4. EXPANDING EXPLOITATION OF NATURAL RESOURCES IN MOZAMBIQUE: WILL IT BE A BLESSING OR A CURSE?[35]

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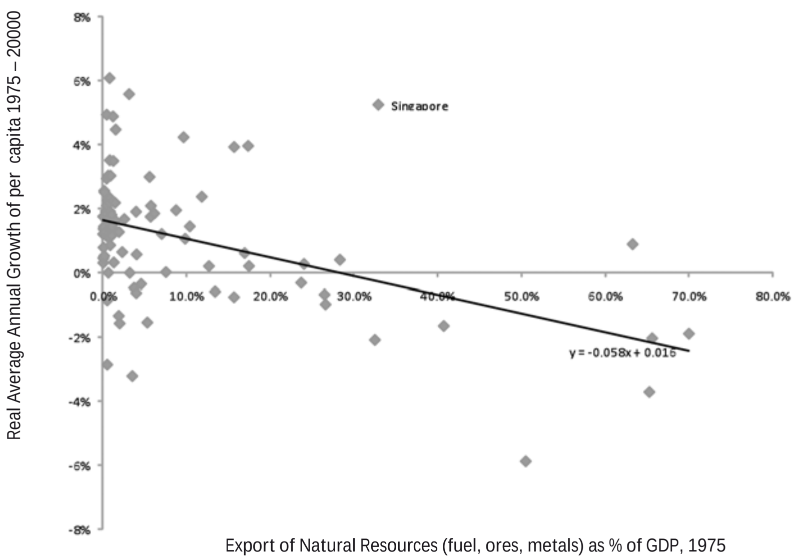
Introduction

Mozambique possesses considerable quantities of natural resources. Contrary to many (African) countries, however, Mozambique is still predominantly virgin soil: most natural resources are yet to be exploited. These resources include natural gas, coal, mineral sands, hydropower and most likely also oil. The Government of Mozambique is determined to extract and export its natural resource potential as fast as possible, supposing that this will contribute positively to economic growth and poverty reduction. Intuition suggests that resource wealth is a gift for the good: it may generate economic dynamics and a flow of income to finance investment programs and policies to fight poverty and stimulate economic development. And indeed, illuminating examples of this do exist: Australia, Canada, Norway and Botswana have been able to use their resource wealth to embark on a structural positive economic growth path. At the same time, the majority of resource rich countries have not been able to replicate this scenario. For example, in Nigeria the poverty incidence increased between 1970 and 2000 from 36% to 70%, in spite of receiving roughly US$ 350 billion (!) in oil revenues over the same period (Sala-i-Martin and Subramanian 2003). Unfortunately, Nigeria is not an isolated example: countries like Angola, Sudan, Sierra Leone, Liberia and Congo are all gifted with considerable natural resource wealth (including oil, diamonds, coltan, rubber and copper) but decades-long exploitation of their resource abundance has not lifted them from the lowest ranks in the Human Development Index list. Likewise, the member countries of the oil cartel OPEC have failed to realize sustainable economic growth despite their oil abundance: the GDP of the OPEC as a whole decreased on average by 1.3% per year between 1965 and 1998 (Karl 1997). This co-existence of natural resource wealth and poor economic performance is known as the "resource curse" or the "paradox of plenty".

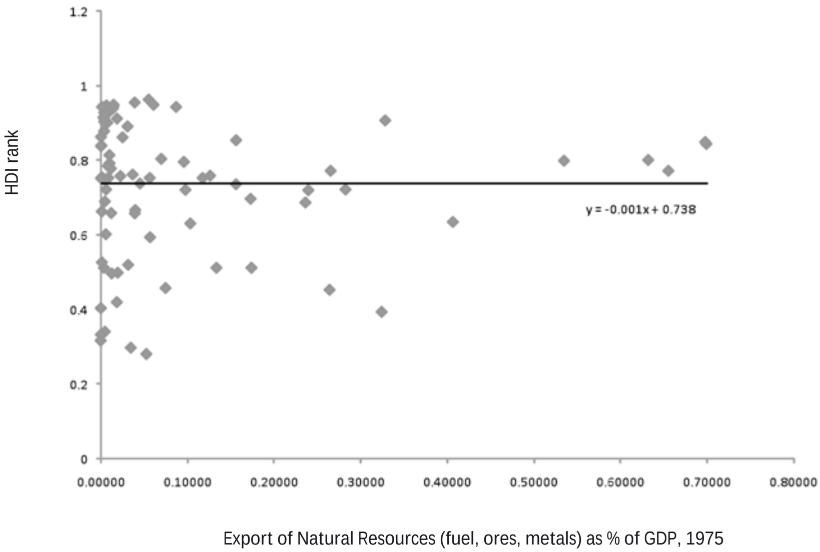
Figure 1 illustrates this phenomenon by depicting the simple relationship between natural resource wealth and economic growth for a cross-country sample of 90 countries. Resource wealth is measured as the export of natural resources as % of GDP in 1975 and economic growth is measured as the real average annual growth rate of GDP per capita during the period 1975-2005.[36]

FIGURE 1: The Relationship between natural resources welath and economic growth



From Figure 1 it can be seen that the simple relationship between long run GDP growth and resource wealth is negative (with an estimated coefficient of – 0.058). In other words: countries historically blessed with relative natural resource abundance exhibit a relatively low average GDP growth rate. However, the Figure also confirms the existence of positive exceptions to this negative correlation, such as Singapore, Chile and Norway. Surely, one might argue that GDP growth is a poor indicator to measure welfare or well-being, and therefore we also present a picture of the simple relationship between natural resource wealth (again measured as the export of natural resources as % of GDP) and the most well-known alternative indicator of welfare, the Human Development Index (in 2000). This index measures well-being across countries as a composite index of GDP per capita, life expectancy at birth and the adult literacy rate. The result is shown in Figure 2, for a cross-country sample of 85 countries.

FIGURE 2: The Relationship between natural resource wealth and hdi ranking



From Figure 2 it can be seen that there is no significant relationship between resource wealth in 1975 and well-being in 2000 (the estimated coefficient is 0.006). Some resource rich countries, such as Gabon, Zambia, Congo and Nigeria, have not been able to end absolute poverty during 25 years of natural resource exploitation. On the contrary, the majority of the most developed nations, like Sweden and Japan, are poor in terms of natural resources. Also within the sub-sample of Sub-Saharan Africa, the established resource rich African nations have generally performed no better than other African countries. In other words, history shows that it is far from obvious that natural resource wealth brings about improved well-being of a country's population.

In sum, natural resource abundance may turn into either a blessing or a curse with respect to a country's economic development. Given the (potential) resource wealth in Mozambique, the obvious question then is: will exploitation of these resources in the (near) future prove to be a blessing to Mozambique's development or is it more likely to pose a serious threat? And what can we do to ensure that future resource exploration in Mozambique will help to embark on a Norwegian- rather than a Nigerian-type of development path? The aim of this study is to answer these questions. To do so, we first need to identify the size and characteristics of Mozambique's natural resource wealth, including existing and future exploitation and export flows. This is the subject of section 2, which to the best of our knowledge results in the first comprehensive overview of Mozambique's natural resource wealth available to the general public. Subsequently, in section 3 we discuss the various mechanisms that may help explain the existence of a resource curse, based on a review and classification of the growing body of the economic literature in this area. In section 4 we combine these insights with the data on natural resources in Mozambique to evaluate the risk of a resource curse occuring in Mozambique. Apart from our focus on Mozambique, this approach differentiates our study from most contributions to the resource curse literature, which concentrate on the historical role of resource wealth in determining economic performance. Of course this change in perspective is motivated by the very fact that Mozambique does not yet have a past of large scale resource extraction, while the first projects have been implemented only recently and many more projects can be expected in the (near) future. Then in section 5 we try to come up with suggestions to avert a Mozambican resource curse. A final section resumes and concludes.

Natural Resources in Mozambique

Natural resources are given by nature, not created by man, and can be divided into renewable and non-renewable resources. A further differentiation can be made between point- and diffuse resources, depending on whether or not the resource is concentrated and can be exploited within a limited area (Auty 2001). Le Billon (2001) added to this classification the decisive factor of whether the distance between the resource and the central government is small or large, i.e. whether the resource can be easily controlled or not. In general, examples of point resources include oil, natural gas, minerals and diamonds while natural resources like agricultural products are much more dispersed. Consequently, rents of agricultural activities are in general transferred throughout the whole economy while exploitation and rents of point resources are often concentrated in the hands of a few.

When talking about Natural Resources in this study we do not take into account the exploitation of agricultural, fisheries and forestry resources but limit ourselves to ores, metals and fuels, including electricity.[37] Although strictly speaking electricity is not a natural resource but a man-made product, we will treat electricity in this study as an integral part of Mozambique's resource wealth. The reason is that by far the largest current and future electricity generation in Mozambique is based on hydropower, the exploitation of which requires investments that in essence do not much differ from the investments needed to extract and process natural gas, coal, mineral sands and oil. To assess the potential impact of Mozambique's natural resource wealth on its economy we have compiled a comprehensive data set of Mozambique's natural resources, including data on reserves as well as current and future exploitation and export flows. We collected our information through the Ministry of Energy and the Ministry of Mineral Resources (who mainly rely on information provided by the various companies in the energy and extractive industry) as well as a variety of other sources including the United States Geological Survey (USGS) Minerals Yearbook, the journal African Mining Review and websites of the companies involved. Our data should be read as best-estimates based on information and knowledge available in 2007. To the best of our knowledge, our dataset is the first comprehensive overview of Mozambique's natural resource wealth available to the general public, bringing together information that until now has been largely dispersed and unpublished. However, we fully acknowledge that this data can and should be improved upon regularly, and if more information comes available. Key results of our efforts are reported in Table 1.

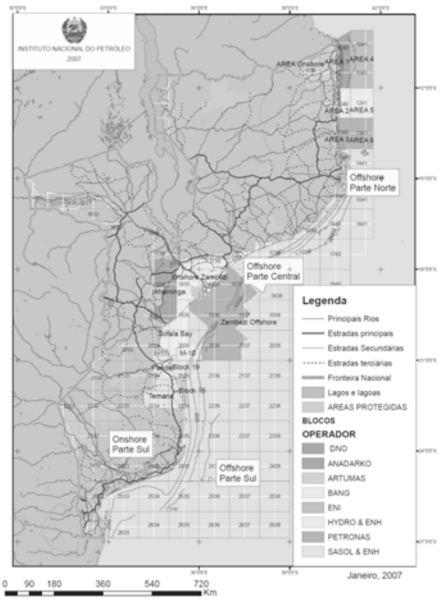
Table 1 shows that coal, natural gas, hydropower and mineral sands are currently the principal natural resources of Mozambique. Hydropower is a renewable resource that serves to generate electricity, while in the near future also part of the natural gas and coal reserves in Mozambique will be used as (non-renewable) sources of electricity generation. In addition, it is very likely that Mozambique possesses oil. So far these oil reserves are unproven, but in 2006 a number of oil companies were licensed to investigate these supposedly considerable potential oil reserves in Mozambique, both on-shore as well as off-shore (Mozambique and Rovuma-basins).

