Exchange Rate Options for Saudi Economy: Evidence from the Computable General Equilibrium Model

Imtithal A. Althumairi
Department of Economics - King Saud University, Riyadh

ABSTRACT: This paper attempts to provide an evaluation of the selection and assessment of exchange rate options for the economy of Saudi Arabia. It examines the impact of changes in oil and petroleum prices, the results specify that adjustment in foreign savings, supporting fixed real exchange rate in the context of changes in oil world prices, quite effectively can isolate the domestic economy from international price fluctuations. If the economy is forced to adjust to the fall in world prices without offsetting changes in foreign savings, the resulting loss of export earnings and associated depreciation have major impacts on aggregate absorption and the structure of production.

Keywords: CGE model, Exchange Rate, Saudi Arabian economy.

1 Introduction

An important feature of the global economy is the great variety of exchange rate policies. Since the collapse of the Bretton Woods system in 1973, the comparative properties of fixed and flexible exchange rates have been of concern and interest to many international economists.  

The experience of numerous emerging economies over the last decade has led to a refreshed discussion of the question of whether to adopt a fixed or flexible exchange rate regime.  

Several economic studies emphasized the credibility gains from adopting a peg arrangement (Giavazzi and Giovannini, 1989; Dornbusch, 2001; among others). The main argument in favor of fixed rates is their ability to induce discipline and make the monetary policy more credible because the adoption of

---

1 In a classical paper Helpman (1981) formally compares different exchange rate regimes. He points out that in the presence of no market distortions and perfect foresight all equilibrium allocations are Pareto efficient.

2 Obstfeld (2002) discusses the stabilization benefits of different exchange rate regimes under the perspectives of the new open economy macroeconomics. Lane (2003) illustrates the effectiveness of stabilization policies in emerging markets in the context of different exchange rate regimes.
lax monetary (and fiscal) policies would eventually lead to an exhaustion of reserves and the collapse of the fixed exchange rate system, thus implying a big political cost for policy-makers. In the same way, some empirical studies introduced considerations on optimal macroeconomic stabilization, adding proxies for various types of shocks (see, for example, Melvin, 1985; Savvides, 1990, 1993). These authors find that the presence of domestic nominal shocks raises the likelihood of a currency peg, while real shocks reduce it.

In Saudi Arabia’s economy, one policy frequently debated is a reassessment of the riyal against the dollar or a switch to a basket of currencies. The reasoning is that this would help contain inflationary pressures, some of which trace to higher import prices resulting from the weaker dollar. However, it appears that the Saudi Riyals will remain pegged to the USD as Saudi Arabia Monetary Authority (SAMA) affirms its commitment to its exchange rate policy of pegging the Saudi riyal to the US dollar as a strategic choice that has supported economic growth in Saudi Arabia for over three decades. Furthermore, SAMA remains committed to maintaining the exchange rate at the official rate of 3.75 riyals to the dollar as an anchor of monetary and financial stability.\(^3\)

Given Saudi Arabia’s economic structure, the dollar peg makes sense as an oil (a USD-denominated commodity) represents 49% of GDP, 89% of exports, and around 75% of all fiscal revenues. The authorities are trying to build up the non-hydrocarbon sector to reduce reliance on oil revenues in the future, and a revaluation would make this sector less competitive.

This paper attempts to assess the impact of important strategies related to Saudi Arabia’s Exchange Rates choices using a Computable General Equilibrium (CGE) model of Saudi Arabia. These policies are separated into two groups of policy simulations. The scenarios are designed to find out the effect of increases and decreases in the world oil and refined petroleum products of 15 percent with different closure rules across the simulations. The first Closure rule is to have this increase in oil price with Fixed Exchange Rate (the riyals’ dollar peg). The second Closure is to have this increase in oil price with Flexible Exchange Rate.

The main benefit of Computable General Equilibrium Models over other types of economy-wide models is their consistency with microeconomic theory and their high degree of structural details. The CGE model offers a laboratory for doing exact experiments, changing parameters and exogenous variables, and computing the impact of those changes on the economy. The results of these experiments deliver information about the empirical magnitudes of such impacts, linking them to changes in the economic variables (e.g., world prices) and/or particular policy tools. The use of simulation models to do “counterfactual experiments” is useful for policy analysis, allowing the analyst to isolate the impact of particular policy changes or exogenous shocks. However, such experiments do not provide forecasts on how an economy will change over time. This requires projections of changes in all exogenous variables and parameters, while counterfactual simulations involve changing only a few, selected, exogenous variables and parameters.

