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**Inflation and Exchange Rate policies  
in Saudi Arabia:  
an inflation targeting perspective**

**R Fakieh**

**PhD**

**2018**

**Inflation and Exchange Rate policies in  
Saudi Arabia:  
an inflation targeting perspective**

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**A thesis submitted in partial fulfilment  
at  
the Manchester Metropolitan University  
for the award of Doctor of Philosophy  
Department of Economics, Policy and  
International Business  
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## ABSTRACT

This research evaluates the effectiveness of the current fixed exchange rate regime between the USA dollar and the Saudi Arabian Riyal in place since 1987, from the perspective of the Saudi Arabian economy. From the USA's point of view, the regime is beneficial as it guarantees a stable value of oil imports from Saudi Arabia at all times. However, this is not necessarily the case for Saudi Arabia, in particular when the USA authorities engage in expansionary monetary policies in order to stimulate the USA economy and Saudi Arabia is subject to inflationary pressures. That is not to say that the current fixed exchange rate regime is ineffective for the Saudi Arabian economy at all times. When both the USA and the Saudi economies are experiencing sustainable growth, the regime works for both countries. In other words, business cycle synchronicity is a prerequisite for the regime to be conducive to maintaining low inflation in Saudi Arabia via anchoring inflationary expectations, in the same way business cycle synchronicity is assisting Eurozone's viability.

In the absence of such synchronicity, the regime produces rigid monetary policies for Saudi Arabia, as it effectively renders them ineffective, and the Saudi authorities have to resort to contractionary fiscal policies as the only alternative to reducing deficits. The thesis is therefore evaluating alternative exchange rate regimes that could potentially be adopted by Saudi Arabia, and tests their effectiveness.

Despite therefore Saudi Arabia resuming its stable macroeconomic framework when its economy is recovering, which is, quite often attributed to its fixed exchange rate regime, alternative regimes could provide Pareto improvements in particular when the Saudi economy is in recession. By estimating ARDL and VECM models, the thesis provides strong evidence in favour of an exchange rate regime based on inflation targeting. The application of these models provides strong evidence that inflation targeting, if adopted, would successfully reduce inflation and at the same time stabilise the Riyal's exchange rate parities. This would include periods of sustained oil price volatility. In addition, as Saudi Arabia is the core GCC member country the implications of creating a common currency area are tested by using a G-PPP model. Interestingly, the results reveal that GCC countries meet the Optimum Currency Area criteria and therefore a single currency with Saudi Arabia as its base currency/country will be viable.

Thus, while fully recognising the political impediments, the main conclusion from a purely economic perspective is that Saudi Arabia should review its current exchange rate arrangements; employ inflation targeting; and lead efforts to create a currency union with the rest of the GCC member countries.

# CHAPTER 1

## Introduction

The adoption of the appropriate exchange rate policy has always been a critical issue for most countries, including the Middle East. Since the Bretton Woods agreement in 1944, the discussion about the two extreme regimes, namely fixed or flexible, on how to encourage the domestic economy, mainly via stimulating export activity is a crucial tool for any country to ensure a balance of payment strength.

Saudi Arabia is a compelling case to investigate since it has a fixed exchange rate peg with the US Dollar at the rate of 3.75 Riyals per \$1USA, since the reform of the Saudi monetary agency in 1952. However, in the early 1980s, the Saudi authorities allowed for some flexibility within a band for a few years, then moved back again to a fixed rate with the US Dollar in 1987. This was also the case in 2008-2009 (Al-Thumairi, 2012).

The Saudi economy has experienced many challenges in its local conditions and international relations. Since the early 2000s, the Saudi authorities have implemented a considerable infrastructure plan for all sectors of the economy such as education, health and trade. The 2008 economic and financial crisis had a massive impact on the Saudi economy because of its strong relation to the American economy.

Maintaining the fixed exchange rate, within the permitted fluctuation bands proved difficult, and inflation rates jumped to 8 percent. This situation calls for a re-evaluation of the Saudi monetary and fiscal policies, in order to stabilise domestic economic conditions and reduce inflation.

Moreover, since the last quarter of 2014, the drop-in oil prices has had a negative impact on the Saudi economy, as oil is the main export commodity. This has adversely affected the Saudi government budget, and the Saudi authorities have since looked for other alternatives.

An example of the new way of thinking is to improve the financial sector by issuing bonds and render the stock market accessible to international investors. On the other hand, the current political situation, since the early 2015 aiming to restrict terrorist attacks

and the war with Yemen also have a significant impact on the Saudi government spending.

These obstacles facing Saudi Arabia require appropriate macroeconomic management and policies to ensure stability. The exchange rate, inflation and other economic indicators are vital to Saudi Arabia as a country. It should also be considered that Saudi Arabia is part of the Gulf Cooperation Council (GCC), which initially planned to have a single currency by 2010. This objective has been postponed, for several reasons but mainly due to the European Monetary Union (EMU) debt crisis.

The plan was to create a single currency within the GCC countries and fix its value to the US Dollar in a similar manner that the Riyal has. Quite strikingly, the plan involved having a single currency pegged to the US Dollar instead of having a more independent exchange rate policy from the United States.

### **1.1 Research aim**

Thus, this thesis aims to evaluate the effectiveness of current exchange rate policies in Saudi Arabia and identify a more suitable exchange rate regime (EXRR) capable of coping with the local and international challenges encountered by the Saudi Arabian economy.

### **1.2 Research objectives**

In doing so, the thesis reviews the plan of reforming the single currency project with the other GCC members and apply the optimum currency area (OCA) theory to fulfil the need for macroeconomic stability. As a result, the research objectives are:

1. To identify the appropriate exchange rate regime for Saudi Arabia via an assessment of all available alternatives exchange rate policies (strong peg, managed float, pure float, etc.) while addressing all the main factors that influence the monetary and fiscal policies pursued in the Kingdom.
2. To recognise the relationship between inflation and exchange rate policies (EXRP) and addresses the possibility of pursuing inflation targeting (IT).

3. Examine the implications of adopting a single currency with other GCC countries by taking into account the manner it will influence the exchange rate peg and inflation in the Saudi economy and to the GCC region as a whole.

The choice of Saudi Arabia as a case study for my thesis is due to many reasons. First, Saudi Arabia is one of the main exporter countries in the world for oil, and they are a main influencer into OPEC policies. Second, Saudi Arabia has the two-holy mosque for the Islamic believers as they tend to come to visit the country for Hajj and Umrah. The Saudi Arabian Government with the rest of the GCC countries has already started the plan for having a single Currency. Saudi Arabia, Bahrain, Oman, Qatar and Kuwait formed the Gulf Cooperation Countries in 1981 to increase the economic and political integration. In 2008 Saudi Arabia, Kuwait, Qatar and UAE created a monetary central bank as a step for creating a single currency. Regardless, further details of the Saudi importance and the steps of the single currency creation in Saudi Arabia and the GCC is discussed in Chapter 3.

Therefore, this research focuses primarily on identifying the appropriate regime using a pure positivist and empiricist approach. To achieve these objectives, time-series econometric techniques are used to analyse the Saudi Arabian economy and find the most beneficial policy for the Kingdom. The data is yearly, covering the period from 1980-2015, to keep up to date with the current economic developments.

Econometric techniques are used to ensure objectivity and consistency with the results and provide a stronger platform for the Saudi economy to stand with its policies and regimes. The use of time series assesses different aspects of the Saudi Arabian economy.

Therefore, one of the primary econometric technique is the use of Augmented Dickey Fuller (ADF) tests, unit root and co-integration analysis to ensure white noise and stationarity. The use of ARDL technique with exchange rate and inflation targeting dummies were employed to assess different regimes with other determinant variables. Thus, different macroeconomic indicators are used such as GDP, interest rate, oil prices, nominal and real exchange rates, consumer price indices, export and import prices and government spending.

In relation to OCA, the model developed by G-PPP was considered to examine the Optimum Currency Area (OCA) in the GCC countries by assessing different real exchange rates. As discussed earlier, the challenges facing the Saudi Arabian authorities regarding the country's economic situation and adopting sounder policies is enormous. Further, existing research on the field features a literature gap regarding the impact of exchange rate policy on inflation rate volatility in the GCC region.

Most studies have focused on either exchange rate determination or inflation without considering them together. Therefore, this study is filling this literature gap by providing more evidence and insights into the relationship between inflation and exchange rate policies for Saudi Arabia and the GCC. As it stands, only Khan (2009) has put forward a proposal for addressing these topics together with data analysis. For GCC. Most previous studies focus on either inflation or Exchange rate separately and rarely discuss the relationship between the two agents.

This research also considers the single currency between GCC countries to shape monetary policies in Saudi Arabia. This research is important for authors who are interested in the Saudi economy and the MENA Region. The thesis provides recommendations to the Saudi monetary agency for an appropriate exchange rate regime leading potentially to an improvement in the current fiscal and monetary policies. As a result, these will be relevant to the Saudi authorities responsible for the macroeconomic decision-making in the Kingdom.

In addition, the analysis on creating a single currency in GCC, linked to ongoing EMU debt crisis has a stronger impact on the decision for committing to such a policy. Thus, the assessment of the main three aspects of this research namely exchange rate policy, inflation and optimum currency area facilitates drawing broader conclusions for the Saudi Arabian economy in particular and the GCC region as a whole.

This provides a significant input to current debates on Saudi Arabia's monetary options. This in conjunction with the growing interest the western world has shown and the wider interest in studying the GCC regional economy, due to the recent changes occurring in the region. The fall in oil prices and the recent terrorist attacks inform the

economic background of the GCC region. Overall, the research aims to be influential in terms of putting forward a set of policies that could ultimately ensure economic stability.

This Thesis is organised as follows. Chapter 2 presents a review of the literature. Thus, it evaluates the theory of exchange rate regimes. In doing so, it addresses all the possibilities for adopting such regimes and their advantages and disadvantages. In addition, it discusses the effects of inflation on macroeconomics stability and the use of inflation targeting as a means of ensuring low inflation, and the way inflation targeting has been successfully applied in various countries. The last part of chapter 2 discusses the OCA theory, its application in the European Union context while discussing the problems of the EMU debt crisis. The chapter draws on the experiences of other countries and on the way Saudi Arabia could adopt different regimes.

Chapter 3 focuses on the Saudi Arabia economy by discussing the importance of Saudi Arabia demographics to the rest of the world, and discuss the historical development for the Saudi Arabian economy, with the highlight on the Saudi Arabia plans for the future up to 2030. Furthermore, the research provides and analysis of previous studies in terms of exchange rate regimes in Saudi Arabia. The chapter also considers the primary determinants of inflation together with a critical analysis of previous studies. Finally, this chapter argues in favour of the application of the single currency in the GCC region and the way this will improve the economy of the area based on previous scholar opinions.

Chapter 4 sets out the methodology, starting with consideration of the main econometric models related to the topic and a critical analysis leading to the identification of the ones most suitable for this research. This is followed by model selection. Then, it discusses the theoretical background of the econometrics techniques used in the thesis.

Chapter 5 employs the most suitable models and applies them by using the STATA program to conduct the statistical analysis. The results are then interpreted, compared and contrasted with the ones of previous studies. Chapter 6 provides an interpretation of the results, with recommendations associated with current policies in Saudi Arabia

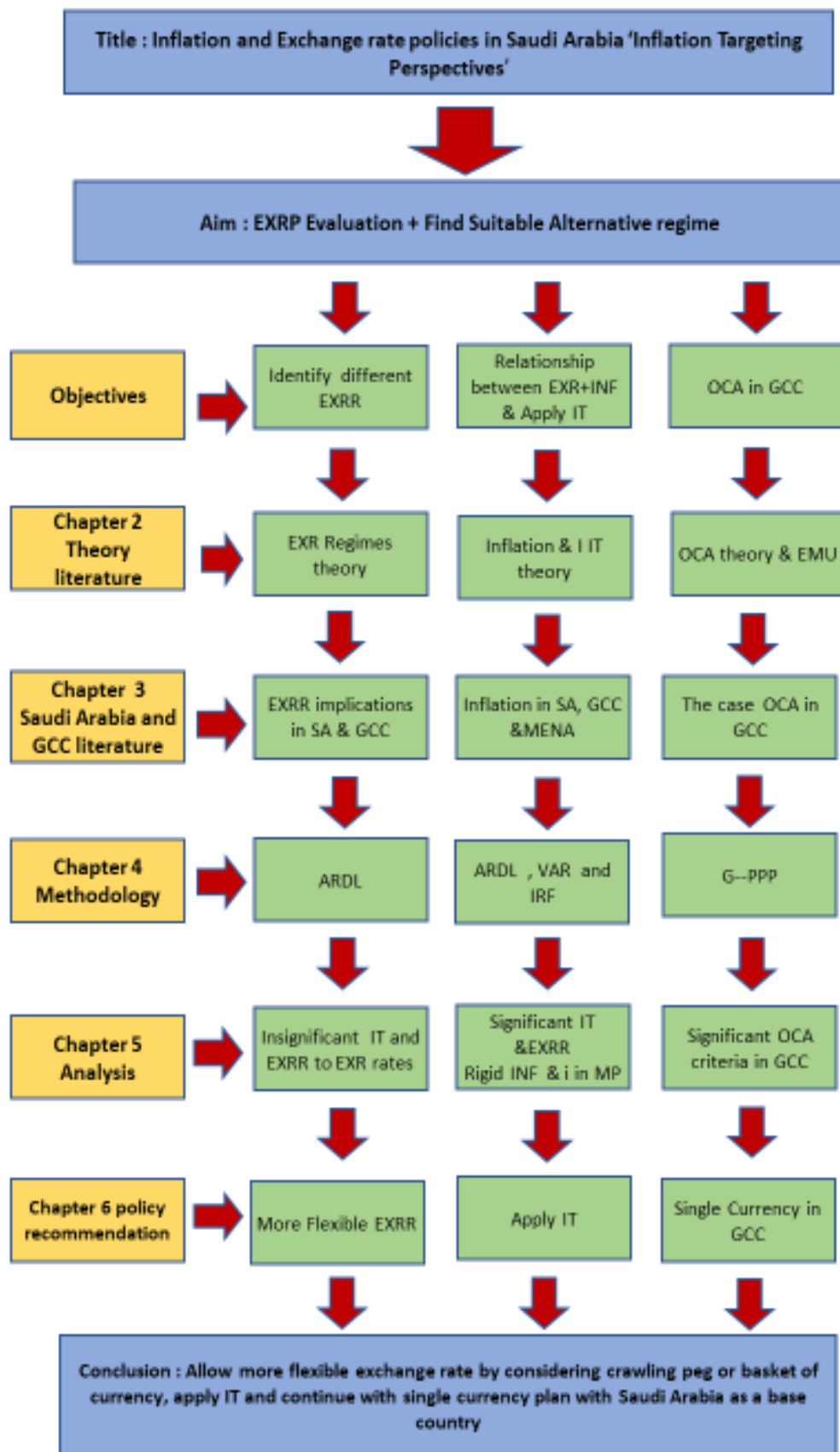
and the way these policies are influenced by political developments in the USA and the Kingdom.

Data assessment and evaluation informs the analysis at this stage, while the way the results are contributing to the existing literature on the Saudi Arabian economy is reflected.

Chapter 7 presents the main conclusion, summarising the main theories pertaining to different exchange rate regimes, inflation targeting and optimum union currency areas. The next diagram clarifies the thesis structure, and summarises the main outcomes.



Figure 1.1 Thesis structure



## CHAPTER 2

### Background to Alternative Exchange Rate Regimes

#### 2.1 Exchange rate parities

Exchange rate policies and international cooperation in the area have a profound impact into international monetary relations. According to Pilbeam (2006:5), the exchange rate is “*the domestic currency unit per a unit of foreign currency*”. The exchange rate parity of the domestic currency unit is measured in different ways, primarily as the nominal and the real exchange rate. The nominal exchange rate for example, between the pound sterling and the USA dollar, refers to the necessary amount of dollars required to purchase one pound in foreign exchange markets, while the real exchange rate is using nominal exchange rates and relative prices within a cross-country consideration (Pilbeam, 2006). Further, exchange rate volatility is highly correlated with relative price fluctuations that are caused by supply shocks that will alter the elasticity of demand for both goods and money. Real and nominal exchange rates will be affected by consumption of both foreign and domestic goods. The changes in real supply and demand shocks will disturb the exchange rate equilibrium. These changes will challenge central banks in achieving the optimal regime for the country especially in relation to purchasing power parity deviation (Stockman, 1980).

However, when trying to assess exchange rate issues, it is extremely important to take into consideration other factors such as import and export prices, economic growth and inflation (Montiel, 2009). Zumaqero and Rivero (2012) found that real exchange rates have a correlation with structural breaks in relation to banking and debt crisis and cause changes in nominal exchange rates regimes. Monetary policy has an important role in exchange rate determination and interest rates effects on real output. An appreciation in the exchange rate will impact the price level. On the other hand, a monetary expansion will cause a depreciation in the exchange rate parity and that will affect the trade, aggregate demand and real interest rates. The exchange rates are a critical channel to control monetary policy into aggregate demand and output (Dornbusch, 1976).

Another aspect that should be considered regarding exchange rate volatility especially in relation to inflation is exchange rate pass-through. In open economies, the degree of exchange rate pass-through causes inflation and influences import prices and therefore monetary policies (Shintani *et al.*, 2013). Fluctuations in exchange rates has adverse effects on import prices and makes consumer price index more volatile. This has a major impact on the exchange rate regime under perspective. As such, the choice of exchange rate and inflation regimes should be conducted carefully to stabilise the domestic economy and enhance the volumes of international trade.

## 2.2 Exchange rate regimes

The country-specific exchange rate regime has a major impact on the international monetary system and to a large extent influences relation between countries (Bayoumi and Eichengreen, 1998). Historically, in the post war period the most well-known system was that of the Bretton Woods, which functioned from 1944 to 1973 (Montiel, 2009). The collapse of Bretton woods led most countries to adopt a flexible exchange rate based on their currencies' market values as determined by supply and demand (Pilbeam, 2006). One of the reasons accounting for the collapse of Bretton Woods is the interaction of politics and their influence on international monetary relations (Eichengreen and Razo-Garcia, 2006).

Governments and central banks should be particularly careful when choosing an exchange rate regime. Any country that aims to prevent an exchange rate depreciation will try to fix its foreign exchange reserves to avoid borrowing. On the other hand, avoiding exchange rate appreciation will challenge the central banks inflation target. Therefore, central bank should consider the demand for domestic currency and choose exchange rate to clear the money market changes over time domestically, in order to avoid a balance of payment crisis (Krugman, 2002).

A failure in adopting a proper exchange rate regime is a core ingredient for financial crisis, the inconsistency in the relation between country exchange rate arrangement and domestic policies will overvalue the exchange rates. This is a particular feature in the first-generation exchange rate crises models. Thus, any country that favours free capital

movements must make a consistent choice between internal and external (exchange rate) policies (Ha *et al.*, 2013). Riveo and Ramos Herrera's (2014) cross-country study reveals that using different income levels, inflation rates are maintained higher for high income countries under flexible exchange rates and vice versa, while mid-income level countries under intermediate exchange rate regimes will normally experience less volatile inflation and exchange rates.

Therefore, in terms of assessing the different types of exchange rate regimes and their effectiveness it is essential for countries to determine whether pursuing their preferred independent monetary and fiscal policies is possible. The two main forms of exchange rate systems are floating and fixed exchange rates regimes. Each regime has advantages and disadvantages that affect countries' macroeconomics policy framework.

#### 2.2.1 Flexible Exchange rate regime

Many developed countries, in particular in North Europe and the Anglo-Saxon world, operate on floating exchange rates. According to Dornbusch (1976), flexible exchange rate regimes will enhance capital mobility in the short-run under the Mundell-Fleming analysis. Within the increase of capital mobility worldwide, the flexible exchange rate seems more appealing to encourage the capital market freedom (Levy-Yeyti and Struzengger, 2005).

Under flexible exchange rates, the supply and demand for currencies will eventually lead to equilibrium in currency markets (Pilbeam, 2006). Calvo and Mishkin (2003) also agree that flexible exchange rate regimes would be most appropriate for the production or trade shocks, provide more policy options to governments to obtain transparency in fiscal and monetary policies and be able to adopt inflation targeting as a means of maintaining low inflation and anchoring inflationary expectations. In addition, flexible exchange rates smooth the adjustment of the domestic economy to international shocks, in particular with regard to unemployment (Stockman, 1999). Countries that have experienced strong growth, export concentration and financial development will opt for a flexible exchange rate regime. Also, countries that are more sensitive to external shocks like the emerging market countries, featuring financial stability and

innovation, will have less control over capital and favoured flexible exchange rates (Gosh, 2014).

On the other hand, flexible exchange rate regimes have many weaknesses such as inflation persistence (Alogoskoufis and Smith, 1991). In addition, the ability to balance the foreign trade portfolio will be difficult with a flexible exchange rate regime (Krugman, 2002). In terms of real exchange rates, flexible exchange rate will increase the volatility of real exchange rate movements especially in time of crises (Zumaquero and Rivero, 2012). A depreciation of the US Dollar will have adverse effects to countries that have lent money to, either the USA or to other countries in USA dollars (Calvo and Mishkin, 2003). This can explain that while flexible exchange rate regimes provide flexibility to monetary policy and currency markets, they also cause many disruptions in the proper functioning of money markets and inflation targeting. Montoro and Moreno (2011) has emphasized the danger of inflation and its variability associated with flexible exchange rates.

The inability to controlling exchange rate markets by neither the government or foreign exchange markets will alter the trade of domestic money by foreigners, which will affect the aggregate portfolio. Exchange rates fluctuations are sensitive to expectations and these will reflect into the foreign exchange market in the short run (Krugman, 2002).

On the other hand, a fixed exchange rate regime offers another policy option for monetary authorities to maintain a stable economy. Again, a fixed exchange rate regime has advantages and disadvantages that have a major influence on the other economic variables. Such a system provides the ability to countries to trade with their trade partners in a far easier manner than otherwise (Levy-Yeyati and Sturzenegger, 2005). Countries that have balance sheet problems and share foreign currency liabilities will favour fix exchange rate to avoid a worsening in their debt servicing that caused by exchange rate volatility especially if they hold reserves (Ghosh, 2014). In addition, a fixed exchange rate regime provides enhanced macroeconomic stability because of the direct relationship between prices of foreign goods and the domestic currency (Montiel, 2009). The nominal exchange rate volatility will also be reduced with a pegged policy (Levy-Yeyati and Sturzenegger, 2005).

In the case of nominal shocks caused by money supply or money demand fluctuations, fixed exchange rates are more conducive to maintaining a stable economy (Calvo and Mishkin, 2003). For Stockman (1999), a fixed exchange rate regime provides a nominal base for the creation of a disinflationary environment and benefits the economy if there are similar shocks in the countries joining the system. Especially in countries where they suffer from less credible financial institutions the Pegging regime will reduce inflationary pressures (Rose, 2011). From an empirical point of view, fixed exchange rates can reduce inflation by 6 % per year and around 5% in three years. This will be achieved by central bank importing the good performance of the policies from the anchor country (Rivero and Ramos-Herrera, 2014). In addition, the government can engage part of its resources for an expansionary fiscal policy (e.g. via utilising part of its reserves) (Krugman, 2002). From a microeconomic perspective, the fixed exchange rate will reduce transaction costs, which will be more appealing for trade and also reduce the exchange rate risks for investors (Rose, 2011).

#### 2.2.2 Fixed exchange rate regime

On the other hand, fixed exchange rate regimes feature several disadvantages. Countries that pegged their currencies to US Dollar have/could experience potential speculative attacks with regard to their pegged rate (Levy-Yeyati and Struzenegger, 2005). These speculative attacks will have a huge effect on government reserves that will reduce the domestic money supply through to the exchange rate (Krugman, 2002). As the interest rate is controlled by the USA, Saudi Arabia has limited scope of utilising an independent monetary policy for the attainment of domestic policy objectives (Calvo and Mishkin, 2003).

In the case of a deficit, as long as the government is keeping its exchange rates fixed, the deficit will be controlled and firmed; however, the pegging effort will collapse at some point and that will lead to a massive crisis in the balance of payments. The certainty restored in government policy will undergo three stages: first, declining reserves; second, sudden attacks; and third, currency depreciation after the crisis (Krugman, 2002). In fact, Roubini (2006) described the current exchange rate arrangements as a Bretton Woods 2 (BW2). Roubini argued that BW2 is inherently unstable and eventually

the regime will cause major imbalances to the world economy, similar to the ones experienced under the Bretton Woods up until 1973. In restoring these international balances, the USA has lowered its rate of interest to unprecedented levels by historical standards. The USA current account deficit is increasing more than the efforts by world central banks to stabilise their dollar reserves, thus there is a need for financing the US deficit. The USA external debt will not remain sustainable and at some point, the USA dollar will depreciate. One of the main countries that is influenced by this is China, in which case the Chinese central bank will struggle to adjust its currency over the global current account imbalances.

The disadvantages of fixed exchange rate regimes leading to massive speculative attacks against the fixed pegged forced countries to a flexible exchange rate regime and free-floating exchange rates for domestic currencies. Argentina, in 2001, provides an example of such a case. Central banks managed to change their domestic contracts to adjust the foreign currency index, following massive depreciation. The case of Latin American countries is indicative with central banks not able to borrow in order to defend the pegged regime, which precipitated speculative attacks on their domestic currencies (Ha *et al.*, 2013).

After 2011, central banks in emerging market economies became heavily involved in foreign exchange markets to access US Dollars to prevent currency movements and prevent exchange rate depreciations. That has caused increases in inflation rates from import prices (Gosh, 2014). The fixed exchange rate can help reduce high inflation rates in the short-run but in the long-run – it will not be useful once a certain level of inflation has been achieved (Rivero and Ramos-Herrera, 2014). To summarise, the next table will focus on the main pros and cons for each Exchange rate system.

**Table 2.1: Summary of flexible and fixed exchange rate regimes advantages and disadvantages**

	Fixed Exchange rate regime	Flexible exchange rate regime
Advantages	<ul style="list-style-type: none"> <li>* Stability in trade transaction costs (certainty about Exchange rates).</li> <li>* Macroeconomics stability regarding to foreign good and local currency.</li> <li>* Reduce Nominal exchange rate Volatility.</li> <li>* Create Nominal base for disinflationary environment.</li> <li>* Government can improve their resources in expansionary fiscal policy.</li> </ul>	<ul style="list-style-type: none"> <li>* Enhance capital mobility (capital freedom).</li> <li>* Increase transparency in Monetary and Fiscal policies conducted by Central bank.</li> <li>* Automatic Adjustment for currency equilibrium market.</li> <li>* Adjustment to international shock.</li> </ul>
Disadvantages	<ul style="list-style-type: none"> <li>* Countries will suffer from speculative attacks.</li> <li>* Deficit will be controlled by government as it will collapse in the long run, this will lead to balance of payment crisis.</li> <li>* Imbalances in world economy similar to Bretton woods era.</li> <li>* Increase inflation from import prices.</li> </ul>	<ul style="list-style-type: none"> <li>* Inflation persistence.</li> <li>* Difficulty in Balancing foreign trade portfolio.</li> <li>* Increase real exchange rate volatility.</li> <li>* Problems in controlling Exchange rate market.</li> </ul>

### 2.2.3 Exchange rate regimes and politics

The debate between fixed and flexible exchange rate regimes kept pace with the changes of the world economy. Rose (2011) has argued in favour of the credibility of different exchange rate regimes, as quite often central banks claim to have a free-floating regime but they do intervene to mitigate the negative effects of exchange rate volatility. On the other hand, countries that have fixed exchange rates could suffer from high inflation and capital controls and they could experience an underground market for foreign currency traders. In addition, there are many classifications of fixed exchange rate regimes according to different authors. Another aspect is that the exchange rate regime in perspective is highly influenced by politics, for example: countries that were formerly colonised tend to keep their exchange rate fixed to their colonial powers.



From the empirical studies, the choice of an exchange rate system remains a controversy and it is not based on strong statistical evidence or clear-cut advantages. Ha *et al.* (2013) have addressed the impact of government ideology into exchange rate policies. They have argued that left-wing governments are prone towards higher inflation as they tend to manipulate monetary policy. They also tend to combine high degree of free capital mobility with fixed exchange rate that can cause a currency crisis. On the other hand, developing countries with right wing governments have failed to deal with credible policies and stick to fixed exchange rate systems to ensure financial stability, as a means of financing their budget deficits. However, left-wing governments tend to have higher budget deficits than right government because they are more prone to speculative attacks. Thus, the central bank' policies should be separated from government ideology and vested interests in order to avoid crises. Some researchers also argue that normally the smaller the countries the more flexible their exchange rate will be. Empirically, this has been proven to be wrong since the smallest countries in the world do not have a flexible exchange rate regime.

There was also a belief that countries with a population exceeding 2.5 million people are reluctant to fix the parity of their currencies. This is certainly not true in the case of China that operates under a system of quasi-fixed exchange rate system. Therefore, the size of the economy and the population are trivial issues to central banks policies compared to other economic variables (Rose, 2011). However, the Chinese growth model focusing primarily on boosting exports in excess of 30% of GDP and the massive increases in its trade as a means of serving its political interests, has already caused controversies with the new USA administration that requests a more flexible regime. Re-visiting the debate will enhance our understanding of the advantages and disadvantages conferred by both regimes and answer the thesis' question relating to theoretical foundations.

## 2.3 Inflation

Inflation, defined as the percentage price increased per calendar year, causes a variety of problems to every economy. It leads to poor functioning of product and labour markets, it disturbs monitoring suppliers and competitors, has a negative impact on the Purchasing Power (PP) of households and consumers, and renders the domestic economy less competitive in international markets leading to market loss. By distorting decision-making, it hinders investment and investment programmes (Sloman *et al.*, 2014).

### 2.3.1 Importance of inflation

Inflation is one of the main concerns for monetary authorities since high rates will strain the domestic economy. Empirically, the period from the mid-1970s to early 1990s was characterised by high inflation rates. Since then inflation rates decelerated; this reflects the importance of employing fiscal and monetary policies with the aim of reducing inflation (Montiel, 2009). In addition, changes in USA inflation rates are not only influenced by internal sources but also by trading partners (Montiel, 2009). The rate of inflation is also influenced by other factors, such as supply shocks and exchange rate regimes (Bernanke and Mishkin, 1997). High inflation rates are associated with countries that adopt flexible exchange rates and have low per capita income, while low inflation is observed in countries with high income and target their exchange rate parities (Rivero and Ramos-Herrera, 2014).

One of the main problems of inflation is that inflationary expectations could disturb monetary authorities in setting their targets, as a result having an inflation anchor will be important to prevent such shifts (Bernanke *et al.*, 1999).

Conway *et al.*, (1998) has addressed inflation costs into consumer uncertainty which will affect future purchasing power and disturb monetary authority steadiness, in small open economies, as the movement of nominal exchange rate will have a direct effect on import prices that will increase the pressure on inflation rates.

### 2.3.2 Inflation targeting

Inflation targeting has been widely adopted in several countries such as the UK, Russia and New Zealand. In order to be able to pursue inflation targeting, countries need to be in a flexible exchange rate regime (Kara and Nelson, 2003). Inflation targeting is a specific framework for monetary policy that is based on central banks publicly announcing the inflation rate target over a specific period, including potential reviews of the target. Often, the challenges from inflation targeting relate to the rules-versus-discretion debate in optimal monetary policy. The rules-based approach is automatic, credible as the monetary authority does not require the public's engagement with inflation policies, and based on a constant money growth known beforehand, which enhances the power of forecasting. On the other hand, discretionary-based approach does not seek public engagement in the policy formulation; the central bank can set and review the inflation target on pre-specified time intervals. It is also flexible and quick to adjust to new information and changing economic circumstances. An obstacle with the discretion-based approach is the potential lack of discipline that could result in uncertainty in the public's perception of emerging inflationary pressures. Such pressures could emerge from political intervention aiming to reduce unemployment by manipulating the rate of interest, which could have adverse effects to future inflation and to the stability of the economy. This could lead to 'time-inconsistency' problem in monetary policy. In simple terms, this implies that a policy that is optimal today is no longer optimal tomorrow.

Overall, inflation targeting could be used to smooth out the volatility of output and employment. Depending on the institutional arrangements and the relationship between central banks and the government, inflation targeting is usually preferred by the latter as a means of reducing inflation. Over time, monetary authorities have used inflation as a monetary policy target.

Moderate inflation rates are harmful to the economic efficiency as they could lead to misallocation of resources and thus to economic growth. This reflects the need to adopt monetary policy aiming to anchor inflationary expectations (Bernanke, 1999).

Friedman's critique on monetary policy that there is no trade-off between inflation and unemployment, therefore the Central Bank's credibility needs to form the basis of

monetary policy. If the trade-off is only short-run in nature, in the medium to the long-run there is no trade-off as workers, recognising the loss in real wages, demand increases in nominal wages, causing an increase in expectations generated inflation. On the other hand, supporters of the trade-off theory, argue that there is a trade-off between inflation and unemployment by accepting some inflation with lower rate of unemployment (Palley, 2003, 2008). In practice, inflation acceleration in the 1970s rendered inflation targeting and anchoring of inflationary expectations vital for many countries including the UK.

Lucas' critique questions the use of optimal control as there is a lack of consideration of public expectations and this could lead to difficulties in controlling the economy in the face of uncertainty. In addition, there is no empirical evidence in favour of public expectations.

#### *2.3.2.1 Benefits of inflation targeting*

The benefits of inflation targeting include a reduction in inflation rates and anchoring inflation expectations. Inflation targeting could be conducive to lowering the pass through of shocks to the domestic price level, and it also has the potential to reduce the nominal interest rate. Broadly and depending on country specific conditions, inflation targeting has proved a useful tool of macroeconomic policy (Bernanke *et al.*, 1999). Inflation targeting increases output and reduces inflation variability, and it improves inflation rate forecasts especially in countries that have consistent fiscal policies and enjoy surpluses, financial depth and high ratios of M2 to GDP will encourage monetary authorities to adopt inflation targeting system (Hu, 2006).

#### *2.3.2.2 Drawbacks of inflation targeting*

It involves resources to restore inflation to target. Although it could cope very well with supply shocks, inflation targeting consumes resources in terms of output and employment. Another problem with central banks is that they employ inflation targeting as a framework, in that the monetary policy focus only on the temporary level of prices that have a direct effect on exchange rates by concentrating on import prices. From import prices, they estimate a consumer price index. Monetary authorities have to also

consider the persistence source of inflation rate, so called 'core' inflation. This is one of the problems with Svenson's model. In arguing against inflation targeting, Svenson has focused only on domestic inflation targeting rule, by targeting the consumer price index, while ignoring the flexible rule of controlling output gap (Conway *et al.*, 1998). Countries that have lax fiscal policies and have high deficits could not have an expansionary monetary policy therefore, they cannot benefit from inflation targeting. In addition, countries that have high external debts cannot adopt inflation targeting (Hu, 2006).

The choice of inflation targeting by a central bank and the monetary authorities of countries provides certainty in the domestic economy (Svensson, 2000). Regardless of the degree of capital mobility, inflation targeting could prove superior and more beneficial than the fixed rate policy, as it will place emphasis on the role of monetary policy as well (Kara and Nelson, 2003). An inflation-targeting regime seems attractive in many respects. First, the use of exchange rate policies for conducting the monetary policy under a flexible regime framework will be successful (Svensson 2000, Brenner and Sokoler 2010).

However, inflation targeting could be conducted under other intermediate regimes such as crawling peg and crawling band but not with hard peg regime (Truman, 2003). Second, it provides a ceiling for the economy to avoid demand shocks (Bernanke and Mishkin, 1997). Third, the appreciation of the domestic currency will cause a decline in GDP and inflation, due to output and competitiveness losses, which lead to a monetary policy mechanism (Taylor, 2001). Fourth, the shortcomings of various fixed exchange rate regimes in many regions, the trade-offs between output, and inflation restores the credibility of monetary authorities to the public (Bernanke and Mishkin, 1997). Yet, adopting inflation targeting cannot ensure exchange rate stability; therefore, the central bank should monitor exchange rate fluctuations even with a flexible inflation targeting framework (Truman, 2003).

#### *2.3.2.3. Example of countries inflation targeting application*

An example of inflation targeting as a monetary rule is provided by the United Kingdom. The Bank of England adopted inflation targeting in 1992 when inflation rates ranged

between 1 - 4%; and in 1997, the monetary policy authorities reduced the upper limit to 2.5% (Angeriz and Arestis, 2007). The relation between inflation and exchange rates becomes more important in the UK after adopting the inflation targeting policy framework in 1992 (Kara and Nelson, 2003). The UK provides an example of credible monetary policy as monetary authorities keep publishing detailed reports on inflation rates and inflation rates forecasts to support the overall predictions for the UK economy and enhance the credibility of the central bank (Bernanke and Mishkin, 1997). The Bank of England has used a variety of methods to conduct inflation targeting. These include instrument paths such as deviation from output, judgemental adjustment (not relying on a model alone), open letter system by announcing why inflation should be less than 2.5% and publishing inflation forecasts after monetary policy meetings to monitor the quality of the policy (Svensson,1999). Inflation targeting in the UK provides more discretion in monetary policy and helps maintain a low inflation rate (Angeriz and Arestis, 2007).

Another country that has adopted inflation targeting under different scenarios is Israel. It is the only country that adopted inflation targeting when inflation was at double digits level and used both inflation and exchange rate targeting. It started to adopt inflation targeting in 1985 following hyperinflation and large deficits. The Israeli Central bank managed to complete the transition from fixed exchange rates to inflation targeting in 1998 after they successfully stabilised prices, reduced inflation to under 10%, and increased the flexibility of policies to reduce their currency (Shekel) shocks (Bernanke *et al.*, 1999).

#### *2.3.2.4 Financial Dollarization*

Financial dollarization occurs when most assets and liabilities are denominated in a foreign currency (e.g. US Dollar), and partially replace the local currency in financial markets. Most countries that are dollarized are usually experiencing low growth and high volatility. The reason for that is they are more prone to slow financial development due to inflation and depreciation of the real exchange rate. On the other hand, the countries that used inflation targeting have lower real exchange rate fluctuations.

Therefore, the use for inflation targeting within a flexible exchange rate regime will help to reduce inflationary volatility and real exchange rate depreciation. From an empirical perspective, the inflation-targeting tool has reduced the volatility of financial dollarization by 8%. However, countries that have experienced a sharp depreciation in real exchange rate are less likely to use inflation targeting as a monetary rule, as high inflation will increase the money growth and help openness in trade, thus the fixed exchange rate will be favoured over inflation targeting regime.

Lin and Ye suggest that the Monetary Policy Authorities in such countries need to focus on insuring the stability of inflation and real exchange rates, as inflation targeting would help to reduce financial dollarization problem in dollarized economies (Lin and Ye, 2012).

The central bank behaviour is quite different in emerging markets, compared to developed countries. In emerging markets, once the central banks commit to inflation targeting, the inflation rate reduces respectively. The IMF reported that inflating has reduced 4.8% in emerging markets, together with volatility. The reduction in inflation in the end will reduce oil prices and exchange rate shocks, which will lead to stable capital flows and eliminate sudden stops. However, these countries will be more prone to disinflation pressures.

Several authors have argued that the monetary policy behaviours do not differ in countries that adopt inflation targeting and others that do not. They point to Latin American countries used the interest rate policy as monetary tool. The response to inflation before adopting inflation targeting in 1999 was strong and persistence, after inflation targeting the nominal exchange rate was stabilized. Inflation targeting behave similarly to fixed exchange rate systems in insuring interest rate and exchange rate stability with more freedom in Central Bank authorities. This study also differs between commodity and non-commodity countries; again, the support for the credibility of inflation targeting is shown in commodity exporting countries, because they suffer from high inflation and interest rates. Inflation targeting has reduced real exchange rate and has increased interest rates in the short run in commodity countries. However, the real exchange rate depreciation should not be the only reason for monetary authorities to adopt inflation targeting. The validity of such an approach could be diminished over time

and fail in its goal in reducing inflation and anchor nominal interest rate, especially in the commodity countries (Aizenman *et al.*, 2011).

#### *2.3.2.5 The relation between inflation targeting and economic agents*

Conway *et al.* (1998) have addressed different economic agents in relation to inflation targeting: by including household, firms, government, foreign sector and the monetary authorities, when there is an excess demand, the pressure on inflation increases. Therefore, domestic prices are not sensitive to exchange rates and they reduce the importance of using consumer price index as an anchor for inflation. Households base their expectation on utility, subject to a budget constraint so they choose either consuming or saving; on the other hand, firms' main concern is maximizing their profit with constant return, thus both of them share the same high expectation of output that will increase inflation (Bernake *et al.*, 1999). The government will use fiscal policy to increase expenditure and debt; the foreign companies will import goods and purchase domestic exports. All of these agents will enhance the increase of inflation that urge the use of inflation targeting to secure monetary policy (Conway *et al.*, 1998).

From an empirical investigation into different categories of countries (industrial and non-industrial), the support for countries with open economies and non-industrial was limited for inflation targeting. This is because they are more vulnerable to external factors and variable inflation; the inflation targeting will not help them to control inflation. In addition, there was little evidence that inflation targeting has improved the macroeconomic performance after adopting. This is due to the fact that each country has different external and internal factors that could be tested to check the credibility of inflation targeting. In addition, the monetary authorities could use other policies at the same time with inflation targeting to enhance its credibility. This is more the case with emerging markets countries.

Another aspect from the empirical analysis was the relation between inflation and growth. Countries that want to improve their growth rates would adopt inflation targeting to improve their economic performance. Financial crisis and external exchange rate pressure encourage the choice of inflation targeting to eliminate these problems.



This study also suggests that the IMF should support the inflation-targeting regime as a policy framework (Truman, 2003). Whether the country is having a financial support from IMF or not, IMF could provide advice and recommendation for countries to the importance of inflation targeting by addressing the limited risk for this policy and the relaxed condition that is associated with it. The IMF could set specific criteria that could be applied for countries who wish to adopt an inflation targeting policy.

#### *2.3.2.6 Challenges of inflation targeting - credibility in times of crises*

After two decades of applying inflation targeting, the challenges faced have increased massively. Especially after the 2008 financial crisis and the European debt crisis. The monetary authorities find it more difficult to keep their credibility with the public in providing data and forecast related to macroeconomic performance that is a pillar for keeping inflation targeting. Another problem is that the 2008 crisis has caused severe deflation demand shocks that decline inflation to zero rate (Schmidt-Hebbel, 2010).

In addition, the asset pricing controlling failure after the 2008 crisis is another challenge for inflation targeting, asset prices fluctuations due to regulation consistency along with bank behaviours. One of the solution to overcome the asset pricing swings is to combine fiscal and monetary policies to cure the imbalances. Relying on inflation targeting will not solve the issue due to restriction in central bank independency in times of crises. Some argue that inflation targeting could increase asset prices due to increase in interest rates. Low growth could be associated with high interest rate if there was no fiscal intervention. However, a large fiscal injection could cause a deficit and decrease interest rates to very low interest rates. That should not be a reason for the failure of inflation targeting, it is the global imbalances that should be addressed – which is beyond central banks' control (Allsop, 2010).

## **2.4 OCA**

Mundell first identified the benefits accruing from the creation of an OCA. These include central bank cooperation, a reduction of unemployment and inflation bias, protection of depositors, reduction of exchange rate risk exposure and stress alleviation from

calculating conversion costs and accounting standards (McKinnon 1996, Copeland 2008).

#### 2.4.1 OCA and EU

The inability of flexible exchange rates to reduce exchange rate volatility in the 1970s led a number of countries, notably France and Germany, to promote the idea of monetary integration among countries with similar economic characteristics and geographic proximity. Ultimately, this could lead to the establishment of a single currency, as is the case in the European Monetary Union (EMU). Indeed, the EMU is an example of a fixed exchange rate regime involving member countries that have some sort of limited discretion (Copeland, 2008). In addition, under a monetary union, monetary, fiscal and exchange rate policies should be made based on collective decision-making (Montiel, 2009). For a monetary union to be viable, central banks need to have a strong institutional support (Eichengreen and Razo-Garcia, 2006). The European Central Bank (ECB) provides a very good example, as countries in the Euro-zone formulated the final stage of monetary integration by adopting a single currency as their legal tender (the Euro) in 2002. In total, 19 member countries have joined the EMU. The European Monetary Union though has faced immense challenges recently regarding the massive debts accumulated in its Southern countries (Montiel, 2009).

Participation in an optimum currency area involves the fulfilment of various criteria. An OCA in order to be viable should provide some flexibility in terms of agreeing the fiscal and monetary policy to be adopted for the area as a whole by ensuring: 1) price stability via inflation targeting, 2) considering and anchoring inflation expectations, 3) employ pro-cyclical fiscal policies to minimise the impact of exogenous or asymmetric shocks (Ferrero, 2009).

The optimum currency area seems an appropriate framework for its members in several respects. According to Bayoumi and Eichengreen (1998), the main benefit of OCAs is that they accommodate asymmetric shocks. Bayoumi and Eichengreen also claimed that in open capital markets, the OCA will be supportive and the intervention will help to reach a very efficient capital market (Bayoumi and Eichengreen, 1998). In addition, when

Mundell (1961) first introduced the theory of the OCA, many benefits accruing from joining/establishing were considered. First, the OCA is based on co-operation among central banks, which will provide the international supply of money something that could prove superior to a single currency. However, central banks could have achieved independence domestically through government, but might need some changes; and is separated from the common central banks (Baldwin and Wyplosz, 2015). Second, within an OCA, unemployment and inflation bias will be reduced since the central bank authorities are willing to utilise surpluses to support deficit regions of the area.

