Fiscal Reform – an Aid or Hindrance to Economic Diversification in Saudi Arabia: A Computable General Equilibrium (CGE) analysis*

Roos Elizabeth. L[1, 2] and Adams Philip D[1].

[1]Centre of Policy Studies, Victoria University, Melbourne, Australia.

[2] Corresponding author. Tel + 61 3 9919 1491

*The work described in this paper was carried out by the Centre of Policy Studies. The views expressed are those of the authors and not do represent the views of the organisation or members thereof.

Abstract

The oil price fell from around $US110 per barrel in 2014 to less than $US50per barrel at the start of 2017. This put enormous pressure on government budgets within the Gulf Cooperation Council (GCC) region, especially the budgets of oil exporting countries. The focus of GCC economic policies quickly shifted to fiscal reform. In this paper we use a dynamic CGE model to investigate the economic impact of introducing a 5 per cent Value Added Tax (VAT and a tax on business profit, with specific reference to the Kingdom of Saudi Arabia (KSA).

Our study shows that although the introduction of new taxes improves government tax revenue, markets are distorted lowering economic efficiency and production due to a tax. In all simulations, real GDP, real investment and capital stock falls in the long-run. This highlights the importance of (1) understanding the potential harm caused to economic efficiency and production due to taxes, and (2) fiscal reform includes both government expenditure reform and identifying non-oil revenue sources. This allows for the design of an optimal tax system that meets all future requirements for each of the individual Gulf States.

Keywords: Computable General Equilibrium (CGE) models, Saudi Arabia, Fiscal reform

JEL Classification: C68, D58, E63, O53

Table of Contents

1 Introduction

The long-term sustainable economic growth is the overriding target of economic policy for any country, including the GCC States. With this in mind, the Charter of the Gulf Cooperation Council was signed in May 1981, thereby officially establishing the Gulf Cooperation Council (GCC). The member states are the United Arab Emirates (UAE), Kingdom of Bahrain, Kingdom of Saudi Arabia, Sultanate of Oman, State of Qatar and the State of Kuwait. The objectives of the GCC is to enhance and promote co-ordination, integration and inter-connectivity among the states.[1]

The GCC countries share common features. Firstly, all member states are monarchies. Secondly, all have economies that rely on the production of hydrocarbons for export. Their economies lack diversification and is mostly build around a small group of sectors, such as crude oil and gas and related petroleum sectors. Third, all have fiscal structures that provide large subsidies on domestic consumption of energy commodities - which is financed from oil and gas sales. In most of the region, around 90 per cent of fiscal revenue comes from oil and gas profits earned by state owned enterprises. With higher oil prices, the Gulf States functioned within a largely tax-free environment. Fourth, the labour market is characterised by a large expatriate community working mostly in the private sector and an overrepresentation of nationals working in the public sector. Finally, all of the economies are facing significant long-term pressure for structural reform due to declining hydrocarbon reserves. Currently, this pressure is exacerbated by the comparatively low price of oil. With the oil price falling from around $US100 per barrel in 2014 to less than $US50 per barrel at the start of 2017, many oil exporting GCC countries experience a fall in foreign revenue earnings, resulting in current account and government budget deficits.

Strategies for achieving long-term sustainable growth given the challenges faced in the GCC include: (1) Fiscal restructuring; (2) Labour market reform and (3) Economic diversification. While these strategies make good sense in their own right, they do overlap and hence there is a potential for conflict. For example, fiscal reforms (e.g. the introduction of new taxes and domestic price reforms for energy products) may change the structure (and hence diversity) of the economy; diversification of the industrial structure may affect the structure of demand for skills and occupations; and both diversification and labour market reform may have significant fiscal effects. These overlaps may reduce the overall effectiveness of the package of strategies.

In this paper, using a recursive dynamic CGE model[2] for the Kingdom of Saudi Arabia (KSA), we investigate the economic impact of the introduction of a 5 per cent VAT on the use of goods and services paid by the final user. We also include two illustrative simulations where we introduce tax on business profit. The model is called the General Equilibrium Model for Saudi Arabia (GEMSA).

CGE models are useful in analysing the impact of tax reform because they: (1) are rich in detail related to the domestic production and imports of commodities, and the use of these commodities by different domestic and foreign users; (2) link the production and/or use of these commodities to the treatment of different taxes, subsidies and prices; (3) allow for the detailed modelling of government income and spending, and (4) allow for government income to be transferred back to the economy via

[1] The objectives of the Charter is to achieve and enhance unity between the states and to formulate similar regulations in fields such as economics and financial issues, commerce and communication, education and culture, social and health affairs, tourism and information as well as legislative and administrative issues.

[2] A recursive dynamic CGE model explicitly trace each variable through time and are solved sequentially, on period at a time.

different channels, such as public sector investment in strategic sectors or lump sum payments to vulnerable households. Since the GCC States function largely in a tax free environment, CGE models can inform on the relative efficiency impacts of introducing new taxes. This is useful when designing an optimal tax system that will meet all future requirements for each of the individual Gulf States and also the GCC as an economic bloc.

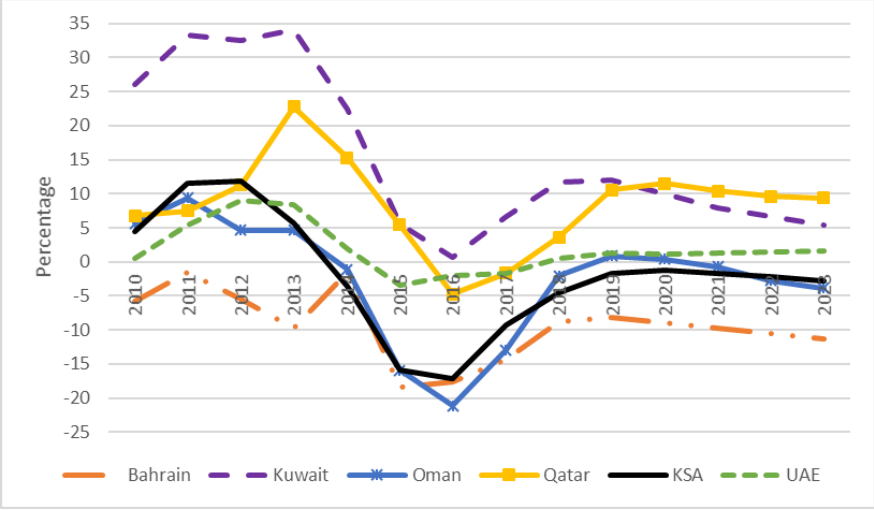
The rest of the paper is organised as follows. Section 2 provides background information on the current economic situation in the GCC States, with particular emphasis on fiscal reform. Section 3 presents the Saudi CGE model used in this study. An overview of the data which forms the core database is given in Section 4. Section 5 describes the simulation design. Results are presented in Section 6, and concluding remarks are in Section 7.

2 Lower oil price and fiscal reform

2.1 Fiscal and current account positions of the GCC states

The lower oil price impacted the fiscal and current account positions of the GCC states to different degrees. Figures 1 and 2 show the fiscal balance and current account balance as a percentage of GDP from 2010 to 2023. These data were sourced from the IMF with estimates starting from 2017 onwards. Figure 1 shows, with the exception of Bahrain, that the GCC States had budget surpluses (indicated by the positive ratio) for the years preceding 2014. With the fall in the oil price, government revenues fell, resulting in large deficits of more than 15 per cent of GDP for Oman, KSA and Bahrain in 2015.

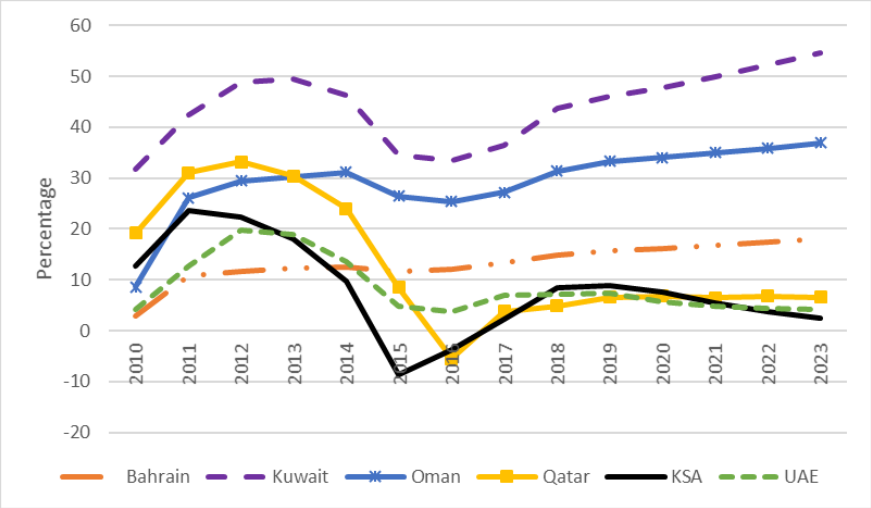
Figure 1. Fiscal balances as a share of GDP for the GCC States, 2010 – 2023 (% of GDP)



Source: IMF WEO data, 2018. Estimates start after 2017.

Figure 2 shows the current account balance as a share of GDP from 2010 to 2023. The impact of the lower oil price results in reduced and negative current account balances. For Saudi Arabia and Qatar, the current account balance moved toward deficit in 2015 and 2016, but improved in 2017.

Figure 2. Current account balances as a share of GDP for the GCC States, 2010-2023 (% of GDP)



Source: IMF WEO data, 2018. Estimates start after 2017.

In response to the recent fall in the oil price, GCC States embarked on fiscal reforms, including the removal of energy subsidies, the introduction of taxes[3] and reducing government spending. The overriding purpose of introducing these reforms is to narrow fiscal deficits prevalent since 2015. It is expected that the fiscal deficits will narrow as these reforms are implemented over time.

2.2 Taxes in the GCC

Historically, various taxes have been introduced in the GCC. For example, Kuwait was the first country to introduce corporate tax in 1955. Although other GCC states soon followed, corporate tax rates were drastically reduced to promote foreign investment (IMF, 2016: 4-5).[4] The KSA introduced personal income, corporate and capital gains taxes in 1950 on both nationals and non-Saudis. However, within 6 months the tax law was changed to exclude nationals and in 1975 income tax on foreigners were suspended (IMF, 2016: 4-5).

Although the current mix of tax revenue in the GCC are limited, there are some characteristics (IMF, 2016: 5-6): Firstly, there is limited personal income taxes levied in the GCC. In general, there is no taxes on wage income earned by national and non-nationals. Qatar and the KSA have limited income taxes and fees on non-GCC national working in these countries. In addition, Zakat is paid by nationals and is levied at 2.5 per cent of a person or companies net worth and is paid to help the poor.[5]

[3] GCC countries have been exploring the possibility of raising non-oil revenue through various taxes including business profit tax, taxes on remittances, taxes on income and wages paid to foreign workers and taxes on financial transactions (IMF, 2016: 4).

