How wealthy is Mozambique after the discovery of coal and gas?

Measuring wealth in Mozambique using the wealth accounting framework[1]

World Bank Mozambique - Policy Note

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1. Wealth in Mozambique

a. Introduction and conceptual framework

Mozambique is rich in subsoil assets – but these do not automatically generate income for the country's population. Efforts will be needed to generate a stream of income from this wealth and invest it in other forms of wealth to sustain income levels. The development of the gas and coal sectors provides Mozambique with an incredible opportunity to leap forward and use its natural resources to accelerate development and improve the well-being of its population to a level it did not seem possible just a few years ago. Coal deposits are estimated above 20 billion tons and coal exports could be around 100 million tons annually at peak, making Mozambique one of the top ten coal exporters in the world. Known gas reserves in the Rovuma basin are estimated at over 130 tcf (trillion cubic feet), with a significant upside risk, providing Mozambique with the 3rd largest gas reserves in Africa and if current LNG investment plans materialize Mozambique will become a global player in LNG exports. This subsoil wealth does not automatically generate income for Mozambique. It has to be extracted, Mozambique will need to capture a fair share of the economic rents, and the rents need to be wisely used – to transform subsoil wealth into other forms of wealth. Given their enclave-type nature, the coal and gas sectors will benefit Mozambique primarily through paying taxes and the use that the Government of Mozambique makes of that additional revenue. As in other countries experiencing a natural resources boom, there is a wide set of reforms that need to be implemented to maximize benefits and ensure they are widespread. The experience of many countries in exploiting natural resources is one of unmet expectations and a significant concentration in the distribution of the benefits, often accompanied by worsening governance and stability.

The wealth accounts framework can tell us something about the sustainability of growth patterns – particularly important for resource rich countries such as Mozambique is about to become. Wealth accounting differs from conventional national accounting in its primary focus; whereas Gross Domestic Product (GDP) measures the flow of income accruing to a country within a year, *total wealth* measures the stock of assets a country uses to generate its income[2]. In that sense, knowledge about wealth allows us to say something about both current and future income. Income that is derived from depletion of current wealth affects future wealth, depending on the use that countries make of that income (consuming vs. investing it). Wealth accounting has become increasingly popular in recent years since the method allows researchers to account for the improvement or degradation of forms of capital that are often ignored by economists and policy-makers, but nevertheless enormously important for the long-run development of a country.

[2] Another relevant measure of income flows is the Gross National Income (GNI). GNI is the sum of value added by all resident producers plus net receipts of primary income from abroad. It is often very similar to GDP, but in Mozambique's case for example large transfers from abroad (in the form of grants) mean that there may be significant differences between GDP and GNI.

Box 1: ***How are wealth estimates built? A brief note on methodology***

The idea of wealth can be conceptualized in much the same way as that of GDP. However, some components of wealth are not observable in the same way and must be deducted. Total wealth is seen as the present value of future consumption, and the sum of the wealth components must equal this. A basic decomposition of wealth may look this way:

$$Total\ Wealth = K + V + NFA + IC$$

where K is *produced* capital, including machinery, equipment, structures and urban land. V measures natural capital (energy resources, minerals, timber, forest, crop land, pasture land and protected areas), NFA stands for *net foreign assets* and IC *intangible capital.* The latter can be estimated as a combination of human capital and rule of law, but in practice is calculated as the residual of the above equation when total wealth is estimated as the present value of future consumption, $\int_t^{\infty} C(t) * e^{-\rho(s-t)ds}$.

It is important to note that future consumption is not easy to measure. Therefore, in practice the estimate for present value of future consumption is calculated in a way to mimic a situation where the economy is on a sustainable path (i.e. where savings offset capital depletion). In order to do this, researchers use 5-year averages centered on the year of interest in order to smooth out any irregularities in consumption and afterwards adjust the savings/ consumption breakdown to reflect a sustainable consumption path.

For a more detailed discussion on the methodology used to estimate wealth, please see Annex A in the World Bank publication 'The Changing Wealth of Nations' (2011).

Wealth is divided into three types of wealth: produced capital, natural capital and intangible capital (which includes human capital). Wealth accounts attempt to measure the wealth of a country by decomposing its total wealth into *produced capital*, *natural capital* and *intangible capital.* The former encompasses what is normally seen as capital in national accounting (machinery, structures, equipment) but also urban land. Natural capital includes agricultural land, protected areas, forests, minerals and energy whereas intangible capital is supposed to measure human, social and institutional capital. Produced capital and natural capital can be observed, but intangible capital is in practice derived as the residual of the equation described in box 1. The exercise of updating Mozambique's wealth accounts up to 2011 focuses on developments in the subsoil assets category. Although this focus is limiting and it does not capture important developments in other sectors, the focus is justified because some of the major changes in wealth in the past few years are related to the discovery and commercial exploitation of subsoil assets and there are important policy questions related to the management of these resources. Future exercises should look at wealth in a more comprehensive manner (including other types of natural resources or with a focus on human capital) to address other types of policy questions.

The objective of this policy note is to inform policy discussions around the management of natural resources and reforms needed to translate natural capital into other forms of capital, and it does so by using the wealth accounting framework. Wealth (e.g. in the form of natural resources) may or may not translate into sustained flows of income in the long run. The extent to which natural capital translates into other forms of

capital from which to derive a sustainable income stream is what lies at the heart of natural resources management and what differentiates successful natural resource rich countries from less successful ones. The outcome of the process depends on institutional capacity and political decisions along the way. Experience shows that the quality of governance and institutional capability are key for countries to be able to translate natural capital into other forms of capital in an effective way. According to a variety of governance indicators, Mozambique's institutions are relatively weak – raising concerns about the country's ability to manage natural resources well. But Mozambique can also build on significant progress in some areas. Democratic elections, free press and a vocal civil society suggest of a gradual strengthening of institutions. Although the main audience of this policy note is Mozambican policy makers – the discussion around management of natural resources needs to be much broader, and as such civil society, private sector and the international community may also find the note useful.

The management of natural resources revenue will need to deal with the decision of how much spend today vs. save for precautionary purposes and the future as well as reforms to improve public spending and asset management. Translating natural capital wealth into other forms of wealth will need to be led by the public sector. Given the characteristics of natural resources, the state will play a major role in recovering and using a share of the economic rents from natural resources. A strategy for transforming natural capital into other forms of capital should therefore focus on, but not be limited to, the public sector. Countries seeking to translate their natural resources into other forms of capital have to get policies in three key areas right: (i) policies to ensure efficient resource extraction to maximize resource rents, codified in a clear legal, regulatory and contractual framework (ii) a stable and fair fiscal regime that balances the interests of companies and governments while enabling government to recover a fair share of the rents, taking into account the country's administrative capacity and fostering transparency and (iii) a clear policy for effective investment of resource rents in productive assets, with a framework that helps decide how much to save and spend from the resource revenues, as well as reforms for more efficient public spending and management of financial assets.

a. The relation between GDP and wealth

GDP is the annual rent that a country derives from its wealth – and the sustainability of that rent depends on the extent to which the country consumes or invests those rents. Consideration of the relation between GDP and wealth can help to see why it is important not only to concentrate on flows of the economy but also the assets. Since GDP can be seen as the annual rent of a country's total wealth, higher wealth would, ceteris paribus, lead to higher GDP, just like a farmer can decide to consume income or invest it in mechanizing the farm, better seeds, livestock. If the farmer choses the latter, by consuming less and using the savings to invest in the mechanization of the farm, she is likely to have higher income in the future.

There is a positive relationship between wealth and GDP growth – as wealth grows, so does the income derived from that wealth. One should therefore also expect a second order relationship between the two; namely that growth in GDP and growth in wealth are positively related. On a sustainable growth path, more wealth is generated every year as the stocks of physical and intangible capital increase. In turn, growth in GDP

can be maintained. The most recent cross-national data on wealth accounts[3] indicate that this is the case for most countries, and the relationship seems to hold for both resource rich countries (proxied by a share of natural capital in total wealth of 30 percent and higher) and those that are not rich in natural resources (Figure 1 and Figure 2). High GDP growth does not guarantee widespread welfare improvements though. Investments in key public services (health, education), infrastructure and institutions that allow people to participate and share in the benefits generated by rapid growth all contribute to ensuring that growth translates into welfare improvements across the population.

Figure 1: Relationship between wealth and GDP growth for non-resource rich countries

Source: World Bank staff estimates

Figure 2: Relationship between wealth and GDP growth for resource rich countries

Source: World Bank staff estimates

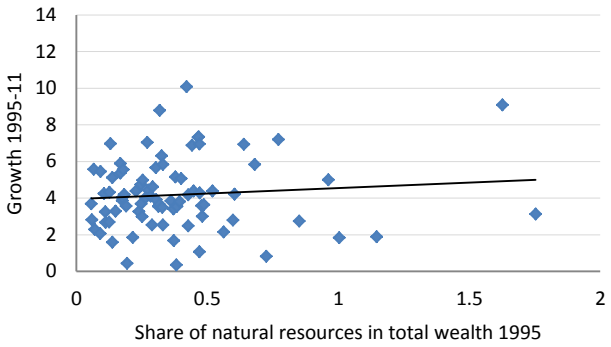
But the relationship between wealth and growth is not always positive – and for resource rich countries it often shows that the country is growing by depleting its wealth – not growing it. There is a significant number of countries rich in natural resources that have seen high and positive GDP growth while posting negative or no growth in wealth over the period. In resource economies, high growth in GDP cannot always be associated with a growing asset-base, but often only reflects the depletion of natural capital. Indeed, some of the countries with high GDP growth rates have in fact become poorer in terms of total wealth over time. The growth rates of these countries do not seem sustainable in the long run, suggesting that resource rich countries should pay particular attention to the sources of their growth and whether they are in a sustainable growth path, as resources are finite. The reserve horizon for Mozambique's gas reserves is not clear yet, particularly as the discoveries are still relatively new and exploration is ongoing, but reserves in existing fields could be exploited over a 40-50 year horizon.

