended in front of a variable this denotes a conversion of the variable to the natural logarithm.

Table 1. Variable notation and description

Symbol	Variable Description
YCAP	GDP per Capita
IUSD	Interest Rate on US Dollar
TRADE	Ratio of Trade to GDP
REAL	Real Effective Exchange Rate
OIL	Price of Crude Oil
NEFFRATE	Nominal Effective Exchange Rate
INT	Domestic 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
CA	Current Account to GDP

4. Methodology

4.1 Panel unit root tests

As a first step in the analysis, it is important to test for the existence of unit roots in the time series data. Most economic data are characterized by seasonality and their statistical properties, such as mean, variance, and correlation, may not be constant through time. Therefore, such data need to be transformed and differenced to become stationary, otherwise regression analysis cannot be conducted and, if attempted, provides spurious results. The first difference of a time series is the series of changes from one period to another. All variables are taken in

natural logarithm, except for the ratio of the current account to GDP (CA) because the logarithm of a negative number is not defined. The first difference is applied on the log variables.

In Table 2, the null hypothesis is not rejected, therefore the variable CA is non-stationary. But after differencing the variable, the null is rejected, therefore the variable CA is stationary in first-difference. In Table 3, the null of non-stationarity fails to be rejected for all the variables. Therefore, all the variables are non-stationary. After differencing the variables using individual panel root tests, the nulls are rejected, and therefore, all variables are now stationary. An individual unit root test changes the unit root for each country. The difference between individual unit root and common unit root is that, in the common unit root test, all countries have one and only one specific root.

Table 2. Panel Unit Root Tests. Sample period: 1996 to 2015. The null hypothesis is non-stationarity. Actual p-values are reported.

	X	**X**	**Δ(X)**	**Δ(X)**
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 Square C: PP-Fisher Chi-Square	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 Square C: PP-Fisher Chi-Square
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

Four panel 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 results obtained are reported in Table 2 and in Table 3. All these tests are routinely calculated with the EViews 9.5 (2016) statistical package.

Table 3. panel unit root tests

	Log(X)	Log(X)	ΔLog(X)	ΔLog(X)
X	Common Unit Root Levin, Lin & Chu t*	Individual Unit Root A: Im Pesaran & Shin W-Stat B: ADF-Fisher Chi-Sq C: PP Fisher Chi-Sq	Common Unit Root Levin, Lin & Chu t*	Individual Unit Root A: Im, Pesaran & Shin W-Stat B: ADF – Fisher Chi-Sq 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
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	0.0000	A = 0.0000

		B = 0.7957		B = 0.0000
		C = 0.8558		C = 0.0000
NEFFRATE	0.0016	A = 0.0076	0.0413	A = 0.0304
		B = 0.0188		B = 0.0496
		C = 0.2884		C = 0.0334
INT	0.3477	A = 0.3812	0.0000	A = 0.0000
		B = 0.2795		B = 0.0000
		C = 0.9427		C = 0.0000
MONEY	0.6148	A = 0.5353	0.0000	A = 0.0000
		B = 0.6813		B = 0.0000
		C = 0.6818		C = 0.0000
IMPORTS	0.2780	A = 0.5408	0.0000	A = 0.0000
		B = 0.5632		B = 0.0000
		C = 0.5872		C = 0.0000
GDP	0.0978	A = 0.9517	0.0000	A = 0.0000
		B = 0.9931		B = 0.0000
		C = 0.9929		C = 0.0000
FOREX	0.2379	A = 0.9794	0.0000	A = 0.0000
		B = 0.9979		B = 0.0000
		C = 0.9994		C = 0.0000
DEBT	0.1466	A = 0.6140	0.0068	A = 0.0108
		B = 0.7644		B = 0.0267
		C = 0.9464		C = 0.0281
OIL	0.1973	A = 0.5373	0.0000	A = 0.0000
		B = 0.7957		B = 0.0000
		C = 0.8558		C = 0.0000
IUSD	0.0021	A = 0.0326	0.0000	A = 0.0000
		B = 0.0791		B = 0.0000
		C = 0.4053		C = 0.0000

4.2 Intervention Model

In order to examine whether there is a cointegration relationship among the variables, panel cointegration tests are conducted on the non-differenced variables. The tests are carried out twice, for the case of FOREX and for the case of total international reserves, which includes gold and other assets (RESERVE). Only the case of FOREX is reported. The results with the RESERVE variable are immaterially different and are not reported.

