Managing Natural Revenue for Sustainable Development in Ghana: Simulations using a DSGE Model

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Abstract: The success of long-term growth strategies rests on infrastructure development. It is a key ingredient for economic transformation. One of the building blocks of Ghana's Long Term National Development Plan (2018-2057) consists of achieving industrialization, inclusive and resilient economy growth supported by a national infrastructure plan. While infrastructure development is vital for growth, its financial implications could be huge and cannot be met by traditional sources of financing only. Using a DSGE model applied to Ghana, this paper combines four fiscal rules for managing oil revenue for public investment spending: i) the government combines both oil proceeds and borrowing (*baseline* experiment); ii) the government saves all oil proceeds and resort to borrowing (*Bird-in-Hand* experiment); iii) the government invests all oil proceeds and does not borrow (*Hand-to-Mouth* experiment); iv) aggressive investment approach; and v) baseline with structural reforms. We find that the baseline rule is susceptible to generate an intermediate impact on non-oil GDP growth and non-oil fiscal balance while minimizing the macroeconomic and fiscal volatility. We find that the baseline rule is susceptible to generate an intermediate impact on non-oil GDP growth and non-oil fiscal balance while minimizing macroeconomic and fiscal volatilities. However, the speed of scaling up and degree of frontloading of public investment are much higher in the baseline, which creates considerable absorption pressures and Dutch disease effects. In contrast, the *Bird-in-Hand* approach to scaling up public investment generates a smooth and long lasting non-oil GDP growth, and is susceptible to offset absorptive capacity constraints and Dutch disease effects. The *Hand-to-Mouth* approach leads to macroeconomic volatility, lower non-oil GDP growth and declining non-oil fiscal balance as a share of GDP. The aggressive investment approach is likely to produce higher non-oil GDP growth compared to the baseline but will accentuate downside risks in the baseline. Furthermore, we find that structural reforms that improve the efficiency of the baseline scaling up of public investment create sizable increase in public capital stock which has additional positive spillover effect to the rest of the economy as evidenced by higher additional growth of the non-oil GDP. However, the study has shown evidence of long run capital depreciation due to lack of maintenance, which explains that the public capital stock is not sustained, as shown by the long term decline. Finally, our results highlight the sensitivity of budgetary revenues to oil output and price changes, which could affect both government spending and potential non-oil output growth and emphasize the importance of continuing to save as oil revenue is declining in order to avoid abruptly adjusting when it completely exhausts.

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I. Introduction

The success of long-term growth strategies rests on infrastructure development. It is a key ingredient for economic transformation. The building blocks of Ghana's Long Term National Development Plan (2018-2057) consists of achieving industrialization, fostering inclusive and resilient economic growth supported by a national infrastructure plan. Improved infrastructure would facilitate increased intra-regional and international trade, reduce the cost of doing business and enhance the country's competitiveness internally and in the global economy. It ultimately encourages private investment which is a prerequisite for economic growth.

While there is a strong consensus that scaling up public infrastructure investment can provide impetus for growth, the issue of how to finance infrastructure projects cannot be ignored. The financing issue is even more apparent at current juncture of growing unreliability and inadequacy of traditional sources of development finance, particularly those from external provenance, including official development assistance (ODA). Domestic resource mobilization is also suffering from illicit financial flows, tax evasion and narrow tax base of many developing countries. In these circumstances, a compelling case can be made for channeling part of natural resource revenue for the financing of infrastructure projects aimed at promoting the non-resource sectors in such a way that allows the economy to continue to grow and generate jobs when natural resources run out. How should a country like Ghana with surging oil revenue and pressing development needs, manage this resource properly to achieve development objectives, while avoiding many pitfalls afflict resource rich countries. The objective of this paper is to answer this question in a DSGE model applied to Ghana.

The theoretical literature on natural resource management proposes different fiscal strategies. Until recently, the conventional policy advice for resource-rich countries has been mostly guided by the Permanent Income Approach (PIH); see e.g., Barnett and Ossowski (2003) and Davis et al. (2001). The PIH requires that most of the resource windfall should be saved as external financial assets in a bid to guarantee intergenerational consumption and fiscal sustainability. However, recent works have challenged its relevance in that it does not provide greater flexibility to accommodate a scaling-up of public investment for relatively poorer current people.

Ghana like other resource-rich developing countries (RRDCs) is faced with the urgent challenge of improving living conditions and providing employment opportunities for low skilled and idle youth. A PIH-based rule might not be appropriate in this context. Moreover, a PIH approach of the buildup of foreign assets assumes that there is high capital mobility, which also means that RRCs have access to international capital market. However, the reality is that some RRDCs do face external borrowing constraints, with the investors' demand for high yield. Thus, investment opportunities are sometimes delayed. For instance, in August 2016, Ghana abandoned plans to issue debt due to high yield demanded by investors. A month later, the government was able to

raise $750 million selling Eurobonds at a yield of 9.25 percent.[4] In such circumstances, resource windfalls can relax financing constraints and domestic investment spending can be frontloaded for a timely achievement of development outcomes (Collier and others, 2010, IMF, 2012a, van der Ploeg and Venables, 2011). For instance, the "bird-in-hand" approach argues that countries that experience resource windfall should accumulate these revenues in a Sovereign Wealth Fund (SWF) and use the SWF to smooth fluctuation of government's spending as resource revenues deplete (Collier and others, 2010). Other studies have advocated that part of the resource revenues should be saved and the rest invested in the form of domestic assets (e.g., infrastructure) in order to speed up development outcomes (Sachs and Warner, 1999).

Two key challenges for RRDCs emerge and stem from (i) deciding how much of the resource revenue to consume or invest in the short term, and how much to save, given that natural resources are exhaustible and the production horizon is uncertain; and (ii) finding ways to delink spending from volatile revenue in a view to avoid boom-bust cycles. On the first challenge, too aggressive frontloading of current consumption or investment can lead to Dutch Disease and jeopardize debt sustainability, particularly in the presence of capacity or absorption constraints. In this regard, Berg et al. (2013) develop a general equilibrium model to assess the macroeconomic impact of scaling up public investment and propose a sustainable investing approach implying a gradual and cautious buildup of public capital to ensure macroeconomic stability and long-lasting growth benefits from investing the resource windfall.

To address the second challenge, Baunsgaard et al. (2012) and IMF (2012a) propose a set of fiscal rules tailored to the various circumstances of RRDCs, recognizing that the resource-production horizon is a key variable. Countries with relatively short reserve horizons, where issues of exhaustibility are dominant, should target a non-resource primary balance designed to ensure fiscal sustainability. For countries with long reserve horizons (i.e., where the key issue is to avoid boom-bust cycles), a structural primary balance rule based on a price-based rule may be appropriate.

Furthermore, RRDCs face significant constraints in ensuring an efficient use of the additional resources: physical, human capital, and poverty gaps are larger and more pressing than in other countries, while administrative capacity is lower. Low public investment efficiency can diminish the growth benefit of public investment as shown in many studies (see Berg and others 2013 and van den Bremer and van der Ploeg 2013 among them). Collier et al. (2010) propose a measured approach to build up capacity to manage investment while suggesting that if absorptive capacity is constrained it is advisable to postpone investment and invest in capital (including human capital) that increases the country's capacity to invest ("investing in investment").

Finally, ramping up domestic consumption and investment spending can lead to high domestic demand for non-traded goods, which pushes up their prices when supply bottlenecks become a concern. This in turn can possibly adversely impact the tradable sector (Dutch disease) in two

[4] The fact that investors are looking for high yields in emerging markets is also due to the U.S. Federal Reserve increases of interest rates, the so-called "taper tantrum".

different ways. First is an increasing labor cost and a fall in the sector output as a result of reallocation of labor factor at the expense of the tradable sector. Second is an inflationary pressure and possibly exchange rate overshooting which negatively affect the demand for traded goods.

This paper uses a Dynamic Stochastic General Equilibrium (DSGE) in the spirit of Melina, Yang, and Zanna (2016) to analyze the tradeoffs between savings, debt and public investment in Ghana, a country that is at infant stage of oil production and has not yet reached a peak production.[5] The model features a natural resource sector, investment efficiency and absorptive capacity constraints, Dutch disease effects, and a resource fund. Oil production and price, and public investment profiles are assumed to be exogenous in order to analyze their macroeconomic impacts in terms of stock of capital, growth, public debt and resource fund, over the period 2016-2036.

The model is a three-sector model of a small open economy with: Oil production sector, a nontraded good sector, and non-oil traded good sector. Since oil sector employs a small and stable fraction of the labor force and a large manufacturing part of investment in oil sector is financed by foreign investment, we assume oil production to be an exogenous process. Oil price is also assumed to be exogenous given that Ghana is a small economy whose oil production does not influence international oil prices.

There are three types of public sector debt—external concessional, external commercial and domestic debt—and various fiscal instruments along with a resource fund. Public capital enters the production of traded and nontraded goods and the cost of building up public capital increases with public investment inefficiencies and absorptive capacity constraints. Natural resource production and prices are assumed to be exogenous.

The economy features two types of households. A fraction called Ricardian households have access to capital and financial markets and are optimisers. The remaining fraction called rule of thumb households are liquidity constrained and consume all of their disposable income in each period. The presence of rule of thumb households captures a relatively less developed financial market. Ricardian households can acquire domestic government bonds and international bonds with portfolio adjustment costs, which restrict the degree of capital account openness. On its foreign debt the private sector pays a constant premium over the interest rate that the government pays on its external debt.

Finally, the fiscal block of the model includes the budget and the resource fund. Government expenditure (consumption and investment) is an aggregate of traded and nontraded goods. To finance its expenditures government uses revenues from taxes on resource and non-resource sectors, interest income from the sovereign wealth fund, as well as domestic and foreign borrowing. The latter is subject to a risk premium depending on the deviation of total external

[5] There is still the possibility of finding new reserves but further explorations have been suspended until further notice through request by the Special Chamber of the International Tribunal of the Law of the Sea, and this, following a dispute between Cote d'Ivoire and Ghana on maritime boundary. Naturally, capital allowances to the oil sector for pumping the new fields will lead to a pickup in investment.

public debt to GDP ratio from a steady state level. Every period the budget surplus (excess resource revenues) is saved in the resource fund. If there is a deficit, it is absorbed by a withdrawal from the resource fund, unless the balance of the resource fund falls below a pre-specified level. When the resource fund lower bound constraint binds, fiscal policy has to react to cover the gap either through external borrowing, tax adjustments or adjustments in government expenditures.

To the best of our knowledge, previous applications of similar models to Ghana include Dagher et al (2010). Their study was done at time when Ghana was at the very infant stage of oil production in 2010. The recent developments in the oil sector and the current falling prices show that their projection of oil revenue in 2010 should be updated. In particular, their projections assumed that a peak of revenue is reached in 2015-2016, and that oil revenue would decline gradually, starting from that peak. Yet Ghana recently discovered new oil fields, the Tweneboa, Enyenra an Ntome, which suggests that the peak production is yet to come. In addition, their model does not include a sovereign wealth fund, yet the Ghana Stabilization Fund (GSF) was established in 2014 under the Petroleum Revenue Management Act (Act 815), whose mandate is to provide budgetary support in times of shortfalls in expected petroleum revenues, and contribute to debt servicing through a sinking fund. Thus the model accounts for a stabilization fund, which allows to study different fiscal rules for managing oil revenue in Ghana, in line with the long-term national development vision which the government is pursuing.

We study the macroeconomic and fiscal impacts of four fiscal rules for managing oil revenue for public investment spending: i) the government combines both oil windfall and borrowing (baseline experiment); ii) the government saves all oil windfall and resorts to borrowing (*Bird-in-Hand* experiment); iii) the government spends all oil windfall and does not borrow (*Hand-to-Mouth* experiment); and iv) baseline experiment with structural reforms.

We find that the baseline rule generates an intermediate impact on non-oil GDP growth and non-oil fiscal balance, while minimizing the macroeconomic and fiscal volatility. However, the speed of the scaling and degree of public investment overshooting are much higher in the baseline, which creates considerable absorptive pressures and Dutch disease effects. In contrast, the *Bird-in-Hand* approach to scaling up public investment generates a smooth and long lasting non-oil GDP growth, and can offset absorptive capacity constraints and Dutch disease effects. Yet, the steady, albeit gradual increase in the public investment becomes difficult to cope with in the long term, especially with the downward trending of overall GDP growth. Thus, the decline in overall fiscal balance is more pronounced. At the other end, the *Hand-to-Mouth* approach leads to macroeconomic volatility, lower non-oil GDP growth and declining non-oil fiscal balance as a share of GDP. Furthermore, we find that structural reforms that improve the efficiency of the baseline scaling up of public investment create sizable increase in public capital stock which has additional positive spillover effects on the rest of the economy, as evidenced by higher additional growth of the non-oil GDP. However, the there is evidence of long term decline of capital stock due to long run capital depreciation on the back of lack of maintenance. This suggests, that the public capital stock is not sustained.

