The Impact of a Fixed Exchange Rate Regime on Growth and Volatility in an Oil-dependent Economy

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Honors Thesis submitted in partial fulfillment of the requirements for Graduation with Distinction in Economics in Trinity College of Duke University.

Duke University
Durham, North Carolina
2018

Acknowledgements

We would like to thank our primary advisor Professor Lori Leachman of Duke University for encouraging our passion, and for her continued support and intellectual input throughout this process. We would also like to thank Professor Grace Kim for the insightful feedback and early guidance she provided throughout the Honors Thesis seminar. Last, but not least, we would like to thank our families for their indispensable support throughout our undergraduate careers, despite being overseas. Forever indebted to Osman Ali Malik, Sahar Atif Ibrahim, Bandar Alsaadi, and Fairooz Abdullah Alharbi.

Abstract

This study examines the relationship between the fixed exchange rate regime, economic growth, and output volatility in oil-producing Saudi Arabia over the post-Bretton Woods period (1973–2016). We assess the implications of the current exchange rate regime on macroeconomic and growth performance, and evaluate its sustainability in the context of oil-dependency and market dynamics. We develop and employ a theoretical framework and empirical specification based on previous literature to find that for Saudi Arabia, the fix is associated with faster growth and lower output volatility. We believe the result is primarily driven by the credibility of the fix in terms of establishing a strong nominal anchor and monetary policy framework.

JEL classification: E42; F31; F36; F41; O53

Keywords: exchange rate regimes; macroeconomic stability; oil-dependency; growth performance; output volatility

Contents

1 Introduction

The Nixon shock of 1971 where the United States terminated the convertibility of the U.S. dollar to gold marked the end of the Bretton-Woods system. Since then, assessing the performance of economies that have adopted different exchange rate regimes has been a primary focus in international economics and macroeconomics research (Calvo, & Reinhard, 2002; Frankel, 2003; Husain et al., 2005; Harms, & Kretschmann, 2007). These studies discuss the relative advantages of various exchange rate systems, and their potential macroeconomic, and economic growth costs and benefits. In addition, the determinants of exchange rate movements have been of central focus given the exchange rate volatility experienced by both More Economically Developed Countries (MEDCs) and Less Economically Developed Countries (LEDCs). As a result, evaluating the effects of exchange rate volatility on economic activity is an important challenge that has dominated policy debates in emerging, developing, and developed markets.

The abrupt fall in the value of the Thai Baht in 1997 is widely recognized as the precipitating event which reinvigorated the modern debate over the optimal exchange rate system. From the 1980s until the Baht was allowed to float in July 1997, Thailand pegged the nominal exchange rate of the Baht to the U.S. dollar. Before the collapse, Malaysia, Indonesia, South Korea, and the Philippines pegged or placed high weights on the U.S dollar in determining the nominal value of their local currencies. Whether or not the collapse was a result of pure speculation or deteriorating fundamentals, its economic repercussions were both widespread and severe, prompting the Asian financial crisis. These exchange rate regimes that adopted some form of fixing contributed to the stability of the real exchange rate (RER) in East Asian countries by maintaining the domestic price of tradable goods relative to foreign prices. This allowed for macroeconomic discipline (Sazanami, & Yoshimura, 1999). However, this eventually led to a currency crisis, which puts into question the efficacy of a fixed exchange rate regime relative to a free float system.

Several economies have since opted for a high degree of exchange rate variability in order to establish a scope for independent monetary policy. This, coupled with global capital integration and cross-border mobility, has not only increased exchange rate volatility, but is also responsible for introducing currency wars, as various economies institute and manage monetary and exchange rate policy with the objective of boosting export competitiveness (Kandil, & Nandwa, 2015). In turn, discussion has shifted to economic performance under real exchange rate (RER) stability, optimal exchange rate alignment with underlying fundamentals, and optimal currency areas (OCAs). This is because exchange rate volatility is directly transmitted to the domestic economy, ultimately impacting international competitiveness, diversification, the trade balance, inflation, as well as financial stability given that exchange rate fluctuations are

accompanied by interest rate changes (Cowan, & De Gregorio, 1997; Edwards, 2002; Aydin, 2010).

The debate over the optimal exchange rate regime for oil-producing emerging market economies has recently resurfaced, owing to the extreme volatility in crude oil prices, and the appreciation of the U.S. dollar. This is of particular relevance to oil-exporting economies in the Gulf Cooperation Council (GCC) because of their propensity to peg the nominal value of their currency to the U.S. dollar; the currency of denomination for Brent oil in international markets. The severe decline in oil prices that began in 2014 has so far persisted, with Brent crude expected to trade in the $60/bbl. region for the foreseeable future. In U.S. dollar terms, the price of oil plummeted to approximately 50% of the price that prevailed for much of the past decade. To put this in perspective, GCC countries are overly dependent on hydrocarbon receipts for revenue and fiscal spending, and accordingly, have suffered in light of unfavorable fluctuations in the international price of oil. Elbadawi and Gelb (2010) show that a 30–35% shock to the price of oil can cause an income shock that can be as high as 6% of GDP in an economy where oil constitutes 20% of GDP. Oil constitutes a much greater percentage of GDP in oil-producing Arab economies. In Saudi Arabia, on average, oil accounts for 55% of GDP, and in the United Arab Emirates (UAE), it accounts for 37% of GDP.

Moreover, oil priced in U.S. dollars is the main source of government revenue in most GCC oil-dependent countries. For example, in 2011, oil revenues accounted for 88.7% of total fiscal revenue for Saudi Arabia and 75.9% of total fiscal revenue for the United Arab Emirates (UAE). In these respective countries, oil revenues account for almost the entirety of total fiscal revenues. Accordingly, these economies are expected to have significant fiscal deficits given the plunge in international oil prices. Both of these countries adopt the most rigid pegged exchange rate regime among the Gulf Cooperation Council (GCC) countries. Despite tightened fiscal spending, both Saudi Arabia and the UAE have thus far retained their peg, primarily due to their foreign currency reserves and sovereign wealth funds. Unlike Saudi Arabia, which will be the country of focus throughout this paper, the UAE has managed to diversify and develop other sectors, and so is better equipped to withstand volatility in oil prices. Naturally, more diverse economies with sufficient financial buffers and more flexible exchange rate regimes are better able to endure shocks caused by lower oil prices, and cap the spillover effect on non-energy sectors (Kandil, & Nandwa, 2015). Naturally, for these countries, cyclical volatility due to the excessive dependency on oil revenues is expected. However, its effects can, arguably, be mitigated by the implementation of appropriate fiscal and monetary policies, and appropriate exchange rate regimes (Frankel, 2010).

The inability to cope with volatility produced by fluctuations in the oil prices is argued to be the main reason behind the macroeconomic instability and post boom growth decline that oil-dependent economies exhibit (Elbadawi, & Kaltani, 2008). Like most oil-dependent GCC economies, Saudi Arabia adopts pro-cyclical fiscal policies, ramping up

spending during oil price booms. However, lack of diversification and rigid exchange rate systems has left these economies susceptible to severe fiscal withdrawal and economic downturn during periods of lower-than-expected oil revenues. Accordingly, economic diversification to counter the effect of movements in oil prices should be at the forefront of macroeconomic policy in oil-dependent countries, particularly in light of the presence of fixed exchange rate regimes. These economies, in theory, should strive for the ability to bolster domestic spending, especially during periods of low oil prices. Thus far, oil-dependent emerging market economies in the GCC have not been able to implement effective stabilization policies or curb the macroeconomic effects of oil-cyclicality. In addition to limited diversification, there is evidence to suggest that the inflexibility in exchange rate has been a key factor in the failure of counter oil-cyclicality efforts (Kandil, & Nandwa, 2015).

Moreover, pegging to the U.S. dollar entails the importation of U.S. monetary policy, which could be detrimental to the domestic economy if the direction of monetary policy in the U.S. moves in the opposite direction to oil prices. This was the case following the Great Recession, which stimulated expansionary monetary policy via quantitative easing in the United States, amid record high Brent crude prices. Accordingly, this elevated inflationary pressures in oil-dependent economies that fix the domestic currency to the U.S. dollar. Lately, the Federal Reserve has adopted a more hawkish stance, hiking interest rates three times in 2017, and once thus far in 2018, marking the sixth rate hike since the Federal Open Market Committee began raising the benchmark funds rate in December 2015. This, coupled with the oil slump, presents renewed challenges for GCC economies, given the pro-cyclicality dictated by the fixed exchange rate regimes.

From a Saudi perspective, pegging to the U.S. dollar is analogous to forming a currency union with the United States, which brings into relevance the theory of OCAs. Accordingly, we begin our analysis by considering the structural alignment between Saudi Arabia and the United States in order to theoretically assess the appropriateness of the fix.

The implications of different exchange rate regimes on inflation and policy credibility have received much attention, however, less work has been done on the impact on economic growth and output volatility, partially due to the fact that nominal variables are considered to be unrelated to growth in the long-term. Even when the economic literature does suggest a link between exchange rate regime and growth, the sign of the relationship is often ambiguous, even as is relevant to oil-dependent emerging market economies. Some of the literature supports the notion that fixed exchange rate regimes lead to higher growth, while the other camp argues that flexible exchange rate regimes are better equipped to support sustainable growth (Levy-Yeyati, & Sturzenegger, 2003).

Currently, the hard peg adopted by Saudi Arabia does not allow flexibility in the exchange rate and therefore the entire effect of oil price fluctuations is transmitted to the domestic economy. This may potentially hinder economic growth because it entails

slowdowns in low oil price environments, and inflation when prices are high. On the other hand, the fixed exchange rate may remove uncertainty and thereby stimulate investment and international trade, ultimately, increasing growth. Whether a significant link between exchange rate regime, growth, and output volatility exists is a matter that can only be resolved through empirical analysis. Accordingly, the purpose of this paper is to address this issue by assessing the efficacy of the fixed exchange rate regime in terms of real GDP per capita growth and volatility in oil-dependent Saudi Arabia over the post-Bretton Woods period (1973–2016).

Contrary to what may have been inferred from the literature, we find that, in fact, the firm fix exchange rate regime in Saudi Arabia is associated with higher real GDP per capita growth. In addition, our tests on the impact of a fixed exchange rate regime on output volatility confound the theoretical framework and standard view that supports the presence of a negative link between output volatility and exchange rate flexibility. In the case of Saudi Arabia, we find a negative yet significant association between the fixed exchange rate regime and output volatility. In that regard, we suspect that our findings are driven by the fact that Saudi Arabia, in particular, benefits from strong credibility in terms of the nominal anchor and monetary policy framework that the U.S. dollar peg establishes.

It is important to note here that while we do revisit previous findings in the growth and output volatility literature to either substantiate or highlight a significant difference in our results, we do not intend on assessing the sensitivity of previous findings to different combinations of independent variables or to the addition of the firm fix dummy. Instead, we draw on those previous findings to obtain a reasonable set of controls that are used to test the impact of the fixed exchange rate regime on growth and output volatility, and its significance.

We improve upon previous work in two main ways. First, we adjust the existing models to cater for oil-dependent emerging market economies by incorporating variables such as oil rents and reserves as a percentage of GDP, as well as personal remittances, which are important yet specific to the nature of labor markets in GCC economies. Also, while previous models use panel or cross-sectional datasets across numerous countries, our model allows for country-specific analysis primarily because of the inclusion of a fixed exchange rate dummy variable in the context of time-series data. The inclusion of a firm fix dummy variable is possible because there exists a period in our sample in which Saudi Arabia did not implement a hard peg (1973 to mid-1986). Although our empirical assessment section focuses on Saudi Arabia, our model has broader applicability to other oil-dependent economies, particularly those in the GCC. Second, our model specification builds on growth and output volatility literature that exists, focusing on the post-Bretton Woods period and expanding the sample size to include data points up to 2016, covering the most recent oil cycle slump. Moreover, for Saudi Arabia, assessing the efficacy of the current fixed exchange rate regime in terms of its impact on the macro-economy and real

per capita GDP growth and volatility is important for two main reasons. Firstly, the government should be able to implement policies that aim at safeguarding the non-oil economy from shocks that result from oil price volatility. Secondly, oil is a finite resource and therefore exporting countries should adopt exchange rate regimes that aid the development of other sectors and steer the economy away from a cycle that is purely dependent on oil receipts.