Central banks intervene in the foreign exchange market to reduce exchange rate volatility. Official intervention by the central bank in the foreign exchange market is high when there is high exchange rate volatility, or high LREAL squared, which causes foreign exchange reserves to fall. If countries allow exchange rate variability then they will hold less foreign reserves. In a previous regression with the same variables, the actual p-value of the coefficient on the LNEFFRATE (the log of the nominal effective exchange rate) is higher than the significance level of 5 percent, being 0.5844. Therefore the nominal effective exchange rate insignificantly affects foreign exchange reserves. P-values of the other independent variables (LREAL, $LREAL^2$ (LREAL Squared), and LOIL) are less than the two-tailed significance level of 5 percent, meaning that the variables significantly affect the demand for forex reserves. After omitting the insignificant variable from the regression analysis, the value of the Schwarz criterion falls from 2.5094 to 2.4723, meaning that omitting the insignificant variable improves the Schwarz information criterion, a sign of a better specification. Hence, in the final model LNEERATE is omitted from the regression and

LREAL, LREAL squared, and LOIL are included. See Table 4. A higher value for LREAL, a depreciation, increases foreign reserves through an export-led mechanism. A higher value for LREAL squared, measuring volatility, consumes reserves, and higher oil prices replenish reserves by increasing the returns on the exported oil. It is notable that the R-square is quite high (around 80%). Table 4 portrays the results of the panel least squares.

Table 4. OLS Panel Least Squares with LFOREX as Dependent Variable

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 information criterion	2.472309

Two types of cointegration tests are conducted on the same regression in Table 4 – Pedroni Residual Cointegration Test and Johansen Fisher Panel Cointegration Test. Table 5 portrays the results. The null hypotheses of no-cointegration are rejected at lower than the 5% marginal significance level. This implies that there is cointegration among the independent variables in the Intervention Model. All the above indicates that the Intervention Model is supported as a description of the long run demand for foreign reserves.

Table 5. Pedroni Residual Cointegration Test, and Johansen Fisher Panel Cointegration test with LFOREX 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

4.3 Asset Choice Model

The Asset-Choice Model is now considered. In this model, foreign reserves are treated as one of several assets that appear in a bank's portfolio. In a preliminary step a regression is carried out on the variables that this model assumes to be relevant, and which are: LGDP, LINT, LIUSD, LREAL, and LOIL. The actual P-values of LGDP and LINT are less than the two-tailed significance level of 5 percent, meaning that GDP and the call money rate significantly affect the demand for forex reserves. The actual P-values of LIUSD, LREAL, and LOIL are higher than the significance level of 5 percent, meaning that the interest rate on the US dollar, the real effective exchange rate, and the oil price insignificantly affect the demand for forex reserves in GCC countries. A second regression analysis is conducted on the significant variables only. However, before proceeding with the constrained 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 jointly zero. The results of the Wald Test show an actual P-value of 0.3933, well above 5%. The null hypothesis fails to be rejected and all omitted insignificant variables are jointly insignificant. The constrained regression is carried out using only the significant independent variables. Table 6 shows the results of this constrained regression analysis.

Table 6. Panel EGLS (Cross-Section Random Effects) on the two Significant Independent Variables

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			

As portrayed in Table 6, the actual P-values of the constrained regression analysis are still below the significance level of 5 percent, meaning that these two variables still significantly affect the demand for foreign exchange reserves. The implications are 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 the domestic call money rate will lower forex reserves by 0.165 percent.

Then the two types of cointegration tests are conducted on the constrained regression – Pedroni Residual Cointegration Test and Johansen Fisher Panel Cointegration Test. Table 7 portrays the results. These tests reject the nulls of no-cointegration.

Table 7. Pedroni Residual Cointegration Test, and Johansen Fisher Panel Cointegration test with LFOREX 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

4.4 Current and Capital Account Vulnerability

Another model to be considered in this study is the vulnerability model, which includes capital account and current account vulnerabilities. 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 higher reserve demand. It is also expected that a high ratio of current account deficit to GDP, high-short term debt to GDP, and high broad money to GDP are associated with higher capital account vulnerability, which may lead to a rise in reserve holdings.

First an encompassing regression including all variables is run. The selected independent variables are LDEBT, LGDP, LIMPORTS, LINT, LIUSD, LOIL, LREAL, LMONEY, and CA. The actual P-values of LDEBT, LGDP, LMONEY, and CA are less than the marginal significance level of 5 percent. This implies that these four variables significantly affect the demand for forex reserves in GDP.