\section*{2 Literature Review}

There is well-established and fast-growing literature that focuses on economic policy evaluation using computable general equilibrium CGE models. These models have grown in importance as a tool of both research and policy analysis since Johansen's (1960)
model of Norway. Originally limited to universities and research institutions, but recently CGE models are routinely used by governments in policy formulation and debate (Robinson and Devarajan, 2002). The CGE models cover various issues and have influenced many areas such as international trade, public finance and taxation policy, manufacturing, structural adjustment policies, labor market, income distribution, natural resources management, and pollution abatement. Specifically, these models can determine the potential winners and losers from changes in policies and the external environment, and indicate which policies could be applied to facilitate the transition from one equilibrium to another (Ven der Mensbrugghe, 1998).

CGE models have their backgrounds dating back to Leon Walras in the late nineteenth century. Walras, in his mathematical model, summarized the economic system in a set of excess demand equations in as many unknown prices. However, Walras was unsuccessful in his attempt to prove the existence of a unique equilibrium price vector that would solve his general equilibrium model simultaneously. He justified the existence of the solution by referring to the equality between the number of endogenous variables (prices) and the number of equations in his model. Walras also argued theoretically that a tatonnement process would guarantee the existence of the solution through successive price revisions that occur as a result of the discrepancy between quantities demanded and quantities supplied. The situations for the existence and uniqueness of the general equilibrium solution were not proved thoroughly until 1951. Arrow (1951), Arrow and Debreu (1954), Gale (1955), and others who used the Brouwer’s theorem to establish the consistency of the Walrasian model demonstrated this proof (Scarf and Hansen, 1973).

The applied work by Lief Johansen’s (1960) was the first empirical CGE model that was developed and tested using real data. He used his model to analyze policies related to resource allocation issues in Norway. His model assumed that factors of production (capital and labor) are fully employed and also perfectly mobile between sectors. Johnsen first linearized and then solved his model’s equations by simple matrix inversion.

Another earlier work on the CGE model was that of Arnold Harberger (1962), who was the first to numerically analyze income tax policy applied to the United States’ economy. He developed a two-sector, corporate, and no corporate, general equilibrium framework to find equilibrium tax schedules for each sector. The work of Scarf (1967) which develops a reliable algorithm to compute equilibrium prices for an Arrow-Debreu economy gives rise to the emergence of ‘computable general equilibrium, CGE, models. Shoven and Whalley (1973) indicate that the contributions of Johnsen, Harberger, and Scarf provide background and stimulate the practice of the general equilibrium models applying contemporary numerical methods (Shoven and Whalley, 1973).

The high cost of implementing numerical solutions has prevented general equilibrium models from gaining popularity. In the early 1970s, the CGE models became more widely used in economic modeling since numerical solutions became less expensive and more common to solve (Tawi, 1989).

The Johansen’s model (1960) and other CGE models offered during 1960 failed to deal with income distribution, which became a major concern for policymakers in developing countries during 1970. The first model was the Adelman-Robinson (1978) model of South Korea which was developed to explore the feasibility of utilizing different policy instruments to change the distribution of income. Another model dealt with income
distribution was constructed for Brazil. Both models presented several structural changes and incorporated basic structural variables to grasp the stylized facts that characterize developing countries and are significant for capturing important factors that impact income distribution. Improvements in these two models allowed for substitutability between local and imported goods - an assumption that was not used in either the original Korea or Brazil models (Adelman and Robinson, 1987). Today, a variety of CGE models has emerged and flourished with applications for more than 30 developing countries exploring various economic issues.

Computable General Equilibrium (CGE) models are capable of capturing most of the interactions of the various players in the economy. Despite the importance of the exchange rate regime choice of developing countries, little empirical work has been done covering these topics. The following is theoretical and empirical literature on the choice of exchange rate regimes.

