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MOZAMBIQUE'S COMING NATURAL RESOURCE BOOM

EXPECTATIONS, VULNERABILITIES AND POLICIES
FOR SUCCESSFUL MANAGEMENT

Tyler Biggs

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EXECUTIVE SUMMARY

Mozambique is set to become a world-class natural resource exporter with projections indicating that it will experience rapid increases in windfall revenues over the next several decades and well beyond. While this is welcome news for a low-income country with a substantial proportion of the population below the poverty line, it foreshadows some economic management problems ahead. The main concern is the poor economic record of many other low-income countries with large natural resource endowments. It is remarkable how often these countries have experienced inferior rates of growth compared with countries lacking such endowments. This pattern, known as the “natural resource curse,” has been documented in empirical research across a wide sample of nations.

The first section of this study reviews the research that examines the causes of this resource curse in low-income countries. Three channels of transmission are highlighted through which abundant resources can lead to poor economic performance -- volatility, Dutch Disease effects, and institutional weaknesses. Taking volatility first, world commodity prices are extremely volatile. Countries with low diversification and a large share of resources in GDP therefore suffer large swings in revenues and growth per capita. Such high volatility and boom and bust cycles are shown to be harmful to economic growth, particularly where financial markets less developed. Empirical research finds that volatility is a key cause of the “resource curse” problem. Volatility is harmful to growth because cyclical shifts of resources (labor, land, equipment) back and forth across economic activities incur costs (particularly transaction costs). Frictional unemployment and incomplete utilization of capital raises costs and reduces productivity. Volatility in commodity prices and revenues in developing countries often leads to macroeconomic and political instability because monetary and fiscal policy often tends to be pro-cyclical – expansionary in booms and contracting in busts, adding to extent of volatility (resource riches create incentive to borrow and spend and booms act to undercut political decision-making and create false sense of security, encouraging wasteful investment, increases in government employment and benefits, expansion of welfare programs, etc.) In addition, there are pro-cyclical private capital inflows as speculators move into local assets.

Dutch Disease refers to the negative adverse spillover effects of booming resource exports. Four major Dutch Disease effects are emphasized in research on the resource curse: (a) large inflows of foreign exchange (export revenues and FDI inflows) cause real exchange rate appreciation; (b) windfall revenues cause a huge increase in spending (from firm profits, worker incomes, government tax and royalty receipts); (c) real appreciation and the spending effect influence relative prices in the economy causing expansionary and contractionary effects (expansionary effects are associated with increases in non-tradable prices and output, contractionary effects are associated with a decline in non-resource tradables – manufacturing, agriculture, and tourism); (d) finally, real appreciation and the spending effect create incentives for labor and capital to move into booming sector and non-tradables production, which can cause a further decline in the non-resource tradables sector.

Two important impacts on the economy result from Dutch Disease. First, the decline of non-resource tradables can have adverse effects on future growth, as tradables are “special” in that they are crucial for technical change in economy. Second, there are welfare effects that cause a redistribution of income in the economy (a) firms and workers in the booming resource sector gain (higher profits and incomes); (b) government benefits from higher taxes and dividends; (c) producers of non-tradable goods and services gain; (d) primary losers will be producers of non-resource tradables (including import-competing activities). Thus, there will be losers and this is a big part of the Dutch Disease problem.

Lastly, resource booms in low-income countries have been found to have a significant influence on the quality of institutions and this has been shown to be a major channel through which the resource curse influences growth. Booming revenues can worsen governance resulting in corruption and policy mismanagement undermining growth. It is also important to note that the effects of a resource boom on the economy (e.g., macroeconomic stability and growth) are moderated by the quality of a country’s institutions. Countries with strong institutions at the start of a resource boom are shown to do much better, often turning a possible curse into a blessing. Countries with weak institutions are shown to do much worse. Finally, “point-source resources” (oil, gas, minerals, diamonds) are found to have the most negative effects on a country’s institutions because of the central command of resource revenues by government.

Given this background, section 2 of the study turns to Mozambique’s vulnerabilities to the possible adverse effects of the coming resource boom. The first issue is the expected extent of the coming boom and its impact on the economy. Recent IMF estimates (which were made before the large Anadarko and ENI gas discoveries) assume a 50% rise in Sasol (natural gas) and start of coal production by Vale and Rio Tinto, with full capacity by reached by 2020, project a boost to mega-project share in GDP from a current 8-10% to 18-20 % by about 2016 to 2020. Adding to this estimate the new Anadarko and ENI gas discoveries would increase the share of mega-projects in GDP to around 40-50% (assuming the value of the discoveries to be about \$400 billion over 4 decades, exports of \$10 billion per year, extraction companies take 50% share, Mozambique’s revenues would be roughly \$5 billion, gas-related mega-projects would then add another 20% to IMF projected GDP in year 2020).

This huge projected increase in foreign exchange revenues is likely to expose several key vulnerabilities in Mozambique’s economy that could lead to adverse effects on growth. The first is volatility. Data show Mozambique already experiences high volatility in key economic variables. A striking feature of the real exchange rate over the past several decades has been persistent volatility. High exchange rate volatility can reduce investment, productivity, and growth and have negative effects on tradables. Risks of volatility-related effects are apt to grow larger as Mozambique’s export basket shifts from aluminum towards coal and gas. Coal and natural gas prices are much more volatile than aluminum prices – gas by a factor of 2 and coal by a factor of 3, over the past decade.

Second, is sensitivity of the real exchange rate to various boom-related shocks? A key adverse effect of resource booms is real appreciation of the exchange rate. The study carries out an econometric analysis of the major determinants of long-run movements of the metical exchange rate to examine its sensitivities to commodity price shocks, as well as supply-side and demand-

side shocks. The study finds that metical is a “commodity currency” like the currencies of some other important commodity exporters – it appreciates when prices of the export commodities Mozambique exports rise and depreciates when they fall? The study shows that the real world-price of aluminum has a significant and stable effect on the metical real exchange rate – a 10 % increase in real commodity price results in a 1.7% real appreciation in the metical. This underscores that a key vulnerability in the coming resource boom will be sensitivity of metical to commodity price fluctuations. The econometric exercise also finds that supply-side shocks (e.g., differential growth rates per capita versus Mozambique’s trading partners) are determinants of long-run real exchange rate movements – a 10 % increase in differential growth rates causes a 5 % real exchange rate appreciation. Lastly, the study finds that capital inflows (measure by net foreign assets) play a significant role in determining movements in the real exchange rate, however the coefficient is negative. It appears that capital inflows flows over the last decade have been associated with large economic leakages (imports, profit remittances), as well as foreign exchange market interventions by BOM.

A third significant vulnerability is the quality of Mozambique’s institutions. The outlook for low-income countries with weak institutions before resource a windfall is particularly worrying. The World Bank’s Governance Indicators for Mozambique 1996-2010 show that the country scores poorly in government effectiveness, corruption, and rule of law and these scores have not improved much over the past 15 years. Areas of relative strength are observed in the indicators for voice and accountability and political stability – there has been a large improvement over period. The fact that government effectiveness, corruption, and rule of law continue to be the weakest areas is worrying because all research shows that “point-source” resource exports like coal and gas are problems for countries lacking strong institutional capability. Government of Mozambique’s adoption of the Extractive Industry Transparency Initiative is a positive sign for the future.

All these vulnerabilities, plus the market imperfections endemic to an economy like Mozambique’s, embryonic financial markets, scarce skilled labor, and inadequate infrastructure, reduce the country’s absorptive capacity. The ability to absorb a large resource windfall is extremely limited in the short to medium-run. Spending on investment or consumption will quickly run into bottlenecks, reducing the value of this spending. The most basic problem is steep supply curves, particularly for non-tradable goods and factors, causing spending to result in higher prices, including real exchange rate appreciation, rather than associated increases in output. Steep supply curves are caused by (a) critical shortages in “home-grown” capital (skills, infrastructure) for production of non-tradables and (b) inefficiencies and constraints in the business environment. Overcoming bottlenecks and building the economy’s absorptive capacity will take time. Bottlenecks can be avoided by importing, but not all necessary human and physical capital can be imported (some must be “home-grown”), and importing everything is not politically feasible or good for long-run development in Mozambique. Absorption constraints, even at this very early stage of the coming boom, are already beginning to show up in rising prices of non-tradables, particularly in urban centers (e.g., real estate, skilled labor).