Table 8. OLS Panel Least Squares on the Significant Variables with LFOREX as Dependent Variable

Variable	Coefficient	Std. Error	t-Statistic	Probability
C	-19.48881	1.398199	-13.93851	0.0000
LDEBT	-0.417961	0.047024	-8.888279	0.0000
LGDP	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			

The actual P-values of LIMPORTS, LINT, LIUSD, LOIL, and LREAL are higher than the significance level of 5 percent, meaning that these variables insignificantly affect the demand for forex reserves in GCC countries. A Wald

Test is conducted on the coefficients of the insignificant variables to see if the joint omission of the variables is valid. The actual P-value is 0.6116, failing to reject the null hypothesis that all five variables are jointly, and not only separately, insignificant. It is surprising that the price of oil does not belong to the first batch of significant variables. Table 8 portrays the results of the constrained regression analysis conducted on the significant variables only. The R-square of the constrained regression is quite high, at 95.4%.

The p-values of all independent variables are now less than the significance level of 5 percent. It can be deduced that a 1 percent increase in the 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, this coefficient being very close to its respective coefficient in the Asset Choice Model. 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 raises forex reserves by 0.0097 or nearly 0.01 percent. Furthermore, the omission of the insignificant variables improved the value of the Schwarz criterion, which fell from 1.2090 in the unrestricted regression analysis to 1.0431 in the restricted regression in Table 8.

To ascertain cointegration among the variables, the same two tests are conducted – Pedroni Residual Cointegration Test and Fisher Panel Cointegration Test. Table 9 portrays the results of the tests. The p-values in both tests are less than the significance level of 5 percent, except for one test out of five, meaning that the null hypothesis of no-cointegration is mainly rejected. This indicates the presence of cointegration among the variables.

Table 9. Pedroni Residual Cointegration Test, and Johansen Fisher Panel Cointegration test with LFOREX 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

4.5 Real Growth Models

In this section, we will look into the relationship between foreign exchange reserve accumulation and aggregate growth. First, we 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 10 portrays the results.

The P-values of LFOREX and LOIL are less than the marginal 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 the price of oil brings GDP up by 0.3599 percent.

Table 10. OLS Panel Least Squares with LGDP as Dependent Variable.

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			

To investigate whether there is cointegration among the variables, the same two types of cointegration tests are conducted: Pedroni Residual Cointegration Test and Johansen Fisher Panel Cointegration Test. Table 11 portrays the results, which support the alternative hypothesis of cointegration.

Table 11. Pedroni Residual Cointegration Test, and Johansen Fisher Panel Cointegration test with LGDP as dependent variable.

			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

Next, we will look into the relationship between foreign exchange reserves and per capita GDP. A regression analysis is conducted with the log of GDP per Capita being the dependent variable and foreign exchange reserves being the independent variable. The oil price variable is also included in the test. The results are similar to those in the Table 10. The panel cointegration tests are also similar to those in Table 11. The results are not reported but are available from the authors.

5. Interpretation

5.1 Intervention Model

The Intervention Model considered in this study shows that a rise in the real effective exchange rate prompts GCC countries to hold higher reserves. When exchange rate volatility is high, central banks intervene by selling some of their foreign currency in a bid to reduce foreign exchange rate volatility. Regarding the price of oil, which is also considered in the model, the analysis shows a positive relationship between foreign exchange reserves and the price of oil in GCC countries. The six GCC countries are major oil-exporting countries, and crude oil is their main export good. Therefore, the positive relationship between forex reserves and crude oil prices can be attributed to the rise in the revenues generated from the sales of crude oil, which is traded internationally in US dollars. However, the results of the regression analysis show that the nominal effective exchange rate insignificantly affect foreign exchange reserves in GCC countries. This finding is not surprising. As we 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 only a slight variability in the nominal effective exchange rate of each country, despite the fact that real effective exchange rates are much more volatile. Econometrically when a variable slightly varies, it exhibits little explanatory power. That is why in GCC countries foreign exchange reserves appear to be insensitive to the nominal effective exchange rate, but sensitive to the real effective exchange rate.