[4] The corporate tax rates in the GCC were reduced in Kuwait from 55 percent in 2007 to the current level of 15 percent, in the KSA from 45 per cent in 1999 to 20 per cent in 2006 and Qatar from 35 per cent in 2009 to 10 per cent in 2010. Bahrain and the UAE records no corporate tax while Oman's corporate tax rate was around 12 per cent until it was increased to 15 per cent in 2017 (Trading economics online data, 2018).

[5] Zakat is mandatory in the KSA, voluntary in Bahrain, Kuwait, and UAE and there is no specific government system in Oman and Qatar (Zakat by country, 2010).

Secondly, taxes on profit mostly applies to foreign non-oil companies (see footnote 4). The effective tax rate paid by foreign companies is lower due to tax relief and incentives extended to foreign companies to compensate for the loss in revenue and to promote investment.

Thirdly, custom duties are unified across the GCC. In January 2003, the Common external Tariff (CET) was introduced at 5 per cent on all non-GCC products, except for those good that are exempted.

Fourth, there are some very low consumption taxes. The UAE, Bahrain and Oman impose municipal taxes ranging from between 3 – 10 per cent on property rentals, hotels, entertainment and government services such as issuing passports and drivers licences. Oman imposes a 2 per cent tax on electricity while Bahrain imposes a 12 per cent sales tax on gasoline. In most GCC countries there are no property taxes.

Fifth, in all GCC States, social security is paid by nationals. Employers and employees pay the social security tax. In all except the KSA, employers pay a higher share while in the KSA the share is equally split between employers and employees.

Sixth, in most of the GCC States there are fees and taxes on the employment of foreign workers which is used to support and train the national labour force. The KSA and Bahrain impose monthly fees on foreign workers to train national. Oman has the same system but the fee is calculated as a percent of the foreign worker wage bill. The UAE imposes bi-annual work permit fees, while Kuwait imposes a tax on the annual net profits of Kuwaiti companies listed on the stock market. Qatar imposes no fees or taxes on wages earned by nationals and non-nationals.

The above section highlights that there are some taxes imposed at low rates in the GCC. There is scope to broaden the tax revenue sources by introducing new taxes and/or increase existing tax rates and fees. As part of the objectives of The Charter of the Arab States of the Gulf cooperation Council (GCC), the Common VAT Framework Agreement between all GCC member states was finalised in 2016.[6] With this agreement, a VAT rate of 5 per cent will be introduced in each Gulf state. [7] There is some discretion that allows states to determine exempted and zero-rated items.[8]

The KSA and the UAE were the first GCC countries to introduce VAT and excise taxes on cigarettes, energy and sugar drinks. The UAE and KSA introduced VAT as of 1 January 2018. Bahrain introduced excise taxes on tobacco products, energy and soft drinks in December 2017 and will introduce VAT on 1 January 2019 (Khaleej Times, 2018). Qatar, Kuwait and Oman requires more time to introduce VAT due to technical and political issues. At the earliest, Oman and Qatar could introduce VAT by middle 2019 (Taxamo, 2018; Khaleej Times, 2017a; Khaleej Times, 2017b). The IMF suggested that if the Gulf States introduce VAT separately, that they decide on a reasonable transition period (3–5 years), by the end of which VAT is uniformly introduced in the GCC States.

[6] This agreement is available at https://www.tax.gov.ae/pdf/GCC-VAT-Agreement.pdf.

[7] The low rate of 5 per cent is advisable because it will encourage the design of simple and broad based taxes which are easier to manage and have little or no efficiency costs and not hinder any efforts to diversify the economy (IMF, 2016b:11).

[8] Exempted supplies (Article 1(27) of the GCC VAT Agreement) include financial services, insurance, military and charitable items.

Zero-rated items implied medicine and medical equipment, good and passenger transport and other allied services and the supply of gold, silver and platinum.

Each state has the right to zero-rate items they see fit. It is likely that most of the GCC states will zero-rate similar items such as oil and oil derivatives, land and transportation (Innovate tax).

Placing a timeframe on the introduction of new taxes, limits the risk to regional competitiveness. Introducing new taxes or widening of tax bases, could lead to a shift in consumption, investment and trade to other countries in the short-run. In the long-run these negative effects on competitiveness could be address through measures improving business and investment and increasing transparency of the tax system. These effort could reduce production costs and attract foreign investment (IMF, 2016b: 11).

The IMF estimated that the introduction of VAT in the region could generate new revenue of 1.5 to 3 per cent of non-oil GDP (IMF, 2016a: 17). According to Oxford Economics, 5 per cent VAT will increase inflation by 2 to 4 per cent in KSA and UAE with little impact on GDP growth, given the counter-measures taken by authorities.[9]

Although fiscal deficits improve over time, introducing new taxes or increasing existing tax rates, effectively distorts market prices by creating a wedge between the price buyers pay and the price received by producers. The deadweight loss (also known as allocative efficiency distortion) of taxation refers to the harm caused to economic efficiency and production due to a tax. Consideration should be given to the distortions created in the market when new taxes are introduced.

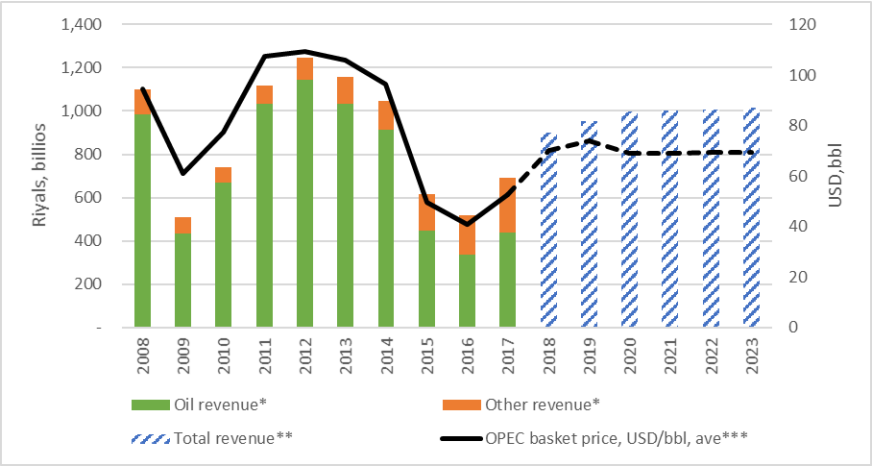
2.3 The case of KSA

Figures 3 to 5 show the fiscal position of the KSA from 2008 to 2023. Figure 3 and 4 focuses on government revenue and expenditure while Figure 5 summarises the budget balance and public debt. The information for 2008 to 2017 is historical data from the Saudi Arabian Monetary Authority (SAMA) while forecast data is taken from the IMF and World Bank.

Figure 3 shows, for 2008 to 2017, government revenue from oil and non-oil revenue sources as well as the oil price per barrel. From 2018 onwards we adopt the IMF forecast for total government revenue. Clearly indicated in this graph is the strong correlation between the oil price (USD/bbl) and government revenue. Oil revenues comprise the largest share of revenue ranging from 92 per cent in 2011 (average oil price of 107 USD/bbl) to 63 per cent in 2017 (average oil price of 52 USD/bbl). From 2018 onward, the IMF forecasts moderate growth in total government revenue.

[9] KSA has approved bonuses for public sector employees, military personnel, pensioners students and recipients of social services.

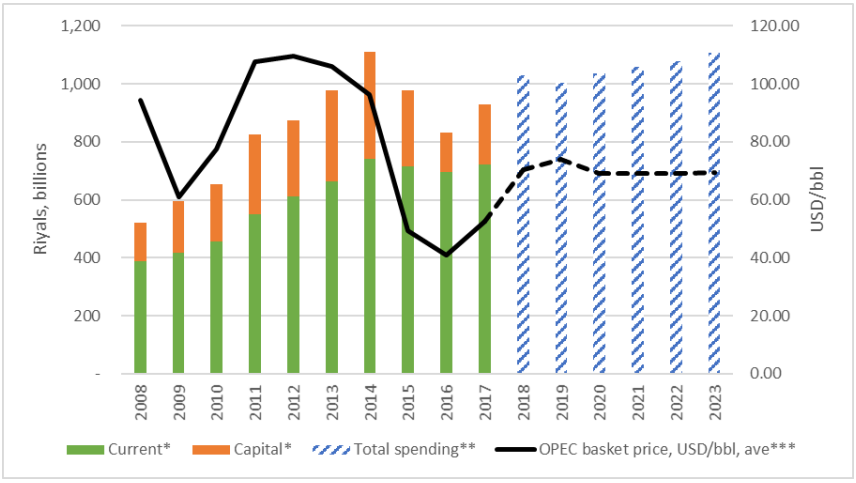
Figure 3. Government revenue and the oil price, 2008 – 2023 (Riyals billions, USD/bbl)



Source: * SAMA, 2017.
** IMF WEO data. Estimates start after 2017.
*** OPEC basket price, 2008 – 2017.
World Bank projections taken from Knoema online data. Estimates after 2017.

With the fall in the oil price in 2014, the contribution of non-oil revenue to total revenue increased. This increase is due to two sources. Firstly, there was an increase of investment income from SAMA. This reflects a willingness by the government to investment in assets with potentially higher-returns (Jadwa Investment, 2017; 2018). Secondly, a number of new and higher fees and taxes were introduced on tobacco products and royalties (Jadwa Investment, 2016). From 2018 onwards, it is expected that the additional VAT revenue will contribute significantly to non-oil tax revenue, with this contribution increasing as the VAT threshold is lowered. Currently, VAT applies to enterprises with an annual income of SR 1 million, but in 2019 this threshold will be lowered to include enterprises with an annual income of SR 375 thousand and above (Jadwa Investment, 2018). Other non-oil revenue sources include expat levies and excise taxes. It is projected that oil revenues as a share of total revenue will decrease to approximately 42 per cent by 2023 (Jadwa Investment, 2017).