TABLE 1: Natural Resource in Mozambique – Reserves, Exploration, Export

	Unit	Capacity (Reserves)				Unit	Production (Exploration)			Export		
		Potential	Explored									
			2006	2008	≥ 2009		2006	2008	≥ 2009	2006	2008	≥ 2009
Electricity	MW	**14 700**	**2 185**	**2 265**	**5 885**	GWh/year	**14 732**	**15 873**	**41 242**	**10 877**	**11 300**	**27 366**
Hydro		12 500	2 185	2 265	3 685		14 732	15 873	25 824	10 877	11 300	15 102
HCB		2 150	2 150	2 150	2 150		14 502	15 067	15 067	10 877	11 300	10 547
Mavuzi & Chicamba		90	35	90	90		230	631	631	0	0	0
Massingir		25		25	25			175	175		0	0
Lúrio		120			120 (2012?)				841 (2012?)			0
Mphanda Nkuwa		1 300			1 300 (2014)				9 110 (2014)			4 555
Zambeze River (others)		6 800										
Others		2 015										
Thermal - Natural Gas		700			700				4 906			2 803
Inhambane		700			700 (2010)				4 906 (2010)			2 803
Thermal – Coal		1 500			1 500				10 512			9 461
Moatize		1 500			1 500 (2012/15)				10 512 (2012/15)			9 461
Natural Gas	TJ	**5 334 000**				TJ/ year	**102 494**	**123 494**	**144 494**	**101 162**	**119 789**	**137 269**
Pande/Temane		5 334 000					102 494	123 494	144 494	101 162	119 789	137 269
Mineral Coal	1000 ton	**6 000 000**				1000 ton/year	**5**	**5**	**15 000**	**4,9**	**4,9**	**13 500**
Moatize		2 400 000					5	5	15 000	4,9	4,9	13 500
Mucanha-Vuzi		3 600 000										
Minerals (Heavy Sands)		**456 220**						**1 466**	**2 888**		**1 466**	**2 888**
Moma		299 000						877	1 316 (2010)		877	1 316
Contained Ilmenite		273 000						800	1 200		800	1 200
Zircon		20 400						56	84		56	84
Rutile		5 600						21	32		21	32
Chibuto*		157 220						589	1 572 (2017)		589	1 572
Titaniferous (titanium) slag		100 000						375	1 000		375	1 000
Zircon		6 250						22	63		22	63
Rutile		1 220						5	12		5	12
High-purity pig iron		49 110						184	491		184	491
Leucoxene		640						3	6		3	6
Oil (crude)		**?**					**0**	**0**	**?**			

* based on: annual exploration × 100 years

FIGURE 3: potential oil fields in mozambique – areas under investigation



Source: Instituto Nacional de Petróleo

Figure 3 gives an impression of the various areas currently investigated. Because the investigation is in its initial phase, no useful data yet exists on the potential oil reserves of Mozambique.

As for electricity, Table 1 shows that hydropower is and will be the main source for electricity generation by far, with an estimated potential of 12,500 MW. Currently, just over 2,000 MW of this potential is being exploited, almost exclusively through the Cahora Bassa dam. In the near future, new dams are planned, including the Mphanda Nkuwa dam (1,300 MW), which will raise total exploitation of hydro potential to around 3,700 MW. In addition, it is expected that in 2010 a 700 MW natural gas-fired electricity plant will become operational, fuelled by gas from the Pande/Temane fields in Inhambane province. Furthermore, the planned large-scale exploitation of the Moatize coal basin (to start in 2009/10) has given rise to the possibility of constructing a coal-fired power station with a capacity of 1,500 MW, of which we expect 1,000 MW to become operational in 2012 while the remaining 500 MW will probably be available as of 2015. As for natural gas, total reserves of the Pande/Temane fields in the

Inhambane province are estimated to consist of more than 5 million TJ. Total coal reserves are estimated to be at least 6 billion tonnes, including the Moatize and Mucanha-Vuzi coal mines in Tete province. In addition, large deposits of Mineral Sands have been identified in Moma in Nampula province and near Chibuto in Gaza province. The most recent figures indicate a reserve of 299 million tonnes of mineral sands in Moma, mainly consisting of contained ilmenite as well as zircon and rutile. The Chibuto (Corridor) heavy sands mine represents one of the world's largest deposits of heavy minerals and has a lifespan of well over a hundred years. Our figures indicate a reserve of at least 157 million tonnes, but there is probably (much) more. Reserves include mainly titanium slag, as well as zircon and rutile, leucoxene and high purity pig-iron. Mineral ilmenite (iron titanium oxide) is smelted into titanium slag and then sold to the pigment industry, rutile can be used directly by pigment manufacturers and titanium metal producers, zircon is used in the ceramics industry, and high purity iron is a by-product of ilmenite smelting.

So far, the major part of Mozambique's natural resources is under-exploited, but this situation is rapidly changing. The right-hand side of Table 1 summarizes current and future production and export of electricity, natural gas, coal and minerals. From the Table it can be seen that during the next 7 years total electricity production is expected to increase from about 15,000 GWh/year to over 41,000 GWh. The major part of electricity is and will be generated from hydropower, followed by coal and natural gas. Large scale natural gas production started in 2004 with the exploitation of the Pande/Temane gas fields in the Inhambane province by the South African company Sasol, and is expected to grow steadily over the next years to around 145,000 TJ per year. Coal production used to be small-scale and became marginal during the civil war. This situation is, however, going to change since the Brazilian Company Vale do Rio Doce (CVRD) won a bid in 2004 to develop the Moatize coalfield in Tete province, with an expected coal production of 15 million tonnes per year, starting in 2009/10. The Moma heavy sands mine, explored by Kenmare Resources, began its operations in 2007 and is expected to gradually increase its annual production from 900,000 tonnes to over 1.3 million tonnes. The start of the exploration of the Chibuto heavy sands deposits has been delayed due to difficulties with the power supply. After redesigning the project, the company Corridor Sands is now expected to start production by the end of 2008 at a level of about 590 tonnes per year, with production gradually increasing to over 1.5 million tonnes per year by 2017.

Most natural resources exploited in Mozambique are exported. With respect to the coal from the Moatize mine, we expect 15% to be marketed in Mozambique, including consumption by the electricity plant, while the remainder will be exported for consumption by steel plants in Brazil (USGS 2005). The vast majority of natural gas is and will be exported to South Africa, although domestic consumption is tending to increase due to the construction in 2005 of a new pipeline to the Beleluane industrial park near Maputo and because of the natural gas-fired electricity plant to be constructed. Also in terms of electricity, almost all production is exported, mainly to South Africa but also to Zimbabwe and in the near future to Malawi. In Table 2 we present our best-estimates of current and future export prices of the various natural resources.

TABLE 2: (Estimated) Prices of Natural Resource Export

	Price of Exports		
	2006	2008	≥ 2009
Electricity			
Hydro	**1,66**	**1,83**	**2,48**
HCB	1,66	1,83	2,21
Mphanda Nkuwa			2,75
Thermal - Natural Gas			**3,20**
Inhambane			3,20
Thermal – Coal			**3,50**
Moatize			3,50
Natural Gas			
Pande/Temane	1 200	1 200	1 200
Mineral Coal			
Moatize	30	32	35
Minerals (Heavy Sands)		**136**	**142**
Moma			
Ilmenite	85	87	92
Zircon	700	714	743
Rutile	450	457	471
Chibuto		**398**	**408**
Titaniferous (titanium) slag	425	429	438
Zircon	700	714	743
Rutile	450	457	471
High-purity pig iron	300	303	309
Leucoxene	500	505	515

Next, we assess the role of current and future natural resource exports in total exports. To this end, we calculated the value of natural resource exports from Mozambique for the period 2006-2020 by taking historical data for the period 2000-2005 from the SADC Trade Database (SADC 2007) and the Ministry of Energy (2007a) and adding to this the product of the (expected) export quantities (Table 1) and prices (Table 2) for the period 2006-2020. The value of non-natural resource exports from Mozambique is also based on historical data for the period 2000-2005 from the SADC Trade Database (SADC 2007) together with the assumption that these non-natural resource exports will grow by 10% annually.[38] The results are shown in Figure 3. The Figure shows a spectacular growth in exports from about 365 million US$ in 2000 to almost 6.5 billion US$ by 2020. Of the latter, about 1.8 billion consists of non-natural resource (related) exports (under the assumption of a 10% annual growth rate). A large part of the primary exports consists of aluminum (products), the growth of which is to be explained by expansion of production capacity of the Mozal factory (Mozal 3, in 2009/10).[39] In addition, electricity, mineral sands and coal will be major elements of Mozambique's exports, while the share of natural gas is relatively small as compared to the other natural resources.

As noted before, no data yet exists on the potential oil reserves of Mozambique because investigation of potential reserves is still in its initial phase. Therefore, we decided to do a kind of thought-experiment to see what happens to natural resource exports if Mozambique becomes an oil producing country similar to one of the existing oil producing nations. Assuming that we may exclude the possibility that Mozambique will become an oil producer of the size of Saudi-Arabia or Iran, we will analyse the situation when Mozambican oil production turns out to be *very small* like Tunisia, *small* like Chad or Gabon, *medium* like Brazil or Libya, or big like Norway. Based on the average oil production of these countries we define *very small* as 75,000 Barrels/day, *small* as 200,000 Barrels/day, *medium* as 1.5 million Barrels/day and *big* as 3 million Barrels/day, while for the sake of the argument we assume oil production to start at full-scale in 2015.[40] Finally, we assume a constant oil price of US$50/Barrel, based on the average oil price in 2006.[41] Under these assumptions and in the case that Mozambique develops into a (very) small oil producer like Tunisia, Chad or Gabon (75,000-200,000 Barrels/day), the value of Mozambican exports will increase to about 10 billion US$ in 2020 as compared to 6.5 billion US$ without oil. However, if Mozambique becomes a medium-size oil producing nation like Brazil or Libya (1.5 million Barrels/day) or a large oil producing nation like Norway (3 million Barrels/day) total export value may explode to over 30 or 60 billion US$, respectively. Of course, if oil prices remain structurally above the assumed average 2006 price level of US$50/Barrel (which we consider a likely scenario), these figures easily (substantially) underestimate the value of Mozambique's future export.

To further illustrate the importance of natural resource (related) exports in Mozambique, we present in Table 3 primary exports (fuel, ores and metal) as % of total exports for the period 2000-2020. In addition we present the primary export share including potential oil exports, according to the scenario's discussed above.

TABLE 3: Natural Resources as of Total Exports

	% of total export										
	2000	2002	2004	2006	2008	2010	2012	2014	2016	2018	2020
Without Oil											
Total Natural Resources	**38,6**	**63,8**	**71,3**	**75,4**	**77,1**	**80,1**	**79,8**	**77,6**	**75,0**	**73,7**	**70,2**
Oil Products	2,4	1,2	0,0	0,8	0,6	0,4	0,4	0,3	0,3	0,3	0,2
Natural Gas	0,0	0,0	2,1	6,5	6,0	4,9	4,3	4,1	3,9	3,5	3,4
Electricity	18,4	8,4	6,9	9,5	8,9	11,3	15,1	16,8	18,1	15,2	14,5
Aluminium(products)	16,5	53,0	61,3	56,8	45,4	49,5	47,9	44,8	41,6	36,6	34,6
Heavy Mineral Sands	0,0	0,0	0,0	0,0	14,6	12,7	11,0	10,4	9,9	16,9	16,3
Other Nat. Resources	1,1	1,1	1,1	1,8	1,5	1,2	1,1	1,1	1,1	1,1	1,1
Non-Natural Resources Exports	61,4	36,2	28,7	24,6	22,9	19,9	20,2	22,4	25,0	26,3	29,8
With Oil – 200,000 Barrels daily											
Total Natural Resources	**38,6**	**63,8**	**71,3**	**75,4**	**77,1**	**80,1**	**79,8**	**77,6**	**85,8**	**84,1**	**81,6**
Oil Products	2,4	1,2	0,0	0,8	0,6	0,4	0,4	0,3	43,2	39,8	38,2
Natural Gas	0,0	0,0	2,1	6,5	6,0	4,9	4,3	4,1	2,2	2,1	2,1
Electricity	18,4	8,4	6,9	9,5	8,9	11,3	15,1	16,8	10,3	9,2	9,0
Aluminium (products)	16,5	53,0	61,3	56,8	45,4	49,5	47,9	44,8	23,7	22,1	21,4
Heavy Mineral Sands	0,0	0,0	0,0	0,0	14,6	12,7	11,0	10,4	5,6	10,2	10,1
Other Nat. Resources	1,1	1,1	1,1	1,8	1,5	1,2	1,1	1,1	0,7	0,7	0,7
Non-Natural Resources Exports	61,4	36,2	28,7	24,6	22,9	19,9	20,2	22,4	14,2	15,9	18,4
With Oil - 1,500,000 Barrels daily											
Total Natural Resources	**38,6**	**63,8**	**71,3**	**75,4**	**77,1**	**80,1**	**79,8**	**77,6**	**96,3**	**95,6**	**94,7**
Oil Products	2,4	1,2	0,0	0,8	0,6	0,4	0,4	0,3	85,0	83,2	82,2
Natural Gas	0,0	0,0	2,1	6,5	6,0	4,9	4,3	4,1	0,6	0,6	0,6
Electricity	18,4	8,4	6,9	9,5	8,9	11,3	15,1	16,8	2,7	2,6	2,6
Aluminium (products)	16,5	53,0	61,3	56,8	45,4	49,5	47,9	44,8	6,3	6,2	6,2
Heavy Mineral Sands	0,0	0,0	0,0	0,0	14,6	12,7	11,0	10,4	1,5	2,9	2,9
Other Nat. Resources	1,1	1,1	1,1	1,8	1,5	1,2	1,1	1,1	0,2	0,2	0,2
Non-Natural Resources Exports	61,4	36,2	28,7	24,6	22,9	19,9	20,2	22,4	3,7	4,4	5,3

From the Table it can be concluded that the share of primary exports in total exports will probably fluctuate between 70 to 80%. It is to be noted that aluminum (products) produced by Mozal constitutes a major part of this. Without aluminum, the share of natural resource (related) exports in total exports will be around 40% to 50%. In case Mozambique develops into an oil producing country, the share of primary exports in total exports will easily grow to over 90%.