5.2 Asset Choice Model

The positive and proportionate relationship between GDP and foreign exchange reserves found in the Asset-Choice model is due to a scale or wealth effect: as output grows, domestic and international transactions also grow which creates a demand for more foreign reserves. Furthermore, the Asset-Choice model yields another finding, which points to a negative relationship between foreign exchange reserves and the domestic call money rate. A one percent increase in call money rates will lower foreign exchange reserves by 0.16 percent. Call money rate is the interest rate imposed on a short-term loan that banks extend to brokers who in turn lend the money in domestic currency to investors to fund margin and brokerage accounts. Since foreign exchange reserves are denominated in foreign exchange, higher call money rates indicates higher opportunity costs, and discourage the accumulation of foreign exchange reserves. Surprisingly, the interest rate on the US dollar appears to insignificantly affect foreign exchange reserve accumulation in GCC countries. This immunity may turn out to be ideal by the countries in the GCC.

5.3 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. A high debt-to-GDP ratio may make it more difficult for a country to pay external debts which are usually denominated in US dollars. When the debt-to-GDP ratio rises, creditors may freak out, inciting them to transfer foreign funds out of the country. 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 reserves.

Like the Asset-Choice Model, the Current and Capital Account Vulnerability Model also points to a positive and proportionate relationship between foreign exchange reserves and GDP in GCC countries. 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 will lead to a rise in reserve holdings because these reserves are necessary to financial capital outflows. Finally, the model exhibits a positive relationship between current account to GDP and foreign exchange reserves in GCC countries. However, the effect is small, as a one percent increase in current account to GDP raises foreign exchange reserves by merely 0.0095 percent. The current account balance as a percent of GDP provides an indication on the level of international competitiveness of a country. The imports-to-GDP ratio appears to insignificantly affect foreign exchange reserves accumulation in GCC countries. This may be attributable to the econometric problem of multicollinearity between independent variables.

5.4 Real Growth Model

In previous models, sections **5.2 and 5.3**, we 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, GDP, and GDP per capita, are considered as dependent variables, 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 positive externalities – like higher capital productivity.

Regarding the price of 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.

Since there is confusion on whether GDP and GDP per capita should be dependent or independent variables a Granger causality test was applied. The results are that log GDP and log forex have bilateral causality, with actual p-values less than 1% for a number of lags of 2 and 3. One might argue that this bi-directional causation is spurious because the variables are non-stationary. That is why another Granger causality test was effectuated with the differences of the logs. This means that the variables of interest are GDP growth and the growth in foreign reserves. The results show again bidirectional causality as all actual p-values are less than 4% for a number of lags of 2 and 3. A final test was conducted: panel cointegration between the logs of GDP and the logs of foreign exchange reserves. The results overwhelmingly point that the long run cointegration relation runs from output to foreign exchange reserves, and not otherwise. Since this is the only piece of outright statistical information it is prudent to conclude that neither GDP nor foreign reserves are exogenous, and that there is no clear-cut econometric evidence on which variable should be the dependent one. Further research on this issue is warranted.

6. Conclusion

The primary focus of this study has been to examine the long run 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. Four models are considered in this research. First, the Intervention Model. Second, the Asset-Choice Model. Third, the study refers to the vulnerability model. Finally, the paper refers to the Real Growth Model. 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 with the macro-economic variables?

Annual data covering the period 1996 through 2015 were used in the study. A panel unit root test is carried out at the beginning, where the variables appear to be non-stationary in the log-level. After showing that the variables are stationary at the first difference, regression analysis has been conducted to determine the significant variables. Then panel cointegration tests have been conducted to test whether there is cointegration among the variables. These tests show that there is cointegration among the variables considered in *all the models*. In the Asset Choice Model, GDP and call money rate appear to significantly affect the stockpile of foreign exchange in GCC countries, unlike the interest rate on US Dollar, the real effective exchange rate and oil prices. 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 in GCC countries. Imports to GDP, call money rate, interest rate on US Dollar, oil prices, and the real effective exchange rate, however, are found to have insignificant effects on foreign exchange in these countries. In the Real Growth Model, we examined how foreign exchange impacts real

growth, but this time with foreign exchange reserves being among the independent variables in two separate cases. It is found that foreign exchange reserves, as well as oil prices, significantly affect GDP and GDP per capita.

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.

Authorities in the GCC countries need to heed to the following considerations:

1- To determine the interrelationship between foreign exchange reserves and the macro-economic variables.

2- To identify the significant variables that affect and are affected by foreign exchange reserves.