Among the works related to exchange rates were the studies carried out by Mussa (1986), Baxter and Stockman (1989) as well as Flood and Rose (1995). The researchers focused on correlations and volatility in the data to analyze the relationship between exchange rate rules and macroeconomic variability. Results showed that floating exchange rate regimes were associated with a higher exchange rate variability. However, Baxter and Stockman argued that different exchange rate regimes were not able to explain shifts in the data of other macroeconomic aggregates. A difficulty with this approach is that a given set of observations may be compatible with different economic interpretations. Bayoumi and Eichengreen (1994) used a VAR model and apply the Blanchard and Quah (1989) approach to examine nominal and real shocks under different exchange rate regimes. Nonetheless, the researchers do not explicitly test for any hypothesis under fixed and floating exchange rates. In 2003 Uribe and Yue (2003) used a panel vector autoregression (PVAR) to analyze the role of fluctuations in US interest rates in driving business cycles in African and Latin American countries. Broda (2003) studied whether adjustments of macroeconomic variables to real shocks vary under different exchange rate options. Using a PVAR approach, the study captured both the stochastic patterns and co-movements of macroeconomic variables and tolerated examining the dynamics in terms of deviations from the equilibrium across countries. The study examined the adjustment process of the real exchange rate, home real output, and the trade balance under different exchange rate regimes based on world output and world real interest rate shocks. Careful consideration is required for the interaction between world output and interest rate shocks; to evaluate the effect of one, it is important to include the other because arrangements in the world interest rate affect world output. For example, when the world output high, demand for financial and physical assets may be high and so might be the world interest rate. This influences the propensity to invest and in turn, feeds back into the development of world output. Consequently, the empirical analyses of world output shocks require the insertion of the world real interest rate in the econometric model to account for possible connections between the two variables. World output shocks are an important tool by which foreign shocks and business cycles are conveyed to small open economies. Changes in world output can be seen as exogenous movements in the demand for small open economies’ goods and services. This affects the wealth of domestic producers and households and impacts domestic absorption which leads firms to revise expectations about future demand. This moves aggregate supply and, as a result, output and the trade balance (Hoffmann, 2005).
Calvo and Reinhart (2002) consider a country experience of very small exchange rate movements but high relative variability in reserves and interest rates. This action is often referred to as the “fear of floating” phenomenon. In many cases, central banks challenge to stabilize the exchange rate since they view devaluations or depreciation as probable causes for adverse effects on the balance sheet, largely when countries have high debts in a foreign currency (Calvo and Reinhart, 2000).

Alesina and Wagner (2006) explained a possible reason for fear of floating. They illustrated that countries with comparatively poor institutional quality are less able to stick to their statements of fixing the exchange rate and hence unrestraint it more often. On the other hand, countries with comparatively good institutions show fear of floating, maybe to indicate their differences from those countries unable of keeping promises of monetary stability. Barajas et al. (2008) provide another reason for fear of floating. They explain that international capital markets might benefit countries that are classified as flexible, and once this “flexibility” is declared, there appears to be no penalty for fear of floating. 4 In contrast, a country may manifest to have a pegged exchange rate, while in fact, it carries out frequent changes in parity. This performance is called the “fear of pegging” phenomenon (Levy-Yeyati and Sturzenegger, 2005). Genberg and Swoboda (2005) believed that countries actively using monetary policy tools to stabilize their exchange rate and not oblige to a fixed exchange rate because they fear of being subjected to speculative attacks. Levy-Yeyati et al. (2013) studied the relationship between exchange rate depreciation, growth, and productivity in developing countries, and concluded that in most cases intervention has been aimed at limiting appreciations rather than depreciations, often motivated by a neo-mercantilist view that a depreciated real exchange rate serves as protection for domestic industries.

3 Research Methodology

To study the exchange rate options, the Dynamic Multi-Sectors Computable General Equilibrium model was used for the case of Saudi Arabia to evaluate policy options and assess policy changes. The Computable General Equilibrium (CGE) models provide a quantitative, comprehensive view of production, consumption, and trade in an economy. They include a disaggregated treatment of producers and consumers, making it possible to consider linkages between different sectors, between production and consumption, and between macro and micro levels of the economy. Over the past twenty-five years, CGE models have become a standard tool for empirical economic analysis. The payoffs from this type of analysis have increased as a result of improvements in model specification, data availability, computer technology, and the skills of policy analysts. While their starting point is the Walrasian market economy, the incorporation of a wide variety of government policies and market rigidities has permitted the new generation of this class of models to capture structural features that typical of real-world economies.

The Model Description

The model is in the neoclassical-structuralist modeling tradition presented in Dervis et al. (1982). It incorporates additional features developed by Lofgren, Robinson, Thomas, and El-Said (2002). It is formulated as a
simultaneous equation system, including both linear and non-linear equations. The equations capture the full circular flow of payments including production (activities producing outputs using factors and intermediate inputs), consumption (by households and the government), investment (private and public), trade, other government revenue, and spending activities, as well as the market equilibrium conditions, macro-balances and dynamic updating equations under which the agents operate.