Third, an OCA will protect depositors and encourage the creditors by developing their long run capital. Fourth, the exchange rate risk will be covered, by affordable costs within the OCA. Furthermore, an OCA will help in reducing the stress of calculating the conversion costs and accounting standards (Copeland, 2008). In practice, the EMU seems rewarded in terms of its central bank control over inflation during the last 13 years (De Grauwe, 2016). On the other hand, OCA theory has a number of shortcomings including successfully reducing exchange rate volatility of its member countries (Copeland, 2008). However, the need for an effective policy response towards inflationary pressures and the different competitiveness rates in each member of the union could jeopardise the functioning of the OCA (Lombardo, 2006). Another drawback of monetary currency area integration is asymmetric shocks. When prices are rigid, a common currency cannot defeat shocks and insulate all countries that belong to the union (Baldwin and Wyplosz, 2015). Generally, even though OCAs have encountered problems these can be attributed to the lack of meeting its criteria, it offers considerable advantages.

According to De Grauwe (2016), the disadvantages of applying the OCA criteria in the case of EMU are the failing of bank supervision and regulation during the recent financial crisis. Another reason is that the EMU and the recent years could not overcome the difference in the fiscal power between the northern countries like Germany and France and the southern countries like Greece and Italy. Therefore, they faced what its known as the Trilemma where EMU countries should have unified Fiscal Sovereignty, no bailout clause and independent Monetary policy, which become impossible in the recent years especially after the 2010 debt crisis. However, the problems facing EMU should not

prevent other countries forming a monetary union since their economic structures are different. He pointed to the currency union in East Asia as an example (De Grauwe, 2016). Therefore, De Grauwe's (2016) proposal strengthens the case that East Asian countries can benefit from forming an OCA.

#### 2.4.2 The EMU as an Optimum Currency Area

According to traditional OCA theory, the extent to which the microeconomic advantages will be able to offset the adjustment costs in the presence of country specific asymmetric shocks will be largely determined by the degree of wage and price flexibility, labour and capital mobility and the integration of trade and production in the countries joining the single currency. Similarly – quite crucial when comparing the efficiency gains with the adjustment costs, in the case of a country-specific asymmetric shock – is the severity and duration of the shock itself (McKinnon, 1996).

In the European Union (EU), the successful functioning of the European Monetary System (EMS) together with the successful implementation of the Single European Act (SEA) during the late 1980s was perceived as fulfilling the traditional conditions necessary for the formation of an OCA, and as such, facilitating the way to the creation of a monetary union. This was reflected in the Delors Report (1989) that contained specific proposals for the creation of a monetary union with a single currency, accompanied by a European System of Central Banks independent of any political influence. The presentation of the Delors Report sparked an intense debate in the EU countries over the desirability of a monetary union and creation of a single currency. The Delors report received legal support by the signing of the Maastricht Treaty in December 1991 that endorsed all of its proposals (Buiter, 1999).

The OCA conditions were accompanied by the Maastricht Treaty criteria as a means of ensuring macroeconomic stability and convergence and were measured quantitatively by specific macroeconomic indicators (inflation rates, interest rates, debt, deficit and exchange rate volatility). The Maastricht Treaty criteria were adopted in order to provide a framework for judging the progress countries made towards joining EMU as well as safeguarding EMU's viability once created. In 1997, when it became apparent

that a large number of countries will make it to the third stage, that of joining the single currency, the Stability Pact was agreed upon as a means of ensuring fiscal sustainability for all countries joining (Currie, 1997).

However, research prior to the creation of the EMU focused on the extent to which the traditional OCA's conditions were fulfilled by the countries aiming to join EMU as well as addressing other criteria that were desirable for the creation of a viable monetary union (Artis and Zhang, 1997; Artis, 2000). These focused primarily on dynamic extensions of the traditional OCA theory and they included the process of countries' economies adjustment over time, structural changes in a monetary union, the importance of capital markets, the credibility of institutional framework and the role of nominal and real exchange rates. Therefore, by combining the traditional OCA theory and its dynamic extensions, a number of conditions were identified necessary for the successful establishment and participation in a monetary union with a single currency (Kawai 1987, Tavlas 1993). These include wage and price flexibility, capital and labour mobility, financial market integration, degree of openness, similarity in production structures, inflation rate convergence and fiscal integration.

The efforts to accelerate political and financial integration in the aftermath of establishing EMU led to policy developments and initiatives aiming to create a European constitution, reassess the role of the European Central Bank, introduce major revisions to the SGP and evaluate the powers the European Parliament can exert on economic policy decision making in EMU. The adoption of a European constitution rejected by referendums in France and the Netherlands in 2005 posed a threat to the process of political integration that has stalled since. At first, this was not a major problem for the EMU functioning. Indeed, from 1999 to 2008, EMU functioned very effectively with its viability guaranteed by the continuous integration of its financial markets (Gros and Mayer, 2010). Further, the success of EMU made it a 'model' monetary union for other regions, such as the GCC, already engaged in early stages of monetary and economic integration (Rossi, 2009).

However, the debt crisis in EMU and the subsequent policies implemented in order to resolve it has led to questioning its effectiveness as a model for completing or at least

enhancing monetary integration. The 'old' arguments against creating a monetary union in EU and against joining once EMU was realised, have re-surfaced and political forces against EMU have gained momentum (Munchau, 2011). The outcome of the May 2014 European Parliament elections attests to that.

Essentially, two different, though not necessarily mutually exclusive, sets of arguments have provided the basis for questioning the durability of the EMU. First, there is the set of considerations which have a predominantly economic focus. These emphasise differences in market rigidities, particularly in labour markets, among the EU member economies. In broad terms, it is maintained that EU is not an optimum currency area in its dynamic extensions and as a result, economic pressures will lead to the collapse of the EMU. The second set of arguments highlights political factors. EMU cannot endure after the failure to ratify the European constitution and thus potentially create a genuine European Political Union in 2005 (Theodore *et al.*, 2017). Consequently, EMU is not politically sustainable and, therefore, its survival is questionable (Strobel, 2005).

At present, both sets of arguments can be qualified as valid. The debt crisis has had a different impact on EMU countries. At the same time, at the absence of a European government, it would appear that the European Central Bank (ECB) functions in a political vacuum. It is independent of the EU member countries' governments and it is constitutionally charged with the responsibility of securing price stability within the union. The ECB determines the EU-wide monetary policy while the member countries' governments retain control of national fiscal policies. Monetary policy is assigned to the objective of price stability but fiscal policy is available for counter cyclical purposes, though EMU member countries are subject to the fiscal constraints of the Pact for Stability and Growth. This feature of current arrangements partly accounts for the conflict between democratically elected governments in the South EMU countries and an institution, the ECB, which is not answerable to these countries' electorate but, nevertheless, has the power to frustrate policies initiated by them (Theodore *et al.*, 2017). Moreover, Theodore *et al.* (2017) discuss the fact of the difference in inflation rates between the EMU countries, in Germany the annual inflation rates is 5.5% while it is 3.6% for the rest of the Eurozone. This insured the claim that the EU are

incompatible. Thus, one solution is to solve the price sickness among the countries and allow a national fiscal sovereignty, this is to show one of the main problems with the IS-LM-BP models application in the Euro region. Another problem with the IS-LM-BP model is that it fails to accommodate the difference in each country fiscal need to overcome debt. In addition, the lack of the use of Taylor-rule is a barrier to have an accurate inflation forecast therefore difficulty to establish an interest rate (Begg *et al.*, 2014). The emergence of such conflicts during the last 3 years and the divergence in various member countries' objectives and interests makes the EMU far more difficult to sustain (Bibow, 2009). Potentially it could also lead to its break down.

Marco (2014) summarise the main two main issues surrounding the European debt crisis as follows. One is that moral hazard is allowed to play a role in financial markets and the role of the US financial system exercises strong influence into Europe. This prompts European banks seeking their independence from the USA in setting their policies. Another problem is market failure, which reflects the limitations of a market-based system. The free market economic theory is not actually free from ideology and politics; therefore, asset prices are not entirely determined by supply and demand.

As such, Juntilla and Korhonen (2012) have argued that the depreciation of the Euro will trigger inflation targeting in Eurozone, which will influence international trade and the intra-Eurozone trade.

#### 2.4.3 Brexit and the EMU

The Brexit outcome of the UK's EU Referendum means the UK will ultimately leave the EU. Although the UK has not joined the Euro, the country is in the EU's Single Market implying freedom of capital and labour movements. Therefore, Brexit will have a great impact on both the UK and the rest of the EU. Brexit will reduce the volumes of trade between the UK and Europe, as it will reduce productivity and therefore GDP from 6.3%-9.5% and will reduce the UK's bargaining power by 18% (Morpet, 2017). Real wages in the UK will decrease as consumer prices have already increased. The depreciation of the pound will be beneficial the UK since the currency was overvalued and will increase the competitiveness of the UK products in the world market (Morpet, 2017). From a

European perspective, banks can move their assets from UK to the continent and that will encourage the banking sector in Europe (Blagden, 2017). In the meantime, Brexit would adversely affect the Euro as it would depreciate in international markets and this will create negative spill overs (Morpet, 2017).



## CHAPTER 3

### Alternative Exchange Rate Regimes – The Case of Saudi Arabia and GCC

#### 3.1 Saudi Arabia: country and economy

Saudi Arabia is located in Western Asia with only the Red Sea dividing it from Africa. Links to the rest of the Gulf and Africa, in particular with Egypt, Sudan and Somalia are facilitated by the port in Jeddah. Saudi Arabia shares borders with Jordan and Iraq to the North, whereas from the East Saudi Arabia is on the coast of the Persian Gulf and shares a border with United Arab of Emirates and Oman and from the South with Yemen.

Before the discovery of oil in early 1920s, the location of Saudi Arabia increased the potential of high volumes of trade since it is connected to two continents through its two principal ports. Dammam from the East connects SA with countries such as Iran, Pakistan, and India. In addition, SA is hugely important among the Muslims by having the two holy mosques.

In Mecca and Medina, Muslims come every year during Hajj period for pilgrimages; or they could come to Umrah which is another Muslims practise that they could do all over the year, but it increases massively during Ramadan with around 3 million visitors in that month every year. Religious tourism is still the second largest economic sector for the country with around 1-2 million foreign visitors and around 1.5 million internal visitors for Hajj by the end of 2016 (Hajj statistics, the General authority of statistics, 2016).

Tourism supports many industries in the country especially in the western region of Saudi such as hotels, transport and trade. The Saudi authorities in the last few years have restricted Hajj visas to ensure security and avoid illegal immigration. This saw the number of hajj declined to less than 2 million from exceeding 3 million in the past ten years (Hajj statistics, the General authority of statistics, 2016).

The oil sector increased massively in the early 1970s, with exports of around 6-8 barrels daily and since then it is the first country in terms of reserves (Cleron, 1978). Massive increases in oil prices in the 1970s have helped the country transform its economy. Since then, Saudi Arabia introduced five-year plans aiming to stimulate the economy.

In the first plan, the focus was in the allocation and the spending, and the oil boom has generated much money to help improve the health and education systems. However, the telecommunication sector at the time failed to meet the target (Wilson, 2005).

The second plan, issued in 1975, was more detailed and had a more precise vision. There was more focus on housing and development of human resources, the work in diversification succeeded especially in relation to the private sector (MERI, 1985). The second plan managed to improve the transformation of the infrastructure by setting hydrocarbon industries and establishing modern administration system (Ramady, 2005).

Oil prices increased Saudi Arabia's advantage and the authorities used it as a policy instrument against the US in case of supporting Israel, which was the main cause of the first oil shock; prices jumped from \$3.00 to \$11.65 within a week. The impact of the Iranian revolution in 1978 led to a doubling of the prices to \$28 (Viotor, 2007).

Nevertheless, the Saudi government wanted to develop other sectors in the economy that reduce the reliance of oil. Agriculture for example was developed in the 1970s; the authorities managed to use the rapid growth of GDP to improve certain crops such as wheat. The wheat production increased massively in the second half of the seventies until the early 1980 from 3,300 tons in 1977 to 600,000 tons of wheat in 1982. Another essential agricultural product is dates, by the end of 1979 Saudi Arabia managed to produce 441, 00 tons yearly (MERI, 1985).

The agriculture sector facilitated job creation. By the end of the 1970s, 24.2% employees were employed in the agriculture sector. The agricultural sectors have faced many challenges because of the climate of the country and the lack of water resources; the government has managed to keep a reasonable production level at the time by using desalination of water (MERI, 1985).

Although women's education was a controversial topic in the late 1950s and the 1960s, the Saudi authorities started to build female schools and colleges in 1970 to increase the share of the female into employment. The general workforce in Saudi was insufficient at the time due to lack of training and education for both genders, but it was more evident in female workers due to cultural and religious beliefs. By the end of 1979, Saudi female workers accounted for only 6% of the total employment rates (Ramady, 2005).

As a result, the country relies heavily on foreigner workers that reached 1.7 million by the end of 1979. Foreigner workers were more active in the economy by around 50% of the labour force. Foreign workers were occupied mainly in the industrial and construction sectors, while Saudis were more into trade services. This new pattern of Saudi population has increased social tensions especially in a country with conservative beliefs and a culture that stresses employability among Saudis (MERI, 1985).

In 1981, Saudi saw oil production reaching \$113 billion; with the country becoming very influential in OPEC (the originator of the forum of petroleum exporting countries), it dominates the oil pricing policies. The oil prices by the mid of 1981 started to decline to reach around \$12 per barrel in 1986 (Veitor, 2007).

Although projects in almost all aspects of the Saudi economy continued, the third plan shifted the focus to encourage the diversity of the economy; the principal essential funds went to human resource development to reduce reliance on foreign workers. Some sectors suffered from budget cuts or stretched their duration due to lack of oil revenues. However, still, Saudis enjoyed high income per capita (MERI, 1985).

Saudi Arabia has focused on maintaining the industries that were built in the 1970s and increased the focus on operation, reconstructing of the economy to allow the participation of the private sector. Investment declined dramatically in the 1980s (Ramady, 2005).

In August 1990, the Gulf region suffered from the Iraq invasion to Kuwait. This caused oil prices to decline at that time and caused a structural break. Therefore, the effect on infrastructure projects and development in Saudi was slower than planned.

Unemployment rates started to be a problem for a new generation, but non-Saudi workers still prevailed. That caused a social dilemma. An exception was the private sector which started to boom in the mid-1990s (Niblock, 2007). This was also part of the Saudi government plans to engage the private sector in the economy as part of a diversification plan, especially in the technology section (Ramady, 2005). Another issue that influenced the Saudi economy in the 1990s was the Asian crisis in 1997-1998. This exerted significant pressure on oil exports to Asian markets (Wilson, 2004).

However, the business sector started turning optimistic taking the lead in the Saudi economy. Bureaucracy and some government policies needed to change. Also, the private sector could participate in infrastructure projects, causing a dilemma between the private and the public sectors (Nioblock, 2007). Furthermore, the government aimed to reduce spending by encouraging privatisation. There were two distinct business cycles during the 1990s. One from 1993-1995, which is considered the stagnation cycle. The other is the reconstruction cycle, which started in 1996 and continued until the 2000s (Ramady, 2005).

Regarding agriculture, the Saudi government started to realise that the cost of maintaining substantial wheat farms was no longer sustainable, so the projects were abandoned. In addition, the Saudi Government started to focus on universities' expansions; the reason was to provide medical and sciences studies to serve the local labour market and increase Sauditization. Sauditization is a government movement to replace non-Saudi workers with Saudis, and create more jobs for Saudi National to reduce unemployment (Wilson, 2004).

As a summary of the 1990s, the Saudi government faced adverse financial developments, increases in unemployment and a lack of opportunities for non-specialist workers. OPEC policies constrained oil revenues. The main difficulty was human resource policies and the inability to change the rules (Heradstveit and Hveem, 2004).

From the start of the new millennium, Saudi authorities adopted a more severe action on security issues given that the 9/11 events threatened to severely undermine relations with the USA (Council special report, 2001). In 2004, oil prices started to pick up and had a different impact into the economy. Given the pressures from the 1990s, vast amounts of money were invested in infrastructure. Also, the private sector started to boom especially after joining WTO in December 2005. Membership encouraged the openness of trade and improved the diversification of trade (Niblock, 2007).

Following the passing of King Fahd in August 2005, King Abdullah started assuming control. The ambitious views he held for the new Saudi generation has led to changing many policies in the Kingdom. He started with the Saudi scholarship programmes for young to study abroad since 2006 with the ministry of education (Council Special Report,

2011). In addition, the Saudi authorities have raised their level of business internally and externally which injected more money into the economy, becoming the top-ranked country in the Middle East for business activity by the end of 2011 (Qatar bank report, June 2015).

From 2005 to 2014, the country enjoyed increased oil revenues injected into the country and improved infrastructure. The policies for women have also been updated since then. Women could now join men in many sectors at work. However, there were some major events that affected the Saudi society and economy. First, there was the stock market collapse during 2006-2007, due to the shift of the leading investors in the Saudi market into foreign markets 'mainly western countries'. Moreover, house prices increased by around 100% during that time (MERI, 2015). Besides, in 2008 Saudi experienced the credit crunch that started in the US. Inflation reached 11% (AlKhathlan, 2011). Nevertheless, high oil revenues and support from the government helped mitigating the problem at the time (Kandil and Morsy, 2011).

Since 2010, the Saudi economy has faced obstacles but managed to register significant improvements. First, the country and the GCC could not meet the plan for the monetary union in 2010. Second, oil prices declined very sharply from \$115/barrel to \$45/barrel in early 2015. This had a huge impact in all sectors of the economy. According to the IMF Report in 2016 b, low prices have reduced public investment and have a massive impact on the Saudi growth since.

On the other hand, during 2010-2015, Saudi Arabia witnessed some achievements. First, the Saudi gas production has boomed to meet energy demand. Second, the banking sector has overcome the profit losses since 2007. Third, business environment continued to improve, is more internationalised and open (Qatar National Bank Report, 2015). Fourth, Saudi Arabia has invested in research and innovation in the last few years. By the end of 2015, there were up to 40 investors in research, Saudi joined the patent cooperation treaty (PCT) in 2013, with this having a major impact into the Saudi innovation sectors (Alsum, 2016).

In 2015, King Abdullah passed away, and his brother King Salman became the King. The new King's son is the crowned prince, and he is only 32 years old. Therefore, there is a young new generation starting to take control in the Saudi government.

Since 2016 the Saudi authorities have announced two new developments plans. One is the national transformation programme-2020 and the second one is the 2030 vision for Saudi Arabia. Lessons learned were mentioned in these reports such as: reducing oil reliance, diversification of the sources of government spending and the need to reduce dependency on oil price increases and encouragement of the non-oil revenue (Vision 2030, 2016). The key objectives of the national transformation programme - 2020 are:

- Creating 450,000 new jobs by 2020.
- Strengthening the private sector, and receiving around 40% of initiative funding.
- Increasing local content of business and production by 270 billion Saudi riyals.
- Creating five digital platforms for national services.

(Transformation Program 2020, June 2016).

The 2020 programme is to be followed by the 2030 one, the main points of which are:

- Start-up facilities, increasing investment, increasing labour market efficiency and deregulation to reduce barriers.
- Reducing water and electric usage by around 60% in 2030, facilitating a more sustainable economy, introducing new water and electricity pricing.
- Reducing the cost and enable expenditure efficiency.
- Starting a value-added tax system from January 2018, that includes harmful products (cigarettes, soft drinks and energy drinks).
- Household allowances, to protect low-income families.

(Vision 2030, June 2016).

In conclusion, the Saudi government has undergone significant changes in the last 35 years. Future forecasts prove very challenging. This raises the importance of changing the Saudi policies and appreciate the importance of other sectors in the economy including policy options. This as a means of identifying a better solution and providing

recommendations that serve the needs of Saudi Arabia as a country and the Middle East region as a whole.

### **3.2 Background to Saudi Arabia's Central Bank policies**

The question over the most suitable exchange rate regime to be adopted by countries received growing attention since the Bretton Woods agreement in 1944. The debate, in the early stages, focused on the desirability of fixed versus flexible exchange rates in terms of facilitating the needs of the domestic economy. The issue is of crucial importance to the Saudi Arabian economy. This is the case as the country is one of the largest oil suppliers in the world with a strong influence in determining OPEC policies regarding oil production and oil supply (Al khareif and Qualls, 2016). Currently, Saudi Arabia operates a pegged exchange rate of 3.75 Riyals to the USA dollar. This restricts the policy instruments available to the Saudi Arabian government as far as the employment of fiscal and monetary policies are concerned (Althumairi, 2012, SAMA inflation report, 2016). Maintaining low inflation is one of the main challenges faced, as the inflation rate jumped to 11% in the aftermath of the 2008 financial crisis (Al-Bassam, 1999). The challenge continues at present after the drastic reductions in government spending, as inflation rates are still relatively high compared to the general level of inflation worldwide (Alkhareif and Barnett, 2015).

In addition, Saudi Arabia is a member of the Gulf Cooperation Council (GCC) and forwarded a proposal that GCC countries create a currency union by 2010. The proposal coincided with the Saudi authorities' decision of linking the Riyal exchange rate parity to that of the US Dollar (Cader and Merza, 2009; SAMA, 2016). Despite the failure to realise such a currency union, the proposal reflected the policy preferences of the Saudi Arabian authorities concerning the preferred exchange rate policies.

### **3.3 Exchange rates regime in Saudi Arabia and GCC**

The Saudi Arabian Monetary Agency (SAMA) decided to adopt a fixed exchange rate for the Saudi Riyal to US Dollar as a means of preserving price stability, economic growth and enhance the country's international trade (Alesia and Dibooglu, 2002). Oil prices in US Dollars will increase the likelihood of having fixed exchange rates to guarantee the

stability of export earning, the accessibility of the US Dollar in the financial markets, the developed level of US institutions and credibility, and anchoring the foreign reserves of dollar to defend the pegging system (Mazovilla and Melle, 2010).

In the mid-1980s, the Saudi Arabian monetary authorities abandoned the fixed regime and adopted flexible exchange rates. This resulted in a flexible monetary policy and the country could absorb shocks easier. However, the Saudi Riyal faced a reduction in its value due to reduced oil revenues. The weakness of the US Dollar against the Saudi Riyal in the 1970s increased inflation in the non-oil private sector by 21.1% annually due to the oil shock. The overvalued Riyal helped reducing import prices. The two major conflicts in the Gulf namely the first and the second Iraqi Wars increased oil prices and that increased the pressure on the Saudi currency (Alkhareif and Qualls, 2016).

Government spending in Saudi Arabia is directly linked to oil revenue in the absence of a tax system (Abdulkheir, 2013). Yet, as discussed in Chapter 2, the Saudi government is planning to introduce a tax system by next year. As oil transactions are denominated in US Dollars, the fixed exchange rate regime is beneficial for the Saudi Arabian economy and the GCC countries as the oil revenue and import prices are denoted in Dollars (Cader and Merza, 2009). In addition, monetary policy makers in Saudi Arabia encouraged the use of the fixed exchange rate regime as it eliminates foreign exchange rate volatility and is therefore conducive to foreign investment in the country (Ramady, 2005).

The fixed exchange rate regime ensures price stability and increases investment and trade by facilitating lower interest rates, leading to higher growth. Currency appreciation will probably not harm exports, and the fixed exchange regime will maintain inflation low thereby reducing the cost of imports. SAMA's substantial foreign exchange reserves dominated by US Dollars assist in maintaining the pegged regime (Alkharief and Qualls, 2016).

In the case of oil price declines, Althumairi (2012) argues that the Saudi government could mitigate the effects by diversifying their foreign exchange reserves to stabilise export revenue and sustain the value of the real exchange rate. Exchange rate and asset price volatility are highly correlated and sensitive to new information. Both exchange rates and financial assets respond rapidly to new information and the currency board



has grown sensitive to other currencies. Thus, negative shocks will increase the volatility and disturb the currency's volatility (Abdalla, 2012). This means that Saudi Arabia and the GCC region financial assets will be affected by any new information related to currency fluctuations.

Jibili and Kramarenko (2003) argue that in an environment of wage and price flexibility, fixed exchange rates will be preferable in Middle East countries and North Africa. The fixed regime will absorb nominal and real shocks with less output losses as wages and prices will adjust to the new market equilibrium. The fixed exchange rate regime is favoured in Saudi Arabia and the GCC as it increases the trade openness and attracts foreign direct investment. In addition, the pegged regime has protected the GCC from the geopolitical risks feeding into the region, as reflected by the impasse with Qatar (Termos et al, 2015).

On the other hand, despite the advantages incurred from the fixed rate, it does not come without obstacles. The asymmetric supply shock to most GCC countries was caused by increases in oil prices until 2014. The demand shock was symmetric, and it also caused significant oil price volatility.

These obstacles reflect the need for reassessing the current fixed exchange rate regime for the region (Albarwani et al, 2010). The fixed exchange rate restricts the ability to boost growth in times of recession or high inflation when the economy is booming (Hakimian and Abdullah, 2015). Although oil prices have declined, the fixed exchange rate still have a negative impact on controlling inflation. Fluctuations in the real exchange rate were caused by oil production and expenditure decisions by the Saudi authorities aiming to maintain the fixed rate. These could potentially destabilise the economy in the near future.

On the other hand, it has been suggested that the fixed exchange rate regime does not have a causal link with oil prices and the real exchange rate in the GCC countries. This also raises the question of the trading partnership between Saudi Arabia and the USA since it only account for 14-17% of the total trade. As Saudi Arabia is heavily dependent on oil revenues and the SAMA assets; this means the foreign and domestic assets are largely sterilized (Habib and Kalamova, 2007).

According to Squalli (2011), the oil price volatility has weakened the validity of the fixed regime in Saudi Arabia. As a result, the decision to fix the Saudi Riyal to the USA dollar has not delivered its main objective; that of reducing oil price volatility (Setser, 2007). Cader and Merza (2009) claim that the pegged regime does not facilitate the creation of a common currency in GCC, as it acts against the coordination of fiscal policies within GCC and as such it does not ensure the success of the pegged regime (Albarwani *et al.*, 2010). Exchange rate fluctuations in MENA region have a negative impact on investment and growth, as dollarized countries will struggle to finance the devaluation of their currencies because of the negative impact on liabilities in the corporate sector and household consumption (Jibili and Kramarenko, 2003). After the financial crisis in 2008, the continuation of the fixed exchange rate regime raises the risk premium for foreign exchange in GCC (Poghosyan, 2010).

Another cause for concern is that capital mobility could be restricted under the fixed rate policy (Kamar and Ben Naceur, 2007; Kandil and Morsy, 2011). Speculative capital flows cause the GCC countries to reduce their interest rates in order to encourage borrowing and credit at a time when the GCC economy need to tighten monetary policy to accommodate the increase in money supply. This increases internal tensions and causes stock market and real estate bubbles (Mazovilla and Melle, 2010; Hakimian and Abdalla, 2015). The oil revenue declines from 2014 have increased the pressure on reserves, therefore the need for changes in revenue by diversification in resources. Reductions in government spending on imported goods and introducing government bonds to domestic borrowers have maintained government deposits (Alkharief and Qualls, 2016).

The lack of independent monetary policy impacts the rates of inflation; switching between traded and non-traded goods is limited, and the scope of expenditure is on that aspect (Khan, 2009). Maintaining the fixed exchange rate in Saudi Arabia and GCC serves more the USA political and economic interests than the interest of GCC region.

However, studies have put forward proposals for the Saudi Arabian authorities concerning the exchange rate policy options available to the Saudi government. Setser (2007), for example, suggested that Saudi Arabia should opt for a more flexible exchange

rate regime facilitating reductions in oil prices. In relation to inflation rates, a flexible exchange rate regime will decrease inflation in the region in particular inflation caused by higher import prices (Altowajri, 2011). One of the solutions to Saudi Arabia's exchange rate policy dilemma is to peg the Riyal to the price of oil rather than to US Dollar.

Since Saudi Arabia is mainly an oil export country, it is worth looking at studies that focus on oil countries and commodities. The problem of oil and commodity price fluctuations was shown in many countries such as: Argentina, Mexico and Britain oil process has also effected international shocks and US interest rates (which will directly affect Saudi interest rates because of the fixed regime).

In addition, if countries adopt more a flexible exchange rate regime they can benefit from the changes of the exchange rate. Oil prices are so sensitive to monetary policy changes in the short run that behave in accordance with the Dornbusch model (discussed in chapter 2) (Mohammadi and Jahan-pravar, 2010; Mehrara and Mohaghegh, 2012). Moreover, a contractionary monetary policy will increase the cost of oil reserve management, which will reduce the oil production and tend to increase oil prices (there is an opposite relation between interest rates and oil) and vice versa.

Therefore, oil-exporting countries should keep oil prices in domestic currency to regain control over monetary policy, by targeting oil prices in local currency. The monetary policy will be more responsive to shocks that will depreciate the value of the domestic currency, however, this will depend on the size of oil reserves and the ability to increase interest rates. This strategy will help the oil exporting countries to be more independent of the US policies. The study shows that when the US monetary policy is relaxed the world interest rates in decreasing and oil prices increase and vice versa (Monadjemi, 2011).

Another study by Coudret *et al.* (2011) discussed the commodity exporting countries dependence on oil prices and the effects of the oil prices volatility. Exporting countries will suffer from problems to control the demand emanating from the massive increase in income and wealth. The increase in commodity prices in the world market will increase wages in oil refinery companies that will also increase pay in other sectors,

therefore, the level of wealth and income will increase which will have a huge impact on saving and spending and increase the real exchange rates. The increase in oil prices and on wealth will adjust exchange rates and facilitate assets to find their way into US net foreign assets. Real exchange rates will increase by 5% if the oil prices increase 10% and will increase real GDP per capita in purchasing power parity.

The anchor currency (which more likely will be the US Dollar) is playing more the role of the stabiliser in the economy rather than the exchange rate regime itself. The exchange rate regime is not vital as long as the countries on the regime are always undervalued if they are fixed to the US Dollar and overvalued if it is to EURO (Coudret *et al.*, 2011).

Frankel (2006) also showed that the commodity prices influence on monetary policy could be used to anchor the price index, instead of the exchange rate or CPI target. This will help tracking the effect of US interest rates more effectively to the demand and supply of the commodity, the firms will want to hold on investors, which will stress commodity prices and loose monetary policy.

Oil prices have a positive correlation with stock markets, as the oil assets are not as good as other stocks due to the unexpected returns of stocks. During the 2000-2003 and 2007-2008 periods, oil price increases caused a decline in stock markets and the exchange rate returns differed from only 0.001% in Italy to 0.18% in Venezuela. UAE was the most volatile in terms of exchange rate returns and stock market during the period of the study (Guesmi and Fattoum, 2014).

These results show that oil price volatility has a very strong impact on stock and exchange rate markets for both importing and exporting oil countries but the effect is stronger in the latter group; the shift of oil demand to China has a positive impact on oil prices increases and world trade. Yet, the hike in stock market values stress the financial problem in the US and weaken the US Dollar (Guesmi and Fattoum, 2014).

Oil exporting countries have a long run effect on real exchange rates that caused what is termed as 'the Dutch disease'. The main symptoms of the disease are competitiveness losses, reduction in the manufacturing sector's shares and a boom in the non-traded sector. Countries with more flexible exchange rate regimes are less likely to suffer from the Dutch disease. Nevertheless, most oil exporting countries can insulate their

domestic economies by increasing imports and foreign investment to increase foreign exchange earnings (Mohammadi and Jahan-Parjar, 2010).

Oil exporting countries are more vulnerable to oil prices volatility. In the long run, 11% of output changes and 5.5% of money volatility was due to oil shocks and that has an impact on macroeconomic disturbance especially to the monetary policy. This is more so when the central bank does not have an independent monetary policy (Mehrara and Mohaghegh, 2011).

Studying OPEC countries shows that oil exporting countries are following the BW2 system, countries that have fixed exchange rate peg their reserves to the anchor currency and they do keep the reserves pegged to their followers even when oil shocks occur that weaken their currencies. When oil-exporting countries have a massive supply, they should allow their currency to appreciate when export increase and depreciate the currency when there is a fall in exports. However, the pegging system in oil exporting countries is far away from the BW2 system, commodity countries account surplus does not depend on real exchange rates to formulate the decisions among investment and government spending, it only effect private consumption as most government spending and investment are policy determined and to some extent import prices. The pegging regime will have a huge impact on public consumption by not accommodating the fast growth of oil prices hike to its slow increase in income (GNP) levels (Roubini, 2006).

Dollarized countries suffer from a negative impact on the balance sheet, and that is mostly because of the fixed exchange rate regime and that increase the inflation pass-through effect (Carranza et al, 2009). An intermediate exchange rate regime could be one option for Saudi Arabia and GCC such as crawling peg. The region is now moving to a more diversified economy and tries to reduce the dependency on oil and the international portfolio. Instead, the focus has shifted to increase of national employment into the market (reduced labour mobility and increase capital mobility (Khan, 2009).

The acceleration of inflation in Saudi Arabia was triggered by the decreased dollar rates against the euro by 19% and 7% against the yen. Therefore, switching to basket of currencies could be a good option for Saudi Arabia. Yet, in the case of oil price decreases,

the economic adjustment will be more difficult. By having a basket of currencies, the Saudi economy could enjoy the stability of a fixed exchange rate regime and boost exports by having different currencies for trade partners (Althumairi, 2012).

Most studies claim that the current fixed exchange rate regime carries more disadvantages than advantages for the Saudi Arabian economy. These previous studies on Saudi Arabian exchange rate regimes has widened understanding on the current position of monetary policy regarding exchange rate policies, inflation for example has a strong relation with the exchange rate and there has been a significant increase in inflation rates recently in Saudi Arabia. In the following section, the possibility of adopting inflation targeting will be addressed by focusing on the case of Saudi Arabia. Before moving to the discussion of the inflation. Table 3.1 reports in more depth details of the Exchange rate models and important result into different macroeconomics indicators in both Saudi Arabia and the GCC.

**Table 3.1: Exchange rate models in previous studies and results table**

	Title	Author	Results
Oil and exchange rate	The effect of exchange rate fluctuation on trade balance: empirical evidence from Saudi Arab economy.	(Saqib, 2013)	<p>*Co-integration results: SA (Saudi Arabia) SIG (significant) relationship between the variables tested. Fluctuation of EXR (exchange rate), (0.52/t test 2.48) and trade balance (015 and t-test 1.89).</p> <p>*Stationery test: -2.251 with intercept and -2.346 with intercept and trend. Again, SIG results.</p> <p>*EGC (Engle-Granger Causality), and ECM (Error correction model) results: statistical values are larger than critical values; in SR (short-run), the study accepted the null hypotheses of Granger Causality in trade balance and the deviation of EXR.</p> <p>*For SA import become Expensive, that will reduce the Purchase of foreign goods and increase local consumption on Domestic goods (low domestic production in SA)</p> <p>*Policy maker should focus on EXR Regimes because of the influences on trade balance in the LR (Long-run).</p>
	Determining real exchange rate fluctuation in the oil-based GCC economies	(Amin and El-Sakka, 2016)	<p>*Unit root test indicates that all the five series are stationery after FD (first difference) and I (1), for the panel of six GCC (Gulf council countries).</p> <p>*Pedroni test result: support the H0 of no co-integration, other tests found evidence of the LR Relationship between EXR and Other variables.</p> <p>*VECM (vector error correction model): optimal lag order 2, 3 co-integration vectors.</p> <p>*Estimated co-integration model show that only GDP (gross domestic product) per capita and oil have LR relationship with RER (real exchange rate). Not with CAB (current account balance) and FDI (foreign direct investment).</p> <p>*VECM SIG At 1% level of the LR between EXR and OP and GDP, SR causality running form OP to EXR at 5%.</p> <p>*ECT (error correction time) has dynamic stability and EXR adjust for SR disequilibria at 4%per year, 25 years for EXR to return to their E(equilibrium) level (slow).</p> <p>*LR relationship between EXR and OP (oil prices) means GCC are more prone to shocks in these prices in LR, will influence Oil Revenues and PPP (purchasing power parity).</p> <p>*The need for changes EXR regimes to reduce inflation.</p> <p>*Lack of LR with FDI, the impact of these inflows is not transferred to the economy, it is invested abroad.</p>
	The political economy of exchange rate regimes in developed and developing countries	(Berdiev <i>et al.</i> , 2011)	<p>*Full sample results: left –wing GOV (government) tend to favour flex (flexible) EXR, Right wing Favour Fix (fixed) EXR, central bank independence increases in Flex regime, prior to election politician support Flex EXR.</p> <p>*For Developed countries, a left wing GOV decrease the possibility of choosing Fixed EXR, no SIG on Flex regime. Left wing GOV favour Flex in developing countries (GOV ideology is important to determine EXR regimes).</p> <p>*Overall; developed economies prefer FIX and developing prefer Flex.</p> <p>*High financial development in developed countries increase the possibility of having FLEX Regime, developing countries with high financial development prefer Fix.</p> <p>*Economic development decreases the probability of FLEX regime.</p>

			*High rate of inflation does not affect the choice of EXR in developed countries (possibly because of IT).
	Dynamics of the real exchange rate, inflation, and output growth: The Case of Malawi.	(Yiheyis and Cleeve, 2016)	*RER is strongly influence, 1% increase in its lagged values leads to .3% it is in current value (+ effect) (positive effect). *2% increase in RER will increase 10% of inflation. *M2 (money supply) +effect on RER in SR. *Real GDP cause real appreciation with L1, opposite for later lags. *Presence of granger causality between variables. *Evidence of presence of LR Causality running interactively through it from other variables as a group to RER.
	Financial development and economic growth in an oil-rich economy: The Case of Saudi Arabia	(Samargandi <i>et al.</i> , 2014)	*Trade openness has positive and SIG effect overall economic growth as well as growth of both Oil and non-oil sectors table 6. *OP has + and SIG affect overall GDP, INSIG (insignificant) on non-oil. *Financial development has negative but INSIG effect on economic growth (SA did not benefit from financial development; natural resource curse could be a reason for this effect). *Financial development on the non-oil sector is + and SIG, at 10%. *Oil sector is controlled by the GOV, thus no sig effect from financial development into growth. *Stats tests used confirm that the LR and SR Coefficients in the ECM are stable and effect growth. *Robustness checks: there is a fundamental problem of credit allocation in SA, insufficient financial regulations and supervision into the banking sector and the lack of investment opportunity. *The Economy crucially depends on price fluctuation and foreign markets as documented by the strong role-played in the analysis OP and openness in trade.

Oil and exchange rate	Oil prices and real exchange rates in oil exporting countries: a bounds testing approach.	(Jahan-pravar and Mohammadi, 2011)	*ADF (augmented Dickey-fuller) failed to reject the null hypothesis of unit root in level but reject after FD except for SA and Indonesia. *That insist the use Of ARDL (Auto-regressive distributed lag) for different level of integration between variables. *ARDL: complicating results of dynamics in RER and OP in each country. *F-stat: at 5% SIG and positive for LR relationship between EXR and OP. *Evidence of unidirectional causality from oil prices to exchange rates to oil prices in Bolivia and Russia, bidirectional causality in Gabon, Indonesia, Nigeria and SA.
	A re-examination of stationarity of energy consumption: evidence from new unit root tests.	(Hasanov and Telatar, 2011)	*The availability of rich energy resources enables countries to maintain stability in energy consumption, which may explain why energy consumption in resource rich countries is Stationery. *This paper tested the non-linearity and structural breaks in the energy consumption and found overwhelming evidence for both nonlinearity and structural break.
	International oil prices and exchange rate in	(Osuji, 2015)	*The continued exportation of crude oil in Nigeria as a primary product and importation of finished goods will only ensure that the demand for the dollar will continue to outperform its supply



	Nigeria: A causality analysis		<p>in the Nigerian market, sustained pressure on EXR and Foreign reserves.</p> <p>*Oil prices exert significant effect on EXR. There is a unidirectional causality running in OP to EXR and OP to Foreign reserves (It's beyond the control of Nigerian policy makers)</p>
	Oil price and stock markets in GCC countries: Empirical evidence from panel analysis	(Arouri and Rault, 2012)	<p>*Results; cannot reject Ho, which means that the variables are non-stationary in the country panel, even after log.</p> <p>*Series of OP stock markets are integrated I (1).</p> <p>*GCC stock market and oil prices do not have CO-integration relationship, use bootstrap critical values.</p> <p>*Over long-term OP and stock market prices move together in GCC, that because of the strong influence of OP (OPEC) (Organisation of petroleum exporting countries), global economic growth, and local political and economic events.</p> <p>*elasticity of stock prices to oil prices is less than 1.</p> <p>*SA does not have the same effect of stock prices and OP, SA different than the other GCC countries, SA stock market is highly dominated by financial industry which is highly linked to America and Europe</p>
Oil and exchange rate	Does Euro or Dollar peg impact the real exchange rate? The case of oil and commodity currencies.	(Coudret et al., 2011)	<p>*For unit root test results: all series has unit root (non-stationary), and co-integrated at I (1).</p> <p>*Panel co-integration are generally in favour for co-integration existence.</p> <p>*In Ko's test, the REER (real effective exchange rate) and term of trade were not Co-integrated.</p> <p>*Testing causality between EXR and economic indicators in the models.</p> <p>*Causality results: there is a causality relation between EXR and term of trade for both group, it is bidirectional in the case of oil exporting countries.</p> <p>* An increase in the term of trade will cause an appreciation in EXR position will increase. The LR elasticity for oil exporting countries are lower which explain the Balassa-Samuelson effect, the net foreign assets are very important in the oil exporting countries (supported by most literature).</p> <p>*Misalignment model for oil exporting countries: Large EXR undervaluation in eight countries out of 16.</p> <p>*In the case of GCC, currencies for Qatar and UAE are overvalued (different from the other GCC countries), these results are like ben Naceur and Kamar (2007).</p> <p>*Bahrain, Kuwait, Oman and SA RER are correlated, need further coordination for monetary union.</p> <p>*Concerns for GCC: Bahrain, Oman and SA and to some point Kuwait, RER is declined over the whole period. REER follow it trend until the 2000, from 2000-2007, equilibrium in EXR has appreciated with the increase of oil prices. But the REER continue to decline because of the decline in US Dollars.</p> <p>*The paper conclude that pegged currencies follow their anchor countries in their EXR behaviours.</p>
	Macroeconomic dynamic in the oil exporting countries: A Panel VAR study.	(Mehrrara and Mohaghegh, 2011)	<p>*All variables were non-stationary on level, and then become stationery after the first difference, in other words, I (1).</p> <p>*Price level +and SIG to oil prices, money supply and output.</p> <p>*Oil shocks cause to increase inflation and decrease output.</p> <p>*The positive impact of demand shocks on price index it relates to the strong influence form government expenditure and oil revenue, indirect relation between oil prices and domestic price level (resources curse).</p>

		<p>*Results emphasize the importance of monetary adjustment in oil exporting countries in response to oil shocks.</p> <p>*Oil shocks have a very small impact on price level. However, the paper conclude that domestic shocks is more responsible for price fluctuations.</p> <p>*The results support the NK approach, which assume rigidities that cause AD shocks will affect both real and nominal variables.</p> <p>*Demand shocks explain 48% of output fluctuation in first year while it is reduced nearly to the 1/5 in the LR.</p> <p>*The monetary shocks in oil exporting countries is SIG and + (positive) to output in the LR, that says that most of output volatility is due to monetary shocks.</p> <p>*Oil-exporting countries benefits from high oil price by influencing the future output movement by 11%.</p> <p>*Domestic macro variables have an impact on world prices by around 90% of the forecasted error variance of oil is related to its own shocks.</p> <p>*Oil shocks is the second most important cause of MS (money supply), which explain that monetary policy is only an indirect channel to prices fluctuations.</p>
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### 3.4 Inflation in Saudi Arabia and the GCC Region

Saudi Arabia monetary authorities (SAMA) experience difficulties in collecting accurate data on inflation. One problem is that the CPI is based on surveys, which may be biased; second, the measures may contain errors when including shock effects. Saudi Arabia faced two types of oil shocks and country specific shocks (stock market meltdown in 2006). Studies suggest that excluding energy prices would be helpful but (cannot be used in Saudi Arabia because of its oil export reliance).

Also, the housing and rental prices are important in understanding core inflation rates. These prices have a massive impact on inflation especially in the period from 2006-2011. Thus, the exclusion of housing prices has disturbed the inflation signal to policy makers (Alkhareif and Barnett, 2015).

SAMA does not follow Taylor's rule strictly. They interpret the rule and apply it in a broad sense since 2007. The rule is linking inflation to changes in output and inflation by ensuring macro stability influenced by the US federal reserves. The challenge for SAMA is to keep tracking the Federal Reserve's fund to reduce the pressure on exchange rates, and keeping interest rates and inflation low. SAMA interest rates are determined by the Federal Reserve's rates (FFR) by around 98% of its variation. Saudi interest rates will have a negative impact on growth (Almansour, 2015). Saudi Arabia is an open economy, with indirect export earnings into the economy, it has no official control over capital outflows, and the authority's sterilising behaviour toward oil revenue limits monetary authorities' ability to control inflation.

Substantial capital outflows are one of the major problems in Saudi Arabia financial sector, especially as the country lacks advanced capital markets. Private outflows can have a negative impact on expected inflation and expected exchange rate depreciation. SAMA introduced bank security deposits in the 1980s and cannot employ interest rates on discount windows, due to Islamic law that prohibits their use (Ramady, 2005).

Thus, SAMA should allow open market operations to finance monetary policy. There are few recommendations to change the monetary system. Firstly, by changing the domestic expenditure, which can be prompted by reductions in the price of oil. Secondly, by financing the balance of payment deficits by drawing on the private sector.