The quality of governance seems to be a key determinant in the relationship between natural resources wealth and growth. The positive relationship between wealth and growth for resource rich countries would seem to contradict the 'resource curse', that claims that there is a negative relationship between natural resources wealth and growth. Figure 3 and Figure 4 depict the relationship between the share of natural resources and growth for countries with strong and weak governance (according to the World Bank

[3] These are unpublished wealth accounts up to 2008, prepared as part of an internal World Bank exercise, and used in this note. The last comprehensive wealth accounts published by the World Bank covered the years 1995-2005.

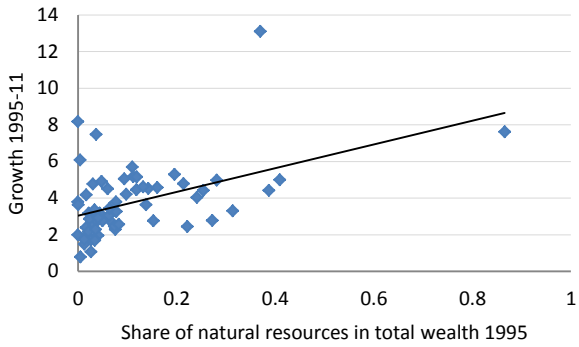
governance indicators). The relationship is positive, but as suggested by the literature, the quality of governance is a key determinant in the relationship between natural resources and growth and the ability of countries to benefit from natural resources, with a much stronger positive relationship between natural resources and growth for countries with good governance.

Figure 3: Relationship between natural resources and growth for weak governance countries



Source: World Bank staff estimates

Figure 4: Relationship between natural resources and growth for strong governance countries

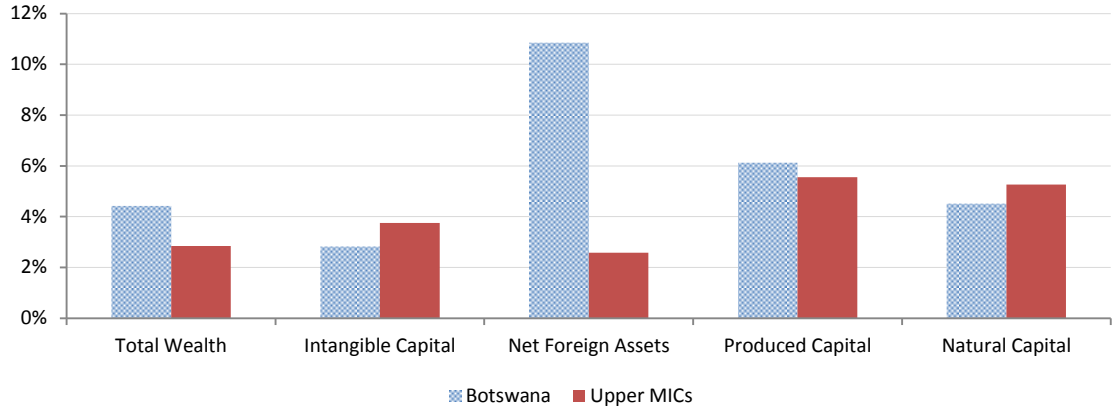


Source: World Bank staff estimates

2. The role of natural resources in wealth creation – investing in human and physical capital

Resource-rich countries can develop by investing their natural resources into other forms of capital (productive, human capital). In the context of developing countries, out of the three forms of capital described above, natural capital is particularly important for two reasons; firstly, because usually in poor countries, a larger part of the economy is based on agriculture and extractive industries and secondly because natural resources can be used as a catalyst for a rapid transition into a higher level of development. This has been the case in a number of countries such as Botswana, which has increased wealth above the average of upper middle income countries by investing in other forms of capital (physical, human, foreign assets), resulting in significant improvements across a whole set of development outcomes (Figure 5)

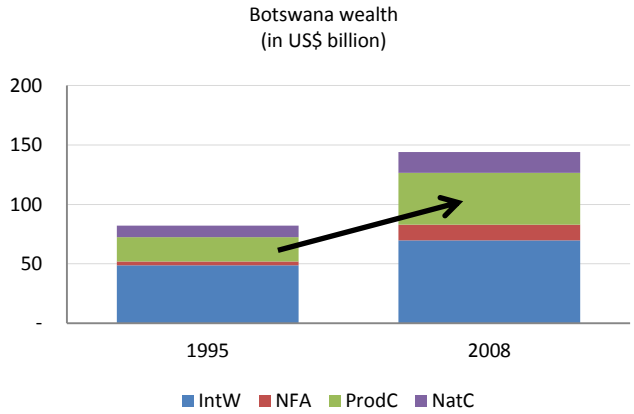
Figure 5: Total wealth in Botswana increased by 4 percent from 1995 to 2008, faster than average for upper middle income countries, driven by net foreign assets as well as productive capital



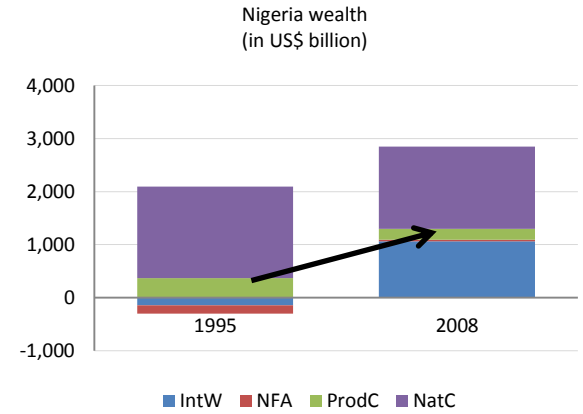
Source: World Bank Staff estimates

Sustainability of development is partly determined by the level of investments that countries chose – the Hartwick rule argues that consumption can only be maintained if rents from non-renewable resources are invested. One possible explanation as to why countries perform differently in terms of turning natural capital into sustainable development point towards investment levels. According to the *Hartwick rule* (Hartwick 1977; Solow 1986), consumption can be maintained if the rents from nonrenewable resources are continuously invested rather than used for consumption. Some countries have failed to translate their natural capital into other forms of capital, because investments in human and productive capital have been limited while natural resources have been exploited or because investments made did not generate significant returns. Botswana's wealth almost doubled from 1995 to 2008 on account of significant growth in all types of wealth (productive, foreign assets as well as human capital) while wealth growth has been significantly lower in Nigeria – with productive capital falling over the same period (Figure 6).

Figure 6: Botswana's wealth has almost doubled from 1995 to 2008, while Nigeria's wealth has grown less and continues to depend heavily on its natural capital. This is best reflected in the growth in produced capital.



Source: World Bank Staff estimates



Source: World Bank Staff estimates

Countries following the Hartwick rule and investing rents from natural resources in other forms of capital have seen a significant growth in their wealth over time. Botswana has been following the Hartwick Rule for sustainability and from the mid-1990s this was institutionalized by a formal rule, the Sustainable Budget Index (SBI). SBI is the ratio of spending on non-investment divided by recurrent revenue, and it should be 1 or less to ensure sustainability of public consumption. Analysis of wealth and per capita value of capital stock shows significant increases over the past 30 years, signaling that Botswana is investing a large share of the rents from resources. Wealth has also been increasing in all of the countries in Table 1 below, although different growth rates also partly reflect use of resources, with Nigeria's per capita wealth growing by around 16 percent in the thirteen years between 1995 and 2008, and per capita wealth growing by over 40 percent in both Botswana and Chile over the same period.