To put these numbers in an international perspective, Table 4 lists a couple of key indicators for Mozambique in comparison with a selected list of countries, including resource-rich and resource-poor countries. Since natural resource exploitation in Mozambique is still in its infancy, we compare the expected figures in Mozambique for 2010 and 2015 with the actual situation in other countries in 2000.

TABLE 4: Primary Exports Mozambique in International Perspective

	Fuel + ores and metals exports (% of GDP)	Fuel + ores and metals exports (% of exports)	Fuel exports (% of exports)	Ores and metals exports (% of exports)
Nigeria	49.7	99.6	99.6	0.0
Congo, Rep.*	48.7	88.0	87.6	0.3
Gabon	42.5	85.0	83.3	1.7
Mozambique 2010	**40.4**	**82.5**	**14.6**	**67.9**
Mozambique 2015, with Oil at 200,000 Barrel/day	**38.2**	**87.6**	**53.5**	**34.0**
Trinidad and Tobago	34.3	65.4	65.3	0.1
Norway	25.2	70.0	63.9	6.1
Mozambique 2010, without Aluminium	**19.1**	**39.0**	**14.6**	**24.4**
Zambia	13.1	63.9	1.6	62.3
Chile	11.8	46.5	1.1	45.3
Malaysia	11.6	10.7	9.6	1.0
Canada	6.8	17.5	13.2	4.4
Australia	6.3	38.5	21.9	16.6
South Africa	4.9	21.0	10.1	10.8
Botswana	3.6	7.1	0.1	7.0
Sweden	2.1	5.6	2.9	2.7
Germany	1.2	3.9	1.5	2.5
United States	0.3	3.8	1.9	1.9
Burkina Faso	0.3	3.3	3.2	0.0
Japan	0.2	1.6	0.4	1.3
Malawi	0.1	0.4	0.2	0.2
Mali	0.1	0.3	0.0	0.3
Angola	0.0	6.9	3.0	3.9

* Natural Resource Data are of 1995

From the Table it can be seen that in 2010 primary exports (fuel, ores and metal) in Mozambique are expected to amount to about 40% of GDP (assuming an annual GDP growth rate of 7.5%). As noted before, the share of primary exports in total exports is expected to be around 80% in 2010. Natural Resource exports consist mainly of ores and metals due to the important role of aluminum in Mozambican export, while the fuel component consists mainly of electricity and natural gas. In terms of these numbers, Mozambique can be defined as a resource rich country that can be compared to countries like the Republic of Congo, Gabon, Trinidad and Tobago, Norway and Zambia. Without aluminum, primary exports drop to about 19% of GDP, and to around 40% of total exports. These numbers are more in line with those of Chile and Malaysia.

So far, we have measured resource dependence (in Mozambique) by the share of primary exports in total exports and as % of GDP. An alternative way to measure natural resource dependence is to calculate the value of resource stocks relative to the total wealth of a country. The remainder of this section is devoted to estimating this stock value of (non-renewable) natural resources in Mozambique according to the methodology used by the World Bank (2006) in its study 'Where is the Wealth of Nations?'. The study provides monetary estimates of the range of assets – produced, natural, and intangible – for a range of 120 countries, based on the year 2000. A key message of this study is that in most countries natural capital is an important share of total wealth, greater than the share of produced capital. This suggests that managing natural resources must be a key part of development strategies. The composition of natural wealth in poor countries emphasizes the major role of agricultural land, but subsoil assets and timber and non-timber forest resources make up another quarter of total natural wealth. For Mozambique no estimates for subsoil assets were provided, due to lack of data and the (near) non-existence of subsoil assets exploitation in 2000. We aim to fill this gap by applying the World Bank methodology to our data and using 2010 as a base year.

The approach used is based on the well-established economic principle that asset values should be measured as the present discounted value of economic profits over the life of the resource.[42] This value, for a particular country and resource, is given by the following expression:

$$V_t = \frac{\sum_{i=t}^{t+T-1} \pi_i q_i}{(1+r)^{(i-t)}} \qquad \textbf{(1)}$$

where $\pi_i\, q_i$ is the economic profit or total rent at time i (π_i denoting unit rent and q_i denoting production), r is the social discount rate, and T is the lifetime of the resource. However, this approach is rarely used for the practical estimation of natural asset values since it requires the knowledge of actual future rents. Instead, simplifications of (1) that implicitly predict future rents based on more or less restrictive assumptions (such as constant total rents, optimality in the extraction path) are used. The simplification used here assumes that the unit rents grow at rate g:

$\frac{\dot{\pi}}{\pi} = g = \frac{r}{1 + (\varepsilon - 1)\,(1 + r)^{(T)}}$ where $\varepsilon = 1.15$ is the curvature of the cost function, assumed to be isoelastic (as in Vincent, 1996). Then, the effective discount rate r^* is defined as $r^* = \frac{r - g}{1 + g}$ and the value of the resource stock can be expressed as:

$$V_t = \pi_t q t \left(1 + \frac{1}{r^*}\right)\left(1 - \frac{1}{(1 + r^*)^T}\right) \qquad \textbf{(2)}$$

This expression is used to value the resource stocks, extending for a period of 20 years.[43] Furthermore we follow the World Bank in assuming a social discount rate of 4%.

To reflect uncertainty regarding future prices of non-renewable resource rents, we calculated the value of resource stock using three scenarios: Low, Medium and High, which differ with respect to the assumed prices. The supposed price ranges are taken from the values listed in Table 2. The results of our calculations for Mozambique based on equation (2) are shown in Table 5 (for more details we refer to Annex 1).

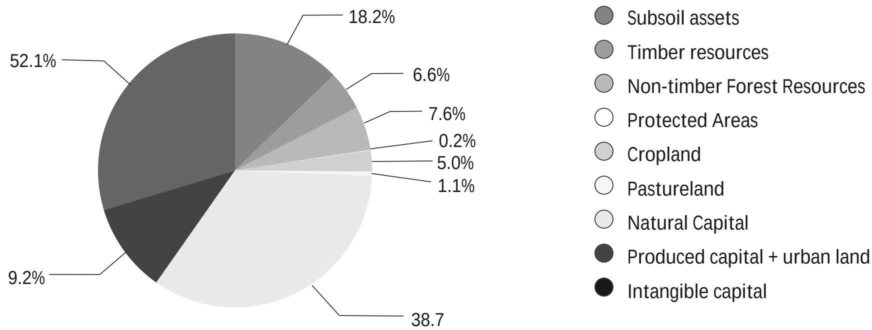
TABLE 5: Estimates of Value of Subsoil Assets Mozambique

		Low	Medium	High	Medium including Oil – 200,000 Barrel/day	Medium including Oil – 1,500,000 Barrel/day
Natural Gas	US$/capita	117	175	234	175	175
Coal		242	303	364	303	303
Heavy Sands		452	462	473	462	462
Oil					1 892	14 192
TOTAL		812	941	1 070	2 833	15 132

* Using 2015 population number (UN projections, medium variant)

From Table 5 it can be seen that the total value of Mozambique's natural resources rents for a period of 20 years is close to 1,000 US$ per capita.[44] The Table shows that the major part of this wealth consists of mineral sands and coal, while the value of natural gas is relatively small. If we take into account a supposed oil production of 200,000 Barrels/day (small, like Chad or Gabon), total value increases substantially to about 3,000 US$/capita and in case of a supposed oil production of 1.5 million Barrels/day (medium, like Brazil or Libya) this value increases further to about 15,000 US$/capita. In Figure 4 we plot the values of resource rents in Mozambique together with the World Bank

FIGURE 4: Wealth Stock Estimates for Mozambique

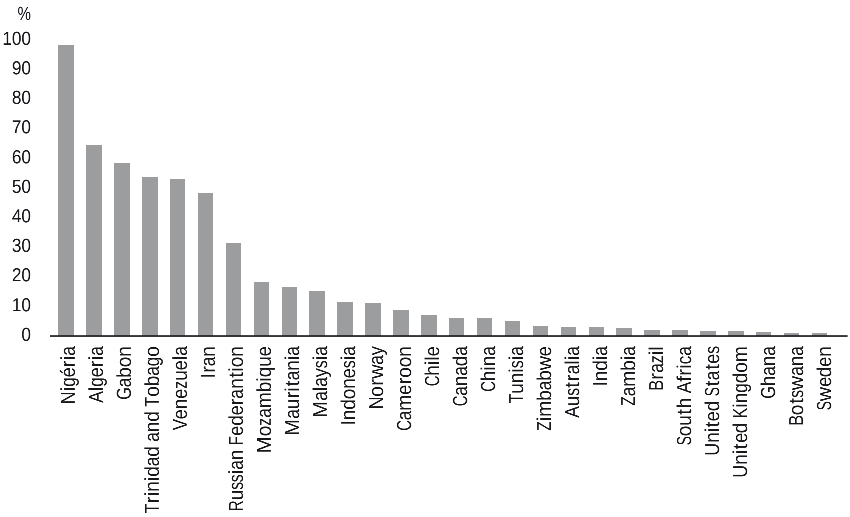


Source: Own calculation and Workbank (2006) estimates of other sources of wealth in Mozambique. From the Figure, it can be seen that with 941 US$/capita, the subsoil assets amount to circa 18% of total estimated value for Mozambique. The largest share of total wealth consists of intangible capital, which includes an amalgam of human capital, governance, and other factors that are difficult to value explicitly. Apart from subsoil assets, Mozambique also has a considerable value of Timber and Non-Timber forest resources (together around 14% of total wealth).

If we assume that Mozambique turns into a small oil producing nation (like Chad or Gabon) the share of subsoil assets in total wealth in Mozambique will increase to about 40%; in case Mozambique becomes a medium-size oil producer (like Brazil or Libya) this number will be around 78%.

In Figure 5 we compare the share of subsoil assets in total wealth in Mozambique with a selected number of other countries according to the World Bank estimates.

FIGURE 5: Percentage of Susoil Assets in Total Wealth in Mozambique within the International Perspective



Source: Own calculations and Worldban (2006)

The Figure shows that even without oil exploration the share of subsoil assets in total wealth in Mozambique (18%) should be considered high in an international perspective. In case Mozambique becomes an oil producing country, its share of subsoil assets in total wealth (40% to 78%) will be comparable to that of oil producing countries like Venezuela, Algeria, or Gabon. In sum, in international perspective and by any standard the Mozambican economy is rapidly becoming natural resource-intensive.

The determinants of a Resource Curse

The observation that countries rich in natural resources are often characterized by relatively poor economic performance has received considerable attention in the economic literature. This large and still growing body of literature has been inspired by the work of Sachs and Warner (1995) who showed that economic growth rates of countries in the 1970s and 1980s were strongly and negatively related to their natural resource affluence (after controlling for other important factors), as shown before in Figure 1 of this chapter. This result has been confirmed by a series of studies (see for example, Gylfason 2001; Leite and Wiedmann 1999; Papyrakis and Gerlagh 2004, 2007; Sachs and Warner 2001; Sala-i-Martin and Subramanian 2003; Mehlum et al. 2005, 2006). Interestingly enough, although most examples of the resource curse come from developing countries, the phenomenon is not restricted to poorer nations. For example, Papyrakis and Gerlagh (2007) found that within the USA, resource-scarce states have outperformed resource-abundant states (such as Alaska and Louisiana). Another example is The Netherlands, where in the previous century large-scale natural gas exploration initially led to unfavorable economic consequences. Apart from documenting the resource curse as such, the economic literature has been concerned with identifying its possible determinants. After all, some countries have escaped the resource curse. So, how come that natural resource wealth stimulates economic performance in some countries but apparently impedes economic development in others? In this section we discuss the main explanations or transmission channels that have been suggested by the literature. We follow Papyrakis (2006) in distinguishing four principle explanations: 1. Dutch disease, 2. Investments, 3. Economic Policy, 4. Institutions. We briefly discuss these explanations below.