The remainder of this paper is organized as follows. Section 2 provides a comprehensive literature review supplemented by relevant Saudi-specific factors and metrics. Section 3 describes the data and displays a first-run analysis. Section 4 presents the baseline growth regressions and discusses possible interpretations. Section 5 details a theoretical framework for output volatility in the context of a fixed exchange rate regime, before specifying the output volatility regressions and discussing the results. Section 6 discusses some of the alternative exchange rate regimes open to oil-dependent economies including Saudi Arabia given the future outlook, and concludes.

2 Literature Review

Our main reference comes from the several empirical papers on growth and volatility determinants, from which we adapt our baseline empirical specification (e.g. Levy-Yeyati, & Sturzenegger, 2003; Levine, & Renelt, 1992; Barro, & Martin, 1995, Rolnick, & Weber, 1997; Ghosh et al, 1997; Ghosh et al, 2000; Bugamelli, & Paterno, 2009; Kandil, & Nandwa, 2015). Also relevant is the limited literature that directly assesses the relationship between growth/output volatility and different exchange rate regimes. Amongst this group of papers, Mundell (1995) looks at the growth of industrialized economies before and after Bretton Woods, concluding that the Bretton Woods era was characterized by faster average growth. Rolnick and Weber (1997) assess the long-term historical growth under fiat standards relative to commodity standards (notably, gold standard), finding output growth to be higher under the former. Ghosh et al. (1997) run growth regressions controlling for exchange rate regime, they find weak evidence to suggest that growth rates are lower under fixed relative to floating exchange rate regimes, but no systematic link. However, Ghosh et al. (2000) also assess hard pegs under currency boards and finds that economies with this system grow faster. Levy-Yeyati and Sturzenegger (2003) examine the relationship between exchange rate regime and output growth for a sample of 183 countries, and find that for developing countries, more rigid exchange rate regimes are associated with slower growth. However, the exchange rate regime does not appear to impact growth in industrial countries. Moreover, for the nonindustrial countries, they find a negative link between exchange rate flexibility and output volatility. Also, the inability of exchange rate adjustments under a peg, along with price rigidity, may arguably result in price distortions and resource misallocation when the economy experiences real shocks. This rationale underpins the view that fixed

exchange rate regimes induce higher output volatility in much of the literature on exchange rate regimes and output volatility (Eichengreen, 1994; Ghosh et al., 1997; Broda, 2001).

The need to defend a fix in face of a negative external shock also implies significant costs. While the precise implication of these mechanisms in terms of growth is not obvious, there is some evidence, both empirical and theoretical, of a positive link between fixed exchange rate regimes and output volatility. As such, we borrow a theoretical framework for the relationship between output volatility and fixing from Furceri and Karras (2007), which better informs our output volatility regressions despite confounding results. Finally, in one of their three regressions, Kandil and Nandwa (2015) assess the impact of exchange rate regime on growth for a group of oil-dependent Arab economies. They group the countries based on whether or not they are a part of the GCC, and the relative rigidity of their exchange rate regime. Ultimately, using panel data for the sample period 1990–2009, they find that subscription to a more flexible exchange rate regime is not significant in explaining real per capita GDP growth.

2.1 Fixed vs. Flexible

In order to assess the practical efficacy of the pegged exchange rate regime in Saudi Arabia, we must first specify alternate exchange rate regimes, establish a classification system, and discuss the theoretical advantages and disadvantages of fixed vs. flexible systems. There is an entire spectrum of regimes that lie between the most flexible to the most rigid fixed exchange rate systems. Frankel (2003) groups the regimes into three broad categories; floating corner, intermediate, and firm fix corner. We analyze the firm fix corner in the context of rigid currency boards, given that is the regime currently adopted by Saudi Arabia. In addition, we consider the floating corner given the history of exchange rate regimes in Saudi Arabia discussed in section 2.4, specifically, in light of the fact that the country did at some point adopt a flexible system, which is assumed to be the base in the regressions that incorporate a firm fix dummy variable.

Although less relevant, it is worth noting that each classification within the intermediate regime can itself range from the more flexible to the more rigid fixed side. For a crawl, this depends on the speed at which the crawl is enacted. For the basket, the classification depends on how many currencies are in the basket and their respective weights. For the adjustable peg, the classification depends on the size of shock that would trigger a change in parity. Moreover, the characteristics of the intermediate regimes are often mixed, for example, basket-band-crawl (BBC) is a single regime that incorporates features of all three. Frankel (2003) separates the boundaries between floating and intermediate, and intermediate and fixed, according to the following classification scheme. All managed floats are considered intermediate regimes if and only if there exists an explicit target at which the central bank interferes. A fixed exchange rate is classified

as firm fixed if and only if it is an institutional commitment, or currency board, rather than a declared policy. In the case of Saudi Arabia, the fixed exchange rate regime instituted in 1986 qualifies as a firm fix.

An evaluation of the pegged exchange rate regime in a commodity-dependent country like Saudi Arabia, and the prospect of alternative more flexible regimes, must start by considering the classic theoretical advantages of each. We discuss two main advantages to fixing, namely; provision of a nominal anchor to monetary policy, and stimulus for trade and investment as it decreases uncertainty. Also, three main advantages to a flexible exchange rate are discussed, namely; the ability to pursue independent monetary policy, the exchange rate working as an automatic mechanism of adjustment to trade shocks, and the ability to collect seigniorage and provide lender of last resort services.

Relative to the other advantages of fixed regimes, economists focus most on the fact that fixing provides a nominal anchor for monetary policy. This can be credited to the fact that there can be favorable inflationary bias when monetary policy is fully transparent. By pegging the exchange rate, central banks fighting inflation achieve greater credibility. Market agents who set wages and prices in the economy will act with the expectation of low future inflation because the fixing no longer allows the central bank to pursue independent monetary policy, and in particular eliminates the ability to print money. For any given output level, this will result in a lower level of inflation. This argument assumes that the country pegs to a hard currency that benefits from steady monetary control, which is the case with the U.S. dollar peg.

Finally, evidence from econometric studies by Parsley and Wei (2001), Frankel and Rose (2002) suggest that exchange rate variability in developing countries does impact trade. It is argued that fixed regimes do not exhibit exchange rate volatility, thus, there is more certainty relative to flexible regimes. Hence, fixing would encourage international trade and investment. Theoretically, there are two rebuttals to this claim. First, the fact that exchange rate volatility is just a reflection of variability in economic fundamentals, thus, suppressing exchange rate variability will cause the effect to appear elsewhere, specifically, in the price level. Second, borrowers and lenders, importers and exporters, can hedge the risk of uncertainty by utilizing forward markets, but incur costs in doing so. However, exchange rate volatility is not always related to changes in macroeconomic fundamentals. Additionally, Saudi Arabia has thinly traded forward markets because market expectations are such that the nominal value of the currency will remain due to the credibility of the firm fix.

The primary advantage to exchange rate flexibility is that a country retains its ability to pursue independent monetary policy. In case of an economic disturbance, such as a fall in demand for goods produced or a rapid increase in the price level, the government would benefit from the ability to make monetary adjustments geared at steering the economy away from recession. However, under a fixed exchange rate, no arbitrage in

interest rates entails the diversion of monetary policy to dealing with the balance of payments. In the extreme case of firm fixing under the European Monetary Union, each individual country forfeits its ability to affect its internal balance. Fixing therefore requires that the local interest rate be dependent on the interest rate in the foreign country. In recession, the domestic economy cannot effectively expand the money supply; any new money injected will simply flow out through a balance of payments deficit. Recessions will persist until an automatic mechanism of adjustment reverses the adverse circumstances, which may take time. Floating, however, allows the country to swiftly respond through monetary expansion and currency devaluation. This has the effect of increasing the demand for domestic products, with employment and output returning to desired levels faster relative to economies that fix their currency and rely on automatic mechanisms. Flexible-rates not only allow for changes in monetary policy, but also characterize a mechanism that automatically adjusts to trade shocks. Adverse terms of trade shifts are accompanied by depreciation, thus, the rate automatically adjusts to account for the real depreciation that must occur during periods of unfavorable export markets.

Additionally, under floating systems, the government may institute an independent central bank, which is necessary to retain seigniorage and the lender of last resort ability, both of which are important advantages. Essentially, the central bank is able to lend or bail out other banks because of its ability to create money when necessary. Under a firm fix, this is not possible. It is worth noting that other mechanisms, such as insurance pools may be pursued to fulfil the lender of last resort role. However, the counterargument often cited is that the central bank of a fixing country does not need the ability to be a lender of last resort, as long as foreign banks are permitted to operate (Edwards, 2002). To the extent that the banking system consists of foreign banks, foreign parents of the subsidiaries will always bail them out in times of crisis. Case studies on the collapse of Argentina's currency board may be used to evaluate this argument. Argentina maintained a highly dollarized currency board, however, in 2001, when faced with recession, foreign banks did not bailout their subsidiaries. As Edwards (2002) points out, contrary to what supporters of firm-fixed regimes have argued, the case of Argentina disproves the claim that a banking system dominated by foreign banks will not experience a run on deposits. Ultimately, this led to catastrophic consequences, with Minister Cavallo implementing exchange controls and a freeze on deposits. That being said, it is important to note that overvaluation and crashes can occur under both fixed and flexible exchange rate regimes.

2.2 Merits of Saudi Peg

To put this into perspective, Saudi Arabia has been adamant about fixing for the several merits that it provides, some of which are specific to the structure of the economy in Saudi

Arabia. Firstly, bearing in mind their relatively flexible labor market and strong fiscal position, the fixed regime has helped the economy avoid nominal shocks from geopolitical risks (Khan, 2009; Elbadawi, & Gelb, 2010). As a result, fluctuations in oil prices have long been the only source of fluctuations in domestic liquidity. In terms of flexibility in labor markets, the high share of foreign labor, which is characterized by short-term contracts has allowed for the ability to align wages/salaries with the business cycle. Ultimately, this labor market flexibility mitigates the unfavorable effects of fixing on competitiveness.

In particular, in Saudi Arabia, as per 2011 data, foreign labor made up 90% of the workforce in the non-oil private sector, with nationals constituting a mere 50% of the overall labor force. Fasano and Goyal (2004) attribute this segmentation to the "implicit" guarantee of employment to nationals in the public sector, which is characterized by relatively higher wages, better job security, and more generous allowances. The largest proportion of Saudi employees is in the public sector, with nationals constituting 92% of the public labor force, as shown in Appendix 3. The average monthly wage in the government and public enterprises sectors are significantly higher than salaries in the private-sector, as shown in Appendix 4. This difference is attributed to the open access of a highly elastic supply of foreign labor at internationally competitive prices for private firms (Fasano, & Goyal, 2004).

Secondly, the dollar peg has provided Saudi Arabia with a universally understood and credible anchor for monetary policy. This has helped reduce speculative risks that would arise in relation to the direction of exchange rate movements, which would be recognized through changes in oil prices. Thirdly, pegging to the U.S. dollar has mitigated potential fluctuations of income and stabilized earnings from U.S. denominated financial wealth pools, such as the Sovereign Wealth Fund (SWF), most of which are invested in international markets abroad. Fourthly, from an institutional and administrative standpoint, maintaining the peg does not require strong institutions which would otherwise be necessary in order to implement independent monetary policy and manage domestic liquidity in face of shocks. Finally, limited domestic capital markets and shallow credit market, coupled with the limited ability of market interest rates to impact credit, has made the peg beneficial in ensuring macroeconomic stabilization (Khan, 2009).

