

Flagship Report Paper Series

Paper 2: Timing and magnitude of new natural resource revenues in Africa



AFRICAN DEVELOPMENT BANK GROUP

BILL & MELINDA
GATES foundation

Preface

History shows that an abundance of natural resources does not necessarily improve a country's human development. How can governments turn new discoveries of natural resources into outcomes that matter for their citizens – including better health, better education, and access to quality social services?

Most governments have expressed a commitment to turn revenues from new natural resource discoveries into outcomes that matter for their citizens: better health, better education, and access to quality social services. They also want to make sure the discovery of extractives translates into more and better jobs and business opportunities. Yet they are also aware that delivering on those commitments demands tough and sometimes complex policy choices, including balancing the need for social sector investments with the needs of other sectors across the economy, being transparent and carefully managing citizen expectations, and adequately distributing benefits both between extractives and non-extractives communities and between current and future generations.

In light of these challenges, the African Development Bank (AfDB) and the Bill and Melinda Gates Foundation (BMGF) came together to produce a joint Flagship Report: *'Delivering on the promise: Leveraging natural resources to accelerate human development in Africa'*.

This paper is one of a series of eight in-depth technical background papers which supported the development of the flagship publication. While each background paper can stand alone, they also build on each other. Paper 1 sets out a framework for understanding four key channels through which natural resources can translate into improved human development: 1# public spending on health, education, and social protection; 2# public spending aimed at fostering growth and economic diversification; 3# industry spending on infrastructure, procurement, skills, and employment; and 4# companies' spending on social investments. Paper 2 estimates the likely timing and magnitude of revenue from new discoveries of oil, gas or minerals in six African countries: Ghana, Liberia, Mozambique, Sierra Leone, Tanzania, and Uganda.

The next three papers examine the public spending channels described in the first paper. Paper 3 discusses the macroeconomic risks and policy choices associated with an influx of new revenues from natural resources. Paper 4 explores the potential of new revenues to improve health and education services, comparing the expected scale of revenues to financing needs in the six featured African countries and introducing a diagnostic framework for policy choices. Paper 5 looks at the case for using new revenues to fund basic social protection programs, including the potential to boost demand for health and education services.

The final three papers examine the industry activity channels described in Paper 1. Paper 6 looks at how policies on local content can leverage spending on extractives industry projects to create more broad-based economic growth. Relatedly, Paper 7 explores the policy choices involved in leveraging extractives projects to build skills and human capital. Finally, Paper 8 asks how governments and industry can maximize the human development impact of companies' social investment, a relatively small but potentially important part of company spending in extractives industry projects.

To access the Flagship Report and the other seven background papers presenting complementary in-depth discussions of the policy choices described in this paper, readers are encouraged to consult the dedicated website at: www.NaturalResourcesForHumanDev.org.

Paper 1 – A framework: Human development and the links to natural resources

Paper 2 – Timing and magnitude of new natural resource revenues in Africa

Paper 3 – Natural resource revenues and macroeconomic policy choices

Paper 4 – How to use natural resource revenues to improve health and education in Africa

Paper 5 – How to use natural resource revenues to enhance demand for public services through social protection

Paper 6 – Creating local content for human development in Africa's new natural resource-rich countries

Paper 7 – Leveraging extractive industries for skills development to maximize sustainable growth and employment

Paper 8 – Extractive industries and social investments: Principles for sustainability and options for support

For further information:

AfDB

Pietro Toigo, Chief Macro-Economist, African Natural Resources Center

Email: p.toigo@afdb.org

BMGF

Rodrigo Salvado, Senior Program Officer, Development Policy and Finance

Email: Rodrigo.Salvado@gatesfoundation.org

Acknowledgements

The Flagship Report '*Delivering on the promise: Leveraging natural resources to accelerate human development in Africa*' is the work of the AfDB and BMGF and grew from a mutual commitment to seeing natural resource revenues used to further human development outcomes in Africa.

The Flagship Report project was carried out under the general guidance of Steve Kayizzi-Mugerwa, Ag. Chief Economist and Vice President, Sunita Pitamber, Ag. Director, Human Development Department, and Sheila Khama, Director African Natural Resources Center (AfDB), and Gargee Ghosh, Director, Development Policy and Finance (BMGF). The research for this project was conducted between February 2014 and May 2015.

The AfDB and the BMGF would like to thank the authors of the background research papers and the expert peer reviewers for their high-quality work and would also like to extend their thanks to Oxford Policy Management (OPM) for hosting the research and acting as the secretariat for the project, and to everyone who participated in technical workshops, expert panels, and general consultations.

This paper was written by Dan Haglund (OPM), with contributions from Chris Hearle (OPM) and Maja Jakobsen (OPM). The authors of this paper would particularly like to thank Keith Myers and Olle Ostensson for their expert opinions and input, and the participants at technical workshops; without holding them responsible for the views expressed, their contributions have immeasurably improved this paper.

For further information:

AfDB

Pietro Toigo, Chief Macro-Economist, African Natural Resources Center
Email: p.toigo@afdb.org

BMGF

Rodrigo Salvado, Senior Program Officer, Development Policy and Finance
Email: Rodrigo.Salvado@gatesfoundation.org

OPM

Mark Henstridge, Chief Economist, OPM
Email: Mark.Henstridge@opml.co.uk

Maja Jakobsen, Project Manager, OPM
Email: Maja.Jakobsen@opml.co.uk

Disclaimer

This series of papers focuses on one part of the extractives debate and reflects research gaps identified by the contributors within their areas of expertise. The contributors are not held responsible for the views expressed in this report. This paper is based on research, analytics, and expert consultations completed during the writing of the eight background papers. However, this paper should not be considered as an alternative to in-depth technical expertise. Any mention of specific entities, individuals, source materials, trade names, or commercial processes in this publication does not constitute endorsement by the AfDB or the BMGF.

Key messages

- **In Mozambique, Tanzania, Ghana, Uganda, Sierra Leone, and Liberia, recent discoveries of natural resources offer opportunities to translate new revenues into better human development outcomes.** The likely timing and scale of revenues from these resources is projected for the first time, providing a basis for discussions about the policy choices facing governments in these and other natural resource-rich countries.
- **These six countries are explored in detail as policy frameworks in the relevant sectors have yet to be elaborated.** This presents an especially significant opportunity to leverage extractives projects for human development. We also consider the outlook for new natural resource revenues in Kenya and Guinea, where natural resources have also recently been discovered in a sector where policy frameworks remain to be elaborated, but where uncertainty about revenues is too great to make meaningful projections.
- **In these six countries, new natural resource revenues are expected to be significant. However, they will not have a transformational impact.** In absolute terms, they are projected to range from US\$ 144 million in Liberia to US\$ 2.6 billion in Uganda over the first ten years of production. In relative terms, they are projected to range from 1.9 per cent of gross domestic product (GDP) in Tanzania to 5.7 per cent of GDP in Liberia over the first ten years of production.
- **Revenues will take time to materialize in most countries.** It can take up to ten years from discovery for production to start, during which revenues accruing to the government are minimal, and then a further seven to 12 years for production to reach its peak. Once revenues hit their peak, they will slowly decline over the next 50 years as resources run out.
- **Policy-makers must manage popular expectations about the likely scale and timing of new natural resource revenues.** Expectation management is necessary in part to minimize the risk that popular discontent will lead to pressure for unpredictable changes in institutional and policy frameworks. If investors start to fear for the stability, coherence or transparency of institutional and policy frameworks, it is possible that revenues in our sample countries could fail to materialize at all.
- **Revenues depend on international prices, which have historically been volatile and notoriously hard to predict.** For example, the sharp falls in oil and iron ore prices during the second half of 2014 took most analysts by surprise. While it is generally considered likely that demand for oil, gas, and commodities will continue to increase over the coming decades due to the growth of emerging markets, there is much greater uncertainty around supply.
- **As projections are difficult to make with confidence, we have presented our estimates as a range.** We have built a price sensitivity analysis into our projections, which accounts for prices being 25 per cent higher or lower than our midpoint estimates. These are best estimates, which are likely to be of the right order of magnitude. However, they are naturally subject to risks and uncertainties and will, in the future, need updating.

Table of contents

Preface	i
Acknowledgements	iii
Key messages	1
List of tables and figures	3
List of abbreviations	4
1 Introduction	5
2 Methodology	7
2.1 Selection of countries	7
2.2 Selection of projects	7
2.3 Approach, assumptions, and data sources: the basis for our projections	8
3 The timing and order of magnitude of new natural resource revenues	12
3.1 Cross-country findings	13
3.2 Individual country findings	17
4 Risks to future government revenues from natural resources	28
4.1 Volatility of international commodity prices	28
4.2 Policy, regulatory and institutional risk	29
4.3 Economic and social shocks	29
4.4 Technical and logistical challenges that increase costs	30
5 Policy implications	31
Bibliography	33
Annex A Approach to modeling natural resource projections	37
A.1 Our approach	37
A.2 Data required	37
A.3 Projections of macroeconomic indicators	38
Annex B Project-specific assumptions	39

List of tables and figures

Figure 1: Selected mineral commodity price trends.....	5
Figure 2: Timing of new natural resource revenues.....	13
Figure 3: Absolute value of government revenues from new extractive industry projects	14
Figure 4: Relative importance of government revenues from new extractive industry projects as a share of total baseline government revenue.....	15
Figure 5: Relative importance of government revenue from new extractive industry projects as a share of GDP	16
Figure 6: Resource revenue per capita	17
Figure 7: Magnitude and timing of new revenue contributions: TEN and Jubilee Phase 1	18
Figure 8: Magnitude and timing of new revenue contributions: Anadarko Rovuma Basin Area 1 ..	19
Figure 9: Magnitude and timing of new revenue contributions: Lake Albert Rift Basin.....	21
Figure 10: Magnitude and timing of new revenue contributions: Western Range, Bong Iron Ore project, Putu, and Western Cluster.....	22
Figure 11: Magnitude and timing of new revenue contributions: Tonkolili and Marampa	24
Figure 12: Magnitude and timing of new revenue contributions: Blocks 1, 2, 3, and 4.....	25
Table 1: Commodity and regional diversity of selected countries	7
Table 2: Sample countries and projects	8
Table 3: Key project-specific assumptions for oil and gas projects.....	39
Table 4: Key project-specific assumptions for iron ore projects	40

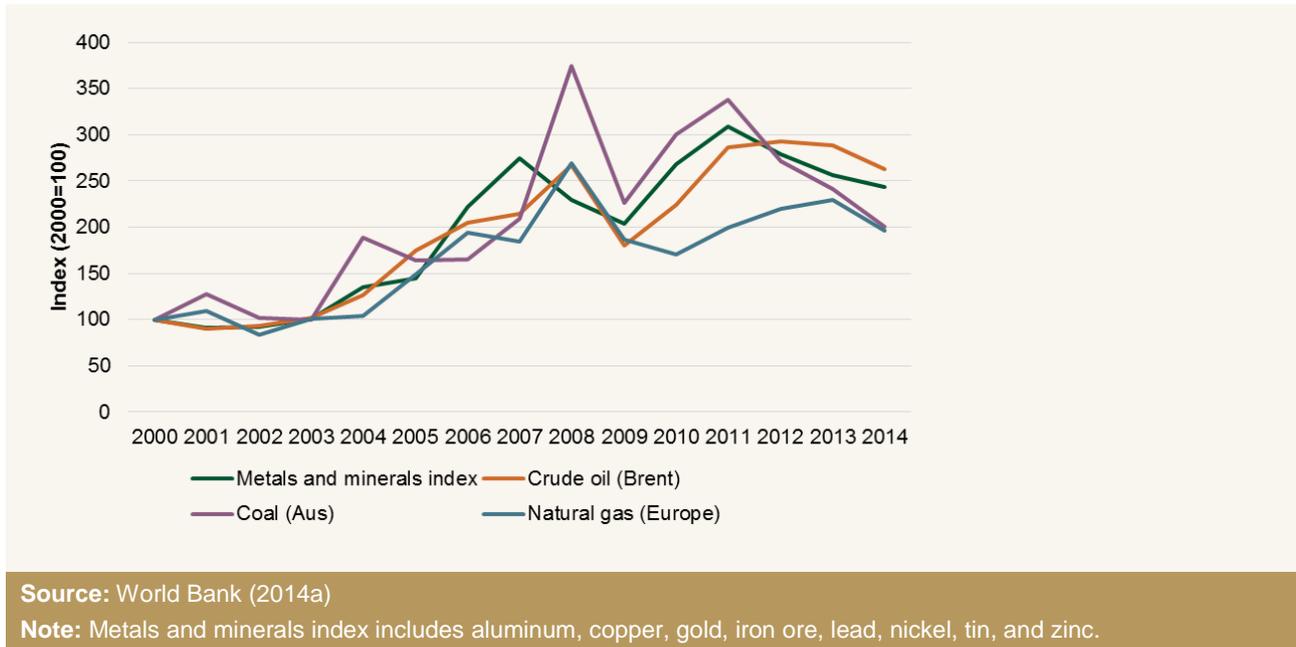
List of abbreviations

AfDB	African Development Bank
BMGF	Bill and Melinda Gates Foundation
BOE	Barrels of Oil Equivalent
CNOOC	Chinese National Offshore Oil Corporation
EA	Exploration Area
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
IMF	International Monetary Fund
LNG	Liquefied Natural Gas
MoU	Memorandum of Understanding
OPM	Oxford Policy Management
PSA	Production Sharing Agreement
TEN	Tweneboa-Enyenra-Ntomme
US\$	United States Dollar

1 Introduction

Between 2000 and 2014, the prices of many mineral commodities more than doubled, despite the interruption caused by the 2008 financial crisis and a more recent moderation (see Figure 1). This long commodity price boom encouraged investment in significant new exploration, resulting in discoveries of new commercially viable oil, gas, and mineral assets across a range of African countries, some of which have already gone into production.

Figure 1: Selected mineral commodity price trends



Newly discovered natural resources offer countries the prospect of increased government revenues. These revenues present opportunities for accelerated human development, but to achieve this governments need to ensure that revenues are well managed. In order to frame these policy choices, we first need to understand the likely timing and magnitude of new natural resource revenues, as well as the risk that projects will not materialize or be delayed. This paper provides a set of projections around these issues, building on existing research on the revenue impacts of natural resource discoveries.¹ For more in-depth discussions of the critical macroeconomic policy choices that countries face when deciding how to use natural resource revenues as well as the potential for investments in social sectors see, respectively, papers 3 and 4 in this series.