The last section of the study, section 3, takes up a discussion of policy options for managing the coming resource boom. There are several overarching boom-related and Mozambique-specific economic constraints that policy formulation must consider:

- Resource revenues result from depleting a finite stock of resources, so they are temporary;
- Resource revenues are highly uncertain, as commodity prices are highly volatile;
- A low-income, capital-scarce country like Mozambique needs to raise consumption to reduce poverty, as well as increase investment in public goods (education, infrastructure, etc.) to grow faster;
- The current capacity in Mozambique to rapidly absorb windfall revenues is quite limited; the investment process in the country is not capable of delivering high returns on very large volumes of investment; and
- Capacities associated with effective governance and economic management are still weak.

These constraints to policy formulation mean that (a) policies for managing revenues are constrained by absorptive capacity and (b) adverse effects of the coming boom are likely to be stronger. Hence, policy will also have to explicitly address volatility and Dutch Disease problems.

The top priority of revenue management should be to raise domestic investment, both public and private, to increase growth and, boost consumption. Implementing this priority involves complications – low absorptive capacity which severely constrains potential investment returns. Until investment capacity is improved, there is no other practical option than to buy time by accumulating resources in a Sovereign Wealth Fund (SWF) or broader Natural Resource Fund (NRF), which can invest both at home and abroad. As a form of national savings, these Funds ensure that gains are partially shared with future generations. However, it will be important not to allow the overseas investment operations of the Funds to delay improvements in absorptive capacity at home. Safeguards needed to be built-in to ensure Funds are not raided by politicians – the ultimate safeguard is transparency (The Extractive Industry Transparency Initiative is a positive program in this regard). Government’s role in raising investment must also involve policies to stimulate more private sector investment (e.g. improve investment environment). Government investments in infrastructure will be complementary to these policy initiatives.

The second important priority is to allocate a fraction of revenues directly to citizens. It is important to raise consumption straight away to address poverty and this increase in incomes would help finance some private sector investments. Direct distributions of revenues to citizens also would reduce some of the risk of public misuse of resources and establish the principle that resources belong to all of Mozambique’s citizens. Given the volatility of revenues, however, consumption should be raised slowly to avoid future costly roll-backs.

Implementing direct distributions to citizens will not be easy in Mozambique and would take some time to develop. Currently there is no system of citizen registration and everyone not in the tax system. Given there is no infrastructure set up for direct distributions, a program running through central, district, and municipal governments will incur “leakages,” but the task is not impossible – it has been done in other countries. The most efficient approach would be to use new technologies, e.g., biometric identification, smartcards and electronic payments into mobile bank accounts.

Dealing with the potential adverse effects of boom – coping with volatility and moderating Dutch Disease will have to be an explicit part of the policy package. First, coping with long-run volatility of resource depletion will involve making high-return investments in domestic assets to increase future incomes, as well as saving a portion of revenues for future generations. Coping with short-run volatility of commodity price fluctuations could be accomplished to some degree by indexing contracts with international extraction companies based on future market conditions with agreements to share gains and losses in some proportion. It could also be handled by stabilizing consumption expenditures, which are economically and politically the most sensitive economic variables, and allowing the investment rate to fluctuate, which is shown to have much less influence on economic performance.

Intervening to moderate Dutch Disease the best option is the Sovereign Wealth Fund or Natural Resource Fund. The Funds reduce spending effects in economy and generate capital exports. This is a special kind of exchange rate protection policy, which benefits firms in the lagging, non-resource tradable sectors in a uniform way, not selectively. Another way to protect the exchange rate is accumulating reserves via foreign exchange intervention by BOM. However, over the long run this policy option has some difficulties. Once BOM has enough reserves (judged by precautionary and monetary criteria) it is costly as a long-run strategy. The third option to moderate Dutch Disease is selective protection (e.g., subsidies, tax breaks, tariffs), however this is a much less desirable policy option than the option of exchange rate protection. Selective, uneven protection can be quite difficult to manage, inefficient, and generate rent-seeking.

The welfare effects of interventions to moderate Dutch Disease should be a focus of attention in managing these interventions. First, there will be losers (e.g., firms benefiting from more capital investment in Mozambique rather than abroad); and winners (e.g., firms in non-resource tradable sector) as a result of the intervention to manage Dutch Disease; so there will be a redistribution of income in economy. Second, the interventions impose costs in form of potential underinvestment in Mozambique – if revenues go to lower-return foreign investments (via the sovereign wealth fund) over higher-return investments in Mozambique, then intervention results in a “cost of protection”. The policy argument in this study is that the “cost of protection” imposed by allocating revenues to a Fund, today, is low, given low absorptive capacity. But this cost will rise as capacity improves in the economy; hence, revenues should be allocated over time more and more towards raising the domestic investment rate.

1. INTRODUCTION

Mozambique is set to become a world-class natural resource exporter with projections indicating that it will experience rapid increases in windfall revenues over the next several decades and well beyond. While this is welcome news for a low-income country with a substantial proportion of the population below the poverty line, it foreshadows some economic management problems ahead. The main concern is the lack of economic performance of other low-income countries with large natural resource endowments. It is remarkable how often these countries have experienced inferior rates of growth compared with countries lacking such endowments. This pattern, known as the “natural resource curse,” has been documented in empirical research across a wide sample of nations. Its causes have been traced to important negative spillover effects that come from heavy specialization in natural resource exports, and it has been shown that these adverse effects can be especially pronounced in low-income countries with embryonic financial markets and weak institutions. Importantly, there is also evidence that resource-rich countries can do something about this problem. Resource wealth is not necessarily a one-way ticket to inferior economic outcomes. More accurately, natural resource wealth is a situation that bestows mixed possibilities, conferring both benefits and risks. The priority for any country should be to magnify the benefits and identify ways to manage the economy around the risks and problems that have badly affected other natural resource producers in the past, and, in doing so, put the economy on a successful development trajectory.

This study examines the coming resource boom in Mozambique and its implications for future economic development prospects. To set the stage for our assessment of possible effects on the economy, section 1 reviews the empirical research on the resource curse in low-income countries and its causes. Given this backdrop, section 2 then investigates Mozambique’s economic vulnerabilities to the types of adverse effects that can be generated by a resource boom. Finally, with this knowledge of potential vulnerabilities in hand, section 3 outlines a set of policy options for managing the coming windfall revenues and dealing with specific adverse effects of a boom.

2. NATURAL RESOURCE WEALTH AND ECONOMIC PERFORMANCE: THE EXPERIENCE IN DEVELOPING COUNTRIES

2.1. THE GROWTH RECORD OF RESOURCE-RICH COUNTRIES

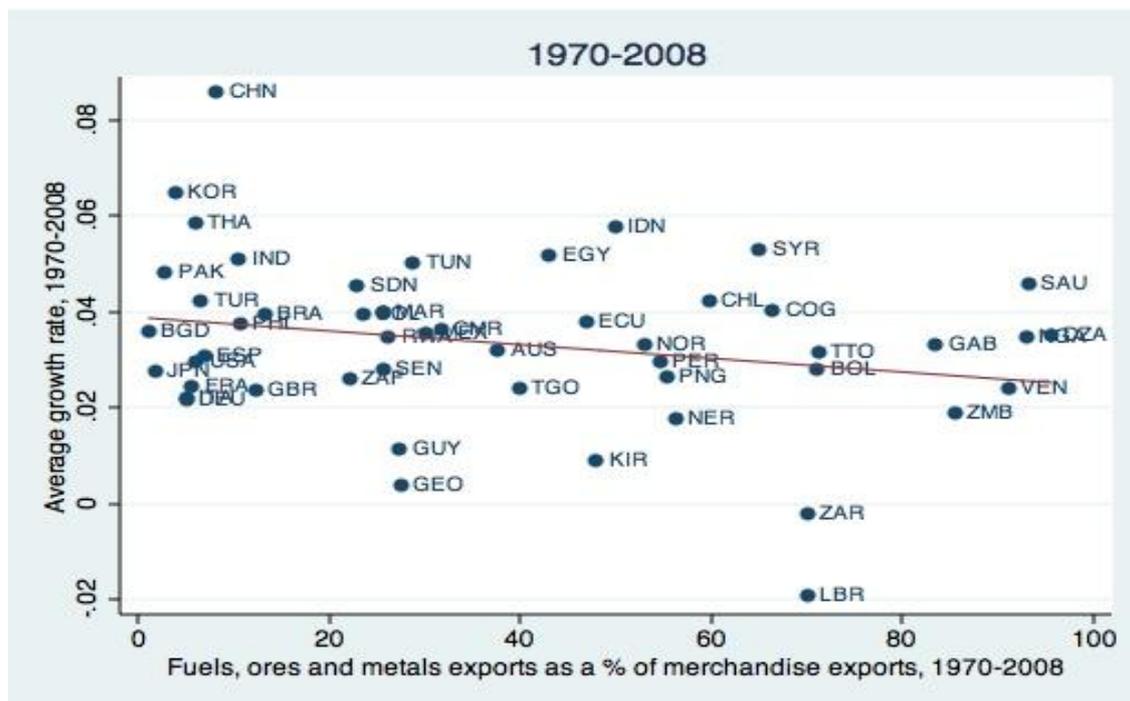
It has been known for some time that resource abundance does not inevitably bestow economic success. Many countries have achieved high and sustained living standards lacking virtually any exportable resources, while many countries rich in oil and gas, minerals, and precious stones, continue to have low levels of per capita income and generally poor economic performance.