Table 1: Per Capita Wealth trends – 1995 - 2008

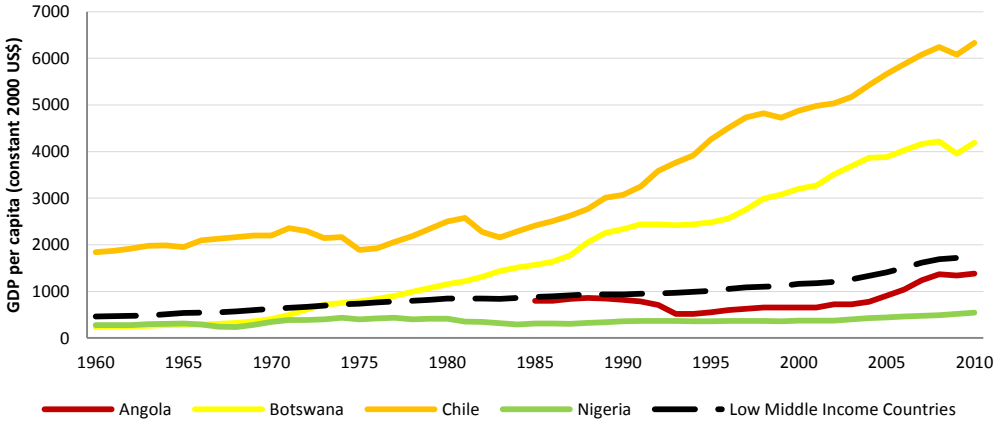
	1995	2000	2005	2008	Growth 95-08
Angola	8,951	18,011	21,531	23,484	162%
Botswana	52,929	56,574	68,557	74,939	42%
Chile	89,998	117,961	127,409	130,921	45%
Nigeria	16,281	15,083	15,870	18,850	16%

Source: World Bank Staff Estimates

Those countries that invest a large share of their natural resources wealth tend to grow faster over longer periods of time, while countries with low investment ratios show limited growth over the long term. In Angola, for example, capital expenditure accounts for less than 10 percent of GDP, significantly lower than most other countries in South-Saharan Africa. This results in relatively low capital formation, estimated at only 13 percent in the past decade. This compares with GCF of 28 in Botswana for the same period[4]. Nigeria seems to be a case of low *quality* of investments; i.e. investments with low rates of return. These differences in approach and results are well illustrated in Figure 7. While in 1960 Botswana and Nigeria had a very similar per capita income, over the past 50 years GDP per capita has grown by 6 percent per year in Botswana, while it has only grown by 1 percent in Nigeria.

[4] GFC for OECD-countries average 21 percent of GDP, Low and middle income countries 26 percent and sub-Saharan Africa 19 percent for the period 1985-2011

Figure 7: Development of per capita income in selected countries.



Source: World Development Indicators

For sustainability of growth and wealth creation – it matters not only how much a country invests but also how well it invests. Some countries may be following the Hartwick rule, but investments are of poor quality, not able to generate the returns that would allow for sustainable consumption levels. Sala-i-Martin and Subramanian (2003) investigates the role of public investment in the case of Nigeria. While Nigeria has some of the largest oil deposits in the world, which have generated huge government revenues since the 1970's, the country continues to experience relatively high poverty[5]. While Nigeria significantly increased public investment during oil booms, with almost the entire windfall gains from oil re-invested in physical capital, this has not led the country onto a path of sustainable development. The returns to investment seem to have been low as a result of relatively poor investments. Average capacity utilization in manufacturing plummeted from around 80 percent in the 1970's to a level of around 30-40 percent since the mid-80s. In the same period, total factor productivity (TFP) had a negative growth rate of about 1.2 percent p.a. which suggests over investment in capital. There is also anecdotal evidence to illustrate the argument that investments may not have generated the expected returns. In the late 70s the Government of Nigeria started to build the Ajakouta steel complex. After the government reportedly spending over US$5 billion in the past 40 years, the complex has not produced any commercial steel to date. The quality of public investment to a large extent determines the impact of investment on growth (as suggested by recent literature such as Arslanalp et al. 2010; Gupta et al. 2011) and Mozambique scores relatively poorly in its public investment management system, highlighting the need to improve its ability to manage a potentially increasing resource envelop for investment.

Many countries struggle with ensuring that a large share of revenues from natural resources is invested – and that it is done in an effective manner. Even in a success story such as Botswana, recent analysis shows some limitations in the adoption of a policy framework favoring investment (such as the adoption of certain fiscal rules). Lange et al, 2004, and Kojo, 2010, discuss Botswana's application of the SBI and argue that much of what is considered public investment to estimate the SBI is actually recurrent spending, such as subsidies or recurrent spending on health and education. A revised SBI from 1976 to 2001 with a more stringent definition

[5] Nigeria's poverty headcount rate was around 65 percent in 2000 compared to 35 percent in 1970.

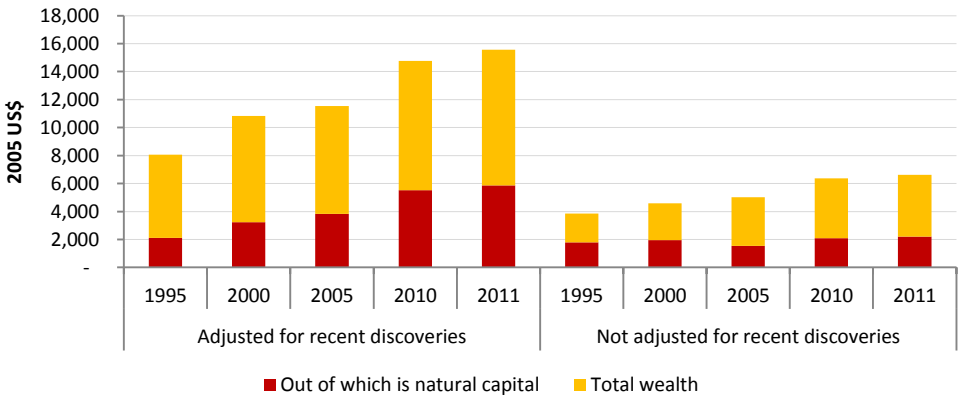
of investment would show that public spending has not been sustainable (recurrent spending higher than non-resource revenue).

3. Wealth Accounts in Mozambique

a. Trends 1995-2011

The sustainable development of the gas and coal sectors in Mozambique has the potential of significantly increasing wealth. The recent discoveries of coal and gas have significantly increased Mozambique's wealth, since they seem to be commercially viable. The determination of the country's wealth depends on if and how recent large discoveries of coal and natural gas are entered into the equation. The chart below shows total wealth in 1995, 2000, 2005, 2010 and 2011 in two scenarios; to the left a situation where the current knowledge about stocks of natural resources to be extracted in the future is taken into account and increases wealth (a departure of the usual methodology described below), and to the right a situation in which natural capital is estimated as usual, which assumes zero growth in rents, and therefore wealth estimates are based on current and not future potential rents from natural resources (Figure 8). In the first scenario, the future consumption stream was also adjusted to take into account projected rents from natural resources, resulting in an overall increase in wealth. See annex II and World Bank (2011) for further details on methodology.

Figure 8: Development of per capita wealth in Mozambique, estimating the impact of future rents on wealth

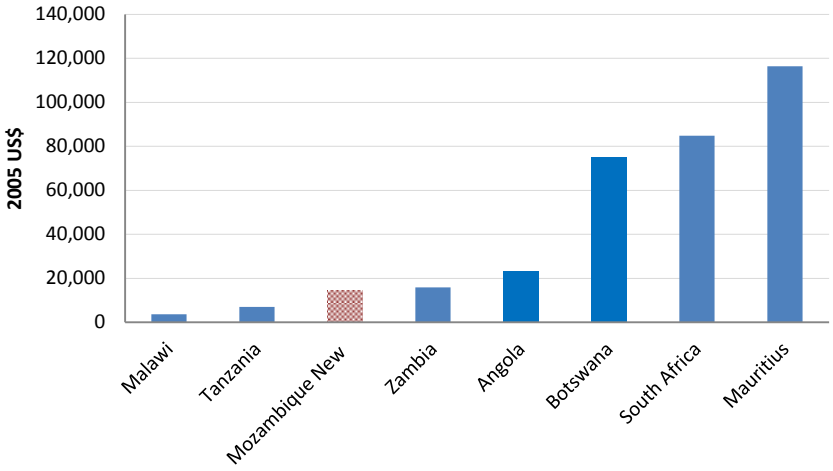


Source: World Bank Staff Estimates

Per capita wealth in Mozambique would be less than half in a scenario with no or limited development of the gas and coal sectors. In the first scenario, wealth in 2011 totals around US$15,500 per capita and includes potential future rents of gas and coal under relatively conservative scenarios – but assuming that investments and developments go ahead as planned. The development depicted to the right shows the much lower per capita wealth of Mozambique if the natural capital discovered in recent years is not taken into account. This scenario would represent a situation in which recent gas discoveries in the Rovuma basin are not exploited and the coal sector stagnates at current low levels. Total wealth in 2011 would lie around US$6,600 per capita, around 40% of the estimate of wealth if coal and gas sectors are developed.

Despite this newly discovered wealth Mozambique will continue to be one of the poorest countries in the region. The alternative methodology used more than doubles per capita wealth. But wealth remains relatively low, as Figure 9 illustrates. Despite this new wealth in natural resources, Mozambique's wealth is still significantly lower than many other countries in the region, such as Botswana, Mauritius and South Africa, highlighting the need to continue investing in other forms of wealth (physical and human capital) that can lead to higher and sustainable income levels.

Figure 9: Comparison of per capita wealth of Mozambique with some peers in 2008



Source: World Bank Staff Estimates

Over time, the share of productive over natural capital in Mozambique has been declining – a result of strong growth of natural capital over the last fifteen years. A sustainable development process for a low income country rich in natural resources often involves transforming natural capital into produced and human capital. While the overall wealth of Mozambique has grown and is likely to continue growing as the country continues to benefit from rents from natural resources, it is important to look at the shares of the different components of wealth. Table 2 presents wealth divided into the components of natural, produced and intangible capital for the years 1995, 2000, 2005 and 2010. For Mozambique it is particularly interesting to observe the ratio of produced to natural capital, which has been declining since 1995. This has been primarily the result of large increases in natural capital – partly the result of the start of mining and petroleum operations – although produced capital has also been growing at rapid rates.