¹ The Africa Progress Panel report in 2013 provides some estimates of the magnitude of the macroeconomic impacts of new natural resource discoveries across a selection of African countries. There are also a few country-specific reports that project government revenues from new oil, gas, and mining projects. For example, IMF (2013) projects government revenue from the Anadarko LNG project in Mozambique using the IMF's Fiscal Analysis of Resource Industries modeling system. This analysis suggests that the project could generate – at its peak – a third of the total government revenues. IMF (2014) provides projections of government revenue from a Tanzania LNG project producing 20 million metric tonne per annum. Henstridge and Page (2012) provide initial projections for Uganda's oil sector revenues and Rosenfeld (2012) provides projections of government revenue from Mozambique's coal sector.

To date, efforts to make natural resource revenue projections have focused on individual countries and with limited detail on how projections differ between types of natural resources.² This paper fills this gap and presents, for the first time, detailed projections for oil, gas, and mining sector projects across a selection of countries with recent resource discoveries. By developing revenue projections, this paper provides:

- A sense of the order of magnitude and timing of new revenue contributions from a variety of natural resources in a selection of countries; and
- An understanding of the risks that could affect these revenues materializing.

The rest of the paper is structured as follows:

- Section 2 summarizes how we developed our projections. It outlines which countries and projects we look at and why;
- Section 3 presents an overview of our projections in both absolute and relative terms. It also gives a brief overview of the situation in each of our eight sample countries;
- Section 4 discusses the various factors that may affect the timing and magnitude of new resource revenues;
- Section 5 outlines the main implications for policy-makers; and
- Annexes A and B provide further information on our approach and assumptions.

² For instance, lead times are longer in oil and gas projects than in mining, and production tends to take longer to reach its peak in LNG projects than in oil projects. These differences mean that it is inappropriate to take one standard approach to projecting revenue, regardless of the type of resource.

2 Methodology

This section outlines the rationale behind our selection of countries and projects, and the approach used to forecast revenues from the selected projects.³

Discoveries of new natural resources always represent new opportunities, regardless of whether or not the country has a history of developing that or any other resource. The policy analysis in the subsequent papers of the Flagship Report Series is therefore relevant to all countries with new natural resource discoveries or existing production. However, when additional natural resources are discovered in a country which has already developed a policy framework to handle them – including decisions on saving, spending, and investment – the challenge of fully capitalizing on those opportunities to convert natural resources into human development may be greater than in countries which are developing such a policy framework from scratch. For this reason, we focus our projections in this paper on a selection of African countries that have recently discovered new oil, gas, or mineral resources in sectors that have not previously been exploited in the country.

2.1 Selection of countries

We looked for a mix of countries where (1) commercial oil, gas, and/or mining deposits are known, (2) where significant production is yet to take place, and (3) that would represent Africa's different regions and languages. We identified eight African countries with recent discoveries in new resource sectors: Mozambique, Tanzania, Ghana, Uganda, Kenya, Sierra Leone, Liberia, and Guinea (see Table 1). Some countries with recent discoveries in new natural resource sectors were excluded due to a lack of sufficient data to project future government revenues.

Table 1: Commodity and regional diversity of selected countries

	Anglophone	Francophone	Lusophone
Oil	Ghana, Kenya, Uganda	-	-
Gas	Tanzania	-	Mozambique
Mined minerals	Sierra Leone, Liberia	Guinea	-

Source: see project-specific assumptions in Annex B.

Note: The table classifies countries based on their dominant extractive industry sector – some countries have emerging extractive industries in several sectors.

2.2 Selection of projects

Within the eight selected countries, we focus on projects in advanced stages of planning; with the exceptions of those in Ghana and Sierra Leone, which have already begun.^{4, 5} Among these, we identified projects for which sufficient data exists to model future revenue contributions (such as production start date, expected peak volumes, investment costs, and the fiscal framework). The

³ Data and information searches were carried out in spring 2014.

⁴ Projections include production from the Jubilee field, which started in 2011.

⁵ Projections include iron production, which started in 2012.

availability of such information varied across countries. For Mozambique, Tanzania, Ghana, Uganda, Sierra Leone, and Liberia, sufficient information was available to quantify the timing and magnitude of additional government revenues using project-specific estimates. For Kenya, project-level information was not available, and for Guinea planned projects were associated with high levels of uncertainty. For these two countries, we therefore provide a more qualitative discussion of the potential for extractive industries to contribute to future government revenues.

Table 2 presents an overview of the projects that we consider in each country, the minerals they extract, and our broad approach to projecting incremental government revenues from these projects. There may be several additional projects in these countries – current or planned – that could boost resource revenues to the government, but that are not explicitly accounted for in this study as sufficient data was not available at the time of writing.

Table 2: Sample countries and projects

Country	Project (Operator)	Assumed investment required (CAPEX) (US\$ million)	Main mineral	Approach to projection
Mozambique	Rovuma Offshore Area 1 (Anadarko)	40,000	Natural gas	Quantified
Tanzania	Blocks 1, 3 and 4 (BG)	20,000 (*)	Natural gas	Quantified
	Statoil/ExxonMobil	20,000 (*)	Natural gas	Quantified
Ghana	Tweneboa-Enyenra-Ntomme (TEN) (Tullow)	4,900	Oil (offshore)	Quantified
	Jubilee Phase 1 and 1A (Tullow)	7,000	Oil (offshore)	Quantified
Uganda	Lake Albert Rift Basin (Tullow)	8,000	Oil (on-shore)	Quantified
Kenya	Turkana Rift Basin (Tullow)	n/a	Oil (on-shore)	Order-of-magnitude estimate
Liberia	Western Range (ArcelorMittal)	2,200	Iron ore	Quantified
	Bong mines (China Union)	2,600	Iron ore	Quantified
	Western Cluster (Vedanta)	1,000	Iron ore	Quantified
	Putu (Severstal)	1,000	Iron ore	Quantified
Sierra Leone	Tonkolili (African Minerals)	2,184	Iron ore	Quantified
	Marampa (LonMin)	520	Iron ore	Quantified
Guinea	Simandou (Rio Tinto), Mount Nimba (Newmont)	20,000	Iron ore	Qualitative discussion

Source: see project-specific assumptions in 0

Note: (*) includes upstream gas extraction only

2.3 Approach, assumptions, and data sources: the basis for our projections

In order to create resource revenue projections, our approach was to develop financial models for the oil, gas, and mining projects listed above. These models first calculate revenues generated by the project, based on assumptions regarding the timing of production, the volume of production,

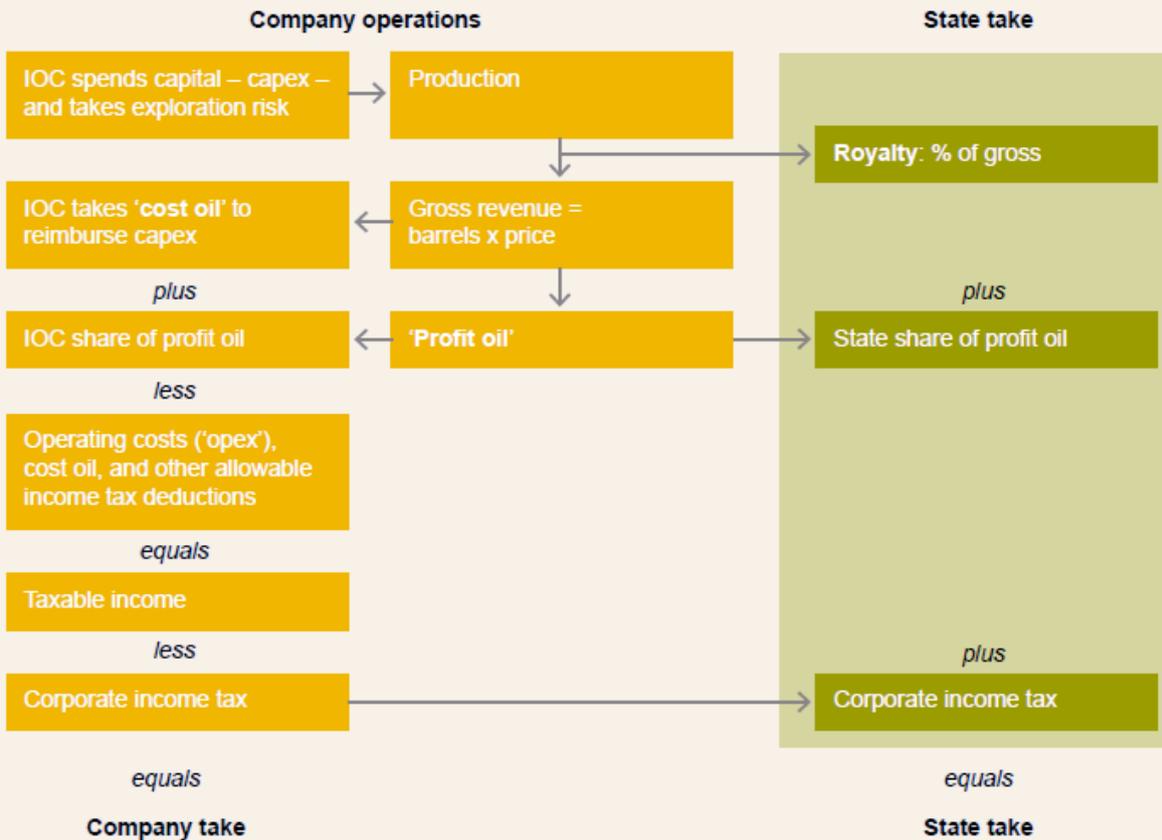
and commodity prices. The total sales projections derived in this way are then used to calculate royalties accruing to host governments. For projects based on production sharing agreements (PSAs) (see Box 1), we calculate the production share that is due to the government based on project-specific criteria for cost recovery limits. The models then deduct costs associated with the project (including investment, operating, and financing costs) in order to estimate the corporation tax due to the government. In conformity with typical practice, we assume that all costs are recovered before corporation tax is paid. Finally, we estimate any dividends – payable out of net profit for the year – to state-owned enterprises participating in the project.

Some of the key building blocks of our projections are as follows:

- We include four types of government revenue: royalties, corporate income tax, dividends, and, for oil and gas projects, production share;
- We exclude duties, VAT, and withholding taxes (on dividends as well as pay-as-you-earn salary taxes), as well as production (and other) bonuses, and corporate income tax paid by local contractors;
- We assume that the present fiscal regime (tax and other rates) remains unchanged for the duration of the projections. This therefore assumes away options to further optimize the tax regime, as outside the scope of the paper; and
- Where the terms of the fiscal regimes set out in project-specific contracts are not publicly available, we use model contracts for mining, or model PSAs for oil and gas projects (see Box 1), or make assumptions based on other similar projects.

Box 1: The anatomy of a PSA

PSAs are the most common form of contract in the oil and gas sectors. PSAs are agreements in which the government contracts a private company to carry out oil or gas operations while the government retains ownership of the oil or gas reserves. If oil or gas is discovered and subsequently extracted, the contractor is entitled to a share of production to recover capital expenditure and reimburse operating costs, usually up to a ceiling, or 'cost recovery limit'. This share of production is called 'cost oil' (or 'cost gas'). The rest of production ('profit oil') is shared between the government and the contractor according to the shares set out in the PSA. In addition, the contractor is normally required to pay corporation tax on 'taxable income', or profit.



Source: OPM (2013a)

In developing projections, we use data from various sources including company statements and production estimates; government statements; publications by the AfDB, the World Bank, and the International Monetary Fund (IMF); and press reports. Where possible, we have used data sourced directly from the government or resource companies, corroborated by cross-referencing other sources. Where information was not available, we have made assumptions based on OPM's experience from previous work in the oil, gas, and mining sectors in Africa. We have also approached some of the companies conducting the projects under consideration for their comments on our assumptions. To make projections as realistic as possible, we engaged with a range of industry observers through a multi-stakeholder process that included two workshops to test and refine assumptions.

Importantly, even where high-quality project-level data are readily available, the projections presented here are subject to a range of risks and uncertainties. These relate to factors external to the host country, such as international commodity prices, as well as national political, economic, and social factors. These risks are discussed in detail in Section 4 as they may change the profile of future government revenues, and in some cases preclude projects from going ahead at all. While it is not possible to map the implications of all these risks, we illustrate the potential consequences of commodity price volatility – a key source of uncertainty. Our baseline projections are based on the assumption that prices of oil, gas, and iron ore remain constant over the forecast period. In addition, we model two alternative scenarios; one in which commodity prices are 25 per cent lower than our baseline price, and another in which prices are 25 per cent higher than the baseline price.

The importance of this type of sensitivity analysis has been underlined by the recent fluctuations in commodity prices, which have highlighted their inherent volatility. In response to recent price trends, we adjusted the prices of all commodities in our baseline projections in early 2015: oil prices were revised from US\$ 100 to US\$ 80 per barrel of crude oil; gas prices from US\$ 13.2 per million to US\$ 11.5 per million British thermal units; and iron ore from US\$ 102 to US\$ 90 per dry metric ton. We also changed our price sensitivity analysis to allow for greater volatility in prices. For oil and gas, we started off modelling a 20 per cent rise or fall in prices, but increased this to 25 per cent. Similarly for iron ore, we switched from modelling a 10 per cent fluctuation to a 25 per cent fluctuation in prices.

The annexes at the end of this paper provide further information on the approach used to develop these projections. Annex A outlines the assumptions that underpin our projections, and our approach to modelling the macroeconomic indicators that were used to put these revenue projections in context. Annex B contains project-specific data and assumptions on key variables such as the estimated start date for production, the level of peak production, the royalty rate, and the income tax rate.