Figure 4. Government expenditure, 2008 – 2023 (Riyals billions, USD/bbl)

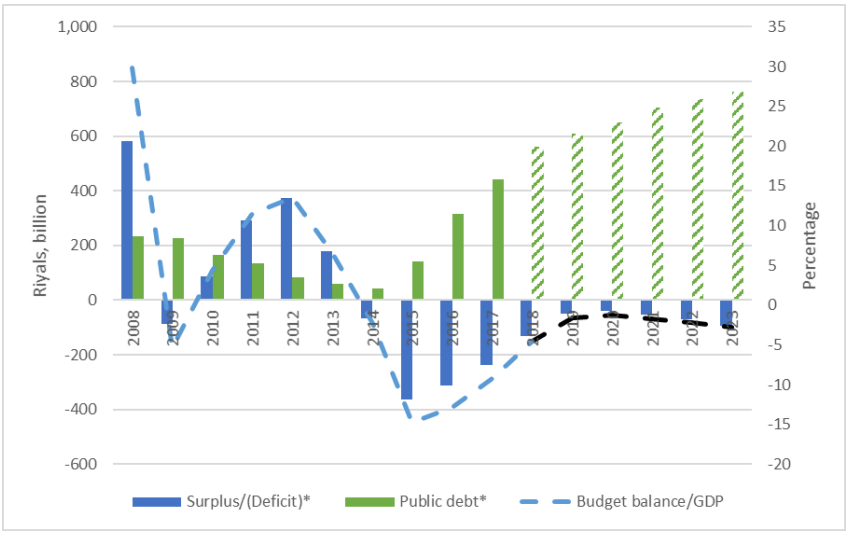


Source: * SAMA, 2017.
** IMF WEO data. Estimates start after 2017.
*** OPEC basket price, 2008 – 2017.
World Bank projections taken from Knoema online data. Estimates after 2017.

Figure 4 shows government expenditure for 2008 to 2023. For 2008 to 2017 spending is distinguished by type of spending (current and capital). Thereafter, the IMF forecast for total government expenditure is illustrated. The largest share of spending is current spending. Since 2015, the growth in current spending has slowed down due to lower spending on allowances which contributed to a reduced wage bill (Jadwa Investment, 2016; 2017). Capital spending is set to increase over time. The increase in capital spending is an attempt by the government to promote private sector growth and to help achieve the objectives of Vision 2030, especially initiatives in housing, mining, energy, manufacturing, transport, entertainment, telecommunications and SME's (Jadwa Investment, 2017). The returns on these investments is projected to increase non-oil revenues (see Figure 3). The largest expenditure item is on military and security, which is approximately 37 per cent of expenditure, followed by education and health at approximately 25 and 13 per cent respectively. Together, the combined spending allocations is 75 per cent of total allocations. It is expected that the distribution of spending will remain unchanged in future.

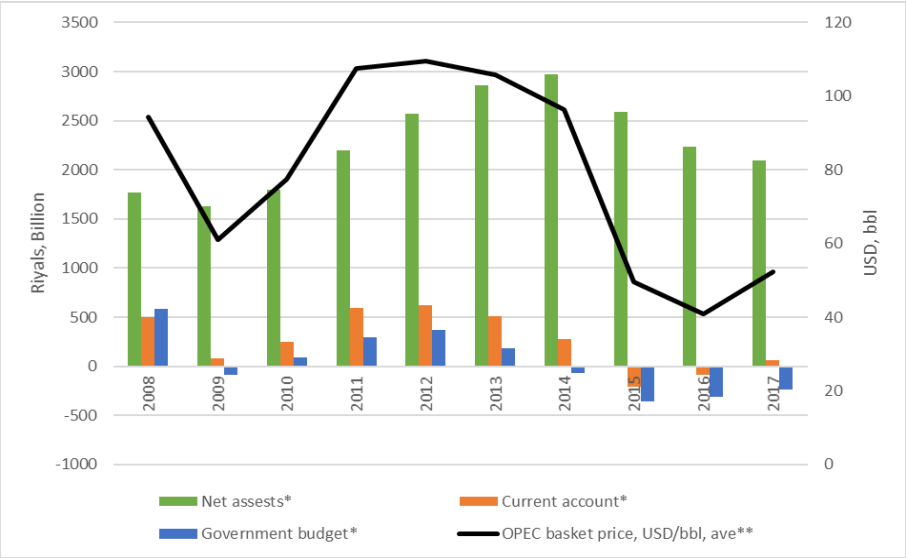
Figure 5 shows the Riyal value of the budget balance, public sector debt as well as the budget as a share of GDP. For 2008 to 2017, the observed values are taken from SAMA while data from 2018 onwards is from the IMF. Historically, public debt as a percentage of GDP was low. However, with the low oil price and accompanied deficit, public debt increased. Public debt totalled SR 443 billion at the end of 2017, which is approximately 17.2 per cent of GDP (SAMA, 2017). The government has also revised its borrowing requirement, with debt projections set to increase close to 25 per cent of GDP in 2025 (Jadwa Investment, 2018).

Figure 5. Government budget balance and public debt, 2008 – 2023 (Riyals, billions)



Source: * SAMA, 2017.
IMF WEO data. Estimates start after 2017

Figure 6. Net assets, government budget and current account balance, 2008-2017 (Riyal billion)



Source: * SAMA, 2017.
** OPEC basket price, 2008 – 2017.

Figure 6 shows the correlation between the change in the oil price per barrel, the government budget balance, the current account balance and net foreign reserves. This figure shows that the KSA holds considerable net foreign assets which allowed the Kingdom to alleviate the impact of lower oil prices and finance deficits. This figure shows the correlation between high (low) oil prices, government budget surplus (deficit), current account surplus (deficit) and an increase (decrease) in net foreign reserves. The general trend is that if the oil price is high (lower) the current account and government balance improves (worsens). Net foreign liabilities follow the same trend. Financing deficits by drawing on net foreign assets is not sustainable in the long-run. This reinforces the need for reforms, including the diversification of non-oil revenue sources that would allow the government to generate a stable and predictable revenue stream, independent of changes in the oil price.

In this paper, we focus on the introduction of a 5 per cent value added tax (VAT) using the General Equilibrium Model of Saudi Arabia (GEMSA). GEMSA is a single region, dynamic Computable General Equilibrium (CGE) model. Our model is rich in detail and includes specific representation of various price and tax (subsidy) variables. Although we do not present the model equations in detail, we explain in Section 3 key equations and mechanisms through which VAT impacts the Saudi economy.

3 The model

Modelling the economy-wide impact of an increase in the VAT rate on all non-zero commodities requires a detailed model that accounts for commodity-specific tax rates paid by specific users – in this case households.

GEMSA[10] models production of 57 commodities by 57 industries. Figure 7 illustrates the production structure. Each industry in GEMSA produce (supply) output using intermediate inputs, i.e., commodities from domestic or imported sources, capital, land, and labour. Labour is distinguished by 9 occupational types, nationality and gender. The production specification is managed by a series of

[10] See Dixon et al (1982) and Dixon and Rimmer (2002).

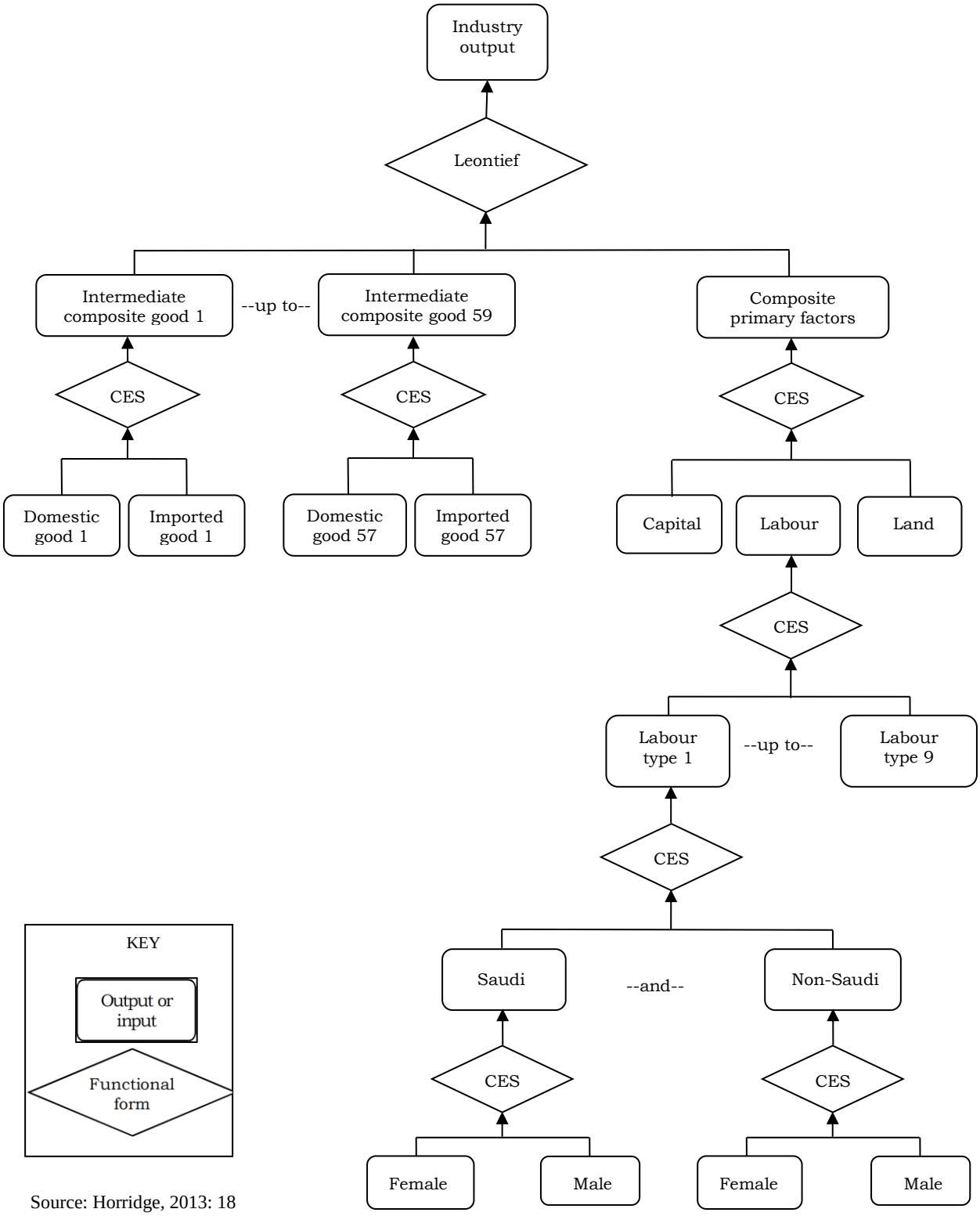
separability assumptions illustrated by the nesting structure in Figure 7. Each nest includes demand equations derived from solving optimisation problems. For example, the bottom right hand corner of Figure 7 shows the labour-gender nest. This nest include equations, which determine industry's gender-specific labour demand that minimise labour cost subject to a constant elasticity of substitution (CES) production function. Nests for the demand for primary factors and composite intermediate commodities represent a similar optimisation problem.