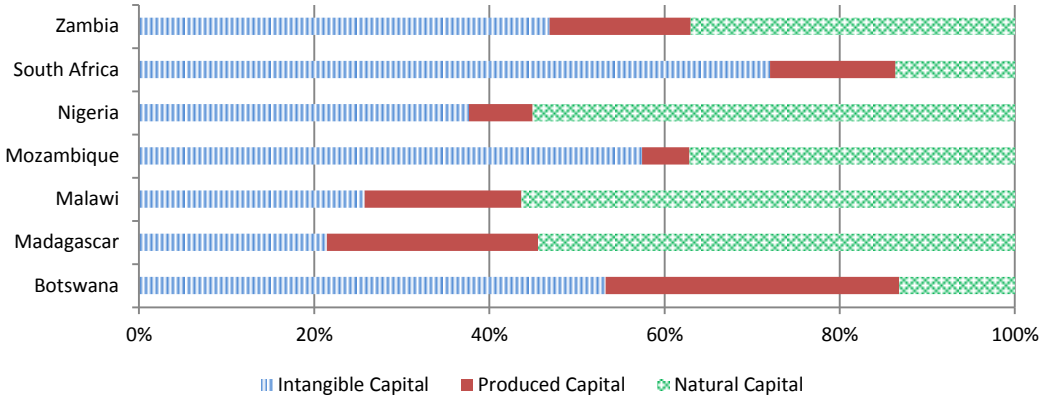
Table 2: Development of the shares of different types of Capital in Mozambique

	Natural (subsoil)	Produced	Intangible	Net foreing assets	Produced/Natural
1995	26% (0%)	5%	74%	-5%	0.19
2000	30% (0%)	6%	68%	-3%	0.18
2005	33% (2%)	6%	64%	-3%	0.17
2010	37% (7%)	5%	59%	-1%	0.14

Source: World Bank Staff Estimates

The share of produced capital in total wealth in Mozambique is one of the lowest in the region. The trends above can also be put in perspective by comparing Mozambique with some countries in Africa. Compared with these countries, some of them also rich in natural resources, produced capital accounts for a relatively small share of Mozambique's wealth (Figure 10). The ratio of produced capital to natural capital is the lowest in the group of comparison countries chosen. This may be a reflection of strong growth of natural capital recently, not so much a lack of investing in physical or human capital, but it reinforces the need to invest the newly found natural resources into other forms of capital to move in the direction of Botswana or South Africa, both rich in natural resources but with significant shares of both intangible and physical capital.

Figure 10: Composition of wealth in a number of Sub-Saharan African countries, 2008



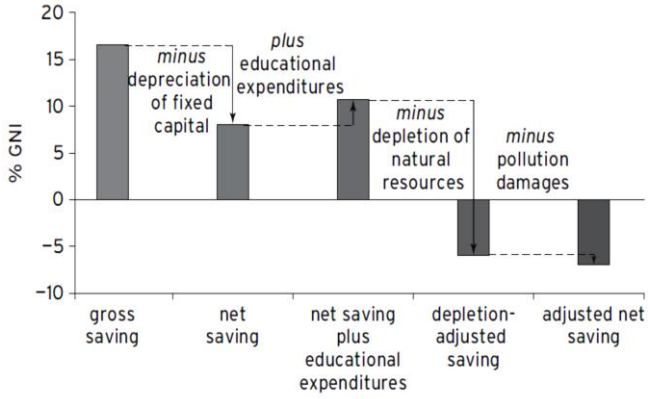
Note: Mozambique data are for 2011
Source: World Bank Staff Estimates

b. The concept of Adjusted Net Savings

To measure to what extent countries are saving and investing in a sustainable manner, the wealth accounting framework uses the concept of adjusted net savings, which takes into account investments in different forms of capital as well as their depreciation. Savings and investments play a critical role in determining the changes in wealth over time. In national accounting, the focus is on investments in physical capital whether gross or net. In wealth accounting, the analogous term is *adjusted net savings* (ANS). Apart from the depreciation of (produced) physical capital, the calculation of the ANS also considers the effect of educational expenditure, depletion of natural resources and damages to the environment done by pollution. Educational expenditures are seen as investments in intangible capital whereas depletion of natural resources is a *negative* investment in the natural capital of a country. Adjusted net saving approximates the changes in wealth over shorter periods. While the measure fails to take into account parts of the intangible capital (e.g. public health) and natural capital (e.g. agricultural land) it will work as a reasonably good proxy especially in developing countries with high resource dependence. And to quote the World Bank (2011), "A policy maker noting an ANS of – 10 % can be certain that the country is not on a sustainable development path". Below is an excerpt from the World Bank (2011) showing the calculation route from gross savings to adjusted net saving (Figure 11) and the relationship between adjusted net savings and rents from energy and minerals as a

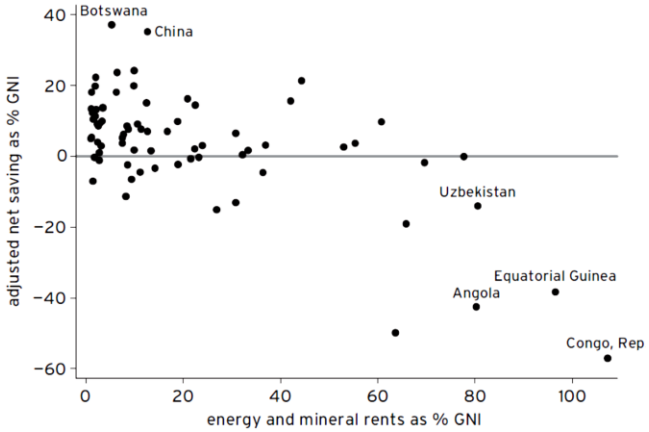
percentage of GNI (Figure 12), illustrating that many resource-rich countries do not seem to be on a sustainable development path.

Figure 11: Adjusted Net Savings are negative for SSA, primarily driven by Nigeria and a few other countries



Source: World Bank, 2011

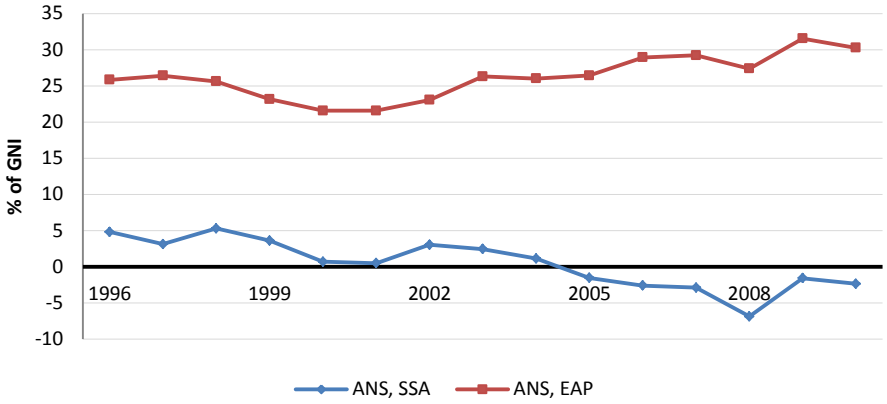
Figure 12: Relationship between ANS and the share of energy rents in GNI



Source: World Bank, 2011

Adjusted net savings illustrates the sustainability of growth – negative ANS point at non-sustainable growth patterns, a characteristic of growth in many countries in Sub-Saharan Africa rich in natural resources. There is a clear tendency for countries with a higher dependency on non-renewable resources to record lower adjusted net savings meaning; the growth these countries experience is less sustainable. While gross savings may be positive and growing, adjusted net savings become negative. The recent boom in natural resources has resulted in relatively fast growth in countries with abundant natural resources, but this growth does not seem to be sustainable and is built on rapid depletion of natural resources. When comparing adjusted net savings in Sub-Saharan Africa with East Asia the diverging trends are illustrative of the drivers of growth in these two regions. While Sub-Saharan Africa seems to be growing by depleting natural resources, with ANS declining and turning negative in the middle of the past decade, ANS has been growing in East Asia over the past 10 years (Figure 13).

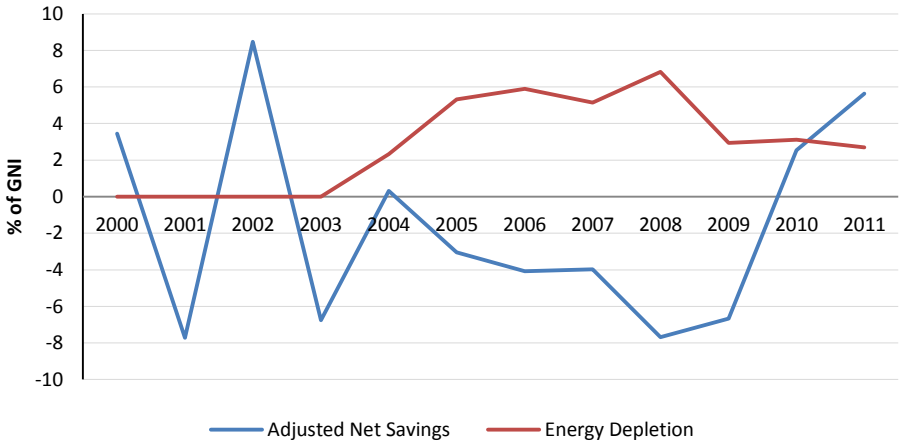
Figure 13: ANS in SSA has been negative in the past decade, illustrating the unsustainable nature of growth



Source: World Development Indicators

Adjusted net savings in Mozambique were negative for most of the last decade, a result of increasing energy depletion. Looking at the ANS for the past decade shows a declining trend from 2004 (the start of gas exports by Sasol) to about 2008, mirrored by a significant increase in energy depletion. That the ANS decreases and becomes negative when natural resources are depleted suggests that the gains stemming from these resources have not been adequately re-invested. Since 2008 there seems to have been a reversal. While from 2004 to 2008 energy depletion seemed to be driving ANS, since 2008 positive ANS seem to be the result of higher gross savings, resulting in a positive (but relatively low) ANS by 2010 (Figure 14).