3 The timing and order of magnitude of new natural resource revenues

This section provides an overview of the key findings on the timing, scale, and economic significance of new natural resource revenues from the projects covered by the study. It offers, for the first time, a cross-country picture of the magnitude and timing of new natural resource revenues. The findings are presented first from a comparative perspective, and then for each country. For the latter, we start by providing an overview of the extractive industry in each country, and new discoveries and production. For countries with quantified projections, we then illustrate our findings regarding the timing and magnitude of new government revenues with two figures and one table showing:

- The contribution of new extractive industries to government revenue in absolute terms;
- The sensitivity of projected new revenues to changes in commodity prices. Our baseline scenario is based on assumptions of constant prices of oil, gas, and iron ore.⁶ We model two scenarios by shifting prices up or down by +/-25 per cent (oil, gas, and iron ore);⁷ and
- The value of new natural resource revenues over the first ten years of production in each country. This is presented in absolute terms; as a share of GDP and total government revenue; and on a per capita basis. To capture the uncertainty surrounding these projections, instead of presenting our baseline values, we provide a range of values, the lower and upper bounds of which represent projected revenues in the two alternative price scenarios.

We present our projections as average values over the first ten years of production, instead of looking at the same time period across countries, because start dates for production differ substantially across countries. We also present our projections in relative terms – as a share of GDP, total government revenue, and as an amount per person – in order to allow for meaningful comparisons across economies of very different sizes and with varying degrees of success in mobilizing revenue.

Due to data limitations, for Kenya and Guinea we restrict ourselves to providing a qualitative discussion regarding the potential for the future contributions of the oil, gas, and mining sectors to government revenues.

⁶ The baseline scenario is based on assumptions of constant prices of oil, gas, and iron ore.

- The baseline price for crude oil is 80 US\$ per barrel.
- The baseline LNG price is 11.50 US\$ per million British thermal units free-on-board in East Africa with deliveries to Japan.
- The baseline price for iron ore is 90 US\$ per dry metric ton.

⁷ We note that this analysis may overestimate the differences in government revenue contributions between the high and low scenarios, since in practice costs typically follow prices – as prices go up (down) costs will also go up (down), thereby mitigating the impact of the price change on government revenues. On the other hand, falls in prices will sometimes lead to projects no longer being profitable, i.e. resulting in the cancellation of projects rather than simply reduced government revenues.

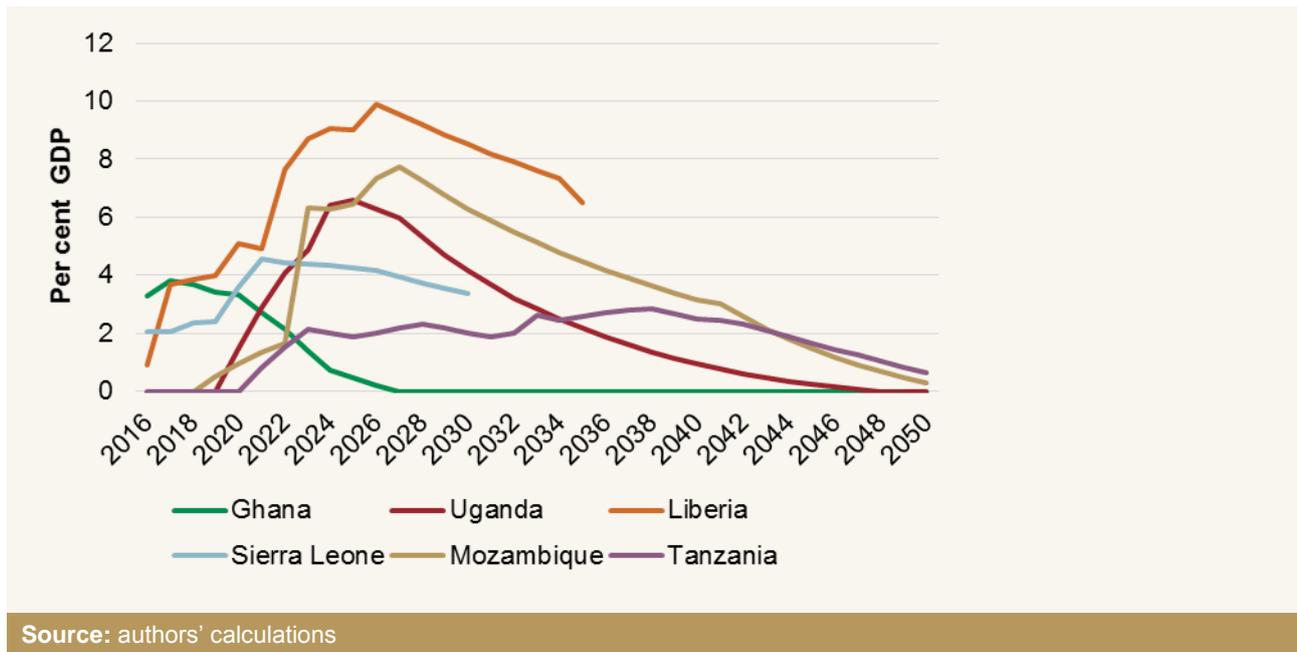
3.1 Cross-country findings

This subsection addresses estimates of the timing of new resource revenues in the eight sample countries, their absolute value and significance relative to GDP and existing government revenues.

3.1.1 Timing of new natural resource revenues

The timing of new natural resource revenues is set to vary across the eight sample countries (see Figure 2). Governments start receiving some revenue from the natural resource sector as soon as production begins. In some countries, production from recent discoveries has already started (e.g. Ghana and Sierra Leone), but in others it is at least a decade away (e.g. Tanzania and Kenya). In mining countries (Sierra Leone and Liberia), and in Ghana, this early stage revenue derives mainly from the payment of royalties. In countries that use PSAs (Uganda, Tanzania, and Mozambique), early government revenues come from a combination of royalties and production sharing. Revenue from PSAs has an initial ceiling on the share of production that is allocated to operators for the recovery of initial capital investment costs. This ensures that there is a ‘profit share’ for the government as soon as production starts.

Figure 2: Timing of new natural resource revenues



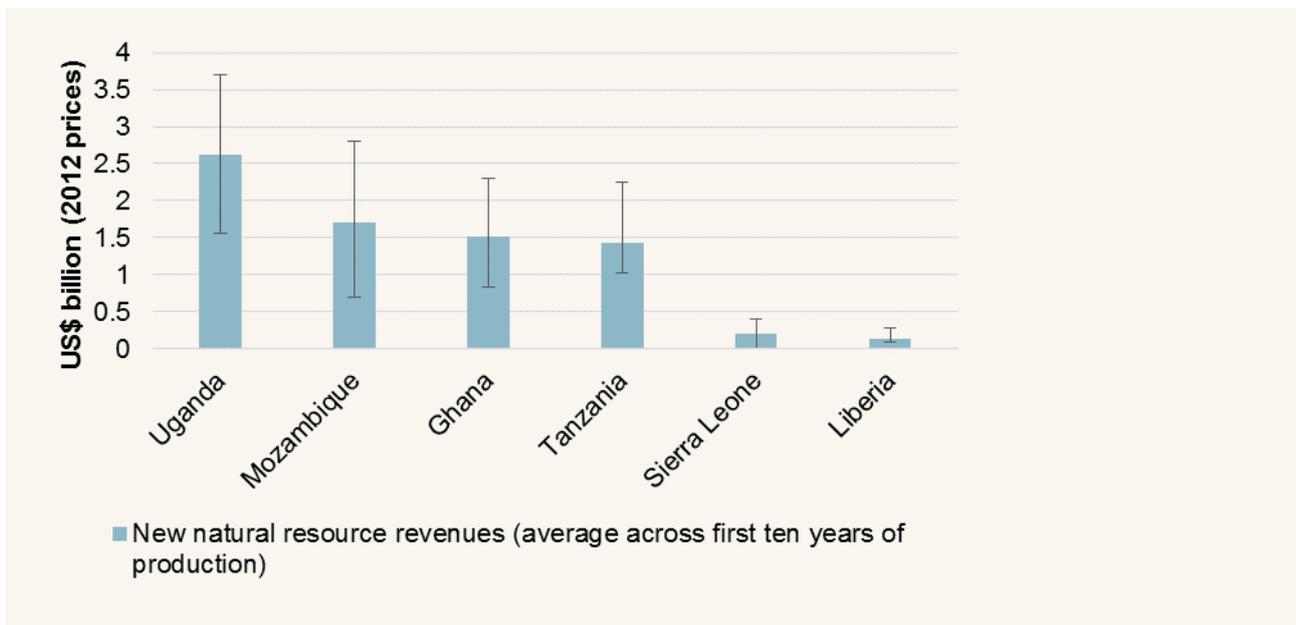
Most projects feature a staggered profile, in some cases with sudden increases in government revenues. For example, in Mozambique government revenues increase sharply in 2023 when capital investment costs are fully recovered and corporate income tax, therefore, begins to be paid on the ‘upstream’ natural gas extraction. Subsequently, in 2027 investments costs are fully recovered also on the ‘mid-stream’ Liquefied Natural Gas (LNG) operations, triggering additional new government revenue flows in the form of corporate income tax and dividends.

3.1.2 Absolute values of new revenue

The absolute value of new resource revenues will, likewise, vary across projects and sectors. For natural gas and LNG projects in Mozambique and Tanzania, new resource revenue during the first ten years of production will average around US\$ 1.7 and US\$ 1.4 billion per year, respectively. We estimate that the oil projects examined in Uganda and Ghana will contribute on average US\$ 2.6 and US\$ 1.5 billion per year to government revenue during the first ten years of production. The mining projects covered in Liberia and Sierra Leone are smaller, with new government revenues expected to average US\$ 144 and US\$ 202 million per year during the first ten years of production (see Figure 3 below). The low figures for Liberia and Sierra Leone in part reflect the fact that mining projects were operational at the start of the forecast, but have been delayed due to the Ebola outbreak and depressed iron ore markets.

These baseline projections are subject to uncertainty, not least because of the risk of commodity price volatility. Fluctuations in prices would have significant implications for new revenue flows, as indicated by the black bars in Figure 3. These depict a range of possible outcomes around the baseline, with the bottom of each bar representing average revenue in the low-price scenario and the top of each bar representing revenue in the high-price scenario. As the figure illustrates, a 25 per cent increase or decrease in commodity prices would have major implications for new natural resource revenue flows. For instance, in Uganda average revenue over the first ten years of production would amount to US\$ 1.6 billion in the low-price scenario and US\$ 3.7 billion in the high-price scenario. The equivalent figures for Mozambique are US\$ 704 million and US\$ 2.8 billion, respectively.

Figure 3: Absolute value of government revenues from new extractive industry projects



Source: authors' calculations

Note: If more than one project, start of production for the first project marks the start of the ten-year average

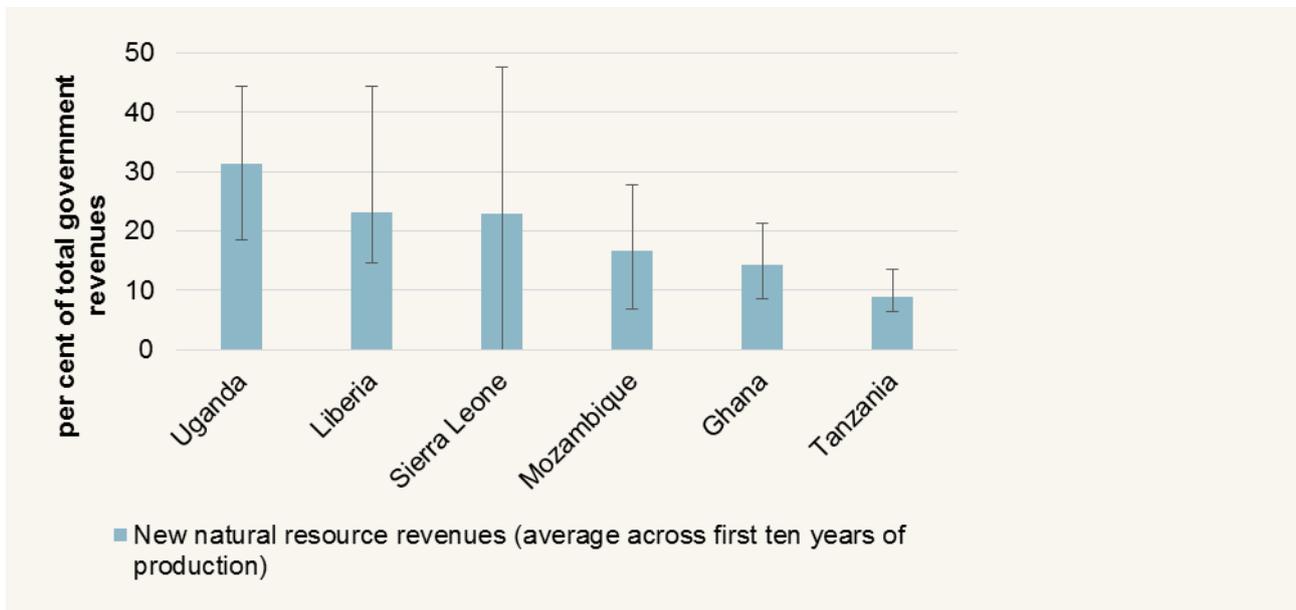
3.1.3 The economic significance of new natural resource revenue

To facilitate meaningful comparisons across countries and provide an indication of the economic significance of new natural resource revenue flows, we present our projections in relation to national GDP, tax revenue from other sources, and the size of the population.

New natural resource revenues will amount to a significant share of total government revenues in some of the countries (see Figure 4). Over the first ten years of production, the scale relative to baseline government revenues (total revenue excluding new natural resource revenue) will be smallest in Tanzania (9 per cent) and Ghana (14 per cent). It will be highest in Uganda (31 per cent), reflecting the relatively small tax base and low collection rates prevalent in the country. It will also be sizable in Sierra Leone (23 per cent) and Liberia (23 per cent), both of which have relatively small economies.

In line with the findings on absolute values, these projections are very sensitive to price fluctuations (see black bars in Figure 4). In Mozambique, new resource revenues would account for 28 per cent of baseline government revenue in the high-price scenario and just 7 per cent in the low-price scenario. In Sierra Leone, the difference is even starker. In the event of a 25 per cent price increase, new resource revenue would amount to 48 per cent of government revenue from other sources. However, if iron ore prices in the country were to fall by 25 per cent, the two projects considered in this paper would become uneconomical. There would therefore be *no* contribution to government revenue from new natural resources.