Thirdly, by changing net credit issued by the commercial banks to the private sector, but this does not support domestic investment as it leads to capital outflows. Therefore, the private sector should reduce their foreign holdings and divert investment to domestic markets. SAMA could control capital outflows and domestic liquidity recently by enhancing domestic markets (Akikina and Alhoshan, 2003).

This encouraged the monetary authorities to establish and preserve a fixed exchange rate with the USA dollar in 1981. The monetary policy focused on stabilizing inflation and prices with the objective of protecting the pegged exchange rate to the USA dollar (Ramady, 2005). However, in the aftermath of the 2008 financial crisis in the USA, inflation jumped to 11% (Altowaijri, 2011). In addition, since Saudi Arabia is an open economy, the rise of inflation was caused by both internal and external sources (Al-Bassam, 1999). One of the main reasons of the hike in inflation rate in the GCC region was because of the pegging regime to the dollar; this has caused import-push inflation in the country and decreases the power of purchase in GCC (Squalli, 2011; Altowaijri, 2011).

The fixed exchange rate regime implies that the Saudi Arabian economy and the GCC countries are exposed to international developments in inflation rates (Khan, 2009). The expansionary monetary policies in the USA and the decrease in the rate of interest have exported inflation to Saudi Arabia via the fixed peg between the two countries (Altowaijri, 2011). As a result, the growth rate of the money supply, real income and the Saudi Riyals fluctuations against the USA dollar had a major impact on the Saudi Arabian inflation rates (Al-Bassam, 1999). The intervention by SAMA after the gulf war in 1990 where they provided liquidity has reduced that inflation rate on the non-oil sector by 3.6% that was due to the decline in petrochemical exports, which moves in tandem with oil prices (Alkhareif and Qualls, 2016).

Under fixed exchange rates, controlling inflation in GCC by employing monetary policy tools has been rendered impossible (Squalli, 2011). The monetary authorities have lost the ability to use monetary tools effectively in terms of reducing inflation largely due to their exchange rate regime policy choice (Hasan and Alogeel, 2008). Imported inflation from the USA has affected food prices in the GCC especially in Oman and Saudi Arabia.

Inflationary pressures caused by weak domestic demand lead to declines in import prices, thus, high inflation will cause a spill over from major trading partners into domestic rates especially in the absence of an exchange rate adjustment (Kandil and Morsy, 2011). Between 1984-1989, the reduction in government spending helped to reduce inflation rates (Al-Bassam, 1999).

While high spending of governments in all GCC countries assisted the pegged rate regime, it also caused high inflation (Setser, 2007). The increase in oil prices from 2007-2010 increased inflationary pressures and challenged the trade-offs of monetary policies in GCC countries because of the pegged regime (Coudert et al, 2011). The fact that the Saudi Arabian economy is more open than the USA economy, suggests that flexible exchange rates could prove more effective in terms of maintaining inflation at low levels by adopting inflation targeting (Keran and AlMalik, 1979). Finally, the risk premium in the foreign exchange markets was influenced by the increase in inflation and consumption, caused by the fixed exchange rate regime (Poghosyan, 2010).

However, Kahn (2009) suggested that inflation targeting with a floating exchange rate might be a better option for the GCC countries. However, inflation targeting should be adopted following the introduction of sophisticated market based operations, central bank credibility, developed inflation forecasting and managed liquidity (Khan, 2009). Inflation targeting will help to keep SAMA objectives in line with rising interest rates when output gap is positive or when inflation exceed the reasonable rate especially in the case of using Taylor-Rule (Almansour, 2015). Mondajemi (2011) argues that commodity prices such as oil should be excluded from CPI.

As a result, inflation targeting may not be successful for those countries, and the monetary policy authorities should consider targeting import and export prices instead of inflation. Inflation targeting needs advanced financial markets, still lacking in most developing countries. The use of commodity prices will be more helpful for central banks regarding fiscal and monetary policies than inflation targeting. The study suggests targeting major export goods prices to preserve a flexible exchange regime from external shocks. Another study by Coudret *et al.* (2011) suggested the use of export

prices would reduce price volatility. The reason for that is that the real exchange rate is derived from commodity prices, which always behave similarly in the long run.

Since the single currency union with the other GCC countries is under review by Saudi Arabian authorities, in particular after the increases in inflation rates in 2008, with unemployment not a major concern in the area, there is a need of considering alternative exchange rate policy options (Albarwani et al, 2010). GCC Countries need to identify the core elements determining inflation that will facilitate forming the GCC monetary union, and attract prospected investors seeking for opportunities in the area (Abdulbasher and alsamadisy, 2012).

Frankel (2006) argues that inflation targeting for commodity producing countries could not be useful for the following three reasons: first, most people will not understand the core elements of CPI, which will reduce its credibility if they do not. Second, targeting CPI normally does not respond to oil shocks. Thirdly, the decrease in oil prices worldwide leads to declining oil export revenues (for Saudi Arabia) and import prices increase (e.g. wheat in Saudi Arabia).

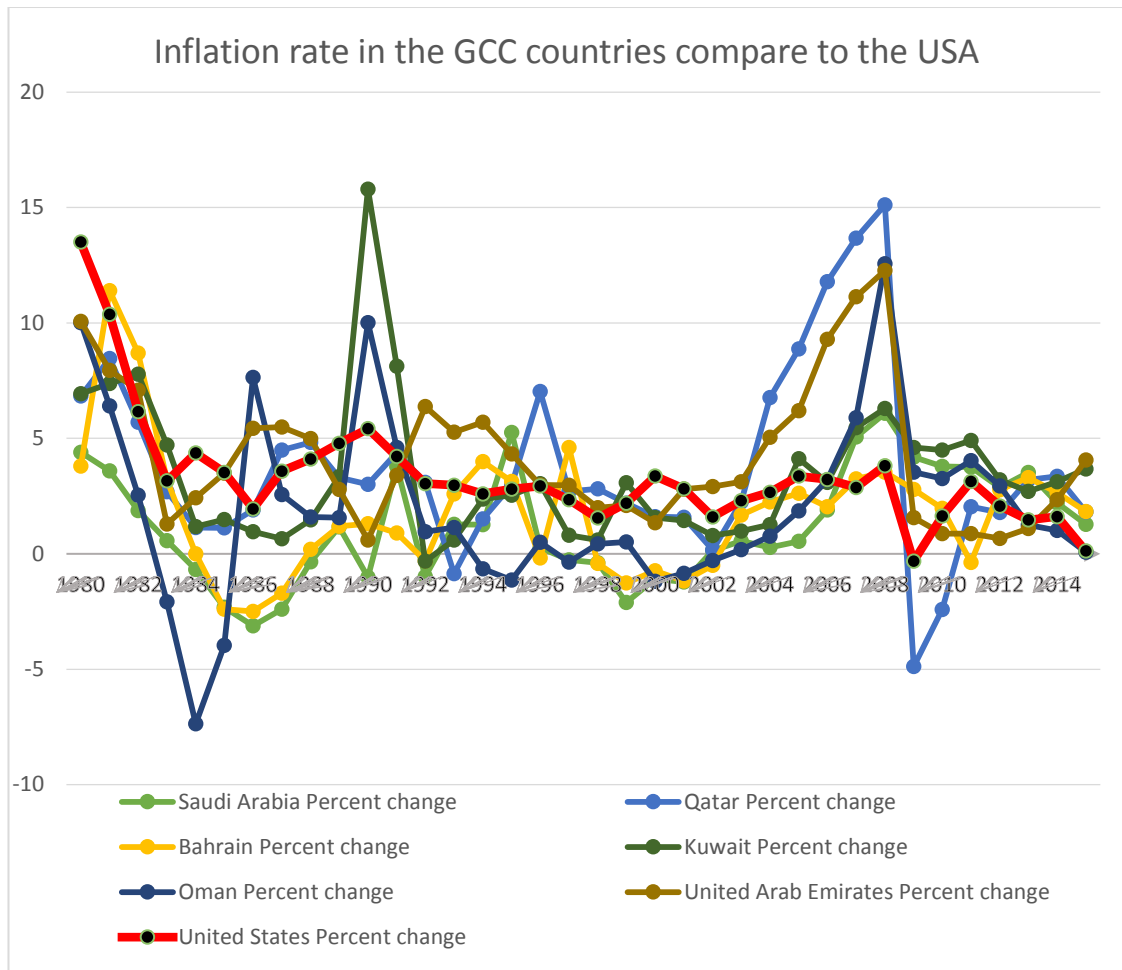
High inflation rates in Qatar and United Arab Emirates do not undermine the prospects of a monetary union because inflationary pressures are short term in nature (Khan, 2009). However, inflation in the GCC countries is highly dependent on the US monetary policy and that effects the dispersion among the GCC countries (AlQudsi *et al.*, 2008; Balli *et al.*, 2010). In addition, higher inflationary pressures in the GCC countries have an adverse effect on investment and growth (AlKhater, 2012). Differences in inflation rates among the GCC countries have also influenced monetary expansion in a different way while the fixed peg to the US Dollar has a major impact on monetary growth by sterilisation policies on international reserves (Hassan *et al.*, 2013).

The fixed peg of all GCC countries' currencies to the US Dollar, with the notable exception of Kuwait has caused import-push inflation in the countries, which causes a decrease in purchasing power (Altowaijri, 2011). The fixed exchange rate regime implies that the GCC countries are exposed to international developments such as the depreciation of the US Dollar and inflation rate policies pursued abroad (Khan 2009, Hassan *et al.*, 2013). The fixed peg to the dollar implies that monetary authorities have

lost the ability to use monetary tools effectively in order to control inflation in GCC countries (Squalli 2011, Hasan and Alogeel 2008). As a result, imported inflation from the USA caused an increase in food prices in the GCC, especially in Oman and Saudi Arabia (Kandil and Morsy, 2011).

Having tight fiscal policies in the GCC will reduce the growth in the non-hydrocarbon sector, while using monetary policy will be more appropriate in relation to inflation rates. GCC dependence on imported goods in all other commodities except oil influences domestic prices. Studies identified a strong correlation between oil prices hikes and inflation rates, which determine the fiscal stance; increases in the money supply is the main cause of inflation in both the short and the long run. Mimicking Fed's reserve interest rates in all GCC countries increases the pressure on inflation and this causes the demand of money supply to increase (for example: Capital flow). One reason for this is the export of hydrocarbon revenue have no direct effect on the domestic economy it has to be channelled through government spending. The rental price increases in both residential and commercial sectors, do not match with the increase of foreign workers in the region. In addition, the high pass-through effect of exchange rates into import prices in the GCC will influence CPI rates (Abdulbasher and alsamadisy, 2012).

**Figure 3.1 GCC Inflation Rates compared to the USA**



\*Source: IMF Regional economic outlook (2016)

Inflation rates for the GCC economies from 1980 to 2015 are presented in Figure 3.1. As can be observed, inflation peaked to 15% for Qatar in 2008 due to the financial crisis. Following the financial crisis in the USA, it decelerated to reach minus 5% by the end of 2009. Since then, the average inflation rate in GCC fluctuated from 3-5%. In addition, in comparison with the USA inflation rates, the USA did not have the same massive increase in inflation rates that the GCC countries had. For example, in 2008 after the credit crunch the USA, the inflation rates increase to around 4% only. Before the 2008 crisis, the US inflation rates seems to be parallel with the rest of GCC countries rates, except for 1990/1991 years were the rates has been shaken due to the Kuwaiti-Iraqi war (structural Break). However, volatility in inflation rates has contributed to fluctuations in growth rates during the same time-period. None of the GCC countries has adopted



inflation targeting and some researchers recommend this policy for the region. Thus, it worth looking on examples form neighbour countries. The idea of inflation targeting was introduced to countries in the MENA region. Some countries like Egypt, Morocco and Tunisia have shown interest to adopt inflation targeting.

Turkey has adopted inflation targeting informally in 2002 and formally since 2006 with very good results to date (Boughzala and Cobham, 2011). Turkey, has signed an agreement with the IMF to help stabilise the economy and it did help form the 2005-2007. From 2008, the global financial crisis has triggered the exchange rate and interest rates and increased foreign exchange risk. As a result, inflation rates in Turkey remained above target and the persistence prompted its revision in 2008. This was followed by declines in energy prices. The Turkish Central Bank managed to meet the 6.5% target in 2009, by successfully easing the currency's liquidity and reducing foreign reserves to domestic currency reserves.

Yet, Turkey faced challenges in the following years, as the authorities seek to enhance the credibility of the Central Bank and coordinate policies regarding prices (Ersel and Ozatay, 2011). Neaime (2011) evaluates six countries from the MENA region and found that Morocco and Tunisia are moving towards inflation targeting, by fixing the real exchange rate instead of the nominal to increase competitiveness and reduce currency overvaluation. Egypt, since 2002, gradually allowed its exchange rate to be more flexible (until a free float by the end of 2016) and shifted its monetary policy towards accommodating a flexible exchange rate regime (The Financial Times, November 4<sup>th</sup>, 2016).

However, these shifts will depend on the ability of the Central Bank to control different types of shocks. Turkey has successfully managed to mitigate shocks but the Turkish economy faces a series of challenges in terms of reducing interest payments on its national debt while maintaining inflation targeting. In both Turkey and Egypt, exchange rate adjustments are the main facilitator of the transmission mechanism of the monetary policy, while in other countries like Tunisia and Jordan interest rate setting dominate monetary policy.

For the MENA region, flexibility provided by inflation targeting is important in terms of avoiding an exchange rate appreciation. Again, Central Bank independence in policymaking is essential in solving most debt problems, facilitating inflation targeting.

Therefore, most of the previous studies attributed the increase in inflation rates in Saudi Arabia and the GCC to the fixed peg, which provides motives for considering alternative regimes. Previous researchers have not addressed the application of IT in Saudi Arabia, with the notable exception of Khan (2009). Moreover, the decision of the GCC countries to create a single currency requires more investigation and focus on the inflation and the exchange rate policies to be tested and be able to adopt the right path for Saudi Arabia and the GCC in whole (Termos *et al.*, 2015). The following table will address a further discussion about inflation in Saudi Arabia and the GCC.

**Table 3.2: inflation rate in GCC and inflation targeting previous studies results table:**

	Title	Author	Results
Inflation and inflation targeting	Exchange rate regimes and real exchange rate volatility; does inflation targeting help or Hurt?	Ouyang <i>et al.</i> , 2016)	<ul style="list-style-type: none"> <li>*IT (inflation targeting) regimes Appear to be associated with greater REER volatility compared supply centre regimes.</li> <li>*Wald test result shows that IT create more volatility than FEX EXR in REER.</li> <li>*Splitting the sample into developing and developed countries, the IT works better in developed countries that allow them to behave more like Floating EXR.</li> <li>* Volatility in internal prices tend to be less in both hard fixers and It regimes.</li> <li>*Matching result: It regimes seems to be more associated with higher REER compared to Hard EXR, but IT seems to reduce internal prices although the result is not SIG.</li> <li>*GMM (generalised method of moments) results: still IT tend to associate with greater REER Volatility than EXR regimes due to External prices, still the developed countries have more privileges to use IT and Float EXR due to more advance institution arrangements.</li> </ul>

Determinants of inflation in GCC	(Kandil and Morsy, 2011)	<p>*Main results for LR: 1. trading partners are major determination of inflation in Bahrain, Kuwait, SA, UAE, 2. EXR depreciation increase in Bahrain, Oman, Qatar and SA, 3. Bahrain, Oman, and UAE higher government eases capacity of constraints and moderate inflation. 4. Monetary growth increase inflation in Bahrain and UAE, 5. Quick adjustment to Equilibrium.</p> <p>*Main results for SR: 1. higher inflation in trading partner increase inflation in SA and Qatar, 2. EXR depreciation tend to increase inflation in Bahrain and UAE reflecting higher price of imports, 3. higher international food prices raises domestic inflation in Oman and SA, 4. higher government spending fuels inflation in Bahrain, Kuwait, Oman and UAE, 5. Excess demand relative to potential is significant factor for higher inflation in Kuwait, Oman, Qatar and UAE.</p> <p>*Little support of the pass-through effect of exchange rate depreciation in the short run. EXR fluctuation not SIG except for UAE and Bahrain.</p>
Two targets, two instruments: Monetary and exchange rate policies in emerging market economies	(Gosh <i>et al.</i> , 2016)	<p>*IT central banks in EME generally conduct their interest rate policy in accordance with the 'Taylor-rule'; tighten real interest rates when inflation expected to be above target or output above its natural level. They respond to RXR rate movement beyond any impact on expected inflation.</p> <p>*IT central banks in EMEs (emerging markets economies) do intervene in the foreign EX Market (Less aggressively than non-IT), but not following Flex EXR.</p>
The role of inflation regime in the exchange rate pass-through to import prices	(Junttila and Korhonen, 2012)	<p>*On average in SR And LR, depreciation of importing country currency against exporting lead to about 4.8% and 7.4% rise in Aggregate IMP (import prices). (ERPT 'exchange rate pass-through' decreased over the sample time analysed)</p> <p>*SR ERPT Coefficient are in many cases both from zero and one, so local currency or producer currency have ERPT into Aggregate import prices in SR.</p> <p>*LR producer currency were accepted (the effect of ERPT) but not local currency.</p> <p>*ERPT to IMP is very similar for the main Euro area. Single currency does not lead to large differences between the member countries rates of CPI.</p> <p>*Lower inflation regimes decrease ERPT.</p> <p>*(Calvo and Reinhart, 2002), shows that ERPT tend to be higher in small inflation countries compared to large low inflation countries.</p>
Implicit Asymmetric exchange rate peg under inflation targeting	(Benlialper and Comert, 2016)	<p>*Shocks to food prices is the most common determinate of inflation in Emerging markets economy, followed by EXR.</p> <p>*Inflation volatility in commodity prices explain 20%, 13% EXR, and 7% interest rates.</p> <p>*CPI inflation 33% are caused by EXR and commodity prices.</p>

regimes: the case of Turkey		<p>*MP authorities in developing countries take into account the movement of EXR when setting interest rates*following the shocks, interest rates increase within the first three months as a result of the depreciation variables (NEER), MP change in response to NEER in an asymmetric way.</p> <p>*Nature of foreign exchange intervention in this period is compatible with the asymmetric nature of EXR policy in Turkish central bank.</p> <p>*EXR appreciation have cost because its directly related to massive capital flows, IT take positive action to control that (currency crisis in 1990 because of massive capital inflow in relation to EXR movements).</p> <p>*RER appreciation may have negative effect on economic growth in the LR and will create Currency crisis (similar to 1990s crisis).</p> <p>*IT developing countries may favour appreciation in their currencies which have major impacts on the economy, need to focus on financial development and exchange rate movements causes and solution along with IT (avoid the old style of applying IT).</p>
Commodity prices, inflation pressure and monetary policy: Evidence from BRICS Economies	(Mallick and Sousa, 2012)	<p>*IRFs (impulsive response function) results: MP (monetary policy) contraction lead to a fall in RGDP (real GCP) for about 6, although the small price puzzle.</p> <p>*MP shocks counts for reasonable fraction, 6% inflation, raw material prices 8%, RGDP 10%, Equity prices 10%.</p> <p>*The strong fall in the commodity prices after the shocks (4 quarters), help explain the reduction in inflation and is in accordance to interest rates improvement and inflation forecast, increase in MP transparency and effectiveness of IT.</p> <p>*Money growth fall in a response to contractionary monetary policy.</p> <p>*Interest rates increases and inflation get less, but that cost output reduction.</p> <p>*Commodity prices shocks cause appreciation in REER, and high inflationary pressure, but have positive impact into output.</p> <p>*In normal condition MP have negative effect on RGDP lead to fall in commodity prices inflation, tight liquidity and negative impact on stock markets.</p>
Price level and inflation in the GCC countries	(Murshed and Nakibullah, 2015)	<p>*Past prices level, foreign prices are the main determents of CPI (consumer price index) in GCC.</p> <p>*Depreciation in currency has an immediate SIG effect on CPI of all countries except Bahrain and Kuwait.</p> <p>*Change in MS has an immediate impact on price levels in Oman, Qatar and UAE, whereas changes in OP has direct impact on prices in Bahrain, Qatar and SA.</p> <p>*Domestic factors affecting CPI are not common in all GCC countries, even if they have similar production structure and consumption pattern. (Openness and</p>

		<p>growth of non-oil) domestic factor will not contribute much.</p> <p>* Inflation in GCC is mainly imported, foreign price level is more or less completely transmitted immediately or in the short-run to the domestic price levels of Bahrain, Kuwait and SA.</p> <p>*LR and SR impact of EXRPT on Domestic prices of the GCC is small or insignificant for all countries except for Oman. LR Elasticity on domestic prices level of Bahrain, Kuwait and SA are statistically insignificant.</p> <p>*Depreciation of their currencies increases their price level except for Bahrain.</p> <p>*Low ERPT is due to Widespread subsidies in electricity and water, gasoline, education and health services (start to change after VAT and other re planning structure by GCC GOV).</p> <p>*Monetary growth rates of Oman, Qatar, and UAE have significant LR impacts on domestic CPI. (Second highest contributor).</p> <p>*LR OP elasticity is SIG only for Qatar and SA, second other economically and stat SIG contributor to inflation in SA in LR.</p> <p>* Increase in relative OP GDP with rise in OP, fed into inflation of these countries nominal prices of the non-oil GDP.</p>
Impacts of foreign and domestic structural shocks on consumer prices of the GCC countries	(Nakibullah,2016)	<p>*Results are that variables are non-stationery and co-integrated in I(1).</p> <p>*EXR Deprecation decrease real wealth thereby depress demand and deflation in the LR.</p> <p>*Kuwait blamed the 2002-2007 prolonged dollar depreciation to accelerate inflation in Kuwait 'switch to basket in 2008'</p> <p>*IRF shows that EXR, OP, foreign trading partners CPI have generally positive effect on CPI.</p> <p>*Variance decomposition shows besides own CPI shocks, OP, EXR, Foreign prices shocks all contributes to the changes in CPI of the different countries to different extent 'each country have different source of CPI shocks'.</p>
Inflation in the kingdom of Saudi Arabia: the bound test analysis	(Alkathlan, 2011)	<p>*The use of simple bivariate framework where it relates CPI to openness of trade is always negative.</p> <p>*All variables were non-stationary, stationary after the first difference.</p> <p>*There is no problem for correlation in the first, second and third order of the equation, the same results goes for Heteroscedasticity</p> <p>*F-statistics shows that there is long relationship between the variables.</p> <p>*Negative coefficient of NEER and GDP gap, positive for MS and WPI (world price index), and this is consistent with the theory.</p>

		<p>*Depreciations of Saudi Riyals against other currency will create a pressure into inflation because of the MS and WPI, another reason is that the actual output is less than the expected output.</p> <p>*External factor plays a huge role in in effecting the price level in SA in the long-run.</p> <p>*Domestic factors such as MS play larger effect in the SR.</p>
Country heterogeneity and Long-run determination of inflation in the Gulf Arab states.	(Abul Basher and Elsamadisy, 2012)	<p>*High correlation between money and other measure of AD (aggregate demand) in GCC (Money is main determinate of Demand).</p> <p>*Government spending financed by oil revenue in US Dollar lead to high deposit of foreign currencies in Saudi banks.</p> <p>*Non –stationarity test shows (panel) shows that the variables have unit root.</p> <p>*Panel co-integration result prove that the AD is affected by the non-hydrocarbon output in Westlund, while the other test denies the co-integration relationship, which means a LR relationship in the long run at 5%.</p> <p>*Time series results shows; Engle-granger test that there is no co-integration, but Johanssen have a strong support for the Co-integration.</p> <p>*For SA, Johanssen strongly reject the non-co-integration evidence.</p> <p>*Results of MD (money demand) (ECM) shows that LR coefficient for EXR and MS (money supply) are significant at 5% and 10% respectively, that could be explained because of the collinearity relation between money and non –oil output</p> <p>*ECM for SR has negative sign and high SIG, MS and AD is a proven to be the main determined of inflation in GCC in SR.</p> <p>*By replacing non-oil with government spending, LR coefficient are correct for all variables and sign at 5%.</p> <p>*Foreign prices, EXR and MS are the most SIG LR determinant of inflation in GCC.</p> <p>*Lack of CPI response to EXR is due to MP independence in GCC (Fixed to US Dollar).</p>
Monetary policy in Saudi Arabia: A Taylor-Rule analysis	(Almounsor, 2015)	<p>*The interest rate is correlated in most of the sample period for SA.</p> <p>*For the period 1984-1990 and 1997-2002, the policy was tighter than it should be, thus, if the MP follow Taylor-rule then inflation will be extremely low, output will be in minus and it will have very low interest rates.</p> <p>*On the other hand, the MP was quite loose in the period 1991-1996 and 2007-2013.inflaton was high especially in the later period (5.5 and 10 %in 2008), output gap was positive, and the interest rates was higher than the rates observed for SA.</p>

			<p>*Generally, SA MP is tight in the first period of the analysis and loose in the last period.</p> <p>*All variable is stationary in different level: interest rates + FFR are stationary with constant and trend, the rest of the variable are stationary with trend only.</p> <p>*Wald test results: all coefficient was jointly SIG.</p> <p>*Means behaving well and there is autocorrelation existence in the residuals.</p> <p>*MP in SA represented by short term interest rates where it does not respond well to inflation and output gap, this occur because of the fixed exchange rate regime to the dollar (cannot be independent in the case of exogenous shocks).</p> <p>*FFR is the only SIG factor that effect MP in SA, it's the most important determinate of SA interest rates, this goes along with the theory of fixed exchange rate and lack of control in MP.</p> <p>*The addition of FFR in the model help to get a more meaningful equation and the other variable became explainable, while if we remove the FFR, the other variable becomes insignificant.</p> <p>*The trend variable is negatively associated with SA interest rates, this explain the small effect of MP into other macroeconomic indicators in SA such as Growth, structural changes, diversification and financial intermediation.</p>
	<p>What to target? inflation or Exchange rate</p>	<p>(Lin and Ye, 2012)</p>	<p>*Result from matching: inflation rate under an EXR regime target is SIG higher than under IT on average (SIG at 5% level).</p> <p>*The average value in matching method with neighbour countries is around 0.23 compared to IT that is EXR target will induce inflation increase by around 2.468 more than IT.</p> <p>*Result of robust checks: reserves and current account are INSIG in the regression, so that is not a good support for fixed Regime.</p> <p>*Financially open countries are more prone to adopt fix EXR with positive and SIG support at 1% level.</p> <p>*The USA inflation do not have a SIG coefficient in the equation.</p> <p>*The evidence from the robust checks that, IT perform better with lowering inflation and do not worsen growth compared to EXR target.</p> <p>*In developing countries, fix exchange rate has significantly higher inflation and not much better growth than the IT countries.</p> <p>*In all inflation regressions, the EXR regime coefficient and other regimes coefficient are significant and positive, IT is better than those two in reducing inflation, with no cost on growth.</p> <p>*Drawback: not measure the effect of financial crisis.</p>

	<p>Modelling monetary transmission in less developed emerging countries: the case of Tunisia.</p>	<p>(Przystupa and Worbel, 2015)</p>	<p>*Liquidity supply shocks impact loan and output: +shocks to bank reserves in non-recursive decompositions increase loans and interest rates, innovations to reserves supply and demands may not have been well addressed.          *CPI reaction is short-lived and small but (significant), which support the hypothesis of inflation persistence.          *small increase in output and EXR, only if restrictions are applied, in non-recursive decomposition this effect is not SIG.          *High influence of MP to EXR and prices.</p>
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### 3.5 The GCC as an Optimum Currency Area

The Gulf Cooperation Council was formed in 1981 consisting of Saudi Arabia, Kuwait, Bahrain, Qatar, United Arab Emirates and Oman (AlKholifey and Alreshan, 2010). It involved the creation of a common market in which all six countries participated. In order to ensure a smooth transition into a monetary union, in 2009 an inter-governmental technical financial and economic committee was formed with the aim of assessing the state of monetary cooperation. The same year the GCC Central Bank was established by four of the six GCC countries namely Saudi Arabia, Kuwait, Bahrain, Qatar (Takagi, 2012).

Despite the similarities in GCC, there are differences in the six GCC economies ranging from inflationary performances to domestic labour markets to fiscal policies (Kim and Hammoudeh, 2012). The creation of a single currency among the GCC countries was intended to enhance economic stability as far as the supply of oil and gas reserves are concerned (Cader and Meza, 2009). AlBarwani argues for the creation of a GCC single currency, as its member countries are meeting most of the OCA criteria. He also mentioned that the common features of the GCC economies such as geographic proximity, language, the use of hydrocarbon resources and the GCC central banks cooperation act in favour of this argument (AlBarwani *et al.*, 2010).

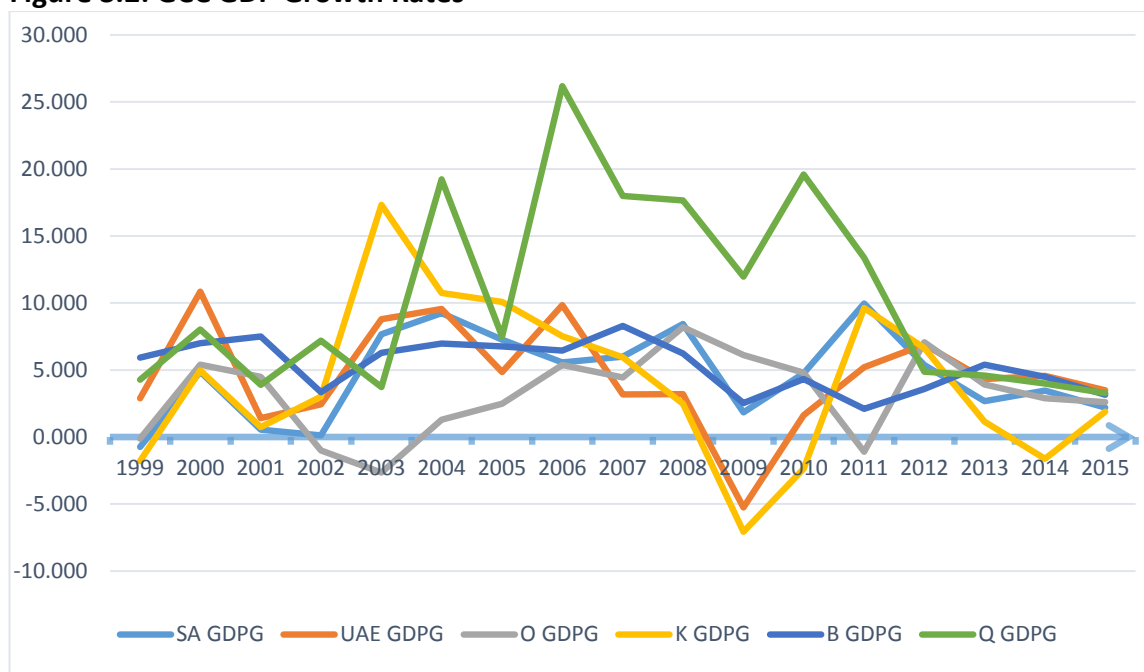
**Table 3.3: GCC countries and OCA criteria**

OCA criteria	Found in GCC Economy	Not Found in GCC economy
Openness	X	
Factor mobility (labour / capital)		X
Diversification		X
Production structure	X	
Prices and wages flexibility		X
Inflation convergence	X	
Policy integration	X	
Political integration	X	

\*Labaas and Limam (2002)

Table 3.3 presents the OCA criteria fulfilled by the GCC countries in relation to the ones that do not meet them. As it can be observed factor mobility, both capital and labour, diversification and wage and price flexibility are the three criteria not met. The creation of a single currency due to take place in 2010 has been postponed primarily due to the Euro debt crisis (Takagi, 2012). Establishing a single currency among GCC countries and decoupling from the fixed peg with the US Dollar, could provide a viable solution to the observed accelerating inflation (AlKholifey and Alreshan, 2010). In addition, high inflation rates have resulted to negative real interest rates (Abul-Basher, 2013). On the other hand, AlKholifey and Alreshan (2010) claim that the fixed exchange rate regime to US Dollar has helped stabilising the interest rate in the region and, has, therefore strengthened the GCC commitment to a single currency.

**Figure 3.2: GCC GDP Growth Rates**

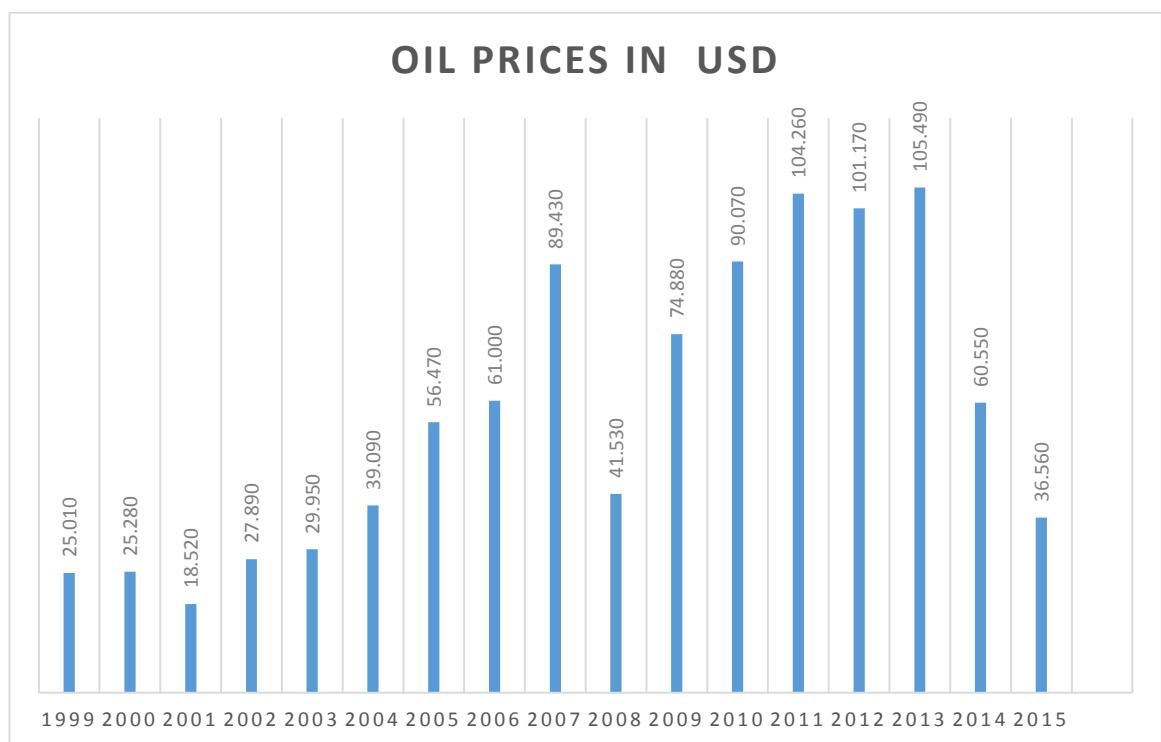


In Figure 3.2, growth rates are explored in the GCC, as it can be seen, the country experiencing the highest volatility is QATAR with (nominal) growth reaching 25% in 2006 to be reduced to less than 5% in 2014. Growth rates in GCC are correlated with oil prices as we can see that all GCC economies experienced low growth since 2013, when oil prices dropped dramatically. In addition, regarding to GDP per capita, Qatar had the

highest rates by 29% of the whole GCC which is around \$34,960, while Saudi have the lowest by only 8.23% which is around \$9,854 (Nusair, 2012).

The fact that most GCC countries' oil revenues exceed 70 per cent of their GDP helps to form a currency union. However, the impact from unanticipated US monetary policies shocks could potentially have a negative impact on GCC countries' economic performance (Balli *et al.*, 2010 a). As a result, the dependence on oil revenues and the lack of alternative sources may reflect that the GCC region is not ready for a monetary union (AlKholeify and Alrashan, 2010). The importance of oil revenue and the fact that oil is priced in US Dollars is challenging the choice of the fixed exchange rate regime due to the high volatility in oil prices (Abed *et al.*, 2003).

**Figure 3.3: real oil Prices 1999-2015**



\*Source: IMF Regional economic outlook (2016)

In Figure 3.3, the movements of the real oil prices from 1999-2015 are illustrated. As it can be seen, the collapse of oil price during 2014-15, from \$105 to \$37 in 2015. The collapse in oil revenue has deprived the GCC countries' authorities from vital resources

facilitating the absence of income tax and other form of taxation and the implementation of a wide range of social policies. The GCC respective central banks' policies could have been more accommodative had their currencies not been party to the fixed peg to the dollar. Further, the oil price volatility influences income levels in the region, which in turn also has an impact on consumption patterns and investments programmes in the GCC economies (Abul-Basher, 2013).

From an oil production prospective, oil prices show no correlation with the domestic industrial production in Kuwait, Oman and Saudi Arabia, the GCC production does not have a direct influence into prices, the prices are determined globally (Kim and Hammoudeh, 2012).

During the last decade, China has emerged as a major GCC oil consumer. In 2006, China's share reached 37% of GCC countries' oil exports and the oil trade between China and UAE reached \$ 14 billion (Echague, 2007). The increased demand for oil in countries such as China and India since 2002 has prompted a reassessment of the fixed exchange rate policy to the US Dollar as its depreciation from 2007 to 2013 caused a significant reduction in oil revenues for the GCC countries. This placed oil revenues under further strain (Kneissl and Kowdeweski, 2007; AlQudsi *et al.* 2008; Balli *et al.*, 2010).

In addition, the increase in oil prices from 2009 to 2013 caused by the dollar's depreciation caused inflationary pressures in the GCC countries. Kim and Hammoudeh (2012) study shows that oil prices feature a positive correlation with the US export prices, China's PPI, Japan's export prices and EU's export prices. Again, the Dollar's depreciation has a positive effect of the rest of the world export (USA, Japan and EU).

The GCC economies are very open (Table 3.3). Imports are primarily basic goods such as food, clothes and IT products, which are mainly imported from Asia, Europe and North America. However, the total share of these products to the volume of exports is only 4.8% and 8.5% respectively reflecting the dominant role of oil for the GCC economies (Takagi, 2012). This reflects the need for the GCC economies to diversify their export markets rather than being so heavily dependent on oil revenues in order to prevent specific sector shocks and thus satisfy the OCA requirement for monetary union (Rafiq, 2011). The GCC countries have developed strong oil trade links with China and Japan

and this has shown to reduce the volatility in oil prices when they tested to use local currency (AlQudsi *et al.*, 2008). Trade with Japan has reached almost 16% of total imports and exports in the region (Saidi *et al.*, 2010).

Oil exports to emerging market economies will encourage the reform of exchange rate policies and current practices in particular in the aftermath of the 2008 crisis (Abul-Basher, 2013). High volumes of trade and oil dependency to China and India has prompted a revision of the fixed exchange rate regime to the US Dollar. This is the case as the depreciation of the US Dollar pre-2013 led to depreciating GCC currencies in relation to the Asian currencies and the Yen impacting on the volumes of trade (Abed *et al.*, 2003; AlQudsi *et al.*, 2008; Rafiq, 2011).

Creating a monetary union in GCC would be further conducive to accommodating asymmetric shocks and increasing the macroeconomic independence of the region (Takagi, 2012). In addition, a single currency would provide stability for idiosyncratic shocks and it will facilitate the functioning of the common market for goods and services (Rafiq, 2011). This will provide a stable economic environment in the region (Hassan *et al.*, 2013). Although Nusair (2012) argues, that GCC economy is homogenous and the risk of having asymmetric shocks in the region is low. Thrope (2008) mentioned that in the near future the energy reserves are going to decline and that will increase the need for diversification of the economy which will increase the possibility for asymmetric shocks.

To achieve successful monetary integration and create a single currency, the GCC needs to consider its financial integration by revising the financial system to allocate capital and the transmission of various assets prices and interest rates. The financial system in the GCC is dominated by the commercial banks both local and franchise banks, the size of the banking system varies between the countries with Saudi Arabia and UAE account for around 75% of total bank assets, the operations in GCC banks mainly focus on lending and private deposits. Bahrain is the more open country to foreign liabilities with 47% while Saudi have only 8%. In relation to dollar peg system in the region, the internal rate convergence is relatively fast in the GCC, the slowdown of accommodating the arbitrage effect make the region less sufficient to remove arbitrage opportunities. Internal GCC

equity markets are more integrated than most other emerging countries, although, they still need to address some issues relating to liquidity and process information that will improve the financial system in the region (Espionza *et al.*, 2011).

Non-oil sector and investment will increase the diversity and reduce the volatility of prices. In addition, GCC could increase productivity and invest in technology to increase job opportunity and introduces income tax to their Central Bank system (Hakimian and Abdalla, 2015). On the other hand, there are disadvantages from creating a monetary union. The GCC economies' surpluses could cause a moral hazard problem in terms of financial regulation when they adopt a single currency (AlKahter, 2012). In the case of employing different tools to control inflation, the GCC members should consider the limitations involved when creating a single currency (Kandil and Morsy, 2011).

Takagi (2012) claimed that the GCC countries have to improve their international trade and capital mobility and implement political reforms in order to meet the OCA criteria for a viable monetary union. In addition, the macroeconomic imbalances between GCC countries' economies require the adoption of policies addressing the economic obstacles of the GCC region as a whole rather than individual country policy decision-making (AlKhatir, 2012).

A high fiscal deficit in one state could trigger unsustainable fiscal policies and 'force' the member to increase interest rates, which will have crowding out effects on the private sector (Thrope, 2008). As a result, the GCC countries need to meet the OCA criteria before adopting a single currency. Failure to do so could have a negative impact on the real exchange rates and inflation (Gurrib, 2012). Other points to be considered by the GCC countries include the reliability of their statistics in order for further research to be conducted in the field (Ben Naceur and Kamar, 2007).

Rutledge (2009) added that the GCC measures of CPI are outdated, each country is using a different base year, and they need to start improving data structures and modelling to meet the convergence target. In addition, the trade links and integration between the GCC will have to be further enhanced (Ramady, 2012). The absence of unified trade policies between GCC members will make it harder for them to act as regional bloc if they want to have international trades and deals with rest of the world (Rutledge, 2008).

Although the GCC countries are relatively open in trade, still the openness in intra-trade is quite low, the level of international trade is not rising a lot, in last few years with very low rates in Saudi and relatively higher is UAE and Bahrain. The GCC need to reduce capital restrictions, and obstacles to free movements of labour and enhance policy coordination in the region.

Another problem the GCC faces is the big gap between private and public sectors and the difference between foreign and national workers, which will increase the political and public criticism among the credibility of the creation (Nusair, 2012). In addition, the political will of creating a supra-national monetary policy among the members and reserves management should be considered, the central budget would eliminate problems and allow fiscal transfers to solve asymmetric shocks (Thrope, 2008).

The GCC will need to take the seignior distribution revenues and foreign reserves in tandem with the political decisions to vote for future policies committee, the political will might be more important than the economic reform, the current political troubles from Iran, Iraq and Yemen will increase the necessity of reforming an economic and political integration (Rutledge, 2009).

However, even if the GCC countries decide to establish a single currency, if pegged to the US Dollar could have a negative impact on inflation and the balance of payments (Albarwani *et al.*, 2010). For example, the Saudi Arabian and Kuwait economies have higher GDP per capita than UAE and Qatar, something that could generate inflationary pressures for some parts in the region (Hasan and Alogeel 2008; Albarwani *et al.*, 2010). The GCC will have to bear the cost of maintaining a fixed exchange rate regime to the US Dollar when faced with deficits caused by external shocks (Takagi, 2012). The asymmetric nature of these shocks could potentially destabilise certain regions or countries in the GCC monetary union. Cader and Merza (2009) claim that the current pegged regime does not facilitate the creation of a common currency in GCC, as it acts against the coordination of fiscal policies within GCC and as such it does not ensure the success of the pegged regime (AlBarwani *et al.*, 2010). The continuation of the fixed exchange rate regime in the post 2008 era raises the risk premium for foreign exchange in GCC (Poghosyan, 2010).

The USA is trying to reflect the importance of the use of the US Dollar because it is a vehicle currency, and oil is priced in Dollars. That will increase the pressure on GCC Central Banks to form a currency union internally among the member and externally for the foreign markets. The GCC face many challenges regarding reducing its oil dependency and the diversity of its economies. Bahrain and UAE could develop their financial and tourism sectors, Kuwait and Qatar could specialise on different commodities like gas, whereas Oman and Saudi Arabia could increase their manufacturing production and tourism (Nusair, 2012). The income base of the GCC economy is limited to oil and gas revenues, which increases fiscal strains. In the past the GCC managed to cover all deficits, most GCC countries were within the 60% limit apart from Saudi Arabia (Rutledge, 2009).

In this case, moving away from the fixed exchange rate regime and adopting an appropriate flexible exchange rate regime may provide an alternative worth considering. Various proposals have been put forward. A flexible exchange rate regime in the GCC monetary union would be more appropriate for the GCC economies in the case countries diversify their asset portfolios away from dollar denominated assets to include non-oil exports as well (Abed *et al.*, 2003). An alternative suggestion regarding the creation of a GCC currency is that of pegging its value to a basket of other currencies providing an anchor for the GCC economies (Balli *et al.*, 2010).

A basket that will comprise of the US Dollar and the Euro will be beneficial for the GCC new currency helping stabilising the interest rate (Balli *et al.*, 2010). Such a basket will promote international trade and the non-financial transactions in the GCC economies (Abed *et al.*, 2003). AlQudsi *et al.* (2008) argue for such a basket to include the Yuan and Yen as well as the Euro and the US Dollar as a means of decreasing import and export price volatility. Kim and Hammoudeh (2012) also agree with AlQudsi *et al.* (2008) that GCC need to have a synchronising basket of currency that support the exchange rate of the diversity of the trading partners.