3.1 Production
Each producer (represented by an activity) is assumed to maximize profits, defined as the difference between revenue earned and the cost of factors and intermediate inputs. Profits are maximized subject to a nested production function. In the first nest, the technology is specified by a constant elasticity of substitution (CES) function or a Leontief function of the quantities of value-added and aggregate intermediate input. The Leontief alternative is the default. The CES alternative may be preferable for particular sectors to allow for substitution possibilities in the choice of production factors. Value-added is itself a CES function of primary factors whereas the aggregate intermediate input is a Leontief function of disaggregated intermediate inputs. Each activity produces one or more commodities according to fixed yield coefficients. As noted, a commodity may be produced by more than one activity. The revenue of the activity is defined by the level of the activity, yields, and commodity prices at the producer level. Unless additional factor-related constraints are imposed, the essence of the activity profit-maximizing decision involves employing a set of factors up to the point where the marginal revenue product of each factor is equal to its factor price. Factor wages may differ across activities, not only when the market is segmented but also for mobile factors. In the latter case, the model incorporates discrepancies that stem from exogenous causes (for example, wage differences across activities resulting from considerations such as status, comfort, or health risks). Factor incomes are distributed to domestic and foreign institutions in fixed shares that are defined by factor and activity. The fact that they are disaggregated by activity is a Saudi-Specific extension.

3.2 Institutions
In the CGE model, institutions are represented by households, enterprises, the government, and the rest of the world. The households (disaggregated as in the Social Accounting Matrix (SAM) for Saudi and non-Saudi households) receive income from the factors of production and transfers from other institutions. The households use their income to pay direct taxes, save, consume, and make transfers to other institutions. Direct taxes and transfers to other domestic institutions are defined as fixed shares of household income whereas the savings share is flexible for selected households. The income that remains after taxes, savings, and transfers to other institutions is spent on consumption. Household consumptions purchased at market prices (incorporating or adjusted for taxes). In many CGE model’s household expenditures behavior functions are derived from the maximization of Cobb-Douglas or Constant Elasticity of Substitution (CES) utility. The limitation of using these functional forms for consumption is that they imply a unitary income elasticity of demand. This fails to account for the way changes in income affect the structural adjustment of the economy to exogenous shocks. To avoid such drawbacks, household consumption in the current model is allocated according to the linear expenditure system (LES) demand functions, derived from
the maximization of a Stone–Geary utility function. 5 Instead of being paid directly to the households, factor incomes may be paid to one or more enterprises. Enterprises may also receive transfers from other institutions. Enterprise incomes are allocated to direct taxes, savings, and transfers to other institutions. Enterprises do not consume. Apart from this, the payments to and from enterprises are modeled in the same way as the payments to and from households. The government collects taxes and receives transfers from other institutions. All taxes are at fixed *ad valorem* rates. Transfers from the rest of the world are exogenous in foreign currency whereas transfers from domestic institutions are fixed shares of the net (post-tax and post-savings) incomes of these institutions. The government uses this income to finance its consumption, commodity subsidies, and transfers to other institutions. Government consumption is fixed in real (quantity) terms whereas government transfers to domestic institutions (households and enterprises) are CPI-indexed. Government savings (the difference between government income and spending) is a flexible residual. The final institution is the rest of the world. In addition to transfer payments from the rest of the world to domestic institutions and factors (which all are fixed in foreign currency), Saudi Arabia receives payments from the rest of the world for exports. Saudi Arabia spends pays transfers to the rest of the world modeled as fixed net-income shares for domestic non-government institutions but fixed in foreign currency for the government and imports. Foreign savings (or the current account deficit) is the difference between foreign currency spending and receipts. The treatment of trade with the rest of the world is explained in the discussion of commodity markets, which follows next.

### 3.3 Commodity Markets

All commodities (domestic output and imports) enter markets. The domestic output may be sold in the market or consumed at home. For marketed output, the first stage in the chain consists of generating aggregated domestic output from the output of different activities of a given commodity. These outputs are imperfectly substitutable as a result of, for example, differences in timing, quality, and distance between the locations of activities. A CES function is used as the aggregation function. The demand for the output of each activity is derived from the problem of minimizing the cost of supplying a given quantity of aggregated output subject to this CES function. Activity-specific commodity prices serve to clear the implicit market for each disaggregated commodity. At the next stage, the aggregated domestic output is allocated between exports and domestic sales on the assumption that suppliers maximize sales revenue for any given aggregate output level, subject to imperfect transformability between exports and domestic sales, expressed by a constant elasticity of transformation (CET) function.