Despite the merits that the economy of Saudi Arabia has secured as a result of the dollar peg, the transmission of inflation to the economy during periods of high oil prices and weak dollar, coupled with increasing global financial liberalization, has arguably posed a challenge to the long-term benefits of fixing to the U.S. dollar. Firstly, the dollar peg implies that adjustments to the real exchange rate occur through inflation since a new equilibrium cannot be achieved by adjustments to the nominal exchange rate. This is illustrated in Figure 1 wherein inflation in Saudi Arabia mirrors the trend in U.S. 3-months Treasury bills (rate), as expected. Kandil and Nandwa (2015) argues that this

results in a higher propensity to import and failure to boost competitiveness and spur diversification into non-energy sectors. Secondly, the peg implies that interest rates in Saudi Arabia cannot be at variance with U.S. interest rates, which again, implies the importation of monetary policy from the U.S. even at times of incongruent business cycles.

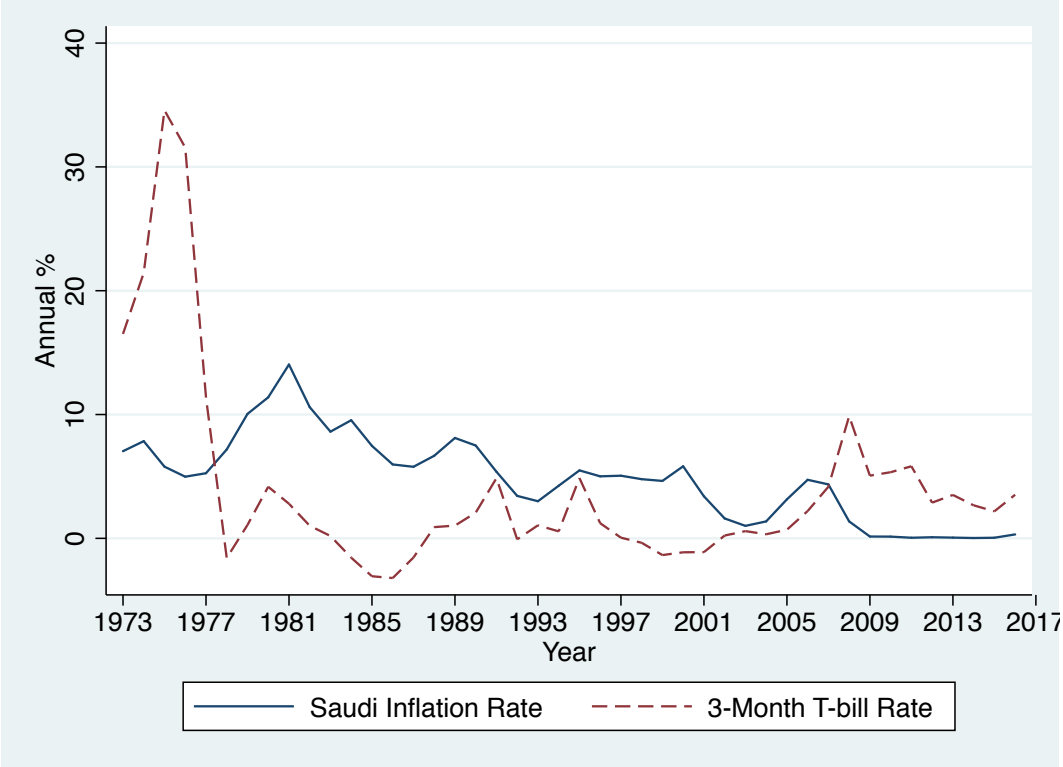

Figure 1: Saudi Arabia inflation and three months' T-bill rate, 1973–2016

2.3 Optimum Currency Areas (OCAs)

Whether the advantages of fixing regimes outweigh the advantages of floating regimes depends on the economic dynamics of the specific country in question. Currently, Saudi Arabia adopts a hard fix to the U.S. dollar; $1 will always purchase ~3.74 Saudi Arabian Riyals (SAR), and ~3.75 SAR will always purchase $1, bearing in mind the bid-offer spread. The traditional criteria used to assess the efficacy of fixing the domestic currency to a foreign currency is whether or not the two countries satisfy the conditions to form an Optimum Currency Area (OCA). In this particular case, whether Saudi Arabia has an integrated business cycle with the United States. Robert Mundell (1961) introduced the theory of optimum currency areas, which is the innovative idea that countries may be better off by having a single currency, as opposed to independent currencies. This optimum currency area is dependent on the countries having similar economic structures and business cycles, high factor mobility, openness, and diversification. Mundell postulates that if these requirements are met, the economy need not depend on the

nominal exchange rate for macroeconomic adjustment, and economic welfare is maximized by the adoption of a common currency due to lower transaction costs. Since then, academic research has focused extensively on the assessment of the preconditions, evaluation of whether different countries should form a common currency, and cost-benefit analyses. Notable yet early developers of the theory include McKinnon (1993), who focused on the importance of openness, and Kennen (1969), who stressed the importance of diversification.

Mundell (1961) emphasized the importance of structural convergence and factor mobility, with his argument best described through example. Take Saudi Arabia and the United States. If both countries experience similar shocks, then similar macroeconomic policies will be adopted. If both countries experience recession, characterized by low demand, high unemployment, and low growth, both would adopt monetary easing policies. Analogously, if both countries face a common shock (lower oil prices affecting oil revenue, or a decrease in demand for exported goods) that leads to deficits in the balance of payment, both countries would similarly favor currency devaluation, and other monetary/fiscal measures to restore the economy. If both countries experience symmetric shocks, then the two countries would desire similar policies whether implemented independently or together, thus, they could benefit from a common currency without the drawbacks of fixing.

If both countries encounter asymmetric shocks, then a common currency is problematic. Firm-fixing is analogous to implementing a common currency. Consider country A and country B. If demand shifted from A to B, then country A would experience unemployment while country B would experience inflation. Under a common currency, or fixing, this is problematic because monetary policy cannot simultaneously stabilize both unemployment in country A and inflation in country B. Mundell argues that this could only be resolved through high factor mobility, particularly labor mobility. The rationale is that high factor mobility entails that capital and labor can move to country B, where there is more demand. This lowers unemployment in country A, and curbs inflation in country B because more capital and labor entails more production. However, if factor mobility is low, an independent flexible exchange rate is more appropriate. In this case, changes in the nominal exchange rate will correct disturbances in the balance of payments. Moreover, the central bank in country A could combat unemployment by lowering interest rates. In summation, Mundell's principle requires, (1) structural convergence indicating symmetric shocks, and (2) high factor mobility, to the extent that it can restore equilibrium when asymmetric shocks arise. Whether Saudi Arabia experiences symmetric shocks with the United states, and whether the two countries benefit from high factor mobility, is questionable. Figure 2 displays Saudi Arabia GDP and U.S. GDP from 1973–2016, while Figure 3 shows Saudi Arabia GDP growth and U.S. GDP growth. As expected, both graphs demonstrate periods of business cycle misalignment between Saudi Arabia and the U.S.

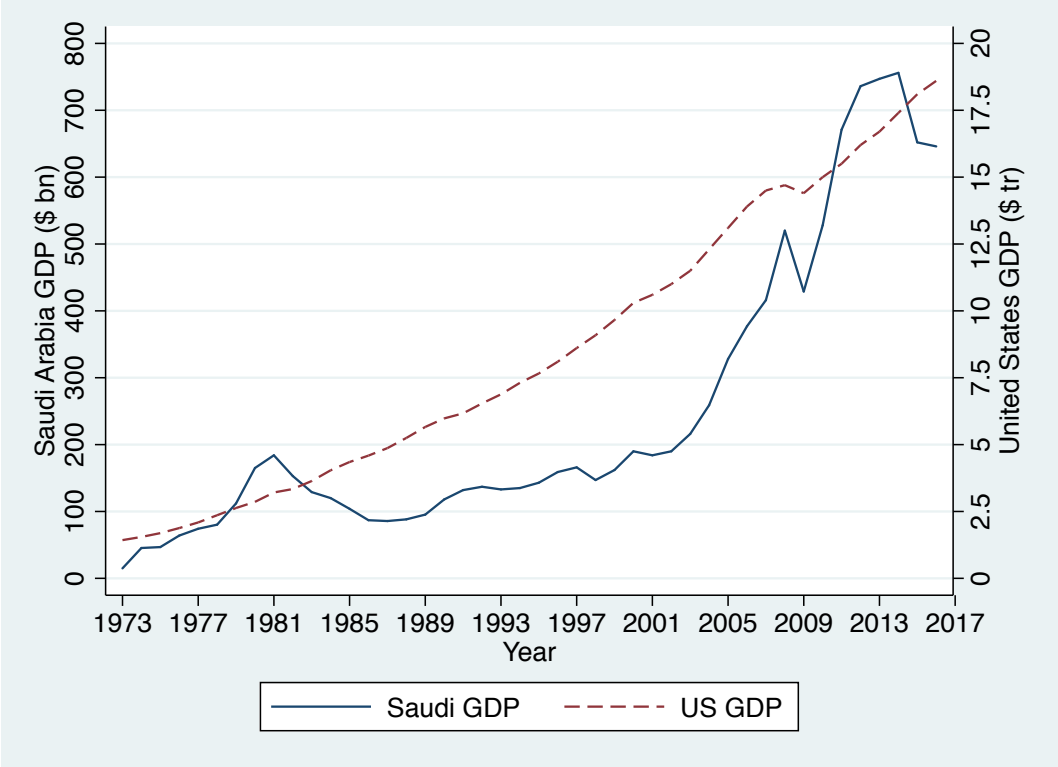

Figure 2: Saudi Arabia GDP and U.S. GDP, 1973–2016

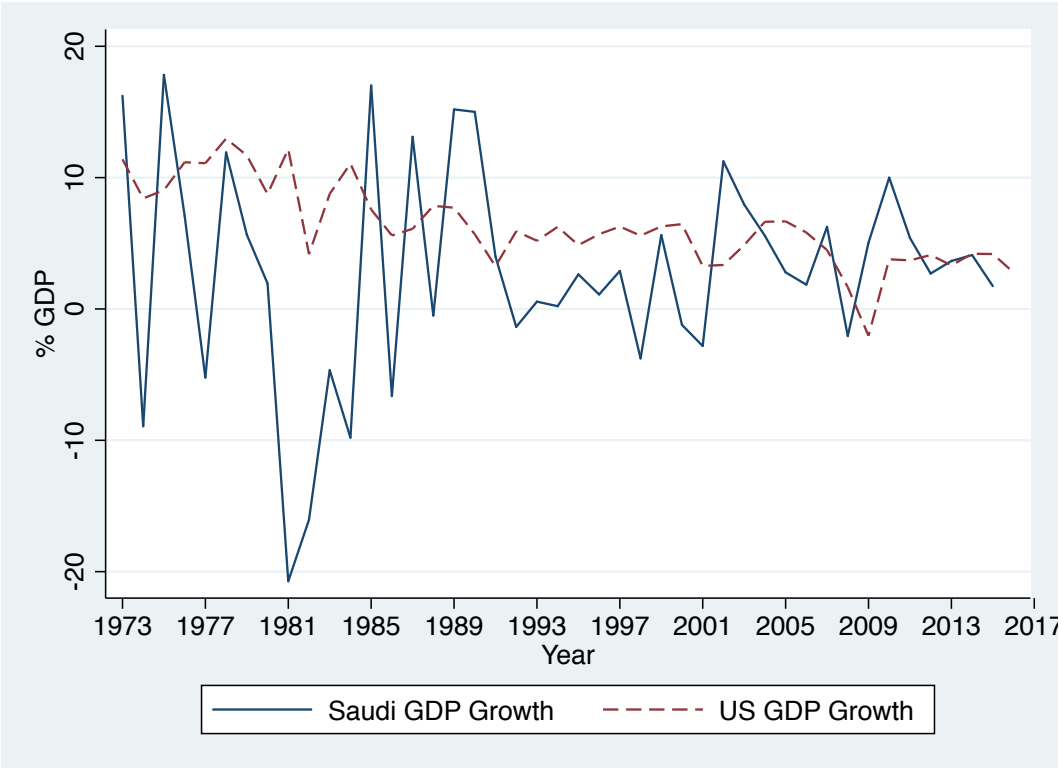

Figure 3: Saudi Arabia GDP growth and U.S. GDP growth, 1973–2016

The fundamental international economic structural change underpinning the transition from Bretton Woods to the floating rate era is the rise of financial capital mobility. This was a result of three developments, namely; the Eurodollar market growth that took place in the early 1950s, technological advancement that allowed for greater speeds and volumes for financial transactions, and most relevant, the eradication of capital controls and international financial deregulation (Helleiner, 1994). To put this in perspective, the foreign exchange market average daily turnover increased from U.S. $100 billion in 1979 to U.S. 400 billion in 1989 (Helleiner, 1994). This rapid development of international financial capital mobility has, and continues to have, specific implications for the choice of exchange rate policy. The Mundell-Fleming Trilemma, also known as the 'unholy trinity', followed; it states that governments cannot simultaneously achieve the policy objectives of capital mobility, domestic macroeconomic and monetary policy autonomy, and exchange rate stability—except in rare cases where the interests of both countries coincide under an OCA. Moreover, only two of the three so called desiderata may be pursued at any one time. In addition to a long-standing position of maintaining the dollar fix without intervention, the Saudi Arabian Monetary Authority (SAMA) has historically refrained from instituting any form of capital controls. However, lower crude prices have created a budget crisis, with a lot of speculation suggesting that SAMA may now have reason to implement new capital controls.