Finally, our results highlight the sensitivity of budgetary revenues to oil output and price changes, which could affect both government spending and potential non-oil output growth and emphasize the importance of continuing to save as oil revenue decline in order to avoid abruptly adjusting when it completely exhausts.

The policy implications from this study are fourfold. First and foremost, if the government is equally concerned about meeting the development goals of Ghana and macroeconomic and fiscal stability, neither the full saving (*Bird-in-Hand*) nor the full spending (*Hand-to-Mouth*) is the optimal fiscal response to oil windfalls. In this case, it is important to find the right balance by investing domestically with a fraction of the windfall to close infrastructure gaps, and saving the other fraction in a sovereign wealth fund to help reduce macroeconomic and fiscal volatility. Second, the findings reveal that public investment scaling-ups should be commensurate with the country's capacity to absorb, everything that shields the economy from running into short-run supply side bottlenecks and to Dutch disease effects. Third, implementing structural reforms in order to address absorptive capacity constraints can help mitigate adverse macroeconomic effects by improving the efficiency constraint. Fourth, the long run public capital sustainability warrants that when the capital is installed, sufficient investment in maintenance is in place to ensure a sustained flow of productive capital to the private sector.

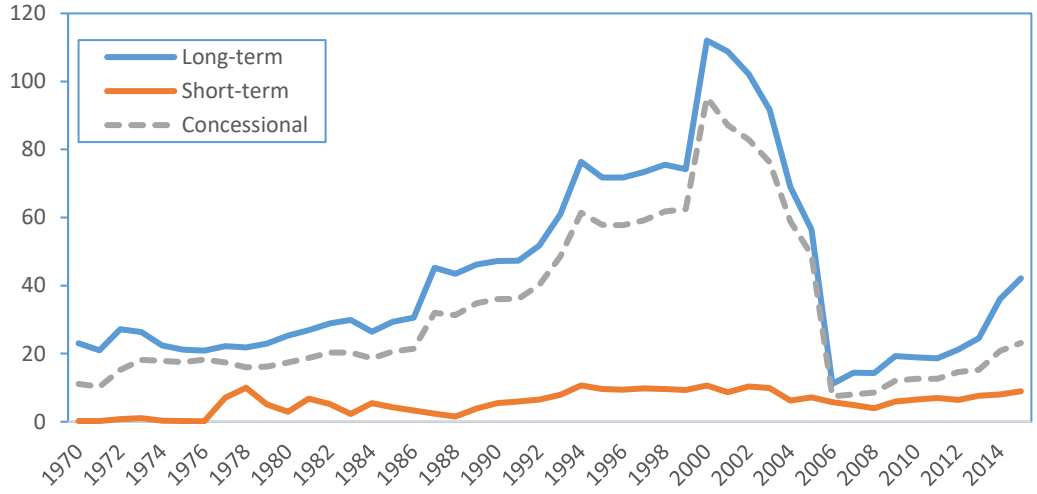
The remainder of the paper is organized as follows: Section II discusses recent developments of the Ghanaian economy, and the state of the oil windfall management; Section III presents a non-technical discussion of the model; Section IV discusses the model calibration for Ghana; Section V lays out the finding of the model simulations; and section VI discusses the policy implications and concludes.

II. Ghana: Key Stylized Facts and Oil

1. Stylized Facts

Ghana's economy faced a number of headwinds in recent years, most of which were at play in 2014. Of the other challenges include a 3-year power crisis, rising fiscal deficit and public debt levels, a significant external sector deficit and unpredictably low world prices for the country's other commodity exports. The external debt stock of the government is on the rise since 2007 (Figure 1). The economy grew at an estimated 3.7 percent in 2015, down from 4 percent in 2014 and has not recovered in 2016, with an estimated GDP growth of 3.6 percent. The services sector was the main driver of growth. The industrial sector also showed a positive growth rate of 9.1 percent in 2015. A recovery in economic growth is expected in 2017 and will depend on fiscal consolidation measures, quick resolution of the power crisis, additional oil revenue from the recent discovery of new wells, improved cocoa harvest and gold production.

Figure 1: External Debt Stocks as a percent of GDP, 1970-2015



Source: World Development Indicator, 2016

2. Ghana: Natural Resource Management

The discovery of oil in 2007 had brought hope that Ghana would use the newfound wealth wisely and avoid the economic and political malaise affecting many oil-exporting nations. But, the discovery of oil coincided with high public debt which continued to rise on the promise of future oil revenue and large capital inflows in foreign direct investment. Surely, these inflows were necessary for Ghana in order to undertake capital investments to develop the oil sector, but after seven years of oil windfalls, Ghana ended up with subpar growth.

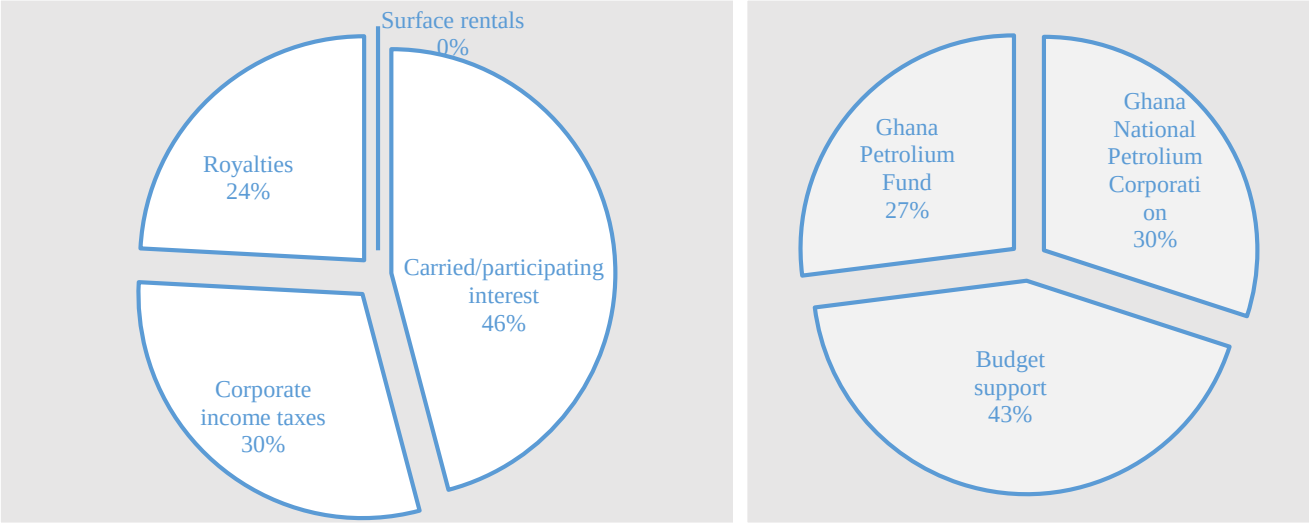
Ghana's Petroleum Revenue Management Act (Act 815) which was set up in 2011 highlights the key parameters for the collection and utilization of petroleum revenues due the Government of Ghana. Under this law, Ghana's Stabilization Fund (GSF) was established. The GSF was intended to provide budgetary support in times of shortfalls in expected petroleum revenues. However, the Act was later revised to allow excess resources in the fund to be moved into a sinking fund for debts repayment purposes.

Ghana realized a total of US$3.3 billion dollars since the commercial production of oil started in 2011 in the Jubilee field. The collection of oil revenue is regulated by the Petroleum Revenue Management Act (Act 815) which also stipulates how the revenue should be distributed. Based on the Act, transfers were made to the Ghana National Petroleum Corporation (GNPC), to the Annual Budget Funding Amount (ABFA) and the Ghana Petroleum Funds.

Oil revenue is collected in the form of royalties, corporate income taxes, participating interest and surface rentals. In 2013, each component represented 24 percent, 46 percent, 30 percent and zero percent of total collected revenue respectively (Figure 3). Over the last five years, GNPC received a total of US$959 million, representing 30 percent of all revenue received from oil. The ABFA,

which is the share of the oil revenue used to support the budget has received a total of US$1.4 billion, representing 43 percent of all oil revenues. The Ghana Petroleum Funds, which comprises the Stabilization Fund and the Heritage Fund, received US$874 million, representing 27 percent of all oil revenue since inception.

Figure 3: Revenue Streams in 2013 and Allocations since Inception in 2011

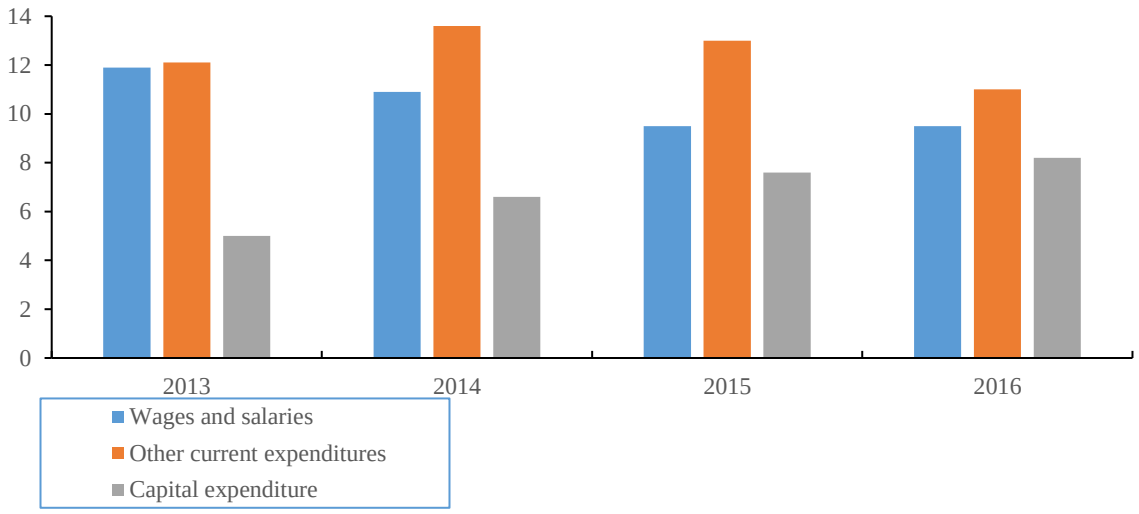


Source: Ghana Extractive Industries Transparency Initiative (GHEITI) website: http://gheiti.gov.gh/; Petroleum Revenue Management Act, 2011

On the utilization side, successive governments have diverted the newfound oil revenue into the pockets of civil servants, instead of investing in infrastructure, public goods, and job creation. This has created large fiscal slippages. The public sector wage bill represented more than 40 percent of the budget in 2013, while capital expenditure represented 17 percent (Figure 2).

With most of the spending diverted directly into consumption instead of investment, domestic demand increases, which also created inflationary pressures in the booming economy. Prices increases was also fueled by international capital inflows in the oil sector. As prices rose, the currency began to appreciate in real terms while remaining nominally stable because of capital inflows. Procyclical oil revenue spending, large deficits, high debt, high inflation, and currency overvaluation were the ingredient of an imminent crisis, but policymakers ignored these early warning signs. Then, in 2013, the price of gold collapsed and exports lost significant value. With the terms of trade deteriorating sharply, the current account deficit widened to 12.3 percent of GDP, but narrowed to some 6.15 percent of GDP in 2016. The fiscal deficit also worsened, as government coffers lost revenues from export tariffs on oil. The budget deficit stood at 9 percent of GDP in 2016 and is expected to narrow in the coming years.

Figure 2: Composition of Public Expenditure (Percent GDP)[1]



[1]2013 and 2014 (estimates), and 2015 and 2016 (projections); wages and salaries include deferred payments.
Source: IMF Article IV, 2014

Ghana's high twin deficits have resulted in a full-blown currency crisis in 2014 and 2015, with the cedi losing significant value. Owing to concerns about sustainability of the twin deficits, international investors pulled out, increasing pressure on the cedi. Rising import prices due to rising domestic consumption have exacerbated inflation, which stood at 17.1 percent in 2015, easing to 15.4 percent in 2016, well above the central bank target of 8 percent. Monetary policy placed an important role of reducing inflationary pressures in 2016. Furthermore, to the extent that external debt is denominated in foreign currency, the balance sheet effect has increased the government's debt service substantially, as more revenue in local currency are required to service the same debts in foreign currency.

III. Model[6]

The model under use is a long-term macroeconomic and fiscal sustainability framework for natural resource-rich countries similar to Melina, Yang, and Zanna (2016).[7] It is a Dynamic Stochastic General Equilibrium (DSGE) model with public and private investment augmented by several frictions including investment inefficiencies, absorptive capacity constraints and limits to

[6] A full description of the model is available in Melina, Yang, and Zanna (2016).
[7] Since this model aims to study the macroeconomic impacts of public investment, then the time horizon is the long term (more than 20 years). Thus it abstracts from nominal rigidities and focuses on the real economy. Therefore, monetary policy does not make sense. The short-run policy of managing natural resource is explored in another model.

borrowing and features different fiscal policy instruments and a resource fund. The model is calibrated to the Ghana under which different public investment strategies are studied based on different assumptions on oil revenue profiles and structural reforms.