Figure 4: Relative importance of government revenues from new extractive industry projects as a share of total baseline government revenue



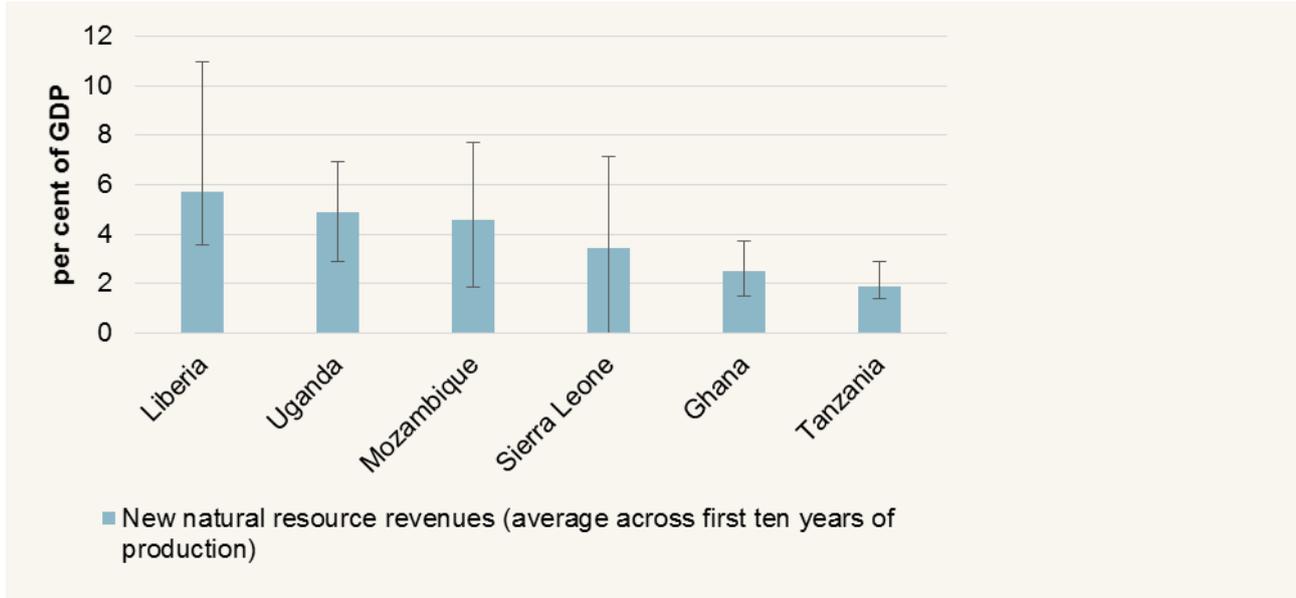
Source: authors' calculations

Note: If more than one project, start of production for the first project marks the start of the ten-year average

Relative to GDP, the magnitude of new resource revenues over the first ten years of production ranges from 2 per cent in Tanzania to almost 6 per cent in Liberia (see Figure 5). The finding that contributions in relation to GDP are comparatively high in Sierra Leone and Liberia, despite the much lower contributions in dollar terms, reflects the much smaller size of the economy in these

countries. Once again, these projections are highly sensitive to price variations. In Tanzania, the value of new resource revenues as a share of GDP is projected at 1.4 per cent in the low-price scenario and 2.9 per cent in the high-price scenario. In Liberia, it ranges from 3.6 per cent to 10.9 per cent in the two alternative price scenarios.

Figure 5: Relative importance of government revenue from new extractive industry projects as a share of GDP

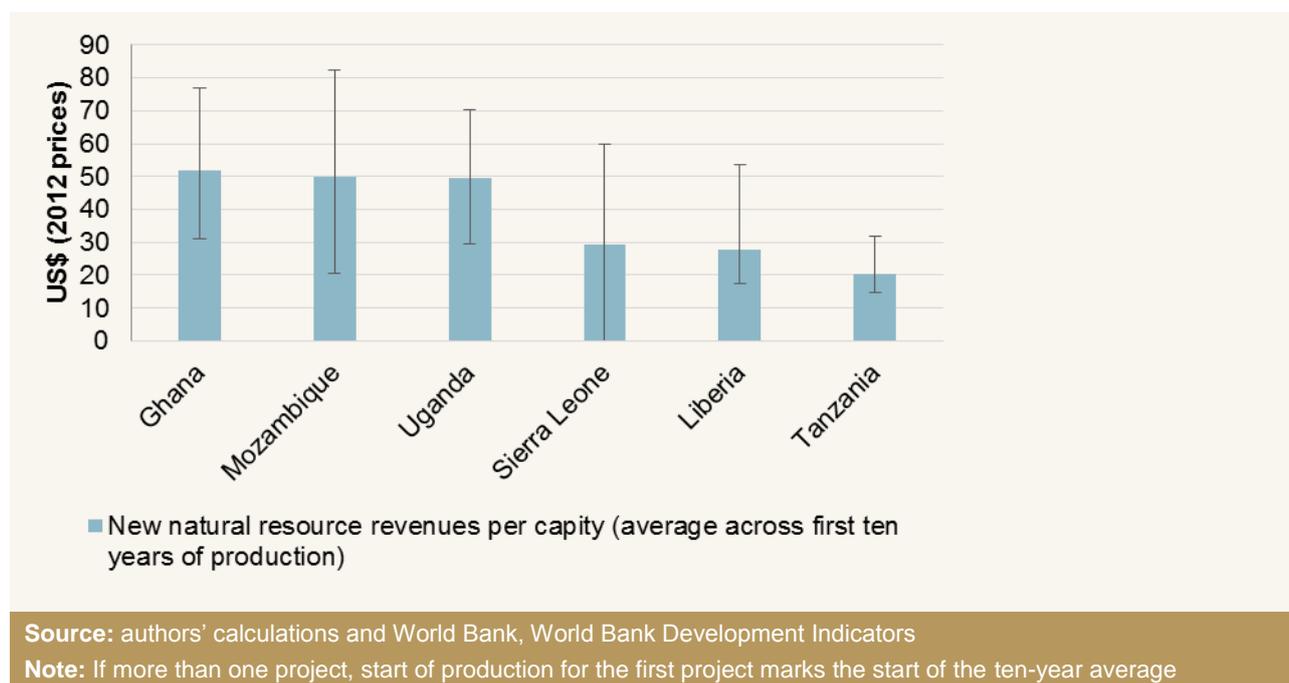


Source: authors' calculations

Note: If more than one project, start of production for the first project marks the start of the ten-year average

Over the first ten years of production, new resource revenue per capita is projected to range from US\$ 20 in Tanzania (which has the largest population of the six countries) to US\$ 52 in Ghana. In line with the other findings and as illustrated in Figure 6 below, these projections are very sensitive to fluctuations in prices. Sierra Leone is the most extreme case (US\$ 60 in the high-price scenario and nothing in the low-price scenario), but the differences are also striking in the other countries. For instance, in Mozambique the per capita value of new natural resource revenue is projected at US\$ 82 in the high-price scenario and US\$ 20 in the low-price scenario.

Figure 6: New natural resource revenue per capita



3.2 Individual country findings

This subsection provides an overview of the extractive industry in each country, and new discoveries and production. For each country with quantified projections, findings on the timing and magnitude of new government revenues are presented.

3.2.1 Oil in Ghana

Ghana is Africa's second-largest gold producer and has a long tradition of large-scale gold mining. The mining sector contributed 27 per cent of domestic tax collections in 2012 (Ghana Chamber of Mines, 2013).

In June 2007, Ghana announced the discovery of oil in the Jubilee field 60km off its southwest coast. This triggered further exploration, and in 2014 Richmond Energy Partners estimated that Ghana had discovered commercial oil reserves of 1.7 billion barrels, as well as 3.6 trillion cubic feet of recoverable gas in 16 potentially commercial discoveries.

Production in the Jubilee field began in 2011. The operator is Tullow Oil, with Ghana National Petroleum Corporation, Kosmos, Anadarko Petroleum Corporation, and Sabre Oil and Gas shareholders in the consortium (KPMG, 2013). A current expansion (Jubilee Phase 1A) is expected to bring oil production volumes to 130 million barrels per day by 2015. The Jubilee field also includes significant gas reserves but until recently this gas has been re-injected into the reservoir awaiting the completion of a gas processing plant at Atuabo.

A second project, the TEN project, involving the same consortium, has been approved with first production expected in 2016.⁸ TEN's reserves have been estimated at 245 million barrels of oil and

⁸ TEN is located in the Deepwater Tano License.

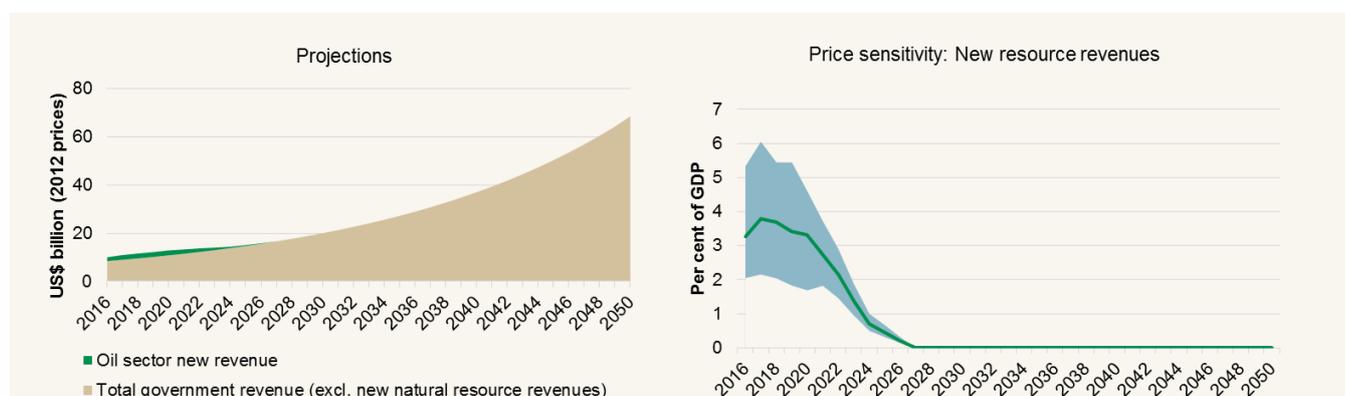
367 billion cubic feet of gas. Tullow expects the project to cost around US\$ 5 billion, with peak production of 80,000 barrels per day.

Another development is driven by ENI, which is planning – together with partners Vitol and the Ghana National Petroleum Corporation – to develop the offshore oil and gas fields Sankofa and Gye Nyame. ENI has estimated that it can recover as much as 150 million barrels of oil equivalent (BOE) of the estimated 450 million BOE in place (Oil and Gas Journal, Jan 17, 2013).

We project revenues from the Jubilee (phases 1 and 1A) and the TEN project. Data needed for detailed projections were not available for the ENI project. Although these and other projects have access to large gas reserves, at the time of writing, the commercialization of these resources was unclear and hence we do not provide projections for additional government revenues from gas production.

Figure 7 presents the absolute and relative scale and timing of revenues from the Jubilee and TEN projects. The left-hand figure shows our projections of new natural resource revenue and total government revenue (excluding new natural resource revenue) under the baseline scenario, in which commodity prices remain constant. Our sensitivity analysis (right-hand figure) shows that varying the oil price by +/- 25 per cent could result in substantial changes in the contribution that new natural resource revenues make to GDP. The table below the figures shows new natural resource revenues, in absolute and relative terms, over the first ten years of production. The values are presented as a range around the baseline, depicting revenue flows in the low- and high-price scenarios. For instance, the table indicates that new natural resource revenues would account for 1.5 percent of GDP on average over the first ten years of production if prices were to fall by 25 per cent, and 3.7 percent of GDP if they were to increase by 25 per cent.

Figure 7: Magnitude and timing of new revenue contributions: TEN and Jubilee Phase 1



Order of magnitude for natural resource revenues (average across first ten years of production)

	2012 GDP per capita (US\$)	Absolute value (US\$ billion)	Share of total revenues (per cent)	Share of GDP (per cent)	Per capita (US\$)
Ghana	1,519	0.8 – 2.3	8 – 21	1.5 – 3.7	31 – 77

Source: authors and AfDB, World Bank, World Development Indicators

Note: For each indicator, a range of values is provided. These represent projected revenues in the event of a low-price scenario (commodity prices are 25 per cent lower than baseline prices) and a high-price scenario (prices are 25 per cent higher than baseline prices).

3.2.2 LNG and natural gas in Mozambique

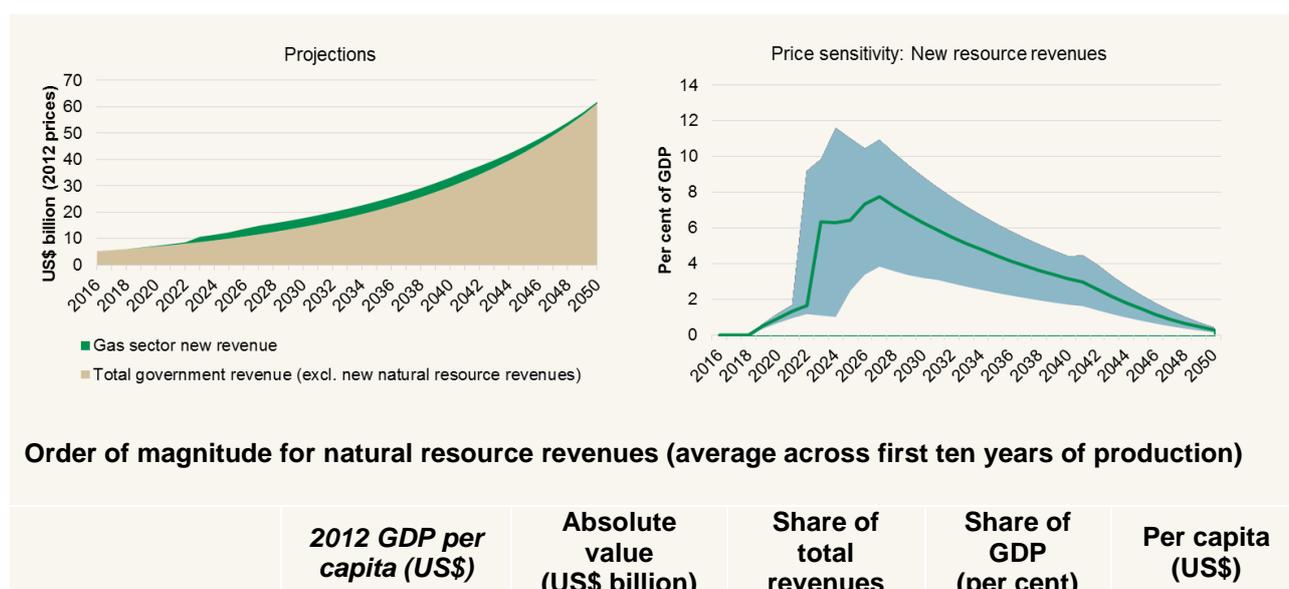
Mozambique has large natural gas and coal reserves. The country has been producing natural gas on a modest scale since 2004 through the operations of the South Africa-based Sasol, but the petroleum sector has remained relatively small.⁹ More recently, discoveries by consortia led by Anadarko and ENI respectively indicate large-scale reserves of natural gas in the offshore Rovuma Basin. In 2014, Richmond Energy Partners estimated reserves of 36.5 trillion cubic feet for Anadarko and 53.5 trillion cubic feet for the ENI-led consortium.