This relationship between natural resource wealth and economic performance, often called the “paradox of plenty” or the “natural resource curse,” is depicted in figure 1. The scatter diagram presents the correlation between average growth rate of GDP and the percent of natural resources in total exports for a sample of countries over approximately four decades. In general, the relationship is shown to be negative. Countries, such as China and Korea, with low exports of natural resources, exhibit high growth rates, and countries with high exports of natural resources, such as Zambia, Nigeria, Venezuela, and Gabon, exhibit low growth rates. However, this negative correlation, as one can observe from the slope of the line running through the data, is not highly robust. Some countries with resource abundance manage to do well. What is perhaps most striking about the scatter diagram is that the overall relationship is not shown to be positive in all cases. Intuitively, one might expect to see countries with lots of natural resource exports perform spectacularly well.

This negative link between resource wealth and growth has also been confirmed by statistical tests of the determinants of economic performance across countries, where one can control for other factors determining growth. Sachs and Warner (1995, 2001), for example, find that resource abundance is strongly associated with slower growth, after controlling for traditional growth drivers, such as initial income levels, domestic investment rates, openness to trade, and institutional development. The authors also claim (a) that their results are robust to different ways of measuring resource abundance (b) that there is no direct evidence of omitted geographical or climate variables explaining the result, and (c) that there is no bias in their estimates stemming from other unobserved, growth-constraining variables. Sachs and Warner state that this “empirical support for the resource curse is not bullet proof, but it is quite strong.” Several other cross-country regression studies support this finding, especially for point-source resources, such as oil (Ross 2001; Sala-i-Martin and Subramanian 2003; Smith 2004; Ploeg 2007).¹

¹ While overall the empirical literature on the topic concludes that, at least in LDCs, large endowments of certain types of resources have a negative impact on economic growth, some researchers have questioned the results of these cross-country studies on the grounds that the regressions suffer from various problems of omitted variable and endogeneity bias and measurement error. Panel data has been used in some studies to avoid these problems and these studies have found the same negative association between resources and growth. However, both cross-country and panel-data results are sensitive to changing sample periods, different country samples, and definitions of various explanatory variables. In the end, the data may not allow us to really nail things down with unquestionable precision because it is difficult to distinguish between important drivers of growth, as all of the variables generally employed as explanatory variables are highly correlated.

FIGURE 1: STATISTICAL RELATIONSHIP BETWEEN NATURAL RESOURCE EXPORTS AND GROWTH.



Source: Frankel (2011); from data source: *World Development Indicators*, World Bank

Notwithstanding this evidence that natural resource dependence can have detrimental impacts on economic performance, the natural resource curse is not inevitable. Figure 1 makes this clear. There are examples of countries around the world that have managed to escape the curse despite having large shares of natural resources in exports. Botswana, for example, has been a leading African growth performer, despite the fact that 40 percent of its GDP comes from diamonds. Botswana began its post-colonial development with low investment rates in both human and physical capital and substantial inequality. Since then, it has maintained high investment rates, particularly in education, substantially reduced inequality, and, from 1965 on, enjoyed one of the world’s highest rates of growth. Norway is the world’s third largest oil exporter, but it maintains high growth rates of GDP, has well-developed institutions, good economic policies, and little corruption. Latin American countries, such as Chile, Brazil, and Peru, which for the most part abandoned heavy-handed state interventions in natural resource sectors, encouraged foreign investment in mining, and increased property rights in mining investment, have been able to achieve high growth rates. And United Arab Emirates and Dubai, despite some of the world’s largest oil reserves, have managed to escape the resource curse through economic diversification, modernization of infrastructure, job creation, and well-functioning state welfare systems.

Hence, it is not that countries with natural resource wealth will automatically achieve poorer performance than those countries lacking resources. Resource-rich countries can be successful. The question is how to make the best use of the abundant resources at hand. The central objective should be to achieve the growth record of the countries that have managed to escape the resource curse rather than suffer the disappointments of those that have not. The first step in this process is to understand the possible negative spillover effects from specialization in natural resources.

In the next section, we examine the channels through which natural resources impact economic performance and explain how they work to reduce growth.

2.2. WHY DO MANY RESOURCE-RICH COUNTRIES SUFFER FROM THE PARADOX OF PLENTY?

Recent research highlights three channels of transmission through which abundant resources can lead to poor economic performance (Ploeg 2011, Frankel 2011). First, the extreme volatility of commodity prices on world markets can be detrimental to growth. Second, natural resource booms can cause real exchange rate appreciation, which undermines the competitiveness of other, non-resource tradable sectors. Third, huge revenues from natural resource exports, together with growing state command of resources, can encourage a host of governance, rent-seeking, and institutional development problems that undermine growth. Each of these transmission channels is reviewed in greater detail below.

VOLATILITY

World commodity prices are extremely volatile, far more so than prices of manufactured products or services. Crude oil and natural gas exhibit the highest price volatility, with a standard deviation of more than 30 percent (Ploeg 2010). Prices of basic food commodities come next, followed by prices of ores and minerals. The least volatile of the commodities cohort is agricultural raw materials, but even here, price volatility is still much higher than in the cases of manufactures or services. World market price volatility, particularly of point-source commodities, is high because short-run price elasticities of supply and demand are low. As a consequence, relatively small changes in demand or supply require large changes in price to restore market equilibrium.

For countries that lack diversification and have a large share of natural resources in GDP and in exports, volatile prices mean large swings in revenues and in growth per capita. Countries with a share of natural resource exports in GDP greater than 20 percent have a standard deviation in annual growth of GDP per capita of 7.4 percent, while countries with a ratio of resource exports to GDP of less than 6 percent have a standard deviation of growth of just 2.8 percent (Ploeg 2010). The Middle East and sub-Saharan Africa are the poster children for the high volatility cohort. The Middle East, with its high dependency on oil, has the highest volatility, with a standard deviation in annual growth of GDP per capita of 8 percent. Sub-Saharan Africa is a close second, with average volatility of annual output per capita of 6.5 percent. In highly diversified economies like the US and Europe, annual growth volatility drops to very low levels of just around 2 percent.

It is high volatility and boom and bust cycles that are shown to be harmful to economic growth, particularly in countries with underdeveloped financial markets. Blattman et. al. (2007), using a century-long time series of country commodity prices on a sample of developed and developing countries, found that, if one looks at development over the long run – from 1870 to the 1940s –

countries whose commodity endowments were more volatile in price grew much more slowly. In fact, commodity volatility is shown to be among the best long-term predictors of which countries grew rich and which others remained poor. Mansano and Rigobon (2001) found that the effect of resource dependence on growth is mainly driven by boom and bust cycles, produced by swings in commodity prices, high debt, and credit constraints, rather than other factors. Finally, Ploeg and Poelhekke (2010) showed that the indirect negative effect of resource exports on growth, transmitted via the volatility channel, out-weights any positive effect of resources on growth. They argue that volatility appears to be the core of the resource curse problem, but its impact is offset to some degree in countries with well developed financial markets.