IV. Calibration

The model is calibrated to the Ghana economy using annual data. The initial steady state is based on macroeconomic developments at the end of 2016 (WDI (2016), IMF Article IV (2014), Central Bank of Ghana, Petroleum Revenue Management Act (2011)), and our projections run over the period 2016-2036. Private investment in terms of GDP is calibrated at 0.173, export share in terms of GDP is set at 0.438 and import share at 0.554. Total oil GDP is estimated at 6 percent GDP. On the fiscal side, the ratio of government current spending to GDP is set at 20.15 percent and the ratio of government investment to GDP is set at 8.5 percent. Total revenue from oil is estimated at 2.6 percent of GDP based on a benchmark crude oil price of 53 US dollar per barrel and of production of 40.15 million barrels (110,000 barrels per day). The size of the sovereign wealth fund at the end of 2016 is 0.26 percent of GDP. The initial total public debt is set at 72.1 percent of GDP. Government's revenues from oil represent 11 percent of total fiscal revenues. Interest rate on domestic debt is set at 22.5 percent. For the remaining parameters we follow the standard values in the literature (see Berg and others (2013), Melina, Yang, and Zanna (2016) and Balma and Ncube (2015)). Table A in Appendix provides a complete list of the parameters of the model.

V. Model Simulations: Oil Revenue Forecasts and Fiscal Policy Rules

Oil production and prices, and investment profiles are determined exogenously in the model through a benchmark scenario that reflects the recent developments in the Ghana oil sector and prices. Since oil revenue forecasts and policies are subject to uncertainties, we define alternative scenarios against the benchmark.[8]

Oil Revenue Forecast Scenarios

We assess future oil revenue (production and prices) under two main scenarios (Figure 4): a *benchmark scenario* and an *optimistic scenario*.

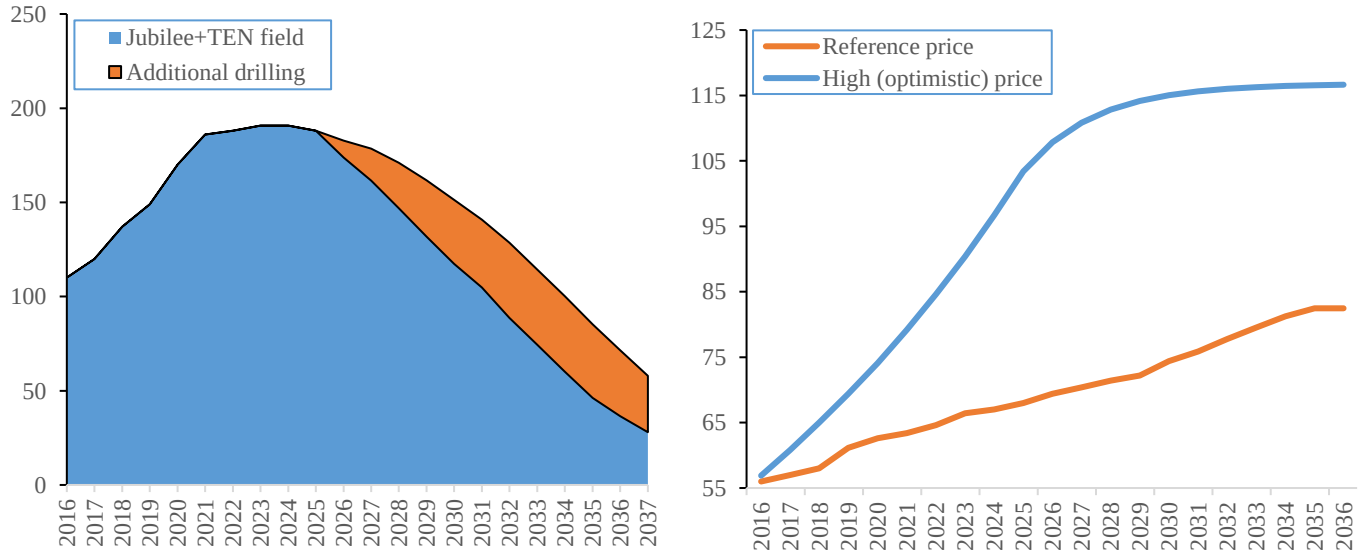
The *benchmark scenario* builds on the Jubilee oil field production and accounting for the recent discovery of the Tweneboa-Enyenra-Ntomme (TEN) field. Full year 2016 gross production from the Jubilee field averaged 73,700 barrels per day. In addition, it is expected that production from the TEN field will be around 50,000 barrels per day in 2017, although work continues to consider ways to increase production capacity. Accordingly, we assume a peak production capacity to be reached in 2021-24, corresponding to four years after the new field is operational. Then, it is

[8] The simulations under study here are not random shocks but deterministic which succeed in capturing countries' investment plan in the medium-term. But the random nature of shocks hitting oil prices calls for reconsidering the modelling of oil price shocks and making them random.

assumed that production will decline gradually until 2036. The baseline oil prices refer to WEO (2015)'s projections. Oil price is assumed to stand above 50 US dollar per barrel in 2017 and are projected to increase gradually to 85 US dollar per barrel by 2036. Since our assumptions on oil production profile considers only production forecasts associated with projects already under exploitation, it is obvious that our baseline might be fairly conservative.

The *optimistic scenario* aims to capture potential revenue windfall from new oil fields' exploration projects and from further increases in oil prices in the future. Indeed, plans for further explorations are possible in order to increase the production capacity, but have been temporarily suspended following a request by the Special Chamber of the International Tribunal of the Law of the Sea over disputes between Cote d'Ivoire and Ghana on maritime boundary. Therefore, future activation of new deep water development projects will have significant implications for the production profile. However, the suspension of new explorations and long gestation periods of undersea infrastructure development imply that additional oil production would not materialize before the next seven years.[9] Therefore, we assume that oil output will increase relative to the baseline by 2025.In the optimistic scenario, oil price is expected to reach around 116 US dollar per barrel by 2036, from 60 US dollar per barrel in 2017.

Figure 4: Ghana: Production Profile Forecast for the Jubilee and TEN Fields and price assumptions



Source: Tullow Ltd (2017): Oil output; WEO (2015): Oil prices; and authors' assumptions.
Note: Production in thousands barrels per day and price in US dollars per barrel.

[9] For instance, the TEN field become operational after seven years of deep water explorations and undersea infrastructure developments.

Fiscal Rules

We consider different fiscal rules for the management of natural resource revenues for public investment and consumption spending in Ghana: (i) "baseline scaling-up" experiment, (ii) "full saving" experiment, (iii) "full spending" experiment; (iv) "aggressive scaling-up" experiment; and (v) "baseline scaling-up with reform" experiment. These five approaches to investing resource revenues are conducted under specified profiles of oil revenue for the period 2016-36.

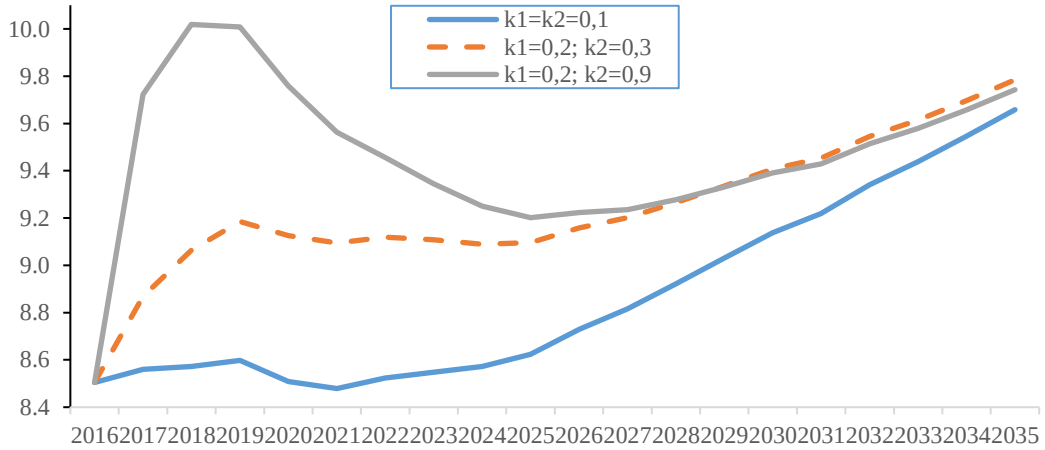
- The "baseline scaling-up" experiment assumes no change in public investment efficiency relative to its historical level which is consistent with observations in several developing countries that do not enact structural reforms. Public investment is gradually scaled up from the initial level of 8.5 percent of GDP in 2016 until it reaches a peak level of 11.7 percent of GDP in 2019, which is more than 3 percentage point increase in three years. Then it is expected to gradually decline to the steady state level by 2030 as oil revenue declines. The baseline investing approach is an attempt to mimic the ambitious investment plan of Ghana and overlaps in the first-five series of medium-term development plans (2018-2037) contained in the Long-Term National Development Plan (LTNDP) for 2018-2057.[10] It assumes that over this period, public investment as a ratio of GDP will be ramped up with a peak increase of more than 3 percentage point in 2019. It will then decline gradually after this period. During this upward movement period of public investment, public consumption declines from 17.6 percent in 2017 to 16.8 percent in 2019 and then 16.2 percent in 2021. This is consistent with the government consolidation plan which consists to contain current spending.

- The "*Bird-in-Hand*" experiment correspond to a full saving of the proceeds of oil resources and has been discussed in the literature (Collier and others, 2010). This approach assumes that during the first few years the focus is on building up fiscal buffers, so that public investment is scaled up gradually (we set the speed of scale-up *k1* to *0.1* and the degree of overshooting *k2* to *0.1*; see Figure 6). Rather than being procyclical, the gradual scaling up delinks spending decisions from oil revenue flows. In this case all the resource windfall is accumulated in a sovereign wealth fund and only the interest income generated by the fund is used to finance government spending on consumption and investment. As a stabilization fund, the saving from natural resource rents can be used to smooth fluctuations that can emanate from future resource revenue shocks. In particular, the government combines investment spending with saving in stabilization fund for a given path of public investment and public consumption, which allows for depositing when there are surplus revenues and withdrawing when there is a revenue shortfall. In that sense, the aim is to achieve more or

[10] The Ghana Shared Growth and Development Agenda (GSGDA) II is a medium-term development which is due to expire in 2017. The successor long-term development plan is constituted by a series of 10 medium term development plans that will be implemented by successive governments.

less smooth government spending, and in particular to delink it from the dynamics of resource revenue in order to avoid boom-bust cycles.

Figure 6: Different speeds (*k1*) and degree of overshooting (*k2*) of investment scaling-ups (percent of GDP)



- The "*Hand-to-Mouth*" experiment corresponds to full spending policy where all the oil revenue is spent on capital investment. This experiment is consistent with the view that governments in developing countries should use natural resource revenue to address their development needs. This is particularly important in capital scarce economies that have infrastructure deficits, and poor delivery of basic social services. In this experiment, the resource fund is drawn down below its initial level of 0.26 percent of GDP in 2016, while public investment is scaled up. No cap on the resource fund is defined to accommodate the Ghanaian government's consistent lowering of the cap on Ghana Stabilization Fund (GSF). Indeed, under the Petroleum Revenue Management Act (Act 815), the GSF was to provide budgetary support in times of shortfalls in expected petroleum revenues. However, the Act was later revised to allow excess resources in the fund, beyond US$150 million, to be moved into a sinking fund for debts repayment purposes.

  In 2014, the GSF had a balance of US$379.19 million. The same year, the Ministry of Finance announced a cap of US$250 million, which allowed the excess amount to be channeled into a contingency fund to allow for debt servicing. A year later even as petroleum revenues fell, the Minister of Finance lowered the cap on the fund to US$150 million, and transferred the excess to the Sinking Fund to be used for debt servicing. Then in the 2016 mid-year budget review, the Ministry of Finance announced a reduction of the cap to US$100 million, which allowed to transfer the excess for debt servicing again. In 2016, an amount in excess of US$74 million was moved to a sinking fund, as the government's bid to issue Eurobonds has been met with demands by investors for excessive yields.

- The "aggressive scaling-up" experiment is a Marshall-type aimed at transforming the Ghanaian economy. In the baseline scenario we assumed a peak investment scaling-up of 11.7 percent of GDP in 2019 (from 8.5 percent in 2016) and a gradual decline in subsequent years. In this experiment, the peak level of public investment in percent of will reach 13 percent in 2019 and will be maintained above 12 percent until 2025. This represents about 5 percentage point increase in 3 years from the actual level.

- The "baseline scaling-up with reform" experiment assumes that public investment will increase similarly as in the "baseline scaling-up" scenario. In addition, it assumes an improvement in the efficiency of public investment relative to Ghana's historical average, similar to the median low-income countries' efficiency levels. The reform element of the scenario incorporates the assumption that structural impediments are lifted in order to ensure that a greater share of public investment translates into effective capital stock. This implies that public investment efficiency is higher than otherwise.