Mozambique's coal mining sector is growing quickly, based on discoveries mainly in Tete province, with investments by Rio Tinto, Vale, and Eurasian Natural Resources Corporation, as well as junior firms (see Rosenfeld 2012). The sector is poised for rapid production growth, but subject to significant logistical challenges in accessing export markets.

The discoveries by Anadarko and ENI are each of sufficient scale for an LNG project, and both are advancing plans to develop offshore gas extraction projects. The IMF (2013a) estimates that peak production volumes for the first phase of the Anadarko project could be 20 million metric tons of LNG per year, with capital investment of US\$ 40 billion. The companies have announced that they would cooperate on the development of LNG 'mid-stream' facilities to convert the gas into LNG (Anadarko, Aug 25, 2013).

Figure 8 illustrates the magnitude and timing of the revenue contributions from the Anadarko Rovuma Basin Area 1 LNG project. We do not project revenues for the ENI project or the coal sector, due to data limitations. The left-hand figure shows new revenue from the gas sector and projected revenue from other sources. The right-hand figure illustrates the large gap between new resource revenues in the event of a 25 per cent decline in prices and a 25 per cent increase. In the former case, new gas revenue is projected to amount to 1.9 percent of GDP; in the latter, it amounts to 7.7 percent of GDP. These figures differ markedly from the baseline projection of 4.6 percent of GDP.

Figure 8: Magnitude and timing of new revenue contributions: Anadarko Rovuma Basin Area 1



⁹ Mineral fuel exports accounted for 15.1 per cent of total exports in 2010 (UNCTADstat, 2012).

			(per cent)		
Mozambique	634	0.7 – 2.8	7 – 28	1.9 – 7.7	20 – 82

Source: authors and AfDB, World Bank, World Development Indicators

Note: For each indicator, a range of values is provided. These represent projected revenues in the event of a low-price scenario (commodity prices are 25 per cent lower than baseline prices) and a high-price scenario (prices are 25 per cent higher than baseline prices).

3.2.3 Oil in Uganda

Following unsuccessful oil exploration in the 1930s and then again in the 1980s, Heritage Oil discovered oil in 2006. The Heritage licenses, and others, were then acquired by Tullow Oil. A total of 1.7 billion barrels of ‘recoverable oil resources’ was announced in Tullow Oil’s 2013 full year results – an indication of what has been found to date and what they expect to find going forward.

The oil reserves are in the Albertine Graben in western Uganda. Tullow Oil, now in partnership with Total and China National Offshore Oil Corporation (CNOOC), will work in a joint venture, each with a 33.3 per cent ownership. The license area Exploration Area 1 (EA-1) will be operated by Total; blocks EA-2 and former EA-3 will be operated by Tullow Oil; and CNOOC will operate the new Kanywataba and Kingfisher license areas.

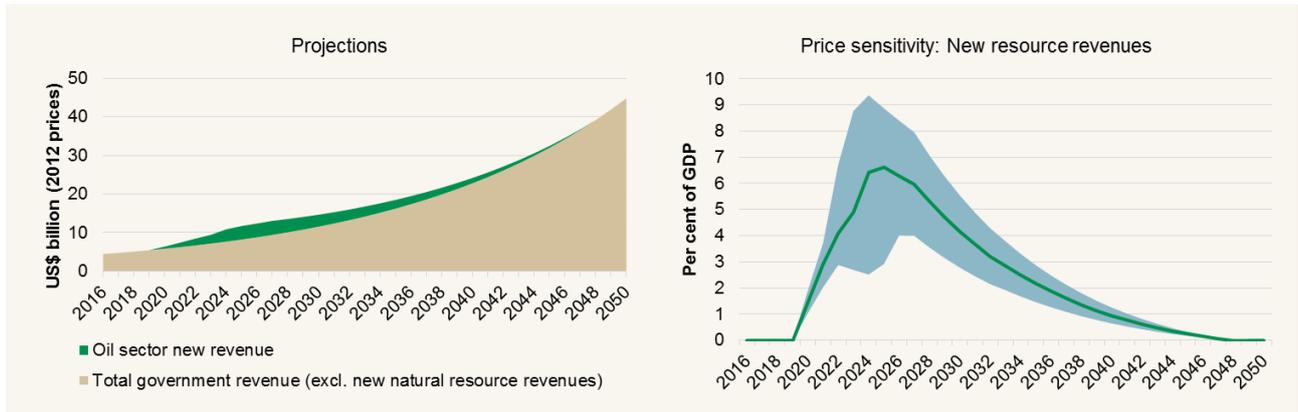
As Uganda is a land-locked country, oil production requires the presence of an oil refinery and/or a pipeline (as well as transit agreements with neighboring countries) to access export markets. Uganda aims to build a 30,000 barrel per day refinery by 2016/17 (Reuters, Jun 25, 2013) but uncertainty on the timing of the project remains.

With respect to the pipeline, on February 6, 2014, a Memorandum of Understanding (MoU) was signed between the companies and the government which obliges the government to investigate pipeline construction with neighboring countries (Bloomberg, Feb 6, 2014). In October 2014, the IFC approved a US\$ 600 million loan to facilitate the construction of the pipeline, which is expected to cost US\$ 5 billion. The proposed 1,400-kilometer pipeline – from central Uganda to Lamu on Kenya’s east coast – is critical for realizing Uganda’s hydrocarbon potential, and could potentially connect other countries, including South Sudan, to Kenya’s terminal.

Figure 9 presents our projections for the Lake Albert Rift Basin project, which is expected to require investment of US\$ 14 billion. Over its 30-odd years of production, revenue from the project is expected to account for 17 per cent of baseline government revenue. This reflects both the significant size of the project and Uganda’s low prevailing tax collection rates.¹⁰ Once again, these projections are highly sensitive to price, as illustrated by the right-hand figure and the table below. Over the first ten years of production, new oil revenues are expected to amount to 2 per cent of GDP in the event of a 25 per cent decline in prices, and 6.9 percent of GDP if prices were to rise by 25 per cent. In the baseline scenario, they are projected to amount to 4.9 percent of GDP.

¹⁰ In 2009 Uganda’s total revenue expressed as a share of GDP was only 12.5 per cent (IMF 2013a). To put this in context, total revenue as a percentage of GDP was higher in Ghana (22.5 per cent), Liberia (26.8 per cent), Mozambique (17.8 per cent), Kenya (21.2 per cent), and Tanzania (16.7 per cent).

Figure 9: Magnitude and timing of new revenue contributions: Lake Albert Rift Basin



Order of magnitude for natural resource revenues (average across first ten years of production)

	<i>2012 GDP per capita (US\$)</i>	<i>Absolute value (US\$ billion)</i>	<i>Share of total revenues (per cent)</i>	<i>Share of GDP (per cent)</i>	<i>Per capita (US\$)</i>
Uganda	558	1.6 – 3.7	18 – 44	2.9 – 6.9	29 – 70

Source: authors and AfDB, World Bank, World Development Indicators

Note: For each indicator, a range of values is provided. These represent projected revenues in the event of a low-price scenario (commodity prices are 25 per cent lower than baseline prices) and a high-price scenario (prices are 25 per cent higher than baseline prices).

3.2.4 Iron ore in Liberia

Liberia has large deposits of diamonds, gold, and iron ore. The country’s iron ore sector in particular has attracted significant foreign direct investment (FDI) into exploration and production.¹¹ Since 2011, African Petroleum Ltd has also been conducting a major offshore oil exploration campaign, without any commercial finds to date (allAfrica, December 20, 2013).

The largest iron ore mines are ArcelorMittal’s Western Range Project, the Bong Iron Ore Mine owned by China Union, the Putu mine owned by Russian steel producer Severstal, and the Western Cluster project owned by Sesa Goa (a subsidiary of Vedanta Resources).

The Western Range Project will require some US\$ 2.2 billion in investment and hold around one billion metric tons of iron ore deposits. The mine was closed during the civil war but started shipping ore again in 2011.¹² Plans were in place to increase capacity from 4 to 15 million metric tons per year by 2015. However, the Ebola outbreak and depressed iron ore prices have cast doubt on these plans. For our projections, we assume the capacity expansion will be delayed by two years to 2017. Given its remote location, ArcelorMittal has renovated the railway, repaired bridges and service roads, and redeveloped the southern port at Buchanan.

The Bong Iron Ore Mine is reported to contain over 1.3 billion metric tons of reserves (The Economic Times, May 27, 2010). It is located 150km north of Monrovia and was, like the Western

¹¹ BHP Billiton, the world’s largest mining company, also holds four licenses for iron ore exploration in Liberia (Africa Progress Report, 2013).

¹² The second Liberian civil war lasted from 1999 to 2003.

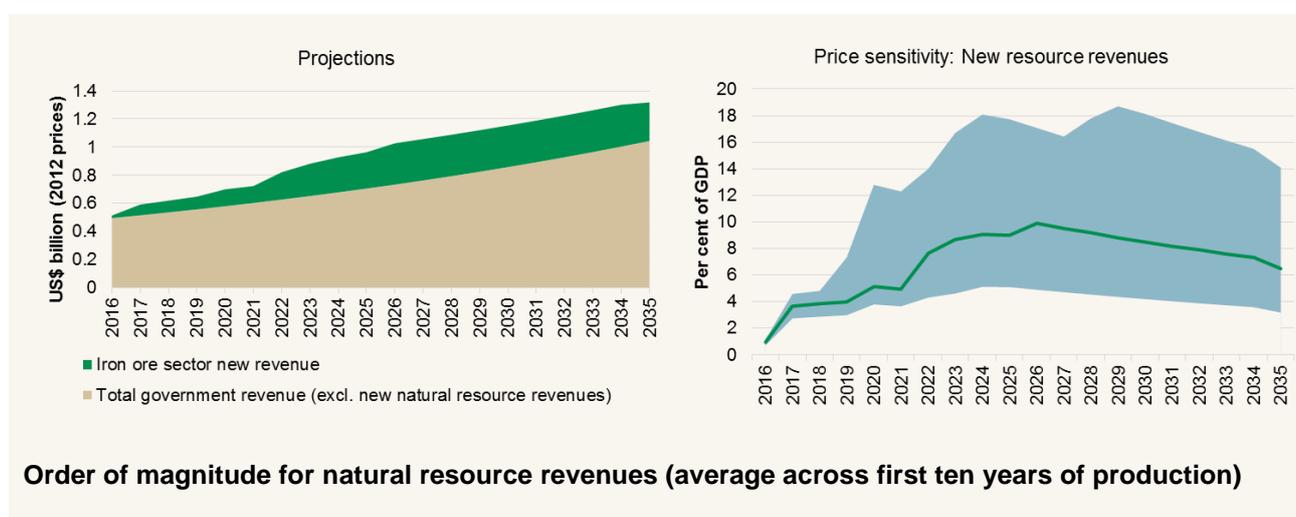
Range Project above, in production prior to the civil war. The cost of developing the mine, at US\$ 2.6 billion, represents Liberia's largest FDI to date. The initial investment was undertaken in 2013/14, with the onset of production planned for 2015. Given the Ebola outbreak and depressed iron ore prices, we assume that production will start in 2017.

The Putu Range iron ore project is a 13km-long iron-rich ridge, located 130km inland from the shoreline of Eastern Liberia, currently owned by Russian firm Severstal. The latest independent mineral resource report estimated 4.4 billion metric tons of iron ore at a 34 per cent total iron content. Following the signature of a Mineral Development Agreement in 2010, a feasibility study was submitted to the government on March 31, 2014 and a mining license was issued in July 2014. The capacity will be 7 million metric tons per year in a first stage of investment (US\$ 1 billion), with plans to eventually expand this to 25-30 million metric tons per year. The smaller initial scale reflects challenges in securing funding in the current price environment for iron ore. We assume that production will begin in 2018.

The Western Cluster project is wholly owned by a subsidiary of Vedanta Resources and comprises the Manor River deposits, the Bomi Hills deposits, and the Bea Mountain deposits. The project has a potential iron ore resource of over 1 billion metric tons. Production was scheduled to begin in 2014, and to gradually reach a total capacity of 30 million metric tons per year. However, the project has been delayed, due to challenges in financing the necessary infrastructure and increases in cost caused by the Ebola outbreak. Our projections assume there will be an investment of US\$ 1 billion and that production will begin in 2018.

Figure 10 presents our projections for these four mining projects. New natural resource revenue flows from the projects are likely to be substantial relative to the size of the Liberian economy, although this is somewhat dependent on a favorable outlook for prices. Under our baseline scenario, in which prices remain constant, revenue from these projects is expected to amount to 28 per cent of baseline government revenue over the next 20 years (during which the projects are expected to be operational; see left-hand figure below). The contribution of new revenue flows to GDP is highly sensitive to price, varying from an average of 3.6 per cent over the next ten years under the low-price scenario and 10.9 per cent under the high-price scenario.

Figure 10: Magnitude and timing of new revenue contributions: Western Range, Bong Iron Ore project, Putu, and Western Cluster



	<i>2012 GDP per capita (US\$)</i>	<i>Absolute value (US\$ billion)</i>	<i>Share of total revenues (per cent)</i>	<i>Share of GDP (per cent)</i>	<i>Per capita (US\$)</i>
Liberia	436	0.09 – 0.27	15 – 44	3.6 – 10.9	17 – 54

Source: authors and AfDB, World Bank, World Development Indicators

Note: For each indicator, a range of values is provided. These represent projected revenues in the event of a low-price scenario (commodity prices are 25 per cent lower than baseline prices) and a high-price scenario (prices are 25 per cent higher than baseline prices).