Why is volatility so detrimental to growth? Frankel (2011) highlights the costs of volatility on the economy. He writes that “cyclical shifts of movable resources (labor and land) back and forth across sectors – mineral, agricultural, manufacturing, services – may incur needless transaction costs. Frictional unemployment of labor, incomplete utilization of the capital stock, and incomplete occupancy of dwellings are true deadweight costs, even if they are temporary.” Aghion et. al. emphasize the effect of commodity price volatility on real exchange rate volatility. They demonstrate that commodity price volatility leads to real exchange rate volatility, which, in turn, harms long-term productivity growth, especially in countries with underdeveloped financial markets. Ploeg and Poelhekke (2009) stress the impact of commodity price volatility on liquidity constraints. They show that, when commodity prices are volatile, liquidity constraints in the economy are more apt to bind and, as a consequence, investment, innovation, and growth decline.

In addition, volatility is often amplified in developing countries by domestic macroeconomic and political instability. Monetary and fiscal policy in these countries are generally pro-cyclical rather than countercyclical, just the opposite of what the theory of inter-temporal optimization calls for. Rather than acting as a countercyclical force moderating swings, monetary and fiscal policy tends to be expansionary in booms and to contract in busts, adding to the extent of fluctuations. Pro-cyclical capital flows often exacerbate the volatility further.

Several reasons have been put forward to explain the pro-cyclical policy phenomena. One is that resource riches (much higher tax receipts and royalties) create an incentive to borrow and spend excessively (Mansoorian 1991; Manzanano and Rigobon 2001; Arezki, Hamilton and Kazimov 2011). Another is that resource booms often act to undercut political decision-making and create a false sense of security. This can encourage investment in wasteful projects, sustain bad policies and increase policy mismanagement, induce large expansions in state welfare programs, and trigger hefty increases in government employment and benefits. Many studies have shown that this type of hyperactive fiscal policy is much more apt to be pro-cyclical in developing countries than in developed countries (Mendoza and Terrones 2008). On top of this, during a resource boom, pro-cyclical capital flows tend to pick up considerably, as speculators move in to snap up local assets – real estate, and stocks and bonds where there are equity and fixed asset markets. For example, during the commodity boom of the 2000s, net capital flows have been highly pro-cyclical to emerging markets (Frankel 2011).

DUTCH DISEASE EFFECTS

Dutch Disease is a name given to some negative spillover effects of a natural resource export boom, or some other transfer effect, such as foreign aid, which produces a surge in extra wealth for the country (for details see Corden and Neary, 1982; Corden, 1984). Spillover effects can occur when there is a substantial rise in the price of existing resource exports, or alternatively, when there is a big new natural resource discovery. The ensuing large inflows of foreign exchange from booming exports cause an appreciation in the real exchange rate. A further side-effect can come from foreign capital flows into the booming resource sector to finance its development. These inflows of foreign capital also cause real exchange rate appreciation. In the case of a floating exchange rate, real appreciation occurs via a nominal appreciation of the currency and in the case of a fixed exchange rate real appreciation is produced by way of a change in the price level.

Resource windfalls also bring about a huge increase in spending. Spending of the booming sector rises because of higher profits induced by price and output increases, as well as the increase in FDI flows. Some of the spending involves an outflow of funds from the country, as it goes to imports, remittances of dividends abroad, and to the purchase of various foreign assets. These outflows act to partially depreciate the real exchange rate, moderating the initial appreciation. The part of the windfall not spent abroad is spent domestically – this is called the “spending effect” of the resource boom on the economy. These funds are spent directly by firms involved in the resource boom, or indirectly by those receiving higher windfall-related incomes. Additionally, higher government tax revenues and royalties generated by the windfall will lead to increased public spending, as we noted above.

Windfall-related exchange rate appreciation and the spending effect influence relative prices in the economy, causing expansionary and contractionary effects in different sectors.² One can divide economic sectors into tradables and non-tradables. Tradable sectors include exports and import-competing activities, which can be broken up further into resource exports (the booming sector) and non-resource exports and import competing activities (the lagging sector). Tradable prices are determined in world markets, and thus are set by world prices and the exchange rate. Non-tradable prices, such as prices of housing and haircuts, are determined by domestic supply and demand. On the expansionary side, as prices of non-tradables are determined domestically, the spending effect of the boom puts upward pressure on prices of non-tradable goods and services and output expands (the magnitude depending on supply elasticities in the sector). Because tradable prices are determined in world markets and are not affected by domestic spending, prices of non-tradables will rise relative to tradable prices. This increase in the relative price of non-tradables will trigger a further real appreciation of the exchange rate. On the contractionary side, there are two consequences of the boom for non-resource tradables: (a) real

² The extent to which a nominal exchange rate appreciation affects prices will depend on the magnitude of the exchange rate pass-through (ERPT). In most low-income countries, the ERPT is quite high (upwards of 60 to 70%). Assuming that most exports are not consumed locally, nominal appreciation via the ERPT will mostly impact the import-competing prices component of the CPI. On the other hand, the spending effect will impact the non-tradable prices component of the CPI, as tradable prices are determined on world markets (following the Law of One Price).

appreciation of the exchange rate reduces profitability and competitiveness of non-resource exports (manufacturing, agriculture, and tourism) and output and exports decline and (b) rising prices and output of non-tradables push up wages (particularly of skilled labor) in non-tradables, which spills over to the rest of the economy, causing profits to fall further in non-resource tradables, seeing as output prices are fixed by world markets.

In the longer run, structural changes will occur in the economy as exchange rate appreciation and spending effects from the windfall create incentives for labor, land, and capital to move into non-traded and booming sector production, crowding out domestic output of non-resource tradables. Recent research shows the extent of the resource movement effect in response to the boom. Ismail (2010), using disaggregated sectoral data for manufacturing, finds that a 10 percent increase in the size of the resource windfall, on average, produces a 3.4 percent decline in value added across manufacturing. This effect is found to be smaller in countries that have restrictions on capital flows and in sectors that are highly capital intensive. Brahmhatt et. al. (2010) show that, in countries where natural resources are more than 30 percent of GDP, the size of the tradables sector is 15 percent below what is considered normal, as defined by Chenery and Syrquin 1975. Lastly, Harding and Venables (2011), focusing on trade variables, show that structural changes in the balance of payments can be quite significant. Using data on 133 countries for the period 1975-2007, they find that the response to a one dollar increase in revenue from natural resource exports is a decrease in non-resource exports of 50 cents and an increase in imports of 15 cents. That corresponds to a decline in non-resource tradables (exports and import-competing activities) of 65 cents. Savings from the dollar's worth of natural resource revenues is 35 cents. These savings are primarily a change in net foreign savings, which are available for domestic investment, paying down debt, accumulation in a sovereign wealth fund, or, perhaps, direct distribution to citizens.

The decline of non-resource tradables can have an important effect on future economic growth. Non-resource tradables are thought to be “special”. They are considered to be the crucial wellspring of technological change in the economy, because production of tradable goods generates technological spillover effects (learning-by-doing and other positive external economies, such as economies of scale, that accrue to the rest of the economy (Wijnbergen 1984; Matsuyama 1992; Sachs and Warner 1992).³ In developing countries, tradables production is also a vital source of technology transfer from more advanced countries. Consequently, a reduction in the size of the non-resource tradables sector, because of Dutch Disease, can be harmful to long-term economic performance. Adverse effects on growth, however, may be offset to some degree by productivity advances in other activities. Production of non-tradables (for example, construction) may also benefit from learning by doing and other technological advances that spillover to the rest of the economy, although perhaps to a lesser extent than manufacturing (Torvik 2001). And so can the booming sector. In many countries, oil and gas and minerals mining have achieved significant technological advances (Frankel 2010).

³ Sala-i-Martin and Subramanian (2003) argue that the proposition that tradable sectors are “special” or “superior” because of learning-by-doing and other positive externalities—a necessary condition for Dutch Disease to exert a drag on long-run growth—is “largely unproven.” There is, however, a good deal of research showing that export-led growth of manufactures does promote increased technology transfer and faster productivity improvement.