On the other hand, since the GCC countries' economies are primarily oil exporting, pegging to oil prices rather than to the USA dollar or any basket of currencies would stabilize the GCC countries' economies and help formulating the currency union



(Shamlo, 2005). Abul-Basher (2013) suggested that oil prices could be included into the basket of currencies so if the US Dollar depreciates the domestic prices will appreciate in terms of dollar.

However, Balli *et al.* (2010) insist that moving away from dollar to euro will not benefit GCC area; the inflation shelter in Euro zone is higher than the USA. The GCC non-oil output is not correlated with either the US or the European countries, the GCC has high growth and less stability than EU and US by at least 3 times higher. In addition, the Euro will not be beneficial for GCC because of the asymmetric shocks, which will cost a major adjustment cost. The US Dollar remains the best option for GCC to smooth the demand shocks in the region. All GCC are subject to similar shocks except for UAE. GCC trials on diversifying the economy will improve export and current account balance unless they rely on importing raw material where that will not help into massive production benefits.

Whereas, Khan (2009) suggested that pegging to US Dollar may be useful when adopting the single currency, but at a later stage, as the regime should become more flexible to better accommodate potential oil shocks. This will make fiscal policy more effective in terms of reducing exchange rate volatility. Others have maintained that the US Dollar is a more appropriate currency for the GCC single currency to be pegged as it can smooth the demand shocks in GCC economies (Hassan *et al.*, 2013). Saidi *et al.* (2010) recommended that the dollar peg would only be suitable in the early stages of adopting the single currency. Later on, the GCC monetary authorities could move to a pegging based on a basket of currencies as a means of widening their international markets (Saidi *et al.*, 2010).

A fully flexible regime requires high levels of liquidity in financial markets incompatible with the liquidity of the GCC economies making a flexible exchange rate regime not such a good option (Kneissl and Kowaleski, 2007). Conversely, Kahn (2009) suggested that inflation targeting with a flexible exchange rate might be a better option for the GCC countries. Thrope (2008) mentioned that inflation targeting for GCC would help to avoid the changes of exchange rates when final stages are determined and will stabilise interest rates by balancing all prices. Table 3.4 explores the most recent literature that

discussed the GCC single currency steps and plans, with a further analysis on the possible impact into the GCC economies and influence into the world economies.

**Table 3.4: GCC and OCA previous studies results and models table**

	Title	Author	Results
OCA and GCC	The MENA region – An optimal currency area? Evaluating its Stability by Taylor-Rule derived stress tests	(Karara, 2014)	<p>*Taylor rates of SA, Iran, Iraq, Kuwait and Algeria have increased sharply compared to other countries.</p> <p>*Acute increase in inflation rates of these counties as observed form the GDP deflators of each countries, it might be due to low OP in 1997-1999, result in import inflation due to high reliance on import form their trading partners (EU for Example).</p> <p>*Union mean stress test (UMS): the GCC could be highly sustainable potential union, as the UMS is low.</p> <p>*KSA and Iran are the main player in MENA region with 29% and 21% respectively (GDP shares); KSA average Taylor rate is 10.7%.</p> <p>*GCC has the highest potential among all other union proposed in the MENA Region, considered the second anticipated union after EU, due to strong similarity between countries in economic structure, unified goals.</p> <p>*GCC leaders did not considered the 2010 date; leaders should value the economies gain of the union.</p>
	Is the Dollar peg suitable for the largest economies of the Gulf cooperation council?	(Sequalli, 2011)	<p>*Correlation between output and inflation shocks is negative in SA, stat SIG at 0.05%. (Not very strong).</p> <p>*Although the evidence makes the Fix Regime stronger to be used, it must be treated with caution due to the frequent bouts of positive correlation, which weaken the case.</p> <p>*Fixed regime is not good for Qatar and UAE, correlation between output and inflation shocks is negative and not significant.</p> <p>*Negative result could be due to subsamples used in the analysis.</p> <p>*NEER (nominal exchange rate) appear to follow downward trend since 2001, that</p>

		<p>suggest rising imported inflation, dollar peg is unsustainable for SA, Qatar and suitable for UAE, all three countries have been affected by Dollar Peg Unsuitability, that mean dollar peg is not suitable for all three countries.</p>
<p>Sterilisation and monetary control by the GCC member countries</p>	<p>(Hassan, 2013)</p>	<p>*Fix EXR in GCC, interest rates did not converge to the interest rates in US; Assets of GCC are not perfect substitute to US Assets, obstacles of movements of fund between GCC and US.</p> <p>*Inflation rates differentials between GCC countries, and the US is that the GCC had different money growth than the US. CB in GCC have had some control over their money growth by sterilising the changes in international reserves.</p> <p>*Inflation rate variable is included to capture monetary authority behaviour in relation to domestic credit policy, in the case of Bahrain it is the least likely country to have monetary control and ideal GCC country that lost monetary control, due to peg regime.</p> <p>*The accommodating credit policy of these countries has exasperated the recent inflation, Bahrain is an exception.</p> <p>*The significance of seasonal dummies for all the GCC countries indicates the point that much of the variation in the domestic credit policy instruments is in the defence of monetary stability rather than in active pursuits of other policy goals.</p> <p>*GCC kept official pegged against US Dollar but had effective fixed exchange rate against the US Dollar and has had no restriction over capital movements.</p> <p>*Capital are not perfectly mobile between these countries. Monetary authorities of GCC have had some room to manoeuvring Monetary policy.</p> <p>*GCC central banks should be able to pursue the same policy options as a group to maintain the monetary independent and can reap the benefits of monetary efficiency of the monetary union.</p>
<p>Modelling a potential GCC single currency</p>	<p>(Mohamed and Irandoust, 2014)</p>	<p>*Result shows, that proposed monetary union is likely to yield economic benefits for GCC if they adopted a foreign EXR pegged to SDR (Basket of currencies consist of; Yen, dollar, pound and Euro).</p>

	<p>The optimality of a gulf currency union: Commonalities and Idiosyncrasies</p>	<p>(Rafiq, 2011)</p>	<p>*From Plotting Real output growth at business cycle frequencies 80-05, all GCC economies suffered from Volatile output cycle.</p> <p>*results from Correlation shows; there has been on average STAT SIG increase in output correlation between GCC economies, common factor innovation should be more important for output fluctuation at business Cycle.</p> <p>*GCC are more diverse after 1992, marinating the possibility of regional spill over 'shocks', degree of correlation will continue as long as common shocks continue.</p> <p>* The Advantage of using Multivariate model, it prevents the idiosyncratic shocks for SA' 50% of GCC population',</p> <p>*Probable shocks 'particularly US', had strong bearing into GCC economies, one reason is the Pegged regime to US Dollar. Another reason is GCC is mainly Oil exporting country 'Demand condition to US'. Economic Development in US and GCC are closely related.</p> <p>*Most obvious example for the GCC concerns the similarities of the monetary policy objectives pursued over 15-20 years, Oil and Gas prices is a one of the biggest common factors shocks to GCC 'less diverse economies'.</p> <p>*Results shows that GCC output fluctuation already reflect the commonality of MP</p> <p>*Result from sensitivity test shows that fall in common factor shocks variance would been because of downward force on GCC output correlation over time 'oil shocks increase output correlation'.</p>
	<p>Is the US Dollar a suitable anchor for the newly proposed GCC currency?</p>	<p>(Balli et al, 2010)</p>	<p>*Economies of GCC have grown about three times faster than has to overall US, but volatility in GCC for non-oil sector in GCC is four times less stable than US, first gulf war is a main contributor to volatility in GCC 'Kuwait 10 more times higher than other GCC'.</p> <p>*Result shows relevance of monetary policy in the US to the GCC countries' Helped to reduce Inflation in the 80s. However, form 2000 inflation increased in GCC due to boom in infrastructure projects and reinvestment of oil revenues.</p>

			<p>*For inflation: an increase in US interest rates by 1% will increase in inflation that last for one period then decrease below the country baseline, this result is consistent with the US contractionary monetary policy on inflation at home, Price puzzle is anomaly in VAR for US.</p> <p>*Monetary policy that work for the US might work for the GCC as a group in terms of inflation (expected because of peg regime).</p> <p>*Positive supply shocks due to reinvestment of oil revenue, dominate the effect of the foreign monetary policy shocks in GCC, MP form US do not influence GCC non-oil output growth in a way similar to US.</p> <p>*Inflation response are more synchronised than the output responses to US monetary shocks, Inflation is more sensitive to US monetary policy than non-oil output is, inflation determination are not similar in the GCC.</p> <p>*It has been confirmed that GCC has imported MP from US because of The Peg regime, validate the use of US Dollar as an anchor. However, if US Dollar continue to depreciate, and start to loss the importance of a major currency, then Basket of currency could be better for GCC than US Dollar only.</p>
	<p>Are GCC countries ready for Currency union?</p>	<p>(Laabas and Limam, 2002)</p>	<p>* Similarities of the variation in NER rates of GCC 'Dollars', almost the same except for Oman it was fluctuated less than other GCC countries' currencies.</p> <p>*ADF results: RER in GCC are non-stationery.</p> <p>* Series for NER and RER are I (1).</p> <p>*G-PPP holds in GCC and meet OCA requirements, EXR for All GCC except Oman enter the Co-integration (SIG), Oman could not be rejected at 95%.</p> <p>*Oman is least favourable to join the GCC single currency, low relative correlation between Macro variables in Oman and the rest of GCC.</p> <p>*Need harmonisation and monetary policy coordination to help form OCA in GCC, and remove restriction in Goods and factors movement.</p> <p>*business cycle in GCC do not seem Synchronised.</p>

			<p>*The correlation of GDP growth rates between GCC is not uniform, Oil price fluctuation has different impact on the countries region, and the adjustment of shocks is different in each country in GCC.</p> <p>*Lack of evidence of convergence among GCC main macroeconomics fundamentals compared to the EU.</p>
	<p>Empirical results for some monetary areas according to optimum currency area criteria</p>	<p>(Adamek and Kappel, 2015)</p>	<p>*NAFTA: Both Canada and Mexico have better condition to adopt OCA with the US in case of trade, difference and openness, but once GDP is included, US have much higher GP.</p> <p>*MERCOSUR: Paraguay is the smallest and Brazil is the largest, the most linked economies in the region are Argentina-Uruguay, Brazil- Paraguay and Brazil-Uruguay, Venezuela is less open that before the crisis.</p> <p>*Canada and Mexico could form OCA with US, but for MERCOSUR: Venezuela has the worst indicators. Other countries perform better but still the evidence for OCA is quite small compared to EURO.</p>

OCA and GCC	<p>Is the Gulf cooperation council an optimum currency area?</p>	<p>(Nusair, 2012)</p>	<p>*Tests were not able to detect Iraq invasion.  *Major political and economic events that lead to the belief of structural breaks existence in the study series.  *According to G-PPP, even if the RER is not stationery, grouping could overcome the white noise.  *In the case of USA as a base country and all GCC is included, there is four vector co-integration.  *G-PPP holds for all different groups in the case of USA as a base country, that means LR relationship between RER and US Dollar 'shocks in one will affect the other', in another words, asymmetric shocks and therefore fit OCA criteria.  *In the SA base country case, only 2 Co-integration exist, one co-integration when the researchers exclude UAE and Oman.  *Currency union in GCC based on the results could be formed by having US Dollar as external and SAR as internal, UAE and Oman being excluding have no results for OCA.  *Stability test from 1977-2009, the results without the structural breaks show the G-PPP relationship has been stable over time  *Other OCA criteria has been examined, which could be summarised as follow:  A. the need of different diversification.  B. GCC is open to international trade.  C. correlation between output growth, money growth, inflation and RER is low and negative, that suggest that the GCC economies are not moving together.  D. limited mobility in the labour sector, big gap between national and non-nationals, private and public sectors.  E. political will challenges.  F. intra trade between GCC is small.  *Overall, G-PPP suggest that GCC fits OCA criteria.  *Need more policy coordination between members of GCC by eliminating all restrictions on capital and labour.  *Once the currency is formed, GCC will need more focus on intra trade between the member's countries by coordinating diversification in the region economies.</p>
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	<p>Impact of global and domestic shocks on inflation and economic growth for actual and potential GCC members countries</p>	<p>(Kim and Hammoudeh, 2012)</p>	<p>*Correlation results shows: EXR and oil prices have a positive correlation, china producer price, US export, EU export and Japan export. (PPP)</p> <p>*Oil production countries shows no correlation with the domestic industrial production with Kuwait, Oman and Saudi Arabia, which says that oil prices have indirect with oil production.</p> <p>*Industrial sector excluding oil in many GCC is less than 10% of the GDP (services are dominated), other non-oil exports are a small percentage of GCC industrial production.</p> <p>*US exports show positive correlation with EU and Japan exports, CPI of Jordan, Kuwait, Oman and SA and with the industrial production of Kuwait and SA.</p> <p>*EU export show positive correlation with JAPAN exports, CPI of Jordan, Kuwait and SA.</p> <p>*Japan exports shows positive correlation with CPI of Jordan, Oman and SA and Kuwait industrial production.</p> <p>*Impulsive response results show: EXR depreciation shocks the EXR rise (US deprecation) by around 2.2% and stabilize at 2.6% in the LR.</p> <p>*EXR shocks has positive and SIG effect on oil prices, by around 4.565 and 7.5% in the LR, Chinese producer prices rises by 0.075 and 2.0% in the LR, US exports prices rises by 0.6% and 1.75 in the LR</p> <p>*The low sensitivity in Japanese Exports prices is due to the deflation and liquidity trap.</p> <p>* Oil prices shocks has negative and SIG impact on the US Dollar appreciation. In the LR, + and SIG on the export of US, EU, Japan and China producer prices, global increase in AD that shock oil prices</p> <p>*high volatility in the Oil prices is due to the instability in the geo-political in the ME.</p> <p>*Oil prices increase by 9.3% at the instant of the shocks and 11.1% in the LR.</p> <p>*The CPI of all GCC and Jordan show positive response to the US EXR depreciation shocks, that is due to the link with the US Dollar EXR regime that cause imported Inflation.</p> <p>*Most of Industrial production and CPI of the GCC countries in IRF graphs shows ad</p>
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		<p>rise due to oil shocks. IP of Kuwait, Oman and SA rise by 2.1%, 0.5% and 2.2% respectively in the LR. Oil prices has huge impact on inflation and the industrial production in the region</p> <p>*According to the Chinese producer prices shocks, all GCC response will due to the strong trade relations, oil prices decrease due to chinses prices shocks. (Jordan shows negative and insignificant response to Chinese producers' shocks).</p> <p>*IP of Kuwait, Oman and SA is greatly affected by oil shocks, chinese producer prices shocks, EU exports price shocks and its own IP shocks.</p> <p>*The shocks correlation response in relation to GCC growth and EXR deprecation is positive.</p> <p>*All global shocks in the paper has a positive effect on inflation of GCC, which is caused by oil boom. Us depreciation and imported inflation.</p>
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## **CHAPTER 4**

### **Methodology for empirical analysis**

In this chapter, different models and techniques are employed to test the primary objectives of the research. Firstly, the models that explain the relationship between the Real Exchange Rate (RER) and oil prices in Saudi Arabia are discussed. In this section, the models for testing the exchange rate regimes are evaluated, explaining the main models and estimations conducted on the same issue from previous studies. Following that, the most suitable models are estimated by using time series econometrics. A discussion on the variables and their descriptive statistics follows. Different econometric tests and techniques have been explained at the end since the technique overlap with the models employed in the thesis. Sections 1-3 employ the same econometric techniques. A chart summary showing the techniques employed in each section is presented.

Secondly, we have discussed previous studies and models applied, that determine inflation in SA and GCC. Subsequently, a model on the inflation targeting (IT) approach is assessed. A model of inflation rate determination that includes two dummy variables for IT and Exchange rate regime is designed and estimated. Next, we discuss the models for applying the IT regime in SA by using a VAR and VECM model focusing on the primary fiscal and monetary variables tools. Again, we follow the same structure as the section before by explaining the variables, descriptive statistics and econometric tests.

Thirdly, we explain the models of Optimum Currency Areas (OCA) in the Gulf Cooperation Council Countries (GCC). In this section, the use of the Mundell-Fleming model (IS-LM-BP), Fisher model, G-PPP between GCC countries are considered. Our model estimation was based on the G-PPP approach. The same structure as the above two sections. This will be discussing the previous studies result, following some main influential models. Then, we will demonstrate our model results.

Fourthly, we discuss the different econometric techniques used for the purposes of the Thesis, discussing different unit roots test for time series, explaining the Co-integration tests, Error Correction Model test, Wald test for the joint hypothesis, and the general models for VAR, and IRF.

## 4.1 Modelling exchange rates in Saudi Arabia

### Models explain the relation between real exchange rate (RER) and oil prices (OP)

We follow an Error Correction Model (ECM) used by Yiheyis and Cleeve (2016) and apply ARDL technique to explain the relationship between Real Exchange Rates oil prices. Industrial production is replaced with oil prices the model is defined as follows:

$$\begin{aligned} \Delta \log z_t = & \alpha_{1z} + \lambda_{1z} \log z_{t-1} + \lambda_{2z} \log P_{t-1} + \lambda_{3z} \log e_{t-1} + \lambda_{4z} \log M_{t-1} + \\ & \lambda_{5z} \log y_{t-1} + \lambda_{6z} \log F_{t-1} + \sum_{i=1}^n \beta_{iz} \Delta \log z_{t-i} + \sum_{i=1}^n \gamma_{iz} \Delta \log P_{t-i} + \\ & \sum_{i=1}^n \delta_{iz} \Delta \log e_{t-i} + \sum_{i=1}^n \theta_{iz} \Delta \log M_{t-i} + \sum_{i=1}^n \phi_{iz} \Delta \log y_{t-i} + \sum_{i=1}^n \phi_{iz} \Delta \log FX_{t-i} + \\ & \mu_{tz}. \end{aligned} \quad (4.1.1)$$

Where  $z = (P, e, M, y, FX)$ ,  $n = \text{lag length}$ ,  $\Delta$  is the difference operator,  $\mu$  is the error term, and  $\lambda$  is the long run multiplier where it represents long run co-integration relationship. After estimating the above equation and performing unit root tests, we continue with co-integration test. We estimate the short run dynamic from the above equation and we will replace  $z$  by real exchange rate therefore, we will get:

$$\begin{aligned} \Delta \log e_t = & \alpha_0 + \alpha_1 \Delta \log e_{t-1} + \alpha_2 \Delta \log P_{t-4} + \alpha_3 \Delta \log M_{t-3} + \alpha_4 \Delta \log M_{t-4} + \\ & \alpha_5 \Delta \log y_{t-1} - \alpha_6 \Delta \log y_{t-4} - \alpha_7 \Delta \log FX_{t-3} - \alpha_8 \Delta \log ect_{t-1} + \text{residual}. \end{aligned} \quad (4.1.2)$$

When estimating the above equation, the authors used dummy variables for Fixed/Floating exchange rate in the estimation, but did not include it in the formula. However, we have added oil prices to the above as it is an important factor influencing RER in Saudi Arabia. A Granger causality test between the variables has been applied to check the direction between variables.

Another option considered, was estimating the relationship between the RER and Oil prices by considering the formula below from Amin and El-Sakka (2016):

$$ER_{it} = \alpha_i + \beta_{1i} OP_{it} + \beta_{2i} CA_{it} + \beta_{3i} GDPPC_{it} + \beta_{4i} FDI_{it} + \mu_{it} \quad (4.1.3)$$

Where, ER=real exchange rate, OP=real oil prices, CA=Real current account balance, GDPPC=Real GDP per Capita, FDI=Real Foreign Direct investment inflows.

Before estimating the dummy variable for the exchange rate, we were aware of different exchange rate classifications. Thus, this thesis considered, the two most common types

namely Reinhart and Rogoff (2002) and Levy Yeyati and Struzengger (2005). Previous studies have considered these two papers.

However, these papers have updated their methods and data regarding exchange rate classifications to include essential changes that occurred in the millennium such as the creation of Euro, countries adopting an inflation targeting system and the Great Recession. The new exchange rate arrangement of Reinhart and Rogoff has been updated in 2017 by Ilzetzki, Reinhart and Rogoff.

The new database includes 194 countries from 1946-2016. The authors found that the US Dollar is still the main dominant currency used as an anchor, but the Euro has differed. The paper also includes countries that used IT system as their policy. The analysis of the exchange rate arrangement is based on anchor history, capital control, new measures of foreign exchange and monetary policy independence, which is referred to as the macroeconomics Trilemma. In addition, the new data allows for more algorithms on multiple currency poles and information on parallel exchange rates into the index of both de jure and de facto regimes.

As a result, the paper has found that there might be more diverse exchange rate arrangements in the future depending on the region such as using Renminbi in Asia, Dollar in the America and Euro in Europe (Ilzetzki, et. al, 2017).

Another main paper on classification is Levy-Yeyati and Sturzenegger (2015), where they used cluster analysis to capture exchange rate volatility and reserves. The paper discusses the fact that most countries that adopted a float exchange rate system do have some influence on the movement of the exchange rate in practice. It is much closer to the conventional peg than to float.

The paper has found out that most developing countries experience currency appreciation and more countries are adopting inflation targeting. The researchers also found that low-income countries are more prone to choose fix exchange rate, while the medium and high-income countries prefer floating regimes.

Nevertheless, for our thesis and data analyses, we considered Reinhart and Rogoff data for exchange rate regime classification. We need to establish a system that will help us

to demonstrate the dummy variable for our model. In our thesis, we have used the newly updated classification from 2017.

In relation to other contributions that might discuss exchange rate models such as Markov switch models and STAR, we did not consider them in our models because they are not appropriate for our country case. Saudi Arabia did not switch or change their fixed regime to the US Dollar.

**Models considered and Smart chart summarises for this section procedure:**

From the methodologies considered in this section, the one most relevant for this thesis, are the following:

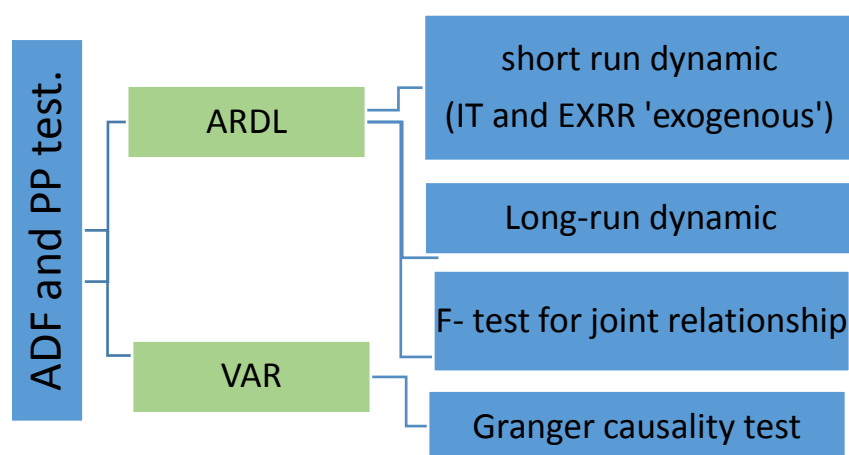
The use of ARDL model was the most suited for our variables, as we have a different level of stationary level for each variable. Before we estimated the model; we have the ADF and PP test to check for stationarity and transform the variables to become stationary. ARDL can deal with the different level of co-integration level.

The model we have constructed is based on Yiheyies and Cleeve (2016) of using ARDL. We have added two exogenous variables into our model; the two exogenous variables are dummy variables for Inflation Targeting (IT) and Exchange Rate Regime (EXRR).

In our model, both dummies are independent variables. STATA has generated the correct lag needed for our ARDL model. However, the ARDL equation used in our analysis is given in the following ARDL (1, 0, 2, 0, 1, and 0):

$$lsre_t = \beta_0 + \beta_1 lsre_{t-1} + \alpha_0 lscpi_t + \alpha_1 loopr_t + \alpha_2 loopr_{t-1} + \alpha_3 loopr_{t-2} + \alpha_4 lsmqga_t + \alpha_5 lsgcus_t + \alpha_6 lsgcus_{t-1} + \alpha_6 lsopen_t + \alpha_7 IT + \alpha_8 EXRR + \varepsilon_t \quad (4.1.9)$$

Figure 4.1.1 procedure of the real exchange rate model



**Variables and data used for the model:**

Data is collected from different resources for Saudi Arabia. We used annual data from 1980-2015. The next table explains the ARDL model with the variables needed for our model, with a full description of each variable. For some variables, more than one data set may be needed because we will have to calculate it before including it in the model; further details about the dataset can be found in Appendix A.

We use lower case letters of the variable name as it makes it easier to estimate the model by STATA. All our variables are in log form (l), the letter (l) before variable means variables in the log.

**Table 4.1.1: variable for ARDL model (Real exchange rate):**

Model	Variable (full name)	Data	Source
ARDL equation for the real exchange rate with IT and Exchange rate regime as exogenous variables	lsre (Saudi real exchange rate)	Annual series '1980-2015.'	World bank (WB)
	lscpii (Saudi consumer price index) 2010=100	Annual series '1980-2015.'	World bank
	lopr (real oil prices), OPEC basket	Annual series '1980-2015.'	OPEC
	lsmqga (Saudi M2 and Quasi-annual change)	Annual series '1980-2015.'	World bank
	lsgcus (GDP per capita in US Dollar)	Annual series '1980-2015.'	World bank
	Isopen (Saudi openness of trade) calculated in STATA, using the following formula= $simc + sexc / sgccus$ . simc (Saudi import prices in US Dollars) sexc (Saudi export prices in US Dollars) sgccus (Saudi GDP in US current prices)	simc , annual series '1980-2015.'	United nation statistic
		sexc, annual series '1980-2015.'	United nation statistic
		sgccus, annual series '1980-2015.'	World bank
	IT (inflation targeting dummy variable)	Created by considering the following values: 0=above 2% inflation 1= below 2% The consideration based on Saudi inflation rate index (si)	si index from the world bank
	EXRR (exchange rate regime dummy variable)	Created by considering Reinhart and Rogoff index with creating the following values: 0=hard peg 1=otherwise.	Paper of Ilzetki, Reinhart and Rogoff (2017).

**Table 4.1.2: Descriptive statistics for variables used in this section**

Variable	Mean	Standard deviation (st)	Minimum	Maximum
lsre	4.86	0.30	4.53	5.502
lscpii	4.38	0.16	4.20	4.77
lopr	3.70	0.54	2.71	4.52
lsmqga	2.01	0.83	-0.13	3.49
lsgcus	9.74	0.16	9.56	10.18
lsopen	24.91	0.68	24.15	26.26
IT	0.58	0.5	0	1
EXRR	0.27	0.45	0	1

In addition, some diagram show some of the variables trend can be found in appendix B.

## 4.2 Models for inflation and inflation targeting in Saudi Arabia

### Inflation determination in Saudi:

Before testing the relationship between exchange rates and inflation, it is worth investigating the determinants of inflation in Saudi Arabia. GCC countries have similar economic patterns. Therefore, the studies that addressed the GCC case could be used for Saudi Arabia, where they examine inflation to estimate the model. Kandil and Morsy (2011) explained the price level in the long run as follows:

$$P = f(NEER, P^*, M, G), \quad (4.2.1)$$

where  $P$  = domestic price level (CPI),

$NEER$  = Nominal effective exchange rate ,

$P^*$  = weighted average of prices in major trading partners,

$M$  = broad money and

$G$  = government spending.



By using a co-integration test, it was found that there was a co-integration relation. Thus, the researchers have constructed an ECM model to explain the long run with the short-run dynamic as follows:

$$\begin{aligned} \Delta p_t = & c + \delta(p_{t-1} - \alpha_1 neer_{t-1} - \alpha_2 p_{t-1}^* - \alpha_3 m_{t-1} - \alpha_4 g_{t-1}) + \sum_{i=1}^k b_{1i} \Delta p_{t-i} + \\ & \sum_{i=1}^k b_{2i} \Delta neer_{t-i} + \sum_{i=1}^k b_{3i} \Delta p_{t-i}^* + \sum_{i=1}^k b_{4i} \Delta m_{t-i} + \sum_{i=1}^k b_{5i} \Delta g_{t-i} + \\ & \sum_{i=1}^k b_{6i} \Delta p_{t-i}^f + \sum_{i=1}^k b_{7i} \Delta excd_{t-i}. \end{aligned} \quad (4.2.2)$$

K is the number of the lags in the short run dynamic model. Lowercase variables mean that the variables have been logged. In addition, there are two new variables: first difference of the food prices, and the measure of the excess demand. The measure of the excess demand could be computed as follows:

$$excd_t = RGDP - \overline{RGDP}$$

Where RGDP is the measure of the real income 'Real GDP' and  $\overline{RGDP}$  is the potential by using HP filter. One of the primary results from Kandil and Morsy (2011) is that Saudi Arabia has an exchange rate pass-through effect in the long-run. According to Murshed and Nakibullah (2015), the overall domestic price level can be written as:

$$P = P_m^\alpha P_d^{(1-\alpha)} \quad \text{or} \quad p = \alpha p_m + (1 - \alpha) p_d, \quad (4.2.3)$$

where  $p$  = domestic price level,

$p_m$  = index of import prices ,

$p_d$  = price by domestic factors,

$\alpha$  = share of import price

The lowercase letter means that the variables are in log form. If we assume that absolute PPP holds, then we can write:

$$P_m = P^* \times E, \quad \text{where} \quad (4.2.4)$$

$P^*$  = foreign price level and

$E$  = exchange rate is unit of domestic currency per unit of foreign.

The exchange rate and the foreign price level are the main determinates of inflation in GCC Area. The other determinates are domestic factors, and this could be explained by the following:

$$P_d = f(Y, G, M, P^{oil}), \quad (4.2.5)$$

where  $Y = \text{real income}$ ,  $G = \text{government spending}$ ,

$M = \text{Money supply}$  and  $P^{oil} = \text{oil prices}$ .

Overall GDP (Y) for the GCC countries will be explained by:

$$Y_t = Y_t^{noil} + \pi_t^{oil} Y_t^{oil},$$

$$\pi_t^{oil} = \frac{p^{oil}}{p^{noil}}$$

Two thirds of the government revenue in GCC is oil revenue. Therefore we could derive the government spending by:

$$G_t = \theta_t \pi_t^{oil} Y_t^{oil}, \theta = \text{share of oil revenue} \quad (4.2.6)$$

Money supply might not have a significant effect on the price level in the long-run, due to the pegged regime of the exchange rate then the money supply is a main determinate if keeping fixed rates, we can explain the money supply by:

$$M = m \times MB = m(NDA + NFA) \quad (4.2.7)$$

Following the discussion above we can express the long-run model of inflation in GCC would be:

$$P = f(P^*, E, X). \quad (4.2.8)$$

We will need to use bound testing for Co-integration, the use of the Johansen approach is applicable.

$$\text{If we define } z_t = (p_t, p_t^*, e_t, x_t)' = (p_t, h_t)'. \quad (4.2.9)$$

Then we could write our ECM model as follow:

$$\Delta p_t = c + \alpha p_{t-1} + \beta' h_{t-1} + \delta' \Delta h_t + \sum_{i=1}^{q-1} \phi'_i \Delta z_{t-i} + u_t, \quad (4.2.10)$$

where  $q = \text{lag order for the first - differenced lagged variable.}$

We will run co-integration test; and once the co-integration is proven, use ARDL for second bound testing. The ARDL for the price level will look like:

$$p_t = \alpha_0 + \sum_{i=1}^r \alpha_i p_{t-i} + \sum_{i=0}^s \beta'_i h_{t-i} + \varepsilon_t \quad (4.2.11)$$

Alkathlan (2011) examine the inflation in Saudi Arabia by using the money supply and include the price index of the world as follows:

$$P = f(\text{MS, NEER, Pw, GDP gap}) \quad (4.2.12)$$

That will lead to:

$$P = \alpha + \beta_1 MS + \beta_2 NEER + \beta_3 Pw + \beta_4 GDP \text{ gap} + u_i \quad (4.2.13)$$

By using the above estimation, we will have to use ADF and PP test for stationarity . By using panel data model, we could estimate the source of inflation as discussed by Abdul basher and El-Samadis (2012) in GCC as:

$$p_{it} = \alpha_i + \beta_{1i} p_t^* + \beta_{2i} e_{it} + \beta_{3i} m_{it} + \beta_{4i} z_{it} + \varepsilon_{it}. \quad (4.2.14)$$

The unrestricted error correction model for the previous equation form in ARDL where it will transform:

$$\begin{aligned} \Delta lP_t = & \alpha_0 + \sum_{i=1}^n \alpha_{1i} \Delta lP_{t-i} + \sum_{i=1}^n \alpha_{2i} \Delta lNEER_{t-i} + \sum_{i=1}^n \alpha_{3i} \Delta lMS_{t-i} + \\ & \sum_{i=1}^n \alpha_{4i} \Delta lPW_{t-i} + \sum_{i=1}^n \alpha_{5i} \Delta lGDP \text{ gap}_{t-i} + \beta_1 lP_{t-1} + \beta_2 lNEER_{t-1} + \\ & \beta_3 lMS_{t-1} + \beta_4 lPW_{t-1} + \beta_5 lGDP \text{ gap}_{t-1} + \varepsilon_t \end{aligned} \quad (4.2.15)$$

Almansour (2015) has estimated Taylor–rule that is also helpful for our next step where we have examined the relationship between exchange rate and inflation when using the VAR model for monetary policy transmission. The Taylor rule takes the following form:

$$i = r^* + \pi^* + \alpha(\pi - \pi^*) + \beta y, \text{ where } i = \text{nominal policy rate}, \quad (4.2.16)$$

$r^* = \text{long run equilibrium for real interest rate},$

$\pi = \text{current inflation}, y = \text{current output gap},$

$(\pi - \pi^*) = \text{fluctuation in inflation rate from the central bank}$

The above equation represents the general form of Taylor–rule; Taylor (2001) has used this to explain the US monetary situation, the researcher has added weight to 1.5 to inflation and 0.5 for the output gap. However, by using Taylor-rule in the Saudi Arabia context, the paper has used the augmented form as Saudi Arabia has a pegged exchange rate regime to the US Dollar, the model, therefore, included the Fed rates for the US and the effect of REER. Besides, the augmented Taylor-rule will be as follows:

$$i = r^* + \pi^* + \alpha(\pi - \pi^*) + \beta y + \delta FFR + \lambda REER + \theta \text{ trend} + \theta \quad (4.2.17)$$

The variables are the same as in the Taylor formula; the study added the Federal fund rate of the US (FFR) and the real effective exchange rate (REER), the trend is the trend to a time where there has been structural change in the economy.

Data used Saudi 3-month interbank deposit rate ( $i$ ),  $r^*$  is calculated as the difference between the 3-month interbank rate and the average inflation,  $\pi$  is the annual change in CPI, and  $\pi^*$  is calculated using HP filter with a smoothing parameter of 100 for annual data. GDP or potential is the log of GDP with using the HP filter smoothing parameter 100 for annual data. FFR is from the Federal Reserve System, REER is from IMF data, the trend is time trend variable. For testing, the inflation targeting the consideration of Hu (2006) model where the use of logit model was applied. Creating a dummy variable for choosing IT or not as a dependent variable ( $Y$ ) is the dummy variables for IT choice the formula looks like:

$$Y_{it} = \alpha_0 + \alpha_1 ES_{it} + \alpha_2 EI_{it} + \alpha_3 controlvar_{it} + year + \varepsilon_{it} \quad (4.2.18)$$

Where ( $Y$ ) is the dummy variable for the inflation targeting (1, target and 0 otherwise).  $ES$  is economic structure variable, which contains four variables: (Fiscal position, trade openness, external indebtedness and financial depth). Each of these variables could be calculated using the formula provided in the paper. For the second vector is the economic, institutional variables have three variables: (central bank autonomy, the De facto regime and de jure regime). The third vector is the control variables, which contain: (Real GDP growth and one year lagged inflation rate).

Although in theory, inflation targeting is always associated with the flexible exchange rate as Taylor suggested (2001); in empirical terms, inflation targeting could exist with having other forms of exchange rate regimes, even a fixed peg and this is shown in the case of Israel (Bernanke *et al.*, 1999).

**Models considered and Smart chart summarises the section procedure:**

From the methodologies considered in this chapter, the most relevant one for this thesis, is the following:

1. ARDL model like the one we constructed for the RER, but for this model, we have considered the Saudi consumer price index (CPI) as an independent variable and we have used other variables that determined the inflation rate.

Again, we have used the same two dummy variables for IT and EXRR.

The ARDL model equation (2, 2, 1, 2, 0, and 2) is as followed:

$$\begin{aligned}
lscpii_t = & \beta_0 + \beta_1 lscpii_{t-1} + \beta_2 lscpii_{t-2} + \alpha_0 lsne_t + \alpha_1 lsne_{t-1} + \\
& \alpha_2 lsne_{t-2} + \alpha_3 lsbmgt + \alpha_4 lsbmgt_{t-1} + \alpha_5 lsge_t + \alpha_6 lsge_{t-1} + \alpha_7 lsge_{t-2} + \\
& \alpha_8 lsmpt_t + \alpha_9 lsopen_t + \alpha_{10} lsopen_{t-1} + \alpha_{11} lsopen_{t-2} + \alpha_{12} IT + \\
& \alpha_{13} EXRR + \varepsilon_t
\end{aligned}
\tag{4.2.19}$$

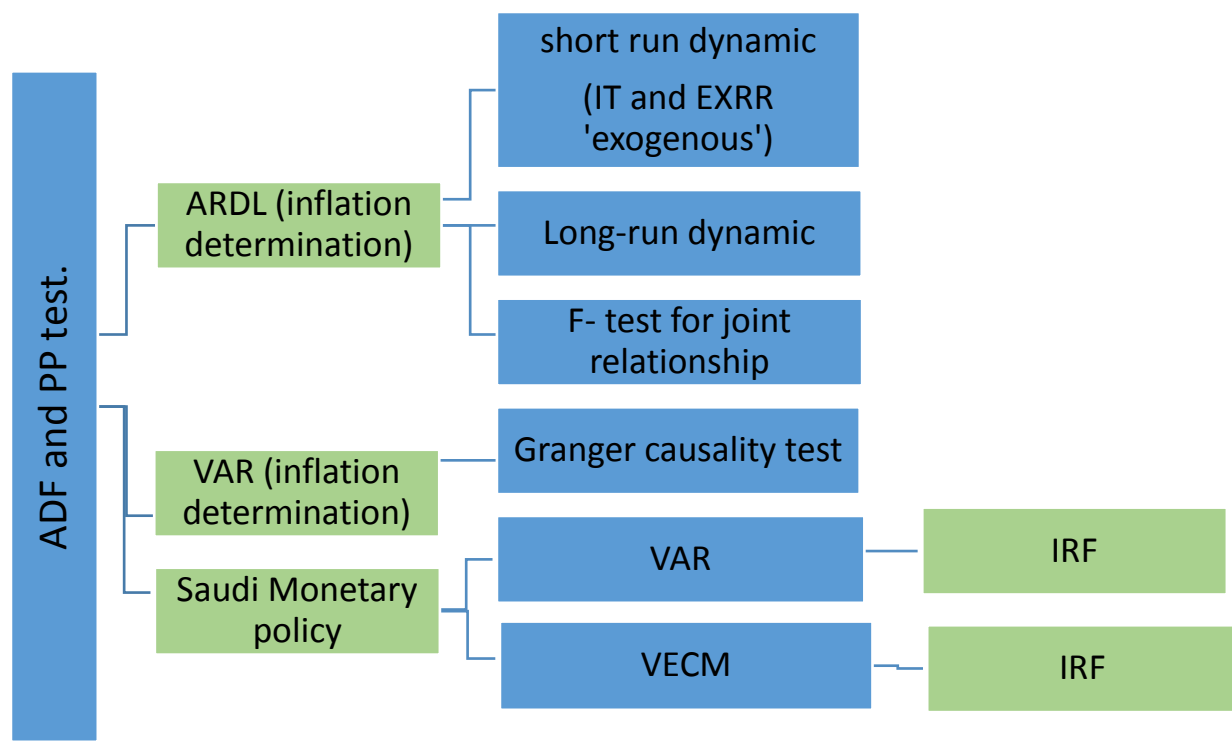
2. We have estimated a VAR model for the main central bank tools using the following equations:

$$\begin{aligned}
lsgccus_{t,i} = & \alpha + \alpha_1 lsgccus_{i,t-1} + \alpha_2 lscpii_{i,t-1} + \alpha_3 lsne_{i,t-1} + \alpha_4 sirb_{i,t-1} + \varepsilon_{1,t}, \\
lscpii_{t,i} = & \beta + \beta_1 lscpii_{i,t-1} + \beta_2 lsgccus_{i,t-1} + \beta_3 lsne_{i,t-1} + \beta_4 sirb_{i,t-1} + \varepsilon_{2,t}, \\
lsne_{t,i} = & \delta + \delta_1 lsne_{i,t-1} + \delta_2 lsgccus_{i,t-1} + \delta_3 lscpii_{i,t-1} + \delta_4 sirb_{i,t-1} + \varepsilon_{3,t}, \\
sirb_{t,i} = & \gamma + \gamma_1 sirb_{i,t-1} + \gamma_2 lsgccus_{i,t-1} + \gamma_3 lscpii_{i,t-1} + \gamma_4 lsne_{i,t-1} + \varepsilon_{4,t},
\end{aligned}
\tag{4.2.20}$$

The choice of variables has been determined by using some of the variables that have been employed in previous papers. Although, our study focused on the Saudi Arabian case and included two exogenous dummy variables for testing different regimes into the inflation rate determination function.

For the monetary policy equation, we have followed (Naime, 2011) study, by applying simple VAR with the main Policy factors variable. For this section, the main motivation was to observe the transmission of the monetary policy in Saudi Arabia over the years, and if the economy has been disturbed by any shocks either internally or externally.

Figure 4.2.1: the procedure of the inflation models



**Variables and data used in this section models:**

Table 4.2.1: variables for ARDL model ‘Saudi inflation’ and Saudi VAR model for monetary policy

Model	Variables	Data	Source
ARDL for the inflation rate determination in Saudi Arabia with IT ad EXRR as exogenous variables	lscpii (Saudi consumer price index) 2010=100	Annual series ‘1980-2015.’	World bank
	Isopen (Saudi openness of trade) calculated in STATA, using the following formula $Isopen = simc + sexc / sgccus.$	simc, annual series ‘1980-2015.’	United nation statistic
		sexc, annual series ‘1980-2015.’	United nation statistic
	sgccus (Saudi GDP in US current prices)	Sgccus, annual series ‘1980-2015.’	World bank

	lsne (Saudi nominal exchange rate)	Annual series '1980-2015.'	World bank
	lsbmg (Saudi broad money as a percentage of GDP)	Annual series '1980-2015.'	World bank
	lsge (Saudi government spending)	Annual series '1980-2015'	IMF
	lmtp = Formula form (Kandil and Morsy, 2011), used STATA to make the calculation). Total of three /3 to get average.	Annual series '1980-2015.'	World bank
		WUSA*USCPI	World bank
		WCH*CHCPI	World bank
	IT (inflation targeting dummy variable)	Annual series '1980-2015.'	World bank
WJA*JACPI		World bank	
EXRR (exchange rate regime dummy variable)	Created by considering the following values: 0=above 2% inflation 1= below 2% The consideration based on Saudi inflation rate index (si)	si index from the world bank	
	Created by considering Reinhart and Rogoff index with creating the following values: 0=hard peg 1=otherwise.	Paper of Ilzetzki, Reinhart and Rogoff (2017).	
VAR model for Saudi monetary policy.	lsgccus (Saudi GDP in US current prices)	Annual series '1980-2015.'	World bank
	lscpii (Saudi consumer price index) 2010=100	Annual series '1980-2015.'	World bank
	lsne (Saudi nominal exchange rate)	Annual series '1980-2015.'	World bank
	sirb (Saudi interest rate bank '3-month rate').	Annual series '1980-2015.'	World bank

In addition, further details about the dataset used in this section are discussed in Appendix A.