Dutch disease

Originally the Dutch disease phenomenon referred to the situation in the Netherlands during the 1960s when the discovery and export of natural gas in this country caused adverse impacts on its manufacturing sector through an appreciation of the currency. Natural resource exploitation and its revenues cause a demand shock that may lead to inflationary pressure at home as well as an overvaluation of the currency due to increased demand from abroad (Corden 1984; Neary and Van

Wijnbergen 1986). As a result, prices of non-natural resource goods increase, in that way turning the non-natural resource sector less competitive and also hampering diversification of the economy (Fardmanesh 1991). Since the size of exports and the degree of openness of an economy are important determinants of economic growth (Frankel and Romer 1999), natural resource wealth might in this way – paradoxically – have a negative impact on economic development. In greater detail, the Dutch disease consists of three principal mechanisms:

- The *spending effect*, which refers to an increasing demand for non-tradable goods and services, pushing up their prices. The discovery of considerable quantities of natural resources is often associated with large direct foreign investments (FDI), particularly in developing countries like Mozambique, and a sharp increase of export revenues. The implied inflow of foreign currencies causes an appreciation of the domestic currency, turning the non-natural resource sectors less competitive. At the same time, this causes increasing demand for goods and services, invoking increased prices and wages.

- The *movement effect*, which refers to a reallocation of production factors (capital, labour) from other sectors (manufacturing) towards the primary sector due to its increased marginal productivity (Corden and Nery, 1982). If new reserves of oil, natural gas, or coal are discovered in an economy that finds itself close to its maximum production level, the extra demand for production factors to extract the discovered resources may cause scarcity of these resources in other sectors. As a result, the wage premium in the primary sector – motivated by its high marginal productivity – causes a crowding-out effect regarding other activities in the economy.

- The *spillover-loss effect*, refers to natural resource exploitation undermining the positive externalities (spillovers) generated by other sectors including the development of know-how, innovations in the area of technology and management and all kinds of skills of the labour force. In general these effects are principally generated by the manufacturing sector due to its exposure to international competition, with considerable positive effects on the productivity of the economy as a whole (Matsuyama, 1992; Krugman, 1987). In contrast, the primary sector generates in general little positive externalities for the rest of the economy, due to its capital intensity and very specific activity. As a result the primary sector often establishes only limited forward and backward linkages with the rest of the economy, particularly in developing countries with its high share of unskilled labour. Hence, a contraction of the manufacturing sector (see above) in favour of the primary sector might lead to a decrease in positive spillovers and thus a slow down of productivity increase at the level of the economy as a whole.

The Dutch disease becomes an even more serious problem when non-renewable resources (like natural gas, coal, mineral sands, etc.) are getting exhausted. If the other sectors of the economy have suffered for many years from Dutch disease phenomena, a country will face great difficulties in restoring its competitiveness once the natural resource wealth is reaching its end.

Investments

The important role of investments in promoting economic development has been well documented in the economic literature (see, for example, Barro 1991; Grier and Tullock 1989; Kormendi and Meguire 1985). Recent empirical research has identified the effect of natural resource abundance on *crowding out* investments and thus hindering economic growth, with circa 40% of the negative impact of mining on economic growth to be attributed to a fall in investments (Papyrakis and Gerlagh 2004). A principal reason for this is that world market prices for primary products tend to be more volatile than the prices of other goods and services, which makes an economy based on primary products vulnerable to frequent booms as well as recessions. These fluctuations in economic conjuncture often cause exchange rate volatility and (consequently) increased risks and uncertainty for investors (Herbertsson et al. 1999). This fact is reflected in a strong negative correlation between resource abundance and the level of FDI (Gylfason 2001b).

Additionally, natural resource wealth diminishes the sense of necessity of savings and investment because resource revenues feed the illusion that current and future wealth and prosperity do not depend much on capital accumulation (Papyrakis and Gerlagh 2004). Furthermore, resource rents may reduce the need for financial intermediation with negative consequences for the development of financial institutions that usually promote investments in the long run. On top of this, as noted before, Dutch disease effects may invoke contraction of the manufacturing sector, thereby further contributing to reduced capital accumulation. Finally, governments of resource abundant countries may spend their revenues on unproductive investments and consumption, including expenses for the military and security or all kinds of prestige projects with little or no sustainable positive impact on the economy (Ascher 1999).

Policy failures

Natural resource wealth creates frequently a false sense of euphoria and confidence that undermines careful planning and prudent economic policies by the government (Gylfason 2001a). Resource revenues may contribute to myopic behavior and irrational expectations on the part of governments, leading to accumulation of debt with resource stocks as collateral. This makes countries vulnerable in the sense that resource price volatility on the world market might easily lead to a heavy debt burden (in case prices fall). Moreover, wealth that is easily obtained often stimulates unproductive behavior and undermines willingness to make great efforts – this is not only true for individuals but also for governments. Hence, natural resource wealth often encourages bureaucracy, inefficiency and corruption which in turn undermine innovation and improvements in efficiency (Papyrakis and Gerlagh 2004). Moreover, governments often tend to use resource revenues for subsidies and transfers supporting uncompetitive industries instead of promoting diversification and competitiveness (Auty 1994). Furthermore, investments in education are often neglected in resource abundant countries, which can be explained by the fact that the primary sector is principally in need of low-skilled labour (Gylfason 2001a), and also by the lack of sense of urgency to invest in human capital in the face of increased income from resources. This however makes it increasingly difficult for the economy to diversify its activities, because the non-resource sectors often do require skilled labour. Finally, since the resource revenues are collected by the government, the decisions about its spending are often in the hands of a few, which – against the background of weak democracies in many resource abundant countries – often implies lack of control, thereby contributing to further weakening of a country's institutions.

Institutions

Institutions are the "the rules of the game in a society" (North, 1990). The institutional quality of a country reflects the quality of laws and their enforcement, efficiency of the bureaucracy, level of corruption, political stability, democratic values and transparency. The economic growth literature leaves no doubt about the strong positive role good institutions play in bringing about economic development (see, for example, Acemoglu et al. 2001; Knack and Keefer 1995; Mauro 1995; Easterly & Levine 2003). In the resource curse literature it has not gone unnoticed that those natural resource rich countries that have escaped a resource curse (like Botswana, Australia, Canada, Norway) are characterized by the relatively high quality of their institutions, while most countries that suffer from a resource curse have poor institutions (Auty 2001; Bulte et al. 2003; Karl 1997; Ross 1999, 2001; Mehlum et al. 2005, 2006; Sala-i-Martin and Subramanian 2003; Torvik 2002). The idea is that weak (*grabber friendly*) institutions allow for resource revenues to be spent on all kinds of unproductive activities, whereas in the presence of strong (*producer friendly*) institutions the natural resource abundance is likely to be spent on productive investment in physical and human capital. In other words, the transmission of resource wealth into broad-based economic development depends critically on the institutional quality in a country.

Many authors, who point to institutions as the fundamental link between natural resource abundance and economic performance, take this reasoning one step further by arguing that natural resource exploitation actively undermines the institutional quality of a country. The underlying mechanism is to be found in the inclination of individuals to engage in rent-seeking rather than productive activities once resource wealth starts emerging, which often includes preventing the establishment of proper institutions or actively undermining existing institutions (see Baland and Francois 2000; Karl 1997; Ross 2001; Tornell and Lane 1999; Torvik 2002). As a result countries with weak institutions that start to exploit their natural resources suffer from a double resource curse according to this view: weak institutions that impede economic development are further weakened by natural resource exploitation as a result of which economic development is even more hampered, thus creating a vicious cycle that keeps countries trapped in poverty.

As noted before, rent-seeking behaviour has much to do with the nature of the resource wealth: point-resources (like oil, natural gas, minerals and diamonds) that allow for limiting access make a country particularly vulnerable to rent seeking with all its negative consequences for economic growth. One of these consequences is lack of competition and the accumulation of much wealth by a few. The higher the potential resource rents the stronger rent-seeking activities will be (Auty 2001). It is important to realize that rent-seeking as such is in principle not an illegal activity. However, often the existence of resource rents invokes illegal activities by individuals in search for personal wealth, which undermines government administrations and their institutions (Leite and Weidmann 1999; Murphy et al. 1993). In many cases, even in established market economies, the management of natural resources is often not guided by open and transparent competition and licensing of concessions but rather by politically networked interests that lead to negotiations between companies and senior government officials outside the control of democratic institutions and the public in general.

Another aspect of institutional quality as a determinant of the resource curse refers to the way resource revenues are spent in the economy. In general, a significant part of these resource revenues is captured by the government which regularly uses these funds to satisfy specific interests of specific groups in society, particular those that constitute and support the government's power base. This often not only implies that these revenues are invested in projects with limited return for the economy as a whole, but it also may invoke feelings of injustice and disputes between various groups within society which in turn easily undermine democratic processes and political stability. The latter may be further enhanced by the fact that natural resources are often geographically concentrated, as a result of which discrimination across various interest groups easily translates into ethnic or regional tensions that ultimately may result in armed conflicts and civil wars (Collier and Hoeffler 1998). Evidently, this has a dramatic impact on economic development, as illustrated by the recent history of countries such as Nigeria, Congo, Angola and Sierra Leone.

Evaluating the Risk of a Resource Curse in Mozambique

Mozambique has never suffered from a natural resource curse, simply because the country never experienced large scale resource extraction.[45] However, as shown in section 2, this situation is currently changing with Mozambique developing rapidly into a natural resource-intensive economy. Will this foreseen exploitation of Mozambique's natural resources prove to be a blessing or a curse on its (long-term) economic performance? We address this question by making an assessment of the chance that the Mozambican economy will suffer from each of the possible determinants of a resource curse, as discussed in the previous section. To this end, we aggregate these determinants into two areas: problems of an economic nature (Dutch disease, crowding out of investments, policy failures including under-investment in human capital and infrastructure, debt accumulation, etc.) and problems of an institutional nature (lack of transparency, corruption, rent-seeking, nepotism, waste of money, tribalism, weakening of democracy, etc.).

Problems of an Economic Nature

The Dutch disease explanation for the existence of a resource curse points to the contraction of the non-resource tradable sectors as a result of a boom in the natural resource sector. The contraction reflects decreasing competitiveness of the other tradable sectors caused by real currency appreciation due to a substantial inflow of foreign exchange, which in turn has an upward effect on prices and wages. This so--called *spending effect* may be accompanied by a *movement effect or resource allocation effect* if factors of production are re-allocated towards the natural resource sector, motivated by increased demand and higher wages. To assess the risk of these effects for Mozambique we show in Table 6 an estimate of the impact of the natural resource sector on the Balance of Payments up to 2020[46], together with data on the exchange rate as well as inflation.[47]

TABLE 6. Dutch Dutch Disease and Natural Resource Exploration

	2000	2002	2004	2006	2008	2010	2012	2014	2016	2018	2020
Balance of payment Effect											
Aluminuim (mozal)	-318	-575	151	226	247	-467	437	451	460	470	480
Electricity	8	10	19	40	151	225	321	331	337	343	350
HCB	8	10	19	40	151	169	174	178	181	183	189
Mphanda Nkuwa	0	0	0	0	0	0	0	6	9	11	14
Thermal Central Inhambane	0	0	0	0	0	56	56	56	56	56	56
Thermal Central Moatize	0	0	0	0	0	0	91	91	91	91	91
Natural Gas (Sasol)	0	19	19	19	21	24	25	26	27	28	29
Mineral Coal (Moatize)	0	0	0	0	0	232	232	232	232	232	232
Heavy Sands	0	0	0	0	74	158	176	180	183	186	279
Corridor	0	0	0	0	12	33	49	50	51	52	143
Moma	0	0	0	0	62	125	127	130	132	134	136
Total	-310	-546	189	286	494	173	1,192	1,220	1,240	1,260	1,370
BoP Effect in % of GDP	-8.6%	-12.2%	3.7%	4.8%	7.2%	2.2%	13.0%	11.5%	10.1%	8.9%	8.4%
Exchange Rate (MT/US$)	15.7	23.7	22.6	25.8	27.6	29.2					
Inflation Rate	12.7%	16.8%	12.6%	8.1%							

Souce: own calculations and Ministry of Planning and Development

From the Table it can be seen that the real exchange rate shows a trend of small depreciation rather than appreciation, while inflation figures also show a modest reduction over time. Except for their respective periods of construction, the different natural resource (related) projects in Mozambique will have a considerable positive effect on the Balance of Payment, reaching an estimated 1.3 billion US$ by 2020. It is to be noted that the balance of payment effect is much smaller than the direct effect on the balance of trade (around 3.4 billion US$) because of substantial amounts of profit repatriation and debt service. Assuming a constant annual GDP growth rate of 7.5%, the total balance of payment effect of the natural resource (related) sector is expected to amount on average between 7 and 8% of GDP in the long run, with a peak of 13% around 2012. Obviously, these numbers will increase considerably once we include the revenues from oil exploration and export. However, lack of information does prevent us from making any meaningful estimate of the total balance of payment effect of oil exports. In sum, at this moment we do not have any indication that Mozambique is particularly vulnerable to Dutch disease-like phenomena. Of course, prudent spending of natural resource earnings remains a prerequisite for avoiding the risk of a Dutch disease, which is especially true in the event that Mozambique starts to export considerable quantities of oil (products).[48]

In addition, we consider the risk of a movement or resource allocation effect in Mozambique as fairly small. The principal argument here is simple: the number of jobs offered by (future) natural resource (related) projects is very small in comparison with the total labour supply. Moreover, it is to be noted that the main non-natural resource export sector in Mozambique is not manufacturing but fisheries and agriculture, which are small in size and technologically backward. Hence, in the case of a possible real exchange rate appreciation, the reduction of economic dynamics due to the so-called spill-over loss effect will mainly result from the agricultural rather than the manufacturing sector. However, so far there are no indications of this happening.