In terms of fiscal deficit financing, we assume that Government makes use of domestic and external commercial borrowing or a mix of both in order to close the fiscal gap in all the investment strategies. Indeed in 2016, Ghana issued Eurobonds after receiving the fourth tranche of close to $1 billion from the IMF under the extended credit facility program. The Eurobond sale proceeds are destined to repay maturing debt and finance infrastructure projects. In addition, government consumption spending is used as an adjustment instrument during the scaling-up phase of public investment in order to clear the budget constraint. This is consistent with the government's current consolidation plan, which aims to contain overspending due to rising public sector wage bills and make room for increases in capital spending. Finally the four mentioned approaches keep consumption and income tax rates constant.

VI. Simulation Results

A. Baseline experiment

Table 1 and Figure 7 illustrate the impacts of the baseline experiment (at the given benchmark oil revenue path as described in section 5) on the economy through 2036. These include: (i) non-oil GDP growth is expected to average 3.7 percent per year. The materialization of this annual growth rate in terms of non-oil revenue dividends is not immediate, but it begins to take effect in the long run. Oil revenue progresses from 11 percent of total government revenue in 2016 to 21.8 percent in 2024, but thereafter, it is expected to decline gradually to around 6 percent at the end of 2036; (ii) on the expenditure side, capital expenditures are assumed to increase from 8.5 percent of GDP in 2016 to 11.7 percent in 2019 and then to decline gradually until it return to the initial level by the end of 2029. At the same time total government expenditures decline from 28.7 percent in 2016 to 25.4 percent in 2025 which reflect the decline in current expenditures, and to increase to 28.1

percent in 2036. Indeed current expenditures regress from 20.2 percent of GDP in 2016 to 16.2 percent in 2022. From that year, it is then expected to progress until around 19.5 percent in 2036; (iii) the consolidated effect of these developments delivers a non-oil primary deficit which first increases to 9 percent of GDP in 2019—corresponding to the peak year of public investment—from 8.6 percent of GDP in 2016, and then declines to around 6.6 percent of GDP in 2026.

It is assumed that the fiscal deficit will be financed through a mix of proceeds from oil and external commercial borrowing. Figure 7 shows that external commercial debt GDP ratio increases during the scaling up period of public investments from 42 percent in 2016 to 64.2 percent in 2019 before declining gradually. The declining debt path suggests that debt sustainability is not at risk. Regarding the resource fund, it does not accumulate until 2023 when public investment is scaled up. It is then expected to accumulate starting from 2023. At the end of 2036, the stabilization is expected to represent 11 percent of GDP.

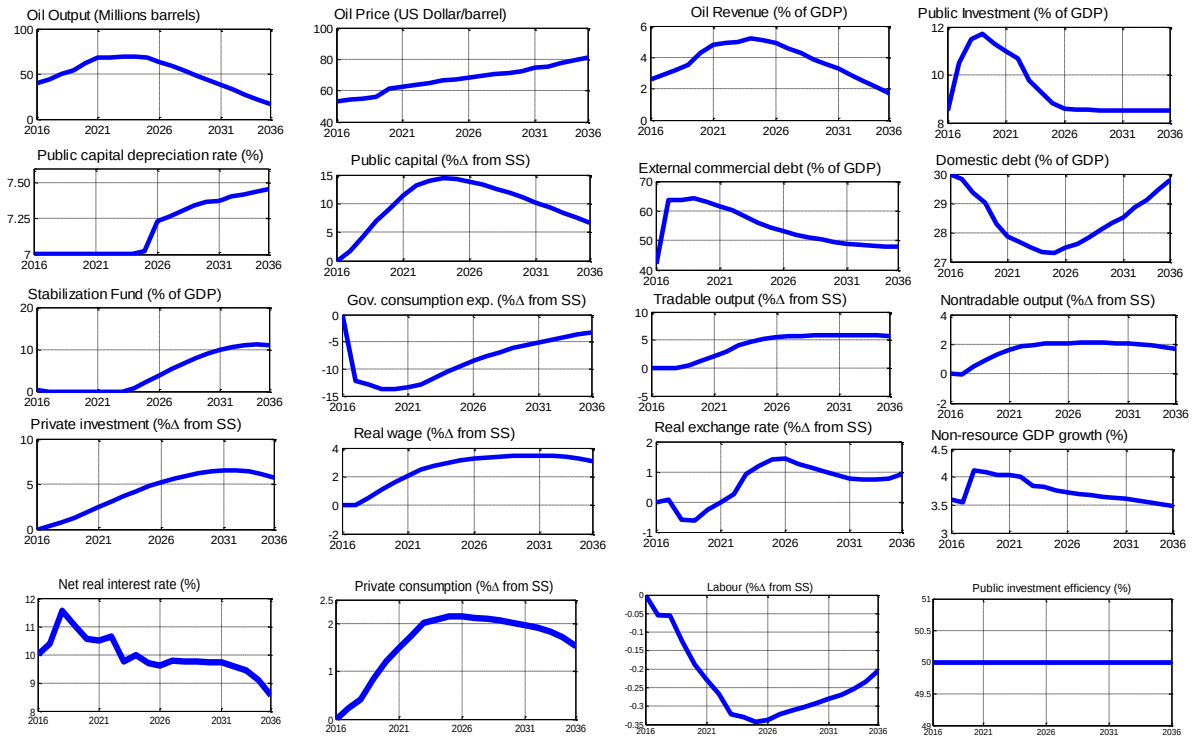
Furthermore, the projected path of public investment delivers a sizeable increase in the public capital stock. Indeed, public capital gradually accumulates, reaching a peak increase of 14.4 percent relative the steady state in 2024. However, the experiment shows that the increase in public capital is not sustainable as it is expected to decline in subsequent years. This long term decline in public capital possibly stems from the lack of maintenance, which requires that sufficient investment spending is available in order to cover maintenance costs. The lack of such maintenance in the long term is what causes public capital to depreciate. This is shown through the increase in the depreciation rate of public capital from 7 percent to around 7.4 percent at the end of 2036. As it appears clearly the increase in the depreciation rate coincides with the decline phase of public investment.

In the long run, the scaling-up of public investment has positive spillovers to the rest of the economy. The accumulation of public capital crowds in private investment as well as non-oil output which increase relative to the steady state (Figure 7). Also, the increase in the government investment spending creates a wealth effect through higher income to households, resulting from higher wages. The wealth effect causes households to increase total private consumption.

Indeed, the expansion in aggregate demand, combined with absorptive capacity constraints lead to real wage increases and real appreciation. The capacity constraints entail that ramping up public investment in a shorter period requires capacities in terms of skilled labor, technical as well as administrative capacity necessary for the implementation of projects. The pace of the increase in the investment is not commensurate with the economy's absorption capacity, leading to a resource movement from the non-resource tradable sectors. Therefore, the shortage of labor and the pressing need for such factor in order to increase production of nontradables explains why real wages increase. As a result, non-resource tradable and nontradable sectors do not expand or in the short-term, but the shrinking of the tradable sector is the result of one more effect in addition to the resource reallocation effect. Indeed the real appreciation reduces the competitiveness of the non-resource tradable goods, which compounds the negative effect on the sector and explain why it

initially shrinks. In particular, the real exchange rate is in the negative territory (which is an appreciation) during the first-five years. It then goes into the positive territory at the end of 2021. Accordingly, the traded good sector stagnates until 2019.

Figure 7: Baseline scenario: Macroeconomic outcomes



B. The "Bird-in-Hand" experiment

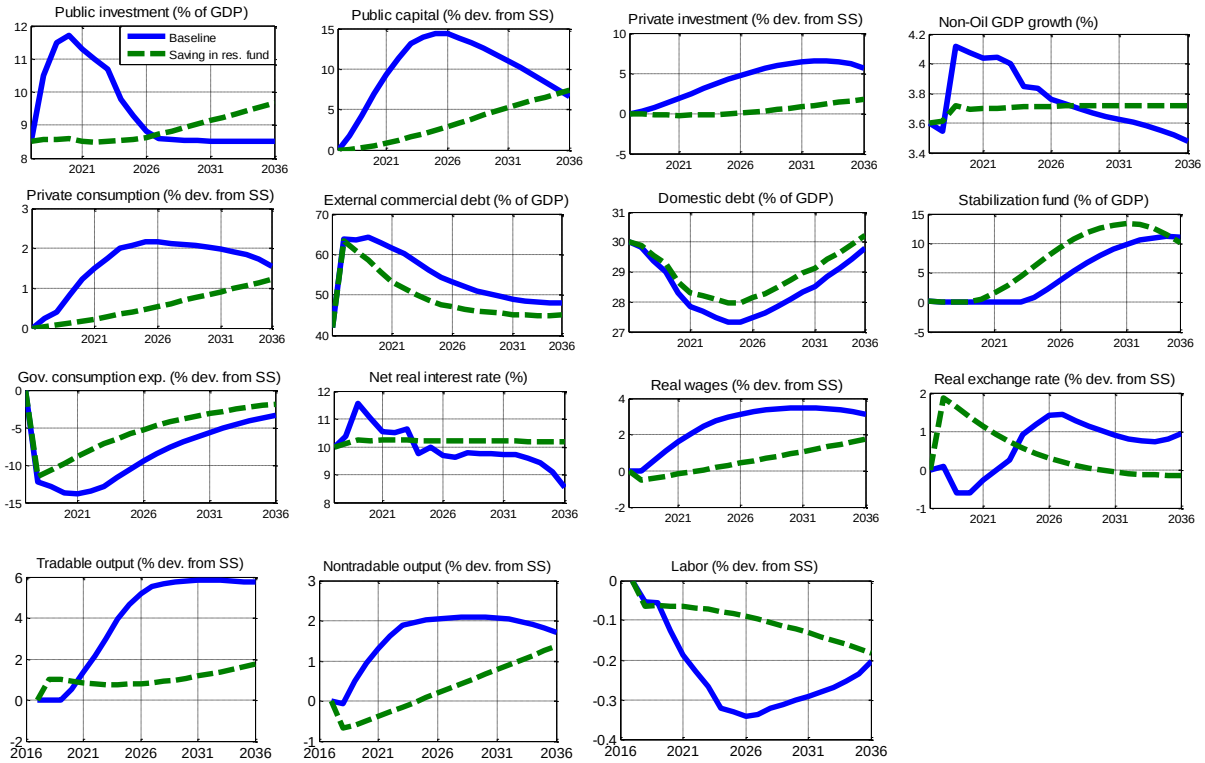
Figure 8 and Table 2 shows the macroeconomic impacts of the "*Bird-in-Hand*" approach of oil revenue management. The aim of this experiment is to delink government spending from the dynamics of resource revenue as a means to avoid boom-bust cycles. Notably, if all the resource windfall is saved, Dutch disease effects are eliminated, and volatility in the fiscal variables is reduced. In comparison to the baseline, Figure 8 shows that under this rule, the speed of the rise in government spending is very slow until 2026, corresponding to the period when oil revenue is expected to surge.[11] As a result, public investment increases at slower pace and government consumption fall in the very first years before normalizing gradually in the long term.

The "*Bird-in-Hand*" experiment delivers the best macroeconomic outcomes. Although the macroeconomic outcomes are smaller in size, especially in the short-term, the economic dynamics in the long-term is sustained. In particular, steadily increased public investment as modeled in this approach builds up more productive public capital over time, to the extent that it does not return to the steady state level in the long-term as compared to the baseline.[12] Subsequently, the economy enjoys higher private investment and non-oil GDP growth follows suit. Since the focus in the first few years is on building fiscal buffers, the economy is able to build sizeable resource fund and the assumed fiscal consolidation on the expenditure side is less tidy. The slower and gradual rise in public investment and the falling government consumption cause the overall primary deficit to drop (Table 2). The result is that public external commercial debt drops by substantially more compared to the baseline.

Furthermore, given the fact that public investment spending is delinked from the resource revenue in the "*Bird-in-Hand*" approach, the economy is less prone to "overheating" (Dutch disease effect). The marginal and gradual rise in public investment reduce the absorption pressures; hence employment fall but by less than the baseline experiment and the real wage hike is mitigated in the long-term. Indeed, the expansion of aggregate demand for nontradable goods is absorbed so the resource reallocation effect in the baseline is dampened. In addition, the real appreciation observed in the baseline is reversed. Therefore, the real depreciation increases the competiveness of the non-resource tradable goods, causing the sector to expand.

[11] Public investment spending is 8.5 percent of GDP until 2026.
[12] Note that these are deterministic shocks, so stationarity is not an issue.

Figure 8: "Bird-in-Hand" versus baseline experiment



C. The "Hand-to-Mouth" experiment

The "*Hand-to-Mouth*" experiment consists of a full spending of resource windfall on investment, so government spending adjusts automatically by the amount of the windfall, and there is no asset accumulation in the stabilization fund. On the procyclicality, it can be seen that public investment moves in tandem with oil revenue, and the stabilization fund remains at about the initial of 0.26 percent of GDP (Figure 9). When oil revenue grows, government investment spending also grows by the same amount.