2.4 Evolution of Saudi Arabia Exchange Rate, Crude Price Volatility, and Growth Performance

This subsection describes the history of the prevailing exchange rate regime in Saudi Arabia, the currency board that ensures its continued subscription, and historical growth performance under oil market conditions. Over most of the period from 1973 to present day, Saudi Arabian exchange rate policy has been dominated by a de-jure and de-facto peg of the riyal to either the IMF's Special Drawing Rights (SDR) basket or the U.S. dollar. From 1973–1981, the Saudi Arabian riyal was loosely pegged to the SDR basket of currencies (±7.5%). However, in mid-1981, the SDR peg was abandoned in favor of a lower float against the dollar that was sustained until mid-1986 when the riyal was tightly pegged to the U.S. dollar at SAR 3.75/$, which is the rate that has prevailed since (Alkhareif et al., 2017). In dollar terms, the riyal saw a period of appreciation from 1973–1980, with the rate dropping from SAR 3.56/$ to SAR 3.33/$ from year end 1973 to year end 1980. As shown in Figure 4, this trend was reversed and the riyal depreciated against the dollar from SAR 3.33/$ in 1981 to SAR 3.75 by mid-1986. Part of the depreciation is certainly due to the strength of the dollar during this period, however, it is also worth noting that another factor was the collapse in oil prices and production cutbacks that saw Saudi Arabian oil export revenues decline from SAR 375.3 billion in 1981 to SAR 66.7 billion in 1986 (Alkhareif et al., 2017).

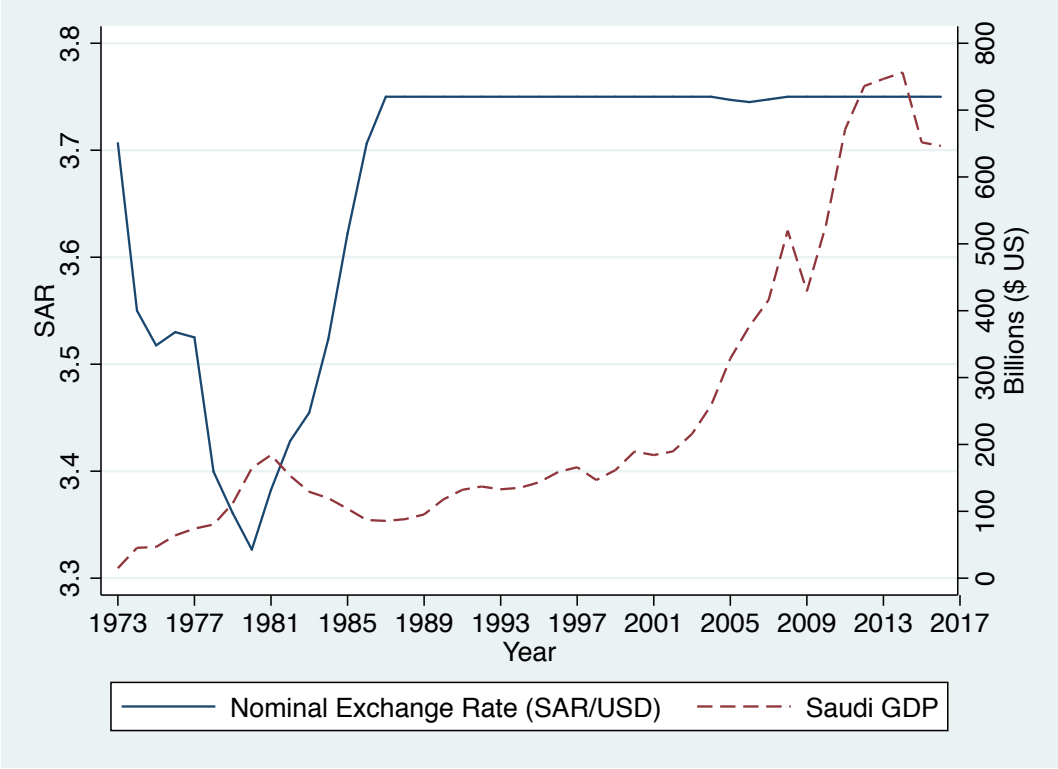

Figure 4: Saudi Arabia nominal exchange rate and GDP, 1973–2016

Since June 1986, Saudi Arabia has kept the riyal tightly pegged to the U.S. dollar, despite the two Gulf Wars (1990–1991, 2003–2004), and two major declines in oil prices; 1993–2000, and the present decline. The massive decrease in national income that Saudi Arabia experienced in 1993/1994 and 1998/1999 put the riyal under pressure. However, in both instances, the spot value of the riyal did not decrease by more than 10 basis points, primarily due to the fact that the Saudi Arabian Monetary Agency (SAMA) intervened in forward market; $655 million in 1993 and $820 million in 1998 (Alkhareif et al., 2017).

The maintenance of the tight dollar peg may largely be credited to SAMA's preservation of considerable liquid foreign currency assets. These reserves are supported by government deposits and are important for two main reasons. First, FX reserves provide liquidity to support the riyal, but more importantly, they deter speculators. The foreign reserves at SAMA's disposal amounted to SAR 2.3 trillion as of year-end 2015, which underpins the credibility of the exchange rate and monetary policy for the time being (Alkhareif et al., 2017). The vast reserves that Saudi Arabia boasts are likely sufficient to sustain the peg and may last for several more years despite low oil prices. However, at the current depletion rate of reserves and assuming that oil prices remain depressed, reserves will eventually be exhausted, unless other sources of revenue are developed or government spending is limited. Figure 5 illustrates a dip in Saudi Arabia total reserves that corresponds with the oil slump. This puts the long-term efficacy of the

fixed exchange rate regime into question, as a devaluation of the riyal in order to balance the budget may be optimal for economic development in the long-run.

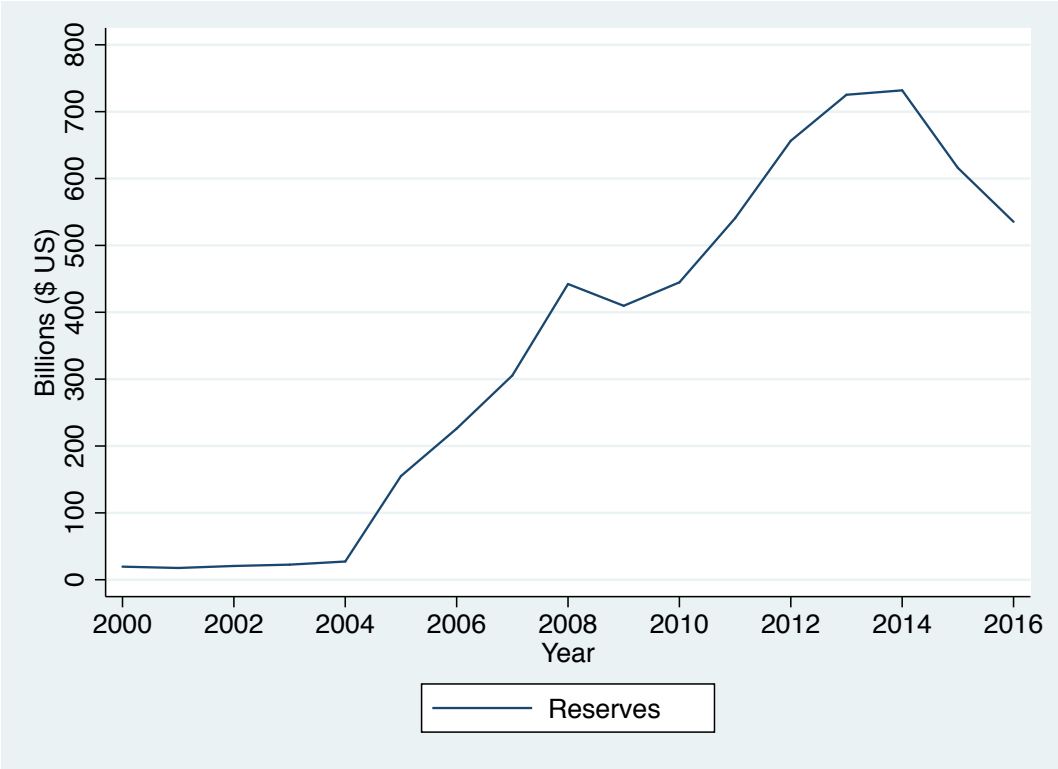

Figure 5: Total Reserves including FX but excluding gold, 1973–2016

Relative to non-natural resource economies, natural resource economies are vulnerable to significant revenue volatility, which has a negative impact on economic performance. Like other oil-dependent economies, revenue volatility in Saudi Arabia is driven by the uncertainty, and as recently evident, extreme volatility in international oil market prices as shown in Figure 6. The graph depicts the trend in annual average price of OPEC's oil basket over the 1970–2017 period. The relative stability seen in the early 1980s and 1990s has been replaced by a trend of substantial variability since the late 1990s, which can be attributed to an international surge in demand as well as supply-side constraints stemming from political instability in the Middle East. The current account balance and oil rents for Saudi Arabia, both as a percentage of GDP, are depicted in Figure 7. As illustrated, Saudi Arabia experienced significant upbeat movements in the current account balance, particularly in the 2003–2007 period, which corresponded with a surge in oil prices, as indicated by the increase in the portion of oil rents in GDP. From the graphical illustration in Figure 7, it is clear that the economy in Saudi Arabia exhibits pro-cyclicality of GDP growth with oil rents (% GDP) and current account balances (% GDP), which has arguably been harmful for macroeconomic stabilization (Kandil, & Nandwa, 2015).