In creating capital, investors choose inputs that are cost minimising combinations of Saudi and foreign commodities. We assume that domestic and imported varieties of commodities are imperfect substitutes for each other, using constant elasticity of substitution (CES) functions. GEMSA has one representative household. This household optimisation problem is solved in two nests. In the first nest, we assume that the household chooses a combination of composite commodities to maximise utility subject to their budget. In the second nest, the household chooses commodities from domestic or imported sources to minimise costs, subject to a CES function. The export demand equations for Saudi commodities relate export volume inversely to foreign-currency prices. GEMSA has one central government and includes equations determining the consumption of source-specific commodities by government. Government demand is either determined exogenously, or can be linked to aggregate household consumption. The model includes equations determining various tax and subsidy rates, which facilitates modelling of both indirect and direct tax collections.

GEMSA recognises three main types of dynamic adjustment: capital accumulation, a lagged adjustment mechanism in the labour market, and public debt accumulation. These dynamic relationships allow the model to trace explicitly each variable through time at annual intervals.

Each industry accumulates capital, which links to industry-specific net investment. Changes in industry-specific investment are linked to changes in industry-specific rates of return. Annual changes in the net liability position of the economy are related to the annual current account balance. GEMSA includes a mechanism that guides the labour market from a typical short-run scenario (employment adjusts while the real wage remains sticky) to a long-run scenario (real wage adjusts while employment remains unchanged from the baseline). Typically, a positive (negative) labour market outcome manifests in the short-run as an increase (decrease) in employment away from the baseline, while real wages remain sticky. In the long run, a positive (negative) outcome manifests as an increase (decrease) in the real wage away from the baseline while employment moves toward the baseline.

Figure 7. Structure of production



Source: Horridge, 2013: 18

In this paper we are interested in the introduction of a new tax. GEMSA includes three paths through which changes in commodity-specific taxes are accounted for.

1. Taxes are accounted for in the purchasers' price of commodities[11] and any change in the tax rates or underlying tax base on which the tax rate is levied, will have direct and indirect impacts. The direct impact of tax reform is the increase in the price of taxable commodities. Indirect impacts refer to the knock-on effect of an increase in prices. Overall, when production and commodity taxes are introduced, production and consumer prices increase, raising the cost of living.
2. Tax reforms are accounted for through changes in government revenue and ultimately the government budget balance. Ceteris paribus, raising non-oil revenue improves the government balance.
3. Increased government revenue may allow for greater government spending immediately or in the future. For example, monies can be transferred back to vulnerable groups, such as households, or may be used to finance capital spending in sectors that will promote economic growth a job opportunities. This in turn may increase non-oil revenue.

See Appendix 1 for a description of a set of equations that allows us to understand how taxes are accounted for in the model.

4 The CGE database

In its current configuration, GEMSA is calibrated to the 2010 Supply-Use Tables, updated to 2015 National accounts data (GAS, 2018). These data is complemented with data from the government budget, Saudi Arabia's account with the rest of the world and labour market statistics.[12]

The initial database for a CGE model is important because: (1) it contains information regarding the structure of the Saudi economy in the base year; (2) it is useful in the interpretation of results; and (3) in a Johansen-style CGE model, it is the initial solution to the CGE model (Roos et al., 2015). The SUT is not in the required format of the CGE database and therefore a number of steps were taken to convert the published data into the format required by GEMSA. We highlight the following characteristics of the core database.

The model requires a core database with separate matrices for basic, tax and margin flows for both domestic and imported sources of commodities sold to domestic and foreign users, as well as matrices for the factors of production, namely labour, capital and land. Commodities can be used as intermediate inputs by domestic industries, investors, a representative household, foreigners, the government or held as inventory. GEMSA includes a detailed treatment of margins. For each commodity valued at basic

[11] GEMSA allows for the modelling of various commodity prices. For example, basic prices are prices before taxes on products are added and subsidies on products are subtracted. They do not include the value of margin services on the flow of commodities. Basic prices are the prices received by producers (for domestic goods) or by importers (for imported goods). Sales taxes and margins are excluded but import duties are included (Dixon et al., 1982, 108-115).

Purchasers' price includes margin costs and sales taxes. It is the amount paid by the users of commodities and reflects the actual cots to users (United Nations 2009, 22). Of interest in this paper is the change in the purchasers' price of mainly consumer commodities.

[12] General Authority for Statistics, Kingdom of Saudi Arabia. National Accounts 1437/1438 (2016). Available at: https://www.stats.gov.sa/sites/default/files/national_accounts_2016_en.pdf

Saudi Arabian Monetary Authority. Annual Statistics 2017. Available at: http://www.sama.gov.sa/en-US/EconomicReports/Pages/YearlyStatistics.aspx

prices we have a corresponding margin matrix, showing the cost of margin services used to facilitate the flow of commodities from all sources to the users of these commodities.

Of special interest in this paper is the modelling of taxes. For each commodity valued at basic prices we have tax matrices showing the indirect taxes paid on the use of commodities from all sources by various users. Consistent with the published national accounts, the elements in the tax matrices in the core database are set to zero, reflecting the fact that there are no indirect taxes on the use of commodities. There are import duties, which are explicitly accounted for in the database via a satellite matrix, and are also included in the flow of imported commodities valued at basic price. This allows for the calculation of ad valorem rates as the ratio between tax revenues and the relevant basic flows of commodities on which the taxes are levied.

The database includes matrices showing the value of primary factors used by industries in current production. These matrices include inputs of three factors of production: occupation specific labour payments by industry, nationality and gender, capital rentals by industry and natural resources by industries. Natural resource use is restricted to agricultural and mining industries. Only industries pay production taxes. The database shows that labour, capital, natural resource and production taxes are only used in current production. The database includes a multi-product matrix showing the basic value of commodities produced by the various industries or stated differently, it shows the value of industry output. See Appendix 2 for a summary of the cost and sales structures captured in the database for 26 aggregated sectors.

The data suggests that the economy is largely based on, and driven by one sector namely crude oil and gas. As an industry, crude oil and gas contributes the most in terms of value added followed by the service industries. Manufacturing industries contribute the least, reinforcing the idea that the economy lacks diversification. The labour market is highly segmented. The KSA is highly dependent on foreign, temporary labour. Expatriate labour comprise 56 per cent of the number of employed. In general expatriate workers earn a lower wage than their Saudi counterparts. Expatriate workers are mostly employed in trade services, hotel and accommodation, domestic help and construction while Saudi nationals are mostly employed in the public sector. Female labour market participation rates remain low for both nationals and expatriates. A large share of wages earned by the expatriate community, are transferred abroad as remittances. Remittances as a share of GDP was 5.8 per cent of GDP in 2015.[13]

The government data shows a budget deficit which is 15.8 per cent of GDP. Oil revenue dominates government income at 72.6 per cent. Non-oil revenue contributes 27.4 per cent. Total government spending is dominated by government consumption. Capital spending is 21 per cent of total spending. The database includes values for taxes including customs, taxes on income and profit and visa taxes. Together tax revenue contributes 9.4 per cent of total revenue. This is approximately 2.3 per cent of GDP. The proposed VAT rate of 5 per cent is low compared to other countries. A 5 per cent VAT rate is expected to generate SAR 35 billion, which is approximately 1.3 per cent of GDP. [14]

[13] Balance of Payments data shows that remittances was SAR 141,785 million in 2015 (GAS, 2017).

[14] The introduction of 5 per cent VAT is low compared to other Middle Eastern countries. The standard VAT rate in Jordan is 16 per cent, Lebanon at 10 per cent (IMF, 2016b: 16).

5 Simulation design

To conduct policy simulations with GEMSA, we run two simulations. The first simulation is the baseline forecast simulation. This simulation models the growth of the economy over time in the absence of the policy change under consideration. GEMSA is used to trace out the implications of the specialists' forecasts at a high level of sectorial detail. In this study, the baseline incorporates macro forecast data from the IMF's World Economic Outlook (IMF 2018). Specifically we adopt forecasts for GDP, employment and population growth. In line with the IMF projects, oil prices are expected to remain subdued in the medium term compared to their level before mid- 2014 (IMF, 2016: 7). It is also in the baseline simulation that we that we hold indirect commodity taxes at zero, which in turn generates zero indirect tax revenue, apart from customs.

The second simulation is the policy simulation. The policy simulation generates a second forecast that incorporates all of the exogenous features of the baseline forecast, plus policy-related shocks reflecting the introduction of a 5 per cent VAT rate that is expected to generate SAR 35 billion. The results of the policy simulation are typically reported as percentage deviations away from the baseline forecast. We solve the model using GEMPACK (Horridge et al., 2018; Harrison and Pearson, 1996).

5.1 Closure and macroeconomic assumptions[15]

(a) The labour market is characterised by short-run stickiness of the real wage with flexible employment adjustment. GEMSA includes a mechanism that allows the labour market to transition from a short-run environment to a long-run environment where the real wage adjusts and employment moves to its long run baseline level. In the policy simulation we assume that, if employment deviates from the baseline value initially, real wage adjustment steadily eliminates the short-run employment deviations.

(b) We assume that employment for Saudi nationals is fixed. Changes in the labour market are therefore reflected in changes in the employment status of non-Saudi workers. This reflects the Kingdom's labour market rigidities and the long-run flexible nature of expatriate labour contracts.

(c) Capital and investment are specific to each industry. GEMSA allows for short-run deviations in expected rates of return from their baseline levels. These cause deviations in investment, and hence capital stocks, which gradually erode the initial deviations in rates of return. Provided there are no further shocks, rates of return revert to their baseline levels in the long run.

(d) In our policy simulation, the economy-wide APC is an endogenous variable that moves to ensure that the ratio of the balance of trade to GDP (BOT/GDP ratio) remains at its baseline level.

(e) Tax revenue is determined by initial effective tax rates and the change in the relevant base on which taxes are levied. In the policy closure setting for 2018, we impose a once-off increase in VAT revenue of SAR 35 billion, and allow the model to endogenously determine the required increase in the VAT rate that accommodates the imposed shock to VAT revenue. From 2019 onwards, we hold the VAT rate exogenous at the higher rate. The model then determines VAT revenue based on the higher VAT rate, and any modelled changes in the VAT base. In our policy simulation, we ensure that:

[15] CGE models include a large number of equations and variables. Variables explained by equations in the model are endogenous, while variables not explained by the model are exogenous. By changing the status of endogenous and exogenous variable, different economic scenarios can be modelled. This feature adds to the flexibility of CGE models in policy analysis.

i. the tax rates of the zero-rated items remain at their baseline level;
ii. the VAT increase falls on households, and
iii. the increase in VAT revenue is used to improve the government budget balance.[16]

(f) Non-tax revenue and fees and charges are held at their baseline projection.
(g) Real public spending is held at its baseline forecast.
(h) The BOT/GDP ratio is held constant at its baseline level, via movements in the economy-wide average propensity to consume (APC).
(i) In line with the IMF projections, oil prices are expected to remain subdued and follow their baseline projection.
(j) The model explains changes in relative prices, but has no mechanism to determine the absolute price level. Thus, one price must be exogenous. This price is the benchmark against which all other prices are measured. In the simulations, the numeraire is the nominal exchange rate. This is consistent with the nominal exchange rate pegged to the US$.
(k) GEMSA contains many variables to allow for shifts in technology and household preferences. In the policy scenarios, most of these variables are exogenous and have the same values as in the baseline projection.