As discussed in section 3.2 and 3.3, another risk of a large share of primary products in total exports is that of exchange rate volatility resulting from potential natural resource price fluctuations. Substantial exchange rate volatility will have a negative impact on ('normal') investments by economic agents while (in case of downward resource price movements) it also may cause difficulties in repaying foreign debts, thereby invoking macro-economic instability. However, we believe the risk of exchange rate volatility to be relatively small in the case of Mozambique since for many years to come a considerable part of primary exports in Mozambique is subject to a relatively stable price regime. The majority of electricity exports are and will be subject to long-term contracts which usually do not allow for large price fluctuations. As for aluminum, coal and minerals extracted from the heavy sands deposits, their world market prices are in general much less volatile than crude oil prices.[49] In addition, their export prices are to a large extent also subject to long-term contracts that typically take the form of a fixed market price with standard escalation. Moreover, the prices of all these resources (electricity, coal, aluminum, minerals) are expected to gradually increase for the foreseeable future due to the fact that increasing demand will outpace supply on regional and international markets. With regard to electricity, the excess demand on the regional electricity market is mainly driven by South Africa, while the increasing demand for the other resources is mainly caused by demand from emerging economies such as China, India and Brazil. However, if Mozambique turns into an oil producing country it will definitely become much more vulnerable to exchange rate volatility given the relatively large volatility of international oil prices in combination with the relatively large share of oil exports in total exports (see section 2).

Finally, in section 3.3 we also discussed the risk of the government reducing investments in productive capacity, including education and infrastructure, as a result of the false sense of wealth brought by windfall profits from natural resources. If we do not consider potential windfall profits from oil exploitation, we regard this risk as relatively small, simply because there are not many windfall profits to be expected. So far, the contracts between the Government of Mozambique and the companies exploring natural gas, hydropower and mineral sands foresee very small revenues for the Mozambican government – both in relation to the profits of the companies involved as well as in relation to total government revenues. Concerning the latter, we estimate that fiscal state revenues from the various large companies in the primary sector will increase to around 120 million US$ by 2010 and 250 million US$ by 2020, which is equivalent to about 7-8% of total fiscal and other internal revenues.[50] These estimates are based on fiscal revenue projections from the Quadro Macro model of the Ministry of Planning and Development, in combination with the assumption of a 10% increase in 'normal' fiscal revenues as of 2010 and including specific projections for the different mega projects. Table 7 provides a breakdown of our estimate.

TABLE 7: Estimate of the natural resource sector's contribution to government revenues

	2000	2002	2004	2006	2008	2010	2012	2014	2016	2018	2020
Fiscal Revenues	450	461	791	871	1 155	1 350	1 634	1 977	2 392	2 894	3 502
Natural Resources (megaprojects)	11	18	26	44	64	122	156	182	201	215	256
MOZAL	4	9	16	16	16	26	37	46	56	68	83
HCB	7	9	8	12	11	10	10	11	11	10	10
MPHANDA NKUWA	0	0	0	0	0	0	0	13	13	13	13
CENTRAL TERMICA - Gas Natural Inhambane	0	0	0	0	0	8	8	8	8	8	8
CENTRAL TERMICA - Carvao Mineral Moatze	0	0	0	0	0	0	12	12	18	18	18
SASOL - Gas Natural Inhambane	0	0	2	16	36	49	51	53	55	57	60
MOATIZE coal mine - Moatize Tete	0	0	0	0	0	24	24	24	24	24	24
CORRIDOR Heavy Sands - Chibuto Gaza	0	0	0	0	1	5	13	13	13	14	38
MOMA Heavy Sands - Moma Zambezi	0	0	0	0	0	0	1	2	2	2	2
Other	439	443	765	827	1 091	1 350	1 634	1 977	2 392	2 894	3 502
Other Revenues	25	28	34	39	90	57	68	83	100	121	147
TOTAL	**475**	**488**	**824**	**909**	**1 245**	**1 407**	**1 777**	**2 151**	**2 602**	**3 149**	**3 810**
% Natural Resources (megaprojects)	2,3%	3,7%	3,1%	4,8%	5,2%	8,7%	8,8%	8,5%	7,7%	6,8%	6,7%

The underlying reason for the moderate estimated contribution of the natural resource sector to government revenues is that up to now, the Government of Mozambique has granted large tax benefits to these companies. Somewhat ironically, one could conclude that a positive effect of this is that there are simply no large amounts of money to be wasted on consumption goods or non-productive investments. The latter is further ensured, at least to some extent, by the continued strong role of the international community in providing financial resources for Mozambique in the form of development aid. Again, this situation might change if Mozambique produces considerable quantities of oil, which might easily lead to large windfall profits in the case of (sudden) positive price movements at the international oil market. For example, if Mozambique becomes a small oil producer (like Chad or Gabon, with 200,000 Barrels/day), a price increase of 10 US$ per Barrel implies an additional annual income of over 700 million US$. If we presume that oil contracts are such that 50% of these windfall profits will be captured by the oil companies, the state receives an additional 350 million US$, which might be more than 10% of total internal revenues. It needs no argument that if oil production is greater than the aforementioned 200,000 Barrels/day, these values easily become much larger and so does the risk of a false sense of wealth brought by windfall profits.

Problems of an Institutional Nature

To assess the potential role of institutions in avoiding or enhancing the risk of a resource curse in Mozambique, we show in Table 8 the score of Mozambique on the aforementioned World Bank ranking of Aggregate Governance Indicators (Kaufmann et al. 2006), in comparison with other countries. These indicators are measured in units ranging from –2.5 to 2.5, with higher values corresponding to better governance outcomes. We combine this information with the estimated resource intensity of Mozambique in 2010/15 (as in Table 4). On the right hand side of Table 8 we list the HDI ranking as well as GDP per capita for selected countries in 2000.

TABLE 8: Institutional Quality, Resource Intensity and Economic Development

Country Name	WB Institutions indicator (–2.5-2.5) 2000	Fuel + ores and metals exports (% of GDP)	Fuel + ores and metals exports (% of exports)	GDP per capita (US$) 2000	GDP per capita, PPP (US$) 2000	HDI rank 2000 (1-177) 2000
Sweden	1.68	2.1	5.6	27 012	24 526	6
Australia	1.64	6.3	38.5	20 285	26 181	3
Canada	1.61	6.8	17.5	23 198	27 880	5
Germany	1.51	1.2	3.9	22 750	26 075	20
Norway	1.50	25.2	70.0	39 322	35 132	1
United States	1.48	0.3	3.8	34 599	34 114	10
Japan	1.12	0.2	1.6	37 409	25 974	11
Chile	1.06	11.8	46.5	4 964	9 197	37
Botswana	0.77	3.6	7.1	3 135	7 525	131
Trinidad and Tobago	0.49	34.3	65.4	6 326	8 951	57
South Africa	0.27	4.9	21.0	2 910	9 434	120
Malaysia	0.23	11.6	10.7	3 881	8 952	61
Mali	–0.20	0.1	0.3	223	792	174
Malawi	–0.33	0.1	0.4	166	599	165
Mozambique 2010	**–0.40**	**40.4**	**82.5**	**208**	**874**	**168**
Mozambique 2010, sem alumínio	**–0.40**	**19.1**	**39.0**	**208**	**874**	**168**
Mozambique 2015, com Petroleo**	**–0.40**	**38.2**	**87.6**	**208**	**874**	**168**
Burkina Faso	–0.41	0.3	3.3	231	1 013	175
Zambia	–0.46	13.1	63.9	328	777	166
Gabon	–0.58	42.5	85.0	3 920	6 127	123
Nigeria	–0.99	49.7	99.6	332	878	158
Congo, Rep.*	–1.43	48.7	88.0	934	961	142
Angola	–1.78	6.2	6.9	715	1 952	160

* Natural Resource Data are of 1995. ** At 200,000 Barrel/day

From the Table it can be concluded that with an average score of –0.40 in 2000, the institutional quality in Mozambique is considered weak. In all, the picture that emerges from Table 8 is that of Mozambique as a country that will turn rapidly (within a couple of years) into a natural resource dependent economy with a weak institutional infrastructure and low levels of income and welfare. We are inclined to think that this mix makes Mozambique vulnerable to a resource curse, given the experience of other (African) countries in similar positions. To explore this risk somewhat further let us zoom in on the quality of institutions in Mozambique in an international perspective. In Table 9 we present the scores of Mozambique on the separate World Bank Government Indicators in comparison with a selection of other countries.

TABLE 9. Governance Indicators for Mozambique in Interrnational Perspective

2000	AVERAGE	Voice and Accountability	Political Stability	Government Effectiveness	Regulatory Quality	Rule of Law	Control of Corruption
SWEDEN	1.68	1.45	1.29	1.77	1.30	1.87	2.43
AUSTRALIA	1.64	1.48	1.13	1.89	1.43	1.89	2.00
CANADA	1.61	1.18	1.14	1.94	1.29	1.87	2.25
GERMANY	1.51	1.18	1.14	1.92	1.30	1.84	1.67
NORWAY	1.50	1.33	1.22	1.63	0.87	1.90	2.07
UNITED STATES	1.48	1.11	1.08	1.74	1.45	1.79	1.73
JAPAN	1.12	0.86	1.06	1.15	0.73	1.66	1.28
CHILE	1.06	0.47	0.66	1.31	1.19	1.23	1.50
BOTSWANA	0.77	0.79	0.75	0.84	0.71	0.56	0.95
TRINIDAD AND TOBAGO	0.49	0.58	0.33	0.61	0.73	0.38	0.31
SOUTH AFRICA	0.27	0.96	-0.31	0.40	-0.03	0.15	0.49
MALAYSIA	0.23	-0.35	0.15	0.71	0.28	0.39	0.21
MALI	-0.20	0.26	0.21	-0.72	0.17	-0.69	-0.45
MALAWI	-0.33	-0.31	-0.09	-0.57	-0.17	-0.59	-0.23
MOZAMBIQUE	-0.40	-0.30	-0.33	-0.53	-0.12	-0.71	-0.39
BURKINA FASO	-0.41	-0.36	-0.31	-0.38	-0.06	-0.61	-0.76
ZAMBIA	-0.46	-0.25	-0.73	-0.63	0.25	-0.55	-0.84
GABON	-0.58	-0.49	-0.45	-0.72	-0.36	-0.65	-0.81
NIGERIA	-0.99	-0.61	-1.64	-1.00	-0.45	-1.10	-1.96
CONGO	-1.43	-1.55	-1.85	-1.80	-1.09	-1.26	-1.05
ANGOLA	-1.78	-1.47	-2.47	-1.86	-1.85	-1.52	-1.52

Source: Kaufmann et al. 2006

From the Table it can be concluded that Mozambique has a relatively low score in all six dimensions of governance, but particularly with respect to the Rule of Law and Government Effectiveness. Consequently, there is in our view little reason to nurse high expectations about the capacity of the government to fight rent-seeking and related illegal activities by individuals in search of personal wealth. The same is probably true regarding the extent to which we can expect the design and implementation of effective economic policies by the government, aimed at prudent resource management, and productive investments in, for example, education and infrastructure. In the end, Tables 8 and 9 show that in terms of institutional quality, income (GDP/capita) and welfare (HDI) Mozambique is not at all comparable to a rich resource abundant country such as Norway, but very much comparable to Zambia. On the other hand, Mozambique scores much better than resource abundant countries such as Angola, Congo and Nigeria in terms of institutional quality. Hence, there is also no reason to be overly pessimistic at this point.