3.2.5 Iron ore in Sierra Leone

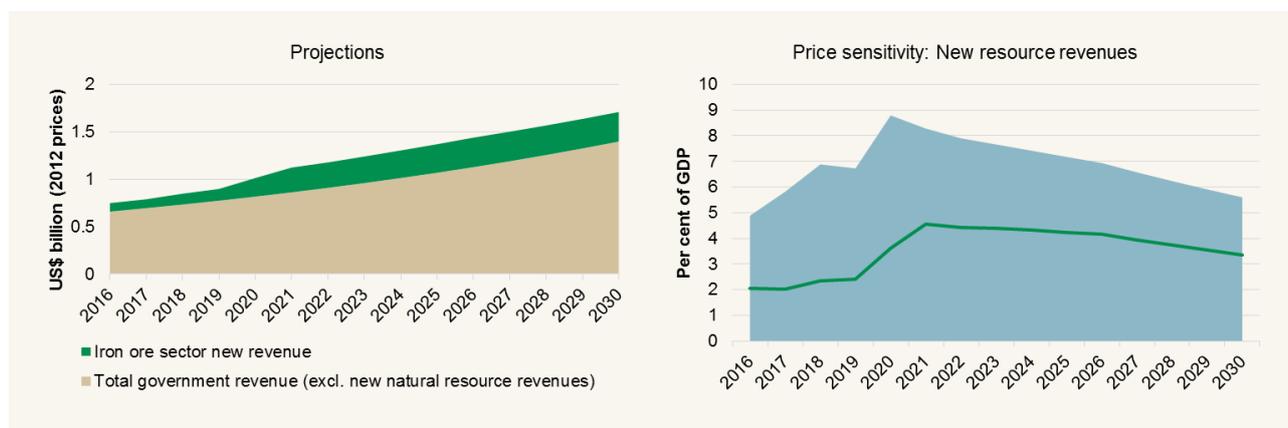
Sierra Leone has large iron ore, diamond, gold, and bauxite deposits. Diamond production is significant, and two gold mines are in advanced stages of development. Sierra Leone's largest iron ore mines are Tonkolili (owned by African Minerals) and the Marampa iron ore mine (owned by London Mining).

The known ore resources in Tonkolili, Sierra Leone's largest iron ore mine, total 12.8 billion metric tons (African Minerals, no date). The mine started production in 2011 and will require US\$ 2.2 billion in investment to generate a peak production of 25 million metric tons per year. Due to the Ebola outbreak and depressed iron ore prices, we expect the expansion of capacity to be delayed and that peak production will only be reached in 2018.

Marampa, the second-largest mine, has resources of over 1 billion metric tons of iron ore (London Mining, 2014). Production recommenced in December 2012 (after having been suspended in 1975), following investment of US\$ 520 million. Due to market uncertainties, high operating costs and uncertainties associated with the Ebola outbreak, London Mining put Marampa into administration in October 2014. The mine was subsequently sold to Timis Corporation. The mine is expected to eventually have a peak production of 9 million metric tons per year. However, due to delays in investment programs, we assume this will not happen until 2019.

Figure 11 illustrates the magnitude and timing of revenues from these two projects. As in Liberia, under the baseline scenario, new natural resource revenue would be equivalent to a sizable share of government revenue from other sources – 23 percent over the first ten years of production, and 21 percent over the remaining period of production. While the economic significance of new natural resource revenues is sensitive to commodity prices in all eight countries considered in this paper, this vulnerability is most stark in the case of Sierra Leone. If the price of iron ore were to rise by 25 per cent, new natural resource revenue would account for roughly 7 per cent of GDP and 48 per cent of government revenue from other sources. If prices were to fall by 25 per cent, we expect that the four projects under consideration would become uneconomical, cutting off revenue flows from this source.

Figure 11: Magnitude and timing of new revenue contributions: Tonkolili and Marampa



Order of magnitude for natural resource revenues (average across first ten years of production)

	2012 GDP per capita (US\$)	Absolute Value (US\$ billion)	Share of total revenues (per cent)	Share of GDP (per cent)	Per capita (US\$)
Sierra Leone	573	0 – 0.4	0 – 48	0 – 7.2	0 – 60

Source: authors and AfDB, World Bank, World Development Indicators

Note: For each indicator, a range of values is provided. These represent projected revenues in the event of a low-price scenario (commodity prices are 25 per cent lower than baseline prices) and a high-price scenario (prices are 25 per cent higher than baseline prices).

3.2.6 LNG and natural gas in Tanzania

Tanzania has been producing natural gas from its Songo Songo fields since 2004. This gas is used to provide about 50 per cent of Tanzania's electricity generation, with the remainder used for industrial purposes. Tanzania also produces significant volumes of mined minerals, in particular gold. The country's large-scale gold mines are mainly located in the Mwanza region and produced 40 metric tons of gold in 2011.

Since 2010, international oil and gas companies have made several large-scale discoveries. Richmond Energy Partners estimated in 2014 that BG/Ophir had 14 trillion cubic feet reserves and that the Statoil/ExxonMobil consortium had discoveries of 13 trillion cubic feet reserves.¹³

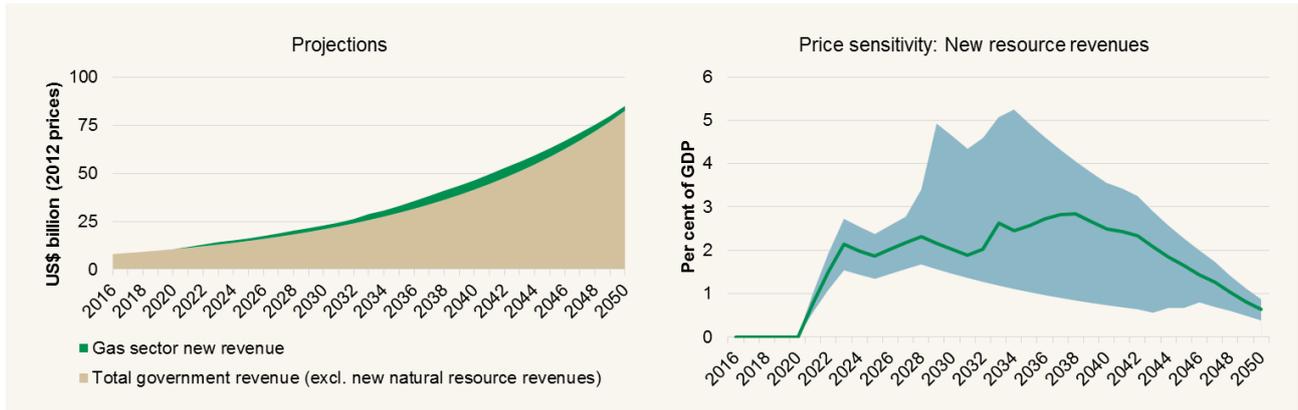
These discoveries are sufficient for large-scale LNG development. However, investment and operating costs for such projects will be high, because the gas is under the seabed, in deep water. Both the BG and Statoil-led projects are estimated to have investment costs of around US\$ 20 billion for the 'upstream' gas extraction operations – each producing sufficient gas to produce 10 million metric tons of LNG per year.

The two consortia have submitted proposals to build a shared on-shore LNG plant (to cool and liquefy the gas once it has been brought on-shore) in the southern region of Lindi. This is estimated to have a further investment cost of US\$ 10 billion.

¹³ Statoil operates the venture with 65 per cent interest, while ExxonMobil owns the remaining 35 per cent.

Figure 12 presents the magnitude and timing of potential revenue contributions from the two projects. Although large in absolute terms, revenue from gas is expected to account for a relatively small share of the economy – under the baseline scenario, it is projected to amount to US\$ 1.4 billion per year on average over the first ten years of production, but to account for 1.9 per cent of GDP and 9 per cent of government revenue from other sources. As illustrated by the right-hand figure and the table below, these figures are highly sensitive to price fluctuations, with the contribution of new natural resource revenues to GDP over the first ten years of production ranging from 1.4 percent to 2.9 percent in the two alternative price scenarios.

Figure 12: Magnitude and timing of new revenue contributions: Blocks 1, 2, 3, and 4



Order of magnitude for natural resource revenues (average across first ten years of production)

	2012 GDP per capita (US\$)	Absolute Value (US\$ billion)	Share of total revenues (per cent)	Share of GDP (per cent)	Per capita (US\$)
Tanzania	629	1.0 – 2.2	6 – 13	1.4 – 2.9	15 – 32

Source: authors and AfDB, World Bank, World Development Indicators

Note: For each indicator, a range of values is provided. These represent projected revenues in the event of a low-price scenario (commodity prices are 25 per cent lower than baseline prices) and a high-price scenario (prices are 25 per cent higher than baseline prices).

3.2.7 Oil in Kenya

In 2012, Tullow Oil and Africa Oil Corporation discovered oil resources of up to 300 million barrels in the Lokichar Basin in the Turkana region. As of early 2014, Tullow Oil, in partnership with Africa Oil Corporation, had discovered up to 600 million barrels of oil (with a potential of over 1 billion barrels) in the Lokichar Rift basin. Tullow has conducted flow tests, but is some way off commercial production.

Tullow Oil’s discovery in 2012 resulted in the entry of other major foreign oil companies into Kenya. Almost all 46 blocks are now licensed, to 23 international companies at various stages of exploration (IMF, 2013b). Offshore gas was encountered in 2012 at the Mbawa prospect by Apache and, more recently, at the Sunbird structure by BG Group, but not, as of yet, in commercial quantities.

Tullow Oil’s consortium discoveries are in the remote and underdeveloped Turkana region in the north western part of Kenya’s Rift Valley. Shipments will initially be made by truck or train for

refining in Mombasa or for exports. As in Uganda, large-scale production from this on-shore field will require the construction of a pipeline to cost-effectively transport the oil to port.¹⁴ The companies and officials from Kenya and Uganda have agreed in principle to construct this pipeline, and feasibility studies were ongoing at the time of writing.

At present there is limited publicly available data on the Tullow Oil project, such as its expected start date, investment costs, and production profiles. It is possible, however, to construct a rough order-of-magnitude estimation of what Kenya's oil resources might deliver, given assumptions of existing reserves and the similarities with Uganda (see Box 2).

Box 2: Order-of-magnitude contributions for Kenya

As Tullow Oil's project in Uganda is similar in terms of geology and location to the company's project in Kenya, we assume the two projects will have the same total costs as a share of gross revenues. Assuming a long-term average oil price of US\$ 80 (our baseline price), this means that 1 billion barrels would generate US\$ 80 billion in gross revenues, of which US\$ 20 billion would relate to operating, capital and transport costs.

Based on Njeru (2009), we assume that the government take of this surplus is 75 per cent. This implies that the Kenyan government would capture 75 per cent of the US\$ 60 billion surplus, i.e. US\$ 45 billion. Assuming a project life of 20 years, this means an average government take of US\$ 2.5 billion per year – roughly US\$ 42 per capita.

Source: authors' calculations

3.2.8 Iron ore in Guinea

Guinea has almost half of the world's total bauxite reserves, as well as significant deposits of iron ore, gold, and diamonds. The country already produces bauxite (being the world's fifth largest producer in 2011) and gold (roughly 15 metric tons per year), but iron ore resources have not yet been exploited on a large scale. A consortium comprising Tullow Oil, Hyperdynamics and Dana Petroleum is exploring for oil, but has not made any commercial discoveries to date.

Guinea has two major untapped iron ore deposits that would – once developed – generate large flows of revenue for the Guinean government:

- The Simandou deposit is one of Africa's largest, with resources estimated at more than three billion metric tons of high-grade iron ore. Rio Tinto acquired the rights to Simandou in 1997, later forming a joint venture with Aluminum Corp of China (Chalco) to exploit the deposit. In 2008, the northern half of the concession was appropriated by the government, and subsequently sold to BSG Resources (FT, Oct 13, 2013). In 2012, Vale S.A. and BSG Resources formed a joint venture to exploit the northern part of Simandou (The Australian, Jan 14, 2014).
- The second large unexploited iron ore deposit is around Mount Nimba, a deposit that is shared between Liberia and Guinea and estimated to comprise one billion metric tons of reserves (AISA, no date). BHP Billiton and Newmont invested in a joint venture to operate the project. However, BHP recently divested its share to ArcelorMittal, which is seeking synergies with mines operated across the border in Liberia.

¹⁴ As in Uganda, the oil is 'waxy', which means that it solidifies at room temperature. It therefore needs to be heated in order to flow, which brings added technical challenges and costs.

The transformational potential of these two iron ore deposits is significant; Simandou alone could support production of 95 million metric tons per year, making Guinea one of the world's largest iron ore exporters, comparable with established producers like Brazil and Australia. Successful development of Simandou could potentially double Guinea's GDP (BBC News, May 7, 2014).

Yet despite this potential, these iron ore projects have not materialized. This is due to a combination of reasons, which include political instability, a lack of a stable mining policy, and infrastructural challenges. As a result, production in Rio Tinto's southern half of Simandou has been repeatedly delayed and estimated costs have more than doubled, from around US\$ 9 billion to US\$ 20 billion (EIU, Jun 18, 2013). Vale announced in 2014 that it intends to exit the project on the northern part of Simandou. Both Newmont and BHP Billiton have slowed down their investments in Mount Nimba, in anticipation of BHP's sale of its share of the project.

On a more positive note, it was announced in May 2014 that the Rio Tinto-led consortium had come to an agreement with the Guinean government by signing a US\$ 20 billion 'investment framework', paving the way for the development of the Simandou deposit (BBC News, May 7, 2014). Under this framework – the details of which are not publicly available – the consortium intends to seek external financing to construct the necessary infrastructure, including a 650km railway and a port, which are estimated to account for two-thirds of the investment costs.

4 Risks to future government revenues from natural resources

The projections in this paper represent a best attempt at quantifying the potential timing and magnitude of new natural resource revenues in a cross-section of African countries with recent discoveries in new resource sectors. In so doing, the aim is to help frame the policy choices facing governments in transforming new-found natural resource wealth into human development.