Figure 14: Energy depletion and adjusted net savings in Mozambique, 2000-2011.

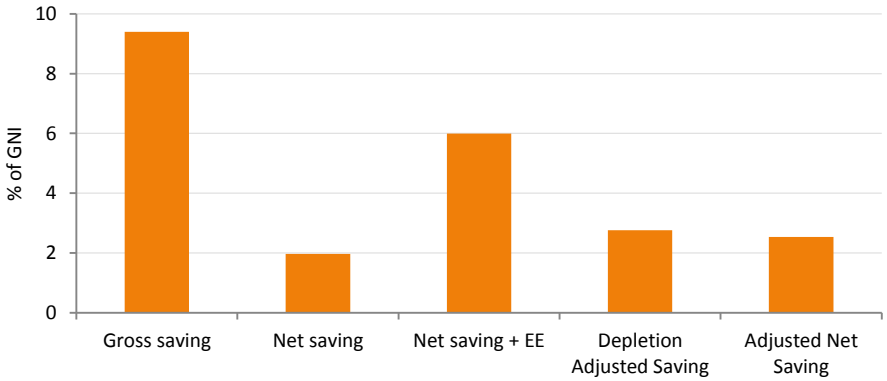


Source: World Development Indicators

For the past few years ANS in Mozambique have been low, but positive… Another aspect that affects the sustainability of savings and investments in an economy is demographics. Adjusted net savings can be positive

as a percentage of GNI, but negative when taking into account population growth. Analogous to Figure 11, Figure 15 below shows how a positive gross investment rate turns into a relatively low adjusted net saving in the latest figures for Mozambique.

Figure 15: Adjusted Net Savings and its components, Mozambique, 2010.



Source: WDI and World Bank Staff Estimates

… while population adjusted ANS as a share of GNI suggests a non-sustainable growth pattern. Population adjusted ANS takes into account population growth. Mozambique has a population growth rate of around 2 percent p.a. This figure is multiplied with the per capita tangible wealth (produced + natural capital) to obtain the so-called *Malthusian term*, which in turn is subtracted from per capita adjusted net savings. The change in per capita wealth is reported in the second row from the bottom in US$ per capita (Table 3). The bottom row shows the population adjusted ANS, i.e. how much more needs to be invested as percent of GNI in order to maintain wealth per capita. The table shows clearly that Mozambique is not on a sustainable development path. Adjusted Net Savings amount to 2.5 percent of GNI while taking population growth into account yields a negative savings rate of 39 %. In fact, according to World Bank (2011) many developing countries reported negative change in per capita wealth with many African countries at the bottom of the chart due to high population growth rates.

Table 3: Change in per capita wealth, population adjusted ANS, Mozambique, 2010 (2005-US$ per capita)
(Adjusted for recent discoveries)

Tangible wealth	6,310
Produced Capital	796
Natural Capital	5,514
ANS	8.92
Population growth	2.3%
Change in per capita wealth (US$)	-136
Population-adjusted ANS (% of GNI)	-39%

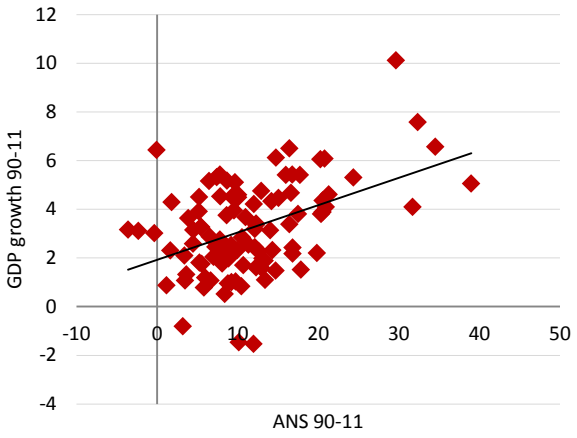
Source: WDI and World Bank Staff Estimates

4. Translating fuel and mineral resources into other forms of capital

a. Management of wealth composition and the role of institutions

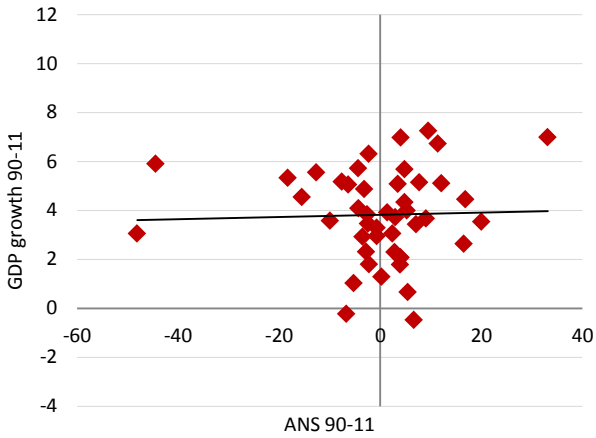
There is a positive relationship between adjusted net savings and growth, which tends to disappear when focusing on natural resource rich countries. Translating natural capital into other forms of capital requires the right investment policy; firstly the application of a rule that ensures that *enough* of the natural capital is re-invested and secondly that investments are of good quality. Looking at the relationship between GDP growth and adjusted net savings in the period 1990-2011 there seems to be a positive relationship; more investment in both produced and human capital in general means higher GDP growth rates. The relationship between ANS and GDP growth seems to be somewhat different when looking at resource-rich countries only (defined as countries in which natural resources account for more than 30 % of total wealth) and two points seem to appear; resource rich economies on average have a much lower adjusted net saving, often negative, and the positive correlation between ANS and growth disappears (Figure 16 and Figure 17). Understanding the factors that influence these observations is key to avoid the resource curse and to ensure that rents from natural capital help developing countries transit out of poverty.

Figure 16: Relationship between growth and ANS for countries without natural resources



Source: WDI and World Bank staff estimates

Figure 17: Relationship between growth and ANS for natural resource rich countries



Source: WDI and World Bank staff estimates

For cash-strapped countries there will be significant pressure to consume a large share of the revenue generated by natural resources. Ensuring positive adjusted net savings and translating it into sustainable economic growth is further complicated by the observation that most of the economies that are highly resource dependent are in their early stages of development. Revenues from natural resources may alleviate fiscal space constraints that have affected countries in the past and it can be tempting to use the new fiscal space on an enlarged or better remunerated public sector or social programs. Often revenue from natural resources is first spent as part of the national budget, and it is only when the most pressing needs are met by public spending that governments consider saving some of the rents from natural resources. In Mongolia, for

instance, public expenditure rose dramatically during the last decade due to increased revenue from mining. After realizing the risks of such a policy framework during the global financial crisis, the country is reconsidering its fiscal framework to increase savings and insulate the use of savings from political interference.

Most countries with nascent extractive industries need to strengthen existing policy frameworks and often implement reforms on the institutions and structures in place to manage natural resources. Political institutions play a pivotal role in the management of natural resources and determination of asset compositions (Atkinson and Hamilton 2003; Collier et al., 2010; Humphreys and Sandbu, 2007). Part of better managing natural resources will entail strengthening existing PFM systems and key agencies (e.g. tax administration). Most countries also introduce new laws and revise the policy frameworks to decide how much of the revenue from natural resources is going to be spent and saved. These laws often seek to maximize the share of the resource revenue attributed to the government and add some constraints to the discretion of the executive on the use of the natural resources revenues. It is likewise common to establish a natural resource fund serving the dual purpose of reducing the volatility of revenues due to large variations in commodity prices and limiting public investments to the absorptive capacity of the economy.