In the international markets, export demands are infinitely elastic at given world prices. The price received by domestic suppliers for exports is expressed in domestic currency and adjusted for the transaction costs (to the border) and export taxes (if any). The supply price for domestic sales is equal to the price paid by dogmatic demanders minus the transaction costs of domestic marketing (from the supplier to the demander) per unit of domestic sales. If the commodity is not exported, the total output is passed to the domestic market. Domestic demand is made up of the sum of demands for household consumption, government consumption, investment (the determination of

---

which is discussed below), intermediate inputs, and transactions (trade and transportation) inputs. If the supply of a commodity destined for domestic use is made up of both imports and domestic output, then all domestic market demands are for a composite commodity made up of imports and domestic output, the demands for which are derived on the assumption that domestic demanders minimize cost subject to imperfect substitutability. This is also captured by a CES aggregation function.\(^6\) Total market demand is directed to imports for commodities that lack domestic production and to domestic output for non-imported commodities. Demand prices are adjusted for commodity taxes and subsidies. The derived demands for imported commodities are met by international supplies that are infinitely elastic at given world prices. The import prices paid by domestic demanders also include import tariffs (at fixed \textit{ad valorem} rates) and the cost of a fixed quantity of transaction services per import unit, covering the cost of moving the commodity from the border to the demander.\(^7\) Similarly, the derived demand for domestic output is met by domestic suppliers. The prices paid by the demanders include the cost of transaction services (if such cost is treated explicitly in the Social Accounting Matrix SAM); in this case reflecting that the commodity was moved from the domestic supplier to the domestic demander. The prices received by domestic suppliers are net of these transaction costs. Flexible prices equilibrate demands and supplies of domestically marketed domestic output. Compared with the alternative assumptions of perfect substitutability and transformability, the assumptions of imperfect transformability (between exports and domestic sales of domestic output) and imperfect substitutability (between imports and domestically sold domestic output) permit the model to better reflect the empirical realities. The assumptions used to give the domestic price system a degree of independence from international prices and prevent unrealistic export and import responses to economic shocks. At the disaggregated commodity level, these assumptions allow for a continuum of tradability and two-way trade, which is commonly observed even at very fine levels of desegregations.

### 4 Policy Scenarios

The first category of Simulations consists of two scenarios aimed at finding out the impact of increases and decreases in the world crude oil and refined petroleum products of 15 percent with different closure rules across the simulations. In the first set of simulations, we assume that the government reacts to the oil-price shock by allowing foreign savings to adjust sufficiently to keep the exchange rate fixed. In the second set of simulations, however, the government is assumed to keep foreign savings at the base level, forcing the adjustment to the oil-price shock onto the domestic economy.

The assumptions for the oil price simulations with different Exchange Rates are described in table 1. For this set of simulations, an analysis will focus on the impact of increases and decreases in the world prices of oil and refined petroleum products of 15%. The simulations are different not only in terms of the direction of the oil price change but also in terms of how the economy will respond at the macro level; i.e. the closure rules differ across the simulations:

---

\(^6\) Armington function. Imperfect substitutability between imports and domestic commodities.

\(^7\) The transaction costs are not \textit{ad valorem}. The rates- the ratio between the margin and the price without the margin- change in the prices of transactions services and/or the commodities that are marketed.
Table 1. The assumptions for the oil price simulations with different Exchange Rate Scenarios

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>First Scenario</th>
<th>Second Scenario</th>
<th>Third Scenario</th>
<th>Fourth Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closure A</td>
<td>Increase world prices of crude and refined petroleum products by 15%</td>
<td>Decrease world prices of crude and refined petroleum products by 15%</td>
<td>Increase world prices of crude and refined petroleum products by 15%</td>
<td>Decrease world prices of crude and refined petroleum products by 15%</td>
</tr>
<tr>
<td></td>
<td>Fixed Real Exchange Rate (RER), foreign savings adjust.</td>
<td></td>
<td>Flexible Real Exchange Rate (RER), foreign savings fixed.</td>
<td></td>
</tr>
</tbody>
</table>

Table 1 demonstrated oil price simulations with different Exchange Rates in the economy of Saudi Arabia. In the first set of simulations, the assumption is that the government reacts to the oil-price shock by allowing foreign savings to adjust sufficiently to keep the exchange rate fixed. In the second set of simulations, the government is assumed to keep foreign savings at the base level, forcing the adjustment to the oil-price shock onto the domestic economy. Figure 1 shows the dynamic path for macroeconomic indicators without shock. This is the so-called Baseline Scenario in which we compare the results when running different scenarios.