Figure 10 contrasts the macroeconomic effects of this investing approach with the baseline investing approach. There is an important macroeconomic instability and boom-bust cycles. Non-oil GDP growth is markedly volatile at the beginning of the period before stabilizing around the baseline. While government spending is procyclical in this scenario, the speed of scaling-up of public investment is less compared to that of the baseline from 2016 to 2025, and hence there is no demand-side effect during this period. In the baseline, public investment returns to its initial level and remains steadily around this level until the end of the period. However, since public investment scaling-up is maintained beyond 2025, the demand-side effect, although feeble is present. In particular, the real exchange rate is below the baseline (which is an appreciation) between 2021 and 2026, and the tradable good production shrinks accordingly. Later, as

productive public capital gradually increases, productivity in the traded goods sector also rises through learning-by-doing

Figure 9: Procyclicality of public investment spending

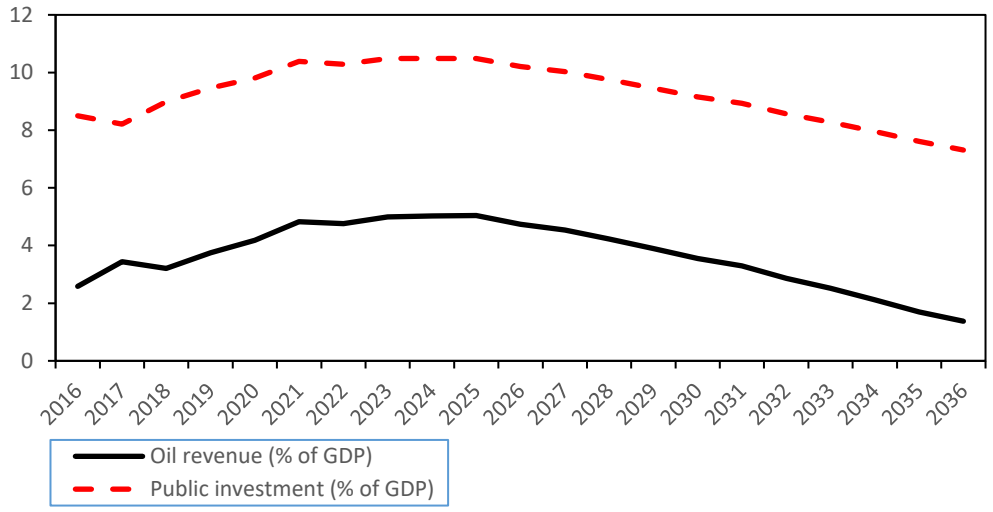
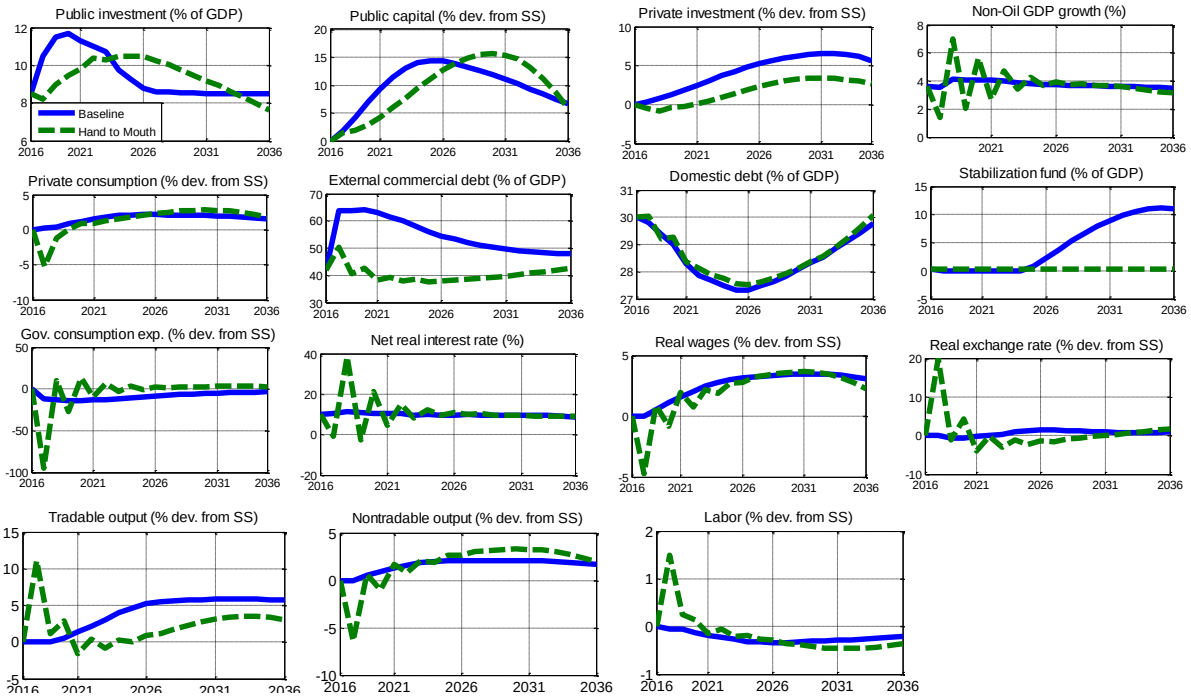


Figure 10: "Hand-to-Mouth versus baseline experiment

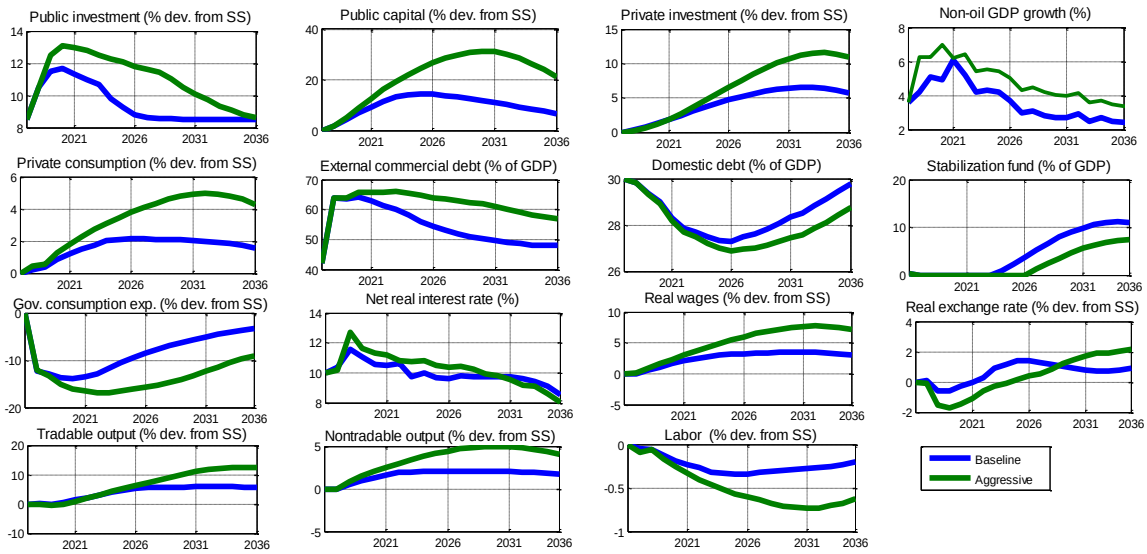


D. The "Aggressive scaling-up" experiment

The "Aggressive scaling-up" scenario produces higher non-oil GDP growth compared to the baseline (Figure 11). In fact, the accumulation of public capital under this experiment is more important so private investment is higher. Moreover, households enjoy much more wealth effect as shown through increased consumption and higher labor disutility. Higher labor disutility and the expansion of aggregate demand put a pressure on the economy's capacity to meet demand. The initial stagnation of the tradable and nontradable outputs explain such capacity constraints. Compared to the baseline, aggressively expanding public investment is likely to worsen such constraints in the short run as revealed by this scenario.

Furthermore, another downside risk association with this scenario in that it causes a prolonged erosion of the sovereign wealth fund and puts external commercial debt on an unsustainable path.

Figure 11: "Aggressive versus baseline experiment



E. Baseline experiment with structural reforms

We have shown how absorption and capacity constraints interfere in the process of translating public investment into growth-inducing capital accumulation. In this section we explore the implications of structural reforms that improve the efficiency of public investment (or reduce the absorption pressure) in the baseline under alternative assumptions on the timing and magnitude of the improvement in efficiency. While capital scarcity calls for ramping up spending for domestic investment, limited absorptive capacity may warrant a slower and gradual pace for scaling up investment spending commensurate with the economy's capacity to manage high scale investment levels is in place. Absorption and capacity constraints imply that skilled administrators are in scarce supply in developing countries and therefore ambitious public and private investment programs are often plagued by poor planning, weak oversight, and a myriad of coordination

problems, all of which contribute to cost overruns.[13] The calibration assumes that even without binding absorptive capacity constraints, on average a dollar of investment expenditure only leads to 0.5 dollar of effective investment so 50 percent is wasted.[14] With additional scaling up, waste can be higher because of absorption constraints.

On structural reforms, we assume a gradual increase until 2026 of the efficiency, to capture the fact that such reforms cannot be implemented in a short period of time. Indeed, it requires much time for an economy to get rid of political, institutional and policy constraints that hinder the capacity to manage investment appropriately. It also takes time to build "home grown" capital (including human capital) necessary to satisfy the expansion of domestic aggregate demand for non-traded goods as shown in the baseline without reforms. In particular, it is assumed that the efficiency of investment increase from 50 percent in 2016 to 60 percent in 2026, so by 2026 a dollar of investment expenditure leads to 0.6 dollar of effective investment, which implies that 40 percent is wasted (Figure 12).

On macroeconomic impacts of the reforms, we find that there is a sizeable and sustainable accumulation of public capital.[15]This in turn has positive spillover effects to the rest of the economy. Non-oil GDP growth is much higher and households enjoy additional wealth effect from more income due to the reforms. This wealth effect is manifested by ample and sustainable increase of private consumption. As a result, the demand side effect already explored is accentuated, which in turn increases the absorption pressures.[16]

Therefore, we can conclude that the reforms component of the experiment yield sizeable and sustainable buildup of public capital and hence higher non-oil GDP growth and income for households. Naturally, this creates additional pressure on demand and again the absorption pressures and Dutch disease effects found in the baseline without reforms are fairly large.

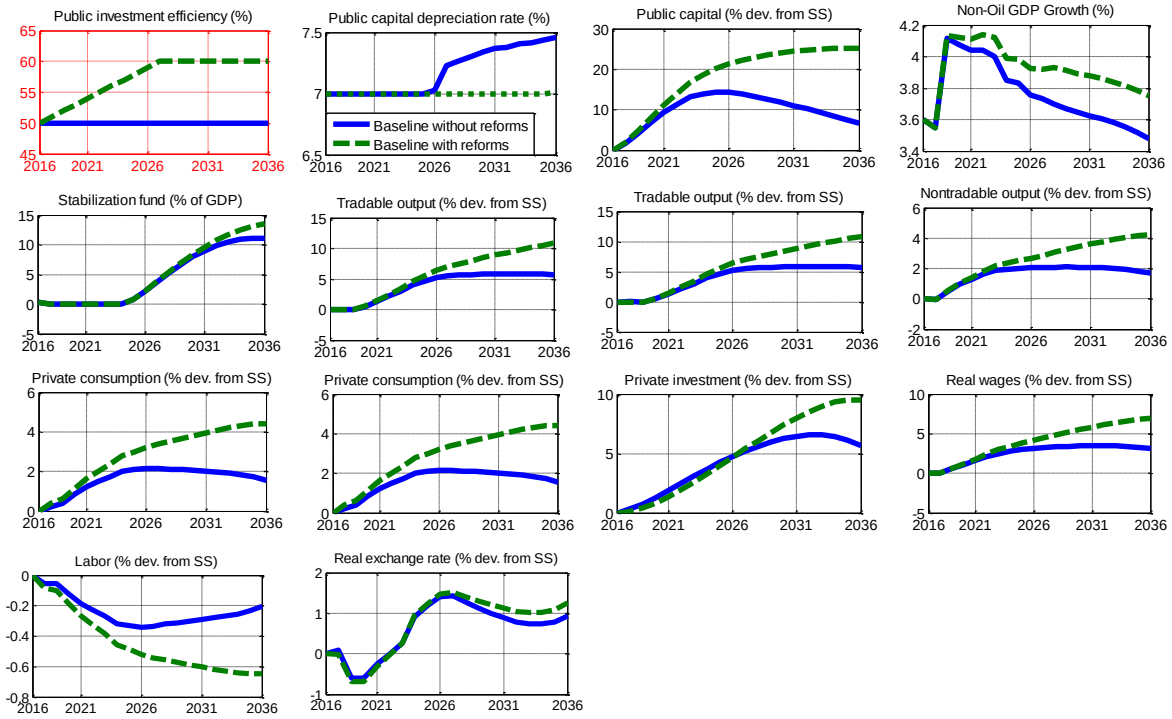
[13] These constraints are especially potent in the short term but are likely to dissipate in the long term when enough time is dedicated to educate and train local workforce.