Yet, the success and effectiveness of such institutions and structures depend largely on the general institutional environment in which they are established. First, it matters if a government plans in advance and introduces the necessary legislation and instruments before the mining or drilling starts. Secondly, implementation of new policies and legislation being adopted is likely to differ based on the strength of governance – and will be affected by issues such as bureaucratic quality or corruption; in fact, without the right institutional set-up from the start governance is likely to suffer, since there is often less accountability attached to resource rents than to, say, tax-money or grants from donors. In this regard, the term 'rentier state' has been coined. This refers to governments that obtain revenue from natural resource, and therefore do not tax citizens and hence become less accountable to them (Moore, 2004). According to Barma et al, 2012, "Natural resource booms turn countries into rentier states that live off unearned income; the state is resourced through rents rather than taxes and requires correspondingly little organizational effort from the state apparatus", thus leading to weaker administrative and institutional capacity. Institutions are endogenous in the sense that they are partly the result of economic growth and income levels, affecting directly how countries use natural resources wealth, but natural resources wealth can also affect the quality of institutions, creating therefore a dynamic (negative) relationship between resource dependence and institutional quality, as illustrated in De Rosa and Iootty (2012).

b. Key challenges for Mozambique

According to a variety of governance indicators, Mozambique's institutions are relatively weak – raising concerns about the country's ability to manage natural resources well. In the Mozambican context, it is difficult to predict how the present institutions will cope with the presumably large future influx of revenue from coal and gas, although a look at some governance indicators suggests that weak governance, broadly understood, is likely to become a constraint in the management of natural resources. According to the World

Bank's Worldwide Governance Indicators[6], which include *government effectiveness, regulatory quality, rule of law, control of corruption, political stability and voice and accountability,* Mozambique belongs to the second quarter from the bottom for all indicators except political stability in which Mozambique belongs in the third quarter. Mozambique's scores are always slightly above the regional average except in political stability and voice and accountability, in which it scores significantly better than its peers in the region (Table 4). On the international comparison index Polity4 that measures constraints on the executive as a proxy for democracy, Mozambique has a similar position globally scoring 5 on a scale that goes from -10 (autocracy) to 10 (democracy). Other countries around the same position include Haiti, Pakistan, Malawi and Nigeria. These indicators draw a general picture of concern about the capabilities of Mozambique to handle large resource rents. However, a weak starting point does not pre-determine the final outcome: capacity and institutions can be built. Democratic elections, free press and a vocal civil society speak in favor of a gradual strengthening of institutions of which there is already some signs; in 2012 Mozambique was declared compliant with the Extractive Industry Transparency Initiative (EITI), a strong signal of increased transparency in managing revenues from natural resources. That it is not impossible to strengthen the institutional capacity prior to resource booms has already been shown in countries that had similarly low capacity levels such as Botswana two decades ago or Sao Tome and Principe or East Timor more recently. A whole set of countries is currently embarked on implementing reforms to better manage natural resources which greatly broadens the possibilities for peer to peer learning.

Table 4: Worldwide Governance Indicators 2011

	Mozambique Ranking	Mozambique Score	Sub-Saharan Africa Average Score
Control of Corruption	122	-0.41	-0.60
Government Effectiveness	136	-0.55	-0.78
Political Stability	89	0.27	-0.51
Regulatory Quality	133	-0.40	-0.70
Rule of Law	139	-0.56	-0.72
Voice and Accountability	117	-0.15	-0.62

Source: Worldwide Development Indicators

There are three main areas in which Mozambique will need to get policies right: (i) efficient resource extraction to maximize resource rents, (ii) a fiscal regime that balances the interests of companies and the Government, and (iii) effective investment of resource rents in productive assets. This policy note has focused on highlighting the need for Mozambique to translate natural resources into other forms of capital, to avoid the development path taken by many resource-rich countries, that have depleted their natural resources without necessarily increasing other forms of capital. Countries seeking to translate their natural resources into

[6] The Worldwide Governance Indicators reports aggregate and individual governance indicators for 215 economies over the period 1996–2011, for six dimensions of governance: (i) Voice and Accountability, (ii) Political Stability and Absence of Violence, (iii) Government Effectiveness, (iv) Regulatory Quality, (v) Rule of Law, and (vi) Control of Corruption. These aggregate indicators combine the views of a large number of enterprise, citizen and expert survey respondents in industrial and developing countries. They are based on 30 individual data sources produced by a variety of survey institutes, think tanks, non-governmental organizations, international organizations, and private sector firms. The scores run from -2.5 to 2.5, with higher values corresponding to better governance. For more information visit http://info.worldbank.org/governance/wgi/index.asp

other forms of capital have to get policies in three key areas straight: (i) policies to ensure an efficient resource extraction to maximize resource rents, (ii) a fiscal regime that balances the interests of companies and governments while enabling government to recover a fair share of the rents, and (iii) a clear policy for investment of resource rents in productive assets. While each country will need to design a policy framework that is appropriate to country circumstances, there are a number of elements that should be reflected (the following is based on the discussion in Mayorga Alba, 2009):

Mozambique will need a clear legal, regulatory and contractual framework for the exploration and exploitation of the country's petroleum and mining resources. This should clearly define the role of the state, providing investors with the needed security, comprehensive environmental protection requirements and a framework for fiscal terms. The law should clearly differentiate between the roles of the state as a regulator and an investor, providing a clear distinction of responsibilities to avoid conflicts of interest. The policy framework should also take into account the country's specific circumstances and inherent risks. Transparent, competitive and non-discretionary procedures will be necessary to attract investment and provide stability to the system. Most countries use 'local content' requirements which can improve the project's economic and social benefits to the country, although if not well designed, taking into account local supply constraints, they can introduce additional risks and costs, jeopardizing the viability of investments. Mozambique will also need the capability to enforce the legal and regulatory framework being established, a concern of policy makers given skills and resources scarcity. Mozambique is currently revising the legislation governing mining and petroleum, with draft legislations already approved by the Government and sent to parliament for approval.

Mozambique will need a stable and fair fiscal regime that takes into account the country's administrative capacity and fosters transparency. The fiscal terms determining how economic rents are shared between the government and investors are often set in the law, with some elements sometimes reserved for contracts or licenses, particularly in the petroleum sector. The system should foster transparency and a comprehensive recording of all transactions, with revenue from extractive industries regularly published by the government. The choice of the fiscal regime needs to take into account Mozambique's administrative capacity. In addition to a stable and fair fiscal regime, Mozambique will also need to build a strong administrative and audit capacity in the relevant institutions, to be able to efficiently collect revenues. Mozambique should also adopt internationally accepted accounting and reporting standards developed to deal with key financial accounting and reporting issues unique to the extractive industries (e.g. transfer pricing). The fiscal terms should be progressive but also simple to administer – particularly in a relatively weak institutional environment. The fiscal terms can evolve over time as uncertainty over the commercial viability of resources (e.g. through availability of newly built infrastructure) as well as country risks are mitigated. How the fairness of the distribution of economic rents between investors and the Government is perceived often determines the stability of both contracts and the framework as a whole. Mozambique is currently revising its fiscal regime for both petroleum and mining. It would be important to ensure that the elements discussed above, particularly on a balanced sharing of economic rents between government and investors as well as the need for transparency, are taken into account. Mozambique has also recently become compliant with the EITI, which requires Mozambique to disclose all payments from companies active in the extractive industry.

Finally, Mozambique will also need to define a clear policy framework to effectively invest resource rents in productive assets. That framework would help decide how much to save from the revenues of extractive industries and how much to spend, as well as contribute to improved public spending, e.g. through an enhanced system for appraisal and implementation of public investment projects[7]. For natural resources revenue management systems to be long-lasting, it is important to design institutional arrangements that foster transparency and sound governance, this is particularly important for the operation of sovereign wealth funds or any other savings arrangements. Key for improved management of public resources and improved allocation of public expenditure is the preparation of an MTEF that reflects the country's priorities as well as clear, rule-based and transparent arrangements that govern the sharing of revenue between the central and local governments, particularly those where extractive industries are located.

Coordination, both within government and with other key stakeholders, will be key to advance this relatively broad reform agenda. This section has discussed some of the challenges that Mozambique will face to improve natural resources management and to be able to translate natural capital into other forms of capital. The breadth and depth of reforms to be implemented, in a relatively weak capacity environment, is illustrative of the difficulties in managing natural resources well and partly explains why many countries have failed to efficiently invest resource rents into other forms of capital. The breadth of the reforms to be implemented also calls for intense coordination between all relevant stakeholders, with some ministries taking a lead role in some reform areas (e.g. MIREM on sector regulation or MoF on the fiscal framework). While intra-government coordination will be key, coordination with other stakeholders will be equally important, such as coordination with the parliament, local governments, civil society and the private sector, both domestic and foreign.

5. Conclusions

GDP measures income, not wealth, and it does not provide accurate information for how a country is managing its assets. This is particularly relevant for resource rich countries, which often grow rapidly by depleting their wealth. Most countries use GDP or GNI to collect and measure wellbeing, but these are measures of income that a country derives from its wealth, not wealth per se, and the sustainability of GDP growth depends to a large extent on the use that countries do of their wealth. Wealth is divided into three types of wealth, produced capital, natural capital and intangible capital (which includes both human capital and institutional development) and many successful countries have developed by translating their natural capital into other forms of capital – investing in both physical and human capital. There is a positive relationship between wealth and GDP growth, as wealth grows, so does the income derived from that wealth. But the relationship is not always positive, and resource rich countries can grow for a period of time by depleting their natural resources wealth – without necessarily investing it. This growth path is unsustainable and likely to lead to lower growth and wellbeing in the future. Natural resources or rapid growth does not guarantee improved welfare for a country's population – this often being the result of investments in physical and human capital as

[7] This policy note is part of a broader program of analytical support from the World Bank with a focus on enhanced public expenditure, the focus of this third policy area being discussed. A set of other analytical pieces will cover a number of aspects – such as natural resources revenue management, a public expenditure review or technical assistance on public investment management. As such, the discussion on these areas has been more limited in this policy note since it will be covered in greater detail in other work.

well as institutions that allow people to share in the benefits of growth. The quality of governance seems to be a key determinant in the relationship between natural resources wealth and growth and also determining the use that countries do of their wealth and whether they embark on sustainable growth paths.