As we argued in section 3.4, different types of natural resources bear a different degree of risk regarding the chances of becoming trapped in a resource curse.

Economies rich in so-called point-sources (like oil, natural gas, minerals, diamonds) that are often geographically concentrated, are in general much more vulnerable to rent-seeking and other unproductive activities than economies rich in widely scattered resources (Bulte et al. 2003). The underlying reason is that point resources can be easily controlled by relatively small groups in society. As a result, elites in control of point resources might lose interest in broad-based economic development, including promotion of education and democratic practices since this will dilute their power base. In section 2 we have shown that almost all major natural resources found in Mozambique are point resources: natural gas, coal, mineral sands and probably also oil. Fortunately, we cannot conclude that the elites in Mozambique that are in control of these resources are increasingly resisting the idea of broad-based economic development and instead are widely engaged in actively weakening the institutional infrastructure in Mozambique. On the contrary, the government program has defined as its main goal the fight against poverty and many initiatives are being taken in this respect. Moreover, Mozambique formally is a democracy and there is active involvement of the international community in all areas of policy making. However, it is also to be noted that Mozambique has a young and thus vulnerable democracy and effective control of the government is still relatively weak. In this respect it is beyond doubt that a formidable challenge and responsibility for the government exists with respect to good management and distribution of resource revenues in order to avoid feelings of injustice and disputes between various groups within a society that in turn may undermine democratic processes and political stability. Without wanting to be unnecessarily alarmist, it is not unrealistic to imagine that, under certain conditions, the likely existence of potentially large oil fields (off the coast) in Cabo Delgado and Sofala provinces might contribute to increasing regional and/or political tensions, particularly since they are geographically distant from the concentration of power in the capital, Maputo, and/or close to areas under the influence of the Renamo opposition party. Additionally, so far the treatment of existing large scale investment projects (the so-called mega projects) in Mozambique – most of them operating in the area of natural resource exploration – has been characterized by lack of transparency and granting of large fiscal benefits (see also Table 7).

Certainly building and improving institutions is a complex and long-term process in any place in the world (North 1990). In other words, there is no 'quick fix' when it comes to creating good institutions. In Table 10 we illustrate the recent evolution of the quality of Mozambique's institutional infrastructure by presenting the 6 indicators for institutional quality for the period 1996-2005.

TABLE 10: Institutional Quality Mozambique 1996-2005

	1996	1998	1998	2000	2002	2003	2004	2005
Voice and Accountability	−0.26	−0.13	−0.13	−0.3	−0.3	−0.1	−0.11	-0.06
Political Stability	−0.59	−0.65	-0.65	−0.33	0.47	0.31	0.08	0.04
Government Effectiveness	−0.54	−0.42	−0.42	−0.53	−0.45	−0.48	−0.42	−0.34
Regulatory Quality	−1.07	−0.4	−0.4	−0.12	−0.55	−0.46	−0.43	−0.6
Rule of Law	−1.29	−1	−1	−0.71	−0.61	−0.71	−0.69	-0.72
Control of Corruption	−0.54	−0.87	−0.87	−0.39	−0.83	−0.8	-0.81	−0.68
Average	-0.72	−0.58	−0.58	−0.4	−0.38	−0.38	−0.4	-0.39

From the Table it can be concluded that in spite of continued high economic growth, political stability, considerable FDI and a consistent political discourse in favor of good governance, the regulatory quality and control of corruption in Mozambique have deteriorated over the last 5 years. The only factor showing considerable improvement is political stability, as a result of which the overall quality of institutions in Mozambique (measured as the unweighted average of the 6 indicators) has been more or less constant since 2000. Although we cannot draw firm conclusions from these perception-based indicators, these figures also do not exactly portray the ideal starting point for large scale natural resource exploration, given the experience in other (African) countries during recent decades. The current rather weak institutional infrastructure, which is not clearly improving, in combination with a rapid expansion of natural resource exploitation underscores our concern that Mozambique indeed is vulnerable to a resource curse that operates through the indirect effect of institutions.

Ways to Avoid a Resource Curse

Vulnerability to a resource curse is not to say that the resource curse is inevitable for Mozambique. In the end, some countries have (to a large extent) avoided a resource curse and others have even benefited from their resource wealth to construct a prosperous society due to sustainable economic development (such as Norway). What can be done to ensure that future natural resource exploitation in Mozambique will be a blessing instead of a curse? Without claiming to be exhaustive, we discuss below several options to decrease the risk of a resource curse.

The first three options are mainly motivated by the wish to reduce revenue volatility caused by fluctuations in natural resource prices. In general, volatility is a bad thing: it hampers investment by increasing interest rates and uncertainty, it makes government planning difficult and it tends to raise debts and deficits because it is easier to raise spending when prices rise than to cut it back when prices fall. The other options deal with diversification, transparency and prudent exploitation as strategies to guarantee proper management of natural resources and their revenues.

Prudent and anti-cyclical spending and borrowing

The first option to mitigate the negative effects of volatility is that the government sticks to a policy of prudent budgeting as well as avoiding pro-cyclical spending and borrowing. Such a policy also helps to curb Dutch disease phenomena, such as inflation, that may be aggravated by increased government spending of resource revenues. Needless to say, this policy prescription is easier to give than to implement, especially in poor countries like Mozambique: it requires a strong finance minister who is able to fight uphill political battles to save, not spend, windfall profits while there are many public and politically networked interests that want to spend the money. An unorthodox solution to this problem is to distribute resource revenues directly to the public and require the government to rely on normal fiscal principles to determine appropriate levels of taxation and expenditure (Sala-i-Martin and Subramanian 2003; Sandbu 2006). Although an original proposal that we think deserves to be taken seriously, its practical difficulties for implementation in a poor country such as Mozambique are obviously enormous. But, at the very least, the economic damage caused by volatility demands much prudence in borrowing money with natural resources serving as collateral. If these contracts are designed such that the burden of resource price fluctuation falls (to a large extent) on Mozambique, the country indeed becomes increasingly vulnerable to external shocks with potential negative effects falling disproportionately on the poor who are typically less able to cope with volatility.

Stabilization Funds

Another way to reduce volatility in government resources is using natural resource revenues to create stabilization funds – the so-called ‘rainy-day funds’ (Stiglitz 2005) –

which may provide some guarantee for smoothing government spending and investment against the background of fluctuating natural resource prices. Since stabilization funds create a certain degree of separation of accounts, these funds also provide other functions, including reducing the risk that high resource revenues translate into Dutch disease problems (for example, through investments in other sectors in order to diversify exports), reducing the risk of revenues being squandered rather than spent on investments in human and physical capital that may compensate for the exhaustion of non-renewable resources. However, while examples of well managed oil funds do exist (for example in Alaska and Norway), they are exceptions to the rule that these funds are very hard to operate and subject to political intrigues and corruption. One possible way to increase proper management of natural resource funds is that they should be directly fed with contracts between private firms and the government, in combination with budget rules about spending the money as well as possible involvement of a third party, for example the World Bank, in order to create a certain distance from the day to day whims of politics.[51]

Good Contracts

A third way to diminish volatility in government revenues is designing good contracts between the government and the extractive industries, for example by using moving-average prices rather than current prices in contracts, in order to shift (at least part of) the volatility to the private companies (Shaxson 2005). Often, the private companies are granted a fairly stable price, while both the negative and positive price deviations on the international market – typically beyond the control of a particular country – are borne by the host country, thus magnifying revenue volatility for the country. Reversing this situation will reduce the latter, while large private firms can relatively easily insure themselves against price risks on the international finance markets.

Diversification

Obviously, reducing dependence on natural resources will reduce the potential negative impact of natural resource exploration on the economy. Resource dependence can be decreased by diversifying economic activity to sectors other than natural resources. In other words, it is important to develop broad based economic development by promoting the agricultural, manufacturing and service sectors, thus creating economic dynamics and prosperity for the population as a whole – something that will never automatically result from natural resource exploitation alone. Revenues from natural resources could help Mozambique provide essential conditions for improving productivity and economic dynamics outside the natural resource sector, for example through financing physical infrastructure (roads, electricity), investment in human capital (education, health) and a healthy financial sector. However, a remaining key obstacle in Mozambique in this respect is its very complicated business environment.[52] In essence this is again a problem of institutional quality, which will not be easy to solve in the short run.

Transparency

Transparency is probably the most important strategy to avert a resource curse. It includes making public the interaction between the government and the companies extracting natural resources, the bidding and licensing procedures, the contracts signed, the quantity of resources exploited, the revenues received and the way the revenues are spent. Transparency reduces opportunities for corruption through an information effect: if the public is better informed regarding the resource revenues received by the state, this helps motivate the population to exert pressure on the government to monitor these funds appropriately and to spend them on investments that contribute to poverty reduction.

Given the current rather weak institutional infrastructure in Mozambique, in our opinion the international community has a key role to play in improving and guaranteeing transparency. This includes exerting pressure on (foreign) companies in making their payments to the government public, and on the government to promote and implement anti-corruption measures. An important way to do this exists in the form of the Extractive Industries Transparency Initiative (EITI), a potentially useful instrument to promote transparency and good governance in the area of natural resource exploitation through international auditing and publishing of payments made by mining and extractive industries (Andersson et al. 2007). Mozambique is currently considering membership of EITI .

Prudent Exploitation

Finally, we want to question the widespread (and often implicit) assumption that natural resource extraction will always raise a country's wealth by generating resource revenues. For it is important to take into consideration the fact that in one way extraction of non-renewable resources reduces the wealth of a country – since the stock of natural capital reduces irreversibly as a result of exploitation of non-renewable resources. Just as firms include in their accounts the depreciation of their assets, degradation of natural capital should ideally also be reflected in the (annual) accounts of a country. If a country sells its natural resources and borrows money with future resource wealth as collateral, it may show an increase of consumption and GDP in the short run, but integrated accounting including all kinds of capital stocks may show that in fact the country is gradually reducing its wealth because once non-renewable resources (such as oil, natural gas, coal, minerals) are extracted and sold, the natural capital component of a country's wealth decreases (World Bank 2006). Investments in human and physical capital may, however, to some extent compensate for degradation of natural capital. In this way, natural resource exploitation can be seen as a reallocation of a country's portfolio with one asset (resources) being substituted for other assets (human and physical capital). In any case, high extraction rates without appropriate planning regarding ways to spend the revenues on productive investments may easily lead to a sub-optimal strategy for increasing wealth and reducing poverty. In such a case it is better to postpone exploitation of the resources, a strategy which also makes perfectly sense in the light of current rising prices of the resources on the international market. Instead of selling now at a low price, selling in, for examples, 20 years time at a high price can be an optimal strategy if the goal is to increase welfare across existing and future generations.

Conclusions

Many resource rich countries are among the poorest nations in the world, in spite of decades of exploitation of their natural wealth. This phenomenon is often referred to as the 'paradox of abundance' or 'resource curse'. Mozambique has considerable quantities of unexploited natural resources, the large scale exploitation of which has just begun and is expected to grow rapidly during the next decade. Will this be a blessing for the country, or is it more likely to turn into a curse?

To answer this question, we first have estimated the potential resource wealth of Mozambique in comparison to that of other countries. Our data comprise a comprehensive set of best-estimates of Mozambique's natural resource reserves as well as current and expected exploitation and export flows – information that until now predominantly has been dispersed and unpublished. The major natural resources of Mozambique include coal, mineral sands, natural gas, hydropower, and probably also oil. Research into potential oil reserves in Mozambique is in its initial phase, and therefore no useful data yet exist regarding these potential reserves. Instead, we conducted a kind of thought experiment to see what natural resource exports would look like if Mozambique becomes an oil producing country similar to existing oil producing nations of varying sizes. Our calculations for the period 2000-2020 show that by any means Mozambique is rapidly becoming a highly natural resource-intensive economy, comparable to countries such as the Republic of Congo, Gabon, Norway, Trinidad and Tobago, and Zambia. We estimate that the share of primary exports in total exports (including aluminum) will be in the range of 70-80%, or around 40% of GDP, while the stock of natural capital (including forest resources) comprises over 30% of the country's total wealth. Once Mozambique starts to exploit oil, these figures will further increase, depending on the size of oil production. Next, we reviewed the growing body of literature on the determinants of a natural resource curse, discussing various transmission channels through which natural resource wealth may impact the economy. Subsequently, we assessed the risks of a resource curse occurring in Mozambique in the (near) future by assessing the different possible transmission channels in the Mozambican context. To this end we distinguished between economic and institutional transmission channels.