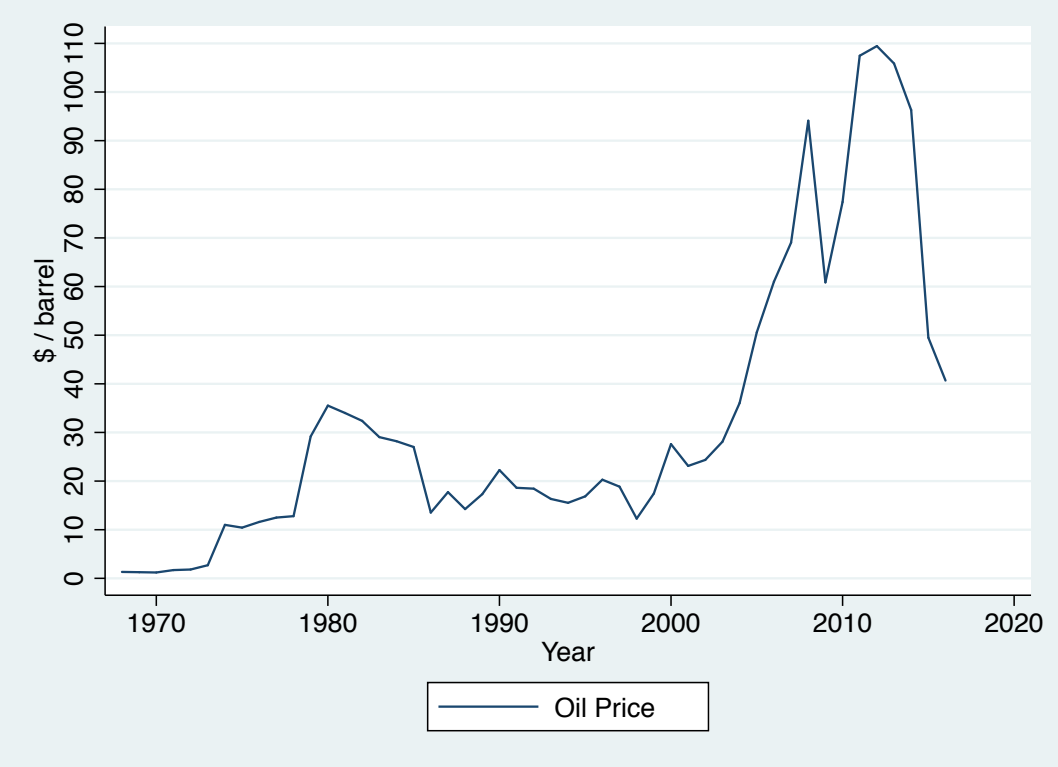

Figure 6: OPEC Oil Basket Annual Average Price, 1968–2016

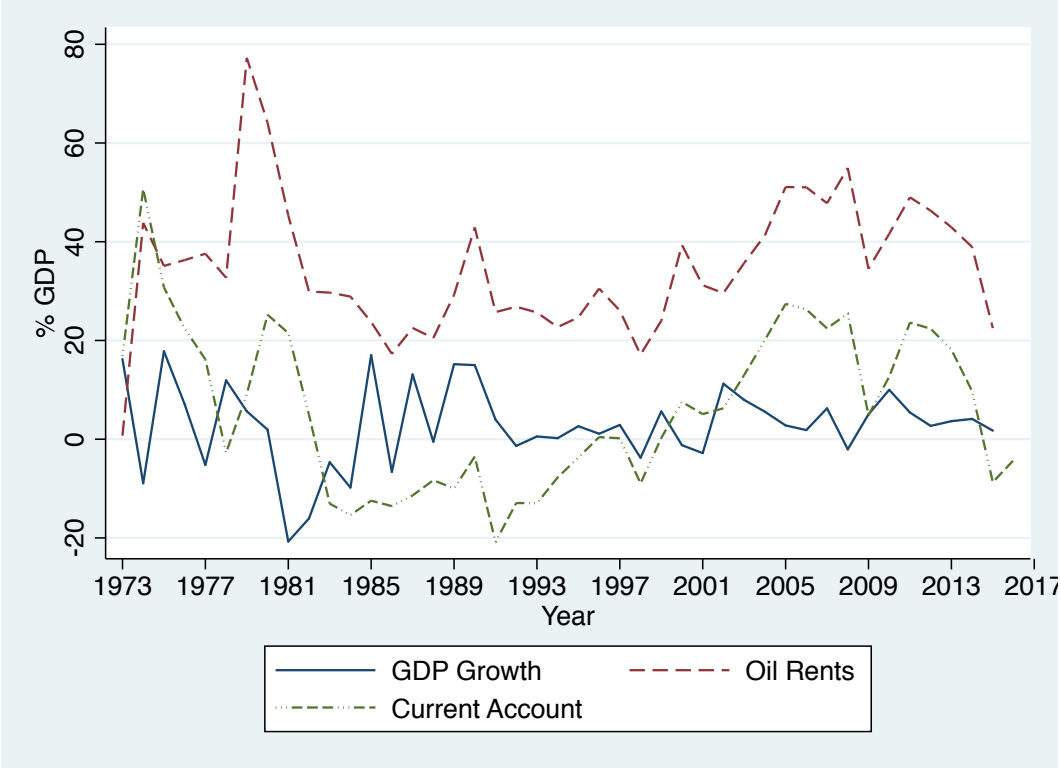

Figure 7: Saudi Arabia GDP growth, current account balances and oil rents (% GDP), 1973–2016

Husain et al. (2008) analyzed a sample of major oil exporting countries and concluded that economies with a larger share of oil rents as a percentage of GDP are prone to higher GDP volatility, as well as shorter business cycles. Despite shorter cycles, output volatility is amplified in oil producing economies because of the high dependency on the natural resource, which translates to an economy constantly exposed to fluctuations in oil prices, ultimately increasing both the frequency and volatility of the business cycle (Kandil, & Nandwa, 2015). Moreover, Husain et al. (2008) evaluated the variation in the fiscal stance of major oil-producing countries, including Saudi Arabia, and found that oil-rich countries that were highly dependent on the resource for revenue experienced greater fiscal volatility compared to countries with less reserves. In contrast to Saudi Arabia, Norway is a prime example of an oil-rich country that has nonetheless managed to reduce the transmission of fiscal impulse to the domestic economy, which was achieved through robust fiscal policy, its SWF, and arguably, a flexible exchange rate regime.

As is relevant to oil-producing economies, much of the previous research analyzes the relationship between oil prices and exchange rates, in order to shed light on the impact of oil price volatility on the currency (Elbadawi, & Kaltani, 2008; Elbadawi, & Gelb, 2010; Kandil, & Nandwa 2015). While the movement in exchange rates is not always fully attributed to oil prices, many of the studies concluded that oil price is a major determinant of exchange rate behavior in exporting countries (Amin, & El-Sakka, 2016). Oil booms were found to lead to currency appreciation in net oil exporting economies, and currency depreciation in net oil importing economies. In addition, the inability of major oil exporting countries to withstand severe fluctuations in international oil prices is argued as the main reason for macroeconomic instability and the post oil boom growth decline seen in oil-dependent countries (Elbadawi, & Kaltani, 2008).

Several studies have illustrated that in fact, most oil-dependent economies, including GCC economies, have experienced stagnant growth and significant output volatility since the 1970s (Elbadawi, & Gelb, 2010; Kandil, & Nandwa, 2015), leading to discussion regarding the concept of a resource curse. In terms of real GDP annual growth rates, Saudi Arabia experienced average annual growth of −0.6% from 1980–1989, compared to a world average annual growth rate of 3.21% during the same period. More recently, Saudi Arabia recorded an average annual growth rate of 3.5% from 2000–2010, compared to an average world growth rate of 3.74% during the same period (World Economic Outlook). Much of the economic growth and volatility in GCC oil-dependent economies is positively correlated to the various energy cycles over time. For example, the decline in real GDP annual growth rates in Saudi Arabia from 1980–1989 is typically viewed as an adjustment following the oil price boom of the mid-1970s.

Moreover, Elbadawi and Gelb (2010) analyzed per capita GDP growth in Saudi Arabia and compared it with Norway, since both countries have substantial hydrocarbon reserves, particularly relative to the average amongst OECD countries. This is illustrated in Figure 8. It is worth noting that per capita GDP in Saudi Arabia declined from $33,000

in 1980 to $20,000 in 2010. Although other circumstances may justify the differences in per capita GDP growth between the two countries, Norway adopts a flexible exchange rate regime that is free float, which may have cushioned the economy at times of significant external price shocks, and may also have provided more opportunities for economic diversification.

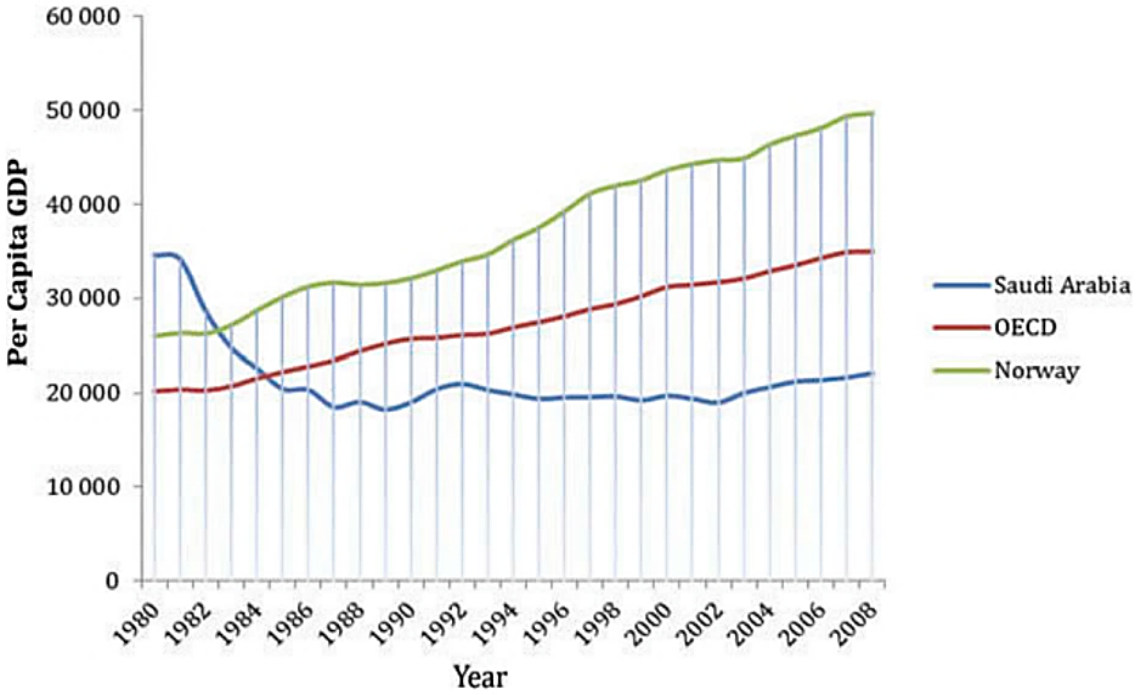

Figure 8: GDP per capita for Saudi Arabia, OECD, and Norway.

Source: Elbadawi and Gelb (2010)

It is reasonable to claim that the nature of the political economy in emerging market resource endowed economies, such as Saudi Arabia, coupled with limited institutional capability has undoubtedly contributed to stagnant per capita GDP growth and poor economic performance. However, there is also evidence to suggest that inappropriate monetary policy and choice of exchange rate regime is also partially responsible for economic underperformance (Elbadawi, & Gelb, 2010). Numerous studies have concluded that the strategies employed by oil-dependent economies to keep their domestic currency from fluctuating, which includes heavy intervention in foreign exchange markets and pegging to the U.S. dollar, have actually been counter-effective (Blanchard, & Gali, 2007; Frankel, 2010; Elbadawi, & Gelb, 2010). Based on findings from the studies, these strategies have arguably exasperated the impact of oil price slumps on the domestic economy, and have hindered efforts to establish independent counter-cyclical measures to bolster the non-energy sector.

3 The Data

Our full-sample covers annual observations over the period 1973–2016, incorporating a period before and after the exchange rate was hard fixed. The formal definitions and sources for all the variables used in throughout the paper is presented in Appendix 1. With the exception of rule of law, all of the data comes from the World Bank, specifically, the World Development Indicators (WDI) database.

3.1 First pass at the data

Descriptive statistics for the sample are reported in Table 1.