Countries that have managed their natural resources well have invested a large share of the income derived from exploiting non-renewable resources. The sustainability of consumption is determined by the level of consumption and investments that countries chose. Consumption can only be maintained if rents from non-renewable resources are invested. Countries that do so, such as Botswana, which has institutionalized this approach in its sustainable budget index (SBI), invest a significant share of the rents from natural resources on other forms of capital and witness a significant growth in their wealth over time. They also tend to grow faster over longer periods of time, while countries with low investment ratios show limited growth over the long term. Other countries have been exploiting natural resources for a generation or more and have little to show for it by way of wellbeing of their populations. Low investment levels are often behind this poor performance. But for sustainability of growth and wealth creation – it matters not only how much a country invests but also how well it does. The quality of public investment to a large extent determines the impact of investment on growth, and Mozambique seems to have a relatively poor public investment management system, highlighting the need to improve the public investment system. Poor management of natural resources will probably lead to a significant waste in scarce resources, but it can also lead to poorer governance, macroeconomic instability and in worst case scenarios social conflict.

Commercial development of the gas fields and coal deposits will more than double wealth in Mozambique – but despite these developments Mozambique will remain one of the poorest countries in the region. The sustainable development of the gas and coal sectors in Mozambique has the potential of significantly increasing wealth. When taking the likely development of the large coal and gas deposits in the north and center of the country into account, per capita wealth more than doubles. Wealth will only increase if the sectors are developed as planned, since these natural resources are worth only as much as their commercial value. In other words, the country will only be able to derive an income of these assets if they can be commercially developed. Despite this newly discovered wealth Mozambique continues to be one of the poorest countries in the region.

Mozambique, as many other countries in Africa, seems to have grown in the last decade by depleting its natural resources. To ensure a sustainable growth path, Mozambique should invest a higher share of its income on both human and physical capital. Over time, the share of productive over natural capital in Mozambique has been declining and the share of produced capital in total wealth in Mozambique is one of the lowest in the region, highlighting the need to invest resource rents into other forms of capital: public infrastructure as well as improvements in the provision of health and education public services. Over the last decade, adjusted net savings, a measure to analyze the sustainability of growth, has been negative. Only in the past few years has ANS turned positive although it remains relatively low. This is in line with developments in many other resource rich countries in Sub-Saharan Africa, which seem to have achieved relatively high growth by depleting its natural resources.

To ensure that a large share of the rents from natural resources is invested, Mozambique may want to adopt a fiscal policy framework that takes the particular characteristics of natural resources revenues into account. Most countries with nascent extractive industries need to reform the institutions and structures in place to manage natural resources better, including the adoption of a fiscal policy framework that addresses the challenges of natural resources revenues. The success and effectiveness of such institutions depend largely on the general institutional environment in which they are established. Mozambique's institutions are relatively weak – raising concerns about the country's ability to manage natural resources well. Particularly in the case of cash-strapped countries, such as is the case in Mozambique, there will be pressure to consume a large share of the resource rents to improve the well-being of the population in the short term, limiting the ability of the government to allocate a large share of the revenue for investment and to better manage issues particular to natural resources management such as volatility and the finite nature of natural resources.

The policy framework for managing the mining and petroleum sectors may also need to be reformed, to ensure the sustainable development of the sectors and that Mozambique is able to capture a fair share of the rents from coal and gas. The objective of this policy note, rather than proposing a set of readily implementable policy recommendations, is to generate policy dialogue and debate about the need to translate natural resources into other forms of capital. There are three main areas in which Mozambique will need to get policies right: (i) the definition of a clear legal, regulatory and contractual framework for the exploration and exploitation of the country's natural resources, (ii) a fiscal regime that balances the interests of companies and governments and is in line with the country's administrative capacities, and (iii) a clear policy framework to effectively invest resource rents into other forms of capital (human, institutional and physical. Coordination, both within government and with other key stakeholders, will be key to advance this relatively broad reform agenda as well as a focus on enhancing the capacity of the government to design this broad reform agenda and the capacity to monitor enforcement.

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Annex I: Per Capita Wealth(2008)

#	Country	PC Wealth	#	Country	PC Wealth	#	Country	PC Wealth
1	Norway	1,153,289	52	Lebanon	126,049	103	Philippines	27,562
2	Luxembourg	1,132,858	53	Venezuela, RB	126,030	104	Bolivia	24,501
3	Denmark	938,496	54	Mauritius	116,317	105	Angola	23,484
4	Switzerland	897,313	55	St. Lucia	114,497	106	Mongolia	23,262
5	Iceland	815,551	56	Bulgaria	106,615	107	Solomon Islands	22,476
6	United States	811,582	57	Argentina	105,550	108	Ghana	20,399
7	Sweden	774,299	58	Jamaica	101,323	109	Bhutan	19,779
8	Ireland	760,197	59	Costa Rica	96,138	110	Nicaragua	19,715
9	United Kingdom	742,325	60	Malaysia	87,766	111	Cameroon	19,445
10	France	740,367	61	Dominica	86,796	112	Kyrgyz Republic	19,284
11	Netherlands	740,203	62	Panama	85,516	113	Senegal	18,858
12	Finland	730,151	63	Macedonia, FYR	85,347	114	Djibouti	18,852
13	Austria	703,336	64	South Africa	84,829	115	Nigeria	18,850
14	Belgium	697,544	65	Gabon	83,080	116	Lesotho	18,847
15	Australia	676,770	66	Colombia	81,460	117	Comoros	18,467
16	Germany	674,049	67	Tonga	79,093	118	Sudan	17,698
17	Canada	673,785	68	Belarus	77,923	119	Cote d'Ivoire	17,437
18	Italy	623,535	69	Kazakhstan	75,112	120	Mauritania	17,214
19	United Arab Emirates	589,680	70	Botswana	74,939	121	Zambia	15,916
20	Japan	586,674	71	Albania	73,679	122	Pakistan	15,901
21	Greece	528,412	72	Dominican Republic	73,612	123	Papua New Guinea	13,963
22	Spain	523,591	73	Jordan	72,920	124	Kenya	13,687
23	Qatar	492,524	74	El Salvador	72,303	125	Benin	13,599
24	Cyprus	452,025	75	Fiji	69,175	126	Tajikistan	13,561
25	New Zealand	434,910	76	Belize	66,588	127	India	13,155
26	Israel	426,364	77	Namibia	62,234	128	Lao PDR	12,449
27	Portugal	399,164	78	Peru	57,867	129	Vietnam	12,151
28	Kuwait	364,999	79	Tunisia	57,533	130	Mali	10,574
29	Singapore	359,586	80	Ukraine	56,690	131	Burkina Faso	10,271
30	Czech Republic	275,393	81	Ecuador	56,653	132	Uzbekistan	9,262
31	Bahrain	254,045	82	Armenia	55,452	133	Central African Republic	8,618
32	Korea, Rep.	252,188	83	Thailand	52,486	134	Gambia, The	8,405
33	Estonia	250,841	84	Guatemala	52,244	135	Togo	8,270
34	Slovak Republic	244,151	85	Cape Verde	51,876	136	Rwanda	7,665
35	Croatia	237,611	86	Georgia	49,609	137	Nepal	7,477
36	Hungary	234,990	87	Iran, Islamic Rep.	48,769	138	Bangladesh	7,307
37	Latvia	231,175	88	Algeria	43,511	139	Uganda	7,165
38	Lithuania	216,120	89	Swaziland	43,074	140	Mozambique	7,089
39	Poland	207,893	90	Paraguay	42,931	141	Tanzania	6,982
40	Saudi Arabia	172,753	91	Morocco	40,389	142	Liberia	6,254
41	Trinidad and Tobago	163,350	92	Vanuatu	39,943	143	Sierra Leone	6,122
42	Oman	162,190	93	Maldives	38,325	144	Guinea	6,034
43	Seychelles	158,877	94	Moldova	34,294	145	Chad	5,909
44	Turkey	158,529	95	Azerbaijan	34,098	146	Niger	5,835
45	Mexico	152,539	96	Honduras	33,189	147	Ethiopia	5,172
46	Antigua and Barbuda	147,821	97	Syrian Arab Republic	32,621	148	Madagascar	4,721
47	Russian Federation	140,447	98	Sri Lanka	30,910	149	Malawi	3,696
48	Uruguay	137,661	99	Egypt, Arab Rep.	30,297	150	Congo, Dem. Rep.	2,908
49	Romania	136,675	100	Indonesia	29,323	151	Burundi	2,848
50	Chile	130,921	101	China	28,987	152	Congo, Rep.	2,286
51	Brazil	128,472	102	Guyana	28,565			

Annex II. Constructing the Mozambique Wealth Accounts

Published in 2011, *The Changing Wealth of Nations* (CWON) presented a global dataset of comprehensive wealth accounts for the years 1995, 2000, and 2005. The World Bank team carried out another update to the wealth database later in 2011, adding the year 2008 to the wealth accounts. These 2008 estimates, though used internally, are not yet published.

For this policy note, the team wants to use the most up-to-date data for Mozambique. Given the immense task and time required to complete another full update to the comprehensive wealth accounts to include the latest years 2010 and 2011, the team decided to use the previously updated database (which includes the year 2008) as a baseline and prioritize the components to update for 2010 and 2011 for Mozambique only. The following is a summary of the approach in creating the Mozambique comprehensive wealth accounts, which include years 1995, 2000, 2005, 2010, and 2011. All data are reported in constant 2005 US$.