The economic transmission channels through which natural resource exploitation may harm the economy include decreasing competitiveness of the non-resource tradable sector caused by real currency appreciation (Dutch disease), crowding out of investments, policy failures including under-investment in human capital and infrastructure, and debt accumulation. Our assessment leads us to believe that the risk that Mozambique will suffer from these problems is relatively low in the short- and medium term. In the longer term (after 2015), however, this risk might become relatively high if Mozambique develops into an oil producing country – even if the country is going to be a small producer in international perspective. This judgment is mainly based on the expected increased vulnerability of the country to exchange rate volatility, given the relatively high volatility of international oil prices in combination with the presumably relatively large share of oil exports in future total exports. In addition, the relative size of the potential oil revenues increases the risk of crowding out productive investments and undermining prudent government finances as a result of the increased likeliness of a false sense of wealth brought about by windfall profits.

The institutional transmission channels through which natural resource abundance may hamper economic development include lack of transparency, corruption, rent-seeking, waste of money and weakening of democracy and political stability. We are inclined to think that Mozambique is rather vulnerable to a resource curse that originates from these problems of an institutional nature. The current institutional quality in Mozambique is arguably weak and in spite of continued high economic growth, political stability, considerable FDI and a consistent political discourse in favor of good governance, the perceived regulatory quality as well as the control of corruption in Mozambique has deteriorated since 2000. Moreover, Mozambique is a young democracy where effective control of the government is still relatively fragile. In addition, the current treatment of large investments by the various extractive industries is so far characterized by lack of transparency and granting of large fiscal benefits. It is against this background that Mozambique is rapidly developing into a natural resource dependent economy based on point-resources that can be easily controlled by relatively small groups in society. If the experience of other resource abundant (African) countries may serve as any guide, this is anything but an ideal starting point for large scale natural resource exploitation.

Nevertheless, a resource curse is not an inherently deterministic phenomenon: it can be and has been avoided by resource abundant countries. In this context, recent research has, in our view correctly, stressed the important difference between a resource abundant and resource dependent country (Brunschweiler and Bulte 2008, Stijns 2005). Resource abundance refers to the stock of natural capital while resource dependence indicates the share of natural resource exports in total exports or as percentage of GDP. In short, the experience of other countries suggests that natural resource abundance becomes a problem only when it leads to natural resource dependence. As we have shown, Mozambique is a resource abundant country whose economy is becoming increasingly resource dependent. The main strategies to avoid natural resource dependence include prudent exploitation of natural wealth and stimulating economic development outside the natural resource sector. This implies that fighting rent-seeking and corruption by means of transparent management of revenues is a necessary but not a sufficient requirement for avoiding a resource curse. Economic diversification requires a good investment climate, which in turns depends on political stability, macroeconomic stability, a favorable business climate, reliable infrastructure and a certain supply of skilled labour. Political stability in the face of natural resource wealth asks for appropriate distribution of (future) resource revenues in order to avoid feelings of injustice and disputes between various groups within a society. Macroeconomic stability benefits from conservative, anti-cyclical spending and borrowing as well as from good contracts between the government and private firms that help to limit revenue volatility. A favorable business climate involves, among others, a substantial decrease of the cost of doing business by reducing red tape, simplifying import and export procedures and improving the enforcement of contracts. Reliable infrastructure requires investment in construction and maintenance of roads, railways, electricity, telecommunication and port facilities. Skilled labour results from investments in education.

This set of policy recommendations assumes a strong government and good institutions – which of course helps to explain why only those countries with a relatively high level of institutional quality have been able to avoid a resource curse (see also Brunschweiler and Bulte 2008). At present, a strong government and good institutions are typically not yet in place in Mozambique. This should not come as a surprise given the country's history of colonization and the post-independence civil war. Also, the Mozambican government's determination to fight poverty and stimulate economic development is laudable and making exploitation of the country's natural wealth part of a strategy to eradicate the country's severe poverty is both understandable and economically defensible. But, our analysis suggests that, given the small size of the country's non-primary economic sectors, rapid expansion of natural resource exploitation may easily turn Mozambique into a resource dependent economy. In combination with the country's current low level of institutional quality, this leads us to conclude that the country is vulnerable to a resource curse that eventually may backfire on the fight against poverty. As we have shown this risk is particularly high once Mozambique starts to exploit oil. Hence, resource abundance does not provide an easy way out of poverty. It rather implies increased responsibility as well as increased complexity in designing and implementing a successful long-term economic strategy, in which prudent instead of rapid exploitation of natural resources, diversification of the economy and improving institutional quality are essential ingredients.

APPENDIX 1 – Subsoil Asset Wealth

In section 2 of the main text we estimated the stock value of subsoil assets in Mozambique according to the methodology used by the World Bank in its study 'Where is the Wealth of Nations?' (World Bank 2006). The aggregate results are presented in Table 5 of the main text. Below we present the details.

TABLE A1.1 Estimate of Value of Natural Gas Stocks

Natural Gas				
Pande/Temande		**Low**	**Medium**	**High**
Quantity (q)	TJ	144,494	144,494	144,494
Rents (π)	US$/TJ	1000	1500	2000
Value (V)	US$	2,643,006,804	3,964,510,206	5,286,013,608

TABLE A1.2 Estimate of Value of Coal Stocks

Coal				
Moatize		**Low**	**Medium**	**High**
Quantity (q)	1000 Ton	15,000	15,000	15,000
Rents (π)	US$/ton	20	25	30
Value (V)	US$	5,487,438,562	6,859,298,203	8,231,157,843

TABLE A1.3 Estimate of Value of Heavy Sands Stocks in Moma

Heavy Sands – Moma				
Moma		**Low**	**Medium**	**High**
Ilmenite				
Quantity (q)	1000 Ton	1,200	1,200	1,200
Rents (π)	US$/ton	60	63	67
Value (V)	US$	1,306,010,378	1,382,834,518	1,459,658,658
Zircon				
Quantity (q)	1000 Ton	84	84	84
Rents (π)	US$/ton	490	508	525
Value (V)	US$	752,876,571	779,765,020	806,653,469
Rutile				
Quantity (q)	1000 Ton	32	32	32
Rents (π)	US$/ton	315	326	336
Value (V)	US$	181,497,030	187,546,931	193,596,832
Total Moma	**US$**	**2,240,383,979**	**2,350,146,469**	**2,459,908,959**

TABLE A1.4 Estimate of Value of Heavy Sands Stocks in Chibuto

Heavy Sands – Chibuto		Low	Medium	High
Titanium slag				
Quantity (q)	1000 Ton	1,000	1,000	1,000
Rents (π)	US$/ton	298	301	305
Value (V)	US$	5,441,709,907	5,505,730,024	5,569,750,140
Zircon				
Quantity (q)	1000 Ton	63	63	63
Rents (π)	US$/ton	490	508	525
Value (V)	US$	560,176,020	580,182,306	600,188,593
Rutile				
Quantity (q)	1000 Ton	12	12	12
Rents (π)	US$/ton	315	326	336
Value (V)	US$	70,294,088	72,637,224	74,980,361
High-purity pig iron				
Quantity (q)	1000 Ton	491	491	491
Rents (π)	US$/ton	210	214	217
Value (V)	US$	1,886,416,754	1,917,857,034	1,949,297,313
Leucoxene				
Quantity (q)	1000 Ton	6	6	6
Rents (π)	US$/ton	350	354	357
Value (V)	US$	40,972,875	41,382,603	41,792,332
Total Chibuto	**US$**	**7,999,569,644**	**8,117,789,192**	**8,236,008,739**

TABLE A1.5 Estimate of Value of Oil Stocks under different assumptions

Oil				
		Low	**Medium**	**High**
200,000 Barrel/day				
Quantity (q)	1000 Barrels	73,000	73,000	73,000
Rents (π)	US$/Barrel	28	35	42
Value (V)	US$	37,387,748,070	46,734,685,087	56,081,622,104
1,500,000 Barrel/day				
Quantity (q)	1000 Ton	547,500	547,500	547,500
Rents (π)	US$/ton	28	35	42
Value (V)	US$	280,408,110,522	350,510,138,152	420,612,165,783

APPENDIX 2 – Natural Resource Sector and the Balance of Payment

In this appendix we briefly describe the way in which we estimated the impact of the natural resource sector on the Balance of Payments until 2020. We define the

Balance of Payments effect as the direct trade balance effect (exports minus imports) minus expected debt service and profit repatriation. Our calculations took as a starting point the information provided by Andersson (2001), which we updated and revised where necessary, while adding our own calculations for those projects not included in his paper. As described in the main text, the main sources of our information are the Ministry of Energy, the Ministry of Mineral Resources, and a variety of other sources including the Unites States Geological Survey (USGS) Minerals Yearbook, African Mining Review and websites of the companies involved themselves. The information below is summarized in Table A2.1 at the end of this Appendix.

Aluminium – Mozal

Export and Import figures for 2000-2005 are taken from the SADC trade database (SADC, 2007). For the period 2006-2020 we assume a doubling of production capacity in 2010 (Mozal 3), as well as the following annual growth figures: 2007 (3%), 2008-2009 (1%), 2011 (10%), 2012, (5%), 2013-2014 (1%), 2015-2020 (0.5%). Concerning Mozal 3, we assumed investment data to be the same as for Mozal 1 (circa 1,350 million USD) as given by Andersson (2001), including the assumptions of a 3 year construction phase and 10% of total inputs during construction being sourced from Mozambique. Regarding profit repatriation and debt service, we used the figures provided by Andersson (2001) and subsequently increased this linearly in accordance with the extension of production capacity over time. It is to be noted that our estimates for the Balance of Payments effect of Mozal until 2008 are very much in line with those provided by Castel-Branco and Goldin (2003), once corrected for upwardly revised export figures based on actual information up to 2005 reflecting increased aluminum prices.

Electricity, Hydro – HCB

Export figures for 2000-2006 are provided by HCB, as given in Ministry of Energy (2007a), and assumed to grow from 10,817 GWh in 2006 to a maximum of 10,547 GWh as of 2009 (reflecting effective maximum capacity of HCB). In addition, we assumed export prices to increase gradually from about 1.6 USDc/kWh in 2006 to about 2.6 USDc/kWh by 2020. As for profits, we assume a profit margin of 0.1

USDc/kWh, of which 82% is repatriated until 2006 and 15% as of 2007 – reflecting the transfer of ownership from Portugal to Mozambique. As a result, our numbers for HCB differ significantly from those provided by Andersson (2001) because his calculations obviously did not yet reflect the new deal with ESKOM on electricity prices (2002) as well as the transfer of majority ownership of HCB from Portugal to Mozambique in 2007. We follow Andersson (2001) in assuming that up to 2006 as much as 70% of the turnover is used for debt service payments to the Government of Portugal, while we assume that this reduces to 30% as of 2007 (this would imply a total debt payment of around 1 billion US$ for the period 2007-2020, which is roughly the amount of debt agreed upon with the transfer of ownership).

Electricity, Hydro – Mphanda Nkuwa

We assume that Mphanda Nkuwa will become operational in 2014. Export figures are based on an annual export of 4,555 GWh against 2.75 USDc/kWh in 2014, with an annual increase of 1%. Furthermore we assume total construction costs of 1,600 million US$ (Ministry of Energy, 2007b), of which 10% will be sourced from Mozambique, and a 5-year construction period (2009-2013). Regarding profits we assume again a profit margin of 0.1 USDc/kWh and foreign ownership of 70%, implying that 70% of total profits will be repatriated. Finally, we assume that annual debt service repayments will be 10% of total debt, with debt being 70% of total investment costs (assuming 30% equity).

Electricity, Thermal, Natural Gas, Inhambane

We assume the new 700 MW natural gas fired electricity plant in Inhambane will become operational in 2010. Export figures are based on a price of 3.20 USDc/kWh in 2010, with an annual increase of 1%, and on the scenario that initially all its electricity will be exported to South Africa, while as of 2014 about 100 MW will be acquired by EdM and as of 2017 an additional 200 MW will go to the Corridor Heavy Sands project. Furthermore, we assume total construction costs of 800 million US$, of which 10% will be sourced from Mozambique, and a 4-year construction period (2007-2010, with major works in 2008-2009). Similar to Mphanda Nkuwa we assume again a profit margin of 0.1 USDc/kWh and foreign ownership of 70%, implying that

70% of total profits will be repatriated. Finally, we assume annual debt service repayments to be 10% of total debt, with debt being 70% of total investment costs (assuming 30% equity).