6 Results

This section contains a discussion of the results. Macroeconomic impacts are dealt with first, followed by impacts on industry production and the government budget.

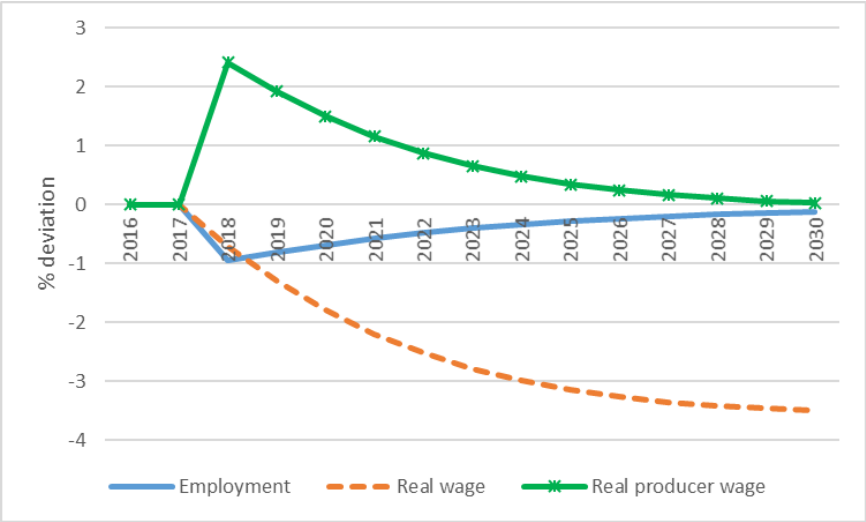
6.1 National results

Our explanation of the macro results begin with the impacts on the labour market. Figure 8 shows the percentage deviation in employment, the real consumer wage and the real cost of labour.[17] According to the labour market specification in the model, the real wage rate is sticky in the short run with flexible treatment of employment. Over time, the labour market moves from this short-run setting to a long-run setting where employment is fixed and real wage adjusts.

[16] Although not part of this paper, VAT revenue generated can be transferred back into the economy via public-sector investment in strategic industries (e.g. manufacturing), or used to finance public programmes targeting the vulnerable.

[17] The real wage is defined as the ratio of the nominal wage rate to the price of consumption. The real cost of labour is defined as the ratio of the nominal wage rate to the national price of output (measured by the factor-cost GDP deflator).

Figure 8. Employment, real cost of labour and the real consumer wage (% deviation from baseline)



Employment falls in the short-run because of an increase in the real cost of labour (Figure 8). The real cost of labour increases relative to the baseline because introducing VAT causes the price of spending (consumption[18], for example) to rise relative to the price of production. Initially, with the real wage rate sticky, the nominal price of labour is tied to the price of consumption. Thus, if the consumption price rises relative to the price of production, the real cost of labour must increase. An increase in the real cost of labour causes producers to substitute away from labour and towards relatively cheaper alternatives, such as capital. Over time, the real wage rate falls relative to the baseline forecast, driving employment back towards its baseline value. In the short-run, with capital fixed, the fall in employment increases the capital/labour ratio.

Figure 8 shows that in the long-run the deviation in national employment is small. However, this does not mean that employment by nationality and gender at an industry level remains close the baseline level. With Saudi employment held at the baseline level, and given flexible labour contract for expatriates, the deviation in employment is accounted for by a fall in non-Saudi employment. Our results shows that non-Saudi employment falls by 3.15 per cent in the shock-year (2018). In most industries, there are significant permanent employment responses, especially in those industries employing a large share of expatriate workers. These industries include domestic services, hotels, construction and manufacturing.

[18] Our results show that CPI increases with 3.7 per cent. This is consistent with findings from a 2011 simulation for Kuwait which estimated the impact of the introduction of a 5 per cent VAT on inflation to not exceed 3.5-4 per cent (IMF, 2016b: 17).

Figure 9. Investment, capital and rates of return (% deviation from baseline)

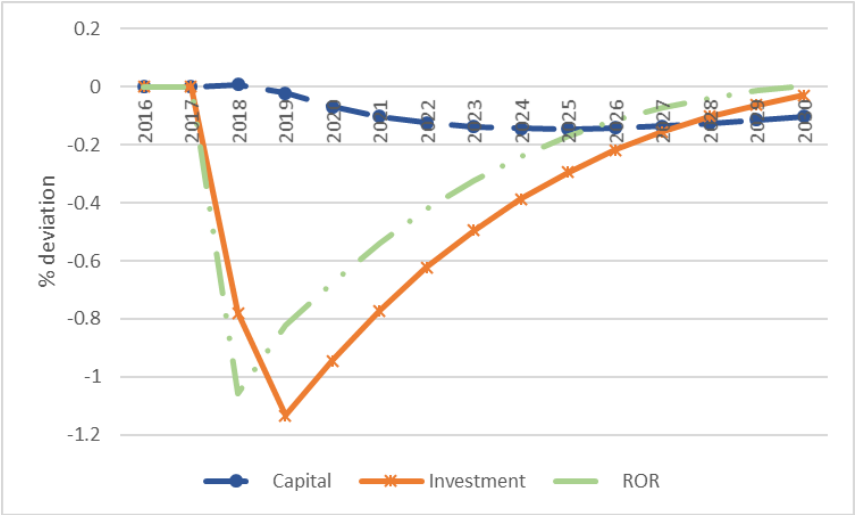
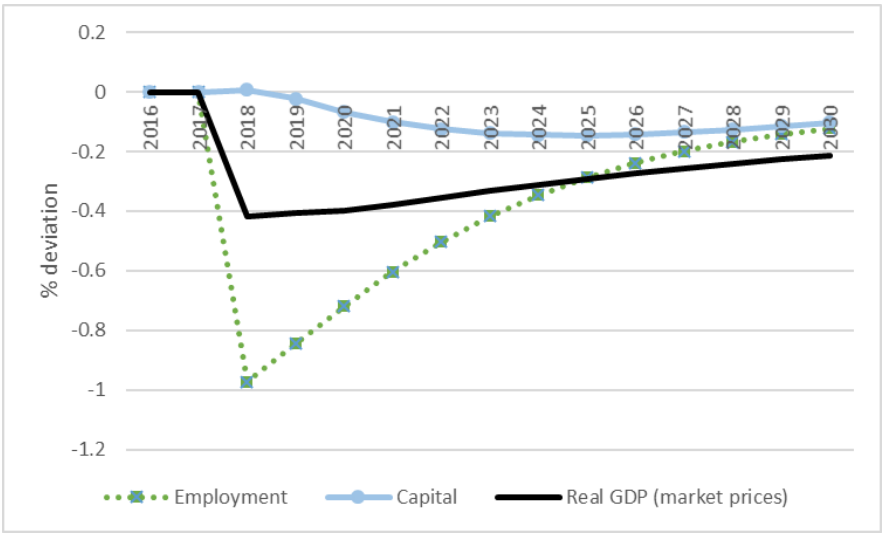


Figure 9 shows the percentage deviations from the baseline in capital, investment and the rates of return. In the short-run, the increase in the capital/labour ratio leads to a fall relative to the baseline in the rates of return on capital. The fall in capital rates of return accounts for the short-run fall in investment. Over time, the capital stock therefore diminishes, driving rates of return back to baseline. This accounts for the gradual adjustment of investment throughout the simulation period.

Figure 10 shows the percentage deviation in national employment, capital and GDP. GDP is calculated as the share-weighted sum of labour and capital.[19] The share of labour and capital in factor cost is 47 and 53 per cent respectively. In the short-run, with employment falling and capital unchanged, GDP falls. We see this confirmed in Figure 10. In the long-run, employment returns to the baseline while capital remains below base. This accounts for the long-run negative GDP outcome.

Figure 10. National employment, capital stock, real GDP (% deviation from baseline)

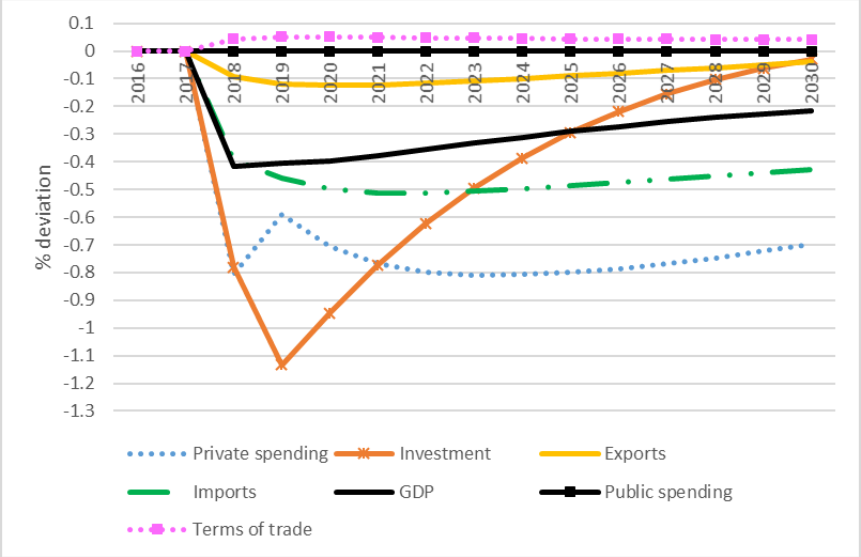


[19] Note that the contributions of natural resource to the real GDP deviation are zero (because in this simulation natural resource supply does not change between policy and baseline) and are not shown.

Figure 11 reports deviations in the expenditure side components of GDP. Via closure assumption, public spending is held exogenous at the baseline level. As discussed with reference to Figure 9, rates of return fall relative to baseline causing investment to fall in the short run, and a fall in the long run capital stock. Investment is relatively import intensive.[20] It is the high import shares and underlying industry activity that account for the negative deviation in import volumes. In our closure assumptions, the BOT/GDP ratio is exogenous. Thus, a fall in import volumes is balanced by a countervailing fall in export volumes. With exports below the baseline, the terms of trade rises.[21]

Because the baseline level of the BOT is a surplus, the negative deviation in imports lies below the negative deviation in exports. With the BOT/GDP ratio held exogenous, the fall in imports requires a fall in exports, but to a lesser extent. Despite investments moving toward baseline, the deviation in imports remain below the GDP deviation throughout the simulation period. This is because VAT permanently raises the price of consumption (CPI), causing a negative deviation in consumption. Consumption has a high import share, and therefore the negative deviation in consumption partly drives the negative deviation in imports.