**Table 4.2.2: Descriptive statistics for variables used in this section**

Variable	Mean	Standard deviation (st)	Minimum	Maximum
Lscpii	4.38	0.16	4.20	4.77
lsne	4.71	0.13	4.56	5.081
lsbmg	3.78	0.32	2.64	4.16
lsge	3.46	0.186	2.76	3.72
lmtp	4.34	0.68	2.61	5.95
lsopen	24.91	0.68	24.15	26.26
IT	0.58	0.50	0	1
EXRR	0.27	0.45	0	1
lsgccus	26.081	0.68	25.17	27.34
sirb	4.089	2.54	0.69	9.03

\*Some extra diagram of the main variables could be found in Appendix B

### 4.3 Models for optimum currency area (OCA) in Gulf cooperation council countries (GCC)

#### Mundell-Fleming model (IS-LM-BP)

This model has been used by many scholars such as Bernanke (1986), Sims (1986), Blanchard and Quah (1989). These scholars have used the SVAR method. For the GCC we will follow Louis *et al.*, (2012), the paper has used the SVAR technique as well, and the reason is that the GCC economies' structure follows the US monetary policies because of the fixed exchange rate regime. In this paper, the researcher assumes the existence of the framework of Mundell Fleming where the equilibrium exists between IS, LM and BP with fixed exchange rate and free capital mobility. However, the SVAR technique used was described as:

$Z_t$  is the vector contain  $\{i_t\}$ =Fed fund rate,  $\{y_t\}$ =non-oil GDP growth,  $\{\pi_t\}$ =inflation. These variables are driven by structural innovation in the SVAR model where  $\{e_t\}$ =us monetary shocks  $\{e_{ft}\}$ = non-oil supply shocks and  $\{e_{it}\}$ =inflation shocks. Thus, our matrices for SVAR and the Impulsive response will take the next form this is:

$$\begin{bmatrix} i_t^{US} \\ y_t \\ \pi_t \end{bmatrix} = \sum_{i=0}^{\infty} L^i \begin{bmatrix} r_{11,i} & r_{12,i} & r_{13,i} \\ r_{21,i} & r_{22,i} & r_{23,i} \\ r_{31,i} & r_{32,i} & r_{33,i} \end{bmatrix} \begin{bmatrix} \varepsilon_{t-i}^p \\ \varepsilon_{t-i}^s \\ \varepsilon_{t-i}^d \end{bmatrix},$$

where ,  $Z_t =$

$$C(L)e_t, \text{ and } R(0)\varepsilon_t e_t \tag{4.3.1}$$

The above SVAR model used the short -run restriction to justify the model Since GCC considered small countries. The non-oil growth response to inflation shocks could be one lag only. Variables: non-oil GDP, GDP deflator, CPI and the fed fund rate.

$$\max: \pi_{xt} = \int_0^{\infty} e^{-it} (x_t - c(x)0). dt , \tag{4.3.2}$$

where,  $\pi_{xt}$  is the total profit from oil export

$$1. y_t = k_1 x_t + k_2 a_0 + k_3 M_0 \quad (4.3.3)$$

$y_n =$  the internal balance,  $y =$  actual GDP,  $M =$  real money supply

$$2. y_t = \left(\frac{1}{m}\right) x_t + \left(\frac{a}{m}\right) (i - i^*), \quad \text{the external balance, } m =$$

marginal propensity to import of  $y$

$$3. p_t = p^* \cdot R_t \quad \text{the PPP relation, } p \text{ is the price of oil export, } p$$

$i^*$  is international price and  $R$  is nominal foreign exchange rate.

$$4. x_t = p_t \cdot q_{x0} \quad \text{the oil export revenue, } q \text{ is quantity of oil export}$$

5. oil export revenue are positively related to the expected foreign exchange rate

$$6. i = i^* \quad \text{interest rate parity (perfect capital mobility),}$$

$i =$  domestic interest rate,  $i^* =$  foreign interest rate.

7. the transversality condition hold

$$8. \text{cost of oil export } C(x), \text{ marginal cost} = 0, c(x) = 0$$

By substituting the PPP relation and if  $i=i^*$

$$\max \pi_{xt} = \int_0^{\infty} e^{-it} [(\delta \cdot E(R_{t+1}) - \left(1 - \left(\frac{\delta}{\beta}\right) \varepsilon_{t+1}\right)) \cdot dt \quad (4.3.4)$$

The above function explained that the oil export revenue can maximise expected foreign exchange rate at a specific level of volatility or when uncertainty is at a minimum at certain exchange rate point.

However, the IS-LM-BP models received many criticisms especially after the Euro zone debt crisis in 2010, the misleading for interest rates and of budget deficit and interest rates has not manage to estimate an accurate IS curve for the European countries. Therefore, failed to adopt an inflation rates that is compatible with consumption and investment demand (Begg *et al.*, 2014).

In the case of the GCC, the restriction of interest rate control due to the fixed exchange rate regime will not estimate a precise model for GCC single currency; this is due to the mimic of USA monetary policy into the GCC monetary policies as shown in Balli *et al.* (2010) study. Copeland (2014) addressed that one of the IS-LM-BP model structure is to have a free capital mobility and more movement in stock assets. This condition is not applicable in the GCC region, as they do not have a complete free capital mobility.

In addition, one for the main Thesis objective is to avoid the EMU problems by estimating a more relevant model to the case of the GCC. Thus, this model was not considered in this research.

### **G-PPP between GCC countries**

The G-PPP theory has been used to analyse PPP in terms of OCA by using the real exchange rate behaviour for a group of countries in respect of a base country. It has been known that the RER is non-stationary due to the main determinates of exchange rate 'forcing variables' that does not allow stationarity to exist in the series. To perform the G-PPP model, it is essential to consider that symmetric shocks should be present among the countries in the study (Mundell, 1961).

Nevertheless, the G-PPP model for  $m$  countries in a world of  $n$  countries there will be a long-term equilibrium relationship between the  $m-1$  and real exchange. Nusiar (2012) has used this technique and Laabas and Limam (2002), the model will take the following form:

$$r_{12t} = \beta_0 + \beta_{13}r_{13t} + \beta_{14}r_{14t} + \dots + \beta_{1m}\beta_{1mt} + \varepsilon_t, \quad (4.3.5)$$

where

$r_{12t}$

= is log of real exchange rate at time  $t$  btween country base and country  $i$ ,

$\beta_{1i}$  = parameters for co – integration 'movement of RER',

$\varepsilon_t$  = stochastic error term.

If the parameter of the co-integration (B) =0, that will transform our model to traditional PPP (Nusiar, 2012). The base country will be the USA as it is the anchor country for exchange rate as an essential test; this model needs to be performed under few tests such as: ADF, PP and co-integration test like Johansen. We have based our model for G-PPP model for GCC based on the above equation. In this thesis, the real exchange rate for each GCC country has been estimated. Following that, we tested for stationarity and co-integration levels.

**Bayoumi and Eichengreen (1998) model for Exchange rate volatility and OCA**

The relationship between Exchange rate volatility and the OCA criteria has been discussed by Bayoumi and Eichengreen (1998), they started their model by explained intervention between countries as follows:

$$intervention_i = \frac{[dres]_i}{narrow_i(-1)} \tag{4.3.6}$$

Where res=reserves, d=difference operator, narrow = narrow money.

The above equation is to measure intervention by country and analyse the exchange rate market pressure by examining to which degree countries can use reserves to change exchange rate movement. Bayoumi and Eichngreen (1998) in the following equation has replaced the  $\frac{[dres]_i}{narrow_i(-1)}$  with  $\frac{[d narrow]_i}{narrow_i(-1)}$ , if unsterilized intervention is effective in managing exchange rate. However, for testing the shadow movement in the exchange rate between countries i and j then:

$$pressure_{ij} = dexrate_{ij} + intervention_i - intevention_j \tag{4.3.7}$$

Where exrate = exchange rate between country I and j. by using the above equation, the scholars made two tables to compare nominal exchange rate pressures between different countries and test the intervention.

In a small country, Bayoumi and Eichengreen (1998) recommended that we should include the log of real GDP of the two countries as follows:

$$SD(y_{ij}) = \alpha + \beta_1 SD(\Delta y_t - \Delta y_j) + \beta_2 Dissim_{ij} + \beta_3 tarde_{ij} + \beta_4 size_{ij} \quad (4.3.8)$$

Where  $SD(y_{ij})$  = the standard deviation of the exchange rate in log form of the end year bilateral exchange rate between country i and j.

$SD(\Delta y_t - \Delta y_j)$  = the standard deviation of the difference in the log form of real output between i and j.

$Dissim_{ij}$  = the sum of absolute difference in the shares of agriculture, mineral and manufacturing trade in a total merchandise trade.

$tarde_{ij}$  = the mean of the ratio of bilateral export to domestic GDP for two countries

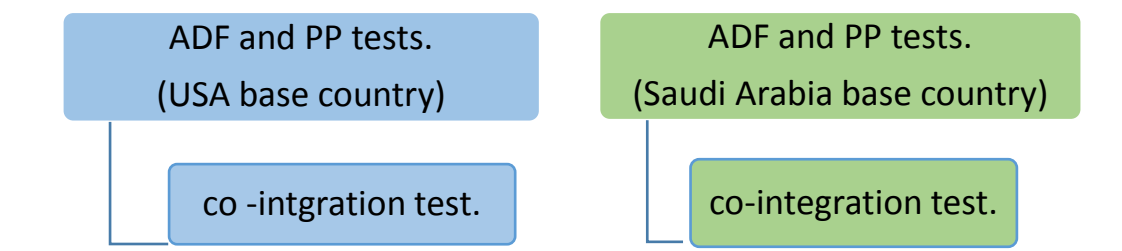
$size_{ij}$  = the mean of the logarithm of the two GDP measured in the US Dollar.

Each of these variables can be calculated following (Adamek and Kappel, 2015), where they used the same model in application to Euro area, NAFTA and MERCOSUR.

**Models considered and Smart chart summarises the section procedure:**

From the methodologies considered in this chapter, the one most relevant for this thesis, are the following. The models that were considered for our GCC monetary union analysis is the G-PPP models. We have constructed the real exchange rate for each GCC country following the same equations suggested by Nusair (2012) and Labbas and Limam (2002), the two base countries foreign rates where Saudi CPI index and USA CPI index. The real exchange rate was constructed using STATA.

Figure 4.3.1: procedures for GCC models



**Variables and data used for the models:**

**Table 4.3.1: variables for G-PPP model ‘US and Saudi base country’**

Model	Variables	Data	Source
G-PPP model 1.USA base (USA CPI)  2.Saudi base (SA CPI)  (created real exchange rate ‘rer’ for each country using STATA.	luare (United Arab of Emirates real exchange rates)	uane (United Arab of Emirates nominal exchange rate) Annual ‘1980-2015.’	World bank
		uacpi (United Arab of Emirates consumer price index) Annual ‘1980-2015.’	World bank
	lkre (Kuwait real exchange rates)	kne (Kuwait nominal exchange rate) Annual ‘1980-2015.’	World bank
		kcpi (Kuwait consumer price index) Annual ‘1980-2015.’	World bank
	lbre (Bahrain real exchange rates)	bne (Bahrain nominal exchange rate) Annual ‘1980-2015.’	World bank
		bcpi (Bahrain nominal exchange rate) Annual ‘1980-2015.’	World bank
	lqre (Qatar real exchange rate)	qne (Qatar nominal exchange rate) annual ‘1980-2015.’	World bank
		qcpi (Qatar consumer price index) annual ‘1980-2015.’	World bank
	lore (Oman real exchange rate)	one (Oman nominal exchange rate), annual ‘1980-2015.’	World bank
		Ocpi (Oman consumer price index), annual: ‘1980-2015.’	World bank
	lscpii (Saudi consumer price index) 2010=100	Annual series ‘1980-2015.’	World bank
	usacpi (USA consumer price index)	Annual series ‘1980-2015.’	World bank
	lsne (Saudi nominal exchange rate)	Annual series ‘1980-2015.’	World bank

\*Additional details of Datasets used in this model can be found in Appendix A.

**Table 4.3.2: Descriptive statistics for the variables used in this section**

Variable	Mean	Standard deviation (st)	Minimum	Maximum
<b>Real exchange rate variables for GCC 'USA as a base country'</b>				
lsre	4.75	0.13	4.54	5.05
luare	4.56	0.18	4.08	4.86
lbre	4.47	0.25	3.95	4.82
lore	4.55	0.23	3.97	4.88
lqre	4.79	0.17	4.49	5.09
lkre	4.631	0.12	4.46	4.86
<b>Real exchange rate variables for GCC 'SA as a base country'</b>				
lsre	4.86	0.30	4.53	5.50
luare	4.67	0.08	4.48	4.88
lbre	4.59	0.09	4.46	4.85
lore	4.67	0.07	4.56	4.83
lqre	4.91	0.25	4.40	5.37
lkre	4.74	0.13	4.60	5.11



## 4.4 Econometrics tests - Theoretical background

### 4.4.1 Unit root for time series

The importance of the unit root test for time series relies on the fact that most time series are not stationary. Thus, each time series would display different features and might diverge away from their means. The time series that will diverge away from the mean will be non-stationary, which will have a misleading estimation or spurious regression (Nkoro and UKo, 2016). The unit root process is a general random walk model, the random walk model explained below (Pesaran, 2015):

$$y_t = y_{t-1} + u_t, \quad (4.4.1.1)$$

The above is allowed following the general linear stationary process:

$$u_t = \sum_{i=0}^{\infty} a_i \varepsilon_{t-j}, \quad (4.4.1.2)$$

Where  $\varepsilon_t$  is mean zero, uncorrelated process, thus  $y_t$  is integrated process of order I (1). In addition,  $u_t$  will be I(0) process. The I(1) means that it is a unit root process without a drift that is explained by:

$$E(y_t) = y_0. \quad (4.4.1.3)$$

The unit root process with a drift is shown by the following equation:

$$\Delta y_t = \mu + u_t, \quad (4.4.1.4)$$

Where  $\mu \neq 0$ , which explained the drift variable of the process. However,  $y_t$  is still an I(1) process but including a drift. Thus the  $y_t$  has a trend as follows:

$$E(y_t) = y_0 + \mu t, \quad t = 0,1,2 \dots \quad (4.4.1.5)$$

Time series that suffer from the unit root will have a constant effect from random shocks, which is why unit root test follow a random walk. Therefore, if the variable is either dependent or independent in the regression, will have a misleading result if using the classical methods (OLS).

The necessity of using different time series test, rely on the fact that it is essential to know if the variable is stationary or not and change it to stationary series if needed by differencing, and that where the concept of integration came from (Nkoro and Uko, 2016). Variable X is integrated in the order I(d) if it becomes stationary after differencing d times (Engle and Granger, 1987).

**Dickey Fuller test (DF):**

Need to consider the flowing AR(1) process with no trend:

$$y_t = \mu(1 - \phi) + \phi y_{t-1} + \varepsilon_t. \tag{4.4.1.6}$$

The drift in the above equation is missed, and the unit root is obtained by the restriction of the intercept. That will be achieved by:  $|\phi| < 1, E(y_t) = \mu$ . Thus, when  $\phi = 1$ , then  $E(y_t) = y_0$ .

The AR(1) explained above shows the process without time trend. Regardless of  $|\phi| < 1$  or  $|\phi| = 1$ . We need to be aware of this, since that depends on the data if it has a unit root model or not. The unit root hypothesis will be as follows:

$$H_0: \phi = 1 \text{ against } H_1 = |\phi| < 1.$$

To calculate the Dicky Fuller (DF) test statistics we need to consider the following (no drift):

$$\Delta y_t = \mu(1 - \phi) - (1 - \phi)y_{t-1} + \varepsilon_t \tag{4.4.1.7}$$

By testing that  $H_0 = 0$  for  $y_{t-1}$ , and replace  $\beta = -(1 - \phi)$ , we can rewrite the above equation as:

$$\Delta y_t = -\mu\beta + \beta y_{t-1} + \varepsilon_t \quad (4.4.1.8)$$

Therefore, the hypothesis test will be:

$$H_0: \beta = 0 \text{ against } H_1 = \beta < 0.$$

That means that  $H_0$ : will be explained by  $\Delta y_t = \varepsilon_t$ . In addition, we need to consider the DF test for the time series model with a drift; the next equation will examine the linear trend with a restricted coefficient:

$$\Delta y_t = \alpha + \mu(1 - \phi)t + \phi y_{t-1} + \varepsilon_t \quad (4.4.1.9)$$

In addition, the following is estimated:

$$\Delta y_t = \alpha + \mu(1 - \phi)t - (1 - \phi)y_{t-1} + \varepsilon_t \quad (4.4.1.10)$$

Again, we will replace  $\beta = -(1 - \phi)$ , and then we could re-write the equation as follows:

$$\Delta y_t = \alpha_0 - \mu\beta t + \beta y_{t-1} + \varepsilon_t \quad (4.4.1.11)$$

The hypothesis testing will have the same assumption for the process without drift, which is:

$$H_0: \beta = 0 \text{ against } H_1 = \beta < 0$$

The DF is given by the t-ratios of the OLS regression estimate of the  $\beta$  in the latest regression (Pesaran, 2015). When the DF test is estimated, we assume that  $\varepsilon_t$  is not

correlated. Thus, the use of ADF to restore the problem of autocorrelation that DF test will fail to handle, that will be solved by adding the lagged difference of the dependent variable (Nkoro and UKo, 2016). This is explained in the next section.

**Augmented dickey-fuller test (ADF):**

ADF is one of the most popular tests for testing whatever the variables are stationary or not; we will follow the next model and applied it to our variables we will follow the process provided in Pesaran (2015):

$$\Delta y_t = \alpha + \mu(1 - \phi)t - (1 - \phi)y_{t-1} + \sum_{i=1}^p \psi_i \Delta y_{t-i} + \varepsilon_t, \quad (4.4.1.12)$$

Where  $p$  is the equation residuals,  $\varepsilon_t$  are serially uncorrelated. However, the use of Akaike information criterion (AIC) or Schwarz Bayesian criterion (SBC) will help to select the  $p^2$ . ADF  $p$  statistics will be provided by the t-ratio of  $y_{t-1}$  in the regression above.

The second part of the equation ( $\sum_{i=1}^p \psi_i \Delta y_{t-i}$ ), is representing the stationary process, therefore the effect could be diminished and be ignored as  $T \rightarrow \infty$ .

We need to be aware of the use of ADF; we should bear in mind the following points when we run the ADF test:

1. ADF could be problematic as we have a finite sample.
2. The choice for  $p$  is a very critical process since it is an augmentation order and there will always be a serial correlation in the residuals.

The ADF test included the lagged values of the dependent variables in the equation; the number of lagged values is typically estimated empirically. Therefore, this test will avoid any correlation in the error term and we will have unbiased estimates (Gujarati and Porter, 2009).

The critical value of the ADF test has different scores to the t or Z test critical values; they are calculated in a table by Fuller (1996) and by Mackinnon (1991). These have been summarised in Pesaran (2015).

However, the downside of the ADF test is that the null hypothesis cannot be rejected because the power of the test is not strong. Thus, the use of Philips-Perron (PP) test or Kwiatkowski, Philipp and Schmidt and Shin (KPSS) test will demonstrate more verified results (Nkoro and Uko, 2016). Another problem with the DF and the ADF tests is that the time span should be large to avoid having a non-stationary series. Finally, if the regression has a structural break, the unit root test will not manage to detect the breaks (Gujarati and Porter, 2009). The next section will explain the PP test in more depth.

**Philips-Perron (PP):**

The PP test is used for a unit root hypothesis in a single time series PP test attempt to correct the residual correlation problem found in the ADF test, by using non-parametric estimates of the long run variance (Pesaran, 2015). The use of non-parametric method will handle the serial correlation in the error term without adding the lagged difference terms (Gujarati and Porter, 2009). The following equation will describe the process for the PP unit root for a model with intercept but with no trends:

$$Z_{\tau,df} = \left( \frac{sT}{sLT} \right) DF_{\tau} - \frac{(s_{LT}^2 - s_{\tau}^2)}{s_{LT} \left[ \frac{\sum_{t=1}^T (y_{t-1} - \bar{y} - 1)^2}{T^2} \right]^{1/2}}, \quad (4.4.1.13)$$

Where  $\bar{y} - 1 = \sum_{t=1}^{T-1} y_{t-1} / T$ .

The pp statistics test in the case of models with an intercept and a linear trend will follow:

$$Z_{\tau,df} = \left( \frac{sT}{sLT} \right) DF_{\tau} - \frac{T^3 (s_{LT}^2 - s_{\tau}^2)}{4 \sqrt{3 s_{LT} D^{\frac{1}{2}}}}, \quad (4.4.1.14)$$

Where D is the determinant of the matrix W'W. The Matrix is derived as follows:

$$\Delta y = W \theta + u$$

$$W = \begin{pmatrix} 1 & 1 & y_0 \\ 1 & 2 & y_1 \\ \vdots & \vdots & \vdots \\ 1 & T-1 & y_{T-2} \\ 1 & T & y_{T-1} \end{pmatrix} \quad (4.4.1.15)$$

(Pesaran, 2015)

The Phillip-Perron (PP) test will be sufficient for the models that have a structural break. This is mostly the case in the thesis where we have at least main known oil prices shocks that is covered in our data analysis period. Oil prices shock related to the Iraqi-invasion of Kuwait in 1990-1991 (Nusair, 2012).

### **KPSS test**

This is an alternative of the testing Unit root by testing the null hypothesis as stationary; this is different to the previous two tests (ADF and PP) where the tests are examining the unit root in the autoregressive in the process. Kwiatkowski, Philipp, Schmidt, and Shin (KPSS) developed this test in 1992. The test is based on the variance of the partial sum series as shown next:

$$s_t = \sum_{j=1}^t \hat{e}_j, \text{ where } \hat{e}_j = y_j - \hat{\alpha} - \hat{\beta}_j, \quad (4.4.1.16)$$

Therefore, the KPSS test will be defined by:

$$\hat{\xi}_T = \left[ \frac{1}{T s_T(l)} \right]^2 \sum_{t=1}^T s_t^2, \quad (4.4.1.17)$$

where  $s_t^2$  is the estimate for the long run variance of  $s_t$  given by

$$s_T^2(l) = \frac{1}{T} \sum_{t=1}^T \hat{e}_t^2 + \frac{2}{T} \left[ \sum_{j=1}^l w_j \left( \sum_{t=j+1}^T \hat{e}_t \hat{e}_{t-j} \right) \right], \text{ and}$$

$$w_j = 1 - \frac{j}{l+1}, j = 1, 2, \dots, l \quad (4.4.1.18)$$

The critical value for the KPSS test shown in the next table:

**Table 4.4.1.1 critical values of KPSS test**

	10%	5%	2.5%	1%
<b>Constant no trend</b>	0.35	0.46	0.57	0.74
<b>Constant with trend</b>	0.12	0.15	0.18	0.22

(Pesaran, 2015)

KPSS test does not provide p-value; it shows different critical values as shown in the table above. If the test statistics are higher than the critical values, then we reject the null. On the other hand, if the test statistics is less than the critical value, then we cannot reject the null hypothesis. Note that KPSS null hypothesis is that the series is stationary (Nkoro and Uko, 2016).

#### 4.5 VAR, VECM and IRF

VAR and VECM will be needed to transform the models from ordinary linear regression to VAR variation. VAR is useful to find endogenous and exogenous variables we need to check the type of variables, each equation may contain exogenous and endogenous variables (Gujarati, 2012).

VAR can be used to forecast economic trends such as inflation and exchange rates; AR has been used to test interest rate model for the federal reserves, to test exogenous shocks and to examine structural stability and misspecification (Rudebusch, 1998).

The VAR model has more than one independent variable, which leads to having more than one equation. Each equation will represent the explanatory variables in lag of the variable under the study including the deterministic trend. Accordingly, if VAR equation has more than two variables we need to be aware of the lag length selection (Koop, 2013).

To understand the VAR system clearly, we need to consider the simple bivariate system in the following two equations as discussed by (Enders, 2010):

$$y_t = b_{10} + b_{12}z_t + \gamma_{11}y_{t-1} + \gamma_{12}z_{t-1} + \varepsilon_{yt}$$

$$z_t = b_{20} + b_{21}y_t + \gamma_{21}y_{t-1} + \gamma_{22}z_{t-1} + \varepsilon_{zt} \quad (4.5.1)$$

The time path of  $\{z_t\}$  will be affected by the current and the past effect of  $\{y_t\}$ . We assume the  $y_t$  and  $z_t$  are stationary and error terms in both equations are white noise and uncorrelated. The previous equations represent the first order vector auto-regression (VAR) because the most extended lag is one. In addition, the previous equations are not considered as a reduced form. That is  $(y_t)$  has an effect on  $(z_t)$  and  $(z_t)$  has an effect on  $(y_t)$ . Therefore, we could re-write the equation in the matrices form as following:

$$\begin{bmatrix} 1 & b_{12} \\ b_{21} & 1 \end{bmatrix} \begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} b_{10} \\ b_{20} \end{bmatrix} + \begin{bmatrix} \gamma_{11} & \gamma_{12} \\ \gamma_{21} & \gamma_{22} \end{bmatrix} \begin{bmatrix} y_{t-1} \\ z_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{yt} \\ \varepsilon_{zt} \end{bmatrix}.$$

Where,  $B = \begin{bmatrix} 1 & b_{12} \\ b_{21} & 1 \end{bmatrix}$ ,  $x_t = \begin{bmatrix} y_t \\ z_t \end{bmatrix}$ ,  $\Gamma_0 = \begin{bmatrix} b_{10} \\ b_{20} \end{bmatrix}$ ,  $\Gamma_1 = \begin{bmatrix} \gamma_{11} & \gamma_{12} \\ \gamma_{21} & \gamma_{22} \end{bmatrix}$  and  $\varepsilon_t = \begin{bmatrix} \varepsilon_{yt} \\ \varepsilon_{zt} \end{bmatrix}$  (4.5.2)

If we want to obtain the VAR model in its standard form, we need to use pre-multiplication by  $B^{-1}$ . Thus, we will get:

$$x_t = A_0 + A_1x_{t-1} + e_t \quad (4.5.3)$$

$$A_0 = B^{-1}\Gamma_0, \quad A_1 = B^{-1}\Gamma_1 \quad \text{and} \quad e_t = B^{-1}\varepsilon_t.$$

We can replace  $A_0 = a_{i0}$  as an element  $i$ ,

$A_1 = a_{ij}$  as an element of  $i$  in row  $j$  of the matrix

and  $e_{it} =$  as an element of vector  $e_t$ .

Thus, we could re-write the VAR standard form in the following form:

$$y_t = \alpha_{10} + \alpha_{11}y_{t-1} + \alpha_{12}z_{t-1} + e_{1t}$$

$$z_t = \alpha_{20} + \alpha_{21}y_{t-1} + \alpha_{22}z_{t-1} + e_{2t} \quad (4.5.6)$$



The error term in the standard represents the two-shock form the structural VAR error terms ( $\varepsilon_{yt}, \varepsilon_{zt}$ ) (Enders, 2010). As we discussed before, to demonstrate VAR we need to be aware of the VAR order. For model selection criteria, we can use Akaike information criteria (AIC) and the Schwarz Bayesian criteria (SBC). The value of the AIC and SBC can be computed as follows:

$$AIC_p = -\frac{Tm}{2} (1 + \log 2\pi) - \frac{T}{2} \log |\widetilde{\Sigma}_p| - ms, \text{ And} \quad (4.5.7)$$

$$SBC_p = -\frac{Tm}{2} (1 + \log 2\pi) - \frac{T}{2} \log |\widetilde{\Sigma}_p| - \frac{ms}{2} \log(T) \quad (4.5.8)$$

The above two criteria can be calculated for  $p=0,1, 2,\dots,P$ . P is the maximum order for VAR model chosen. For testing the hypothesis of VAR model selection that the right order is value p against the alternative that  $P > p$  is expressed in the next equation:

$$LR_{p,p} = T(\log |\widetilde{\Sigma}_p| - \log |\widetilde{\Sigma}^P|). \quad (4.5.9)$$

(Pesaran, 2015).

According to Gujarati and porter (2009), the VAR could have some problems. Firstly, VAR is not accompanied by a substantial theory, and it uses prior knowledge of the nature of the variables, the inclusion or exclusion process play an important role in model specification. Secondly, VAR could not be helpful in the case of policy analysis. Thirdly, the lag choice in VAR could be challenging especially when the VAR equations are more than two. Fourthly, having a different co-integration order of the variables will be complicated even if we manage to transform the data. Finally, it is often difficult to interpret the coefficients.

One of the solution to simplify the interpretation of the VAR coefficient is the use of IRF, where it manages to capture the response of the dependent variable in the VAR to the shocks term, it manages to detect shocks in several periods in the future (Gujarati and Porter, 2009). The next section will explain the IRF response in more depth.

### **IRF:**

The impulsive response that replaced VAR for Taylor rule to have a stronger result for aggregate price shock in Taylor rule (Rudebusch, 1998). To derive the impulsive response function, we will consider the standard form of VAR used in the previous section by Enders (2010) in the matrix form as follows:

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} \alpha_{10} \\ \alpha_{20} \end{bmatrix} + \begin{bmatrix} \alpha_{11} & \alpha_{12} \\ \alpha_{21} & \alpha_{22} \end{bmatrix} \begin{bmatrix} y_{t-1} \\ z_{t-1} \end{bmatrix} + \begin{bmatrix} e_{1t} \\ e_{2t} \end{bmatrix} \quad (4.5.10)$$

We can get the IRF form expressed below:

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} \bar{y} \\ \bar{z} \end{bmatrix} + \sum_{i=0}^{\infty} \begin{bmatrix} \alpha_{11} & \alpha_{12} \\ \alpha_{21} & \alpha_{22} \end{bmatrix}^i + \begin{bmatrix} e_{1t-1} \\ e_{2t-1} \end{bmatrix} \quad (4.5.11)$$

Re-write the previous equation regarding  $(\varepsilon_{yt}, \varepsilon_{zt})$ , therefore, the vector error will be:

$$\begin{bmatrix} e_{1t} \\ e_{2t} \end{bmatrix} = \frac{1}{1-b_{12}b_{21}} \begin{bmatrix} 1 & -b_{12} \\ -b_{21} & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_{yt} \\ \varepsilon_{zt} \end{bmatrix} \quad (4.5.12)$$

Combing the two equation, we will get:

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} \bar{y} \\ \bar{z} \end{bmatrix} + \frac{1}{1-b_{12}b_{21}} \sum_{i=0}^{\infty} \begin{bmatrix} \alpha_{11} & \alpha_{12} \\ \alpha_{21} & \alpha_{22} \end{bmatrix}^i \begin{bmatrix} 1 & -b_{12} \\ -b_{21} & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_{yt-i} \\ \varepsilon_{zt-i} \end{bmatrix} \quad (4.5.13)$$

Rename the matrix by using the notation  $\phi_i = \frac{A_1^i}{1-b_{12}b_{21}} \begin{bmatrix} 1 & -b_{12} \\ -b_{21} & 1 \end{bmatrix}$ , therefore the

Moving Average representation would be explained by:

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} \bar{y} \\ \bar{z} \end{bmatrix} + \sum_{i=0}^{\infty} \begin{bmatrix} \phi_{11}(i) & \phi_{12}(i) \\ \phi_{21}(i) & \phi_{22}(i) \end{bmatrix}^i + \begin{bmatrix} \varepsilon_{yt-i} \\ \varepsilon_{zt-i} \end{bmatrix} \quad (4.5.14)$$

The moving average representation is used to detect the relation between  $(y_t)$  and  $(z_t)$  sequence. The coefficient  $\phi$  in the previous equation could be used to examine the

effect of error terms 'shocks' to the whole-time path of (yt) and (zt). The four sets of the coefficients called the impulse response function. By plotting the function the coefficients, we could estimate visually the behaviour of (yt) and (zt) in a response of shocks (Enders, 2010).

#### 4.6 Co-integration and Error Correction Model (ECM)

The term co-integrated variables mean that two variables have long run relationship or equilibrium between them (Gujarati and Porter, 2009). Co-integration is referred to as the linear combination between non-stationary variables (Enders, 2010).

Co-integration test can keep the long-run information in the time series modelling. Engle and Granger (1987) were the first two scholars to examine the idea of co-integration, by creating models that examine the long-run relationship between a set of variables within dynamic framework. Co-integration will include a specific stationary linear combination of variables that are individually non-stationary but integrated in a particular order I(d). Co-integration test has developed the error correction model, and manage to include the short and long run information in the modelling process (Nkoro and Uko, 2016). A Co-integration test can be thought of as an essential test to avoid the spurious regression position (Gujarati and Porter, 2009).

To define that our variables or series in the vector  $x_t = (x_1, x_2, \dots, x_{nt})$  are co-integrated in order (d, b) for  $x_t \sim CI(d, b)$  If:

1. All the x's are integrated of order d.
2. The vector  $\beta = (\beta_1, \beta_2, \dots, \beta_n)$  have a linear combination of  $\beta x_t = \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_n x_{nt}$ , and is integrated of order (d-b) where b>0. The vector b is called the co-integrated vector (Enders, 2010).

The general definition by Engle and Granger for Co-integration is that the variables should be integrated in the same order. In some occasions, variables can be integrated in a different order where it is called multi co-integration (Enders, 2010). ARDL technique, which will discuss later, can handle this type of combination.

An important aspect we need to be aware of understanding the co-integration process. Is the error correction model (ECM). If x and y are co-integrated, we can explain the relationship between them using ECM. To explore the ECM estimation, we will consider the following equation used by Koop (2013):

$$\Delta Y_t = \varphi + \lambda e_{t-1} + \omega_0 \Delta X_t + \varepsilon_t, \quad (4.6.1)$$

$e_{t-1}$  is the error term from the regression of the models that include Y and X, that could be explained in the following:

$$e_{t-1} = Y_{t-1} - \alpha - \beta X_{t-1}. \quad (4.6.2)$$

$\varepsilon_t$ , is the error term in the ECM model. The dependent variables in the model are  $\Delta X_t$  and  $e_{t-1}$ , we need to assume that  $\lambda < 0$ . We should note that the (e) term is the equilibrium error. Thus, if it is non-zero, the model is not in equilibrium position (Koop, 2013). The ECM is explaining the dynamic of the variable in the system that are deviated from the equilibrium (Enders, 2010).

ECM has both long and short run properties; the long run is represented in the beta, while the short run is netted in the error term and the change in the x as an explanatory variable. This is very similar to the economic equilibrium concepts (Koop, 2013).

The ECM model solves the problem of spurious regression by having a stationary error term and deal with Co-integration existence between X, and one downside of the ECM is, that the inclusion of the error term from the X and y equation as an explanatory variable. We should be aware before carrying on the ECM model that we need to check that Y and x contain unit root and that they are co-integrated by using the appropriate test for each (Koop, 2013).

### **Engle Granger test**

In the case of having co-integrated variables, Engle-granger procedure will help to check if there is a long-run relationship between the two variables. Engle and Granger (1987)

were the first two scholars who explore the concept of co-integration, to evaluate the long-run relationship between sets of variables (Nkoro and Uko, 2016), they used 4 step method to address the level of co-integration of the variable in I(1). As explained by Enders the steps for this test are:

1. By using the DF test, we can check if the variable contains a unit root or not. If the variable is found to be Co-integrated in the same level, we can proceed to the next step. However, if the variables are integrated in a different level, this test cannot be used, or we can conclude that the variables are not cointegrated. On the other hand, if the variables are stationary, then we do not have to continue with this test.
2. After finding the evidence of co-integration existence between the variable. We could run an OLS regression; we will consider the error term ( $E_t$ ) from the equation and run a DF test on the residuals to detect the integration order. Following the next equation:  $\Delta \hat{e}_t = \alpha_1 \hat{e}_{t-1} + \varepsilon_t$ . If we cannot reject the null hypothesis, this means that the residual contains a unit root and the variable are co-integrated. On the other hand, if we reject the null, that says that the residual is stationary and not co-integrated. In case the error term suffers from autocorrelation, we can use the following auto regression model and sum the DF with the same hypothesis assumption as above:

$$3. \Delta \hat{e}_t = \alpha_1 \hat{e}_{t-1} + \sum_{i=1}^n \alpha_{i+1} \Delta e_{t-i} + \varepsilon_t. \quad (4.6.3)$$

4. Using the saved residuals from our long run estimation we could estimate the following error correction model:

$$\begin{aligned} \Delta y_t &= \alpha_1 + \alpha_y \hat{e}_{t-1} + \sum \alpha_{11} (i) \Delta y_{t-i} + \sum \alpha_{12} \Delta z_{t-i} + \varepsilon_{yt} \\ \Delta z_t &= \alpha_2 + \alpha_z \hat{e}_{t-1} + \sum \alpha_{21} (i) \Delta y_{t-i} + \sum \alpha_{22} \Delta z_{t-i} + \varepsilon_{zt} \end{aligned} \quad (4.6.4)$$

The previous equation contains a VAR model in first differences, using the same procedure for regular VAR to get the results for cointegration level.

5. Assess the model to determine if the error correction model is estimated correctly.

The ECM model will help to correct the disequilibrium that caused by the co-integration (Gujarati and Porter, 2009). Therefore, if the variables are co-integrated and the

integration order in the vector in the ECM model above is known, then we can use the traditional statistical test for the model. The ECM provides a short-run dynamic adjustment by using the lagged differences from the long-run adjustment (Kirchganssner *et al.*, 2012).

We also need to be aware if the bivariate system with two variables in I(1) order, we only can have the two possibilities discussed below:

- A. The two variables are not cointegrated. Therefore, the system has two different stochastic trends.
- B. The two variables are co-integrated. Then, the system has one Co-integration relation and one common stochastic trend.

(Kirchganssner *et al.*, 2012).

Because the Engle and Granger test are based on residuals, there are some issues with using them. One, if we have a small sample size, the test result depends heavily on the choice of the left-hand side variable 'dependent'. Two, the Engle-Granger test do not allow more than one cointegration relation. Three, the test does not make the best use of the data and have low power (Pesaran, 2015). The Johansen test (1988) discussed next will consider Co-integration level that is higher than one.

### **Johansen test**

The Engle and Granger test was helpful to detect the co-integration between two variables in the first order and recommend the use of ECM to overcome the disequilibrium problem. However, if we have more than two variables and with more than one Co-integration relation we cannot proceed the test using the Engle and Granger method. Thus, we can use the Johansen technique (Kirchganssner *et al.*, 2012).

### **Autoregressive distributed lag (ARDL)**

The use of ARDL co-integration technique is used when the long run relationship between variables has a different level of integration 'different lag order', ARDL

procedure will give results for both short and long-run relationship of the considered variables. This will solve the problem of having the same level of integration or lag order to proceed with the test like the Johansen or the Engle-Granger tests (Nkoro and Uko, 2016).

The low power of the unit root test, to check whatever the variables under consideration for the analysis are I(1) or not may increase the uncertainty of the models. Therefore, the use of (ARDL), which is the error correction model form for autoregressive distributed lag (ARDL), this will solve the co-integration level problems between the variables. Especially when testing long-run relationships (Pesaran, 2015). Moreover, to estimate ARDL we do not have to test whatever the series or the variable is stationary or not. ARDL will help to estimate the co-integration vector order. Thus, each variable will have its long-run relationship equation (Nkoro and Uko, 2016).

The ARDL (p, q, q2, ., qk) model could be explained as follows:

$$\Phi(L)y_t = \varphi + \theta(L)x_t + u_t \quad \text{And}$$

$$\Phi(L) = 1 - \Phi_1L - \dots - \Phi_pL^p ,$$

$$\theta L = \beta_0 - \beta_1L - \dots \beta_qL^q$$

Thus, the general form of ARDL will be:

$$\Phi(L)y_t = \varphi + \theta_1(L)x_{1t} + \theta_2(L)x_{2t} + \theta_k(L)x_{kt} + \mu. \tag{4.6.8}$$

L represents the lag operator applied to each component. If the error term (Ut) is stationary and it is independent of the x and y. We can process the ARDL with a standard OLS estimation (Nkoro and Uko, 2016).

To test the hypothesis, we need to compute the Wald test (discussed further in the following section). However, if the F-statistics of the Wald test approved that there is a long-run relationship and the sample data is finite or small. Thus, the ARDL error correction will be more efficient. On the other hand, if the F-statistics proved that there is multiple long-run relationships, then we cannot apply (ARDL) (Nkoro and Uko, 2016).

To estimate the ARDL model (p, q1, q2 .... qk) for Co-integration testing we should consider the following:

$$\Delta X_t = \delta_{oi} + \sum_{i=1}^k \alpha_i \Delta X_{t-1} + \sum_{i=1}^k \alpha_2 \Delta Y_{t-i} + \delta_1 X_{t-1} + \delta_2 Y_{t-1} + v_{1t}$$

$$\Delta Y_t = \delta_{oi} + \sum_{i=1}^k \alpha_i \Delta Y_{t-1} + \sum_{i=1}^k \alpha_2 \Delta X_{t-i} + \delta_1 Y_{t-1} + \delta_2 X_{t-1} + v_{1t} \quad (4.6.9)$$

The k represents the ARDL lag order. The f-test for joint hypothesis will test the coefficient of the lagged variables:

$$(\delta_1 X_{t-1}, \delta_2 Y_{t-1} \text{ or } \delta_1 Y_{t-1} + \delta_1 X_{t-1}) = 0, \quad (4.6.10)$$

$(\delta_1 - \delta_2)$  explain the long run relationship, and  $(\alpha_1 - \alpha_2)$  is the short – run dynamic .

Therefore, the hypothesis testing will be as follows:

$$H_0: \delta_0 = \delta_1 = 0$$

*(the null hypothesis that the long run relationships does not exist)*

$$H_1: \delta_1 \neq \delta_2 \neq 0$$

*(alternative, the long – run relationships do exist)*

That is, if the calculated F-test is more significant than the upper bound, then the Ho will be rejected, and the variables are co-integrated and vice versa (Nkoro and Uko, 2016). However, in the case of the same co-integration level, we still can run the ARDL approach if there is evidence of a long run relationship; the ARDL was useful to estimate Monte-Carlo and the fully modified OLS (Pesaran, 2015).

#### 4.7 Granger Causality test

The Causality test will be a helpful test when we have more than one independent variable in our time series. The term causality is referring to the idea of cause and effect. Time periods represented by one observation are too long to capture the change from



a variable to another variable in the next period, especially when dealing with annual data (Kirchgassener *et al.*, 2012).

An empirical example is that if there is a change of oil prices on the international market, the effect on Swiss or German consumer prices for petrol will be a delayed one. Thus, it is necessary to use succession in time to check the causality between the two-time series (Kirchgassener *et al.*, 2012). Therefore, Granger causality test is ideal for checking the causes before the effect, that means that if X is the cause of an event Y, then X should precede Y. In other words X is a Granger cause to Y, past and present information of X will help to predict future values of Y. Thus, using information from both X and Y past and present information to estimate future values of Y (Pesaran, 2015).

Considering that  $\{x_t\}$  and  $\{y_t\}$  are stationary process. Then  $h, y_{T+h/T}^*$  will be the forecast for  $y_{T+h}$  at time T, using the information set in  $\Omega_t$  and  $\widetilde{y_{T+h/T}^*}$  will be the forecast based on the set  $\widetilde{\Omega_T}$ , where its contain all the information of the past and present except the one in the  $\{x_t\}$  process.

The following quadratic loss function will express the process of  $\{x_t\}$  is said to Granger cause  $\{y_t\}$  If:

$$E[L_q(y_T + h, y_{T+h/T}^*)] < E[L_q(y_T + h, \widetilde{y_{T+h/T}^*})], \text{ for at least } h = 1, 2, \dots \quad (4.6.11)$$

If  $\{x_t\}$  fails to Granger cause  $\{y_t\}$ , for all  $h > 0$ , the mean same forecast error for  $y_{T+h/T}^*$  will equal the error for  $\widetilde{y_{T+h/T}^*}$  (Pesaran, 2015).

Although Granger causality test is beneficial to see the effect of X into Y, the test could be misleading, especially if there is a third variable for example Z. In this case, we will need to consider all the possible variables that interact with each other before making any definite conclusion about the causality between the variables (Pesaran, 2015).

Gujarati and Porter (2009) provided some useful aspects, we need to be aware of before using the Granger causality test:

1. The two variables under the test should be stationary.

2. The number of lagged terms, to be introduced in the test should be added to the direction of the causality test.
3. Uncorrelated error terms.
4. No need to estimate the coefficient of the model, the F test will be enough.
5. If the models suffer from spurious correlation, then we must consider VAR.

Nevertheless, if the variables under the test are not stationary, we could use the differencing method to transform them to stationary variables and run the test after differencing. However, if the variables still suffer from non-stationary but they are co-integrated, we will use the Error correction term to account for the causality (Gujarati, 2012).

The following table according to (Kirchgassener *et al.*, 2012), explains the eight-possible causality relationships between x and y according to Granger.

**Table 4.6.1: Granger possibilities of x and y causality relationships**

	Possibility of X and y	Causality relation
1	X and y are independent	$(x, y)$
2	Instantaneous causality between x and y	$(x - y)$
3	X is causal to y, no instantaneous causality	$(x \rightarrow y)$
4	Y is causal to x, no instantaneous causality	$(x \leftarrow y)$
5	X is casual to y with instantaneous causality	$(x \Rightarrow y)$
6	Y is causal to x with instantaneous causality	$(x \Leftarrow y)$
7	There is feedback, no instantaneous causality	$(x \leftrightarrow y)$
8	Feedback and instantaneous causality	$(x \Leftrightarrow y)$

*\*instantaneous causality means: considering the future prediction y and will be better using x past, present and future prediction of x, where feedback means: that their causality in both directions between x and y.*



## **CHAPTER 5**

### **Results and discussion**

In this chapter, Saudi Arabia's macroeconomic determinants are assessed from different perspectives. The first section is exploring the real exchange rate determination model, taking into consideration oil prices and the openness of trade. In addition, two exogenous dummy variables have been included to test the effect of (inflation targeting) IT and exchange rate regime (EXRR) into the model. In the second section the issue of inflation rate determination with the addition of exogenous variables is discussed, similarly to the procedure followed in section one. The third section is examining SA's monetary policy by employing VAR model to test monetary policy's responsiveness to exchange rate and inflation rate fluctuations and forecast the implications of the monetary policy. The last section, is testing the validity of GCC currency area and evaluates whether the region meets the OCA criteria or not.

Before commencing the empirical analysis, there are few points that need to be emphasised: first, we have considered some notation for the analysis. The use of capital (L) for time lags in years (t-), D for the variable difference, C for coefficients, and the letter (I) for co-integration. Lower case letters are used for variable names as this makes it easier in STATA when processing the data analysis. The Stata Software was used to conduct the analysis of this research (further details of the do file and commands used can be found in Appendix C).