Electricity, Thermal, Coal, Moatize

We assume the new 1,500 MW natural gas fired electricity plant in Moatize will become operational in 2012 (1,000MW) and 2015 (500MW). Export figures are based on a price of 3.50 USDc/kWh in 2010, with an annual increase of 1%, and on the assumption that 90% of its production will be exported. Furthermore we assume total construction costs of 1,300 million US$, of which 10% will be sourced from Mozambique, and a 7-year construction period (2009-2015), with major works in 2009-2011 and 2015). Similar to Mphanda Nkuwa and the gas-fired thermal plant in Inhambane, we assume again a profit margin of 0.1 USDc/kWh and foreign ownership of 70%, implying that 70% of total profits will be repatriated. Finally, we assume annual debt service repayments to be 10% of total debt, with debt being 70% of total investment costs (assuming 30% equity).

Natural Gas – SASOL

Export figures for 2000-2006 are provided by Sasol, as given in Ministry of Energy (2007a), and assumed to grow from 102,061 TJ in 2006 to 137,269 TJ as of 2010 (reflecting effective maximum capacity of HCB). In addition, we assumed export prices will gradually increase from about 1.20 TJ US$/GJ in 2006 to about 1.49 US$/GJ by 2020. Regarding the Balance of Payments effect, we used the figures provided by Andersson (2001) and subsequently increased this linearly in accordance with the expansion of export quantities over time.

Coal – MOATIZE

We assume that large-scale exploitation of Moatize coal will start in 2009. Export figures are based on 90% of total production of 15 million ton/year at a price of 35 USD/ton. Furthermore we assume total construction costs of 1,000 million US$, of which 10% will be sourced from Mozambique, and a 4-year construction period

(2006-2009), with major works in 2008-2009). We assume profits to be 40% of total sales and foreign ownership of 90%, implying that 90% of total profits will be repatriated. Finally, we assume annual debt service repayments to be 10% of total debt, with debt being 70% of total investment costs (assuming 30% equity).

Heavy Sands – CORRIDOR

We assume the large-scale exploitation of the Chibuto heavy sands mine will start in 2010. Export figures are based on the information provided in Table 3 in the main text Furthermore we assume total construction costs of 1,000 million US$, and a 10-year construction period (2007-2016), with major works in 2008-2009 and 2014-16). Regarding the Balance of Payments effect, we used the figures provided by Andersson (2001) and subsequently increased this linearly in accordance with the expansion of production over time.

Heavy Sands – MOMA

We assume the large-scale exploitation of the Moma heavy sands mine starts in 2007. Export figures are based on the information provided in Table 3 in the main text. Furthermore, we assume total construction costs of 200 million US$, and a 3-year construction period (2005-2007). Profit figures are taken from Mirabaud (2007) and we assume foreign ownership (Kenmare Resources) of 95%, implying that 95% of total profits will be repatriated. Finally, we assume annual debt service repayments to be 10% of total debt, with debt being 70% of total investment costs (assuming 30% equity).

TABLE A2.1A Trade Balance & Balance of Payment Effect (million USD)

Aluminium-Mozal	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Export	1,106	1,117	1,128	1,692	1,861	1,954	1,974	1,993	2,003	2,013	2,023	2,034	2,044	2,054
Import	580	586	592	887	976	1,025	1,035	1,046	1,051	1,056	1,061	1,067	1,072	1,077
Import construction phase	212	845	160											
Trade Balance Effect	526	531	324	-41	725	929	938	948	953	957	962	967	972	977
Profits Repatriated	124	124	124	186	205	215	217	217	217	217	217	217	217	217
Debt Service	160	160	160	240	264	277	280	280	280	280	280	280	280	280
Balance of Payment Effect	242	247	40	-467	256	437	442	451	456	460	465	470	475	480
Electricity, Hydro – HCD	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Export	206	219	233	245	250	252	255	257	260	262	265	268	270	273
Import	206	219	233	245	250	252	255	257	260	262	265	628	270	273
Trade Balance Effect	206	219	233	245	250	252	255	257	260	262	265	268	270	273
Profits	16	16	16	16	16	16	16	16	16	16	16	16	16	16
Profits Repatriated	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Debt Payment	62	66	70	73	75	76	76	77	78	79	79	80	81	82
Balance of Payment Effect	142	151	161	169	172	174	176	178	179	181	183	185	187	189
Electricity, Hydro – MPHANDA NKUWA	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Export	0	0	0	0	0	0	0	125	127	128	129	130	132	133
Import construction phase	270	360	450	180	180									
Trade Balance Effect	0	0	-270	-360	-450	-180	-180	125	127	128	129	130	132	133
Profits	0	0	0	0	0	0	0	10	10	10	10	10	10	10
Profits Repatriated	0	0	0	0	0	0	0	7	7	7	7	7	7	7
Debt Repayment	112	112	112	112	112	112	112							
Balance of Payment Effect	6	8	9	10	11	13	14							
Electricity – Thermal Natural Gas – Inhambane	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Export	0	0	0	141	143	144	146	140	141	143	96	97	98	99
Import														
Import construction phase	90	270	315	45										
Trade Balance Effect	-90	-270	-315	96	143	144	146	140	141	143	96	97	98	99
Profits	0.0	0.0	0.0	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	
Profits Repatriated	0.0	0.0	0.0	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Debt Repayment	56	56	56	56	56	56	56	56	56	56	56			
Balance of Payment Effect	37	83	84	86	80	82	83	37	37	38	39			

TABLE A2.1B **Trade Balance & Balance of Payment Effect (million USD)**

Electricity – Thermal Coal – Moatize	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Export	0	0	0	0	0	221	223	225	341	345	348	351	355	359
Import														
Import construction phase			150	270	270	90	180	180	45					
Trade Balance Effect	0	0	-150	-270	-270	131	43	45	296	345	348	351	355	359
Profits	0	0	0	0	0	7	7	7	11	11	11	11	11	11
Profits Repatriated	0	0	0	0	0	5	5	5	7	7	7	7	7	7
Debt Repayment	91	91	91	91	91	91	91	91	91					
Balance of Payment Effect	-150	-270	-270	35	-53	-51	198	246	250	253	257	260		
Natural Gas –SASOL	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Export	148	163	168	171	178	182	186	189	193	197	201	205		
Import														
Trade Balance Effect	132	148	163	168	171	175	178	182	186	189	193	197	201	205
Balance of Payment Effect	**19**	**21**	**23**	**24**	**252**	**25**	**26**	**26**	**27**	**27**	**28**	**28**	**29**	**29**
Coal – MOATIZE	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Export	0.2	0.2	472.5	472.5	472.5	472.5	472.5	472.5	472.5	472.5	472.5	472.5	472.5	472.5
Import														
Import construction phase	270	450	90											
Trade Balance Effect	-270	-450	383	473	473	473	473	473	473	473	473	473	473	473
Profits	0.1	0.1	189.0	189.0	189.0	189.0	189.0	189.0	189.0	189.0	189.0	189.0	189.0	189.0
Profits Repatriated	0.0	0.0	132.3	132.3	132.3	132.3	132.3	132.3	132.3	132.3	132.3	132.3	132.3	132.3
Debt Repayment			70	70	70	70	70	70	70	70	70	70	70	70
Balance of Payment Effect			**180**	**270**	**270**	**270**	**270**	**270**	**270**	**270**	**270**	**270**	**270**	**270**
Heavy Sands – CORRIDOR	**2007**	**2008**	**2009**	**2010**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	
Export	0	0	0	238	241	244	246	249	251	254	257	260	703	711
Import														
Import construction phase	96	288	200	5	1	1	1	100	300	100				
Trade Balance Effect	-96	-288	-200	233	240	243	245	149	-49	154	257	260	703	711
	4	12	35	33	49	49	50	50	51	51	52	52	141	143
Heavy Sands – MOMA	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Export	119	122	125	191	196	200	205	209	214	219	224	229	234	239
Import														
Import construction Effect	50													
Trade Balance Effect	69	122	125	191	196	200	205	209	214	219	224	229	234	239
Profits	27	48	51	55	59	62	65	69	73	77	81	85	89	94
Profits	Repatriated	26	46	48	52	56	59	62	66	69	73	77	81	85 89
Debt Repayment	14	14	14	14	14	14	14	14	14	14	14	14	14	14
Balance of payment Effect	30	62	62	125	126	127	129	130	131	132	133	134	135	136

Notes

35 This paper was written when both authors worked at the National Directorate of Studies and Political Analysis (DNEAP) of the Ministry of Planning and Development in Maputo. We would like to thank the Ministry of Planning and Development (MPD) as well as the Ministry of Energy (ME) for access to their facilities and excellent collaboration. Peter Mulder also wants to thank the Danish International Development Agency (Danida) for financial support. The ideas presented in this paper are those of the authors and do not necessarily represent those of Danida, MPD, ME or any other institution of the Government of Mozambique. Any errors are exclusively our responsibility.

36 Source: World bank Development Indicators.

37 We also exclude gold and various types of mineral stones which, although available in Mozambique, are found in very small quantities and are to a large extent explored in an informal (illegal) way.

38 This is in line with the projections of the Quadro Macro of the Ministry of Planning and Development (until 2010).

39 We assume a doubling of production capacity in 2010, as well as the following annual growth figures: 2007: 3%; 2008-2009: 1%; 2011: 10%; 2012: 5%; 2013-2014: 1%; 2015-2020: 0.5%.

40 Note that the investigation period started in 2007 with a maximum of 6 years, to be followed by exploitation.

41 This assumption has rapidly become a rather conservative one in the light of the oil price increases since 2007. This observation underlines the volatility of oil prices and its potential huge impact on the value of oil exports in a country like Mozambique.

42 This paragraph is based on World Bank (2006).

43 From a purely pragmatic point of view, the choice of a longer exhaustion time would demand increasing the time horizon for the predictions of total rents (to feed equation [1]). On the other hand, rents obtained further in the future have less weight since they are more heavily discounted.

44 Of course, electricity based on hydro is a renewable source and as such the methodology is, strictly speaking, not applicable to hydroelectricity. Furthermore, electricity in general is not a subsoil asset; hence, for matters of consistency we excluded electricity from our calculations.

45 Note that although existent, resource extraction (such as coal) was always marginal under Portuguese colonial rule, while the economic significance of the Cahora Bassa dam was frustrated from shortly after its inauguration (1974) until the end of the 1990s due to destruction of the transmission lines during the post-independence civil war.

46 Calculated as the direct trade balance effect (export – import) minus expected debt service and profit repatriation. Our calculations took as a starting point the information provided by Andersson (2001), which we updated and revised where necessary, while adding our own calculations for those projects not included in his paper. For example, our calculations reflect higher aluminum prices than assumed by Andersson, a completely revised calculation for HCB due

to the transfer of its ownership in 2007, as well as new information on the heavy sands mine of Moma, and the exploration of coal and the thermal production of electricity. We refer to Annex 2 for details of our calculations.

[47] Projections are from the Quadro Macro model of the Ministry of Planning and Development.

[48] It should be noted that the inflow of foreign aid in Mozambique during the last decade has also been considerable, accounting for about 20% of GDP in 2005, but it did not cause Dutch disease like problems (see also Foster and Killick 2006).

[49] For example, between 1950 and 2006 average annual fluctuation of real coal prices was – 0.34% with a standard deviation of 0.11. During the same period, real oil prices fluctuated on average by 6.41% per year, while the standard deviation was 0.36 (Source: Energy Information Administration USA, www.eia.doe.gov)

[50] Based on fiscal revenues projections from the Quadro Macro (MPD), assuming a 10% increase in 'normal' fiscal revenues as of 2010 and including Mozal (aluminum), HCB (hydro), Mphanda Nkuwa (hydro), the 2 new thermal power plants in Inhambane and Moatize, Sasol (natural gas), and the companies exploring the Moatize coal field and the Moma and Chibuto heavy sands deposits. See Annex 3 for more details.

[51] That this is not a full guarantee against mismanagement shows in the case of the Chad-Cameroon project, which was designed along these lines, but has been cancelled by the government of Chad in order to spend the money according to its own desires, including military expenses (Shaxson 2005, Yamada 2007).

[52] In the 2006 World Bank ranking 'Ease of Doing Business', Mozambique ranks 140 out of 175, particularly due to red tape (on average 113 days are required to start a business, 364 days to obtain licenses), high costs of import and export, and huge difficulties in enforcing contracts (on average 38 procedures, 1010 days).

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