Table 1: Descriptive Statistics

Variable	No. Obs.	Mean	Std. Dev.	Min	Max
Real GDP Per Capita Growth (%)	48	1.467	11.666	−25.619	52.212
Inflation	44	7.428	4.559	1.198	18.630
Broad Money/GDP (%)	49	3.869	7.559	−3.203	34.576
FDI net inflows/GDP (%)	49	38.928	18.119	6.064	74.560
Current Account/GDP (%)	47	1.162	2.994	−8.219	8.496
Personal Remittances/GDP (%)	46	6.701	15.911	−20.805	50.702
Reserves/GDP (%)	46	5.862	3.076	1.141	13.374
Trade Openness	49	34.749	30.729	5.447	98.815
Oil Rent/GDP (%)	49	77.302	12.573	56.088	120.620

The min/max range and standard deviations for many of the variables is notable, and is likely due to the size of the data set which spans five decades. In addition to different exchange rate regimes, this period is also associated with development changes and significant ramping of oil production as is evident by oil rents, which ranged from a minimum of 0.15% to a maximum of 77% of GDP, with a mean of 32.6%. Over the sample period, on average, personal remittances amount to 5.9% of GDP, ranging between 1.14% to 13.4%. Trade openness is equal to 77.3% on average and can reach extremely high values of around 120%, which is typical of an open high oil-exporting economy. Of all variables reported as a % of GDP, reserves as a % of GDP has the extraordinary high standard deviation, which is justifiable given Saudi Arabia's oil-dependency and the volatility of international oil markets, and rigid exchange rate regime which draws on reserves in periods of shock.

3.2 Augmented Dickey-Fuller Test

In order to run OLS regressions on time-series data, it is important to check whether or not each series is stationary, for which we employ augmented Dickey-Fuller testing. The augmented Dickey-Fuller tests if a variable has a unit root. The null hypothesis is that the variable has a unit root, while the alternative is that the variable has been generated by a stationary process. The test result for each time series is depicted in Table 2.

Table 2: Augmented Dickey-Fuller Test

Variable	Test Statistics	5% Critical Value	10% Critical Value
Real GDP Per Capita Growth (%)	−4.072***	−3.528	−3.197
Volatility of GDP Per Capita Growth	−3.163*	−3.532	−3.199
Inflation	−3.633**	−3.528	−3.197
Broad Money/GDP	−2.278	−3.528	−3.197
FDI net inflows/GDP	−3.290*	−3.528	−3.197
Current Account/GDP	−2.173	−3.528	−3.197
Personal Remittances/GDP	−1.466	−3.528	−3.197
Reserves/GDP	−1.600	−3.528	−3.197
Trade Openness	−2.237	−3.528	−3.197
Oil Rent/GDP	−3.730**	−3.528	−3.197

Note: *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively.
For 10% significance level, results indicate that GDP per capita growth, volatility of GDP per capita growth, inflation, FDI, and oil rents are a result of a stationary process.

The results indicate broad money/GDP, current account/GDP, personal remittances/GDP, reserves/GDP, and trade openness are all non-stationary. Accordingly, the first-difference of these variables is included in all regressions in the next section. Augmented Dickey-Fuller tests were conducted on the first-difference of these variables, with the results indicating that all the first-differenced variables are stationary, as shown in Appendix 2.

3.3 Correlation Matrix

In order to ensure that the select explanatory variables do not suffer from multicollinearity, we run a correlation matrix as depicted in Table 3.

Table 3: Correlation Matrix

	I	BM[a]	FDI	CA[a]	PR[a]	R[a]	TO[a]	OR	FFD
Inflation (I)	1.000								
Broad Money[a] (BM)	−0.072	1.000							
Foreign Direct Investment (FDI)	−0.118	0.353	1.000						
Current Account[a] (CA)	−0.080	−0.736*	−0.521	1.000					
Personal Remit-tances[a] (PR)	−0.092	0.558*	0.288	−0.588	1.000				
Reserves[a] (R)	0.149	0.117	0.337	−0.031	−0.128	1.000			
Trade Openness[a] (TO)	0.049	−0.121	0.097	−0.256	−0.121	0.123	1.000		
Oil Rent (OR)	0.085	−0.388*	0.184	0.348	−0.277	0.189	−0.130	1.000	
Firm Fix Dummy (FFD)	−0.370	−0.165	0.128	0.117	−0.084	0.154	0.067	−0.054	1.000

Note: * indicates a possible interdependence problem.
[a] indicates the first difference of the variable lagged by one period. First difference taken to solve the unit root problem.

It appears that an interdependence problem exists with the inclusion of broad money (% GDP). Given that Saudi Arabia exhibits pro-cyclicality to the oil price, this is suggestive of the fact that volatility in the oil price is transmitted to the macro-economy through domestic liquidity as measured by broad money. Accordingly, in each of the subsequent sections, we run two regressions, excluding broad money as an explanatory variable in the latter.

4 Growth Regressions

Since it is our intention to focus on the significance of the firm fix dummy as opposed to reexamining determinants that are already thoroughly analyzed in the growth literature, we select the following specification for our growth model, which we regard as uncontroversial:

$$y_t = \vec{\alpha} \cdot X_t + \beta z_t + \varepsilon_t \quad (1)$$

where y_t is the growth rate of real GDP per capita for Saudi Arabia in year t. X_t is a vector of explanatory variables: inflation of consumer prices (annual %), first-difference of broad money (% GDP), foreign direct investment net inflows (% GDP), first-difference of current account balance (% GDP), first-difference of personal paid remittances (% GDP), first-difference of total reserves including gold (% GDP), first-difference of trade openness (% GDP), and oil rents (% GDP). The variable z_t is the dummy for the firm fix exchange rate regime, and ε_t is the error term. All variables in the regression are run as a share of GDP. Results are depicted in Table 4.

As a first step in explanatory variable selection, it was important to identify the determinants of real per capita GDP growth. However, as Bugamelli and Paterno (2009) stress, growth in developing economies is dependent on country-specific factors, and not just on global and regional shocks. Accordingly, we have tweaked conventional empirical models on growth to include Saudi-specific factors deemed relevant, such as remittances, given the nature of the domestic labor market. In reference to the explanatory variables, empirical research has focused on the role of financial development and liberalization, institutional strength, and trade openness on output growth and volatility (Easterly et al., 2000; Kose et al., 2003; Buch et al, 2005; Acemoglu et al., 2003).

The first subgroup of explanatory variables may be described as 'globalization' variables. This includes trade openness measured as the sum of exports and imports of goods and services over GDP, it is expected that countries with a high degree of trade openness are able to boost GDP to the extent that the domestic economy is able to integrate with the global economy to support exports, and implement positive trade reform strategies. Personal remittances also fall under the globalization subgroup; it is measured as the personal transfers (made or received) as well as the compensation of resident employees as a % of GDP. Although uncustomary, Bugamelli and Paterno (2009) justify the inclusion of remittances by hypothesizing that remittance inflows may smooth consumption and investment, ultimately contributing to stability and growth. However, in the case of Saudi Arabia, we expect greater remittance outflows due to the migrant-dominant labor market. As a proxy for financial openness, we use net FDI inflows; measured as the sum of foreign equity capital, reinvestment of earnings, and other capital, as a % of GDP.

The second subgroup of variables control for monetary policy distortion and volatility. This includes inflation (annual %), as measured by the consumer price index.

This is an important factor to control for given that theoretically, high inflation rates should hinder real growth. Broad money as a % of GDP is also included as a proxy for the money supply in the economy, measured as the sum of all currency outside of banks. The current account as a % of GDP is also included in order to capture the balance of trade, measured as the sum of net exports of goods and services net income. Total reserves as a % of GDP is included to proxy the financial power and stability of the economy in Saudi Arabia; it is comprised of year-end holdings of monetary gold, special drawing rights, and foreign exchange. Following suggestions of Kamiar and William (2011), oil rent (% GDP), measured as the revenue of oil exports minus costs, is introduced in order capture the spillover effect on nonoil real GDP growth. Finally, a firm fix dummy is included; it takes the value 0 for the years prior to 1986, and 1 for 1986 onwards.

Table 4: Growth Regression Results

Dependent Variable: GDP Per Capita Growth

Variable	**Regression 1.A**	**Regression 1.B**
Inflation	0.478*** (0.173)[s]	0.429** (0.163)
Broad Money[a]	0.358 (0.421)	Excluded
Foreign Direct Investment	−0.664 (0.553)	−0.717 (0.548)
Current Account[a]	0.427* (0.243)	0.292 (0.183)
Personal Remittances[a]	1.336 (1.495)	1.407 (1.487)
Reserves[a]	−0.253 (0.166)	−0.196 (0.152)
Trade Openness[a]	0.229* (0.132)	0.171 (0.113)
Oil Rent	0.090 (0.108)	0.066 (0.104)
Firm Fix Dummy	0.075** (−0.010)	0.069** (0.027)
Constant	−0.095* (0.049)	−0.076* (0.043)
No. Observations	43	43

R-squared	0.447	0.434

Note: Regression A: includes all variables.
Regression B: includes all variables except broad money.
[a] indicates the first difference of the variable lagged by one period. First difference taken to solve the unit root problem.
[s] brackets contain relevant standard deviation for each coefficient.
*, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively.

Inflation has a positive significant effect on real GDP per capita growth. This is confounding as inflation is expected to reduce real growth and restrain the country's ability to stimulate positive growth. Moreover, high inflation is associated with higher inflationary expectations and accordingly, rent-seeking activity, which would disincentive investment and hinder real economic activity. Although the focus is not on the determinants of growth, one possible explanation as to why the sign is confounding is the presence of money illusion within the economy of Saudi Arabia. In other words, the nominal value of money is not differentiated from its real value at previous points in time, as agents within the economy think in nominal rather than real terms. If workers in the labor market in Saudi Arabia evaluate wage offers in nominal terms, firms are able to offer relatively lower real wages despite increasing nominal wages during episodes of high inflation, and workers will be inclined to accept the high nominal wage increases. In fact, lower real wages will enable firms to hire even more workers during periods of high inflation, which may increase economic productivity. There are two additional reasons that are suggestive of the presence of money illusion in the Saudi economy. First, the fixed exchange rate coupled with the fact that most workers are low income foreigners who send a significant portion of pay abroad, makes the presence of confusion about real and nominal value more likely. Second, contracts and laws in Saudi Arabia are not frequently indexed to inflation, which is indicative of the presence of money illusion.

An important determinant of real GDP per capita growth is trade openness, which has a positive and significant sign. Countries that have made an effort to structure themselves so as to integrate with the global economy have profited from a higher degree of openness that not only aids exports, but also allows for reform strategies that accommodate high growth. Trade openness has undoubtedly benefited Saudi Arabia given the importance of petroleum exports. Similarly, the current account is a major factor that boosts growth of real GDP per capita. As the sign and significance indicate, a positive current account balance implies that greater net exports (minus income) boosts real GDP per capita growth, as expected. However, it is worth noting that both current account (% GDP) and trade openness (% GDP) lose significance with the exclusion of broad money (% GDP) as an explanatory variable, as shown in regression 1.B.

The firm fix dummy is positive and highly significant, implying that the fixed exchange rate regime boosts real GDP per capita growth in Saudi Arabia. We believe that this result is primarily driven by the credibility of the fixed exchange rate regime, which

in turn provides a strong nominal anchor and monetary policy framework. Previous research by Kandil and Nandwa (2015) analyzed growth determinants with various exchange rate dummies on panel data, which included Saudi Arabia among several other countries, but found no significance for the fixed exchange rate dummy included in their model. However, when analyzing Saudi Arabia independently, we find that the fixed exchange rate regime has actually stimulated growth. It seems that by reducing relative price volatility, the peg stimulated trade and increased growth. It could also be that lower price uncertainty under the firm fix lead to lower real interest rates, which contributed to real growth. However, the sign and significance of inflation in the regressions, and the presence of money illusion, makes an explanation around interest rates less plausible. Rather, it seems that the credibility of the fixed exchange rate regime in Saudi Arabia contributed to monetary policy discipline, transparency, and predictability, and thereby reducing the economy's vulnerability to speculative fluctuations in the exchange rate. All these factors contribute to stronger growth performance.

5 Output Volatility

5.1 Theoretical Framework

The theoretical framework can be modelled mathematically and follows the New Keynesian monetary policy model first proposed by Clarida et al. (1999) but developed by Furceri and Karras (2007), in order to focus on the factors that will define the macroeconomic costs and benefits of a monetary union. We borrow the following model from Furceri and Karras (2007).