[14] This value is within the range for low-income middle-income economies in line with the literature on public investment efficiency in developing economies. In fact, Pritchett's (2000) estimates of public investment efficiency for Sub-Saharan-African countries point to a public investment efficiency of 50 percent.

[15] Note that all the macroeconomic outcome here are interpreted compared to the baseline without reforms, unless otherwise.

[16] It is important to bear in mind that the reforms implemented here focus on improving how a dollar of investment expenditure is effectively translated into productive capital. In this sense there is no improvement in the economy's human capital which is necessary for dampening the shortage of labor supply.

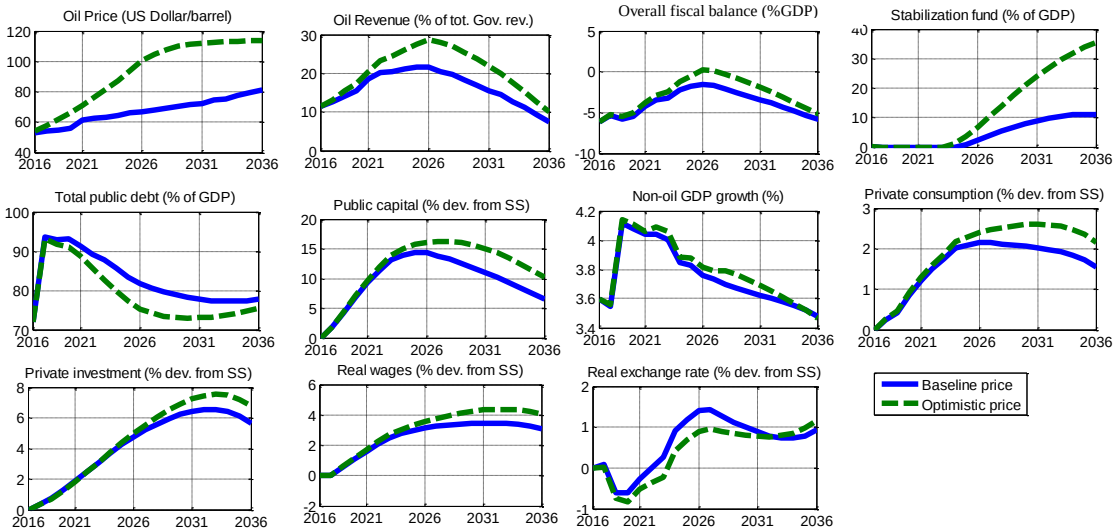
Figure 12: Baseline experiment with structural reforms: Public investment efficiency



F. Alternative Oil Price Forecast Scenario

To highlight the dependence of macroeconomic outcomes on the oil revenue forecast, we trace the macroeconomic dynamics of the baseline investing approach for a more optimistic oil price forecast scenario. Oil production does not change and is given by the baseline path. The results are presented for the two oil price forecast scenarios (Figure 13). The optimistic scenario assumes a period of large positive price shocks where price is projected to deviate sharply from the baseline price forecast path. Oil revenues continue to increase gradually above the baseline, with a peak level in 2026, but drop gradually in the following years. Since government investment expenditure is assumed to follow the baseline path and current expenditure to decline, the revenue windfall from oil price increases create a rise in the overall fiscal primary balance. The consequence of this positive shock to oil revenue is that the resource fund reaches a level more than three times higher at the end of 2036. Also, total public debt GDP ratio declines quickly. On macroeconomic impact of the scenario, non-oil GDP growth is slightly higher. Thus the additional wealth effect from increased revenue is translated into higher private consumption. As a result, Dutch disease effects are significant, as shown by the exchange rate movement. In addition, absorption constraints in the face of demand pressures is translated into a rise a real wages.

Figure 13: More optimistic oil price forecast scenario versus baseline price

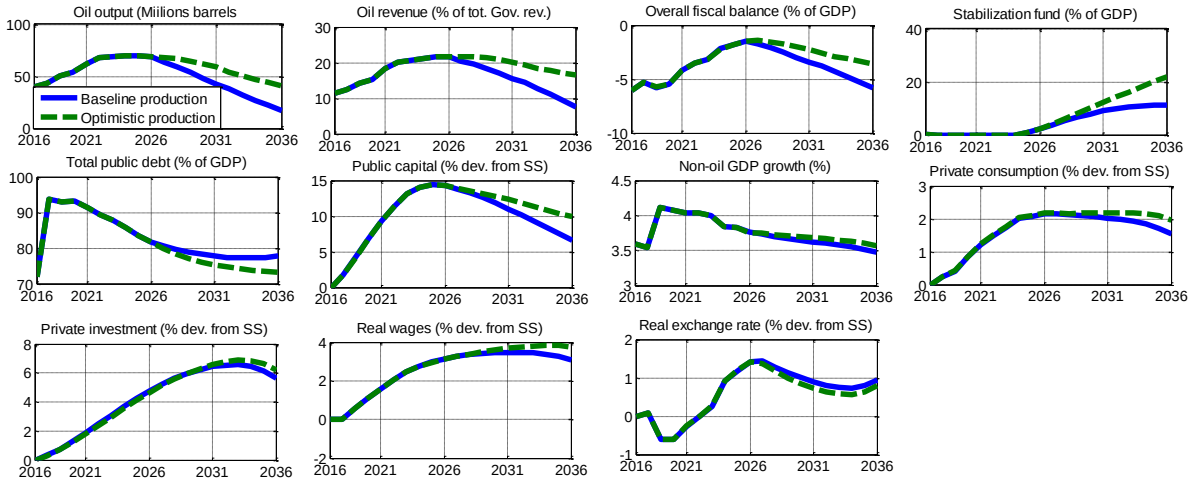


G. Alternative Oil Production Forecast Scenario

Similar to commodity price increases, a resource windfall can also occur if there is a boom in resource production, created by the discovery of new reserves which increases the production capacity of the economy. For Ghana this is likely scenario as evidenced by the recent discovery of the TEN fields, with more explorations still underway. To highlight the impact of this revenue windfall from positive developments concerning oil production, we define an upper path for oil output from 2026, so production is twice higher compared to the baseline at the end of 2036 (Figure 14). To capture the effect, we assume no change in oil price, which is given by the baseline forecast path. Moreover, public investment follows the baseline given profile.

Everything else being equal, the boom in oil production creates the same effect as the boom in prices, since both affects the revenue windfall in the same way. Therefore, the fiscal and macroeconomic outcomes in the case of price surge apply here. Nonetheless, the magnitude of the impacts depends strongly on the scale of change of oil output.

Figure 14: More optimistic oil production forecast scenario versus baseline production



V. Macroeconomic and Fiscal Sustainability Forecast

This long term macroeconomic and fiscal sustainability forecasting aims to inform the Long-Term National Development Plan for Ghana (2018-2057). The forecasting period (2016-2036) overlaps in the first-five series of medium-term development plans (2018-2037) contained in the longer term plan. The forecasting builds on different investing approaches, structural reforms and assumptions on oil revenue windfall. The baseline investing experiment is the likely scenario in line with Ghana's first series of medium-term development plans (2018-2037). It is assumed that until 2026, the government will shift public expenditure from current to capital spending in order to close infrastructure gaps and provide fertile ground for economic diversification and inclusive growth. Therefore, public investment spending is ramped up from its initial level of 8.5 percent of GDP in 2016 to 11.7 percent of GDP in 2019, which is more than 3 percentage point increase within three years. The surge of public investment is expected to last for 10 years from 2016. During the same period, government consumption expenditure is expected to decline sharply from 20 percent of GDP in 2016 to 16.8 percent in 2019 and then 16.2 percent in 2021 (Table 1). Then current expenditure is expected to increase gradually, back to or close to its initial level as capital expenditure declines return to or close to its initial level by 2026. The gradual rise in public current expenditure as a fraction of GDP in the long term is also mirrored in the relative decline of GDP growth. The underlying idea behind frontloading public investment is to ensure that Ghana's surging oil revenue is leveraged toward growth-enhancing investments, as pleaded by the Petroleum Revenue Management Act. Against this likely and baseline approach, we examine alternative investing approaches, notably the "Bird-in-Hand", the "Hand-to-Mouth", and the "aggressive" experiments. We complement with structural reforms that improve the efficiency of the baseline investment, as well as higher oil price scenario that increases the revenue windfall.

Based on this benchmark plan, overall GDP growth is projected at 5.1 percent in 2018 and 6.1 percent 2020. The average GDP growth in 2017-2026 is expected at 4.5 percent. However, the impulse to growth is expected to weaken in the medium term, since the flow of public capital to the private sector is not sustained owing to lack of maintenance of existing capital. As a result

growth momentum is projected to weaken in the long term with an average GDP growth of around 3 percent in 2027-2036. Overall growth will be supported by non-oil GDP growth, which accounted for about 94 percent of total GDP in 2016. Indeed, the average non-oil GDP growth is expected at 4 percent in 2017-2026, and at 3.6 percent in 2027-2036.

The combination of fiscal consolidation (cut in current spending and increase capital spending) as well as fiscal dividends from higher growth between 2017 and 2026 is translated into an increase in overall primary balance. However, since we assume a gradual normalization of current expenditure and capital expenditure remaining steadily around its initial level in the long term, then the rise in government spending dominates the increase in government revenue. Consequently, the overall primary balance is reduced. However, compared to the overall balance, the fall in the non-oil primary balance is lessened because the long term growth impetus in the non-oil sector is higher.

The alternative investing approaches reveal different growth macroeconomic and fiscal patterns as compared to the benchmark approach. First, taking a gradual scaling up approach to investment, while delinking expenditure from oil revenue path ("*Bird-in-Hand*" approach) will create smooth and sustainable non-oil GDP growth until the end of 2036. Average growth of non-oil GDP for the whole period is expected at 3.7 percent. Nevertheless, overall GDP growth is expected to fluctuate in tandem with the baseline growth, due to the oil component.

The gradual increase in capital expenditure does not require drastic cut in consumption expenditure, so current expenditure increases compared to the baseline. In the long term, the rise in the two components of government spending dominates the increase in oil revenue, thereby reducing the overall primary balance, which declines in size and length compared to the baseline.

Third, when government capital expenditure mirrors oil revenue dynamics so that there is no saving in the stabilization fund (*"Hand-to-Mouth"* approach), then all the macroeconomic and fiscal indicators are volatile and unsustainable.

Fourth, a Marshall-type public investment scaling-up produces higher non-oil GDP growth while households enjoy additional wealth effect compared to the baseline. However, the downside risks stressed in the baseline are accentuated in this experiment.

Fourth, the baseline with structural reforms aimed at improving the efficiency of the baseline pubic investment profile performs better in terms of higher and sustained non-oil GDP growth. Overall GDP growth is still unstable because of the volatile oil component, albeit it is more important in magnitude in the long term. Fiscal sustainability is slightly improved compared to the others because higher GDP growth. Indeed, current expenditure as a ratio of GDP is expected to decline relative to the baseline because of higher GDP growth. Since total government revenue is projected

to remain unchanged with the reforms, [17]then the decline in government expenditure induces a slight increase in overall primary balance.

Finally, the higher oil price shock and assuming no change in fiscal policy response similar to the baseline—baseline public investment path and cuts in current spending—improves the dynamic of the fiscal variables. Indeed, overall fiscal balance as a share of GDP is much higher in the medium-term until end of the period and reaches a positive territory in 2025 and 2026. This improvement in overall fiscal balance reflects the accumulation of the additional windfall in the stabilization fund.[18] Nonetheless, non-oil fiscal balance remains unchanged compared to the baseline, mirroring the fact that the fiscal policy response to the positive oil price shock did not change. Furthermore, the increase in the government savings in turn leads to a slight decline in real interest. As a result, private investment and consumption increase compared to the baseline and overall GDP growth follows suit.

[17] As a matter of the fact, the long term rise in non-oil revenue is compensated by the corresponding long term decline in oil revenue, leaving total revenue roughly unchanged.

[18] Note that there is a perfect mapping between government savings and the country's external savings, the so-called "twin deficit".