3- If concerned authorities in GCC countries are already aware of the factors that affect their foreign exchange reserves, this paper goes beyond to provide for the sign and the quantitative magnitude of the relationships between these variables.

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. It is also 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 and real macroeconomic shocks. Additionally, the Asset Choice model shows that the interest rate on US Dollar appears to insignificantly affect foreign exchange reserve accumulation in GCC countries. However, the model shows the existence of a negative relationship between the call money rate and foreign exchange accumulation. This implies that a policy of lowering domestic interest rates may serve additionally and involuntarily to reduce the opportunity cost of reserves.

This study has been faced with some limitations. To start with, it was a little bit hard to collect data of the designated variables from the same source. Even data related to the same variable were not all collected from the same source. Furthermore, all GCC countries are small open economies, with free and high 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 separately, and later generalize the results. If data with higher frequency becomes available it is recommended to run the models again with the bigger sample and for individual countries.

References

Aizenman, J., & Lee, J. (2007). International reserves: precautionary versus mercantilist views, theory and evidence. *Open Economies Review*, *18*(2), 191-214. https://doi.org/10.1007/s11079-007-9030-z

Aizenman, J., & Marion, N. (2003). The high demand for international reserves in the Far East: What is going on?. *Journal of the Japanese and International Economies*, *17*(3), 370-400. https://doi.org/10.1016/S0889-1583(03)00008-X

Aizenman, J., & Marion, N. (2004). International reserve holdings with sovereign risk and costly tax collection. *The Economic Journal*, *114*(497), 569-591. https://doi.org/10.1111/j.1468-0297.2004.00232.x

Badinger, H. (2004). Austria's demand for international reserves and monetary disequilibrium: The case of a small open economy with a fixed exchange rate regime. *Economica*, *71*(281), 39-55. https://doi.org/10.1111/j.0013-0427.2004.00356.x

Bastourre, D., Carrera, J., & Ibarlucia, J. (2009). What is driving reserve accumulation? A dynamic panel data approach. *Review of International Economics*, *17*(4), 861-877. https://doi.org/10.1111/j.1467-9396.2009.00841.x

Batten, D. S. (1982). Central banks' demand for foreign reserves under fixed and floating exchange rates. *Federal Reserve Bank of St. Louis Review*.

Bayat, T., Senturk, M., & Kayhan, S. (2014). Exchange rates and foreign exchange reserves in Turkey: nonlinear and frequency domain causality approach. *Theoretical & Applied Economics*, *21*(11).

Ben-Bassat, A., & Gottlieb, D. (1992). On the effect of opportunity cost on international reserve holdings. *The Review of Economics and Statistics*, 329-332. https://doi.org/10.2307/2109666

Bolbol, Ali A., and Ayten M. Fatheldin. (2005) *Analysis of foreign reserves in the Arab countries, 1980-2002*. No. 10. Economic Policy Institute, Arab Monetary Fund.

Daniels, J. P., & Van Hoose, D. D. (2014) *International Monetary and Financial Economics*, Pearson.

EViews 9.5 (2016) HIS Global Inc., Irvine, CA.

Gosselin, M. A., & Parent, N. (2005). *An empirical analysis of foreign exchange reserves in emerging Asia*. Bank of Canada.

Jalil, Abdul, and Bokhari, S. (2008) The optimal demand for foreign exchange reserves in Pakistan." *International Journal of Applied Econometrics and Quantitative Studies* 5.1, 33-48.

Narayan, P. K., & Smyth, R. (2006). The dynamic relationship between real exchange rates, real interest rates and foreign exchange reserves: empirical evidence from China. *Applied Financial Economics*, *16*(9), 639-651. https://doi.org/10.1080/09603100500401278

Polterovich, V., & Popov, V. (2003). Accumulation of foreign exchange reserves and long term growth. Moscow: New Economic School of Moscow.

Prabheesh, K. P., Malathy, D., & Madhumati, R. (2007). Demand for Foreign Exchange Reserves in India: A Cointegration Approach. *South Asian Journal of Management*, *14*(2), 36.

Riasi, A., & Amiri Aghdaie, S. F. (2013). Effects of a hypothetical Iranian accession to the world trade organization on Iran's flower industry. *Consilience: The Journal of Sustainable Development*, *10*(1), 99-110.

Riasi, A. (2015). Barriers to international supply chain management in Iranian flower industry. *Management Science Letters*, *5*(4), 363-368. https://doi.org/10.5267/j.msl.2015.2.005