If we consider N economies (i = 1, 2, …, N), then the loss function for the monetary authority of each economy may be given by:

$$L_i = \frac{1}{2} E_t \left\{ \sum_{j=0}^{\infty} \beta^j \left[a_i \left(y_{i,t+j} - k_i \right)^2 + \pi_{i,t+j}^2 \right] \right\} \tag{2}$$

In this model, y is the output given in deviations from the trend, π is inflation, a is positive and is the relative weight on the output deviations, ß is just the discount factor, E is the mathematical expectation, and k is the target output.

Aggregate supply for each economy is assumed to follow a New Keynesian expectations-augmented Phillips curve, given by:

$$\pi_{i,t} = \lambda_i y_{i,t} + E_t \pi_{i,t+1} + u_{i,t} \tag{3}$$

where $\lambda_i > 0$

Here, we assume that:

$$u_{i,t} = \phi_i u_{i,t-1} + z_{i,t} \tag{4}$$

where $0 < \phi_i < 1$ and $z_{i,t} \sim iid(0, \tau_i^2)$

By solving for $y_{i,t}$ in (3), we write this in aggregate-supply form as:

$$y_{i,t} = \vartheta_i\left(\pi_{i,t} - E_t\pi_{i,t+1}\right) + v_{i,t} \tag{5}$$

where $\vartheta_i = \frac{1}{\lambda_i}$ and $v_{i,t} = \frac{-u_{i,t}}{\lambda_i}$, so $v_{i,t} = \phi_i v_{i,t-1} - \frac{z_{i,t}}{\lambda_i}$

So, we define:

$$\sigma_i^2 \equiv Var\left(v_{i,t}\right) = \frac{\tau_i^2}{\lambda_i^2\left(1-\phi_i^2\right)} \tag{6}$$

Under an independent monetary authority (no integration), and using the New Keynesian expectations-augmented Phillips curve for aggregate supply, (3), the loss function, (2), is minimized subject to aggregate supply, which gives:

$$\pi_{i,t}^{IND} = a_i q_i u_{i,t} + \frac{a_i}{\lambda_i}k_i = -a_i q_i \lambda_i v_{i,t} + \frac{a_i}{\lambda_i}k_i \tag{7}$$

and

$$y_{i,t}^{IND} = -\lambda_i q_i u_{i,t} = \lambda_i^2 q_i v_{i,t} \tag{8}$$

where $\vartheta_i = \frac{1}{\lambda_i^2 + a_i(1-\beta\phi_i)}$

IND just refers to the case of an economy having an independent monetary authority. Economic performance may then be measured by inflation and output volatility, given by:

$$\overline{\pi}_i^{IND} = \frac{a_i k_i}{\lambda_i} \tag{9}$$

and

$$Var(y_i^{IND}) = \frac{\lambda_i^4 \sigma_i^2}{[\lambda_i^2 + a_i(1-\beta\phi_i)]^2} \tag{10}$$

If we consider the fixed exchange rate policy as a monetary union between Saudi Arabia and the United States with a single currency, then the loss function, (2), in terms of an assumed common monetary authority (*COM*, which indicates parameters for both countries in the union) may be written as:

$$L_{COM} = \frac{1}{2}E_t\left\{\sum_{j=0}^{\infty}\beta^j\left[a_{COM}\left(y_{COM,t+j} - k_{COM}\right)^2 + \pi_{COM,t+j}^2\right]\right\} \tag{11}$$

By substitution with aggregate supply, output is given by:

$$y_{i,t}^{UNION} = -a_{COM}q_{COM}(1-\phi_{COM})v_{COM,t} + v_{i,t} \tag{12}$$

The income of country *i* is affected by its own income shock (given by $v_{i,t}$) but also by the other countries' (that form the currency union) income shocks (in this case this is the

U.S. and Saudi Arabia shock given by $v_{COM,t}$)—this is because the common monetary authority directs monetary policy.

Under a monetary union, the average inflation and output volatility for any one country is given by:

$$\overline{\pi}_i^{UNION} = \frac{a_{COM} k_{COM}}{\lambda_{COM}} \tag{13}$$

and

$$\begin{aligned} Var(y_i^{UNION}) &= a_{COM}^2 q_{COM}^2 (1-\phi_{COM})^2 \sigma_{COM}^2 + \sigma_i^2 \\ &- 2a_{COM} q_{COM} (1-\phi_{COM}) \rho_{i,COM} \sigma_i \sigma_{COM} \end{aligned} \tag{14}$$

implying

$$\rho_{i,COM} \equiv corr\left(v_{i,t}, v_{COM,t}\right) \tag{15}$$

There are three main theoretical implications of relevance that may be deduced from the equations. First, the fact that variation in output for an economy under a monetary union has a negative relationship with the correlation of the home country's income and income of the country with the monetary authority (all countries in the union). Second, if we compare the equations for output volatility under an independent monetary authority and under a monetary union, it is clear that a monetary union may result in an increase in output volatility—that is what is seen as a cost to fixing under a common currency union. Third, since the fixed exchange rate regime followed by Saudi Arabia is not a monetary union between the U.S. and Saudi Arabia with a shared currency, the volatility of the output should depend more on U.S. policy. Therefore, we would expect an even higher output volatility under a fixed exchange rate regime relative to a common monetary union.

5.2 Output Volatility Regressions

In order to examine the relationship between the fixed exchange rate regime in Saudi Arabia and output volatility, we run regressions with the volatility of real per capita GDP growth as the dependent variable, measured as the standard deviation of the growth rate over a preceding 5-year rolling period. For example, the output volatility value for the year 1995 is the standard deviation of the real growth rate for the years 1991-1995, inclusive. We use a rolling period approach to capture changes in volatility over time. The average output cycle duration for Saudi Arabia is 5.6 years (World Economic Outlook), which motivated the use of a 5-year rolling period. The period-end approach allows for more degrees of freedom relative to a centered rolling period given that our dataset could be lagged by 5-years without decreasing the number of observations for the period 1973-2016. We utilize the same regressors used in the previous section, as per the growth literature. Regression results are shown in Table 5. Again, the difference between

regression 1.A and 1.B is that the latter excludes broad money (% of GDP) in order to ensure the robustness of results.

Table 5: Output Volatility Regressions

Dependent Variable: Volatility of GDP Per Capita Growth

Variable	Regression 1.A	Regression 1.B
Inflation	0.069 (0.059)[s]	0.105* (0.058)
Broad Money[a]	−0.264* (0.144)	Excluded
Foreign Direct Investment	−0.387* (0.190)	−0.347* (0.195)
Current Account[a]	0.012 (0.083)	0.112* (0.065)
Personal Remittances[a]	1.681*** (0.513)	1.629*** (0.530)
Reserves[a]	0.068 (0.057)	0.026 (0.054)
Trade Openness[a]	0.034 (0.045)	0.077* (0.040)
Oil Rent	−0.083* (0.037)	−0.065* (0.037)
Fixed Exchange Dummy	−0.066*** (0.100)	−0.061*** (0.100)
Constant	0.153*** (0.017)	0.139* (0.015)
No. Observations	43	43
R-squared	0.754	0.729

Note: Regression A: includes all variables.
Regression B: includes all variables except broad money.
[a] indicates the first difference of the variable lagged by one period. First difference taken to solve the unit root problem.
[s] brackets contain relevant standard deviation for each coefficient.
*, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively.

Inflation is positive and significant in explaining volatility of GDP per capita growth in regression 1B. To the extent that the inflation rate is a good approximation of monetary policy in the economy, the significantly positive coefficient indicates that higher inflation

on average leads to higher GDP per capita growth volatility. This finding is consistent with literature on output volatility (Beck et al., 2006; Denizer et al., 2002), and in the Saudi Arabia case, is also supportive of the presence of money illusion. Similarly, as expected, current account (% GDP) and trade openness are positive and significant in regression 1B.

It is important to note that in addition to the variables that were significant in the growth regressions, we have additional explanatory variables that are significant in explaining output volatility but not growth, namely, broad money, FDI, personal remittances, and oil rent. The significance of these determinants of output volatility warrant some commentary. In regression 1.A, broad money is negative and mildly significant. Given that broad money is an approximation to the money supply in the economy, it is expected that more money in circulation should, in theory, reduce output volatility.

FDI is negative and significant in explaining per capita GDP growth volatility. This is consistent with findings in the literature, most notably, Ćorić and Pugh's (2012) who analyze the effect of FDI on output volatility using GDP data on 85 countries. They find that foreign direct investment had a stabilizing effect on output volatility, particularly in the era of the Great Moderation (lower output volatility in the decades preceding the Great Recession), which is relevant given that our data set spans back to 1973. However, Ćorić and Pugh (2012) acknowledge that individual countries likely have different explanations as to why FDI reduces output volatility, and in the case of Saudi Arabia, more research needs to be conducted to identify the reasons for this relationship. Portes (2007) provides the following plausible explanation. In a closed economy, the entire net worth of agents stems from domestic activity. In contrast, to the extent that an economy is open, the net worth of agents would consist of both domestic and foreign assets, in which case individual net worth is a function of both domestic and foreign GDP changes. Accordingly, as international diversification of net worth increases with globalization, FDI will tend to reduce the volatility of per capita GDP growth.

Personal remittances are positive and very significant in explaining output volatility. In theory, remittances are expected to reduce output volatility by financing investment but in a relatively less pro-cyclical fashion, and by smoothing household consumption. However, this confounding result may be explained by looking at the composition of foreign migrant workers in the Saudi economy. These migrants transfer pay abroad regardless of the economic environment, and it is therefore plausible to suggest that remittances tend to surge rather than smooth income in Saudi Arabia, which would justify the positive effect of remittances on output volatility.

Oil rents has a negative significant effect on output volatility, which indicates that higher oil rents reduce output volatility in Saudi Arabia. This not only highlights the economy's dependency on oil, but also supports the notion that cyclical volatility in Saudi Arabia is driven by oil rents, which are in turn driven by international oil prices.

Moreover, oil rents in this context captures the spillover effect on nonoil real GDP volatility. Accordingly, it is no surprise that the economy in Saudi Arabia would greatly benefit from economic diversification.

Our variable of interest, the fix dummy, has a negative significant effect on output volatility. Not only is this confounding to the theoretical framework that associates a fixed exchange rate regime with higher output volatility, but it is also contradictory to the empirical literature on output volatility reviewed in the introduction. However, as Yeyati and Sturzenegger (2003) state, the evidence on the relationship between output volatility and exchange rate regimes is mixed, with the positive association between a fixed exchange rate regime and output volatility dependent on the economy in question. This finding is consistent with the discussion on the firm fix dummy in the context of the growth regressions, specifically, it appears that the the high credibility of the fixed exchange rate regime in Saudi Arabia coupled with the monetary anchor that it provides has not only contributed to positive growth, but has also reduced output volatility by eliminating uncertainty.

6 Conclusion

This paper provides evidence on the implications of a firm fixed exchange rate regime on economic growth and output volatility in oil-dependent Saudi Arabia. In line with previous studies, our findings strongly indicate that exchange rate regimes do indeed matter in terms of real economic performance. In particular, we find that, the fixed exchange rate regime in Saudi Arabia is associated with higher growth rates. Over the years, Saudi Arabia has managed to accumulate vast wealth and foreign currency reserves that have supported the stability of the nominal exchange rate with unprecedented credibility. While we have not specifically tested the hypotheses that a positive association exists between fixed exchange rate regimes and trade, it plausible to suspect that Saudi Arabia has benefited from pegging in that regard. Among other factors, credibility contributed to monetary policy stability and predictability, which ultimately eliminated the country's vulnerability to speculative exchange rate fluctuations. All of these factors are conducive to stronger growth performance.

In addition, contrary to the bulk of the previous literature, we find that the firm fix is also associated with lower output volatility in the case of Saudi Arabia. Traditionally, the gains of a fixed exchange rate regime in terms of stability and predictability are at odds with the higher output volatility that is associated with pegs. The more conventional argument linking fixed exchange rate regimes with higher output volatility stems from the notion that external shocks suffered by a country may be related to the exchange rate system in place. In particular, fixed exchange rate regimes are subject to costly speculative attacks that come in the form of larger and more frequent shocks. As a result, the firm fix dummy may be capturing some of the impact of this additional external volatility.