Conclusion

Managing natural resource windfalls is a central challenge for policy makers in resource-rich countries. Since governments are typically the main recipient of resource revenue, the impact of resource windfalls on domestic non-resource economy depends directly on the fiscal policy response. While natural resource revenue presents a good opportunity by unlocking the fiscal space needed to speed up development, the macroeconomic and fiscal outcomes are mixed. The paper sought to highlight key factors that come at play in the allocation of oil revenue between spending today and saving in a sovereign wealth fund in Ghana. Thus, we examined four different allocation rules for managing oil revenue. The first allocation rule examines the case where the government combines both oil revenue and borrowing for some scaling up of public investment (in the backdrop of the Long-Term National Development Plan for Ghana (2018-2057)), while saving a proportion of the oil revenue (baseline experiment). In the second allocation rule, the government takes a gradual approach to investing and saves all oil windfalls in a sovereign wealth fund, while borrowing (*Bird-in-Hand* experiment). The third rule is a full spending approach (similar to the current drawdown of Ghana Stabilization Fund) where the government spends all oil windfalls without saving and hence does not borrow (*Hand-to-Mouth* experiment). In addition, in order to show the role of public investment efficiency, we reexamined the baseline experiment with structural reforms aimed at improving the efficiency. Finally, the paper highlighted the sensitivity of budgetary revenues to oil price and output changes.

The results show that the baseline allocation rule is susceptible to generate an intermediate impact on non-oil GDP growth and non-oil fiscal balance while minimizing the macroeconomic volatility. However, the speed of the scaling and degree of public investment overshooting are much higher in the baseline, which creates considerable absorptive pressures and Dutch disease effects. In contrast, the *Bird-in-Hand* approach to scaling up public investment generates a smooth and long lasting non-oil GDP growth, and is susceptible to offset absorptive capacity constraints and Dutch disease effects. Yet, the steady, albeit gradual increase in the public investment becomes difficult to cope with in the long term, especially with the downward trending of overall GDP growth. Thus, the decline in overall fiscal balance is more pronounced. At the other end, the *Hand-to-Mouth* approach leads to overall macroeconomic volatility, lower non-oil GDP growth and declining non-oil fiscal balance as a share of GDP. Finally, a Marshall-type public investment scaling-up produces higher non-oil GDP growth while households enjoy additional wealth effect. However, it is likely to accentuate the downside risks stressed in the baseline.

Furthermore, we find that structural reforms that improve the efficiency of the baseline scaling up of public investment create sizable increase in public capital stock which has additional positive spillover effect to the rest of the economy as evidenced by higher additional growth of the non-oil GDP. However, the study has shown evidence of long run capital depreciation due to lack of maintenance, which explains that the public capital stock is not sustained, as shown by the long term decline.

Finally, our results highlight the sensitivity of budgetary revenues to oil output and price changes, which could affect both government spending and potential non-oil output growth and emphasize the importance of continuing to save as oil revenue is declining in order to avoid abruptly adjusting when it completely exhausts.

The policy implications from this study are fourfold. First and foremost, if the government is equally concerned about meeting the development goals of Ghana and macroeconomic and fiscal stability, neither the full saving (*Bird-in-Hand*) nor the full spending (*Hand-to-Mouth*) is the optimal fiscal response to oil windfalls. In this case, it is important to find the right balance by investing domestically with a fraction of the windfall to close infrastructure gaps, and saving the other fraction in a sovereign wealth fund to help reduce macroeconomic and fiscal volatility. Second, the findings reveal that public investment scaling-ups should be commensurate with the country's capacity to absorb, everything that shields the economy from running into short-run supply side bottlenecks and to Dutch disease effects. Third, implementing structural reforms in order to address absorptive capacity constraints can help mitigate adverse macroeconomic effects by improving the efficiency constraint. Fourth, the long run public capital sustainability warrants that when the capital is installed, efficient maintenance expenditures are in place to ensure a sustained flow of productive capital to private factors of production.

Table 1: Long-Term Macroeconomic and Fiscal Sustainability Forecast (Baseline Scenario)
(In percent of GDP, unless otherwise)

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
GDP Growth (Percent)	**3.6**	**4.2**	**5.1**	**4.9**	**6.1**	**5.2**	**4.2**	**4.3**	**4.2**	**3.7**	**3.0**	**3.1**	**2.8**	**2.7**	**2.7**	**2.9**	**2.5**	**2.7**	**2.5**	**2.4**	**2.7**
Non-Oil GDP Growth (Percent)	3.6	3.5	4.1	4.1	4.0	4.0	4.0	3.8	3.8	3.8	3.7	3.7	3.7	3.6	3.6	3.6	3.6	3.6	3.5	3.5	3.4
Oil GDP	6.0	6.6	7.5	8.3	10.1	11.1	11.3	11.7	12.0	12.0	11.3	10.8	10.0	9.2	8.3	7.7	6.7	5.8	4.9	3.9	3.1
Non-Oil GDP	94.0	93.4	92.5	91.7	89.9	88.9	88.7	88.3	88.0	88.0	88.7	89.2	90.0	90.8	91.7	92.3	93.3	94.2	95.1	96.1	96.9
Total revenue	**22.6**	**22.8**	**22.9**	**23.1**	**23.5**	**23.7**	**23.7**	**23.8**	**23.9**	**23.9**	**23.7**	**23.6**	**23.4**	**23.2**	**23.0**	**22.9**	**22.7**	**22.5**	**22.3**	**22.0**	**21.9**
Oil	2.6	2.9	3.2	3.5	4.3	4.8	4.9	5.0	5.2	5.1	4.9	4.6	4.3	3.9	3.6	3.3	2.9	2.5	2.1	1.7	1.3
Non-Oil	20.0	19.9	19.7	19.5	19.2	18.9	18.9	18.8	18.7	18.7	18.8	18.9	19.1	19.3	19.5	19.6	19.8	20.0	20.2	20.4	20.5
Expenditure	**28.7**	**28.1**	**28.7**	**28.5**	**27.7**	**27.2**	**26.9**	**26.1**	**25.7**	**25.4**	**25.4**	**25.7**	**25.9**	**26.2**	**26.5**	**26.7**	**27.0**	**27.2**	**27.5**	**27.8**	**28.1**
Current	20.2	17.6	17.2	16.8	16.4	16.2	16.2	16.3	16.4	16.6	16.8	17.1	17.4	17.7	17.9	18.2	18.5	18.7	19.0	19.3	19.5
Capital expenditure	8.5	10.5	11.5	11.7	11.3	11.0	10.7	9.8	9.3	8.8	8.6	8.6	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
Overall fiscal balance	**-6.1**	**-5.3**	**-5.8**	**-5.5**	**-4.2**	**-3.5**	**-3.2**	**-2.2**	**-1.8**	**-1.5**	**-1.7**	**-2.1**	**-2.5**	**-3.0**	**-3.4**	**-3.8**	**-4.3**	**-4.8**	**-5.3**	**-5.8**	**-6.2**
Overall fiscal non-oil balance	-8.6	-8.2	-9.0	-9.0	-8.6	-8.3	-8.0	-7.3	-7.0	-6.7	-6.6	-6.7	-6.8	-6.9	-7.0	-7.1	-7.2	-7.3	-7.4	-7.4	-7.5
Public sector debt	72.0	93.6	93.0	93.2	91.3	89.3	87.8	85.7	83.4	81.7	80.7	79.6	78.8	78.3	77.9	77.4	77.4	77.3	77.4	77.7	78.0
Stabilization fund	**0.3**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.8**	**2.2**	**3.7**	**5.3**	**6.7**	**7.9**	**9.0**	**9.9**	**10.5**	**11.0**	**11.1**	**11.1**	**10.9**

Note: Oil revenue (productions and prices) and capital expenditure paths are taken as exogenous

Table 2: Long-Term Macroeconomic and Fiscal Sustainability Forecast ("Bird-in-Hand")

(In percent of GDP, unless otherwise)

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
GDP Growth (Percent)	**3.6**	**3.9**	**4.8**	**4.5**	**5.7**	**4.9**	**3.9**	**4.1**	**4.0**	**3.6**	**2.9**	**3.1**	**2.9**	**2.8**	**2.8**	**3.0**	**2.6**	**2.8**	**2.7**	**2.7**	**2.9**
Non-Oil GDP Growth (Percent)	3.6	3.6	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
Oil GDP	6.0	6.8	7.8	8.5	10.3	11.4	11.6	11.9	12.2	12.1	11.4	10.9	10.1	9.3	8.4	7.8	6.7	5.9	4.9	3.9	3.1
Non-Oil GDP	94.0	93.2	92.2	91.5	89.7	88.6	88.4	88.1	87.8	87.9	88.6	89.1	89.9	90.7	91.6	92.2	93.3	94.1	95.1	96.1	96.9
Total revenue	**22.6**	**22.8**	**23.0**	**23.2**	**23.6**	**23.8**	**23.8**	**23.9**	**24.0**	**23.9**	**23.8**	**23.7**	**23.5**	**23.3**	**23.1**	**23.0**	**22.8**	**22.6**	**22.3**	**22.1**	**22.0**
Oil	2.6	2.9	3.3	3.7	4.4	4.9	5.0	5.1	5.2	5.2	4.9	4.7	4.4	4.0	3.6	3.3	2.9	2.5	2.1	1.7	1.3
Non-Oil	20.0	19.9	19.7	19.5	19.1	18.9	18.9	18.8	18.7	18.7	18.9	19.0	19.2	19.3	19.5	19.6	19.9	20.0	20.2	20.5	20.6
Expenditure	28.7	26.3	26.2	26.3	26.0	25.9	26.1	26.2	26.2	26.4	26.7	27.0	27.3	27.7	28.0	28.2	28.6	28.9	29.2	29.6	27.8
Current	20.2	17.7	17.7	17.7	17.5	17.5	17.6	17.6	17.7	17.8	18.0	18.2	18.4	18.6	18.9	19.0	19.3	19.5	19.7	19.9	20.1
Capital expenditure	8.5	8.6	8.6	8.6	8.5	8.5	8.5	8.5	8.6	8.6	8.7	8.8	8.9	9.0	9.1	9.2	9.3	9.4	9.5	9.7	7.7
Overall fiscal balance	-6.1	-3.4	-3.2	-3.1	-2.4	-2.1	-2.2	-2.3	-2.3	-2.5	-2.9	-3.3	-3.8	-4.3	-4.9	-5.3	-5.9	-6.4	-6.9	-7.5	-5.8
Overall fiscal non-oil balance	-8.6	-6.4	-6.5	-6.8	-6.9	-7.0	-7.2	-7.4	-7.5	-7.7	-7.9	-8.0	-8.2	-8.3	-8.5	-8.6	-8.8	-8.9	-9.0	-9.1	-7.2
Public sector debt	72.0	93.2	90.5	88.0	84.3	81.6	79.8	78.1	76.7	75.6	75.2	74.7	74.5	74.4	74.4	74.2	74.5	74.6	74.9	75.2	75.4
Stabilization fund	**0.3**	**0.0**	**0.0**	**0.0**	**0.5**	**1.6**	**2.9**	**4.4**	**6.1**	**7.8**	**9.3**	**10.7**	**11.8**	**12.6**	**13.1**	**13.3**	**13.1**	**12.5**	**11.5**	**10.1**	**8.2**

Note: Oil revenue (productions and prices) and capital expenditure paths are taken as exogenous

Table 3: Long-Term Macroeconomic and Fiscal Sustainability Forecast ("Hand-to-Mouth")
(In percent of GDP, unless otherwise)

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
GDP Growth (Percent)	**3.6**	**6.2**	**3.4**	**4.2**	**5.7**	**4.9**	**4.1**	**4.2**	**4.2**	**3.8**	**3.1**	**3.2**	**3.0**	**2.8**	**2.8**	**3.0**	**2.4**	**2.5**	**2.3**	**2.1**	**2.3**
Non-Oil GDP Growth (Percent)	3.6	4.2	3.6	3.3	4.2	3.6	4.0	3.9	4.0	3.9	3.8	3.8	3.7	3.7	3.6	3.6	3.5	3.4	3.3	3.2	3.1
Oil GDP	6.0	7.9	7.8	8.6	9.9	11.1	11.2	11.5	11.8	11.7	11.1	10.6	9.9	9.1	8.3	7.7	6.7	5.9	4.9	3.9	3.2
Non-Oil GDP	94.0	92.1	92.2	91.4	90.1	88.9	88.8	88.5	88.2	88.3	88.9	89.4	90.1	90.9	91.7	92.3	93.3	94.1	95.1	96.1	96.8
Total revenue	**22.6**	**22.9**	**22.7**	**23.3**	**23.4**	**23.8**	**23.7**	**23.8**	**23.8**	**23.8**	**23.7**	**23.6**	**23.4**	**23.2**	**23.1**	**22.9**	**22.7**	**22.6**	**22.4**	**22.2**	**22.6**
Oil	2.6	3.4	3.2	3.8	4.2	4.8	4.8	5.0	5.0	5.0	4.7	4.5	4.2	3.9	3.5	3.3	2.9	2.5	2.1	1.7	2.6
Non-Oil	20.0	19.4	19.5	19.5	19.2	18.9	18.9	18.8	18.8	18.8	18.9	19.0	19.2	19.3	19.5	19.6	19.9	20.0	20.2	20.5	20.0
Expenditure	**28.7**	**9.0**	**30.7**	**23.6**	**31.5**	**27.4**	**30.3**	**28.5**	**29.7**	**28.9**	**29.3**	**29.0**	**29.0**	**28.8**	**28.8**	**28.7**	**28.5**	**28.5**	**28.4**	**28.3**	**28.7**
Current	20.2	0.8	21.7	14.2	21.7	17.0	20.0	18.1	19.2	18.4	19.1	18.9	19.3	19.4	19.6	19.8	20.0	20.3	20.4	20.7	20.2
Capital expenditure	8.5	8.2	9.0	9.5	9.8	10.4	10.3	10.5	10.5	10.5	10.2	10.0	9.7	9.5	9.1	8.9	8.6	8.3	8.0	7.6	8.5
Overall fiscal balance	**-6.1**	**13.9**	**-8.0**	**-0.4**	**-8.1**	**-3.6**	**-6.6**	**-4.7**	**-5.9**	**-5.1**	**-5.6**	**-5.4**	**-5.6**	**-5.6**	**-5.7**	**-5.7**	**-5.8**	**-6.0**	**-6.0**	**-6.2**	**-6.1**
Overall fiscal non-oil balance	-8.6	10.4	-11.2	-4.1	-12.3	-8.5	-11.4	-9.7	-11.0	-10.1	-10.4	-9.9	-9.8	-9.5	-9.2	-9.0	-8.7	-8.5	-8.1	-7.9	-8.6
Public sector debt	72.0	79.1	71.3	71.0	67.5	67.0	66.3	66.0	65.5	65.5	65.9	66.3	66.8	67.5	68.2	68.7	69.8	70.6	71.7	72.8	73.8
Stabilization fund	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**