It is important to stress that the description of boom-generated structural changes above assumes economic responses occur instantaneously (or at least rapidly) without running into supply constraints and bottlenecks. Absorptive capacity of the economy, in other words, is assumed to be high – that is to say, capital (skills, equipment, infrastructure and so on) is presumed to be highly mobile and readily available on international markets, so that entrepreneurs do not encounter bottlenecks and relative prices do not have to change hugely to elicit a response. But this assumption is rather naive for low-income economies, where market imperfections are endemic, and where financial capital and skills are scarce, infrastructure is inadequate, and institutions are embryonic. In such settings, capital is “sunk” and not highly mobile between sectors, secondary markets for equipment are generally lacking, and labor’s flexibility is constrained by regulations, market imperfections, and capability. Moreover, as Ploeg and Venables (2010) argue, some important types of capital (both human and physical) are ‘home-grown’ and non-traded, in that they cannot be bought on world markets. Further, production of many types of capital in low-income countries (for example, housing, infrastructure, equipment, and human capital) generally requires some non-tradable inputs, and consequently most new capital produced must be (partly) ‘home-grown’.⁴

Taken together, market imperfections of various kinds, capital immobility, labor inflexibility, and the fact that the economy has to accumulate ‘home-grown’ capital over time, work to limit absorptive capacity and thus constrain the ability to rapidly adjust to the new structure after a foreign exchange windfall. As a result, the adjustment path along which structural change moves will involve much stronger Dutch Disease effects – specifically, adjustment will involve larger relative price changes and economic agents will vary consumption and investment in response to this more volatile path of prices. In their model of resource windfalls and adjustment dynamics, Ploeg and Venables show that if “home-grown” capital is needed for development a foreign exchange windfall produces a sharper appreciation of the real exchange rate. As home-grown capital is accumulated over time, for example, by way of training programs to build worker skills, the real exchange rate gradually depreciates back toward its equilibrium level. In addition, when the boom in revenues hits the economy, real consumption jumps part, but not all the way, to its new, higher steady-state value. Consumers see the path of the appreciating real exchange rate and rising non-tradables prices and postpone some of the increase in real consumption, although nominal consumption may overshoot its new long-run value.

Some oil rich countries in the Middle East have been able to avoid these adjustment bottlenecks by importing everything. The problem of accumulating non-traded, home-grown capital was avoided by making virtually all capital tradable – human capital was imported by immigration of many types of skilled workers, and infrastructure was imported by importing all capital equipment and construction workers. However, in developing countries with large populations this option of importing everything is not politically feasible. Jobs are needed to employ young school-leavers (often a large and growing portion of the population) and to absorb surplus labor more generally. Hence, the problem of accumulating home-grown, human capital to raise absorptive capacity is a binding constraint. Several ways have been suggested to address this

⁴ What makes capital ‘home-grown’ in some cases is due to political decisions – e.g., restrictions on importing certain types of labor, indigenization programs, import restrictions on certain types of capital equipment, domestic content restrictions on foreign investors, “buy-local” restrictions in government procurement and so on.

limitation, including placing some of the foreign exchange windfall in a sovereign wealth fund while absorption constraints are being fixed. We will discuss such policy options in more detail in the final section of this study.

What are the welfare implications of these Dutch Disease effects? Who are the winners and losers? First off, it is clear that firms and workers in the booming natural resource sector are winners, as they benefit from higher profits and incomes, respectively, that derive from the windfall in export revenues. Given that this sector then pays ample taxes and royalties on its windfall revenues, benefits will accrue more widely to the government and, via more public services and investments, to the whole country. Other firms and workers will also benefit depending on how the pattern of demand changes in the economy as the spending effect ramps up – many producers of non-tradable goods and services, in particular, will benefit. The primary losers, when all is said and done, will be the producers of non-resource tradables and import-competing activities.

Does the country benefit overall? The country can potentially benefit in two ways. First, a potential benefit can accrue to the country via the increase in taxes generated by the windfall revenues of the booming resource sector, assuming the tax receipts are large and well spent. Unfortunately, the records of many resource-rich countries have not been terrific in this respect. In some cases, because of the contracts negotiated with foreign investors in the resource sector, taxes and royalties paid by extraction companies have not been as generous as they might have been (Frankel 2010; see Castel-Branco 2008 for Mozambique). Perhaps, more importantly, governments often have not invested taxes received wisely. Many resource-rich African countries, for example, have not done a good job transforming exhaustible natural resources into productive assets at home or abroad (Ploeg 2010). According to a World Bank study (2005), much of resource-rich Africa has negative genuine saving.⁵ That is to say, these countries are depleting their natural resource wealth faster than they are building up their assets (human and physical capital) and thus becoming poorer each year despite abundant natural resources. Second, a benefit to the whole country can accrue (in a Pareto optimal sense) if the beneficiaries of the foreign exchange windfall (booming natural resources) can potentially compensate the losers (non-resource and import competing tradables). The likelihood of full compensation ever being paid, however, is just about nonexistent. So, there will be losers, and in some cases the losses will be large. This is a big part of the Dutch Disease problem.

How should policymakers think about the Dutch Disease problem? While the resource boom is a positive wealth-generating development, spillover effects from the boom produce (a) a potential slowing of growth, generated by a decline in competitiveness of non-resource tradables and import competing activities, and (b) welfare effects that create winners and losers. One way is to view these outcomes is simply as equilibrium phenomena that reflect a change in the underlying fundamentals in response to a foreign exchange windfall shock. Observed in this light, Dutch Disease is not a disease at all: real exchange rate appreciation, changing patterns of demand generated by spending effects, and resource reallocation are all just natural consequences of a

⁵ Genuine saving = public saving + private saving at home and abroad – depreciation + current spending on education – depletion of natural resources – damage of stock of pollutants.

comparative advantage shift in resource specialization and accompanying foreign exchange inflows that do not represent a misalignment (in the real exchange rate) or an anomaly in need of policy intervention. Only in the event that Dutch Disease effects overshoot, as a result, say, of adjustment problems, or miscalculation by economic agents, or on account of poor domestic economic management, would policy intervention be required. For example, domestic economic agents might assume that a temporary resource boom is permanent, causing the real exchange rate to overshoot its Dutch Disease-related level and become overvalued, and eventually unsustainable. In this case, policy intervention would be required to correct the misalignment.

Thinking about Dutch Disease as an equilibrium phenomena is helpful in understanding the nature of the problem, but it is too simplistic to be a practical guide to policy. Policymakers will find it difficult to tell when a boom is temporary or permanent, or to know when the real exchange rate or other variables are overshooting the new post-boom equilibrium. Moreover, in most low-income countries there are many obstacles to adjustment, as noted above, and these countries will find it difficult to absorb large and persistent windfalls. Overshooting in these circumstances will be a standard condition. Policy responses to the resource boom are thus likely to play an important role in determining the overall impact of the shock. The central challenge then will be how to adequately manage the foreign exchange windfall, not whether to manage it. More on policy options in the final section of this study.

INSTITUTIONS

Quality of institutions – rule of law, strength of property rights, quality of political institutions, and so on – has been found to be a key factor (some would say **the** key factor) in determining which countries will grow and prosper and which countries will not (Barro 1995; North 1994 Rodrik, Subramanian, and Trebbi 2003). The contention is that weak institutions can lead to unstable government and civil conflict, expropriation of investors, inequality, and inadequate controls on corruption and rent-seeking, all of which worsen the investment climate and reduce growth.⁶ The important point for our analysis is that natural resource dependence has been found to have a significant influence on the nature and quality of a country's institutions, and this impact has been hypothesized as one of the main channels through which natural resources curse growth and long-run development. Sala-i-Martin and Subramanian (2003) demonstrate in a cross-country study that resource specialization has a detrimental effect on institutional quality, which, in turn, negatively impacts economic growth. The adverse effect of resource dependence on institutional quality and growth is found in just about all the research to be especially strong for oil, diamonds, and minerals production, which have concentrated production and revenues (Auty 1997; Isham et. al. 2003). In addition, there is evidence that resource dependence weakens institutions, which then cause a decline in human welfare, as measured by indicators, such as the human development index, nutrition levels, and life expectancy (Bulte et. al. 2005).

⁶ It should be noted that causation does not run just in one direction. Institutional quality is also found to be a function of growth. Many institutions evolve in response to the level of income, such as financial market organization and instruments, social safety nets, tax systems, and patent systems, intellectual property rules, and perhaps the biggest institution of all, democracy.