## 5.1 Exchange rate determination model

As mentioned in the methodology chapter, stationarity tests for our variables need to be carried out before estimating the model. The table below summarises the ADF and PP tests for our model variables in level and differences with different lags level.

$$lsre_t = \beta_0 + \beta_1 lsre_{t-1} + \alpha_0 lscpi_t + \alpha_1 lopr_t + \alpha_2 lopr_{t-1} + \alpha_3 lopr_{t-2} + \alpha_4 lsmqga_t + \alpha_5 lsgcus_t + \alpha_6 lsgcus_{t-1} + \alpha_6 lsopen_t + \alpha_7 IT + \alpha_8 EXRR + \varepsilon_t$$

**Table 5.1.1: unit root test for Saudi Arabia Exchange rate model variables**

Variable	Series (with trend)	ADF			PP		
		Lag	t-stat	Prob	lag	t-Stat	prob
Lsre	Level I (0)	0	-0.459	0.985	0	-0.896	0.9566
		1	-1.416	0.8561	1	-0.446	0.9677
		2	-1.663	0.7667	2	-0.886	0.9576
	FD I (1)	0	<b>-3.563**</b>	<b>0.0331**</b>	0	<b>-3.407*</b>	<b>0.0505*</b>
		1	<b>-3.451***</b>	<b>0.0449**</b>	1	<b>-3.565**</b>	<b>0.0329**</b>
		2	<b>-3.287*</b>	<b>0.068*</b>	2	<b>-3.516**</b>	<b>0.0377**</b>
Lscpii	Level I (0)	0	0.021	0.994	0	-0.615	0.978
		1	-1.787	0.7111	1	-0.337	0.9886
		2	-2.094	0.5497	2	-0.526	0.9824
	FD I (1)	0	-3.154	0.0940	0	<b>-3.231*</b>	<b>0.078*</b>
		1	-2.611	0.2747	1	<b>-3.146*</b>	<b>0.0956*</b>
		2	-2.744	0.2184	2	<b>-3.206*</b>	<b>0.0832*</b>
Lopr	Level I (0)	0	-1.825	0.692	0	-1.774	0.717
		1	-2.031	0.5847	1	-1.812	0.6987
		2	-2.178	0.5025	2	-1.787	0.7111
	FD I (1)	0	<b>-5.627***</b>	<b>0.0000***</b>	0	<b>-5.596***</b>	<b>0.00***</b>
		1	<b>-4.055***</b>	<b>0.0073***</b>	1	<b>-5.621***</b>	<b>0.000***</b>
		2	-3.002	0.1316	2	<b>-5.604***</b>	<b>0.000***</b>
lsmqga	Level I (0)	0	<b>-3.997*</b>	<b>.0089*</b>	0	<b>-3.880**</b>	<b>0.0129**</b>
		1	<b>-3.512**</b>	<b>0.0381**</b>	1	<b>-3.910**</b>	<b>0.0117**</b>
		2	<b>-3.560**</b>	<b>0.0334**</b>	2	<b>-3.886**</b>	<b>0.0127**</b>

	FD I (1)	0	-8.988***	0.000***	0	-11.268*	0.000*
		1	-6.293***	0.000***	1	-9.327	0.000*
		2	-4.965***	0.0002***	2	-10.315*	0.000*
Lsgcus	Level I (0)	0	-3.391*	0.0526*	0	-3.341*	0.0597*
		1	-5.250***	0.0001***	1	-3.400*	0.0514*
		2	-3.316	0.0636	2	-3.340 *	0.0599*
	FD I (1)	0	-4.403***	0.0022***	0	-4.640***	0.0009***
		1	-2.614	0.2737	1	-4.435***	0.0019***
		2	-2.995	0.1335	2	-4.568***	0.0012***
Lsopen	Level I (0)	0	-2.269	0.4512	0	-1.355	0.8736
		1	-2.269	0.4512	1	-1.316	0.8839
		2	-2.269	.04512	2	-1.366	0.8706
	FD I (1)	0	-3.419**	0.0489**	0	-3.842**	0.0146**
		1	-3.419**	0.0489**	1	-3.920**	0.0114**
		2	-3.525**	0.0368**	2	-3.911**	0.0117**

Note: \*, \*\*, \*\*\* indicate significance at \*10%, \*\*5% and \*\*\* at 1% respectively. FD=first difference,

I (0) integrated order 0, I(1) co-integrated in order (1).

From the table above, we can conclude that we can reject the null hypothesis of non-stationary time series for most variables at the first difference. The only variable that still suffers from a unit root is the (lscpii), which is the log of SA's CPI. This is expected in the case of SA, as inflation rates have been quite volatile. The findings of the Thesis confirm this, as CPI is I (2) for the time period under consideration. However, we could accept that the SA CPI is stationary under the 10% PP test.

The levels of all remaining variables contain a unit root, they are considered non-stationary, and we should accept the null hypothesis. In addition, the results reveal that the variables are co-integrated of order one I(1) as they become stationary after the first difference.

The PP test produces similar results with the ADF test. Our variables are transformed to stationary after being first differenced. For the CPI variables, we could reject the null hypothesis for non-stationary at the 10% level of significance, as the p-value for the CPI

is 0.078. The PP test is better suited for our data since it deals better with structural breaks. However, we can conclude that all our variables are co-integrated of order one, I(1). Although, different level of lags have been used, starting from level two (t-2) until 0 lags. The variables are only transformed to stationary after the first difference in both ADF and PP test. This step was necessary for our analysis, as it is essential to check the order of our integration before estimating ARDL.

To start understanding the mechanisms of real exchange rate, we have estimated an ARDL regression of the real exchange rate in Saudi Arabia. Table 5.1.2 below the results of the regression.

**Table 5.1.2 ARDL regression on level for Saudi Arabia exchange rate**

$\text{lsre} = C1 * \text{lsre}(L1) + C2 * \text{lscpii} + C3 * \text{lopr} + C4 * \text{lopr}(L1) + C5 * \text{lopr}(L2) + C6 * \text{lsmqga} + C7 * \text{lsgcus} + C8 * \text{lsgcus}(L1) + C9 * \text{lsopen} + C10 * \text{IT} + C11 \text{EXRR} + C12$				
Variable	Coefficient	Standard error	t-ratio	Probability
<b>lsre (L1)</b>	<b>1.08671</b>	<b>0.13362</b>	<b>8.13**</b>	<b>0.000**</b>
<b>lscpii</b>	-0.1194512	0.15350	-0.78	0.445
<b>lopr</b>	-0.664015	0.04712	-1.41	0.173
<b>lopr(L1)</b>	0.057703	0.040732	1.42	0.171
<b>lopr(L2)</b>	<b>-0.181228</b>	<b>0.0382341</b>	<b>-4.74**</b>	<b>0.000**</b>
<b>lsmqga(L0)</b>	-0.0111198	0.0108821	-1.03	0.315
<b>lsgcus</b>	<b>-1.101423</b>	<b>0.326128</b>	<b>-3.39</b>	<b>0.003**</b>
<b>lsgcus(L1)</b>	<b>1.012622</b>	<b>0.2107789</b>	<b>4.80**</b>	<b>0.000**</b>
<b>lsopen (L0)</b>	<b>0.234598</b>	<b>0.1082355</b>	<b>2.17**</b>	<b>0.042**</b>
<b>IT(exogenous)</b>	0.0124722	0.0211937	0.59	0.56
<b>EXRR(exogenous)</b>	-0.0449642	0.0282511	-1.59	0.126
<b>constant</b>	<b>-4.161179</b>	<b>1.738799</b>	<b>-2.39**</b>	<b>0.026**</b>
Number of obs=33 (1982-2014), R-squared=0.9881				

Note: \*\* indicate significance at 5% level.

From the above regression for the Saudi real exchange rate determination; the regression shows that the real exchange rate is affected by the changes in the real

exchange rate in the previous year by 1.09. Current decline changes in the real exchange rates are affected by the changes in oil prices two years before current changes by 0.18.

Also, the Saudi GDP has an adverse effect on real exchange rate the same time as the real exchange rate, but the effect changes for the Saudi GDP when we consider the year before. The openness of trade has an essential effect on current real exchange rate by 0.23. These results confirm the importance of oil prices in the Saudi Arabian real exchange rate mechanism, the openness of trade and GDP. The reason is due to the high reliance on the oil industry as oil is the primary export, which encourages the openness of trade and it feeds through the country's GDP. Table 5.1.3 below discusses in more detail the long and short-run dynamics of real exchange rates for the SA economy.

**Table 5.1.3: ARDL (1,0,2,0,1,0) in ECM form, selection based on Akaike information criteria**

	Variable	Coefficient	Standard error	t-ratio	Probability
Long-run equation	$lsre = C1*lsre(L1) + C2*lscpii(L1) + C3*lopr(L1) + C4*lsmqga(L1) + C5*lsgcus(L1) + C6*lsopen(L1).$				
	ADJ Lsre (L1)	0.867	0.1336256	0.65	0.523
	lscpii (L1)	1.378	2.527841	0.54	0.592
	Lopr(L1)	2.190	2.621812	0.84	0.413
	Lsmqga(L1)	0.129	0.2466136	0.52	0.606
	lsgcus(L1)	1.057	158865	0.67	0.513
	lsopen (L1)	-2.706	3.106185	-0.87	0.394
Short-run dynamic	$Dlsre = C1*lscpi(D1) + C2*lopr(D1) + C4*lopr(LD) + C5*lsmqga(D1) + C6*lsgcus(D1) + C7*lsopen + C8*IT + C9*EXRR + C10.$				
	lscpii (D1)	-0.199	0.1535041	-0.78	0.445
	Lopr(D1)	-0.664	0.0471228	-1.41	0.173
	lopr (LD)	<b>0.181</b>	<b>0.0382341</b>	<b>4.74**</b>	<b>0.000**</b>
	lsmqga(D1)	-0.112	0.0108821	-1.03	0.315
	lsgcus (D1)	<b>-1.104</b>	<b>0.3261289</b>	<b>-3.39**</b>	<b>0.003**</b>
	lsopen (D1)	<b>0.235</b>	<b>0.1082355</b>	<b>2.17**</b>	<b>0.042**</b>
	IT(exogenous)	.0125	0.0211937	0.59	.562
	EXRR(exogenous)	-0.045	0.0282511	-1.59	0.126
	Constant	<b>-4.161</b>	<b>1.738799</b>	<b>-2.39**</b>	<b>0.026**</b>
Number of obs=33 (1982-2014), R-squared =0.789.					

Note: \*\* indicate significance at 5% level.



The table above expresses the real exchange dynamics in both the short run and the long run. At this stage, we have considered the first difference in our variable, which is corrected by the ECM regression.

In the long run, all the variables including the adjustment variable are insignificant but have a positive relation to the real exchange rate. The only exception is the openness of trade where it is negative but still insignificant. This suggests that in the long run, all the variables that have a considerable influence on the Saudi economy do not significantly affect real exchange rates.

These results may reflect the rigidity of exchange rate location with the demand and supply of exchange rate and the rigidity of SA Central Bank in controlling exchange rate and following suit the US policies due to the fix Exchange regime.

For the short run, the difference in oil prices in the previous year influences the exchange rate pass-through by 0.18. Moreover, changes in the openness of trade have a positive effect on the changes in the real exchange rate. Saudi GDP affected the exchange rate and reduced it by 1.10. The dummy variable for exchange rate regime has an adverse impact on real exchange rate, but it is insignificant.

Considering the short run dynamics, we can observe that oil prices have an impact on the exchange and the openness of trade. Saudi Arabia is considered as an open economy because of oil exports and imports most other essential goods and services. For the real GDP in the short run, the results enhance the likelihood that fixed exchange rates 'forces' the currency depreciation in order to slow down economic activity.

Regarding IT, still, the effect is insignificant but positive. This suggests, in the short run oil prices, trade and GDP have a significant effect on the real exchange rate. Although that coefficient is insignificant, that might indicate that fixing the exchange rate and keeping inflation low, would improve the behaviour of the Real Exchange Rate (RER). Table 5.1.4 discusses the result of the joint cointegration between the variables in the ARDL model.

**Table 5.1.4 ARDL bounds test result for joint significance**

	Model stat	K#	Critical value 5%		Critical value 1%	
			I (0)	I (1)	I (0)	I (1)
<b>F-Stat</b>	<b>4.627**</b>	5	2.62	3.79	3.41	4.68
<b>t-stat</b>	<b>0.649</b>	5	-2.86	-4.19	-3.43	-4.79

\*critical value is based on Pesaran et al. (2001), case 3

From table 5.1.4, it can be seen that the F-test result for our model is 4.267; this is larger than the upper bound (3.79) critical value at 5% level, which indicates that our model is jointly co-integrated and indicates that the variables all together have a long stable relationship between them. The result also means that all the variables in the model are jointly integrated of order one I(1).

On the other hand, if we consider the 1% level, we might accept the null hypothesis of no-cointegration as it is slightly lower than the upper bound for 1% (4.68). This might explain not having any significant variables in the ARDL long-run model. Table-5.1.5 assesses the causality between variables to test if each variable has a Granger cause to the rest of the variables or not.

**Table 5.1.5 Granger causality Wald test between variables for Saudi Exchange rate variables**

↙	Isre			Iscpii			Lopr			Ismqga			Lsgcus			Isopen		
	Chi2	Df	prob	Chi2	df	prob	Chi2	df	prob	Chi2	df	prob	Chi2	df	prob	Chi2	df	prob
<b>Isre</b>				<b>10.26</b>	<b>2</b>	<b>0.01</b>	<b>5.92</b>	<b>2</b>	<b>0.05</b>	<b>11.77</b>	<b>2</b>	<b>0.00</b>	4.18	2	0.12	<b>11.2</b>	<b>2</b>	<b>0.004</b>
<b>Iscpii</b>	0.094	2	0.95				4.08	2	0.13	0.72	2	0.70	1.62	2	0.44	<b>7.67</b>	<b>2</b>	<b>0.02</b>
<b>lopr</b>	<b>6.04</b>	<b>2</b>	<b>0.05</b>	<b>1.22</b>	<b>2</b>	<b>.054</b>				<b>7.54</b>	<b>2</b>	<b>0.02</b>	2.05	2	0.35	0.99	2	0.60
<b>Ismqga</b>	2.93	2	0.23	1.76	2	0.41	<b>6.44</b>	<b>2</b>	<b>0.04</b>				0.77	2	0.68	<b>10.3</b>	<b>2</b>	<b>0.006</b>
<b>Isgcus</b>	4.08	2	0.14	<b>12.84</b>	<b>2</b>	<b>0.02</b>	0.46	2	0.80	<b>6.45</b>	<b>2</b>	<b>0.04</b>				1.45	2	0.48
<b>Isopen</b>	0.22	2	0.89	3.54	2	0.17	<b>7.72</b>	<b>2</b>	<b>0.02</b>	<b>7.20</b>	<b>2</b>	<b>0.02</b>	0.91	2	0.63			
<b>All</b>	<b>36.36</b>	<b>10</b>	<b>0.00</b>	<b>42.07</b>	<b>10</b>	<b>0.00</b>	<b>32.15</b>	<b>10</b>	<b>0.00</b>	<b>18.87</b>	<b>10</b>	<b>0.04</b>	<b>35.8</b>	<b>10</b>	<b>0.00</b>	<b>52.6</b>	<b>10</b>	<b>0.00</b>

\*p-value>0.05, that indicate a causality relation between the variables based on Wald test. The arrow indicates the direction of the causality relation.

The estimation of Granger Wald test in the table above shows, that the real exchange rate has a Granger effect on oil prices and the coefficient on the lag oil prices is not jointly zero. On the other hand, for the other variables such as inflation (CPI) and openness of trade, we cannot reject the null hypothesis that real exchange rates are not being Granger caused to these variables. Interestingly, CPI does Granger cause the real exchange rate and oil prices. This suggests that increases in inflation would influence the RER and oil prices.

In the case of oil prices, it does Granger cause the real exchange rate and the level of GDP which is evident for the Saudi Arabia case since the oil sector profoundly influences the economy. The money supply has a Granger cause into real exchange rate, oil prices, GDP and openness of trade. The granger effect is significant, due to a high reliance on the Saudi economy on the government and the central bank.

The openness of trade has a granger cause into RER, inflation, and money supply. The influence of oil trade and the high import for most other products with importing inflation rate is reflected in this relation.

## 5.2 inflation rate determination model

For the SA inflation rate determination model, time series models encourage us to evaluate our variables stationarity before we proceed to the regression. The table below shows the stationarity results for the variables by conducting ADF and PP test.

$$\begin{aligned}
 lscpii_t = & \beta_0 + \beta_1 lscpii_{t-1} + \beta_2 lscpii_{t-2} + \alpha_0 lsne_t + \alpha_1 lsne_{t-1} + \alpha_2 lsne_{t-2} \\
 & + \alpha_3 lsbmgt + \alpha_4 lsbmgt_{t-1} + \alpha_5 lsge_t + \alpha_6 lsge_{t-1} + \alpha_7 lsge_{t-2} \\
 & + \alpha_8 lsmpt_t + \alpha_9 lsopen_t + \alpha_{10} lsopen_{t-1} + \alpha_{11} lsopen_{t-2} + \alpha_{12} IT \\
 & + \alpha_{13} EXRR + \varepsilon_t
 \end{aligned}$$

**Table 5.2.1: unit root test for Saudi Arabia inflation rate model variables**

Variable	Series (with trend)	ADF			PP		
		Lag	t-stat	prob	lag	Stat	prob
lscpii	Level I(0)	0	0.021	0.9944	0	-0.615	0.978
		1	-1.787	0.7111	1	-0.337	0.9886
		2	-2.094	0.5497	2	-0.526	0.9824
	FD I(1)	<b>0</b>	<b>-3.154</b>	<b>0.0940</b>	<b>0</b>	<b>-3.231*</b>	<b>0.0785*</b>
		1	-2.611	0.2747	<b>1</b>	<b>-3.146*</b>	<b>0.0956*</b>
		2	-2.744	0.2184	<b>2</b>	<b>-3.206*</b>	<b>0.0832*</b>
lsne	Level I(0)	<b>0</b>	<b>-3.360*</b>	<b>0.0570*</b>	<b>0</b>	<b>-3.466**</b>	<b>0.0432**</b>
		1	-2.361	0.4005	<b>1</b>	<b>-3.311*</b>	<b>0.0645*</b>
		2	-1.694	0.7536	<b>2</b>	<b>-3.329*</b>	<b>0.0616*</b>
	FD I(1)	<b>0</b>	<b>-8.097***</b>	<b>0.000***</b>	0	<b>-8.825***</b>	<b>0.000***</b>
		<b>1</b>	<b>-6.185***</b>	<b>0.000***</b>	<b>1</b>	<b>-8.302***</b>	<b>0.000***</b>
		<b>2</b>	<b>-4.020***</b>	<b>0.0082***</b>	<b>2</b>	<b>-8.798***</b>	<b>0.000***</b>
lsbmgt	Level I(0)	0	<b>-4.189***</b>	<b>0.0046***</b>	<b>0</b>	<b>-4.502***</b>	<b>0.0015***</b>
		1	<b>-5.138***</b>	<b>0.0001***</b>	<b>1</b>	<b>-4.230***</b>	<b>0.0040***</b>
		2	<b>-4.227***</b>	<b>0.0041***</b>	<b>2</b>	<b>-4.392***</b>	<b>0.0023***</b>
	FD I(1)	<b>0</b>	<b>-4.472***</b>	<b>0.0017***</b>	<b>0</b>	<b>-4.448***</b>	<b>0.0018***</b>
		<b>1</b>	<b>-3.667**</b>	<b>0.0246**</b>	<b>1</b>	<b>-4.457***</b>	<b>0.0018***</b>
		2	-2.911	0.1587	<b>2</b>	<b>-4.428***</b>	<b>0.0020***</b>

<b>Isge</b>	Level I(0)	0	<b>-4.219***</b>	<b>0.0042***</b>	0	<b>-4.301***</b>	<b>0.0031***</b>
		1	<b>-4.104***</b>	<b>0.0062***</b>	1	<b>-4.265***</b>	<b>0.0036***</b>
		2	-2.884	0.1678	2	<b>-4.271***</b>	<b>0.0035***</b>
	FD I(1)	0	<b>-5.956***</b>	<b>0.000***</b>	0	<b>-6.005***</b>	<b>0.000***</b>
		1	<b>-4.413***</b>	<b>0.0021***</b>	1	<b>-5.975***</b>	<b>0.000***</b>
		2	<b>-4.020***</b>	<b>0.0082***</b>	2	<b>-5.984***</b>	<b>0.000***</b>
<b>Imtp</b>	Level I(0)	0	<b>-3.732**</b>	<b>0.023**</b>	0	<b>-3.793**</b>	<b>0.0169**</b>
		1	-3.039	0.1216	1	<b>-3.716**</b>	<b>0.0213**</b>
		2	2.104	0.5439	2	<b>-3.686**</b>	<b>0.0233**</b>
	FD I(1)	0	<b>-6.400***</b>	<b>0.000***</b>	0	<b>-6.532***</b>	<b>0.000***</b>
		1	<b>-5.191***</b>	<b>0.0001***</b>	1	<b>-6.422***</b>	<b>0.000***</b>
		2	-2.945	0.1482	2	<b>-6.515***</b>	<b>0.000***</b>
<b>Isopen</b>	Level I(0)	0	-2.269	0.4512	0	-1.355	0.8736
		1	-2.269	0.4512	1	-1.316	0.8839
		2	-2.269	.04512	2	-1.366	0.8706
	FD I(1)	0	<b>-3.419**</b>	<b>0.0489**</b>	0	<b>-3.842**</b>	<b>0.0146**</b>
		1	<b>-3.419**</b>	<b>0.0489**</b>	1	<b>-3.920**</b>	<b>0.0114**</b>
		2	<b>-3.525**</b>	<b>0.0368**</b>	2	<b>-3.911**</b>	<b>0.0117**</b>

Note: \*, \*\*, \*\*\* indicate significance at \*10%, \*\*5% and \*\*\* at 1% respectively. FD=first difference, I(0) integrated order 0, I(1) co-integrated in order (1).

From Table 5.2.1 above, most of our variables are stationary using the ADF test. Therefore, we reject the null hypothesis of the unit root existence in our variables. The only exception is for the log of Saudi CPI where we reject the null hypothesis of non-stationarity at 10% level after the first difference.

Another exception is the variable for openness of trade, which behaves in a similar pattern to the CPI and becomes stationary after the first difference but at the 5% level of significance. Additionally, the PP test produces similar results to the ADF. All the variables for the inflation model are stationary at the level and first difference. Again, the only exceptional variables are the CPI and the openness of Trade, which become stationary after the first difference. For the lag order, both tests have performed very

similarly as the variables have the exact conclusion either we have a high level of lags or zero lags. Therefore, our variables for the model have different co-integration orders. All the variables that are stationary on the level are co-integrated of order (0), while the CPI and Trade of openness are Co-integrated of order (1). Although the ARDL technique does not require a prior knowledge of either the variable is stationary or not, it is essential to have only two levels of co-integration I(0) and I(1) to have a better estimate of the ARDL model. Table 5.2.2 discusses the results from the ARDL regression for the Inflation determination in Saudi with the addition of IT and Exchange Rate Regime as an exogenous variable.

**Table 5.2.2: ARDL regression on level for Saudi Arabia inflation rate**

Iscpii=C1*Iscpii(L1)+C2*Iscpii(L2)+C3*Isne+C4*Isne(L1)+C5*Isne(L2)+C6*Isbmg+C7*Isbmg(L1)+C8*Isge+C9*Isge(L1)+C10*Isge(L2)+C11*Imtp+C12*Isopen+C13*Isopen(L1)+C14*Isopen(L2)+C15*IT + C16 EXRR+C17.				
Variable	Coefficient	Standard error	t-ratio	Probability
Iscpii (L1)	<b>1.0206079</b>	<b>0.170156</b>	<b>7.09**</b>	<b>0.000**</b>
Ispcii(L2)	<b>-0.4122</b>	<b>0.162764</b>	<b>-2.52**</b>	<b>0.025**</b>
Isne	0.0048928	0.020118	0.24	0.812
Isne(L1)	-0.0119206	0.020853	-0.57	0.577
Isne (L2)	<b>-0.05375</b>	<b>0.020608</b>	<b>-2.61**</b>	<b>0.022**</b>
Isbmg	-0.021803	0.032700	-0.67	0.517
Isbmg(L1)	<b>0.050319</b>	<b>0.028119</b>	<b>1.79</b>	<b>0.097*</b>
Isge	<b>-0.048286</b>	<b>0.0264309</b>	<b>-1.83*</b>	<b>0.091*</b>
Isge(L1)	<b>0.0396431</b>	<b>0.0283862</b>	<b>1.40</b>	<b>0.186</b>
Isge(L2)	<b>-0.080524</b>	<b>0.027879</b>	<b>-2.80**</b>	<b>0.015**</b>
Imtp	-0.003054	0.004387	-0.70	0.499
Isopen	0.0150857	0.017893	0.84	0.414
Isopen(L1)	-.0213699	0.0263496	-0.81	0.432
Isopen(L2)	<b>0.044460</b>	<b>0.020652</b>	<b>2.15**</b>	<b>0.015**</b>
IT (exogenous)	<b>-0.02433</b>	<b>0.006251</b>	<b>-3.88***</b>	<b>0.002***</b>
EXRR(exogenous)	<b>-0.02051</b>	<b>0.007068</b>	<b>-2.90**</b>	<b>0.012**</b>
Constant	<b>.048437</b>	<b>0.209551</b>	<b>2.31**</b>	<b>0.038**</b>
Number of obs=30(1982-2014), R-squared =0.998				

Note: \*\* indicate significance at 5% level.

Table 5.2.2 explains the OLS estimation of the inflation rate determination in Saudi by using the ARDL technique. The results show that inflation rate is affected by its own inertia for the previous year and the year before that is L1 and L2, the coefficient is both significant but it shows a positive relation for a previous year then it became negative for CPI (t-2).

The nominal exchange rate has a negative relation to inflation, but it becomes significant when two years' time lags are included. That means that changes in the nominal exchange rate will only feed inflation after two years has passed.

Government expenditure has a negative impact on the same year as the inflation, and it continues two years later, it seems to shift into positive after one year, but for a slightly longer term, it goes back to negative. That explains that the increase in government spending increases the level of income and therefore increases inflation rate.

The openness of trade has a positive relation with inflation, which increases it by 0.04% for every 1% increase. That is due to the high reliance on imports and the rigidity of controlling inflation due to a limitation in monetary policy control. Although that only show after a while, it still has a positive impact.

The IT and Exchange rate regime dummy has a significant effect, but in negative sign: having both controlled will reduce inflation by .024 and 0.02, respectively.

**Table 5.2.3: ARDL (2,2,1,2,0,2) in ECM form, selected based on Akaike information criteria.**

	Variable	Coefficient	Standard error	t-ratio	Probability
Long-run equation	$Iscpi=C1*Iscpi(L1)+C2*Isne(L1)+C3*Isbmg(L1)+C4*Isge(L1)+C5*Imtp(L1)+C6*Isopen(L1).$				
	<b>ADJ Iscpil (L1)</b>	<b>-0.16918</b>	<b>0.06182</b>	<b>-2.74**</b>	<b>0.015**</b>
	<b>Isne</b>	-0.22003	0.18382	-1.20	0.250
	<b>Isbmg</b>	-0.02568	0.15081	-0.17	0.867
	<b>Isge</b>	-0.34875	0.26480	-1.32	0.208
	<b>Lmpt</b>	0.00261	0.02969	0.09	0.931
	<b>Isopen</b>	<b>0.21358</b>	<b>0.03953</b>	<b>5.40**</b>	<b>0.000**</b>
Short-run	$D.Iscpii=C1*Iscpii(LD)+C2*Isne(D1)+C3*Isne(LD)+C4*Isbmg(D1)+C5*Isge(D1)+C6*Isge(LD)+C7*Imtp(LD)+C8*Isopen(D1)+C9*Isopen(LD)+C10*IT+C11*EXRR+C12.$				
	<b>Iscpii(LD)</b>	0.258642	0.18069	1.43	0.173

<i>lsne(D1)</i>	0.0003967	0.02389	0.02	0.987
<i>lsne(LD)</i>	0.029215	0.02265	1.29	0.217
<i>lsbmg(D1)</i>	-0.00150	0.02411	-0.06	0.951
<i>lsge(D1)</i>	<b>-0.563228</b>	<b>0.03168</b>	<b>-1.78*</b>	<b>0.096*</b>
<i>lsge(LD)</i>	0.019132	0.02391	0.80	0.436
<i>lmtp(D1)</i>	0.000441	0.00494	0.09	0.930
<i>lsopen(D1)</i>	0.031816	0.020436	1.55	0.141
<i>lsopen(LD)</i>	-0.0276	0.02249	-1.23	0.237
<i>IT (exogenous)</i>	<b>-0.0261</b>	<b>0.00752</b>	<b>-3.48</b>	<b>0.003</b>
<i>EXRR(exogenous)</i>	<b>-0.0274</b>	<b>0.00803</b>	<b>-3.42</b>	<b>0.004</b>
<i>Constant</i>	0.27095	0.23428	1.16	0.266
Number of obs=32(1982-2014), R-squared=0.938				

After we obtained the ARDL regression with the correct length of lags, the above table produced the long run and the short-run dynamics of CPI inflation in Saudi Arabia.

For the long run, the adjustment coefficient for the CPI has a significant but negative impact into inflation rates; the adjustment coefficient recommends that the disequilibrium caused in the previous year shock dissolve and is recovered in the long run equilibrium in the current year.

Although the nominal exchange rate, money supply, and government spending are not significant in the long-run, they have an indirect relationship with the CPI. Foreign trade average prices have a positive relation, which suggests the operative relation of international prices to the domestic inflation rates in Saudi.

Short run dynamic results revealed that the only significant variable is the first difference of government spending, IT regime and exchange rate and all are indirect relations. That is justified by the fact that Saudi Arabia has only reductions in government spending to resort to when trying to anchor inflationary pressures. The assumption of our model by adding IT and exchange rate dummies into the model has a similar effect on the government spending in the short run.

On the other hand, although the main trading partner average process and openness of trade do not have a significant consequence into CPI, they both have a positive sign, which indicates that Saudi inflation rates are affected by foreign prices and the activity of trade does increase inflation to some extent. Surprisingly, current nominal exchange



rates and previous rates, do not affect inflation neither in the short run or in the long run.

**Table 5.2.4: ARDL bounds test result for joint significance**

	Model stat	K#	Critical value 5%		Critical value 1%	
			I (0)	I (1)	I (0)	I (1)
<b>F-Stat</b>	<b>3.935**</b>	5	2.62	3.79	3.41	4.68
<b>t-stat</b>	<b>-2.737</b>	5	-2.86	-4.19	-3.43	-4.79

*\*critical value is based on Pesaran et al. (2001), case 3*

It is essential to make sure that our model is fitted and jointly co-integrated. Therefore, the use of bound test was conducted; the F test shows that the F test is larger than the upper bound of the critical value of 5%. That means that the five variables (endogenous) are jointly co-integrated, they do not equal zero and have a long -run relationship with them.

However, if we consider the 1% test critical value, the F-test result is not statistically significant. Thus, we accept the null hypothesis of no cointegration between the variables in the inflation model. That might explain the reason for having many variables in the model with no significant effect in the long run.

**Table 5.2.5: Granger causality Wald test between variables for Saudi inflation model variables**

↙	Lscpii			Isne			Isbmg			Isge			Imtp			Isopen		
	Chi2	df	prob	Chi2	df	prob	Chi2	df	prob	Chi2	df	prob	Chi2	df	prob	Chi2	df	prob
<b>lscpii</b>				0.17	1	0.67	0.03	1	0.86	<b>8.97</b>	<b>1</b>	<b>0.003</b>	3.60	1	0.06	0.14	1	0.72
<b>Isne</b>	<b>33.48</b>	<b>1</b>	<b>0.00</b>				<b>3.57</b>	<b>1</b>	<b>0.05</b>	<b>14.02</b>	<b>1</b>	<b>0.00</b>	0.014	1	0.90	<b>13.1</b>	<b>1</b>	<b>0.00</b>
<b>Isbmg</b>	0.015	1	0.90	2.58	1	0.10				1.69	1	0.19	0.55	1	0.45	1.01	1	0.31
<b>Isge</b>	<b>5.23</b>	<b>1</b>	<b>0.02</b>	0.12	1	0.73	1.81	1	0.17				0.26	1	0.60	<b>8.88</b>	<b>1</b>	<b>0.003</b>
<b>Imtp</b>	0.31	1	0.57	1.95	1	0.16	0.17	1	0.67	<b>13.2</b>	<b>1</b>	<b>0.00</b>				<b>4.38</b>	<b>1</b>	<b>0.036</b>
<b>Isopen</b>	<b>10.9</b>	<b>1</b>	<b>0.00</b>	0.14	1	0.70	<b>6.01</b>	<b>1</b>	<b>0.01</b>	1.88	1	0.17	0.19	1	0.68			
<b>All</b>	<b>54.23</b>	<b>5</b>	<b>0.00</b>	9.56	5	0.08	<b>25.55</b>	<b>5</b>	<b>0.00</b>	<b>24.60</b>	<b>5</b>	<b>0.00</b>	10.55	5	0.06	<b>28.9</b>	<b>5</b>	<b>0.00</b>

\*p-value>0.05, that indicate a causality relation between the variables, the arrow indicates the direction of causality relation.

Estimating a Granger causality test is very useful for understanding the direction of the relationship between variables.

Inflation has a Granger causality relation into the nominal exchange rate, government spending and the openness of trade. This is predicted in theory since the increase in inflation will have an impact on exchange rate. Inflation will also impact government spending.

However, the nominal exchange rate does not have any causal relation with the variables. That might be due to the fixed regime and the rigidity into the impact of the exchange rate without the consideration of inflation prices (like in the previous section where we tested the real exchange rate).

The money supply has only significant Granger causality into the nominal exchange rate and the opens of trade. In the case of the nominal exchange rate that might be in the case of a devaluation, where the central bank increases the money supply into the banking system.

In the case of the government spending, it does have a significant causality relation with inflation, nominal exchange rate, and the main trading prices. These results, also

indicate that high government spending increases both inflation, which is also affected by imported inflation (trading partner prices).

The degree of openness has an exciting causality relationship into the nominal exchange rate, government spending and the main trading partner prices. For the nominal exchange rate this is due to the importance of trade in exchange rate prices. Government spending is affected by trade as that will inject money into the country and therefore increase GDP and spending. This is due to the high volumes of trade of oil exports and the effect of that on the Saudi economy.

### 5.3 Saudi Arabia monetary policy model

Prior to estimating a VAR model for Saudi monetary policy, testing for a unit root test is essential. The following table examines the four primary variables for the Saudi Central bank policy, by conducting ADF test and PP stationarity tests.

$$lsgccus_{t,i} = \alpha + \alpha_1 lsgccus_{i,t-1} + \alpha_2 lscpii_{i,t-1} + \alpha_3 lsne_{i,t-1} + \alpha_4 sirb_{i,t-1} + \varepsilon_{1,t},$$

$$lscpii_{t,i} = \beta + \beta_1 lscpii_{i,t-1} + \beta_2 lsgccus_{i,t-1} + \beta_3 lsne_{i,t-1} + \beta_4 sirb_{i,t-1} + \varepsilon_{2,t},$$

$$lsne_{t,i} = \delta + \delta_1 lsne_{i,t-1} + \delta_2 lsgccus_{i,t-1} + \delta_3 lscpii_{i,t-1} + \delta_4 sirb_{i,t-1} + \varepsilon_{3,t},$$

$$sirb_{t,i} = \gamma + \gamma_1 sirb_{i,t-1} + \gamma_2 lsgccus_{i,t-1} + \gamma_3 lscpii_{i,t-1} + \gamma_4 lsne_{i,t-1} + \varepsilon_{4,t},$$

**Table 5.3.6: unit root test for Saudi Arabia Monetary policy model variables.**

Variable	Series	ADF			PP		
		Lag	stat	prob	lag	Stat	prob
	(with trend)						
lsgccus	Level I(0)	0	-2.482	0.3371	0	-2.468	0.344
		<b>1</b>	<b>-3.65**</b>	<b>0.025**</b>	1	-2.460	0.348
		2	-3.044	0.122	2	-2.465	0.345
	FD I(1)	<b>0</b>	<b>-4.230***</b>	<b>0.004***</b>	<b>0</b>	<b>-4.36***</b>	<b>0.0025***</b>
		1	-2.99	0.136	<b>1</b>	<b>-4.297***</b>	<b>0.0032***</b>
		2	-1.846	0.682	<b>2</b>	<b>-4.30***</b>	<b>0.0031***</b>
lscpii	Level I(0)	0	0.021	0.9944	0	-0.615	0.978
		1	-1.787	0.7111	1	-0.337	0.9886
		2	-2.094	0.5497	2	-0.526	0.9824
	FD I(1)	0	-3.154	0.0940	<b>0</b>	<b>-3.231*</b>	<b>0.0785*</b>
		1	-2.611	0.2747	<b>1</b>	<b>-3.146*</b>	<b>0.0956*</b>
		2	-2.744	0.2184	<b>2</b>	<b>-3.206</b>	<b>0.0832</b>
lsne	Level I(0)	<b>0</b>	<b>-3.360*</b>	<b>0.0570*</b>	<b>0</b>	<b>-3.466**</b>	<b>0.0432**</b>
		1	-2.361	0.4005	<b>1</b>	<b>-3.311*</b>	<b>0.0645*</b>
		2	-1.694	0.7536	<b>2</b>	<b>-3.329*</b>	<b>0.0616*</b>
	FD I(1)	<b>0</b>	<b>-8.097***</b>	<b>0.000***</b>	0	<b>-8.825***</b>	<b>0.000***</b>
		<b>1</b>	<b>-6.185***</b>	<b>0.000***</b>	<b>1</b>	<b>-8.302***</b>	<b>0.000***</b>
		<b>2</b>	<b>-4.020***</b>	<b>0.0082***</b>	<b>2</b>	<b>-8.798***</b>	<b>0.000***</b>
sirb	Level I(0)	0	-2.452	0.352	0	-2.686	0.242
		<b>1</b>	<b>-5.495***</b>	<b>0.000***</b>	1	-2.827	0.181
		<b>2</b>	<b>-4.170***</b>	<b>0.005***</b>	2	-2.86	0.173
	FD I(1)	<b>0</b>	<b>-3.223*</b>	<b>0.080*</b>	<b>0</b>	<b>-3.294*</b>	<b>0.067*</b>
		<b>1</b>	<b>-4.532***</b>	<b>0.0013**</b>	<b>1</b>	<b>-3.34*</b>	<b>0.059*</b>
		<b>2</b>	<b>-4.59***</b>	<b>0.0011***</b>	<b>2</b>	<b>-3.294***</b>	<b>0.067**</b>

Note: \*, \*\*, \*\*\* indicate significance at \*10%, \*\*5% and \*\*\* at 1% respectively. FD=first difference,

I(0) integrated order 0, I(1) co-integrated in order (1).

From the table above, the ADF test result shows that the Saudi GDP in US Dollar is only stationary at level with one lag, the variable becomes stationary after the first difference and in that situation. We reject the null hypothesis of a Unit root. For the Inflation variable (lscpii) only becomes stationary after the first difference, and that occurs if we reject the null hypothesis at 10% critical value. In relation to the Saudi nominal exchange rate (lsne), the variable is already stationary at the level regardless of whether lags are added and difference or not. For the interest rates variable (sirb), the variable is stationary at level after the first-time lag L (1), while it is stationary with all different lags after the first difference.

From a PP test perspective, the results resemble the ADF test results for all the variables. Except for the sirb variable, the test shows that the Saudi interest rate is not stationary at the level and only becomes stationary after the first difference.

To estimate the co-integration level, we can conclude from the table that the Saudi GDP, Saudi inflation and Saudi interest rate are co-integrated in the order I(1), while the Saudi nominal exchange rate is co-integrated in the order I(0).

**Table 5.3.7: Johansen co-integration test for Saudi monetary policy VAR and VECM model**

Rank	Max-eigenvalue	Trace statistics	5% critical value
r=0	87.596	78.658	47.21
<b>r=1</b>	<b>112.836</b>	<b>28.178**</b>	<b>29.68**</b>
r=2	120.386	13.078	15.41
r=3	125.56	2.716	3.76

*Note: STATA generates Johansen test based on trace statistics-eigenvalue of a stochastic matrix, and the information criteria (SBIC, HQIC, AIC), r represents the number of co-integration vector. The critical value is obtained using STATA.*

For estimating a VAR model for the monetary policy in Saudi Arabia, we first estimated a Johansen co-integration test to check the level of co-integration between the variables and to check the validity of conducting a VECM model. From the table above, it was evident the variables are co-integrated of order (1). The co-integration level was estimated for the four variables after the first difference. This method was

recommended by Neaime (2011) for the whole MENA region to have the variables differenced.

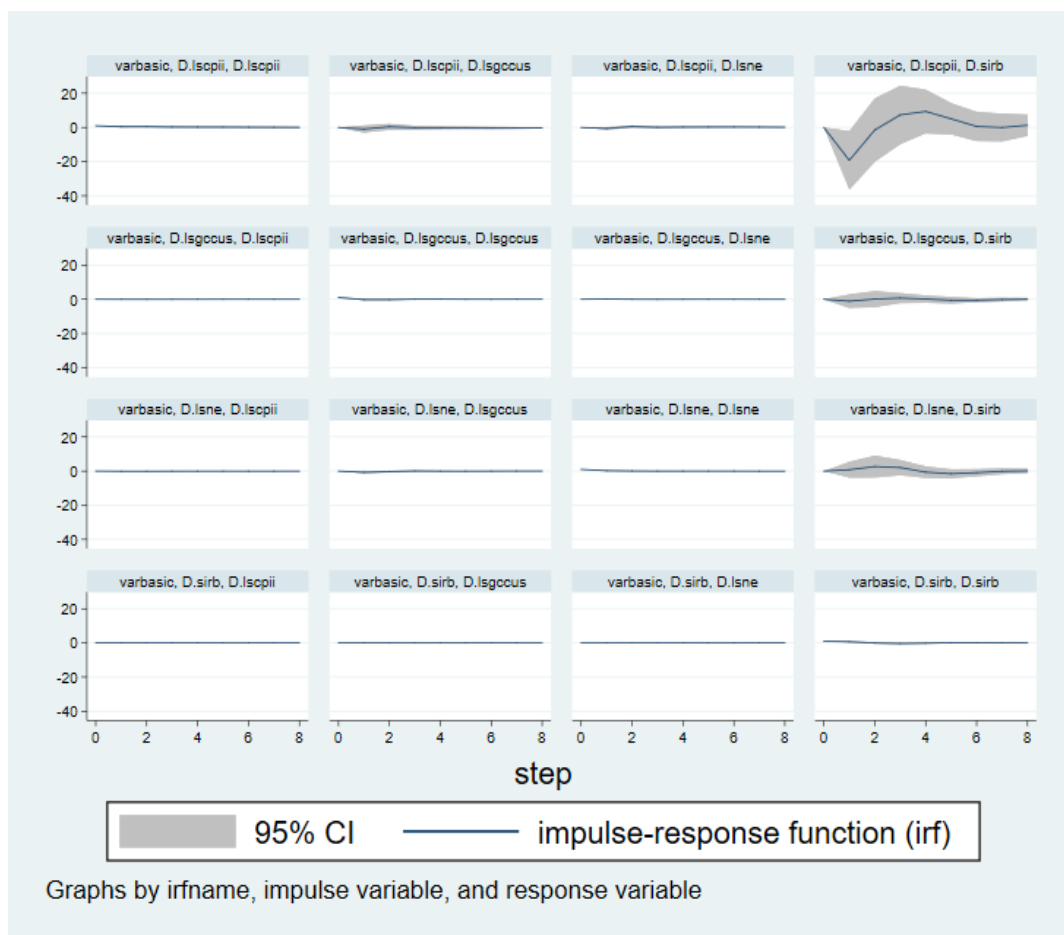
**Table 5.3.8: VAR regression for Saudi Arabia monetary policy.**

	Dlsgccus	Dlscpii	Dlsne	Dsirb
<b>lsgccus (LD)</b>	-0.0032 (0.2191) [-0.01] {0.988}	-0.011 (0.0398) [-0.28] {0.776}	0.052 (0.162) [0.32] {0.748}	-1.873 (2.07) [-0.90] {0.366}
<b>Lscpii(LD)</b>	-0.5743 (0.8695) [-0.66] {0.509}	<b>0.634</b> <b>(0.158)</b> <b>[4.01]</b> <b>{0.00}</b>	-0.027 (0.643) [-0.04] {0.966}	-7.960 (8.22) [-0.97] {0.33}
<b>lsne(LD)</b>	-0.2610 (0.1710) [-1.53] {0.127}	-0.023 (0.0311) [-0.75] {0.45}	<b>-0.3764</b> <b>(0.126)</b> <b>[-2.97]</b> <b>{0.003}</b>	1.587 (1.618) [0.98] {0.327}
<b>sirb(LD)</b>	0.009 (0.017) [0.52] {0.604}	0.002 (0.003) [0.89] {0.375}	-0.017 (0.012) [-1.35] {0.177}	<b>0.431</b> <b>(0.165)</b> <b>[2.60]</b> <b>{0.009}</b>
<b>Constant</b>	<b>0.087</b> <b>(0.029)</b> <b>[2.95]</b> <b>{0.003}</b>	0.009 (0.005) [1.74] {0.082}	-0.020 (0.021) [-0.93] {0.35}	0.140 (0.280) [0.50] {0.617}
Sample (1989-2015), AIC=-5.182.				