Note: Oil revenue (productions and prices) and capital expenditure paths are taken as exogenous

Table 4: Long-Term Macroeconomic and Fiscal Sustainability Forecast (Aggressive Scenario)

(In percent of GDP, unless otherwise)

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
GDP Growth (Percent)	**3.6**	**6.2**	**6.7**	**7.0**	**7.2**	**6.4**	**6.4**	**5.5**	**5.4**	**5.0**	**5.3**	**4.5**	**4.2**	**4.0**	**4.0**	**4.1**	**3.6**	**3.7**	**3.5**	**3.4**	**3.6**
Non-Oil GDP Growth (Percent)	3.6	3.6	4.3	4.3	4.2	4.2	4.2	4.2	4.2	4.1	4.1	4.1	4.0	3.9	3.9	3.8	3.7	3.6	3.5	3.4	3.6
Oil GDP	6.0	6.6	7.5	8.3	10.1	11.1	11.3	11.7	12.0	12.0	11.3	10.8	10.0	9.2	8.3	7.7	6.7	5.8	4.9	3.9	3.1
Non-Oil GDP	94.0	93.4	92.5	91.7	89.9	88.9	88.7	88.3	88.0	88.0	88.7	89.2	90.0	90.8	91.7	92.3	93.3	94.2	95.1	96.1	96.9
Total revenue	**22.6**	**22.8**	**22.9**	**23.1**	**23.4**	**23.7**	**23.7**	**23.7**	**23.8**	**23.8**	**23.6**	**23.5**	**23.3**	**23.1**	**22.9**	**22.8**	**22.6**	**22.4**	**22.2**	**22.0**	**22.6**
Oil	2.6	2.8	3.2	3.5	4.3	4.7	4.8	4.9	5.0	5.0	4.7	4.5	4.2	3.8	3.5	3.2	2.8	2.4	2.0	1.6	2.6
Non-Oil	20	20	19.7	19.6	19.1	19	18.9	18.8	18.8	18.8	18.9	19	19.1	19.3	19.4	19.6	19.8	20	20.2	20.4	20
Expenditure	**28.7**	**28.1**	**29.6**	**29.7**	**29**	**28.4**	**27.9**	**27.5**	**27.2**	**26.9**	**26.9**	**26.8**	**26.5**	**26.2**	**26.1**	**25.9**	**25.8**	**25.9**	**25.9**	**26.1**	**28.7**
Current	20.2	17.6	17.1	16.6	16.0	15.6	15.4	15.2	15.1	15.1	15.3	15.4	15.5	15.7	16.0	16.2	16.5	16.8	17.1	17.5	20.2
Capital expenditure	8.5	10.5	12.5	13.1	13.0	12.8	12.5	12.3	12.1	11.8	11.6	11.4	11.0	10.5	10.1	9.7	9.3	9.1	8.8	8.6	8.5
Overall fiscal balance	**-6.1**	**-5.3**	**-6.7**	**-6.6**	**-5.6**	**-4.7**	**-4.2**	**-3.8**	**-3.4**	**-3.1**	**-3.3**	**-3.3**	**-3.2**	**-3.1**	**-3.2**	**-3.1**	**-3.2**	**-3.5**	**-3.7**	**-4.1**	**-6.1**
Overall fiscal non-oil balance	-8.1	-9.6	-10	-9.4	-9.3	-8.9	-8.6	-8.4	-8.1	-8.1	-7.9	-7.5	-7.1	-6.8	-6.5	-6.2	-6.1	-5.9	-5.9	-8.3	-8.1
Public sector debt	72.0	93.5	93.1	94.6	94.0	93.5	93.5	92.7	91.6	90.8	90.4	89.8	89.5	89.1	88.5	87.5	87.0	86.3	85.9	85.8	72.0
Stabilization fund	**0.3**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**1.4**	**2.5**	**3.6**	**4.7**	**5.6**	**6.3**	**6.8**	**7.2**	**7.5**	**7.6**

Note: Oil revenue (productions and prices) and capital expenditure paths are taken as exogenous

Table 5: Long-Term Macroeconomic and Fiscal Sustainability Forecast (Baseline with structural reforms)

(In percent of GDP, unless otherwise)

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
GDP Growth (Percent)	**3.6**	**4.2**	**5.1**	**4.9**	**6.1**	**5.3**	**4.4**	**4.4**	**4.3**	**3.9**	**3.1**	**3.3**	**3.1**	**3.0**	**2.9**	**3.2**	**2.7**	**2.9**	**2.8**	**2.7**	**3.0**
Non-Oil GDP Growth (Percent)	3.6	3.6	4.1	4.1	4.1	4.1	4.1	4.0	4.0	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.8	3.8	3.8	3.8	3.8
Oil GDP	6.0	6.6	7.5	8.2	10.0	11.1	11.3	11.7	12.0	11.9	11.2	10.6	9.9	9.0	8.2	7.6	6.5	5.7	4.7	3.8	3.0
Non-Oil GDP	94.0	93.4	92.5	91.8	90.0	88.9	88.7	88.3	88.0	88.1	88.8	89.4	90.1	91.0	91.8	92.4	93.5	94.3	95.3	96.2	97.0
Total revenue	**22.6**	**22.8**	**23.0**	**23.1**	**23.5**	**23.7**	**23.7**	**23.8**	**23.9**	**23.9**	**23.7**	**23.6**	**23.4**	**23.2**	**23.0**	**22.8**	**22.6**	**22.4**	**22.2**	**22.0**	**21.8**
Oil	2.6	2.8	3.2	3.5	4.3	4.8	4.9	5.0	5.1	5.1	4.8	4.6	4.2	3.9	3.5	3.2	2.8	2.4	2.0	1.6	1.3
Non-Oil	20.0	19.9	19.7	19.6	19.2	18.9	18.9	18.8	18.7	18.7	18.9	19.0	19.1	19.3	19.5	19.6	19.8	20.0	20.2	20.4	20.5
Expenditure	28.7	28.1	28.7	28.5	27.7	27.1	26.8	26.0	25.6	25.2	25.3	25.4	25.7	25.9	26.1	26.3	26.5	26.7	27.0	27.2	27.4
Current	20.2	17.6	17.2	16.8	16.4	16.1	16.1	16.2	16.3	16.4	16.7	16.9	17.1	17.4	17.6	17.8	18.0	18.2	18.5	18.7	18.9
Capital expenditure	8.5	10.5	11.5	11.7	11.3	11.0	10.7	9.8	9.3	8.8	8.6	8.6	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
Overall fiscal balance	**-6.1**	**-5.3**	**-5.7**	**-5.4**	**-4.2**	**-3.4**	**-3.1**	**-2.1**	**-1.7**	**-1.4**	**-1.6**	**-1.9**	**-2.3**	**-2.7**	**-3.1**	**-3.4**	**-3.9**	**-4.3**	**-4.8**	**-5.2**	**-5.6**
Overall fiscal non-oil balance	-8.6	-8.2	-9.0	-9.0	-8.5	-8.2	-7.9	-7.2	-6.8	-6.5	-6.4	-6.5	-6.5	-6.6	-6.6	-6.7	-6.7	-6.8	-6.8	-6.8	-6.9
Public sector debt	72.0	93.5	93.0	93.3	91.4	89.4	87.9	85.6	83.2	81.4	80.2	79.0	78.1	77.4	76.8	76.1	75.9	75.6	75.5	75.6	75.6
Stabilization fund	**0.3**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.8**	**2.2**	**3.8**	**5.4**	**6.9**	**8.3**	**9.5**	**10.7**	**11.7**	**12.4**	**13.0**	**13.5**	**13.5**

Note: Oil revenue (productions and prices) and capital expenditure paths are taken as exogenous

Table 6: Long-Term Macroeconomic and Fiscal Sustainability Forecast (Optimistic oil price forecast)
(In percent of GDP, unless otherwise)

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
GDP Growth (Percent)	**3.6**	**4.6**	**5.6**	**5.4**	**6.2**	**6.0**	**5.1**	**5.1**	**5.0**	**4.7**	**3.2**	**3.0**	**2.6**	**2.4**	**2.3**	**2.4**	**2.0**	**2.1**	**2.0**	**1.9**	**1.2**
Non-Oil GDP Growth (Percent)	3.6	3.6	4.1	4.1	4.1	4.1	4.1	3.9	3.9	3.8	3.8	3.8	3.8	3.7	3.7	3.7	3.6	3.6	3.5	3.5	3.4
Oil GDP	6.0	7.0	8.3	9.5	11.3	13.0	13.9	14.9	15.8	16.6	16.1	15.4	14.4	13.3	12.1	11.0	9.5	8.1	6.7	5.2	3.1
Non-Oil GDP	94.0	93.0	91.7	90.5	88.7	87.0	86.1	85.1	84.2	83.4	83.9	84.6	85.6	86.7	87.9	89.0	90.5	91.9	93.3	94.8	96.9
Total revenue	**22.6**	**22.8**	**23.1**	**23.4**	**23.7**	**24.1**	**24.3**	**24.5**	**24.7**	**24.8**	**24.7**	**24.6**	**24.4**	**24.1**	**23.8**	**23.6**	**23.3**	**22.9**	**22.6**	**22.3**	**21.8**
Oil	2.6	3.0	3.6	4.1	4.9	5.6	6.0	6.4	6.8	7.1	6.9	6.6	6.2	5.7	5.2	4.7	4.1	3.5	2.9	2.2	1.3
Non-Oil	20.0	19.9	19.5	19.3	18.9	18.5	18.3	18.1	17.9	17.7	17.8	17.9	18.1	18.4	18.6	18.9	19.2	19.5	19.8	20.1	20.5
Expenditure	**28.7**	**28.0**	**28.6**	**28.4**	**27.6**	**27.0**	**26.7**	**25.7**	**25.2**	**24.7**	**24.7**	**24.9**	**25.1**	**25.4**	**25.7**	**26.0**	**26.4**	**26.7**	**27.1**	**27.5**	**28.0**
Current	20.2	17.5	17.1	16.7	16.3	16.0	16.0	15.9	15.9	15.9	16.1	16.3	16.6	16.9	17.2	17.5	17.9	18.2	18.6	19.0	19.5
Capital expenditure	8.5	10.5	11.5	11.7	11.3	11.0	10.7	9.8	9.3	8.8	8.6	8.6	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
Overall fiscal balance	**-6.1**	**-5.2**	**-5.5**	**-5.0**	**-3.8**	**-2.9**	**-2.4**	**-1.2**	**-0.5**	**0.2**	**0.1**	**-0.3**	**-0.8**	**-1.3**	**-1.9**	**-2.4**	**-3.1**	**-3.8**	**-4.5**	**-5.1**	**-6.1**
Overall fiscal non-oil balance	-8.6	-8.2	-9.1	-9.1	-8.7	-8.5	-8.4	-7.6	-7.3	-6.9	-6.8	-6.9	-7.0	-7.0	-7.1	-7.1	-7.2	-7.3	-7.3	-7.4	-7.5
Public sector debt	72.0	93.6	93.0	93.2	91.3	89.3	87.8	85.7	83.4	81.7	80.7	79.6	78.8	78.3	77.9	77.4	77.4	77.3	77.4	77.7	77.7
Stabilization fund	**0.3**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**1.2**	**3.5**	**6.8**	**10.3**	**13.9**	**17.4**	**20.8**	**23.9**	**26.8**	**29.5**	**31.9**	**33.9**	**35.6**	**36.0**

Note: Oil revenue (productions and prices) and capital expenditure paths are taken as exogenous

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