Figure 11. The expenditure components of real GDP
(% deviation from baseline)



6.2 Industry results

For reporting, we aggregate the results for 57 industry output levels to 9 broad sectors. Figure 12 reports the output deviations of the nine broad sectors. While the output of each sector is generally depressed in both the short and long run, not all sectors are impacted in the same way when the VAT rises..

[20] The initial database shows that on average 35 per cent of commodities consumed by households and 46 per cent of investments commodities are imported.

[21] In GEMSA, commodity-specific export volume is negatively related to the commodity-specific export prices.

Real estate is the sector that performs the worst in the long run. This commodity is sold mostly to households.[22] With household consumption depressed due to higher consumption prices, sectors selling their output mostly to households underperform their peers. Similar reasoning explains the fall in output in hotel and restaurants, some financial services (included in the services outcome in Figure 11) and textiles and tobacco (included in the manufacturing outcome).

Public administration and crude oil and gas sector are the two top-ranked sectors in the long-run. Within the aggregate public administration sector, we include health, education[23], research and development and other public administration services. Most of the sales of these services are to public consumption and households. Public health and education is considered out of scope in terms of VAT, while VAT is levied on private health and education. As discussed in Section 5.1, we assume that real public consumption remain on the baseline projection. The negative deviation in the public administration outcome is largely due to the VAT levied on private health and education.

Other industries, such as agriculture, mining, services, utilities[24], and manufacturing, do not have concentrated direct sales to any of the final demand categories. The outputs from these industries generally serve as intermediate inputs to domestic industries. These industries include metal ores, recycling, insurance, wood products, paper and printing, business services, post and telecommunication. For this reason, we find these industries typically exhibit output responses that are broadly in line with the movement in real GDP.

Crude oil and gas owes their outcome to our assumption that the price of oil follows the IMF projection and that a large share of crude oil and gas production is exported while the remainder is sold to domestic industries (such as the petroleum and chemical industries) an intermediate input.[25] These industries in turn sell most of their output to households or as intermediate input to other industries. This illustrates the importance of the underlying linkages between sectors in explaining industry output.

[22] Real estate includes both housing stock and real estate services. Approximately 63 per cent of real estate is sold to households with the remainder sold to industries.

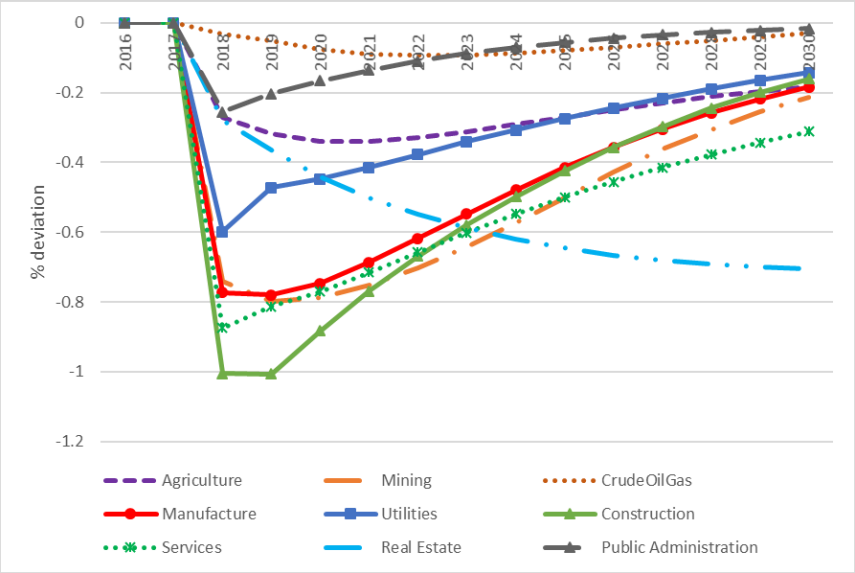
[23] A VAT rate of 5 per cent is levied on private education whereas public education is considered out of scope. In the current version of GEMSA, we do not explicitly make the distinction between public and private education.. Therefore the effective tax rate levied on education is lower than the legislated 5 per cent on private education taking into account the out of scope item.

The VAT rate is levied on private health care while public healthcare is considered out of scope. A number of medicines and medical equipment is zero-rated. Therefore the effective tax rate levied on healthcare is lower than the legislated 5 per cent on private education taking into account the zero-rated and out of scope items.

[24] Saudi Electricity Co. will apply a 5 per cent VAT on electricity bills, connection fees and services fees (Argaam, 2017).

[25] Approximately 82 per cent of crude oil and gas is exported while the remainder is sold to domestic industries, notably refined petroleum and chemical industries. 5 per cent VAT is imposed on fuel, which increases fuel prices (The National, 2017).

Figure 12. Aggregate sectoral output (% deviation from baseline)



6.3 Introducing business profit tax

A report by the IMF suggests that business profit tax could also be introduced as a source of tax revenue (IMF, 2016b: 17-18). Taxes on profit are an important part of most tax systems, and is a significant source of revenue internationally. For example, business profit tax revenues on average amounted to nearly 3% of GDP and 10% of total tax revenues in the OECD economies in 2014 (IMF, 2016b: 18).

As with the low VAT rate, the IMF suggests that business profit tax should be simple and levied at a single, relatively low rate for all businesses. Based on their calculations, a 15 per cent tax of profit, introduced in all GCC States, could yield expected revenue as a percentage of GDP, between 2.1 per cent for Qatar to 3.3 per cent in Bahrain. For the KSA, business profit tax could contribute 2.8 per cent of GDP to tax revenue (IMF, 2016b: 20). Other taxes that could be introduced includes taxes on outward remittances, taxes on foreign workers' income and taxes on financial transactions (IMF, 2016b: 21-23). An important consideration when deciding the tax mix is the relative efficiency of each tax. These can be very different in general due to difference in incidence, exclusion and exemptions from the tax base (Freebairn, 2018).

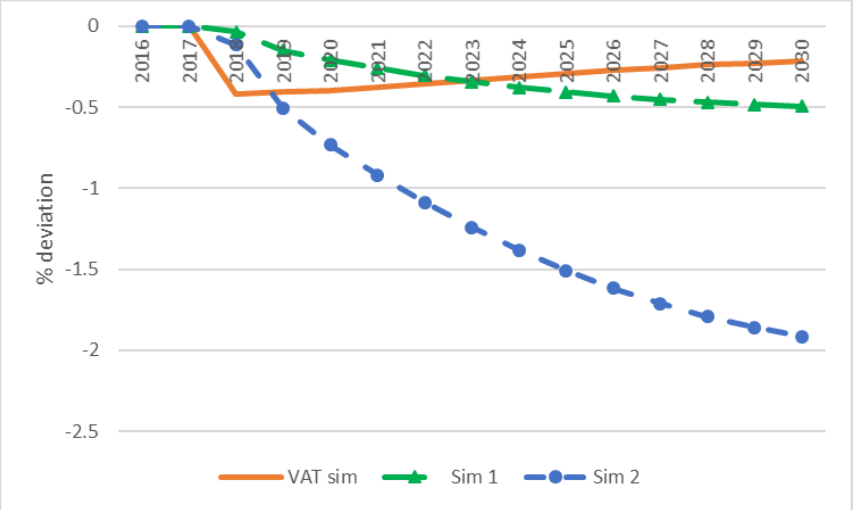
GEMSA is capable of modelling a wide range of taxes, including business profit tax. We use GEMSA to run two illustrative simulations. The first illustrative simulation (hereafter Sim 1) we introduce corporate income tax that generates SAR 35 billion. GEMSA will inform on the change in corporate tax rate required to generate SAR 35 billion. In the second illustrative simulation (hereafter Sim 2) we introduce corporate income tax rate of 15 per cent. In this second simulation, GEMSA yields estimates for the corporate tax revenue generated given a 15 per cent tax on business profits.

Figures 13 to 15 plot the deviation from the baseline for three macro variables: real GDP, real capital stocks and real investment. As expected, our results show that a tax on business profits is more harmful to real GDP than VAT in the long-run. VAT is a tax on consumption, which is paid by the final user of goods and services. Therefore, VAT increases the cost of consumption relative to production. In contrast, a tax on business profit depresses the after-tax rate of return investors earn. This damages investment which damages long-run capital stocks and real GDP. Our results suggests that, in the

absence of any fiscal stimulus, a 15 per cent business tax could reduce capital by 3.5 per cent in the long run, with a long run reduction real GDP of 2 per cent.[26]

Our results suggests that a 15 per cent business profit tax could contribute between 3.2 – 4.8 per cent of GDP to tax revenue. This result is slightly higher than the IMF's illustrative example, which is in part due to factors such as: assumed depreciation rates, and industry compositional impacts

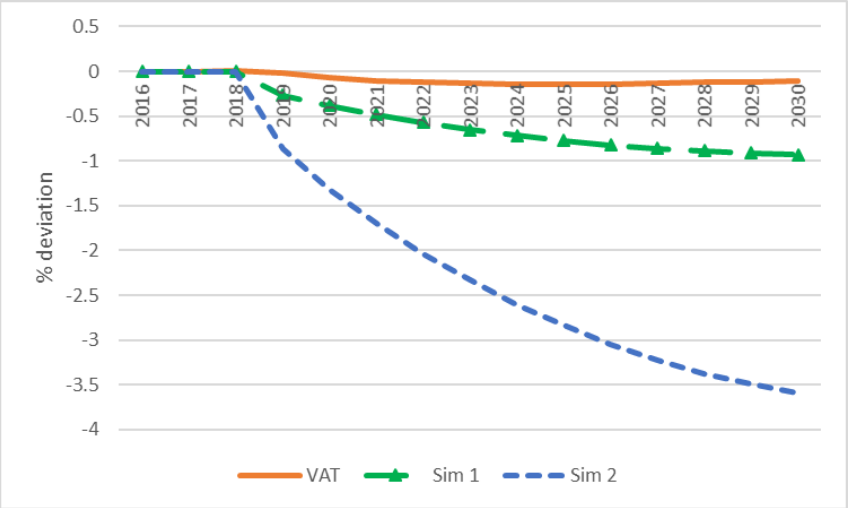
Figure 13. Real GDP (% deviation from baseline)



VAT simulation generates SAR 35 billion
Sim 1 is a business profit tax that generates SAR 35 billion
Sim 2 is 15% business profit tax

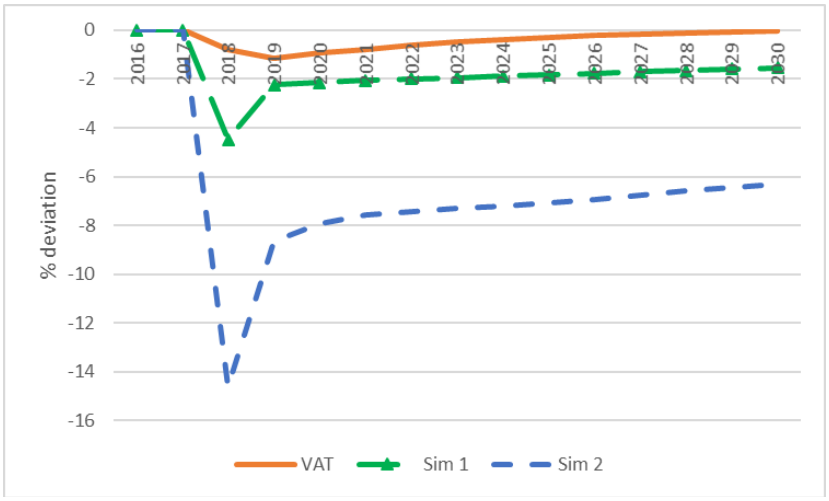
[26] Another way to measure the relative impact of these taxes was pioneered by Harberger (1962) and involves the calculation of tax-specific excess burdens. The term "excess burden" was coined by Harberger (1962) to describe the impact (in totality) of US corporate tax on US national income. Because GEMSA is dynamic, it can calculate year-on-year excess burden measures using a similar principle. Preliminary results show that the business profit tax bears a larger excess burden than the VAT. In relative terms, VAT is therefore preferred means to raise revenue.