\*note: () st, [] z, {} p-value, L=T-1, D=difference. If p-value<0.05 its indicate sig.

From the VAR modle, we estimate that the difference of inflation only effects its own inertia significantly. The same goes for the nominal exchange rate and the interest rates. However, VAR estimation is useful as it provides an indication of how the variables ar relsted and assists in obtaining the IRF graphs which are shown in the next figure.

**Figure 5.3.1: IRF for Saudi Arabia Monetary policy model (VAR)**



From the diagram above, we cannot observe any shock effects on SA's GDP. This is also the case for nominal exchange rate and inflation. However, the only variables that has an influence is the interest rate as its decreases inflation in the first few years (early 1990s) then it stabilised through the 2000s until 2015. This is the case due to interest rate in SA following the same pattern as the US interest rates.

Regarding the rest of the variables, the same explanation applies. The rigidity of controlling exchange rate parities due to the fix regime does not allow any control on monetary policy. The exchange rate shock has a small effect on the early 1990s then it becomes persistent since especially around the 2000's (insignificant). Although the changes do not look significant, they provide a clear indication that the changes in interest rates could be adapted by using an exchange rate channel. GDP also has a very small effect on the interest rates, but it stabilises and is not different to zero in the later years.

None of the graphs above is significant at the 5% level of significance. These results suggest that the monetary transmission in Saudi Arabia is not set by the Central Bank. The results support the evidence that reflects that the Central Bank has limited influence over its monetary policy. Thus, fiscal policies have to share the burden of adjustment in periods of turbulence.

However, since the co-integration results show that the variables are co-integrated of order one, a VECM model has been estimated; the first lags as recommended by Johansen test are used.

**Table 5.3.9: VECM regression for Saudi Arabia monetary policy**

	<i>Dlsgccus</i>	<i>Dlscpii</i>	<i>Dlsne</i>	<i>Dsirb</i>
<b>Adjustment coefficient</b>	-0.153 (0.144) [-1.06] {0.28}	<b>-0.03</b> <b>(0.02)</b> <b>[-1.76]</b> <b>{0.079}</b>	<b>-0.17</b> <b>(0.04)</b> <b>[-3.73]</b> <b>{0.00}</b>	1.630 (1.21) [1.34] {0.17}
<b>lsgccus (LD)</b>	-0.388 (0.22) [-1.76] {0.289}	0.009 (0.03) [0.27] {0.78}	<b>0.018</b> <b>(0.071)</b> <b>[2.60]</b> <b>{0.009}</b>	-0.616 (1.85) [-0.33] {0.73}
<b>lscpii(LD)</b>	-1.544 (1.37) [-1.13] {0.26}	<b>-0.394</b> <b>(0.214)</b> <b>[-1.84]</b> <b>{0.06}</b>	-0.645 (0.44) [-1.46] {0.14}	<b>-25.72</b> <b>(11.49)</b> <b>[-2.24]</b> <b>{0.025}</b>
<b>lsne(LD)</b>	0.081 (0.31) [0.26] {0.79}	0.070 (0.048) [1.46] {0.14}	-0.03 (0.09) [-0.32] {0.75}	-1.781 (2.59) [-0.69] {0.49}
<b>sirb(LD)</b>	0.011 (0.023) [0.49] {0.62}	0.001 (0.003) [0.20] {0.843}	<b>-0.019</b> <b>(0.007)</b> <b>[-2.56]</b> <b>{0.011}</b>	0.072 (0.19) [0.37] {0.71}
<b>Constant</b>	-0.010 (0.028) [-0.38] {0.70}	0.006 (0.004) [0.15] {0.884}	0.014 (0.009) [1.58] {0.114}	0.0005 (0.23) [0.00] {0.99}
Sample (1990-2015), AIC=-6.602				

\*Note: () st, [] z, {} p-value, L=T-1, D=difference. If p-value<0.05 it is statistically significant.



The VECM model produced very interesting results. The adjustment coefficient for the nominal exchange rate is significant, which indicates that the coefficient can adjust to the disequilibrium after one year (the length of lag). This indicates that all the variables (GDP, inflation, nominal exchange rate and interest rates) jointly have a significant effect on the nominal exchange rate in the long run. Furthermore, the real GDP has a significant effect on the nominal exchange rate in the short run. The same result appears for interest rates where it effects the nominal exchange rates in the short run by -0.019 for every 1% increase in exchange rates parities.

In the case of inflation, the adjustment coefficient is significant at the 10% level of significance. This also applies to the lag inflation variables as the p-value is 0.06. This also means that the variables are jointly affecting inflation in the long run. Inflation has a significant effect on interest rates in the short run. The results indicate that the effect reaches 25% for every 1% increase in the interest rates.

The next graph shows the IRF graph for the VECM model. The result from the IRF after the VECM should overcome the cointegration effects, by adjusting the coefficient.

**Figure 5.3.2: IRF for Saudi Arabia monetary policy model (VECM).**



The VECM IRF graph is very similar to the IRF after the VAR. The only visible response variable was the inflation changes in the interest rates, the response of inflation on the interest rates has decreased and that continues until 2015. This could be attributed to interest rates not changing during the last ten years as they follow the USA pattern.

On the other hand, the nominal exchange rate depreciates in a modest manner due to the increase of interest rates, but that only shows at the end of the graph in 2008. The reason for that is the Great Recession and its impact on the Saudi economy by applying the US macroeconomic tools due to peg regime.

All other diagrams are not responsive to shocks; the effect is reflected on a linear line around zero, which indicates the variables are not responsive to any apparent shock.

The results from both VAR and VECM are insignificant, as most economist relies on either 1% significance or 5% most likely (Gujarati, 2012). Therefore, this supports the lack of any SA based policies and adds credibility to the argument in favour of adopting a more flexible exchange rate regime in the Saudi system. Monetary policy has tightening tools to exert control over inflation or interest rates. Saudi could have both an IT and a fixed exchange rate regime like Israel for example. As a first step, authorities could allow a short-run smoothing exchange rate fluctuation, like the one the Saudi Central Bank applied for a short period during the 2008 crisis. The VECM and the VAR model support the fact that the Saudi Arabian monetary policies suffer from the control of the US Monetary policies into the Saudi Central policies. Thus, this explain the need for an exchange rate an inflation policies reform which was done in the previous two models.

## 5.4 GCC model

In this section, we have constructed the RER in the six different GCC member countries.

The table below explains the stationary test results when the base choice USA prices.

$$r_{12t} = \beta_0 + \beta_{13}r_{13t} + \beta_{14}r_{14t} + \dots + \beta_{1m}\beta_{1mt} + \varepsilon_t$$

**Table 5.4.1: unit root tests for GCC 'US as a base country' G-PPP model variables.**

Variable	Series	ADF			PP		
		Lag	stat	prob	lag	Stat	prob
lsre	(with trend)	0	-5.177***	0.0001***	0	-6.704***	0.000***
		1	-6.262***	0.000***	1	-5.806***	0.000***
	Level I (0)	0	-0.643	0.976	0	0.004	0.994
		1	-2.116	0.5371	1	-0.507	0.983
	FD I (1)	0	-2.286	0.441	0	-2.378	0.391
		1	-1.914	0.647	1	-2.327	0.419
luare	Level I (0)	0	-4.461***	0.0017***	0	-4.458***	0.0018***
		1	-3.474**	0.042**	1	-4.469***	0.0017***
	FD I (1)	0	-1.160	0.918	0	-1.383	0.865
		1	-1.838	0.686	1	-1.294	0.889
	Level I (0)	0	-2.896	0.136	0	-2.931	0.152
		1	-3.007	0.130	1	-3.082	0.115
lbre	Level I (0)	0	-1.765	0.721	0	-1.788	0.710
		1	-1.607	0.789	1	-1.763	0.722
	FD I (1)	0	-3.286*	0.0685*	0	-3.290*	0.068*
		1	-2.624	0.268	1	-3.318*	0.063*
	Level I (0)	0	-2.094	0.549	0	-2.317	0.424
		1	-2.392	0.384	1	-2.218	0.479
FD I (1)	0	-3.443**	0.049**	0	-3.303*	0.06*	
	1	-3.446**	0.045**	1	-3.484**	0.041**	
lqre	Level I (0)	0	-0.698	0.973	0	-1.076	0.933
		1	-1.480	0.835	1	-0.978	0.947
	FD I (1)	0	-3.843**	0.014**	0	-3.705**	0.022**
		1	-4.020***	0.0082***	1	-3.904**	0.012**

Note: \*, \*\*, \*\*\* indicate significance at \*10%, \*\*5% and \*\*\* at 1% respectively

The table above explains the result for ADF test in six GCC countries in the case of having the USA prices as a base. The result shows that Saudi Arabia real exchange rate is stationary in level at 1% significance level. For UAE and it became stationary after the first difference at 1% significance level. Qatar and Kuwait became significant after the first difference at 5% level.

In the case of Oman, the rejection of the null hypothesis only can be done at 10% significance level. Though for Bahrain the real exchange rate series suffer from unit root even after differencing.

The PP test result shows the same result as the ADF with the same significance level. In summary, the real exchange rate series are co-integrated of order one, except for Bahrain.

**Table 5.4.2: unit root tests for GCC 'SA as a base country' G-PPP model variables.**

Variable	Series	ADF			PP		
		Lag	stat	prob	lag	Stat	prob
	(with trend)						
lsre	Level I (0)	0	-0.459	0.985	0	-0.896	0.965
		1	-1.416	0.856	1	-0.766	0.677
	FD I (1)	<b>0</b>	<b>-3.563**</b>	<b>0.033**</b>	<b>0</b>	<b>-3.407*</b>	<b>0.05*</b>
		<b>1</b>	<b>-3.451**</b>	<b>0.049**</b>	<b>1</b>	<b>-3.565**</b>	<b>0.03**</b>
luare	Level I (0)	0	-0.427	0.986	0	-1.089	0.931
		1	-1.202	0.921	1	-0.787	0.968
	FD I (1)	<b>0</b>	<b>-4.484***</b>	<b>0.0016***</b>	<b>0</b>	<b>-4.476***</b>	<b>0.0017***</b>
		<b>1</b>	<b>-3.376**</b>	<b>0.05**</b>	<b>1</b>	<b>-4.481***</b>	<b>0.0016***</b>
lbre	Level I (0)	0	-0.964	0.948	0	-1.750	0.728
		1	-1.724	0.740	1	-1.360	0.872
	FD I (1)	<b>0</b>	<b>-3.237*</b>	<b>0.07*</b>	<b>0</b>	<b>-3.26*</b>	<b>0.07*</b>
		1	-2.44	0.356	<b>1</b>	<b>-3.188*</b>	<b>0.08*</b>
lore	Level I (0)	0	-1.189	0.912	0	-1.763	0.722
		1	-1.602	0.791	1	-1.465	0.840
	FD I (1)	<b>0</b>	<b>-3.744**</b>	<b>0.019**</b>	<b>0</b>	<b>-3.810**</b>	<b>0.016**</b>
		1	-2.370	0.395	<b>1</b>	<b>-3.695**</b>	<b>0.022**</b>
lqre	Level	0	-1.362	0.871	0	-2.063	0.565

	I (0)	1	-2.644	0.26	1	-1.785	0.712
	FD	<b>0</b>	<b>-3.172*</b>	<b>0.090*</b>	0	-3.069	0.113
	I (1)	<b>1</b>	<b>-3.167*</b>	<b>0.091*</b>	<b>1</b>	<b>-3.213*</b>	<b>0.081*</b>
Ikre	Level	0	-2.412	0.373	0	-2.430	0.364
	I (0)	1	-2.433	0.362	1	-2.426	0.365
	FD	<b>0</b>	<b>-4.102***</b>	<b>0.0063***</b>	<b>0</b>	<b>-3.969***</b>	<b>0.0097***</b>
	I (1)	<b>1</b>	<b>-4.216***</b>	<b>0.004***</b>	<b>1</b>	<b>-4.134***</b>	<b>0.0056***</b>

Note: \*, \*\*, \*\*\* indicate significance at \*10%, \*\*5% and \*\*\* at 1% respectively.

From the table above, ADF test shows that all the GCC countries real exchange rates are non-stationary at the level. Thus, we accept the null hypothesis that the variables follow a unit root process. The same results have been reached using the PP test.

On the other hand, after changing the variables into the first difference, all our variables have become stationary. We reject the null hypothesis of non-stationary at 5% level for Saudi Arabia and Oman. For UAE and Kuwait, we reject the null hypothesis at 1%, while for Bahrain and Qatar we reject the null hypothesis at 10% level.

Evaluating the results of the PP test, we have a similar conclusion to the ADF result if we did not check the test level significance. All the six-variables become stationary after the first difference. However, if we check the significance level, Saudi Arabia and Oman, we reject at 5% significance level. Kuwait and UAE at 1%, and Bahrain and Qatar at 10%.

Thus, we can conclude that the RER for the GCC is stationary at the first difference in the case of choosing Saudi Arabia as a base country. This also suggests that the RER variable for all the six members of GCC are co-integrated in order one.

**Table 5.4.3: Johansen co-integration test for G-PPP model 'US as a country base'**

<b>Rank</b>	<b>eigenvalue</b>	<b>Max - statistics</b>	<b>SBIC</b>	<b>HQIC</b>	<b>AIC</b>	<b>5% critical value</b>
<i>r=0</i>		37.2981	-21.394	-22.8146	-23.5495	42.48
<i>r=1</i>	0.66613	33.8512	-21.35078	-23.096	-23.999	36.41
<i>r=2</i>	0.63051	24.832	-21.41296	-23.4246	-24.465	30.33
<i>r=3</i>	0.51826	11.8843	<b>-21.4137*</b>	-23.6360	-24.7842	23.78
<i>r=4</i>	0.29499	11.2120	-21.24826	-23.61491	-24.8396	16.87
<i>r=5</i>	0.28091	9.0189	-21.2668	<b>-23.72228*</b>	-24.9929	3.74

Note: STATA generates Johansen test based on trace statistics-eigenvalue of the stochastic matrix, and the information criteria (SBIC, HQIC, AIC), *r* represents the number of co-integration vector. The critical value is obtained using STATA.

The use of co-integration in the case of GCC, is to test if the G-PPP holds among the GCC countries or not. The above table indicates the GCC real exchange rate holds at rank three if we consider the SBIC criteria or rank five if we take into consideration the HQIC criteria.

Regardless, the results indicate that G-PPP hold in the GCC region and that means that a long -run relationship and stationary equilibrium relationship.

In addition, that reflects that shock in one of the rates will affect the other rates. Therefore, the real exchange rate shares the same type of shocks, namely an asymmetrical shock, which indicates the GCC could have a sustainable long-run Optimum Currency Area.

**Table 5.4.4: Johansen co-integration test for G-PPP model 'SA as a country base.'**

<b>Hypothesis</b>	<b>eigenvalue</b>	<b>Max- statistics</b>	<b>SBIC</b>	<b>HQIC</b>	<b>AIC</b>	<b>5% critical value</b>
<i>r=0</i>		39.7402	-21.67807	-23.09806	-23.83293	42.48
<i>r=1</i>	0.68927	30.3724	<b>-21.70601*</b>	-23.45142	-24.3547	36.41
<i>r=2</i>	0.59070	24.6901	-21.66587	-23.67753	-24.71859	30.33
<i>r=3</i>	0.51625	17.6396	-21.66603	-23.88477	-25.03301	23.78
<i>r=4</i>	0.40477	9.1731	-21.66626	-24.03292	-25.2577	16.87
<i>r=5</i>	0.23467	3.9113	-21.62491	<b>-24.08031*</b>	-25.35103	3.74

*Note: STATA generates Johansen test based on trace statistics-eigenvalue of the stochastic matrix, and the information criteria (SBIC, HQIC, AIC),  $r$  represents the number of co-integration vector. The critical value is obtained using STATA.*

We have estimated a co-integration test against the RER in the GCC region, but we have to use the Saudi Arabia prices this time as a base country. The test revealed that the RER are co-integrated in the order  $I(1)$  if we consider the SBIC criteria. On the other hand, it is the order  $I(5)$  if we used the HQIC criteria.

Nevertheless, this result indicates that the GCC countries could consider the choice of having a unified currency that is fixed to the US Dollar as an external exchange rate regime and the Saudi Riyal as the internal regime. This is due to the share of common trend among the RER between the GCC members and supports the argument of forming an OCA area in GCC.

## CHAPTER 6

### **Result interpretation, policy recommendation, research limitation and further research.**

This chapter discusses the implications of the Thesis findings in part 6.1 with emphasis placed in the case of Saudi Arabia. In addition, policy recommendations in line with the results and previous studies are also evaluated. The second part focuses on the research limitations and the challenges encountered by discussing some of the political and social problems. Finally, problems with data collection are also presented.

#### **6.1 Thesis results and policy recommendation**

The results reveal many interesting aspects of exchange rate and inflation policies. Quite often the results coincide with previous studies. In the next section the relationships between exchange rate policies and oil prices alongside with other macroeconomic variables are addressed.

For the GCC countries, the analysis started by constructing a Real Exchange Rate variable (RER) for each GCC member, by forming two types of RERs based on different CPI. For the first set of RERs, the USA inflation rate is used as a base country.

ADF and PP tests were performed for our newly formed variables. The results show that the Saudi RER is stationary at the level. UAE, Oman, Qatar and Kuwait become stationary after differencing. On the other hand, Bahrain's RER still contains a unit root even after first differencing.

These results show that the RER in the GCC region behaves differently when compared with inflation in the US. Our finding is not different from previous studies. According to Sequalli (2011), the behaviour of nominal exchange rates, which forms part of the RER was showing a descendant trend since 2001, which indicates that the rates were affected by imported inflation especially in Saudi Arabia and Qatar.



The different order of co-integration reflects that the GCC countries have different reactions toward the US interest rates, the GCC assets were not correctly substituted to the US assets (Hassan, 2013). The inability to control monetary policy could provide no help to the GCC countries to adjust their interest rates. GCC countries have some differences. Thus, they have a different reaction to the US policies. Laabas and Limam (2002) found that the RERs were not stationary at any level when the US was the base country.

On the other hand, some researchers found that the US base system is better for the GCC case. Balli *et al.* (2010) recommended that pegging to the US Dollar might support the GCC in stabilising inflation. Rafiq (2011) suggested that a US shock has a substantial effect on the GCC, and that the GCC and the US economic development are closely related due to the oil trade between the two countries and as such provide that a strong incentive to keep the pegged regime.

The second tool for considering the US base for GCC was testing the co-integration at level. Our results found that the RERs in GCC are co-integrated of order three if we considered the SBIC and level five from HQIC point of view.

Nusair (2012) found that GCC countries when have a US base, they are co-integrated of order four, supporting the Thesis results. This means that any shocks hitting the US will eventually affect the GCC region. This is exactly what happened in the 2008 credit crunch crisis. The GCC where affected by the crisis badly just because they followed the USA policies.

However, this also means that the G-PPP theory holds and that the GCC countries meet the OCA criteria. This also places the area at risk in terms of still having to follow the Fed's policies. The fact that the GCC should keep the peg regime because of oil prices seems invalid. Kim and Hammoudeh (2012) found that oil prices have a negative impact on the US Dollar appreciation, and it also affects the US export producer prices in the long run. That then will cause an increase in imported inflation and US currency volatility.

As part of the GCC analysis, we have also constructed another set of RERs for the GCC using Saudi Arabia as a base country instead of the USA. As part of the testing, we have

checked the stationary level of the variables. The ADF test and PP results confirm that the RER becomes stationary after first differencing. These results are more appealing for the G-PPP analysis; the variables are co-integrated at the same level, which means that the long relationship between the variables is more stable.

The last step was examining the co-integration level. From the SBIC criteria the RER with Saudi base was co-integrated of order one, but from HQIC it is order five. If we consider the SBIC, we can conclude that choosing the Saudi as a base is much more effective for the GCC as a currency anchor.

Previous studies have confirmed our results. Karara (2014) mentioned that Saudi Arabia and Iran are the essential anchor countries in the Mena region with 29% and 21% of GDP shares and Saudi with 10 % of Taylor rule. Hassan (2013) suggested that the inflation rates in the GCC are different from the US, while it is quite similar with Saudi Arabia, as the economic structure is very similar and the money growth follows the same trend.

In addition, the inflation response is more synchronised than the US case, which suggests that the response to US shocks is more sensitive to the US than other countries (Balli *et al.*, 2010). In addition, the GCC could also consider adopting a basket of currency for its peg regime, as Kuwait has since 2008. This following the 2008 crisis, with Qatar and UAE registering significant deviation since (Espinoza and Prasad, 2012).

To conclude, the thesis provides very strong evidence in favour of the view that the GCC could/should form a currency union as GCC countries follow the G-PPP theory, which indicates they meet the OCA criteria. In addition, the evidence points to the superiority of doing so by adopting, the Saudi Arabian Riyal as a common currency rather than the US Dollar. Alternatively, the GCC countries can use a basket of currencies including the Saudi Riyal among others. A summary of the main policy recommendations is presented below:

### 6.1.1 Exchange rate determination, oil prices and exchange rate regime

In the starting point of the empirical analysis, the variables were tested for stationarity in the exchange rate model. It was concluded that all variables became stationary after first differencing, apart from the GDP in current prices, which was stationary at level.

The results coincide with those of other studies, for example, Saqib (2013) concluded that variables are cointegrated in order one,  $I(1)$ . The paper examined the relationship between exchange rate fluctuations and trade balances in Saudi Arabia. Aroua and Fault (2012) concluded that oil prices and stock market volatility are cointegrated after first differencing for all GCC countries. Courdet *et al.* (2011) also found that oil exporting countries experience unit root and become stationary after the first difference.

On the other hand, Jahan-Palaver and Mohammadi (2011) did not identify Saudi Arabia variables for oil and exchange rate are stationary even after differencing.

Therefore, identifying a unit root in most series is not unique. However, this is an essential step to ensure that the variables are transformed. This could mean that the relationship over time for all variables is strong. Oil prices, exchange rate parities and trade openness all are sensitive to structural changes and important events. The significant relationship between exchange rate parities and oil and their sensitivity to shocks, led to the examination of the policies regarding the most appropriate exchange rate regime.

These results could not offer insights for policy recommendations. They just provide insights into the variables' behaviour within the timeframe of the study.

In the second stage ARDL models for exchange rate determination were estimated. We found that oil prices have a significant effect on exchange rate after a two-year lag, the GDP and the trade openness.

Samargandi *et al.* (2014) came to a similar result; trade openness has a significant effect on growth and oil prices as well. The study of Courdet *et al.* (2011) found the terms of trade cause an appreciation in the exchange rate and benefit the financial status of the country. In addition, oil prices were found to have a positive effect on trade for both

imports and exports, which also influences exchange rates in commodity countries (Frankel, 2006).

This revealed the importance of trade in the Saudi exchange rate parities, illustrating that trade volumes could affect exchange rates significantly. In the case of Saudi Arabia, the exchange rate is fixed to the US Dollar. Thus, exchange rate parities will not be conducive to the objectives of the Saudi authorities in relation to the Saudi economy. In relation to the ARDL error correction model, all variables do not have any significant effect on real exchange rate variables in the long-run. Inflation and oil prices have a positive relationship with the real exchange rate but not a significant one. These results contradict the results from Amin and el-Sakka (2016), who found a long run relationship exists between GDP, oil prices and the Real Exchange Rate (RER). Mehrara and Mohaghegh (2011) has explored the interaction between monetary shocks in oil exporting countries and concluded that output and monetary shocks are significant in the long-run. They also added that these countries are in a stronger position to influence future output movements by a staggering 11 percent. Although the result is not directly linked to the RER, it proved a long-run relation between oil, output and shocks, not evident in the Thesis' results.

In the short run, the results for the RER dynamics were different. Oil prices, money supply, GDP and trade openness were significant. These results support our research aim that there is a relationship between exchange rate and the main macroeconomic variables, especially oil prices. Previous studies also supported that conclusion. Amin and El-Sakka (2016) found holds for exchange rate parities and oil prices in the short run. The adjustment coefficient was adjusted at 4% in both their study and this thesis.

This proves that the adjustment of the exchange rate parity required to return to its equilibrium is slow, and it does not match the fast changes of the other variables' dynamics. From the study on financial development in the oil-rich economy by Samargandi *et al.* (2014) the coefficient of the Error Correction Model (ECM) is stable on growth. Therefore, these results recommend that the short run dynamics between the variables in the Saudi economy are significant.

By obtaining these results, it can be legitimately concluded that the Real Exchange Rate (RER) is not significantly affected by other variables such as inflation and oil prices in the long-run. This contradicts the findings of previous studies. The time span covered in the Thesis could be an explanation for this. It implies that the Saudi economy manages to facilitate a stable relationship between the variables in the long-run.

On the other side, in the short run, the oil prices and inflation were significant for the exchange rate. This sheds considerable light on the primary research objective of exchange rate behaviour and the necessity of introducing some exchange rate flexibility to accommodate the changes in oil prices and inflation rates. The openness of trade has also been influential in the short-run, that is was also due to higher oil exports, and the reliance on importing most goods from abroad. This in turn, influences exchange rate volatility in the short-run.

In addition, the two dummy variables accounting for the exchange rate regime and interest rates appear to be insignificant. This may be due to the data that is already influenced by the peg regime and the imported inflation.

In the final stage, the Granger causality relationship between the variables in our model was estimated. The Real Exchange Rate (RER) is Granger caused to oil prices, and the same goes with oil prices for the Real Exchange Rate, which provides significant evidence that the relationship between oil prices and RERs in both directions is influential. The thesis' results support Osuji (2015) for the case of Nigeria, where the same results were reached. Mehrara and Mohaghegh (2011) also identify a causality relationship between oil prices and RERs that influences the movement of future prices by 11 percent. In addition, Jahan-Pravar and Mohammadi (2011) found a bidirectional causality relation between exchange rate and oil in Saudi Arabia.

In the case of Nigeria, the study concluded that this movement is beyond the reach of the Nigerian policy makers. This is a very similar case to the Saudi economy, where the Central Bank (SAMA) has insufficient control over these prices. Nonetheless, the Saudi Arabia government exerts control in supply of oil and hence interferes in the oil prices via this process (OPEC).

From a dynamic macroeconomic point of view, since there is a significant causality relationship between RERs and oil prices in both directions, this means that oil shocks have a significant influence on the money supply. This was also proven in the causality test results where the money supply has a significant effect on the RER and oil prices. Mehrara and Mohaghegh (2011) found that oil shocks are the second most important factor that has a significant effect on money supply, which causes high price volatility fluctuation in oil exporting countries.

The openness of trade has a causality relationship with the RER, inflation and the money supply. The results from Courdet *et al.* (2011) agree with our findings in the case of oil and commodity exporting currencies. These findings raise the concern on the impact of trade into oil and exchange rate parities that might lead to an undervalued exchange rate.

In summary, it can be legitimately concluded that the Saudi Central Bank (SAMA) should review its exchange rate policies, as the strong causality between oil prices and trade will harm the economy in the future. The fact that Saudi is focusing on diversifying its economy will increase the need of adjusting the fixed exchange rate regime to mitigate the changes that shape the economy. Given the sharp decline in oil prices since November 2014, there has been considerable turbulence in the Saudi economy, which influences the global financial system. The USA has reduced its oil imports from the Arab world, while pricing oil in the US Dollar will not have the same impact as it used to, as the leading importers are China and Japan (Salmaeh, 2016).

Thus, the need of adjusting or even altering the current fixed exchange rate regime is greater at present, indicating the need to employ a basket of currencies to reflect the importance of the new trading partners.

### 6.1.2 Inflation, inflation targeting and monetary policy

In the second part of the analysis, inflation determination was investigated by focusing on the nominal exchange rate and government spending, as they are crucially effective for the Saudi fiscal and monetary policies.

First, we tested for stationarity at the level of the variables, most variables were stationary. This was the case for the nominal exchange areas, broad money, government spending and the main trading partner prices. Most variables continued to be stationary after first differenced. Inflation and openness of trade became stationary after differencing.

These results are quite different to the previous ones, as a study on structural breaks in GCC by Nakibullah (2016) indicates that the variables become stationary after differencing. Abul basher and Elsamadisy (2012) also concluded that the variables for inflation in GCC experience a unit root even after differencing and there is a lack of co-integration relationship between variables. The authors claim that this is due to oil price effects in the region. Alkhathaln (2011) in a study of Saudi inflation found that the variables are cointegrated of order (1).

However, the results for ADF and PP suggest that most of the variables are stationary and co-integrated of order zero. Secondly, inflation was assessed by estimating ARDL regressions. There is a significant effect of past nominal exchange rates, government spending and openness of trade into inflation prices. Both dummy variables (IT and EXRR) have a significant impact on inflation prices.

These results follow the same pattern of other studies. Murshed and Nakibullah (2015) found that the previous price level and international prices are the essential causes of the increase in CPI in the GCC region. Alkhathlan (2011) revealed a negative relationship between CPI and openness of trade that is significant. Kandil and Morsy (2011) established that the trading partners are the most significant determinants of inflation in the GCC area. This result contradicts our findings from the OLS regression.

However, estimations from the Error Correction Model (ECM) should provide more detailed results. In the long-run, the inflation coefficient was significant which validates

the assertion that all the variables jointly influence inflation. The openness of trade affects inflation in the long-run.

The thesis results go along with the results of Murshed and Nakibullah (2015) according to which in the long-run the exchange rate has an insignificant impact on the price level in the GCC. Abul and Elsamadisy (2012) revealed that in the long run government spending has a significant impact on inflation. On the contrary, Junttila and Korhonen (2012) established that in the long-run the producer currencies and prices are significant on inflation. Abdulkheir (2013) also revealed that a co-integration relationship exists between money supply, real GDP, interest rates, exchange rates and inflation.

The results provide concrete evidence of joint effects from all our variables into inflation in the long-run. The confirmation that this relationship exists in the long run allows us to emphasise the necessity of reshaping the behaviour of inflation and other variables in the case of Saudi Arabia.

We recommend that Saudi needs more freedom over controlling its exchange rates and inflation, rather than just depending on reductions on government spending. Instead, in the short run, the model estimated in the thesis shows that the government spending after differencing, the two dummy variables for different regimes are significant and influence inflation. Other studies found different results in the short run, especially for the nominal exchange rate and output variables.

From Alkathlan's (2011) point of view, the money supply has a relevant impact on the price level in the short run in Saudi Arabia. Pryzzystupa and Worbel (2015) in a study of emerging market 'the case of Tunisia' found that a minor increase in output and exchange rate in the short run will impact CPI, which supports the fact of inflation persistence in those countries. Trading partner prices are significant and affect prices in GCC countries including Saudi Arabia (Kandil and Morsy, 2011).

However, the main result that was very appealing in our model was IT and the exchange rate regime are significant in the case of inflation determination in the short run. This result is unique for the case of Saudi Arabia. The result also means that there is a substantial effect on inflation. Both variables have a negative effect, which means both regimes could decrease inflation.



A study by Lin and Ye (2013) on regime choice found that fix exchange rate regimes are more appealing for countries with open economies, but the fixed regimes do not reduce inflation more than inflation targeting. Hu *et al.* (2013) found a similar lack of exchange rate adjustment in emerging market countries.

However, it does not necessarily follow that a country with IT will have a fully flexible exchange rate regime as the emerging market countries who adopted IT still intervene into the foreign exchange rate (Gosh *et al.*, 2016). The IT system could be more beneficial in reducing internal prices than the hard peg, but a fixed regime is more appropriate in dealing with volatility especially in the case of developing countries (Ouyang *et al.*, 2016). Thus, Saudi Arabia could potentially have both an IT regime and a fixed exchange rate regime.

Given the Granger causality test in the thesis, we could claim that inflation has a causal relationship with the nominal exchange rate, government spending and openness of trade. We found that government spending is Granger caused to both inflation and exchange rates, the openness of trade is causing the government spending and the trading partner's prices.

From Abdulkheir (2013) the Granger causality between inflation and exchange rates is a bidirectional effect. This was not reflected in our results. The authors claimed that there is a one directional effect from inflation to exchange rates. These results support our finding that inflation has a significant effect on exchange rates and it could lead to increased exchange rate volatility. However, Murshed and Nakibullah (2015) revealed that inflation in the GCC is mostly imported mainly in the short run. That might explain the impact of Granger causality from inflation to other factors. Moreover, Akikina and Alhoshan (2003) revealed that the money supply is highly affected by high government spending and inflation, which agrees with our causality relationship identified between government spending and inflation.

In summary, it can be legitimately concluded that inflation is affected by trade, IT and the exchange rate regime. Therefore, inflation could be controlled by using an IT system in the case of Saudi Arabia. Since Saudi is an open economy, the fact the trade is effective is due to its importance in the Saudi economy and even that inflation is

imported from the US. The IT regime was beneficial in emerging market cases and should be appropriate for Saudi as well.

The monetary policy transmission was also evaluated by focusing on the main variables that impact on fiscal and monetary policy. Starting with the ADF test, variables have a different level of stationarity due to different lags. However, after the first difference, all variables become stationary.

Almansour (2015) used a Taylor rule analysis for Saudi Arabia. The variables for the equation were all co-integrated of order one. Naime (2011) found that monetary policy transmission variables in the six MENA countries were also stationary after first differencing. This is also supported by the findings of our results.

The variables for the Saudi monetary policy were jointly significant in rank 1, which means that there is a long relationship between the variables. The same result was derived in Almansour (2015) and Naime (2011) for the Case of Morocco only. Alkhtahlan (2011) found that the F-statistics proved that the interaction between variables is found in Saudi Arabia. In addition Abul-basher and Elsamadisy (2012) found that CPI responses to exchange rate were not high, and that is due to lack of monetary independence in the GCC region.

VAR estimations lead us to IRF impulse responses. No evidence of massive impact was detected apart from the case of inflation into interest rates. However, this result alone is significant, as it reflects the fact the inflation is responsive to any changes in interest rates. Nevertheless, as we found co-integration, the VECM result is more accurate and reliable. Thus, our estimation shows that in the long-run, all variables affect both inflation and interest rates. That, of course, includes the nominal exchange rates. In the short -run, the variables are only significant in their inertia. The only exception is the real GDP into nominal exchange rates. Again, the IRF results indicate response only in the case of inflation into interest rates and nominal exchange rate into interest rates. However, these are the main two focus variables in our study.

Naime (2011) IRF analyses in Morocco that monetary shocks will decline interest rates. This is confirmed in our study. Another study by Mallick and Sousa (2012) for BRICS

found that interest rates increases causes inflation declines, and that has a significant impact in reducing GDP because it is costly for the government.

In summary, our results for IRF confirm that the inflation and exchange rates are sensitive to interest rates. Therefore, the Saudi Central Bank should have more independence in controlling interest rates, inflation and exchange rates to enhance stability and have more room than the use of solely fiscal policy in controlling macroeconomic variables. Strong inflationary pressures and currency overvaluation harm potential output.

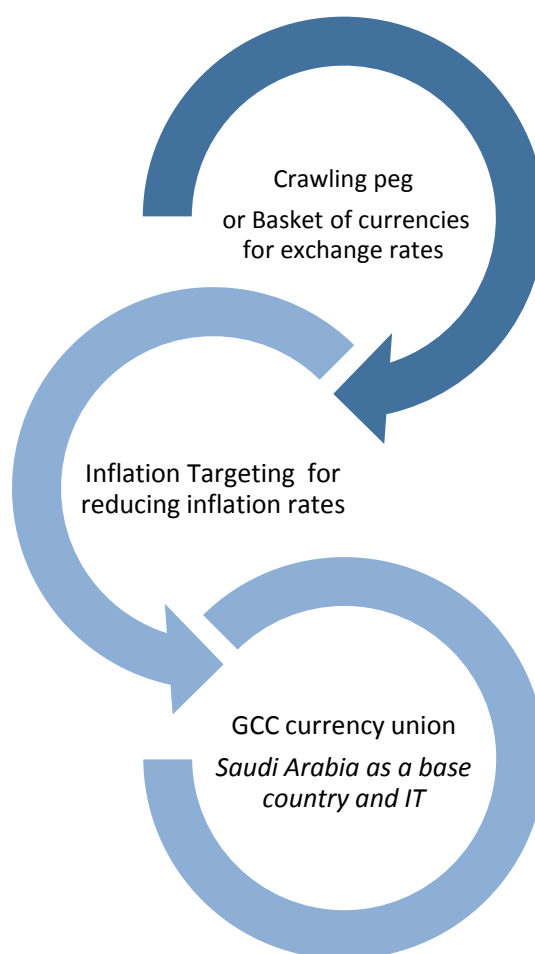
A good example of a country in a similar situation is Israel. Israel has adopted both a fixed exchange rate regime and IT. The country managed to use the IT as a tool to construct its crawling peg. Given the assumption that PPP holds, the depreciation of the exchange rate must be equal to the difference between the inflation in Israel and foreign inflation rates (Benrnanke *et al.*, 1999).

In addition to applying IT, the country acknowledges the level of government spending and aims to control it (Bernanke *et al.*, 1999). As a result, it can be concluded that the Saudi government could potentially adopt both a fixed exchange rate regime with some flexibility (considering for example the adoption of a crawling peg instead of a hard-fixed regime) and an IT system at the same time. This will allow the country to enjoy the stability that the fixed exchange rate regime provides and at the same time anchoring inflation to a manageable level.

## 6.2 Policy recommendation main points and summary diagram

1. Saudi Arabia should allow for more flexibility in its exchange rate policies either by considering a basket of currencies as the anchor (including among others Yen, Euro, Yuan and US Dollar). Alternatively, the country could adopt a crawling peg.
2. IT could be very useful in the case of Saudi Arabia and it seems positive for controlling inflation without harming other macroeconomic indicators.
3. The potential creation of GCC currency union seems very appealing. However, the necessity of fully considering the system should be pointed out. In this regard, the best two policy options reflected in the Thesis is either having Saudi as a base country, or utilising a basket of currencies.
4. The GCC countries also could consider having both IT and a basket of currencies or a crawling peg.

**Figure 6.2 summary for policy recommendation of the thesis.**



### 6.3 Research limitations and further research

Researching any area in Saudi Arabia could prove quite challenging. This thesis is no exception.

First, the lack of relevant literature focusing explicitly on Saudi Arabia and the GCC. In order to meet the thesis aims and objectives the most appropriate and up to date techniques were applied with the analysis accommodated by most up to date studies from the literature.

Second, data collection was quite tricky. Data availability on Saudi Arabia is challenging especially data prior to 1990. The frequency of data was also an issue as we found some quarterly data for some variables from 1990. However, most data available appears in annual form. In addition, we aimed for the most updated data to be included in the study. Nevertheless, the lack of updating information in even international organisations' databases like the World Bank and the IMF for GCC was evident.

Time series encounter some general issues that most statisticians are aware of. Reichmann (1961) references relating to abuse statistics that annual data will be affected from previous years and the line will continue with the same trend as the previous years, reflects the limitations of analyses based of time trends. He added that this problem could be greater if more than one variable is involved in the least squares method.

Another general problem is the underlying assumption that data should always be significant. Although, we strive to derive the best possible results and interpret their implications, we should also be aware that all statistical studies suffer from a number of biases and even sources from the IMF and World Bank could suffer from such biases. This of course is a recurrent research debate, and the focus since the 1970s has been on the merits and demerits of the mixed methods approach adopted in this thesis.

An excellent example of such a problem was mentioned by Best (2004) in his book on more damned lies and statistics, when referring to data about religious affiliation in the US census was deliberately missing to avoid the discussion of asking people about the separation about state and Church.

Another example was mentioned in Jerven (2013) when discussing the data for African countries. IMF data for the Nigerian growth was not accurate; the numbers were divided into few years (past years) instead of adding the increase of 40 % or 60% in one year. This resulted the database for these African countries to be confusing and causing inaccurate results.

For the case of Saudi Arabia and the GCC, the latest report from IMF on policy challenges for GCC by Colacelli *et al.* (2016), mentioned that one of the leading challenges for the GCC is improving its macroeconomic statistics. The Saudi and the other GCC governments should improve the frequency and the variables included in their reports. They advised that the collaboration between national statistic organisations and GCC-Stat is essential to obtain more reliable data.

In this research, issues of data reliability were taken into consideration. However, it needs to be noted that the best use of the data available has been made to the knowledge of the author facilitating the conduct of an economic study on Saudi Arabia in an effort to provide policy recommendations in the Saudi Arabian and the GCC authorities.

Another limitation of our research is disentangling the data analysis and its interpretation from political influences. For example, Saudi Arabia has the highest reserves of oil in the world. Therefore the country is so keen to keep prices at a certain level, to maintain high revenues. Saudi membership in OPEC is the primary tool to achieve this. However, in 2011 this did not act in favour of the US. On the other hand, Saudi authorities cannot ignore the importance of gaining the US's approval (Council Special report, 2011).

Authors have stressed the relationship between oil prices and the political influence. Saudi Arabia needs to restructure its policies by enforcing policies in oil production through OPEC, and the need for domestic policies to ensure stability and improve macroeconomic harmonisation; the Saudi government is aware of the limited options available especially after the end of the Saddam Hussain regime in Iraq in 2004-05 (Heradstveit and Hveem, 2004).

The relationship between the US and Saudi Arabian petrodollar is not only political, but primarily economic as the investment from Saudi Arabia to the US is approximately \$750 billion as estimated in 2016 by Salameh (2016). Therefore, even if the relationship between the countries is not at its best, it will be difficult for the US to abandon the countries' ties and risk losing such investment opportunities.

Saudi Arabia and the rest of the GCC countries are engaged with the US to prevent the risk of war that comes from Iran nuclear development, as the GCC governments are relying on the US to ensure their protection (Council special report, 2011). The geopolitical risk in the area is particularly increased especially after the war with Yemen that Saudi started in 2015. In addition, even the GCC unification is under threat unless the situation is altered. This is the case following the end of diplomatic ties between GCC countries and Qatar in June 2017 (The Economist, 10<sup>th</sup> June 2017).

These changes in the geopolitical status quo and the security relationships with the neighbouring countries has changed the dynamics very rapidly in the last two years. Although recommendations for the GCC countries have been made from a data evaluation perspective these should be treated cautiously in the light of the deteriorating relations with Qatar that have the potential to derail the GCC policies.

In particular for the case of Saudi Arabia, the new plans produced in 2016 for the 2020 national transformation and the 2030 vision form an essential step for future of the country. For example, Saudi will have a VAR system from January 2018; this will transform the economy from relying on Government spending and generate another source for revenue and income (Cornock, 2017).

Awareness of all the obstacles in our analysis allows us to reach the best possible solution for Saudi Arabia and the GCC countries. In relation to the US ties and the other political problems this provides ample opportunities to other researchers to approach the same issues from a different angle based primarily on political relations.

Further, future research could be conducted with more reliable data, as they can employ post 2015 data which features a more exciting trend due to the massive changes in the region that are beyond the scope of this study. The inclusion of data from newly introduced fiscal policy (e.g. tax revenue data) into the analysis and post 2017 statistics

on the economy's diversified sectors could assist in obtaining legitimate results and shedding further light in specific areas of the Saudi Arabian economy.



## CHAPTER 7

### Conclusion

The principal question addressed in the thesis is whether the authorities in Saudi Arabia should review their exchange rate and inflation rate policies with the view of introducing more flexibility in the country's monetary policy. Thus, the thesis has explored the possibility of applying inflation targeting in the Saudi Arabian economy. This is done by taking into consideration other alternative regimes such as flexible exchange rates and monetary unification, as Saudi Arabia is a part of the Gulf Cooperation Council (GCC).

Chapter 2, discussed different exchange rate regime and their applicability was explored. Also, the discussion revolved around inflation targeting theory with the demerits and benefits for the system, steering the research into considering different scenarios were Saudi to pursue inflation targeting. Chapter 2 also evaluated the optimum currency area (OCA) theory, while keeping in mind the latest developments in relation to Brexit and the implications for the EU; this helps inform judgments concerning the realisation of a similar situation in the GCC. The turbulent relations with Qatar render this a likely outcome, at least at present.

Chapter 3 focused on the effect of fixed exchange rates into the Saudi Arabian context. The peg regime ensured stability in oil exporting trade and from this perspective it has been successful. However, Saudi Arabia has not enjoyed the benefits of a flexible regime, particularly when oil prices were high. In addition, the fluctuation of oil prices and the tightness of the regime has led to higher inflation. That was the case in 2008, after the US crisis when inflation reached 11%, which was mainly imported. The peg regime is applied in all GCC countries; thus, the plan was to have a single currency with a fixed rate to the US Dollar. Thus, all GCC member countries will subsequently suffer from shocks and crises when adopting a single currency.

As such, the research has aimed at identifying an optimal solution for the Saudi authorities in terms of controlling inflation and benefiting from more options when setting monetary policies. Saudi Arabia has mitigated financial crises only by resorting to government spending, which will not/cannot be sustainable in the long-run.

The decline in oil prices in 2014 was not a coincidence, this was expected in the market given the oil price volatility. This provided an enhanced incentive to investigate the relationship between oil prices, exchange rates and inflation. This was achieved by exploring exchange rate determination and inflation models from previous regimes and choose the most applicable models for the research.

The choice of model in the thesis was done by bearing in mind the main factors influencing exchange rate and inflation, with the application of inflation targeting and exchange rate policies and the way they impact on the most important macroeconomic indicators in Saudi Arabia. In addition, the possibility of having a single currency with other GCC countries was evaluated.

Model evaluation and model selection is a difficult process in most previous studies in the area. Other studies either focused on the determination of exchange rates or inflation, or on a comparison of different countries with different regimes. In this thesis, the combination of testing for exchange rate determination and inflation with the most recent data available (2015), the use of ARDL techniques managed to account for the possibility of adding two exogenous variables for the exchange rate regime and inflation targeting.