For new resource revenues to drive human development, policy-makers must recognize the various risk factors that may prevent these revenues from materializing or that could cause delays. First, with the exception of some projects in Ghana, Liberia, and Sierra Leone, the final decisions by investors to go ahead with these projects have not yet been taken. Second, like any long-term projections, even where projects do go ahead, the actual revenues generated will not be exactly as projected due to market-related, commercial, technical, and political uncertainties throughout the lifetime of the projects. These factors affect the transformation of sub-soil assets into government revenue in complex and inter-related ways, which impact the timing as well as the magnitude of new natural resource revenues. In this section, we discuss some of the main factors affecting future government revenues from extractive industries.

4.1 Volatility of international commodity prices

The revenues from oil, gas, and mining that are captured by governments will depend to a large degree on international prices. These are shaped by global demand and supply, and expectations of future prices, and have historically been volatile. Short-term price movements are notoriously hard to predict. In fact, none of the professional economic forecasting agencies appear to have foreseen the sharp falls in oil and iron ore prices during the second half of 2014, which seemed to take everyone by surprise. Over the longer term, the outlook for demand remains robust, but there are uncertainties regarding supply (see Box 3).

Importantly, the impact of volatile prices affects different projects and economies differently. Higher-cost operations, such as deep-water oil and gas projects, are more likely to become unviable in the event of a sustained fall in international prices.

Box 3: Long-term outlook for commodity prices

The long-term demand outlook for commodities remains positive: the International Energy Agency predicts that global demand for oil and gas will increase by over one-third by 2035, with emerging markets accounting for almost the entire increase.¹⁵ Unless there is a sustained slowdown in growth, China's continued expansion and urbanization also points to a strong demand for mined minerals, supporting a medium-term recovery in prices (CRU, 2013).

With respect to supply, the outlook is more uncertain. High prices over the last decade have led to increased investment in exploration as well as new technologies, which have resulted in increased production. For example, the new LNG projects proposed in Mozambique and Tanzania will face competition from the new LNG capacity in both the Middle East and Australia.¹⁶ Additional supply could potentially lead to a downward adjustment in prices in Asia, a primary potential market for Tanzania (IMF, 2014). However, additional demand from China for gas to displace coal in relation to power generation could offset such an effect. In the mining sector, major iron ore producers such as BHP Billiton, Rio Tinto, and Vale have all commissioned large projects in the past few years, resulting in a supply glut that is pushing iron ore prices lower.

Source: CRU (2013); IMF (2014)

4.2 Policy, regulatory and institutional risk

The timing and magnitude of new natural resource revenues will be shaped by the wider political, policy, and institutional environment facing the sector. For example, changes to the fiscal regime may come about through changes in government, or from growing demands from citizens to demonstrate greater benefits from natural resources – thereby highlighting the need for careful expectation management.

Investors will look for evidence of a stable, coherent and transparent policy framework. Any real or perceived changes to the 'rules of the game' may deter investment and jeopardize existing or future projects. For example, international financial institutions are less likely to finance projects in jurisdictions perceived to have high levels of regulatory risk.

Even where investment is forthcoming, weak institutions may prevent the government from effectively managing resource revenues, resulting in leakages and squandered opportunities. As Amoako-Tuffour (2010) points out, the capacity to manage the sector is particularly important where fiscal regimes have many elements open to negotiation.

4.3 Economic and social shocks

Widespread economic or social shocks can lead to delays or cancellations of projects. For example, the recent Ebola outbreak in West Africa has resulted in sharp restrictions on the movement of goods and labor in the region, making project execution difficult. Projects in Liberia, Guinea, and Sierra Leone are all likely to be affected by the outbreak, as mining firms within these countries revise production and investment plans. Importantly, such shocks do not only affect extractives projects themselves, but the government's overall capacity to manage the sector and to provide public services to citizens.

¹⁵ For example, global demand for coal is set to increase by 70 per cent to 80 per cent, reflecting growing demand from China and India.

¹⁶ Although East Africa's geographical proximity to customers in China, Japan, Korea, and India will provide some cost advantages.

At the micro-level, around a project site tensions between companies and local communities can affect both the pace of project development and government revenues. In 2013, demonstrations by the local community blocked the entrance to the Bong mine in Sierra Leone, thereby preventing the removal of iron ore from the site until China Union met its social obligations. In November 2013, Tullow Oil was forced to suspend operations due to community unrest, as local Turkana people were frustrated that too many outsiders and contractors were being used.

As Collier (2010) points out, the average square kilometer in Africa has a much lower value of known sub-soil assets than in Europe, despite the latter having been mined for far longer. This suggests that much of Africa's mineral wealth is yet to be discovered. Companies play an active role in the discovery of additional reserves: although projects are often conceptualized as initially having a short production life, the life of a project is often extended as the contractor learns more about the geology and is able to identify further deposits. However, even where additional reserves are discovered, the decision as to whether or not to extract depends heavily on the economic and political environment, given the costliness and riskiness of extracting soil assets.

4.4 Technical and logistical challenges that increase costs

Large-scale oil, gas, and mining projects are subject to a range of logistical and engineering challenges that can lead to delays and escalating costs. Mining projects and on-shore oil and gas projects are often located in remote areas with limited energy, roads, and other infrastructure. This increases production costs, thereby reducing profit and the magnitude of any profit-based taxes due to government.¹⁷

Shortages in the capacity and technical skills needed to address technical and logistical challenges can lead to delays and thereby affect the timing of new natural resource revenues to the government. This is especially the case for larger projects, as there are a limited number of specialist firms that can deliver the necessary turnkey engineering projects.

LNG production, such as that anticipated in Mozambique and Tanzania, is associated with additional uncertainties: the large capital investments required for LNG mean that long-term export contracts usually need to be confirmed before financing can be secured.

Environmental factors also play a role. Some oil, gas, and mining discoveries – such as the oil discoveries in Uganda's Lake Albert Basin – are located in rural and environmentally sensitive areas, which adds to the cost and complexity of the operation. In Liberia, iron ore production is also regularly subject to the risk of unpredictable weather and heavy rain seasons, which can lead to moisture issues with the ore.¹⁸

¹⁷ For example, Uganda's and Kenya's on-shore oil will require a long-distance pipeline to access export markets. Lack of on-shore infrastructure presents a significant risk to LNG sector development in Tanzania. Anadarko's license in Mozambique's Rovuma Area 1 is similarly in a remote area, far from any major city or large port.

¹⁸ In Q4 of 2013, this issue resulted in reduced production at Marampa mine (Mining.com, Jan 24, 2014).

5 Policy implications

This paper has presented the first set of detailed projections relating to the order-of-magnitude estimates of revenues from oil, gas, and mining sector projects across a selection of countries with recent natural resource discoveries. It has highlighted the potential size of new natural resource discoveries in African countries, the likely timing of new natural resource revenues, and the risk factors that determine whether projects will go ahead as planned. By providing a nuanced picture of these considerations, the aim has been to support policy-makers in framing decisions on how best to harness natural resource wealth for development and growth. This section outlines some of the key policy implications.

New natural resource revenues will be meaningful but not transformational

In terms of magnitudes, our study has found that new natural resource revenue in the six sample countries will be meaningful but not transformational, at least over the first ten years of production. This partly reflects the fact that peak revenues take many years to materialize. On a per capita basis, the annual contributions from new natural resource projects (at baseline) identified across our countries – on average during the first ten years of production – range from US\$ 20 to US\$ 29 per year in Tanzania, Sierra Leone, and Liberia, to US\$ 50 to US\$ 52 per year in Mozambique, Ghana, and Uganda.

Expectation management is key, given that revenues will not only fall short of being transformational but will also begin to flow only after a lag. Policy-makers should work with industry to ensure an early and sustained engagement with stakeholders, in particular local communities, to manage expectations and reduce risk of tensions.

The benefits from new resource discoveries take time to materialize

Following new resource discoveries, it typically takes some time for revenues to materialize, and even longer for them to reach their peak. There is often a delay of five to ten years from the discovery of natural resources to first production, and once production starts it can take some seven to 12 years to reach its peak. Furthermore, where the national economy is subject to shocks, such as the Ebola outbreak in West Africa, projects are likely to be delayed, pushing forward the timing of new natural resource revenues.

Volatile international commodity prices also have a bearing on the timing of new natural resource revenues. For example, when prices are higher, revenues will arrive sooner, as initial investment is repaid more quickly. In this context, policy-makers should seek to smooth, over time, the impacts of high and low commodity prices, for example using sovereign wealth funds with clear fiscal rules regarding the apportionment of government revenue from the extractive sectors (this is discussed further in Paper 2). Moreover, policy-makers could benefit from an engagement with the private sector to better understand the drivers of investment and production, in order to assess projects that may be particularly prone to risks of cancellation if prices fall.

The time it takes to design, develop, and commission new extractives projects gives policy-makers time to prepare for the boom, for instance by supporting infrastructure and skills development through public–private partnerships. Starting this work early will help to minimize the risks of

project delays, and also maximize non-fiscal contributions through linkages. This is discussed in more detail in papers 6 and 7.

Risk factors are many and need to be managed

Long-term projections are inherently uncertain, and subject to a range of risk factors that can affect the magnitude as well as the timing of new natural resource revenues. As a project develops, the contractor often learns more about the geology, identifies further deposits, and extends the life of a project. On the other hand, projects may be scaled back or cancelled if there is a sharp fall in commodity prices or a change in the fiscal regime that makes a project unprofitable.

Policy volatility is a key deterrent for investors, and policy-makers should seek to avoid frequent changes in the policy and legal framework. At the same time, oil, gas, and mining policy frameworks must move with the times, and some changes to fiscal and regulatory frameworks are unavoidable. However, unless these changes are pursued through careful consultation with industry, there is a real risk of unintended consequences including reduced investment and a breakdown in trust.

Potential for financing human development gaps

The analysis above shows that, for many countries, new natural resource revenues represent an opportunity to generate significant additional funding for human development. The projections outlined in this paper, together with the analysis in papers 4 and 5 of the Flagship Report Paper Series, indicates that, in all our sample countries, the scope for reducing funding gaps in health, education, and social protection out of extractives revenues is substantial. They are, however, not enough to close the gaps entirely. Papers 4 and 5 set out a series of compelling reasons to invest in social sectors as well as outline the challenges involved in spending natural resource revenues on social sectors.

Bibliography

Publications and reports

- African Development Bank (2014), Data portal: <http://dataportal.afdb.org/>
- Africa Progress Report (2013), Equity in Extractives: Stewarding Africa's natural resources for all. Africa Progress Panel report, available at http://www.africaprogresspanel.org/wp-content/uploads/2013/08/2013_APR_Equity_in_Extractives_25062013_ENG_HR.pdf
- Amoako-Tuffour, J. (2010), An Evaluation of Ghana's Petroleum Fiscal Regime. Ghana Policy Journal, Vol. 4, December 2010. Available at <http://www.ieagh.org/images/pdf/gpj-v4-art1.pdf>
- Anadarko (Aug 25, 2013), Anadarko Announces \$2.64 Billion All-Cash Transaction for Portion of Offshore Mozambique Block. Press release. <http://www.anadarko.com/Investor/Pages/NewsReleases/NewsReleases.aspx?release-id=1849614>
- Anderson, D.M. and A. J. Browne (2011), 'The politics of oil in eastern Africa', Journal of East Africa Studies, 5:2, pp. 369–410, DOI:10.1080/17531055.2011.573187.
- ArcelorMittal (2010), Investor Presentation. Available at http://corporate.arcelormittal.com/~/_media/Files/A/ArcelorMittal/investors/presentations/investor-days/2010/627-48-3-0-InvestorDay2010-Presentation-Pkup.pdf
- CIP (2013), The Rovuma Gas Contracts: The Details and What They Mean. Centro de Integridade Pública Moçambique, Good Governance, Transparency and Integrity - Edition No 03/2013. Available online.
- Collier, P. (2010), The Political Economy of Natural Resources. Social Research: An International Quarterly. Available online.
- CRU (2013), An overview of Chinese mineral demand and supply. CRU Strategies Beijing, workshop presentation.
- Daniel, P. (2012), Extractive Industries – Design and Assessment. Natural Resource Charter Workshop, December 6, 2012.
- Deloitte (2013), The Deloitte Guide to Oil and Gas in East Africa: Where potential lies. 2013 Edition, available at <http://www.deloitte.com/assets/Dcom-Kenya/Local%20Assets/Documents/The%20Deloitte%20Guide%20to%20oil%20and%20gas%20in%20East%20Africa.pdf>
- EIA (2013), Emerging East Africa Energy. US Energy Information Administration, May 23, 2013, available at http://www.eia.gov/countries/analysisbriefs/East_Africa/eeae.pdf
- EIU (2013), Simandou iron ore project likely to miss 2015 start date. Economist Intelligence Unit briefing, 18 June 2013. Available online.
- Gavin, J. (no date), Mining a rich vein. Article in FIRST Magazine.
- Ghana Chamber of Mines (2013), Performance of the Mining Industry In 2012. Available online.
- Henstridge, M. and J. Page (2012), Managing a Modest Boom: Oil Revenues in Uganda. OxCarre Research Paper 90, available at <http://www.theigc.org/sites/default/files/Henstridge%202013.pdf>
- IMF (2012), Fiscal Regimes for Extractive Industries: Design and Implementation. Prepared by the Fiscal Affairs Department, 15 August 2012, available at <http://www.imf.org/external/np/pp/eng/2012/081512.pdf>