An especially important research finding for developing countries indicates that countries already endowed with good institutions at the time of natural resource discoveries are much more likely to put their foreign exchange windfall to use for the whole country's benefit rather than the welfare of a select, well-connected elite (Robinson, Torvik and Verdier 2006; McSherry 2006; Smith 2007; Collier and Goderis 2007; and Boschini, Petterson and Roine 2007). Thus countries with strong institutions can avoid the resource curse and turn it into a blessing. Conversely, resource-rich countries with weak institutions, which are typically low-income and underdeveloped, have tended to stay that way. Central reasons why may be a combination of the following:

- The effects of resource windfalls on macroeconomic stability and on economic growth are moderated by the quality of institutions (Arezki, Hamilton and Kazimov 2011);
- Countries where physical command of mineral deposits by the government or a hereditary elite automatically confers wealth on those in control may be less likely to develop quality institutions, such as rule of law and decentralization of decision-making, that are conducive to economic development, as compared to countries where moderate taxation of a thriving market economy is the only way the government can finance itself (Frankel 2010);
- Booming resource revenues may worsen governance which manifests itself in corruption and policy mismanagement that undermines growth (Collier 2007).
- Entrepreneurs may be encouraged, given increasing government revenues, to shift from profit-seeking towards socially inefficient rent-seeking for government contracts rather than spending their time innovating and trying to become more efficient and competitive (Paldam 1997; Ploeg 2010).

3. MOZAMBIQUE'S VULNERABILITIES TO POTENTIAL ADVERSE EFFECTS OF THE COMING RESOURCE BOOM?

Now that we have some background on the potential adverse effects of resource booms in low-income economies, we can move to take a closer look at the specific issues Mozambique will have to deal with given projections for natural resource exports in the next decade. We begin with an overview of the extent of the coming resource boom in the next section. Following this, we examine Mozambique's possible vulnerabilities to adverse spillovers. In the final section, we look at policies for managing the coming resource windfall. It is not inevitable that resource-rich countries are doomed to experience all the adverse effects of these events. The important question is what policies can be employed to increase the chances of successfully managing the boom.

3.1. EXPECTATIONS REGARDING THE EXTENT OF THE COMING RESOURCE BOOM

Mozambique is set to realize windfall export revenues over the next decade in coal, natural gas (including possibly some oil), and mineral sands. Other mineral export possibilities which have been highlighted are gold, bauxite, beryllium, tantalite, copper, lead, and uranium. In addition, exports of electricity to neighboring countries are predicted to grow substantially with increased investments in hydro and new ventures in coal and natural gas-fired power plants. Downstream, the coming export boom is also stimulating plans for related investments in steel production and ores smelting, as well as essential developments in infrastructure in railways, water barges, roads, ports, and dams. According to David Smith in The Guardian newspaper, this looks a lot like “boom time for Mozambique, once the basket case of Africa.”⁷

Listed below in table 1 are Mozambique’s current so-called Mega projects, in operation or in construction (we also include the CESUL electricity transmission project and Benga power project, as these are large continuing investments), together with Mega projects under consideration for future development. Mozal, an aluminum smelter which has been operating for more than a decade, was Mozambique’s first Mega project. It continues to be the leading Mega exporter in the country, contributing more than half of total export revenues. Mozal currently produces at capacity and has averaged about \$1.2 billion in international sales annually over the last decade. The smelter initiated a phase II expansion of production in 2003 of 245,000 tons per year. Plans for a phase III expansion, according to the company, are contingent on future world market demand and aluminum prices.

Electricity Mega projects are the second largest exporter today. The Cahora Bassa Dam (HCB) is the biggest hydroelectric scheme in Southern Africa. Its powerhouse has five 415 MW turbines giving it 2075 MW of installed capacity.

⁷ The Guardian newspaper Wednesday 28, March 2012.

Table 1. Mozambique's Mega Projects**Table 1**

Company/Project	Sector	Location	Investment	Capacity/Reserves	Production
1. Mozal Mozal II Mozal III	Aluminum	Maputo	\$2.1 b	245,000 tons per year 245,000 tons per year	2000 2003
i2. Hidroelectrica – Cahora Bassa Dam	Electricity	Cahora Bassa CB-North	(n.a.) \$800 m	HCB 2075 MW CEZA/HCB 1245 MW	1998 Start up 2011 Completion 2017
3. CESUL Transmission Project	Electricity	Tete connected with southern provinces	\$2.5 b	Phase I 3100 MW anchored to Cahora Bassa and Mphanda Nakuwa Dams Phase II 6000 MW anchored to coal-fired power plants Vale/Rio Tinto	Start date 2011 completion expected 2016 (Phase 2 depends on Vale/Rio Tinto power plant investment)
4. Benga Power Project	Electricity	Benga coal deposit, Tete	\$1.3 b	Phase I 600 MW Phase II 2000 MW	2013
5. Sasol/ENH 50% Expansion	Natural Gas	Pande, Temane gas fields, Inhambane	\$2.1 b	154 GJ 231 GJ	2004 2011-16
6. Kenmare	Heavy Sands*	Moma, Nampula	\$460 m	900,000 to 1.3 m tons per year ramp up to	2007
7. Vale	Coal (thermal and coking) + coal terminal and railway	Moatize, Tete	\$2.0 b so far; Expansion plans next 4 years \$4 b.	25 m tons per year total capacity (0.6 m tons shipped 2011, aim to increase capacity to 22 m tons by 2014)	2011
8. Rio Tinto/Riverdale	Coal (thermal and coking)	Benga , Tete	\$1.0 b	Total capacity, Benga 10 m tons Adjacent Zambezi 25 m Tete East 10 m	2012
Future Projects Under Consideration					
1. Mphanda Nkuwa	Electricity	Zambezi River, Tete	\$2.9 b	Phase I 1500 MW Phase II 2500 MW	2012-15 2017
2. Anadarko ENI Statoil Petronas	Natural Gas + LNG plant	Rovuma Basin	\$15 b-\$20 b	Exploration, planned LNG plant 2 trains. Between Anadarko and ENI 57-70 TCF of gas discovered offshore.	First gas 2018
3. JSPL	Coal + 2640 MW coal-fired power plant	Changara, Tete	(n.a.)	10 m tons per year	2012-16 ramp up
4. Corridor Sands	Heavy Sands	Chibuto, Gaza Province	\$1 b-\$2 b	Looking for new investor, requires investment in electricity (Mphanda Nkuwa)	(n.a.)

* Limenite, Zircon, Rutile.

Roughly 80 percent of its output is exported to neighboring countries – Mozambique consumes only 19 percent of total output, while South Africa consumes 73 percent. HCB continues to make investments to increase output and future exports. In 2010, a \$10.5 million investment was completed, raising output by 14 percent, and a planned \$800 million expansion at HCB’s North Bank Power Station is scheduled to increase capacity another 1245 MW. Two other electricity generating projects are projected to add significant capacity in the future: the Benga power project and the Mphanda Nkuwa Dam. In 2010, the Government of Mozambique approved the \$1.3 billion Benga Power Project located on the Benga coal deposit in Tete where direct access to required thermal coal supplies are located. Phase I production of 600 MW is scheduled for 2013. Final capacity when phase II is completed will be 2000 MW. Output of phase I will be transmitted by EDM and approximately 63 percent is slated to be sold to Rio Tinto mines and other consumers in Mozambique and what remains to South Africa.

The Mphanda Nkuwa Dam on the Zambezi river in the western province of Tete (60 km downstream from the Cahora Bassa Dam) would add 1500 MW of capacity in phase I and 2500 MW in phase II. It was originally scheduled for construction in 2010 and completion in 2013, but finding delays have disrupted this timetable. An environmental impact assessment was completed in 2011 stating that the dam posed no significant threat to the environment. A consortium of a Brazilian construction firm, Camargo Correa (40 percent ownership), Energia Capital (40 percent), and EDM (20 percent) is now seeking final funding of \$2.9 b for the project. The dam plans to sell its electricity to other SADC countries.

The CESUL Power Project plans to tie all these electricity generation projects together with a transmission line connecting Tete province with the central and southern provinces of the country. The project scheduled for completion in 2016 and will cost \$2.5 b. EDM is funding 51 percent of the project and donors will fund the other half. The transmission line will transport 9000 MW of power generated at the dams. Phase I, which aims to increase transfer capacity by 3,100 MW, will connect the north and south transfer to provide reliable and low-cost electricity to a series of urban centers. It will be anchored to the Cahora Bassa hydropower station 2075 MW and the 1500 MW Mphanda Nkuwa hydroelectric dam. Phase II, which aims to raise transfer capacity by 6000 MW, is less certain, as its completion depends on coal-fired plants to be developed by Vale and Rio Tinto using their discarded low-quality thermal coal.