Figure 1. Macroeconomic indicators (Baseline Scenario 2015-2020)

Baseline: projected dynamic path without shock.
*2020 data estimated based on the GDP and National Accounts First quarter, 2020, 2020/06/30.
5 Empirical Results

The General Equilibrium Model for Saudi Arabia was used to test two categories of assumptions. The first groups of simulations focused on changing oil prices with Fixed Real Exchange Rate (first and second scenarios), and the second groups of simulations related to changing oil price with Flexible Real Exchange Rate (third and fourth scenarios). The results as following:

5.1 The simulations results under fixed real exchange rate

The first sets of simulations consider the increase and decrease of world prices of crude and refined petroleum products by 15%. We assume that the government responds to the changes in world prices of oil and refined petroleum by allowing foreign savings to adjust sufficiently to keep the exchange rate fixed. The intent would be to insulate the domestic economy from the impact of the change in world prices. Table 2 summarizes the macroeconomic results of the oil price simulations under a fixed real exchange rate.

Table 2. Macroeconomic results of the oil price simulations under fixed real exchange rate

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Increase world prices of crude and refined petroleum products by 15%</td>
<td>Decrease world prices of crude and refined petroleum products by 15%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private Consumption</td>
<td>-0.4</td>
<td>-0.77</td>
<td>-1.3</td>
<td>0.43</td>
<td>0.9</td>
<td>1.49</td>
</tr>
<tr>
<td>Total Real Exports</td>
<td>0.42</td>
<td>0.78</td>
<td>1.9</td>
<td>-0.49</td>
<td>-1.06</td>
<td>-2.15</td>
</tr>
<tr>
<td>Total Real Imports</td>
<td>-0.22</td>
<td>-0.42</td>
<td>-1.3</td>
<td>0.22</td>
<td>0.43</td>
<td>1.4</td>
</tr>
<tr>
<td>Foreign Savings (% of GDP)</td>
<td>-3.44</td>
<td>-6.7</td>
<td>-13.25</td>
<td>3.75</td>
<td>7.85</td>
<td>14.26</td>
</tr>
<tr>
<td>GDP at market prices</td>
<td>0.08</td>
<td>0.16</td>
<td>0.46</td>
<td>-0.09</td>
<td>-0.25</td>
<td>-0.55</td>
</tr>
<tr>
<td>Net-indirect taxes</td>
<td>-0.03</td>
<td>-0.08</td>
<td>-0.09</td>
<td>0</td>
<td>-0.04</td>
<td>-0.07</td>
</tr>
<tr>
<td>GDP at factor cost</td>
<td>0.08</td>
<td>0.15</td>
<td>0.55</td>
<td>-0.09</td>
<td>-0.2</td>
<td>-0.46</td>
</tr>
<tr>
<td>Absorption</td>
<td>-0.25</td>
<td>-0.47</td>
<td>-0.82</td>
<td>0.27</td>
<td>0.55</td>
<td>0.93</td>
</tr>
</tbody>
</table>

Note: all results are presented as percentage changes relative to the baseline.
Baseline: projected dynamic path without shock. Foreign savings is the current account deficit.

The effect of negative and positive oil price changes is symmetric except for the fact that the directions of changes are reversed, a positive price shock leads to roughly the same changes as a negative price shock of the same magnitude. It is clear from the simulations results presented in table (2) that a policy of keeping the exchange rate fixed as described in the preceding paragraph does insulate the domestic economy from the price shocks. When the world price of oil and refined petroleum products decreases (increases), this policy leads to a small depreciation (appreciation) of the real exchange rate defined as the ratio of the prices of traded goods to non-traded goods. The current account deficit declines (increases) - foreign savings become less (more) negative- maintaining absorption and its components close to the base levels. It can be seen that the changes in real absorption and its components are all minors. During the current boom: a 15% increase in world prices of crude and refined petroleum products, the total absorption and private consumption both decline for less than -1.5%. Total real imports decrease by -0.22% in 2010, -0.42% in 2015, and -1.3% in 2020. Total
real exports increase by 0.42% in 2010, 0.78% in 2015, and 1.9% in 2020. The total effect on the GDP is positive which will increase by 0.08% in 2010, 0.15% in 2015, and 0.55% in 2020. The fixed exchange rate prevents any changes in domestic prices for traded commodities other than oil and petroleum products. The foreign savings variable shows the cost of insulating the domestic economy from the price shocks. When the world oil price increases foreign savings as a percentage of GDP declined by -3.44% in 2010, -6.7% in 2015, and -13.25% in 2020.