However, in the case of Saudi Arabia, the long-standing highly credible fixed exchange rate system seems to be less affected by external shocks. It could be that some degree of financial dollarization has shielded the country's balance sheet from the effects of fluctuations in the nominal exchange rate, and thereby, reduced output volatility. That being said, further investigation is necessary in order to shed light on Saudi-specific fundamentals that permit lower output volatility under a fixed exchange rate system.

As it stands, this paper opens as many questions as it answers. If we accept the reported results, then it is plausible to question why many previous studies have been so skeptical towards fixed exchange rate regimes. At this point, one should be cautious not to read in our findings the policy implication that emerging market oil-dependent economies should adopt fixed exchange rate regimes. Despite the model benefiting from applicability to other GCC oil-dependent economies, the origins of our result comes from an individual oil-dependent country over a specific time period. However, our findings are a testament to the fact that fixed exchange rate regimes, if managed with high credibility, may in some cases report substantial gains in terms of economic growth.

Our concern remains with the contentious issue of exchange rate regime choice in the context of oil-dependency. Specifically, the fact that lower oil prices may undermine the credibility of the fixed exchange rate regime in the long-run, as evident by the declining reserves that Saudi Arabia has reported. Moreover, in the context of GCC experiences, Kandil and Nandwa (2015) find that some of the adverse effects of pegging include massive exchange rate misalignments that have actually exacerbated the vulnerability to oil price fluctuations. Specifically, the fixed exchange rate system has increased the frequency of pro-cyclical policies that are often to the detriment of non-energy sectors. In that regard, one may suspect that transitioning to an alternative exchange rate regime may be more suitable in order to boost the competitiveness of non-energy exports and widen the scope for diversification in the long-run. This is of particular importance given that oil is a finite resource. The evidence presented here attests to the fact that the fixed exchange rate regime has thus far benefited Saudi Arabia in terms of real economic growth. However, whether that will be the case in the future given the changing dynamics surrounding international oil markets remains to be seen. Additionally, the costs of a transition to a float are substantial and are heavily dependent on initial conditions. As it stands, Saudi Arabia and for that matter, all GCC oil-dependent economies, are not in a position to implement a fully flexible exchange rate regime. Underdeveloped capital markets, weak institutions, and limited scope for independent monetary policy make a fully flexible exchange rate regime unlikely to succeed. These are among many issues that must be addressed before alternative exchange rate regimes are considered. This notwithstanding, we believe that the evidence we present is strong enough to influence the debate on optimal exchange rate regimes for oil-dependent GCC economies.

7 References

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Appendix 1: Definitions and Sources

Variable	Definition	Source
GDP Per Capita Growth (annual %)	Annual percentage growth rate of GDP per capita based on constant local currency. Aggregates are based on constant 2010 U.S. dollars. GDP per capita is gross domestic product divided by midyear population.	World Bank national accounts data, and OECD National Accounts data files.
Volatility of GDP Per Capita Growth (annual %)	Calculated five-year rolling period standard deviation of GDP per capita growth (annual %).	Calculated by the authors.
Inflation, Consumer Prices (annual %)	Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed annually.	International Monetary Fund, International Financial Statistics and data files.
Broad Money (% of GDP)	Broad money is the sum of currency outside banks; demand deposits other than those of the central government; the time, savings, and foreign currency deposits of resident sectors other than the central government; bank and traveler's checks; and other securities such as certificates of deposit and commercial paper.	International Monetary Fund, International Financial Statistics and data files, and World Bank and OECD GDP estimates.
Foreign Direct Investment, net inflows (% of GDP)	Foreign direct investment are the net inflows of investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments. This series shows net inflows (new investment inflows less disinvestment) in the	International Monetary Fund, International Financial Statistics and Balance of Payments databases, World Bank, International Debt Statistics,

	reporting economy from foreign investors, and is divided by GDP.	and World Bank and OECD GDP estimates.)
Current Account (% of GDP)	Current account balance is the sum of net exports of goods and services, net primary income, and net secondary income.	International Monetary Fund, Balance of Payments Statistics Yearbook and data files, and World Bank and OECD GDP estimates.
Personal Remittances, paid (% of GDP)	Personal remittances comprise personal transfers and compensation of employees. Personal transfers consist of all current transfers in cash or in kind made or received by resident households to or from nonresident households. Personal transfers thus include all current transfers between resident and nonresident individuals. Compensation of employees refers to the income of border, seasonal, and other short-term workers who are employed in an economy where they are not resident and of residents employed by nonresident entities. Data are the sum of two items defined in the sixth edition of the IMF's Balance of Payments Manual: personal transfers and compensation of employees. Data are in current U.S. dollars. Authors calculated the relevant percentage of GDP by dividing the values by the GDP value for each year.	World Bank staff estimates based on IMF balance of payments data. Percentages were calculated by the authors.
Total Reserves, including gold (% of GDP)	Total reserves comprise holdings of monetary gold, special drawing rights, reserves of IMF members held by the IMF, and holdings of foreign exchange under the control of monetary authorities.	International Monetary Fund, International Financial Statistics and

	The gold component of these reserves is valued at year-end (December 31) London prices. Data are in current U.S. dollars. Authors calculated the relevant percentage of GDP by dividing the values by the GDP value for each year.	data files. Percentages were calculated by the authors.
Trade Openness (% of GDP)	Trade is the sum of exports and imports of goods and services measured as a share of gross domestic product.	World Bank national accounts data, and OECD National Accounts data files.
Oil Rent (% of GDP)	Oil rents are the difference between the value of crude oil production at world prices and total costs of production.	Estimates based on sources and methods described in "The Changing Wealth of Nations: Measuring Sustainable Development in the New Millennium" (World Bank, 2011).
Fixed Exchange Dummy	Equals 1 for years after firm U.S. dollar peg (1986 onwards).	N.A.

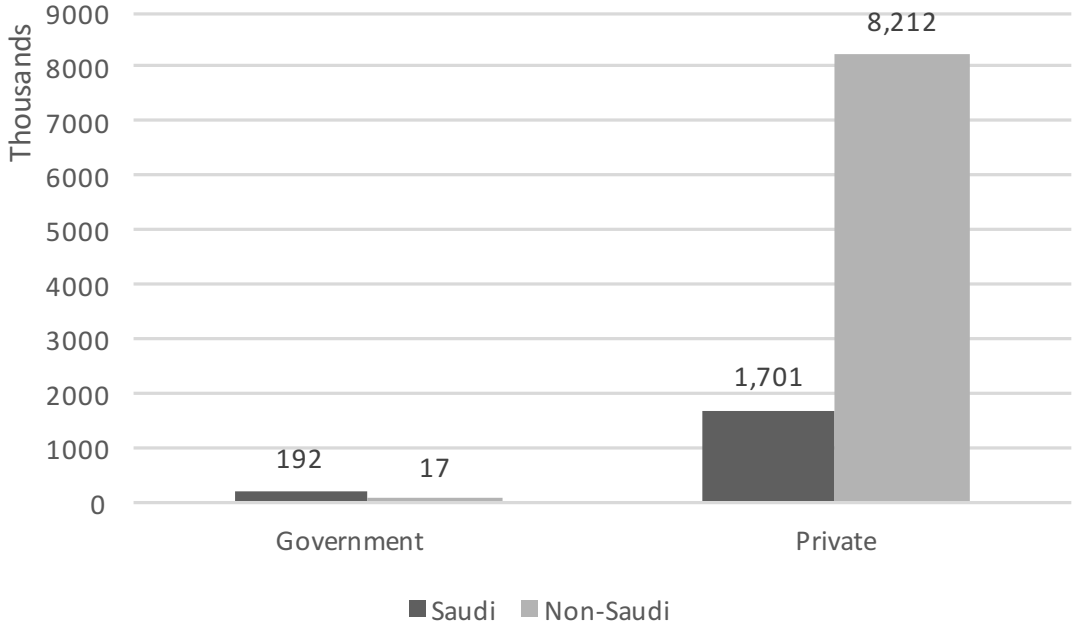
Note: All variables are collected from the World Bank portal. Definitions and sources are taken from the World Bank dataset.

Appendix 2: Augmented Dickey-Fuller Test for the First-Difference of Non-Stationary Variables

Variable (First-Differenced)	Test Statistics	5% Critical Value	10% Critical Value
Broad Money	−4.831***	−3.532	−3.199
Current Account	−5.937***	−3.532	−3.199
Personal Remittances	−5.026***	−3.532	−3.199
Trade Openness	−3.596**	−3.532	−3.199
Reserves	−3.225*	−3.532	−3.199

Note: *, **, and *** indicate significance at %10, %5, and %1 levels, respectively.
For 10% significance level, results show that all the first-differences of non-stationary variables are a result of a stationary process.

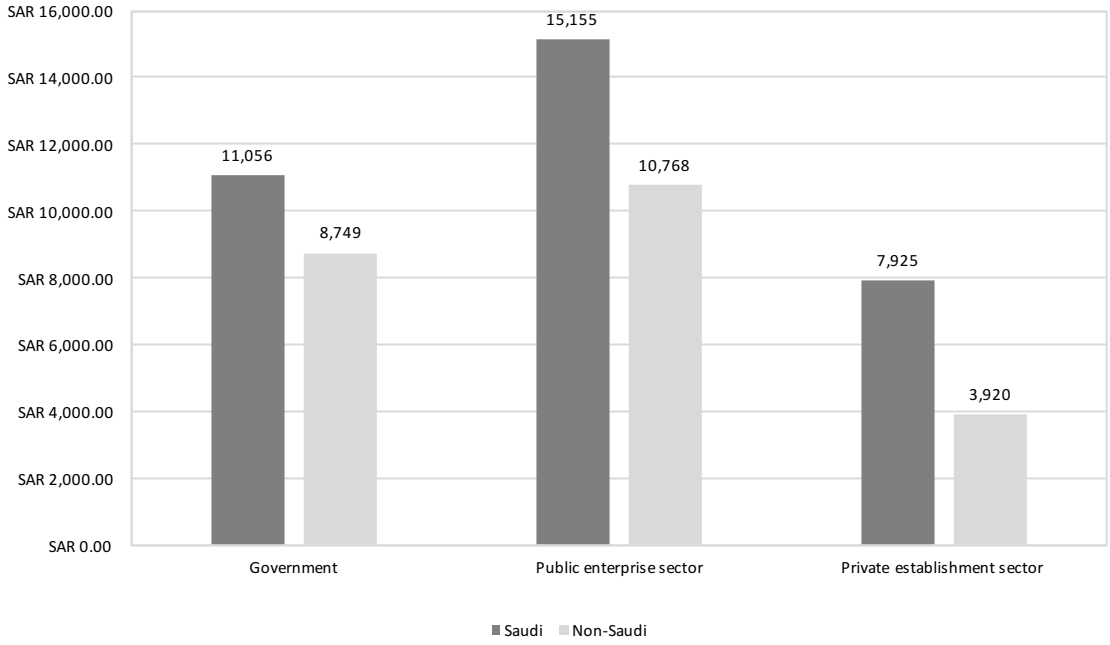
Appendix 3: Employees by sector and nationality



Note: The private sector is highly dominated by expatriate workers, with Saudi nationals accounting for only about 17% of the private workforce. In the public sector, however, Saudi nationals account for 92% of total employees.

Source: General Organization for Social Insurance, Kingdom of Saudi Arabia, "Contributors on the job by sector in the administrative regions 1436 A.H.", 2016.

Appendix 4: Average monthly salaries by sector and nationality



Note: Average monthly salaries for government and public sectors are significantly higher than salaries for the private sector. Within each sector, Saudi employees receive relatively higher salaries than non-Saudis.

Source: General Authority for Statistics, Kingdom of Saudi Arabia, "2016 monthly wage of paid employees index for the first half", 2016.