While aluminum and electricity provided a substantial shot in the arm to trade during the last decade, it is the coming bonanza in coal and natural gas that will catapult exports to a new and much higher growth trajectory in the next decade and beyond. Beginning with coal, the Moatize coal basin in Tete province is said to represent the world’s largest untapped coal reserve with an estimated 6 billion tons. Moatize also contains possibly the last big coking coal mine in the world. Putting Moatize together with the other coal discoveries in the in the Moatize basin of the Zambezi Valley – Zambezi, Benga, Cahora Bassa, Ncondezi, Minas Moatize, Karoo, and Revuboé – total coal reserves in Mozambique are estimated to be approximately 25 billion tons. A report by Standard Bank⁸ estimates the in-situ value of these reserves, assuming long-term

⁸ Rajat Kohli (2012) “Tete Basin Coal: A Key Driver for Mozambique” Standard Bank, Maputo, Mozambique.

average world prices of \$150 per ton for coking coal and \$80 per ton for thermal coal, to be as much as \$1 trillion.

World market demand for coal resources has been strong and is expected to remain so for the foreseeable future, notwithstanding a recent slowdown in economic growth in China and Europe, which has temporarily depressed commodity markets. Thermal coal demand continues to be propelled by overall growth in emerging markets. Coking coal demand, on the other hand, continues to be driven by large investments in infrastructure in India, China, Brazil and the Middle East, which has raised the demand for steel production around the world. World coking coal demand is predicted to grow by 70 to 80 percent over the next 15 years. And Mozambique is in a good strategic location to serve these markets.

Realizing the production and export potential of Mozambique's vast, unexploited coal reserves in the future will not be easy given the country's infrastructure challenges. Most important are the constraints presented by rail and port facilities, which limit the speed of development of coal deposits and put an overall ceiling on exports in the near term. The shortest route to market from the Moatize Basin in Tete is the 580 km Sena rail line to the port of Beira. The capacity of this rebuilt rail line, however, is only 6 m tons per annum and Beira port's old coal terminal can handle only 1.2 m tons at present. In addition, Beira has a shallow port and, even after completed dredging, only smaller Handymax vessels with a coal carrying capacity of 60,000 dwt are permitted to use the facilities.

To deal with these problems plans are in the works to upgrade ports and build a new rail line. Vale is investing \$2.0 b to build a new 200 km rail link from Moatize that would connect with the existing Malawi-Nacala line running through Malawi to the port of Nacala on the northern coast of Mozambique. The Malawi-Nacala line would also be upgraded to give the whole 800 km system a capacity to carry as much as 20 m tons of coal per year. Nacala port is the most feasible long-term solution for the country's vast coal exports in that it is a deep water port with the capability to handle ships of any size. At Nacala a new coal terminal is planned raising existing capacity from 1.5 m tons to around 16 m tons. To add additional capacity to transport coal to Beira, small and medium scale barging down the Zambezi 550 km to Chinde is being proposed, although the depth of the river and seasonality problems with flooding and drought may hamper this alternative to some degree. In addition, the Government of Mozambique, with support from Vale and Rio Tinto, has plans to build a new coal terminal at Beira to raise coal handling capacity to 18-22 m tons. In the end, all these investments to raise transport capacity and improve port handling capacity will be needed to fully exploit Mozambique's coal resources and they will all take some time to complete.

Another jackpot in the making is the recent discovery of natural gas off Mozambique's northern coast. The discoveries of Anadarko and ENI in the Rovuma Basin place Mozambique in the top tier of countries in the world with large natural gas reserves. Based on existing discoveries, Mozambique has proven and probable reserves of between 57 and 70 trillion cubic feet of gas. And seismic information of the current discovery areas suggests that there could be more than 120 tcf of possible reserves. Analysts estimate that natural gas could bring Mozambique revenues of as much as \$400-500 b over the next several decades, a huge windfall for a country whose exports are expected to be about \$4 b this year.

Mozambique's location is also a plus, as it is geographically well situated to serve growing markets in Asia looking for supplies of liquefied natural gas. Once more, however, a great deal of investment will be required to exploit this export opportunity. Phase 1 of the LNG plant investment planned by Anadarko and ENI, which involves two 5 MTPA trains, requires funding of \$20 b. Significant local capital expenditure ancillary to this LNG complex would also be needed to support this investment, such as port facilities, petroleum storage, electricity generation, water, health and other social facilities, and airport development. Putting together the necessary funding for a project this large, including the outlay for ancillary local infrastructure, will be challenging in today's global financial markets. However, other big oil and gas companies are reported to be already looking to take a stake in Mozambique's discoveries and sovereign wealth funds and private equity firms have shown increased interest in funding such projects around Africa.

3.2. THE IMPACT OF MEGA PROJECTS ON THE ECONOMY: PAST AND FUTURE

Several studies have examined the impact of mega projects on the economy (Andersson 2001; Castel-Branco 2003; Sonne-Schmidt, Arndt, and Magaua 2009; IMF Country Report 2011). The focus of these efforts has been on estimating the contribution of mega projects to value added (measured at factor cost) and the rate of growth of value added, as well as on the broader benefits to living standards in Mozambique. The general conclusion of these investigations is that mega projects have made a substantial contribution to GDP over the decade, however, to date the impact of these projects on living standards has been restrained (a) because they are foreign-owned investments that repatriate a large portion of their profits, (b) because the nature of their contracts gives them significant reductions in income and commodity taxes, and allows them to deduct expenditures on infrastructure and employee training from taxes owed (c) because they are capital intensive operations and therefore do not employ many workers, and finally (d) because they rely heavily on imported intermediate inputs and thus have limited linkages with the rest of the economy.

Estimates of the contribution to GDP vary somewhat. Sonne-Schmidt, Arndt, and Magaua analyzed the contribution of the first three mega projects in Mozambique – Mozal (aluminum), Sasol (natural gas), and Moma (heavy sands) – over the period 1996-2006. They found that in the year 2006, these projects, as a group, accounted for approximately ten percent of value added. And the direct contribution of these projects to GDP growth (if one includes the contribution of the construction phase of these projects) was estimated to be 1.1 percentage points per year over the ten year period, with the rest of the economy growing at 7.6 percent per annum. So, mega projects were not found to be the main source of economic growth over these years (although they did make a significant contribution), and the rest of the economy was not stagnate, as is often presumed. The IMF study estimates put the contribution to growth a bit higher. During the period 2003-10, the IMF finds that megaprojects contributed up to 4 percentage points to GDP growth (and 10 to 13 percent of value added depending on the year). However, the IMF points out that, mega project output is limited by capacity constraints; hence, there is a certain dynamics to the role they play in macroeconomic aggregates. When they start operating and up until they reach full capacity, mega projects boost growth. But, once a project reaches full capacity, and its

output ceases to grow, its contribution to the rate of GDP growth disappears and its share in value-added tends to decline somewhat over time as other activities with positive growth rates overtake it. As a consequence, the ability of mega projects to be a continuous engine of growth depends on the initiation of new projects and on the expansion of their capacity.

The effects of mega projects on living standards were found to be very modest. These projects, overall, have created few jobs. And linkages to the public budget via tax revenues have also been small because of tax exemptions. Thus, viewing mega investments only in the light of export volumes leaves an overly optimistic picture of their impact on the economy. They may account for the largest share of exports, but (given the terms of negotiated contracts) they also account for a large share of imports, pay low taxes, and repatriate a large share of their profits, reducing their potential impact on the economy. However, it should be noted, that this assessment of the broader impact of mega projects does not include the benefits of the infrastructure these companies have built, the training of employees they have carried out, and the improvements to the investment climate they have generated by their successful operation, all of which are meaningful contributions to economic development.