Figure 14. Capital (% deviation from baseline)



VAT simulation generates SAR 35 billion
Sim 1 is a business profit tax that generates SAR 35 billion
Sim 2 is 15% business profit tax

Figure 15. Real investment (% deviation from baseline)



VAT simulation generates SAR 35 billion
Sim 1 is a business profit tax that generates SAR 35 billion
Sim 2 is 15% business profit tax

7 Conclusion

For many GCC countries, lower oil prices negatively impacted government revenue from oil sales, leading to an increase in budget deficits and a fall in foreign exchange reserves. Apart from long-term structural change, the immediate response to lower oil prices is the removal of energy subsidies and the introduction of taxes such as excise tax and VAT. Using a dynamic CGE model (GEMSA) for Saudi Arabia, we estimate the impact of a 5 percent VAT paid in full by households.

The additional VAT revenue increases tax revenue as a percentage of GDP to 3.1 per cent in the short-run. This slightly improves the government budget balance. However, introducing taxes also imposes a distortion (deadweight loss) in the market. This opens up the debate on how to mitigate this distortion. In our simulation of introducing a 5 per cent VAT, our results show that real GDP is below baseline throughout the simulation period. In the short-run the GDP outcome is explained by the fall in employment. VAT causes the price of consumption (e.g. CPI) to increase relative to the price of production increasing. With wages indexed to the CPI, the cost of labour will increase. Over time, the real wage rate and the cost of labour move towards the baseline, forcing employment back towards its baseline value. The long-run outcome of GDP is explained by the reduction in capital. As expected, VAT increases the price of consumption which depresses private consumption.

We run two illustrative simulations where we introduce a tax on business profits. The first illustrative simulation is where the business tax on profit generates SAR35 billion and the second is where the business tax is increased to 15 per cent. As expected, without any support or incentives to business, a tax on profit is more harmful than VAT, in terms of real GDP and the growth in investment and capital stock. This highlight the importance of designing a tax system in concurrence with other revenue raising measures and a reduction in government spending. The optimal mix of these measures depends on each countries circumstances.

References

Argaam. (2017). SEC to apply VAT on electricity bills, other services starting Jan 1. Available at: https://www.argaam.com/en/article/articledetail/id/520425

Dixon, P.B., Rimmer, M.T. 2002. "Dynamic General Equilibrium Modelling for Forecasting and Policy: A Practical Guide and Documentation of MONASH." Amsterdam: North-Holland.

Dixon, P.B., Parmenter, B.R., Sutton, J. & Vincent, D.P. 1982. "ORANI: A Multisectoral Model of the Australian Economy." North-Holland, Amsterdam.

General Authority for Statistics. (2017). Available at: https://www.stats.gov.sa/en#

Harberger, A. C. (1962). The incidence of the corporation income tax. Journal of Political Economy. Volume LXX (3), June 1962.

Harrison, W.J. and Pearson, K.R. 1996. "Computing Solutions for Large General Equilibrium Models Using GEMPACK." Computational Economics 9, no. 2: 83-127.

Horridge J. M., Jerie, Mustakinov, D and Schiffmann, F. (2018). GEMPACK manual, GEMPACK Software, ISBN 978-1-921654-34-3. https://www.copsmodels.com/gpmanual.htm

Horridge, J.M. 2013. "ORANI-G: A generic single-country Computable General Equilibrium Model." The ORANI-G Page. Centre of Policy Studies, Victoria University, Melbourne. http://www.copsmodels.com/oranig.htm

Innovate tax. An introduction to setting up VAT in Saudi Arabia. Available at: https://www.innovatetax.com/saudi-arabia-vat-zero-rated-exempt-or-out-of-scope

International Monetary Fund. (2018). World Economic Outlook Database, October 2018. Available at: https://www.imf.org/external/pubs/ft/weo/2018/02/weodata/index.aspx

International Monetary Fund. (2016a). The Economic Outlook and Policy Challenges in the GCC Countries.

International Monetary Fund. (2016b). Diversifying government revenue in the GCC: Next Steps. Paper presented at the Annual Meeting of GCC Ministers of Finance and Central Bank Governors. Doha, November 10. Available at: https://www.imf.org/external/np/pp/eng/2016/102616.pdf

Jadwa Investment. (2018). Q3 2018 Budget Statement. November 2018. http://www.jadwa.com/en/researchsection/research/economic-research/budget-reports

Jadwa Investment. 2017. Saudi Arabia's 2017 fiscal budget. http://www.jadwa.com/en/download/2016-budget-2/gdp-report-15-6-2-1-2

Jadwa Investment. 2016. Saudi Arabia's 2017 fiscal budget. http://www.jadwa.com/en/download/2016-budget-2/gdp-report-15-6-2-1-2

Jadwa Investment. 2015. Saudi Arabia's 2016 fiscal budget. http://www.jadwa.com/en/download/2015-budget-2/gdp-report-15-6-2-1-2

Khaleej Times. (2018). VAT delayed until 2019 in these Gulf countries. 6 January 2018. Available at: https://www.khaleejtimes.com/business/economy//vat-delayed-until-2019-in-these-gulf-countries-

Khaleej Times. (2017a). VAT in Oman postponed until 2019. 26 December 2017. Available at: https://www.khaleejtimes.com/region/oman/vat-in-oman-postponed-until-2019-

Khaleej Times (2017b). Bahrain announces excise tax on cigarettes, energy drinks from December 30. 27 December 2017. Available at: https://www.khaleejtimes.com/business/economy/bahrain-announces-excise-tax-on-cigarettes-energy-drinks-from-december-30-

Knoema. Online database. Crude oil price forecast: 2018, 2019 and long term to 2030. Available at: https://knoema.com/yxptpab/crude-oil-price-forecast-2018-2019-and-long-term-to-2030

Organisation of the Petroleum Exporting Countries (OPEC). Saudi Arabia facts and figures. http://www.opec.org/opec_web/en/about_us/169.htm

Organisation of the Petroleum Exporting Countries (OPEC). OPEC basket price. Available at: https://www.opec.org/opec_web/en/data_graphs/40.htm;

Roos, E.L., Adams, P.D., and van Heerden, J.H. 2015. "Construction a CGE database using GEMPACK for an African country." Computational Economics 46, no. 4: 495-518. DOI 10.1007/s10614-014-9468-1

Saudi Arabian Monetary Agency (SAMA). Economic Reports and Statistics. http://www.sama.gov.sa/en-us/EconomicReports/Pages/default.aspx

Secretariat General of the Gulf Cooperation Council (GCC). Available at: http://www.gcc-sg.org/en-us/Pages/default.aspx.

Taxamo. (2018). VAT in the Gulf: Bahrain set to become third GCC state to introduce a VAT system. Available at: https://blog.taxamo.com/insights/gcc-vat-update2

The National. (2017). Saudi Arabia to impose 5 per cent VAT on petrol. 19 November, 2017. Available at: https://www.thenational.ae/business/economy/saudi-arabia-to-impose-5-per-cent-vat-on-petrol-1.676985

The National. (2018). Four GCC states need more time on VAT, IMF official says. 17 February, 2018. Available at: https://www.thenational.ae/business/economy/four-gcc-states-need-more-time-on-vat-imf-official-says-1.705369

Trading Economics online data. Available at: https://tradingeconomics.com/country-list/corporate-tax-rate?continent=asia

United Nations. 2009. System of National Accounts 2008. https://unstats.un.org/UNSD/nationalaccount/sna2008.asp

Zakat by country. (2010) Available at https://moneyjihad.wordpress.com/2010/08/09/zakat-by-country/

Appendix 1. Accounting for indirect tax rates

Equations (E.1) determines the purchasers' value of the use of commodity c, from source s by user u in region d, as the sum of the commodity use valued at delivered price and sales taxes levied on these commodities.

$$PUR_{(c,s,u)} = BAS_{(c,s,u)} + TAX_{(c,s,u)} + \sum_{m \in MAR} MAR_{(c,s,u,m)} \qquad (E.1)$$

for all c $\in$ COM, s $\in$ SRC, u $\in$ USER, m $\in$ MAR

where

- PUR is the purchasers' value of commodity *c*, from all sources *s* paid by user *u*;
- BAS is the basic value of commodity *c* from all sources *s* to user *u*;
- TAX is the tax (subsidy) value *t* paid by (too) user *u* for commodity *c* from all sources; and
- MAR is the value of margins *m* used to facilitate the flow of commodity *c* from source *s* to user *u*.

Tax revenue is calculated via (E.2).

$$TAX(c,s,u) = BAS(c,s,u) * TAXRATE(c,s,u) \qquad (E.2)$$

for all c $\in$ COM, s $\in$ SRC, u $\in$ USER

where the TAXRATE is a specific tax on each commodity c from source s, used by user u. These tax rates are naturally exogenous (See E.10).

Our focus is on the sales tax term, which is defined in ordinary change below:

$$\begin{aligned} \Delta TAX(c,s,u) = {} & 0.01 * TAX(c,s,u) * \left[xuse(c,s,u) + puse(c,s) \right] \\ & + BAS(c,s,u) * \Delta TAXRATE(c,s,u) \end{aligned} \qquad (E.3)$$

for all c $\in$ COM, s $\in$ SRC, u $\in$ USER

where

- xuse is the percentage change in the use of commodity *c*, from source *s* by user *u*;
- puse is the percentage change in the basic price of commodity *c*, from source *s* by user *u*; and
- Δ TAXRATE is the ordinary change in the tax rate on commodity *c* from source *s* paid by user *u* as determined in (E.8)

Equation (E.3) includes two percentage change variables, xuse and puse, which are the percentage change in the quantity used of commodity *c*, from source *s* by user *u* and the percentage change in the basic price of commodity *c*, from source *s*. The percentage change in the basic price is uniform over all users. The percentage change in the demand for commodity c (xuse) is derived from various optimisation problems.