Table A1. Comprehensive Wealth Components by Year

Component	**1995**	**2000**	**2005**	**2010**	**2011**
• **Timber** • **Non-Timber Resources** • **Protected Areas** • **Crop Land** • **Pasture Land** • **Net Foreign Assets**	***Using the previously-updated dataset (which includes year 2008) as the baseline:***				
	1995 estimates were adjusted to 2005$.	2000 estimates were adjusted to 2005$.	2005 estimates were adjusted to 2005$.	2010 estimates were calculated using the year 2008 estimate as a baseline, adjusted by total wealth growth from 2008 to 2010. Figures adjusted to 2005$.	2011 estimates were calculated using the year 2008 estimate as a baseline, adjusted by total wealth growth from 2008 to 2011. Figures adjusted to 2005$.
• **Total Wealth** • **Produced Capital** • **Subsoil Assets**	Updated and estimated using the latest available data. Figures adjusted to 2005$. See sections below, for more detail.				
• **Intangible Capital**	As in the *CWON*, intangible capital was calculated as the residual, where in a given year, Total Wealth – [Produced Capital + Natural Capital + Net Foreign Assets] = Intangible Capital				

Total Wealth

The total wealth component was updated for years 1995, 2000, and 2005, and also included years 2010 and 2011, drawing from the most recently available data (up to 2011) from the World Development Indicators (World Bank) as well as World Bank staff projections.

Total wealth is calculated as

$$W_t = \int_t^{\infty} C(s) \cdot e^{-r(s-t)} ds$$

where *Wt* is the total value of wealth, or capital, in year *t* ; *C*(*s*) is consumption in year *s*; and *r* is the social rate of return to investment. The social rate of return to investment is expressed as (Ramsey Formula):

$$r = \rho + \eta \frac{\dot{C}}{C}$$

where ρ is the pure rate of time preference and η is the elasticity of utility with respect to consumption. The standard World Bank approach (as used in *CWON*), is to assume that $\eta = 1$ and that consumption grows at a constant rate, allowing the total wealth to be expressed as

$$W_t = \int_t^{\infty} C(t) \cdot e^{-\rho(s-t)} ds \qquad \text{(A.1)}$$

The total wealth at time *t* is a function of the consumption at time *t* and the pure rate of time preference; therefore, total wealth can be calculated independently from the growth rate of consumption. For computation purposes, the pure rate of time preference is assumed to be 1.5 percent, and the time horizon is limited to 25 years. This time horizon roughly corresponds to a generation. The 25-year truncation is used throughout the calculation of wealth, in particular, of natural capital. While the *CWON* uses a five-year centered average in order to smooth consumption when calculating wealth in a given year, this note uses a five-year lagged average in order to use the latest available data.

The methodology in this policy note allows for a ***variable growth rate of consumption***, given the changes in the structure of the economy projected to occur with the rise in subsoil extraction. Therefore, rather than assuming that consumption will grow at a constant rate, the estimates account for the actual future consumption stream as projected by World Bank staff. This change to the methodology creates an issue of what social rate of return to investment (*r*) to use when calculating wealth. For simplicity, the estimates continue to use equation (A.1) to estimate total wealth, therefore using 1.5%. A more precise approach would be to estimate total wealth using *r*, which is a function of ρ and the consumption growth rate, still assuming elasticity is 1.

Expression (A.1) implicitly assumes that consumption is on a sustainable path, that is, the level of saving is enough to offset the depletion of natural resources.

Sustainable consumption is the consumption level that leaves the capital stock intact. So if depletion adjusted savings (gross savings minus consumption of fixed capital and mineral, energy, and net forest depletion) is negative, then the capital stock is being run down. Sustainable consumption would then be estimated as final consumption expenditure minus the amount of depletion adjusted savings. But if depletion adjusted savings is positive, then final consumption expenditure is considered sustainable consumption.

The following table summarizes the data sources and gap-filling measures for the indicators required to build a stream of future sustainable consumption:

Table A2. Sustainable Consumption (2012 – 2035): Data Components

Indicator	Source
Gross National Income (GNI), current US$	World Bank staff projections from 2012-2035
Final Consumption Expenditure (FCE), current US$	Years 2012-2019 were estimated by applying a fixed ratio of GNI, where the ratio (FCE/GNI) is the average ratio from 2000-2011 in Mozambique (98%). Years 2020-2035[8] were estimated by applying a fixed ratio of GNI, where the ratio (FCE/GNI) is the average ratio from 2000-2011 in Sub-Saharan Africa (83%).
Net Transfer Balance (NTR)[9], current US$	World Bank staff projections from 2012-2035
Gross National Saving (GNS)	Years 2012-2035 were constructed, where GNS = GNI – FCE + Net Current Transfers.
Consumption of Fixed Capital (CFC)	Years 2012-2035 were held constant (% of GNI), using the 2000-2011 average estimate.
Energy Depletion (END)	Years 2012-2035 were constructed, given the projected data series for natural gas and hard coal resource rents and reserves.
Mineral Depletion (MID)	Years 2012-2035 were held constant (% of GNI), using the 2000-2011 average estimate.
Net Forest Depletion (NFD)	Years 2012-2035 were held constant (% of GNI), using the 2000-2011 average estimate.
GDP Deflator (to adjust all figures to 2005$)	World Bank staff projections from 2012-2035

* Data up to 2011 are available in the World Bank's *World Development Indicators*.

Produced Capital:

The produced capital component was updated for years 1995, 2000, and 2005, and also included years 2010 and 2011, drawing from the most recently available Gross Capital Formation data (up to 2011) from the World Development Indicators (World Bank). The methodology and data sources were the same as in the *Changing Wealth of Nations*.

Subsoil Assets:

Minerals: Using the most recently available data, the wealth figures for the ten metals and minerals covered in these accounts (bauxite, copper, gold, iron ore, lead, nickel, phosphate rock, silver, tin, and zinc) were updated for years 1995, 2000, and 2005, and also included years 2010 and 2011. The methodology and data sources were the same as in the *Changing Wealth of Nations*.

Natural Gas: Using the most recently available data, natural gas wealth was updated for years 1995, 2000, and 2005, and also included years 2010 and 2011. The following table shows how country data were used to update the accounts and provide more accurate information:

[8] The projected series of final consumption expenditure was split into two groups to represent the country situation before subsoil assets come fully online, and after.

[9] Or, net current transfers.

Table A3. Natural Gas Data Components

Natural Gas	Unit Price	Unit Cost	Total Production	Reserves
Country data	Country data on prices provided for years 2007 to 2030.	Country data on costs provided for years 2004 to 2030.	Country data on production provided for years 2004 to 2030.	Country data on reserves provided for years 2011 to 2030.
World Bank estimates (consistent with *CWON*)	For years prior to 2007, prices were estimated using the 2007 country price as baseline, and inflated by the MUV index.[10]	For years prior to 2004, World Bank cost estimates were used.	For years prior to 2004, World Bank production estimates were used.	
Gap-filled/ Constructed	Prices were assumed constant after year 2030.	Costs were assumed constant after year 2030.	Production was assumed constant after year 2030.	For years prior to 2011 and after 2030, reserves were constructed using annual production and country reserves data.

While natural gas resource rent [(unit price – unit cost) x total production] was calculated consistently with the *CWON* methodology, the wealth calculations were adjusted in order to reflect the projected increases in gas production, which would significantly affect the future rent stream. Wealth is estimated as the present value of resource rents, where the discount rate is 4% and the time horizon of extraction is capped at 25 years. While the standard WB approach is to assume a constant stream of future rents when estimating wealth, the estimates in this policy note accounted for future variability by using the projected rent stream, going up to year 2035.

Hard Coal: Using the most recently available data, hard coal wealth was updated for years 1995, 2000, and 2005, and also included years 2010 and 2011. The following table shows how country data were used to update the accounts and provide more accurate information:

[10] When combining World Bank international price for natural gas (source: World Bank Commodity Price Data) and the country data, there was a significant jump (decrease) in the series from 2006 to 2007, going from WB source to country estimate. This was not the result of gas prices declining, but a result of different types of gas. Whereas the World Bank estimates use an international price for natural gas, the country data series is based on actual prices from Sasol to South Africa via pipeline, which are significantly lower than LNG prices. Therefore in order to capture the approach gas price in Mozambique, the note uses the earliest country data point (year 2007) as the baseline for previous years and constructs the historic series using the MUV index as a deflator.

Table 4. Hard Coal Data Components

Hard Coal	Unit Price	Unit Cost	Total Production	Reserves
Country data	Country data provided for years 2000 to 2030.	Country data provided for years 2007 to 2030.	Country data provided for years 2005 to 2030.	Country data provided for years 2012 to 2030.
World Bank estimates (consistent with *CWON*)	For years prior to 2000, World Bank price estimates were used.	For years prior to 2007, World Bank cost estimates were used.	For years prior to 2005, World Bank production estimates were used.	
Gap-filling/ Constructed	Prices were assumed constant after year 2030.	Costs were assumed constant after year 2030.	Production was assumed constant after year 2030.	For years prior to 2012 and after 2030, reserves were constructed using annual production and country reserves data.

While hard coal resource rent [(unit price – unit cost) x total production] was calculated consistently with the *CWON* methodology, the wealth calculations were adjusted in order to reflect the projected increases in coal production, which would significantly affect the future rent stream. Wealth is estimated as the present value of resource rents, where the discount rate is 4% and the time horizon of extraction is capped at 25 years. While the standard WB approach is to assume a constant stream of future rents when estimating wealth, the estimates in this policy note accounted for future variability by using the projected rent stream, going up to year 2035.