In chapter 5, models' estimation results were presented. The results were significant in many ways; this has filled gaps in the literature, in particular in the application of regime variables into a determination model. The results are very promising on inflation, as both exchange rate regimes and inflation targeting variables were included in the regression.

The first model for determining real exchange rates explored the effects of oil prices and the effects of other variables including the regimes. The results are testing our first objective of having a flexible exchange rate (instead of the current fixed regime) and the impact this will have on the behaviour of exchange rates. Despite the results not being significant in the case of regime testing, the causality relationship identified between oil prices and exchange rates is a very important finding, as the actual exchange rate regime in place becomes a determinant of oil pricing. This in turn reflects the need to review the current policies as oil prices remain volatile.

The second and the third model form the main contribution to knowledge and the focus of the research. The use of an inflation determination model with the regime variables revealed significant results. Inflation rates feature a causality relationship with the nominal exchange rate. Both inflation targeting and exchange rates were positive and significant. This provided evidence that inflation targeting could be beneficial for Saudi Arabia's monetary and fiscal policies. Moreover, testing monetary policy variables shows that inflation and interest rates are affected by exchange rates, GDP, inflation and interest rates together in the VECM model. This proves that inflation and interest rates are sensitive to GDP and exchange rates. Therefore, the Saudi Arabian authorities could successfully control inflation through an exchange rate channel and by exerting a greater control on monetary policy setting.

The last model tested for the establishment of a monetary union in the GCC region; this in order to support the third objective of the thesis. The results are revealing as the use of Saudi Arabia Riyals as a country base for the union is more appealing than having the US Dollar as a base currency. The results demonstrate the fact that the Gulf region including Saudi Arabia could form a currency union independently without the need to rely on the US Dollar.

In addition, the results of the GCC currency union combined with those on the significance of adopting an inflation targeting regime contributed to knowledge and for the interest of improving policies for the region. This could be facilitated by the GCC currency union with the Saudi Riyal used as a base currency and employing inflation targeting to a certain level. This is already the case with the European Monetary Union, as its members have to target their inflation.

As a result, the main recommendation is to have a fixed exchange rate regime for the Saudi currency, use inflation targeting as part of a flexible monetary policy and use a basket of currencies to peg the value of the Riyal to. The thesis has provided consistent evidence that Saudi Arabia and the GCC have many other countries that they trade with, other than the USA. Countries such as Japan, China and many European countries, that are very influential and key to regional trade.

The uniqueness of the result could assist ongoing research on the topic and its applications in the region in particular the Gulf countries and the MENA region. These results are also important for companies willing to do business with countries in the region, as they raise their awareness of the macroeconomic background and policy making of Saudi Arabia in particular and for the GCC countries as a whole. Were the recommendations of the thesis to be adopted, this could prove conducive for the stability of the GCC currency and GCC countries will be better equipped to fully grasp the benefits of openness of trade without having to face the adverse implications of a US Dollar appreciation.

Nevertheless, the harsh political reality and its influence on the region, Saudi Arabian authorities' plans are very promising. The Saudi government is keen to start diversifying the economy away from oil reliance. This will provide more opportunities for business and inspire a more diverse production base. If these plans were to be supplemented by flexibility in policy options, as this thesis legitimately advocates, the result will involve increased government revenue and a reduction in inflation rates. It is the intention of the author to champion these policies up to their adoption.

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## Appendix A

Table A.1: Saudi Arabia Dataset description from 1980-2015

Abbreviation	Description	Source
<b>Sgd</b>	Saudi Arabia GDP growth in percentage change	World bank
<b>Sgdd</b>	Saudi Arabia GDP deflator percentage change	World bank
<b>Sgcus</b>	Saudi Arabia GDP per capita in US Dollar	World bank
<b>Sgccus</b>	Saudi Arabia GDP constant in US Dollar	World bank
<b>Sgppp</b>	Saudi GDP per PPP	www.World economics.com
<b>si</b>	Saudi Arabia inflation rate annual percentage	World bank
<b>svi</b>	Saudi Arabia volume of imports of goods	IMF
<b>scpii</b>	Saudi Arabia consumer price index(CPI) 2010=100	World bank
<b>swpi</b>	Saudi Arabia world price index	World bank
<b>sve</b>	Saudi Arabia volume of Exports goods	IMF
<b>sca</b>	Saudi Arabia current account balance percentage of GDP	IMF
<b>sge</b>	Saudi Arabia government expenditure as percentage of GDP	IMF
<b>sr</b>	Saudi Arabia current total reserve +gold in US Dollar	World bank
<b>srn</b>	Saudi Arabia current total reserve -gold in US Dollar	World bank
<b>srd</b>	Saudi Arabia Sr-Srn in US Dollar	World bank
<b>hcc</b>	Saudi Arabia household consumption local current	World bank
<b>hcp</b>	Saudi Arabia household consumption as percentage of GDP	World bank
<b>soer</b>	Saudi Arabia official exchange rate one dollar to Saudi riyal	World bank
<b>sre</b>	Saudi Arabia real exchange arte	World bank
<b>sne</b>	Saudi Arabia nominal exchange rate	World bank
<b>sbmg</b>	Saudi Arabia board money as percentage of GDP	World bank
<b>sbmc</b>	Saudi Arabia broad money as current price	World Bank
<b>sbma</b>	Saudi Arabia board money as percentage of Annual growth	World Bank
<b>sbmr</b>	Saudi Arabia broad money to total reserves	World Bank
<b>sie</b>	Saudi Arabia internal GCC export	Gulf investment and consumption
<b>sii</b>	Saudi Arabia Internal GCC imports	Gulf investment and consumption website
<b>opn</b>	Oil price nominal OPEC basket	OPEC

<b>opr</b>	Oil price in real OPEC Basket	OPEC
<b>su</b>	Saudi Arabia unemployment rate	World bank
<b>sopt</b>	Saudi Arabia oil prediction total (million barrels per day)	SAMA
<b>sopc</b>	Saudi Arabia oil production in percentage change	SAMA
<b>sopd</b>	Saudi Arabia oil production in daily average.	SAMA
<b>soxna</b>	Saudi Arabia oil export to north America	Saudi Arabia ministry of oil and petroleum
<b>soxsa</b>	Saudi Arabia oil export to south America	Saudi Arabia ministry of oil and petroleum
<b>Soxwe</b>	Saudi Arabia oil export to west Europe	Saudi Arabia ministry of oil and petroleum
<b>soeme</b>	Saudi Arabia oil export to middle east	Saudi Arabia ministry of oil and petroleum
<b>soeaf</b>	Saudi Arabia oil export to Africa	Saudi Arabia ministry of oil and petroleum
<b>soxo</b>	Saudi Arabia oil export to oceanic countries	Saudi Arabia ministry of oil and petroleum
<b>soxae</b>	Saudi Arabia oil export to Asia and Far East	Saudi Arabia ministry of oil and petroleum
<b>soxt</b>	Saudi Arabia total oil export	Saudi Arabia ministry of oil and petroleum
<b>ffr</b>	US federal funds rate in averages	Federal funds reserves bank of St. Louise
<b>rrr</b>	US Reserve repo rate	Federal funds reserves bank of St. Louise
<b>sor</b>	Saudi oil revenue in million riyals	SAMA
<b>sotr</b>	Saudi Arabia other revenue in million riyals	SAMA
<b>srds</b>	Saudi Arabia deficit/Surplus percentage to GDP	SAMA
<b>sirb</b>	Saudi Arabia interest rate bank (3 month) percentage change	SAMA
<b>sdd</b>	Saudi Arabia demand Deposit	SAMA
<b>srr</b>	Saudi Arabia Repo Rate index	SAMA
<b>srrc</b>	Saudi Arabia Repo rate as percentage change	SAMA

<b>slbn</b>	Saudi Arabia lending/borrowing net as percentage of GDP	IMF
<b>sqml</b>	Saudi Arabia Quasi Money in local currency SAR	World Bank
<b>sml</b>	Saudi Arabia money in local currency SAR	World Bank
<b>smql</b>	Saudi Arabia M2 and Quasi in local currency SAR	World Bank
<b>smqg</b>	Saudi Arabia M2 and Quasi as GDP percentage	World Bank
<b>smqr</b>	Saudi Arabia M2 and Quasi as total reserves ration	World Bank
<b>smqga</b>	Saudi Arabia M2 and Quasi as annual growth	World Bank
<b>nfcpl</b>	Non-fuel commodity price	IMF
<b>usdtw</b>	US Dollar trade weighted index	Federal funds reserves bank of St. Louise
<b>Snogdc</b>	Saudi Arabia non-oil GDP at current prices (total of government and private sector)	SAMA
<b>snogdd</b>	Saudi Arabia non-oil GDP Deflator 2010=100	SAMA
<b>sdiic</b>	Saudi Arabia foreign direct investment inflow in US Dollar	WDI
<b>sfdiig</b>	Saudi Arabia foreign direct investment inflow in GDP Percentage	WDI
<b>sfdioc</b>	Saudi Arabia foreign direct investment outflow in US Dollar	WDI
<b>sfdiog</b>	Saudi Arabia foreign direct investment outflow in GDP Percentage	WDI

**Table A.2: UAE dataset description from 1980-2015**

<b>Abbreviation</b>	<b>Description</b>	<b>Source</b>
<b>ugd</b>	UAE GDP constant price - percentage change	IMF
<b>ugdd</b>	UAE GDP deflation (inflation) - percentage change	WB
<b>ui</b>	UAE inflation (CPI) – percentage change	IMF
<b>uvi</b>	UAE volume of imports - percentage change	IMF
<b>uve</b>	UAE volume of exports - percentage change	IMF
<b>uca</b>	UAE current account balance – percentage of GDP	IMF
<b>uge</b>	UAE government expenditure – percentage of GDP	IMF
<b>utr</b>	UAE total reserve including gold - US\$	WB
<b>utr<sub>n</sub></b>	UAE total reserve less gold – US\$	WB
<b>ure</b>	UAE real effective exchange rate	WB
<b>une</b>	UAE nominal effective exchange rate	WB
<b>ubm</b>	UAE broad money – percentage of GDP	WB
<b>uie</b>	UAE export to GCC	Gulf investment bank
<b>u<sub>ii</sub></b>	UAE import from GCC	Gulf investment bank
<b>uu</b>	UAE unemployment – total percent of labour force	WB & IMF

**Table A.3: OMAN Dataset description from1980-2015**

<b>Abbreviation</b>	<b>Description</b>	<b>Source</b>
<b>ogd</b>	OMAN GDP constant price - percentage growth	WB
<b>ogdd</b>	OMAN GDP deflation (inflation) - percentage change	WB
<b>oi</b>	OMAN inflation (CPI) – percentage change	IMF
<b>ovi</b>	OMAN volume of imports - percentage change	IMF
<b>ove</b>	OMAN volume of exports - percentage change	IMF
<b>oca</b>	OMAN current account balance – percentage of GDP	IMF
<b>oge</b>	OMAN government expenditure – percentage of GDP	IMF
<b>otr</b>	OMAN total reserve including gold - US\$	WB
<b>otr<sub>n</sub></b>	OMAN total reserve less gold – U\$	WB
<b>ore</b>	OMAN real effective exchange rate	
<b>one</b>	OMAN nominal effective exchange rate	WB
<b>obm</b>	OMAN broad money – percentage of GDP	WB
<b>oie</b>	OMAN export to GCC	Gulf investment bank
<b>oii</b>	OMAN import to GCC	Gulf investment bank
<b>ou</b>	OMAN unemployment – total percent of labour force	WB

**Table A.4: KUWAIT Dataset description from 1980-2015**

<b>Abbreviation</b>	<b>Description</b>	<b>Source</b>
<b>kgd</b>	KUWAIT GDP constant price - percentage growth	WB
<b>kgdd</b>	KUWAIT GDP deflation (inflation) - percentage change	WB
<b>ki</b>	KUWAIT inflation (CPI) – percentage change	IMF
<b>kvi</b>	KUWAIT volume of imports - percentage change	IMF
<b>kve</b>	KUWAIT volume of exports - percentage change	IMF
<b>kca</b>	KUWAIT current account balance – percentage of GDP	IMF
<b>kge</b>	KUWAIT government expenditure – percentage of GDP	IMF
<b>ktr</b>	KUWAIT total reserve including gold - US\$	WB
<b>ktrn</b>	KUWAIT total reserve less gold – U\$	WB
<b>kre</b>	KUWAIT real effective exchange rate	?
<b>kne</b>	KUWAIT nominal effective exchange rate	WB
<b>kbm</b>	KUWAIT broad money – percentage of GDP	WB
<b>kie</b>	KUWAIT export to GCC	Gulf investment ban
<b>kii</b>	KUWAIT import to GCC	Gulf investment ban
<b>ku</b>	KUWAIT unemployment – total percent of labour force	WB

**Table A.5: BAHRAIN Dataset description from 1980-2015**

<b>Abbreviation</b>	<b>Description</b>	<b>Source</b>
<b>bgd</b>	BAHRAIN GDP constant price - percentage growth, annual	WB
<b>bgdd</b>	BAHRAIN GDP deflation (inflation) - percentage change	WB
<b>bi</b>	BAHRAIN inflation (CPI) – percentage change	IMF
<b>bvi</b>	BAHRAIN volume of imports - percentage change	IMF
<b>bve</b>	BAHRAIN volume of exports - percentage change	IMF
<b>bca</b>	BAHRAIN current account balance – percentage of GDP	IMF
<b>bge</b>	BAHRAIN government expenditure – percentage of GDP	IMF
<b>btr</b>	BAHRAIN total reserve including gold - US\$	WB
<b>btrn</b>	BAHRAIN total reserve less gold – U\$	WB
<b>bre</b>	BAHRAIN real effective exchange rate	WB
<b>bne</b>	BAHRAIN nominal effective exchange rate	WB
<b>bbm</b>	BAHRAIN broad money – percentage of GDP	WB
<b>bie</b>	export to GCC	Gulf investment bank
<b>bii</b>	import to GCC	Gulf investment ban
<b>bu</b>	BAHRAIN unemployment – total percent of labour force	WB & IMF

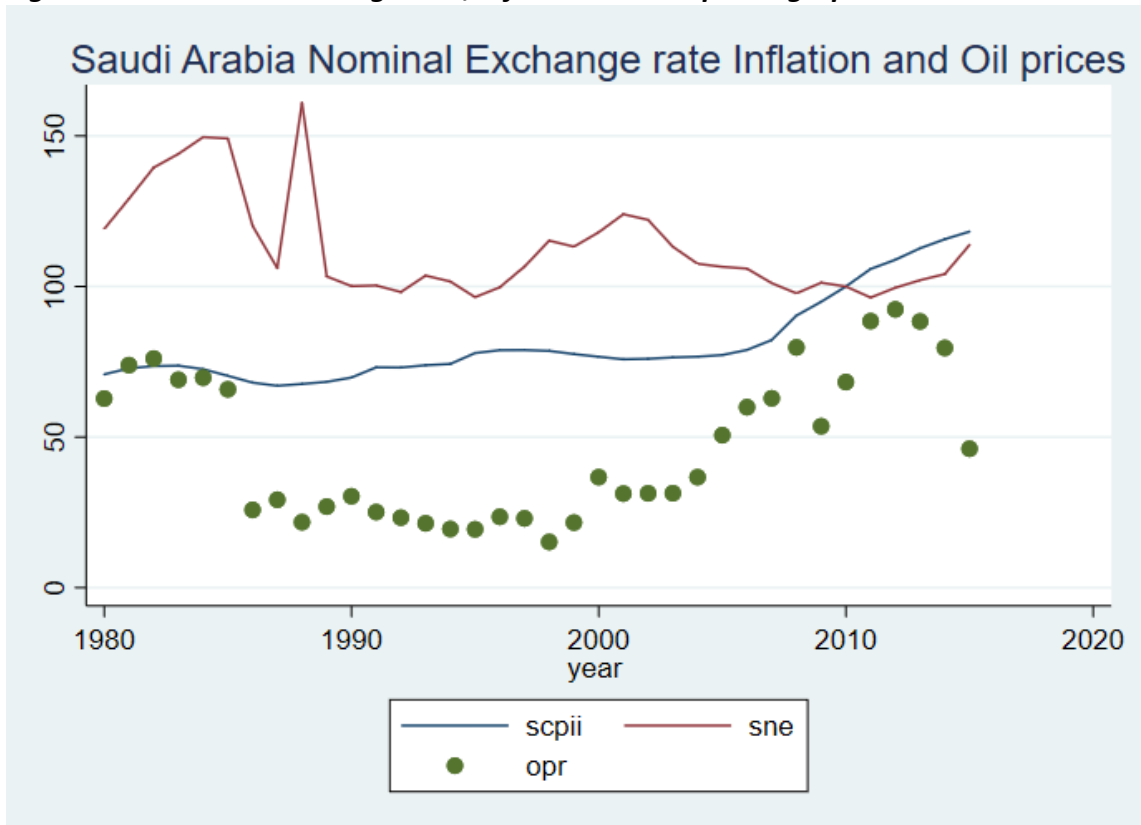
**Table A.6: QATAR Dataset description from 1980-2015**

<b>Abbreviation</b>	<b>Description</b>	<b>Source</b>
<b>qgd</b>	QATAR GDP constant price - percentage growth	WB
<b>qgdd</b>	QATAR GDP deflation (inflation) - percentage change	IMF
<b>qi</b>	QATAR inflation (CPI) – percentage change	IMF
<b>qvi</b>	QATAR volume of imports - percentage change	IMF
<b>qve</b>	QATAR volume of exports - percentage change	IMF
<b>qca</b>	QATAR current account balance – percentage of GDP	IMF
<b>qge</b>	QATAR government expenditure – percentage of GDP	IMF
<b>qtr</b>	QATAR total reserve including gold - US\$	WB
<b>qtrn</b>	QATAR total reserve less gold – U\$	WB
<b>qne</b>	QATAR nominal effective exchange rate	IMF
<b>qbm</b>	QATAR broad money – percentage of GDP	WB
<b>qie</b>	QATAR export to GCC	Gulf investment ban
<b>qii</b>	QATAR import to GCC	Gulf investment ban
<b>qu</b>	QATAR unemployment – total percent of labour force	WB



## Appendix B

**Figure B.1: Nominal exchange rate, inflation and Oil prices graph 1980-2015**



**Figure B.2: Saudi Arabia openness of trade form 1980-2015**

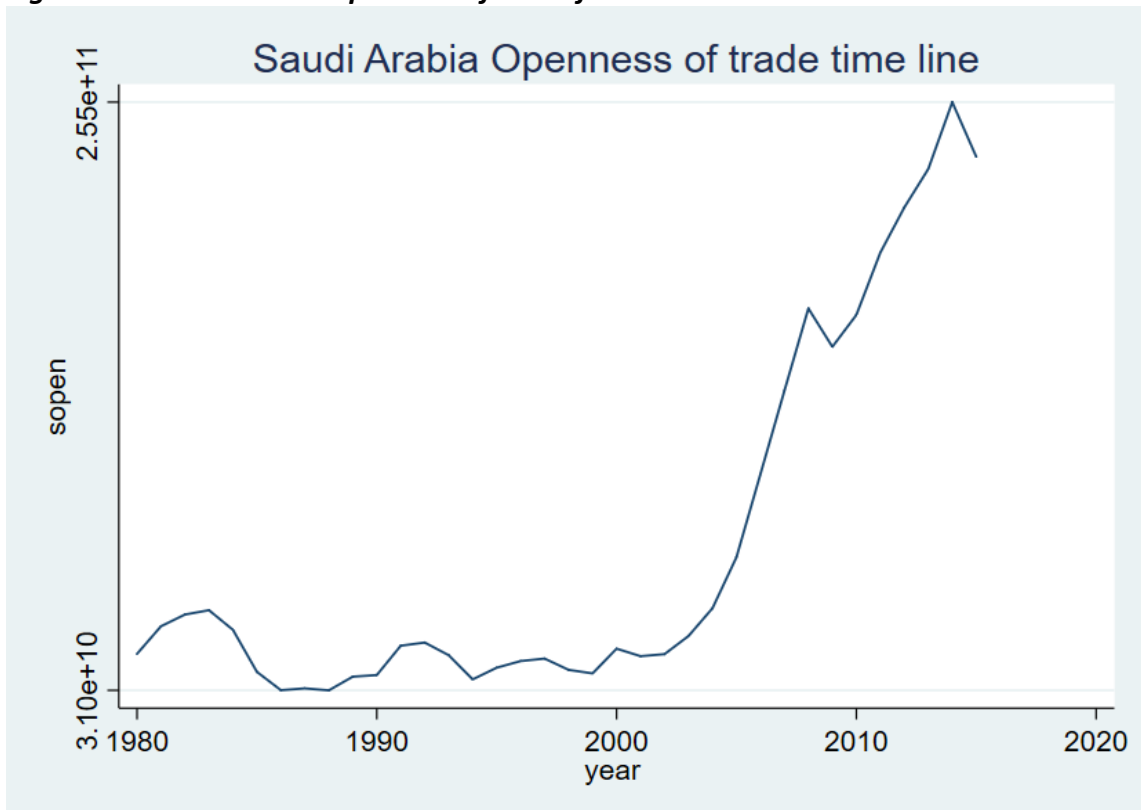


Figure B.3: Saudi Arabia government spending as % of GDP from 1980-2015

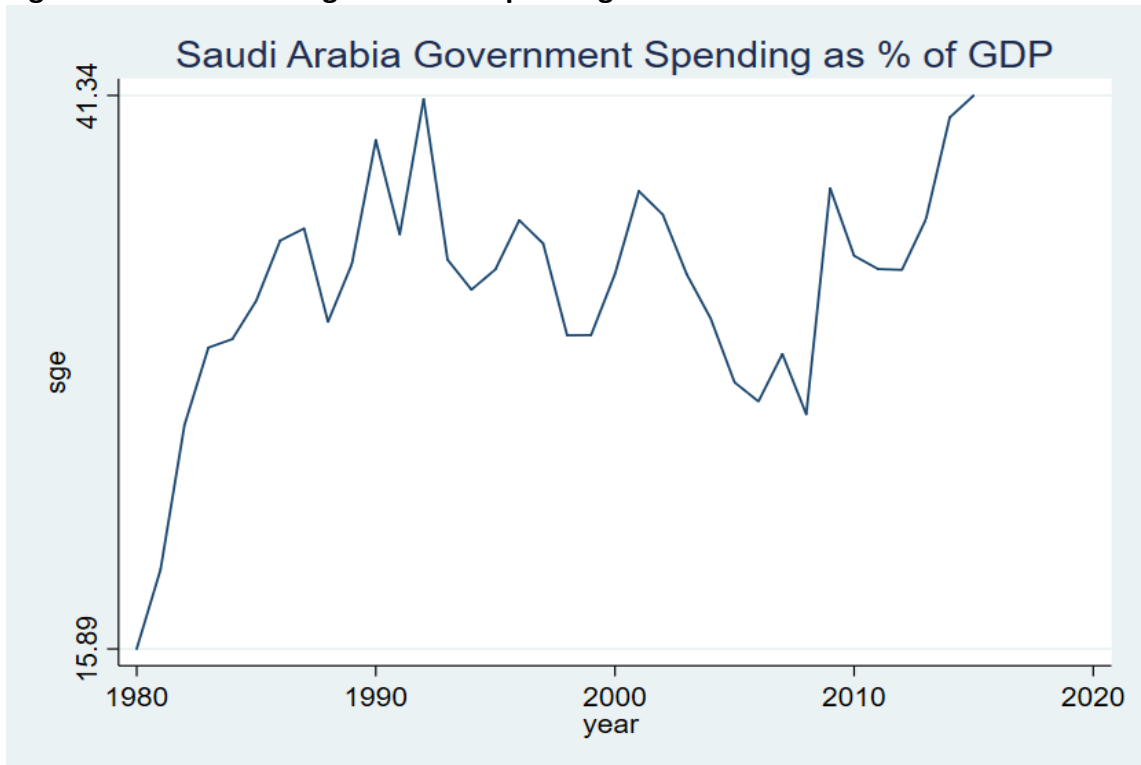


Figure B.4: Saudi Arabia interest rates form 1980-2015

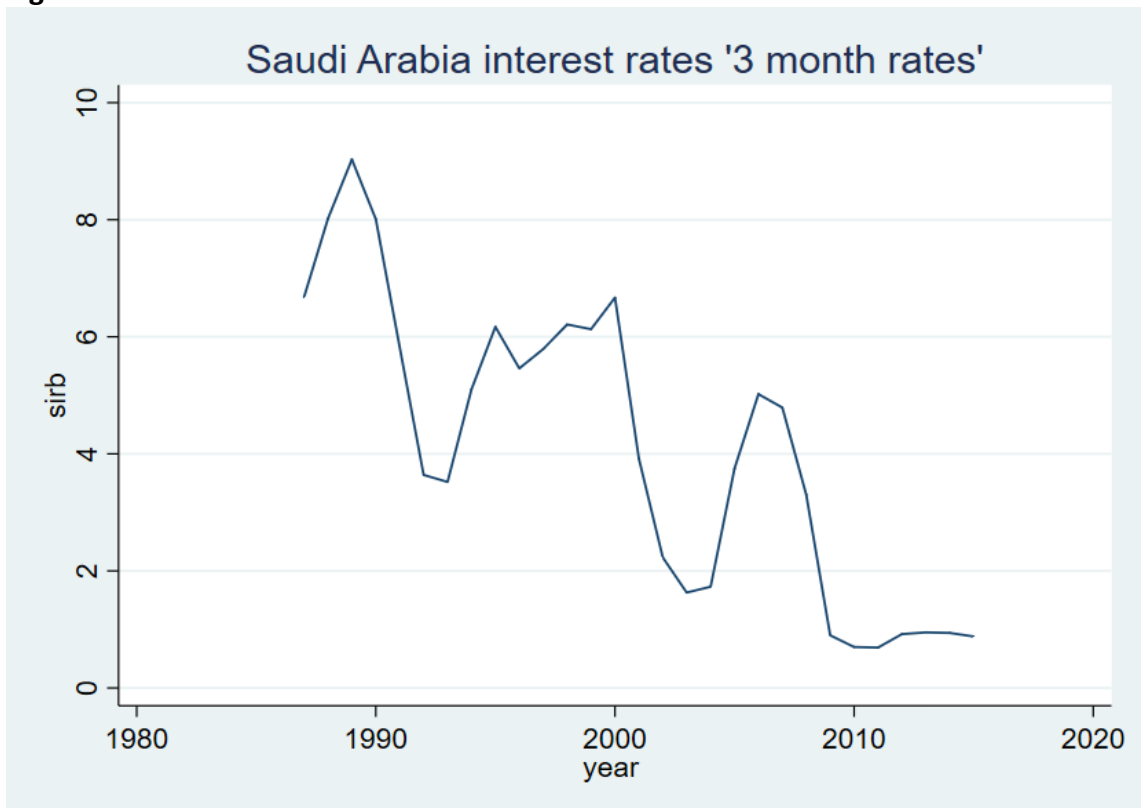
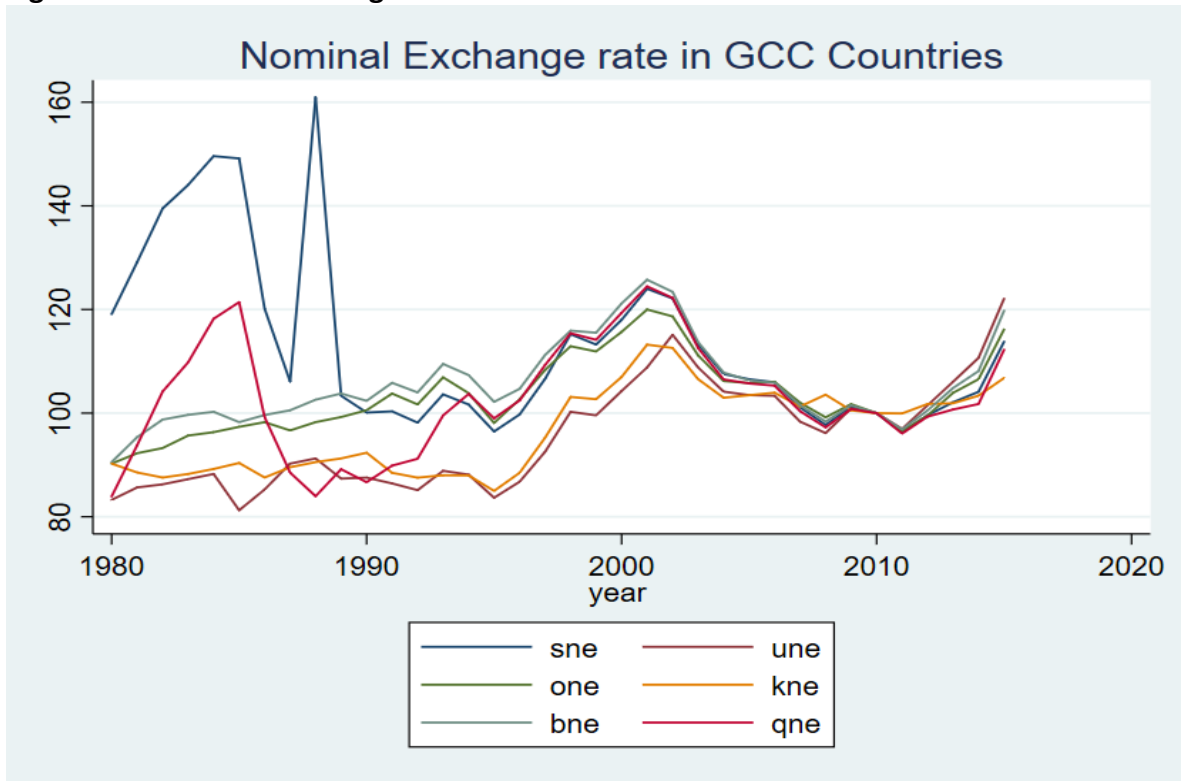


Figure B.5: Nominal Exchange rates in GCC from 1980-2015



## Appendix C

### Do file for the thesis models Analysis.

```
tsset year
// Generating variables for Exchange rate and Inflation models.
gen wusp=20.2*ucpi
gen wjp=12.8*jcpi
gen wchp=6.2*chcpi
gen mtp=wusp+wjp+wchp/3
gen dbreaks=0
replace dbreaks =1 if year==1991
replace dbreaks =1 if year==2002
gen sri=sirb-si
gen sopen=simc+sexc/sgccus
gen shimc= simc/simc+sexc
gen shemc=simc/simc+sexc
gen sged=sge/sgdd
// Generating log, 'Exchange rate and inflation models'
gen lsre= log(sre)
gen lop= log(opr)
gen lsca=log(sca)
gen lsgcus=log(sgcus)
gen lsfdiic=log(sfdiic)
gen lscpii=log(scpii)
gen lsgd=log(sgd)
gen lsgdd=log(sgdd)
gen lsi=log(si)
gen lswpi=log(swpi)
gen lopn=log(opn)
gen lsopc=log(sopc)
gen lsbmg=log(sbmg)
gen lsbma=log(sbma)
gen lsimc=log(simc)
gen lsexc=log(sexc)
gen lsmqga=log(smqga)
//Descriptive statistics for the Saudi exchange rate and oil.
sum lsre lscpii lopr lsmqga lsgcus lsopen IT EXRR
//Descriptive statistics for the Saudi inflation and Exchange rate models.
sum lscpii lsopen lsne lsbmg lsge lmtp lsopen IT EXRR lsgccus sirb
//Generating Real Exchange rate variables for G-PPP model 'USA base'
gen sareus=sne*uscpi/sacpi
gen uareus=uane*uscpi/uacpi
gen breus=bne*uscpi/bcpi
gen oreus=one *uscpi/ocpi
gen qreus=qne*uscpi/qcpi
gen kreus=kne*uscpi/kcpi
//Generating Real Exchange rate variables for G-PPP model 'SA Base'
gen uaresa=uane*sacpi/uascpi
gen bresa=bne*sacpi/bcpi
gen oresa=one*sacpi/ocpi
gen qresa=qne*sacpi/qcpi
gen kresa=kne*sacpi/kcpi
// Garneting log for GCC Real Exchange rate variables
gen lsareus=log(sareus)
gen lsare=log(sre)
gen luaresa=log(uareus)
gen lbreus=log(breus)
gen loreus=log(oreus)
gen lqreus=log(qreus)
gen lkreus=log(kreus)
gen luasesa=log(uasesa)
gen lbresa=log(bresa)
gen loresa=log(oresa)
gen lqresa=log(qresa)
gen lkresa=log(kresa)
```

```
//Descriptive Statistics for Real exchange rate gor GCC
sum lsareus luaresa lbreus loreus lqreus lkreus luasesa lbresa loresa lqresa
lkresa
```

```
// unit root test for SA Exchange rate model ADF
```

```
dfuller lsre , trend regress lags(2)
dfuller d.lsre , trend regress lags (2)
dfuller lsre , trend regress lags(1)
dfuller d.lsre , trend regress lags(1)
dfuller d.lsre , trend regress
dfuller lscpii, trend regress
dfuller lscpii, trend regress lags(2)
dfuller d.lscpii, trend regress lags (2)
dfuller lscpii, trend regress lags(1)
dfuller d.lscpii, trend regress lags(1)
dfuller lscpii, trend regress
dfuller d.lscpii, trend regress
dfuller loopr, trend regress lags(2)
dfuller d.loopr, trend regress lags(2)
dfuller loopr, trend regress lags(1)
dfuller d.loopr, trend regress lags(1)
dfuller loopr, trend regress
dfuller d.loopr, trend regress
dfuller lsmqga, trend regress lags(2)
dfuller d.lsmqga, trend regress lags(2)
dfuller lsmqga, trend regress lags(1)
dfuller d.lsmqga, trend regress lags(1)
dfuller lsmqga, trend regress
dfuller d.lsmqga, trend regress
dfuller lsgcus, trend regress lags(2)
dfuller d.lsgcus,trend regress lags(2)
dfuller lsgcus, trend regress lags(1)
dfuller d.lsgcus,trend regress lags(1)
dfuller lsgcus, trend regress
dfuller d.lsgcus,trend regress
dfuller lsopen, trend regress lags(2)
dfuller d.lsopen, trend regress lags(2)
dfuller lsopen, trend regress lags(1)
dfuller d.lsopen, trend regress lags(1)
dfuller lsopen, trend regress
dfuller d.lsopen, trend regress
// PP test
pperron lsre , trend regress lags(2)
pperron d.lsre , trend regress lags (2)
pperron lsre , trend regress lags(1)
pperron d.lsre , trend regress lags(1)
pperron d.lsre , trend regress
pperron lscpii, trend regress
pperron lscpii, trend regress lags(2)
pperron d.lscpii, trend regress lags (2)
pperron lscpii, trend regress lags(1)
pperron d.lscpii, trend regress lags(1)
pperron lscpii, trend regress
pperron d.lscpii, trend regress
pperron loopr, trend regress lags(2)
pperron d.loopr, trend regress lags(2)
pperron loopr, trend regress lags(1)
pperron d.loopr, trend regress lags(1)
pperron loopr, trend regress
pperron d.loopr, trend regress
pperron lsmqga, trend regress lags(2)
pperron d.lsmqga, trend regress lags(2)
pperron lsmqga, trend regress lags(1)
pperron d.lsmqga, trend regress lags(1)
pperron lsmqga, trend regress
pperron d.lsmqga, trend regress
pperron lsgcus, trend regress lags(2)
pperron d.lsgcus,trend regress lags(2)
```

```

pperron lsgcus, trend regress lags(1)
pperron d.lsgcus,trend regress lags(1)
pperron lsgcus, trend regress
pperron d.lsgcus,trend regress
pperron lsopen, trend regress lags(2)
pperron d.lsopen, trend regress lags(2)
pperron lsopen, trend regress lags(1)
pperron d.lsopen, trend regress lags(1)
pperron lsopen, trend regress
pperron d.lsopen, trend regress
// ARDL regressions for SA EXC
ardl lsre lscpii lopr lsmqga lsgccus lsopen, exog(IT EXRR) maxlags(2) aic
maxcombs(15000)
matrix list e(lags)
ardl lsre lscpii lopr lsmqga lsgccus lsopen, exog(IT EXRR) ec lags(2 2 1 2 2 0)
estat btest
var lsre lscpii lopr lsmqga lsgccus lsopen, exog(IT EXRR) lags(1/2)
vargranger
// unit root test for SA inflation model ADF
dfuller lscpii, trend regress
dfuller lscpii, trend regress lags(2)
dfuller d.lscpii, trend regress lags(2)
dfuller lscpii, trend regress lags(1)
dfuller d.lscpii, trend regress lags(1)
dfuller lscpii, trend regress
dfuller d.lscpii, trend regress
dfuller lsne , trend regress lags(2)
dfuller d.lsne , trend regress lags(2)
dfuller lsne , trend regress lags(1)
dfuller d.lsne , trend regress lags(1)
dfuller d.lsne , trend regress
dfuller lsbmg, trend regress lags(2)
dfuller d.lsbmg, trend regress lags(2)
dfuller lsbmg, trend regress lags(1)
dfuller d.sbm, trend regress lags(1)
dfuller lsbmg, trend regress
dfuller d.lsbmg, trend regress
dfuller lsge, trend regress lags(2)
dfuller d.lsg, trend regress lags(2)
dfuller lsge, trend regress lags(1)
dfuller d.lsge, trend regress lags(1)
dfuller lsge, trend regress
dfuller d.lsge, trend regress
dfuller lmpt,trend regress lags(2)
dfuller d.lmpt,trend regress lags(2)
dfuller lmpt,trend regress lags(1)
dfuller d.lmpt,trend regress lags(1)
dfuller lmpt,trend regress
dfuller d.lmpt,trend regress
dfuller lsopen, trend regress lags(2)
dfuller d.lsopen, trend regress lags(2)
dfuller lsopen, trend regress lags(1)
dfuller d.lsopen, trend regress lags(1)
dfuller lsopen, trend regress
dfuller d.lsopen, trend regress
dfuller lsgccus, trend regress lags(2)
dfuller d.lsgccus,trend regress lags(2)
dfuller lsgccus, trend regress lags(1)
dfuller d.lsgccus,trend regress lags(1)
dfuller lsgccus, trend regress
dfuller d.lsgccus,trend regress
dfuller sirb,trend regress lags(2)
dfuller d.sirb, trend regress lags(2)
dfuller sirb,trend regress lags(1)
dfuller d.sirb, trend regress lags(1)
dfuller sirb,trend regress
dfuller d.sirb, trend regress
// PP test

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pperron lscpii, trend regress
pperron d.lscpii, trend regress lags(2)
pperron d.lscpii, trend regress lags (2)
pperron lscpii, trend regress lags(1)
pperron d.lscpii, trend regress lags(1)
pperron lscpii, trend regress
pperron d.lscpii, trend regress
pperron lsne , trend regress lags(2)
pperron d.lsne , trend regress lags (2)
pperron lsne , trend regress lags(1)
pperron d.lsne , trend regress lags(1)
pperron d.lsne , trend regress
pperron lsbmg, trend regress lags(2)
pperron d.lsbmg, trend regress lags(2)
pperron lsbmg, trend regress lags(1)
pperron d.sbm, trend regress lags(1)
pperron lsbmg, trend regress
pperron d.lsbmg, trend regress
pperron lsge, trend regress lags(2)
pperron d.lsg, trend regress lags(2)
pperron lsge, trend regress lags(1)
pperron d.lsge, trend regress lags(1)
pperron lsge, trend regress
pperron d.lsge, trend regress
pperron lmpt, trend regress lags(2)
pperron d.lmpt, trend regress lags(2)
pperron lmpt, trend regress lags(1)
pperron d.lmpt, trend regress lags(1)
pperron lmpt, trend regress
pperron d.lmpt, trend regress
pperron lsopen, trend regress lags(2)
pperron d.lsopen, trend regress lags(2)
pperron lsopen, trend regress lags(1)
pperron d.lsopen, trend regress lags(1)
pperron lsopen, trend regress
pperron d.lsopen, trend regress
pperron lsgccus, trend regress lags(2)
pperron d.lsgccus, trend regress lags(2)
pperron lsgccus, trend regress lags(1)
pperron d.lsgccus, trend regress lags(1)
pperron lsgccus, trend regress
pperron d.lsgccus, trend regress
pperron sirb, trend regress lags(2)
pperron d.sirb, trend regress lags(2)
pperron sirb, trend regress lags(1)
pperron d.sirb, trend regress lags(1)
pperron sirb, trend regress
pperron d.sirb, trend regress
// ARDL regressions for SA inflation
ardl lscpii lsne lsbmg lsge lmtpt lsopen, exog(IT EXRR) maxlags(2) aic
maxcombs(15000)
matrix list e(lags)
ardl lscpii lsne lsbmg lsge lmtpt lsopen, exog(IT EXRR) ec lags(2 2 1 2 0 2)
estat btest
var lscpii lsne lsbmg lsge lmtpt lsopen, exog(IT EXRR) lags(2)
vargranger
// Monetary policy model
varbasic d.lsgccus d.lscpii d.lsne d.sirb, lags(1)
vecrank d.lsgccus d.lscpii d.lsne d.sirb
vec d.lsgccus d.lscpii d.lsne d.sirb, rank(1)
// unit root test for GCC RER ADF 'USA Base'
dfuller lsreus, trend regress lags(1)
dfuller d.lsreus, trend regress lags(1)
dfuller lsreus, trend regress
dfuller d.lsreus, trend regress
dfuller luareus, trend regress lags(1)
dfuller d.luareus, trend regress lags(1)
dfuller luareus, trend regress

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dfuller d.luareus, trend regress
dfuller lbreus , trend regress lags(1)
dfuller d.lbreus , trend regress lags(1)
dfuller lbreus , trend regress
dfuller d.lbreus , trend regress
dfuller loreus, trend regress lags(1)
dfuller d.loreus, trend regress lags(1)
dfuller loreus, trend regress lags(1)
dfuller loreus, trend regress
dfuller lqreus, trend regress lags(1)
dfuller d.lqreus, trend regress lags(1)
dfuller lqreus, trend regress
dfuller d.lqreus, trend regress
dfuller lkreus, trend regress lags(1)
dfuller d.lkreus, trend regress lags(1)
dfuller lkreus, trend regress
dfuller d.lkreus, trend regress
// PP test for GCC RER 'USA base'
pperron lsreus, trend regress lags(1)
pperron d.lsreus, trend regress lags(1)
pperron lsreus, trend regress
pperron d.lsreus, trend regress
pperron luareus, trend regress lags(1)
pperron d.luareus, trend regress lags(1)
pperron luareus, trend regress
pperron d.luareus, trend regress
pperron lbreus, trend regress lags(1)
pperron d.lbreus, trend regress lags(1)
pperron lbreus, trend regress
pperron d.lbreus, trend regress
pperron loreus,trend regress lags(1)
pperron d.loreus,trend regress lags(1)
pperron loreus,trend regress
pperron d.loreus,trend regress
pperron lqreus,trend regress lags(1)
pperron d.lqreus,trend regress lags(1)
pperron lqreus,trend regress
pperron d.lqreus,trend regress
pperron lkreus, trend regress lags(1)
pperron d.lkreus, trend regress lags(1)
pperron lkreus, trend regress
pperron d.lkreus, trend regress
// GCC RER ADF 'SA Base'
dfuller lsre, trend regress lags(1)
dfuller d.lsre, trend regress lags(1)
dfuller lsre, trend regress
dfuller d.lsre, trend regress
dfuller luaresa , trend regress lags(1)
dfuller d.luaresa , trend regress lags(1)
dfuller luaresa , trend regress
dfuller d.luaresa , trend regress
dfuller lbresa, trend regress lags(1)
dfuller d.lbresa, trend regress lags(1)
dfuller lbresa, trend regress
dfuller d.lbresa, trend regress
dfuller loresa, tredn regress lags(1)
dfuller d.loresa, trend regress lags(1)
dfuller loresa, trend regress
dfuller d.loresa, trend regress
dfuller lqresa , trend regress lags(1)
dfuller d.lqresa , trend regress lags(1)
dfuller lqresa , trend regress
dfuller d.lqresa , trend regress
dfuller lkresa, trend regress lags(1)
dfuller d.lkresa, trend regress lags(1)
dfuller lkresa, trend regress
dfuller d.lkresa, trend regress
// GCC RER PP test 'SA base'

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pperron lsre,trend regress lags(1)
pperron d.lsre,trend regress lags(1)
pperron lsre,trend regress
pperron d.lsre,trend regress
pperron luaresa,trend regress lags(1)
pperron d.luaresa,trend regress lags(1)
pperron luaresa,trend regress
pperron d.luaresa,trend regress
pperron d.lbresa,trend regress lags(1)
pperron lbresa,trend regress
pperron d.lbresa,trend regress
pperron loresa,trend regress lags(1)
pperron loresa,trend regress lags(1)
pperron d.loresa,trend regress lags(1)
pperron loresa,trend regress
pperron d.loresa,trend regress
pperron lqresa,trend regress lags(1)
pperron d.lqresa,trend regress lags(1)
pperron lqresa,trend regress
pperron d.lqresa,trend regress
pperron lkresa, trend regress lags(1)
pperron d.lkresa, trend regress lags(1)
pperron lkresa, trend regress
pperron d.lkresa, trend regress
// CO-integration test for G-PPP 'USA base'
vecrank lsreus luareus lbreus loreus lqreus lkreus, trend(trend) notrace max ic
levela
// CO-integration test for G-PPP 'SA base'
vecrank lsre luaresa lbresa loresa lqresa lkresa, trend(trend) notrace max ic
levela

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