The ordinary change in the respective sales tax rates in (E.3) are set equal to a number of shift variables:

$$\begin{aligned}\Delta\text{TAXRATE}(c,s,u) = \Delta\text{TAXRATE\_u}(c,s) + \Delta\text{TAXRATE\_su}(c) \\ + \Delta\text{TAXRATE\_s}(c,u)\end{aligned} \qquad \text{(E.4)}$$

for $c \in$ COM, $s \in$ SRC, $u \in$ USER

where

- ΔTAXRATE_u is the ordinary change in the ad valorem tax rate *t* paid on commodity *c* from all sources *s.* This rate is uniform over all users *u.*
- ΔTAXRATE_su is the ordinary change in the ad valorem tax rate *t* paid on commodity *c.* This rate is uniform over all users *u* and sources s.
- ΔTAXRATE_s is the ordinary change in the tax rate paid on commodity c by user u. This rate is uniform over all sources.

These shift variables are naturally exogenous and unless their values change[27], the change in the tax rate remains zero.[28] By altering the respective sales tax rates, sales tax revenue change (see E.3), and ultimately the value of commodities at purchasers' price adjust (see E.1).

[27] The shift variables' values can change by (1) directly shocking the appropriate variable and dimension to change a specific tax rate, or (2) altering the exogenous status of the appropriate variable to endogenous. The newly endogenous shift variable can then adjust to accommodate an exogenous change in tax revenue.

[28] Altering the tax rates for specific dimensions highlights the flexibility of the model and allows for various tax proposals to be modelled.

Appendix 2. Summary of cost and sales structures captured in the GEMSA database

Industry-specific results are influenced by the relative change in supply and demand for that industry's output. The cost composition of an industry is important in explaining the change in supply while the sales structure and the macro closure are important in explaining changes in the demand. On the supply side we generally assume that in the short-run capital is fixed as there is not enough time for capital to accumulate. We also assume that employment adjusts in the short run given fixed wages. Therefore in the short-run, any increase (decrease) in output must be accommodated for by an increase (decrease) in employment, holding technologies unchanged. As a consequence, capital-intensive industries have little scope to change output in the short-run. However over time capital adjusts. In the long run we assume that capital adjusts while employment adjusts to return the rate of employment to its baseline level. Thus, in the long-run capital-intensive industries have considerable scope to adjust their output. On the demand side, the initial sales structure as well as the assumptions in the macro closure have an impact on industry production. For example, if public consumption is held exogenous in the macro closure, there is little scope for industries selling their output to government to change their production.

Table 1 shows the share of costs in total costs for aggregated industries in the GEMSA database. The first column shows the cost share accounted for by intermediate inputs excluding petroleum and electricity, columns 2 and 3 show petroleum and electricity as a share of the total costs, and the remaining columns show the share of primary factor costs in total costs. As previous studies have shown, the removal of energy subsidies increases production costs for industries using petroleum and electricity as intermediate inputs. Those industries benefiting the most from the subsidies will experience a larger increase in costs and decline in activity level. The initial cost structure for the aggregate sectors shows that transport sectors (Table 1, row 17) have the highest petroleum cost share. The average share of petroleum in total costs for the aggregate transport sector is approximately 5.6 per cent. Within this sector, the petroleum cost share is highest for the air transport industry (16.5 per cent), followed by land transport (9 per cent) and water transport (7.3 per cent). Other industries with high petroleum cost shares include the fishing industry (9 per cent - included in row 1), chemicals industry (4 per cent - included in row 8) and the water industry (3 per cent - row 13). Industries with the highest electricity costs are other non-metal and mineral industry at 4.8 per cent (included in row 8), electricity industry at 3.7 per cent (row 12), basic metals industry at 4.6 per cent (row 9) and motor vehicle repair at 3.5 per cent (included in row 15).

Table 2 shows the sales structure of each commodity. Commodities can either be sold on the local market to industries as intermediate input (column 1), to investment (column 2), households (column 3), the government (column 5) or held as stocks (column 6), or exported to foreign markets (column 4). Column 7 shows, for margin commodities the value of margins.

For example, the sales structure for refined petroleum (Table 2, row 7) shows that 30.6 per cent of this commodity is exported. Households and industries use (Table 2, row 7) approximately 70 per cent each (Table 2, row 7). The sales structure for electricity shows that 55 per cent of electricity is used by industries as an intermediate input followed by households at 26.4 per cent and the rest used by the government.

Table 1. Cost shares and value added by aggregated sectors (2015)

	Industry	Cost shares								Value added share
		1	2	3	4	5	6	7	8	
		Intermediate (excl petroleum and electricity)	Petroleum	Electricity	Labour	Capital	Natural resource	Other	Total	
1	Agriculture, hunting, forestry and fishing	33.6	1.5	0.5	8.0	48.9	22.4	-12.9	102	3.0
2	Crude oil and gas	1.7	0.1	0.2	2.5	54.2	41.3	0.3	100	34.1
3	Other mining	26.7	3.6	2.3	8.2	55.3	9.0	0.8	106	0.4
4	Food, beverages and tobacco	64.1	0.2	0.6	7.7	28.0	0.0	0.3	101	1.6
5	Textiles and leather products	63.8	0.3	0.9	9.0	25.0	0.0	2.2	101	0.3
6	Wood and paper products including furniture	65.0	0.7	2.7	12.2	22.1	0.0	0.7	103	0.7
7	Petroleum	48.3	0.8	0.0	3.2	48.1	0.0	0.0	101	2.7
8	Other chemicals, rubber, plastic and non-metalic mineral products	67.8	2.8	1.5	4.6	27.5	0.0	0.1	104	3.0
9	Basic metals and fabricated metal products	74.0	1.1	3.3	8.8	16.9	0.0	0.3	104	0.6
10	Machinery and other equipment	53.5	0.6	2.1	6.6	39.6	0.0	0.3	103	1.1
11	Other manufacturing	43.26	0.4	0.7	13.2	43.4	0.0	0.1	101	0.0
12	Electricity and gas	55.5	1.3	3.1	11.3	31.6	0.0	1.6	104	1.3
13	Water	40.2	2.5	1.5	10.6	48.3	0.0	0.9	104	0.1
14	Construction	60.4	1.0	0.6	10.6	28.4	0.0	0.6	102	5.1
15	Wholesale, retail trade, motor vehicles repair	37.6	0.6	2.9	13.8	46.4	0.0	2.2	104	8.4
16	Hotel and restaurant services	13.3	0.3	0.1	19.0	64.3	0.0	3.4	100	1.9
17	Transport, supporting transport services and post	42.6	9.0	0.5	15.9	40.6	0.0	0.8	109	3.1
18	Telecommunication	31.3	0.2	1.1	9.1	59.5	0.0	0.1	101	3.6
19	Finance	38.5	0.0	0.1	10.9	49.7	0.0	0.9	100	2.9
20	Real estate services	13.0	0.1	0.3	5.7	80.7	0.0	0.6	100	2.3
21	Business services	19.6	0.1	0.3	13.8	65.6	0.0	1.0	100	3.8
22	Public administration and defence services	32.0	0.9	2.2	62.2	5.7	0.0	0.0	103	8.6
23	Education services	22.2	1.4	1.7	70.1	7.5	0.0	0.2	103	6.8
24	Health and social work services	36.2	0.6	0.5	46.4	16.8	0.0	0.6	101	2.8
25	Other community services	44.1	1.3	1.8	30.0	25.1	0.0	0.8	103	1.2
26	Private households with employed persons	0.0	0.0	0.0	100.0	0.0	0.0	0.0	100	0.5

Source: authors calculations based on database

Table 2. Sales shares of aggregated commodities (2015)

		Sales share:								
	Commodity	Intermediate	Investors	Households	Exports	Government	Stocks	Margins	Total	Import share
1	Agriculture, hunting, forestry and fishing	44.8	0.0	25.5	1.3	0.0	28.3	0.0	100	22.0
2	Crude oil and gas	17.7	0.0	0.7	81.5	0.0	0.1	0.0	100	0.0
3	Other mining	92.6	0.0	0.0	0.6	0.0	6.8	0.0	100	36.9
4	Food, beverages and tobacco	7.0	0.0	76.6	5.3	0.0	11.1	0.0	100	46.3
5	Textiles and leather products	20.6	1.2	64.0	4.8	0.0	9.4	0.0	100	59.6
6	Wood and paper products including furniture	49.4	23.0	13.9	3.3	0.1	10.2	0.0	100	33.9
7	Petroleum	29.5	0.0	39.9	30.6	0.0	0.0	0.0	100	1.4
8	Other chemicals, rubber, plastic and non-metalic mineral products	53.2	2.7	5.8	20.7	6.9	10.8	0.0	100	27.3
9	Basic metals and fabricated metal products	9.6	80.0	0.0	2.2	0.0	8.2	0.0	100	58.8
10	Machinery and other equipment	2.1	73.5	14.3	1.7	0.2	8.1	0.0	100	84.2
11	Other manufacturing	36.5	47.3	0.0	6.0	1.1	9.1	0.0	100	92.9
12	Electricity and gas	54.5	0.0	26.6	0.7	14.5	3.6	0.0	100	0.0
13	Water	17.0	0.0	77.0	2.0	0.0	3.9	0.0	100	0.0
14	Construction	1.7	75.2	22.6	0.5	0.0	0.0	0.0	100	7.6
15	Wholesale, retail trade, motor vehicles repair	63.7	5.7	23.6	4.0	0.3	2.5	0.0	100	30.3
16	Hotel and restaurant services	30.6	0.0	67.2	2.2	0.0	0.0	0.0	100	35.7
17	Transport, supporting transport services and post	50.0	5.8	21.9	10.1	10.0	2.1	0.0	100	34.8
18	Telecommunication	59.0	0.0	41.0	0.0	0.0	0.0	0.0	100	20.2
19	Finance	76.2	0.0	21.5	2.3	0.0	0.0	0.0	100	15.4
20	Real estate services	33.9	0.0	63.3	1.6	1.1	0.0	0.0	100	17.2
21	Business services	75.8	0.0	22.5	0.0	1.7	0.0	0.0	100	13.4
22	Public administration and defence services	0.9	0.0	0.1	0.0	99.0	0.0	0.0	100	15.6
23	Education services	10.1	0.0	8.7	0.0	81.1	0.0	0.0	100	10.9
24	Health and social work services	12.2	0.0	22.1	0.0	65.7	0.0	0.0	100	23.6
25	Other community services	15.2	0.0	10.0	0.1	74.8	0.0	0.0	100	1.6
26	Private households with employed persons	0.0	0.0	100.0	0.0	0.0	0.0	0.0	100	0.0

Source: authors calculations based on database