In contrast, when the world price of oil and petroleum products declines, this brings a positive effect on the total absorption and its components. Total absorption increases by 0.27% in 2010, 0.55% in 2015, and 0.93% in 2020. The private consumption increases by 0.43% in 2010, 0.9% in 2015, and 1.49% in 2020. Total real imports increase by 0.22% in 2010, 0.43% in 2015, and 1.4% in 2020. Total real exports, however, declined by -0.49% in 2010, -1.06% in 2015, and -2.15% in 2020. The total effect of this simulation on the real GDP is negative for less than -0.5%.

5.2 The simulations results under flexible real exchange rate

The second sets of simulations consider the increase and decrease of world prices of crude and refined petroleum products by 15%. In these experiments, the government is assumed to keep foreign savings at the base level, forcing the domestic economy to adjust to the oil-price shock. The real exchange rate will have to depreciate (appreciate) to adjust to the loss (increase) in export earnings from oil price changes. The effects of negative and positive oil price changes are different from this closure rule (i.e. flexible real exchange rate and foreign savings fixed). Table 3 summarizes the macroeconomic results of the oil price simulations under a flexible real exchange rate.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase world prices of crude and refined petroleum products by 15%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private Consumption</td>
<td>7.42</td>
<td>14.7</td>
<td>24.2</td>
<td>-7.7</td>
<td>-15.94</td>
<td>-25.45</td>
</tr>
<tr>
<td>Total Real Exports</td>
<td>-2.66</td>
<td>-4.87</td>
<td>-10.55</td>
<td>3.14</td>
<td>6.78</td>
<td>12.68</td>
</tr>
<tr>
<td>Total Real Imports</td>
<td>9.2</td>
<td>18.79</td>
<td>20.92</td>
<td>-8.49</td>
<td>-16.33</td>
<td>-18.59</td>
</tr>
<tr>
<td>Foreign Savings (% of GDP)</td>
<td>3.12</td>
<td>5.66</td>
<td>14.23</td>
<td>-3.87</td>
<td>-8.8</td>
<td>-15.77</td>
</tr>
<tr>
<td>GDP at market prices</td>
<td>-0.56</td>
<td>-1.16</td>
<td>-2.14</td>
<td>0.45</td>
<td>0.64</td>
<td>0.89</td>
</tr>
<tr>
<td>Net-indirect taxes</td>
<td>1.07</td>
<td>4.25</td>
<td>8.98</td>
<td>-2.26</td>
<td>-6.08</td>
<td>-12.18</td>
</tr>
<tr>
<td>GDP at factor cost</td>
<td>-0.49</td>
<td>-0.93</td>
<td>-1.52</td>
<td>0.49</td>
<td>0.89</td>
<td>1.23</td>
</tr>
<tr>
<td>Absorption</td>
<td>4.53</td>
<td>8.97</td>
<td>15.3</td>
<td>-4.8</td>
<td>-9.73</td>
<td>-16.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Decrease world prices of crude and refined petroleum products by 15%</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>

Note: all results are presented as percentage changes relative to the baseline.
Baseline: projected dynamic path without shock. Foreign savings is the current account deficit.

In this situation, the increase in the world price leads to a noticeable increase in real absorption and private consumption. Total absorption increases by 4.53% in 2010, 8.97% in 2015, and 15.3% in 2020. Private consumption also increases by 7.42% in 2010, 14.7% in 2015, and 24.2% in 2020. Total real imports increase by 9.2% in 2010, 18.79% in 2015, and 20.92%
in 2020. Total real exports, however, declined by -2.66% in 2010, -4.87% in 2015, and -10.55% in 2020. The total effect from this simulation on the real GDP is negative leading to a decline by -0.56% in 2010, -1.16% in 2015, and 2.14% in 2020. When the world price of oil and petroleum products decline under the flexible real exchange rate, the adjustments are also severe affecting all macroaggregates. Total absorption and its components show a substantial decline. For example, the household consumption decreased by -7.7% in 2010, -15.94% in 2015, and -25.45% in 2020. Total real imports decline by -8.49% in 2010, -16.33% in 2015, and -18.59% in 2020.