- IMF (2013a), Natural Gas, Public Investment and Debt Sustainability in Mozambique. IMF Working Paper prepared by Giovanni Melina and Yi Xiong, African Department and Research Department, November 2013.
- IMF (2013b), Article IV Uganda. Available at <http://www.imf.org/external/pubs/ft/scr/2013/cr13215.pdf> .
- IMF (2013c), Article IV Ghana. Available at <http://www.imf.org/external/pubs/ft/scr/2013/cr13187.pdf>
- IMF World Economic Outlook (2013d), Macroeconomic dataset, available at <http://www.imf.org/external/pubs/ft/weo/2013/01/>
- IMF (2014), Tanzania Selected Issues Paper: Fiscal implications of off-shore gas. Paper prepared by Thomas Baunsgaard, 11 April 2014. Available online.
- KPMG (2013), Oil and gas in Africa: reserves, potential and prospects. Available at <http://www.kpmg.com/Africa/en/IssuesAndInsights/Articles-Publications/Documents/Oil%20and%20Gas%20in%20Africa.pdf>
- International Labour Organization (2011), Economically Active Population, Estimates and Projections (6th edition, October 2011). Available at http://laborsta.ilo.org/applv8/data/EAPEP/eapep_E.html
- Njeru, A. K. (2009), Kenya oil and gas fiscal regime: an economic analysis on attainment of the government objectives. University of Dundee working paper.
- Nyoi, P. M. (2012), Outlook of Oil and Gas Exploration Status in Kenya, East Africa Upstream Summit, Nairobi, 25–26 October.
- Oxford Policy Management (OPM) (2013a), DFID PEAKS Topic Guide: Extractive industries, development and the role of donors, September 2013.
- Oxford Policy Management (OPM) (2013b), Tanzania: An assessment of the macro-level socio-economic impacts of a potential LNG project. Unpublished report for private client.
- PIAC (2012), Report on Petroleum Revenue Management for 2011. Public Interest and Accountability Committee, May 2012. Available at http://piacghana.org/PIAC%20REPORT_2011%20annual_final%20for%20website.pdf
- Rosenfeld, D. (2012), The coal mining sector in Mozambique: a simple mode of predicting government revenue. Paper presented at the Third International IESE Conference “MOÇAMBIQUE: ACUMULAÇÃO E TRANSFORMAÇÃO EM CONTEXTO DE CRISE INTERNACIONAL”.
- Siakor, S., D. Urbaniak, P. de Clerck (2010), Working for development? ArcelorMittal’s mining operations in Liberia. Available at http://www.sdiliberia.org/sites/default/files/publications/2010_Working%20for%20Development.pdf
- Shepherd, B. (2013), Oil in Uganda: International Lessons for Success. Chatham House working paper, February 2013. Available at http://www.chathamhouse.org/sites/default/files/public/Research/Africa/0113pr_ugandaoil.pdf
- Uganda Civil Society Coalition (2010), Contracts Curse: Uganda’s oil agreements place profit before people. February 2010. Available online.
- United Nations (2013), World Population Prospects 2012 Revision: Key Findings and Advance Tables. UN Economic and Social Affairs Department, available at http://esa.un.org/wpp/Documentation/pdf/WPP2012_KEY_FINDINGS.pdf
- UNCTADstat (2012), United Nations Conference on Trade and Development World Statistical Database. Available at <http://unctadstat.unctad.org/>

World Bank (2014a), Global Economic Monitor: Commodities

World Bank (2014b), World Development Indicators, Washington, DC. doi:10.1596/978-1-4648-0163-1. License: Creative Commons Attribution CC BY 3.0 IGO

Corporate and press sources

African Minerals (no date), Tonkolili Project Highlights. <http://www.african-minerals.com/operations/tonkolili-project-highlights>

AISA, no date, <http://www.afristeel.org/> [African Iron and Steel Association]

allAfrica (Dec 20, 2013), AP, Nocal Silent On Oil Discovery in Liberia. <http://allafrica.com/stories/201312201486.html?page=2>

Australian, The (Jan 14, 2014), Rio Tinto warned by Guinea to stick to its Simandou schedule, the Australian, Available at <http://www.theaustralian.com.au/business/mining-energy/rio-tinto-warned-by-guinea-to-stick-to-its-simandou-schedule/story-e6frg9df-1226810861801#>

BBC News (May 7, 2014), Rio Tinto and Chinalco sign \$20bn Guinea iron ore deal. <http://www.bbc.co.uk/news/business-27586508>

BG (2013) http://www.bg-group.com/assets/files/cms/BG_Exploration_LNG_Update_Presentation.pdf

Bloomberg (Feb 14, 2014), Guinea Completes Review of Billionaire Steinmetz's Mine. <http://www.bloomberg.com/news/2014-02-11/guinea-completes-review-of-billionaire-steinmetz-s-mine.html>

Bloomberg (Feb 6, 2014), Total, Tullow, Cnooc Sign Uganda Deal Opening Way for Oil Output. <http://www.bloomberg.com/news/2014-02-06/total-tullow-cnooc-sign-uganda-deal-opening-way-for-oil-output.html?cmpid=yhoo>

Bloomberg (Nov 28, 2013), Eni Sees Mozambique Struggling With 2018 LNG Shipment Deadline. <http://www.bloomberg.com/news/2013-11-28/eni-sees-mozambique-struggling-with-2018-lng-shipment-deadline.html>

Bloomberg (Sep 11, 2013), African Minerals shelves \$2.5bn Tonkolili expansion. <http://www.bloomberg.com/news/2013-09-11/african-minerals-new-ceo-shelves-2-5-billion-expansion.html>

Bloomberg (Dec 12, 2012), Eni-Anadarko African LNG Plant to Be World's Second-Largest. <http://www.bloomberg.com/news/2012-12-21/eni-anadarko-plan-world-s-second-largest-lng-plant-in-africa.html>

Economic Times, The (May 27, 2010), Chinese ban to hit Indian iron ore exports. http://articles.economictimes.indiatimes.com/2010-05-27/news/27608929_1_china-iron-iron-ore-low-grade

FT (Oct 13, 2013), Guinea corruption probe advances but wait for Simandou goes on, Financial times. Available at <http://www.ft.com/cms/s/0/4a85b0ac-d370-11e2-95d4-00144feab7de.html#axzz2vwhhysM>

Independent (Nov 29, 2013), Tullow' Sh 7 trillion investment. <http://www.independent.co.ug/business/business-news/8489-tullows-shs-7-tn-investment>

London Mining (2014), Audited financial results for the full year ended December 31, 2013. <http://www.londonmining.com/media/62951/2014%2003%2006%20-%20FY%20FINANCIAL%20RESULTS%20ANNOUNCEMENT.pdf>

- Mining.com (Jan 24, 2014), London Mining doubles production, trebles sales volumes.
<http://www.mining.com/london-mining-doubles-production-trebles-sales-volumes-32391/>
- Mining Weekly (Feb 4, 2011) <http://www.miningweekly.com/article/10bn-simandou-africas-largest-integrated-project-petmin-enters-into-liberia-exploration-joint-venture-iron-ore-output-to-increase-50-plus-by-2015-vale-2011-02-04>
- Oil and Gas Journal (Jan 17, 2013), Eni group to develop Sankofa East find offshore Ghana.
<http://www.ogj.com/articles/2013/01/eni-group-to-develop-sankofa-east-find-offshore-ghana.html>
- Reuters (Feb 13, 2014), China-Union makes its first shipment of iron ore from Liberia.
<http://www.reuters.com/article/2014/02/13/liberia-iron-idUSL3N0LI5MB20140213>
- Reuters (Feb 25, 2014), B&A pulls out of talks to buy BHP stake in Guinea iron project.
<http://uk.reuters.com/article/2014/02/25/bhp-billiton-mount-nimba-idUKL6N0LU1VI20140225>
- Reuters (Jan 14, 2014), ArcelorMittal will share Liberia iron ore rail with Guinea miners.
<http://uk.reuters.com/article/2014/01/15/uk-liberia-economy-iron-idUKBREA0E1CA20140115>
- Reuters (Nov 22, 2013), Exclusive: Tanzania LNG project set for step forward.
<http://uk.reuters.com/article/2013/11/22/uk-tanzania-gas-idUKBRE9AL0XK20131122>
- Reuters (Jun 25, 2013), Uganda agrees to plan for oil pipeline to new Kenya port.
<http://www.reuters.com/article/2013/06/25/uganda-pipeline-idUSL5N0F138D20130625>
- Reuters (Aug 21, 2013), Tanzania anticipates fivefold increase in gas reserves by 2015.
<http://www.reuters.com/article/2013/08/21/tanzania-naturalgas-idUSL6N0GM2TE20130821>
- Reuters (Dec 20, 2013), Tanzania says to demand \$258 mln tax on Ophir gas deal.
<http://www.reuters.com/article/2013/12/20/tanzania-energy-idUSL6N0JZ25Q20131220>
- RWI (Jan 20, 2012), Guinea: New Review of Mining Contracts Can Bolster Development.
http://www.revenuewatch.org/news/press_releases/new-review-mining-contracts
- RWI (no date) <http://www.revenuewatch.org/countries/36frica/guinea/overview>

Annex A Approach to modeling natural resource projections

This annex presents our approach to modeling projections of new government natural resource revenues, the general and project-specific assumptions used to generate these projections, and our approach to modeling the key macroeconomic indicators used to situate the revenue projections in the country-specific context.

A.1 Our approach

We have developed a set of models that are tailored to each country and project. For example, we use different kinds of models to reflect the relevant fiscal frameworks. For Tanzania, Mozambique, and Uganda, the models are based on a PSA framework (see Box 1), whereas for Ghana, Sierra Leone, and Liberia, we use tax-royalty models. Section 2 also includes a description of the modeling method.

A.2 Data required

The extent of publicly available data on the projects covered by this exercise differs. For some projects, only basic data – including the start date, peak volumes, investment cost, and fiscal framework – are available. For other projects, more detailed data exist, for instance year-by-year production volumes, investment profiles over time, and ownership structures. We have made use of all data available to us. Where data were lacking, we have developed assumptions based on information available in the public domain, as well as on OPM's experience from previous work on the oil, gas, and mining sectors in Africa.¹⁹

General assumptions

Apart from project-specific data, economic modeling also requires inputs on general economic indicators such as commodity prices and inflation rates.

We assume constant commodity prices in real terms. Commodity prices are inherently volatile – as the aftermath of the financial crisis illustrated – and we therefore make no attempt at developing commodity-specific price forecasts. Rather, we assume a price for each commodity which is held constant in all years. This is consistent with how some extractives companies model financial forecasts on their own projects.

Inflation is similarly unpredictable many decades in the future. We assume a zero rate of inflation. This is equivalent to assuming that input costs and sales prices are subjected to the same inflation rate.

Project-specific assumptions

Project characteristics:

- We assume no annual apportionment to an abandonment fund; and

¹⁹ We have been careful not to disclose information that is subject to confidentiality agreements, or which is commercially or market sensitive. Contact the authors for further questions.

- Our projections focus on the main commodities produced and ignore their by-products (e.g. condensates associated with natural gas).

Tax collection:

- We assume no corporate income tax is paid until carry-forward-losses are fully recovered; and
- Throughout our projections, we assume that fiscal terms stay the same and that the taxes due are actually collected.

Role of the national oil company

- National oil company equity interests are carried (i.e. all costs have to be covered by the international oil company). The exception is Ghana, where government shareholders contribute to financing investment, in line with their equity share; and²⁰
- We assume that all revenue collected by the national oil company on behalf of the state is transferred to the state.

A.3 Projections of macroeconomic indicators

We place the revenue projections of new revenues in the context of real GDP and total government revenues. We have therefore made projections of key macroeconomic indicators: our approach is explained below.

We project real GDP based on three measures:

- *Future labor productivity growth* is estimated on the basis of the average labor productivity growth in the last ten years. We calculate it as the year-on-year growth in real GDP per person in the potential labor force (aged 15–59) using data from the World Bank's World Development Indicators and the International Labour Organization database.
- *Future population growth* is taken directly from UN population statistics. We use the number of people (aged 15–59) for each of the countries for the period 2013–2050.
- *Total GDP and GDP per capita in 2012 (2012 prices)* is taken directly from the World Bank's World Development Indicators for each country.

Our projections are calculated by forecasting the real GDP per person from 2012 onwards (aged 15–59) using our measure for future labor productivity growth. Projected real GDP per person (aged 15–59) is multiplied by the UN population projections of people (aged 15–59) to get a figure for the total real GDP (2012 prices).

We project total baseline government revenue in the following way: first, we calculate, for each country, the average of 'total government revenue as a per cent of GDP' for the last five years with the available data (2008 to 2012). We then assume that the total government revenue as a percentage of GDP remains constant, and project total government revenues by applying the five-year average share to our projected GDP figures.

²⁰ In Ghana, "if a discovery is in commercial quantities, the State is entitled to buy additional interest in each contract area, for which it is responsible for full costs during development and production phases. The allowable percentage of this interest varies for each contract" (Amoako-Tuffour 2010).

Annex B Project-specific assumptions

The table below presents key assumptions for each of the projects covered by our projections. For further detail on sources and assumptions, please contact OPM.

Table 3: Key project-specific assumptions for oil and gas projects

	Ghana		Uganda	Mozambique	Tanzania	
Project	Jubilee	TEN	Lake Albert Rift Basin	Rovuma Basin Area 1	Blocks 1, 3 and 4	Block 2
Operator	Tullow	Tullow	Tullow	Anadarko	BG/Shell	Statoil/ExxonMobil
Government share	0.137	0.15	0.15	0.15	0.125	0.125
Production start	2011	2016	2020	2019	2021	2025
Peak production	130 kbbl per day	80 kbbl per day	200 kbbl per day	20 million mt LNG per year	10 million mt LNG per year	10 million mt LNG per year
Price (baseline)	US\$ 80 per barrel	US\$ 80 per barrel	US\$ 80 per barrel	US\$ 11.5 per MMBtu	US\$ 11.5 per MMBtu	US\$ 11.5 per MMBtu
Total investment (US\$ million)	7,000	4,900	8,000	40,000	20,000	20,000
Royalty rate (per cent)	5.0	5.0	Variable (5–12.5)	2.0	5.0	5.0
Income tax rate (per cent)	35.0	35.0	30.0	30.0	30.0	30.0

Source: authors

Note: kbbl – thousand barrels; MMBtu – million British thermal units; mt – metric ton

Table 4: Key project-specific assumptions for iron ore projects

	Sierra Leone		Liberia			
Project	Marampa	Tonkolili	Western Range Project	Bong Mines	Western Cluster	Putu Mines
Operator	LonMin	African Minerals	ArcelorMittal	China Union	Sesa Goa	Severstal
Government share	n/a	n/a	n/a	n/a	n/a	n/a
Production start	2012	2012	2011	2014	2018	2018
Peak production	9 million mt per year	25 million mt per year	15 million mt per year	10 million mt per year	2 million mt per year	7 million mt per year
Price	US\$ 90 per mt	US\$ 90 per mt	US\$ 90 per mt	US\$ 90 per mt	US\$ 90 per mt	US\$ 90 per mt
Total investment (US\$ million)	520	2,184	2,200	2,600	1,000	1,000
Royalty rate (per cent)	3.0	3.0	4.5	3.3	4.5	4.5
Income tax rate (per cent)	25.0	25.0	30.0	25.0	25.0	25.0
Source: authors						
Note: mt – metric tons						