In total, the effect of variations in the world prices of oil and petroleum products is significant for an oil-producing country such as Saudi Arabia. Given the size of foreign savings from oil revenues, the government can minimize the impact of price falls on the domestic economy by varying foreign savings to offset variations in export revenues, thereby supporting a relatively stable real exchange rate. Such policies, aiming at maintaining the exchange rate, can enrich the impact of changes in world prices. If the economy is forced to adjust to the fall in world prices without offsetting changes in foreign savings, the resulting loss of export earnings and associated depreciation have major impacts on aggregate absorption and the structure of production.

6 Conclusion

The comparative qualities of fixed and flexible exchange rates are of relevance to many international economists and policymakers, but no agreement regarding one system’s advantage has been reached. To evocatively add to the debate, this paper examines the impact of changes in oil and petroleum prices in the Saudi Arabian economy under different exchange rate options.

In the experimental part of the paper, the dynamic multi-sector computable general equilibrium model for Saudi Arabia was used to evaluate and assess policy options changes. The empirical results provide support for the adoption of a fixed exchange rate regime. When analyzing the impact of changes in oil and petroleum prices on Saudi Arabia’s economy, results indicate that adjustments in foreign savings can insulate the domestic economy from international price fluctuations. If the economy is forced to adjust to the fall in world prices without offsetting changes in foreign savings, the resulting loss of export earnings and associated depreciation have major impacts on aggregate absorption and the structure of production.

In conclusion, this paper adds to the debate regarding the question of whether to adopt fixed or flexible exchange rate regimes in the Saudi Arabian economy by providing evidence for the benefits of choosing fixed exchange rates policy. Concentrating on negative external shocks, fixed exchange rate options can help stabilize macroeconomic variables in fixed exchange rate economies.

The disaggregation of macroeconomic variables is recommended as it can assist in better judgment for the policies adopted by an economy. This paper has only investigated the fixed and flexible exchange rates effects on some variables; it has not assessed the other market aspects. It is recommended that these factors be assessed. Further research is required to establish well perceptions and support the decision.
**Figure 2.** Macroeconomic effects of the Oil Price Simulations (% change compared with the baseline)
Net-indirect taxes

<table>
<thead>
<tr>
<th>Year</th>
<th>2010</th>
<th>2015</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>1.03</td>
<td>0.12</td>
<td>0.78</td>
</tr>
</tbody>
</table>

GDP at factor cost

<table>
<thead>
<tr>
<th>Year</th>
<th>2010</th>
<th>2015</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>0.08</td>
<td>0.09</td>
<td>0.09</td>
</tr>
</tbody>
</table>

References


Savvides, A. (1993): Pegging the exchange rate and the choice of a standard by LDCs: A joint


خيارات سعر الصرف للاقتصاد السعودي:
دراسة تطبيقية باستخدام نموذج التوازن العام المحسوب

امتثال عبدالله الشمري
قسم الاقتصاد - جامعة الملك سعود - الرياض

المستخلص: تُحاول هذه الورقة تقييم خيارات سعر الصرف للاقتصاد المملكة العربية السعودية. إذ تشير النتائج عند تحليل تأثير التغييرات في أسعار النفط والبرتوكهرميات على اقتصاد المملكة العربية السعودية، إلى أن التعديلات في المدخلات الأجنبية ضمن خيار سعر الصرف الحقيقي الثابت الذي لم يتغير في سياق التغيرات في أسعار النفط العالمية، يمكن أن تعزل الاقتصاد المحلي بشكل فعال عن تقلبات الأسعار الدولية. وفي حين إذا اضطر الاقتصاد إلى التكيف مع انخفاض الأسعار العالمية دون تعويض ذلك من خلال التغير في المدخلات الأجنبية ومع افتراض المحافظة على تلك المدخلات عند مستوى الأساس، فإن الخسارة الناجمة عن ذلك في الإيرادات الصادرة وما يرتبط بها من انخفاض في القيمة لها أثار كبيرة على الاستيعاب الكلي للاقتصاد، وهكذا الإنتاج.