What about the future impact of mega projects? Expanded estimates of coal reserves and new discoveries of natural gas, described above, will be coming on stream over the next decade, and government officials state that the contract terms for these new investments will exclude many of the generous tax breaks and concessions of the past. In addition, there will be huge investments in infrastructure to support these projects. To explore future impacts on the economy, it is helpful to begin with the results of two studies that make forecasts. The first study is by Bucuane and Mulder (2007), which is based on known information about mega investments and resource reserves in 2006. Bucuane and Mulder estimate the future impact of mega projects on the balance of payments. They calculate the direct trade balance effect (exports – imports) minus debt service and repatriation of profits of these projects, and then project these estimates to the year 2020. According to their computations, mega projects will have a positive effect on the balance of payments each year after 2006 and, by the year 2020, will reach \$1.3 b (this is considerably less than the effect on the balance of trade in 2020, which is projected to be \$3.4 b, because of leakages due to debt service and profit remittances). Assuming a constant growth rate of GDP of 7.5 percent for the period, they estimate that the effect on the balance of payments will equal 7 to 8 percent of GDP in 2020, peaking at 13 percent in 2012. Fiscal revenues of the state from these mega projects are projected to rise to around \$250 m in 2020, equal to about 7 percent of estimated total fiscal and other internal revenues. They caution that these numbers may increase considerably if revenues from new projects, such as oil, should come on stream. But they remind the reader that aid flows over the decade have been considerable, equaling 20 percent of GDP in 2005, and these capital flows did not cause Dutch Disease. Hence, the bottom line of their analysis is that these numbers are not cause for great concern, but they warn that prudent spending of natural resource revenues remains a prerequisite for avoiding the problems of a resource curse.

But the situation changed considerably after 2006. The second study of future mega projects impacts takes these changes into consideration. An IMF (Country Report 2011) study projected impacts including the new information about Mozambique's huge coal reserves, which were ramped up substantially at the end of the decade, and an expansion in Sasol capacity.

Accordingly, IMF estimates include an expansion in mega project production that incorporates a 50 percent linear rise in Sasol's capacity by 2016 and the start of coal production by Vale (total capacity 25 m tons) in 2011 and Rio-Tinto (total capacity 45 m tons) in 2012, each reaching projected full capacity by 2016 and 2020, respectively. Assuming that coal infrastructure developments (largely railroad expansions) proceed according to plans (which is a big assumption), growth in the coal industry is estimated boost the share of the mega projects to up to 18 percent of the value added by 2016. And the direct contribution to GDP growth is estimated to be between 2 to 4 percentage points annually. These estimates ramp up the projections of Bucuane and Mulder almost three-fold. But they still appear to be within the manageable range of 20 percent of GDP where aid flows were in 2006.⁹

On top of this, however, we now have to add the impact of new discoveries of gas (and possibly oil) by Anadarko and ENI. Some estimates have put the value of new gas discoveries at as much as \$400 b over the next four decades. If we accept this approximation, Mozambique could conceivably realize exports of gas somewhere near \$10 b per annum in coming years. Assuming that 50 percent of this windfall is captured by foreign exploration companies, this leaves export revenues of roughly \$5 b per year for Mozambique, which could mean another increase of 20 percent in GDP around the year 2020 (assuming GDP equals IMF projections of around \$25 b to \$30 b in that year). Even if we were to conservatively cut this estimate in half, gas exports would be enough to push the impact of mega projects into a range where the country will have difficulties avoiding adverse effects of the windfall (especially considering that we have not added in the impact of all the inflows of investment capital to get coal and gas projects going and related activities). In the end, however, much depends on the ultimate size of the windfall, on how it is spent, on the volatility of commodity prices and how sensitive the exchange rate is to these shocks, and on the absorptive capacity of the economy. We turn to a discussion of these issues in the next section.

⁹ Mega project contribution to employment, which was around 3800 in 2010, compared to a total employment of 10.2 million, is projected to increase to 7000 once the coal mines reach capacity by 2016, bringing the share of mega projects in total employment to just 0.01 percent.

3.3. POTENTIAL BOOM-RELATED VULNERABILITIES

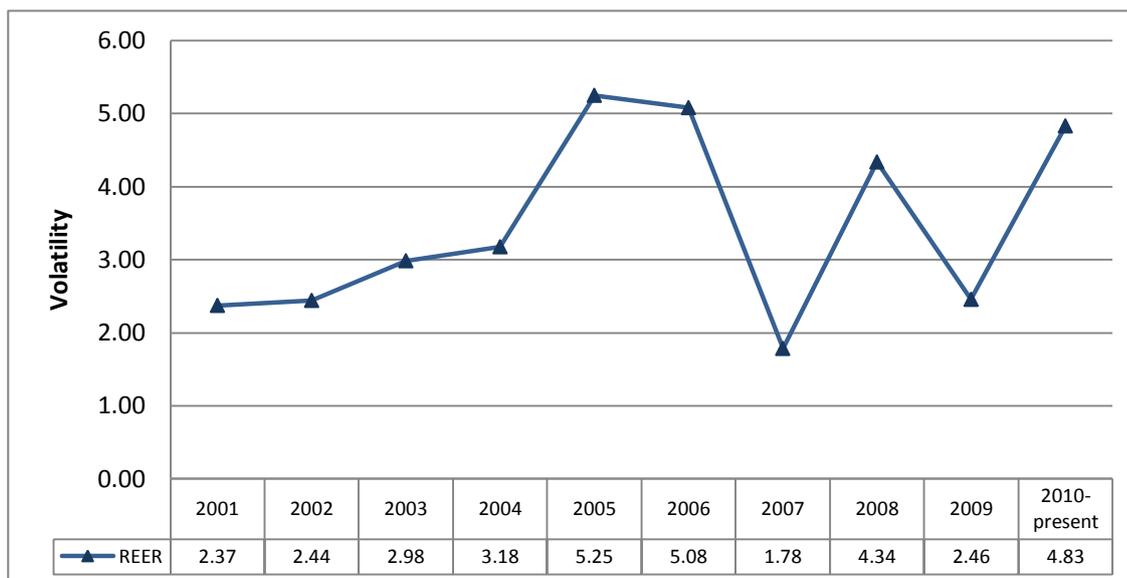
VOLATILITY

Volatility is at the core of potential negative spillover effects of a resource boom, particularly in economies that lack diversification and have embryonic financial markets, as we discussed earlier. The central cause of this volatility, and the boom and bust cycles that often develop, is the extreme volatility of world market commodity prices.

Mozambique today is a prime example of the types of economies that can experience adverse effects from commodity price shocks. The economy is small and production and exports are heavily concentrated in primary commodities. The financial sector is underdeveloped and there are few instruments available for hedging. And monetary and fiscal policy, as well as international capital flows, are likely to be pro-cyclical (if other low-income countries provide a guide for what will happen), amplifying commodity price swings. Data show that Mozambique currently experiences a good deal of volatility in key economic indicators. A case in point is the exchange rate. A striking feature of metical exchange rate movements since it began floating in the mid-1990s has been persistent volatility. Figure 2 and table 2 present a picture of Mozambique's real exchange rate volatility, employing the most widely used measure for calculating exchange rate fluctuations – the standard deviation of the first difference of logarithms of the exchange rate (taken from Biggs 2011). The change in the exchange rate is computed over one month, using end-of-month data. The standard deviation is then averaged over one-year, as an indicator of short-run volatility, which is plotted in figure 2 and shown in the first half of table 2. Volatility is also averaged over a three-year period to capture longer-run volatility, which is shown in the second half of table 2. All the volatility estimates are for the real effective exchange rate for the period 2000-11.

Average real exchange rate volatility is high in Mozambique. The long-run average standard deviation for the whole period is 3.9. In addition, volatility appears to have risen over the decade – increasing 40 percent, from an average volatility of 2.6 in the first half of the decade to 3.7 in the second half. To put these estimates in perspective, Mozambique's exchange rate volatility is almost twice as high as in advanced countries, where volatility averages between 2 and 2.5. Such low average exchange rate volatility is expected in advanced countries, as they adjust more smoothly to shocks, given their more diversified economies, and currencies trade in large and liquid markets, with many instruments available to hedge volatility, helping these markets to clear quickly and reducing potentially large movements in exchange rates. When benchmarked against exchange rate volatility in other developing countries, Mozambique compares more favorably, although it is still on the high side. Developing countries as a group tend to have roughly twice the average volatility of advance countries. Mozambique appears to fit most naturally with a group of developing countries classified as non-fuel primary exporters, which exhibit the highest levels of average real exchange rate volatility across the world. In this developing country cohort, Mozambique's average exchange rate volatility ranks about in the middle. As a rule, these countries are small and subject to more frequent terms of trade shocks, owing to volatility in global commodity markets.

FIGURE 2: VOLATILITY OF REAL EFFECTIVE EXCHANGE RATE



Source: Biggs 2011.

Rate Year	Table 2 : Volatility of Real Effective Exchange	Real Effective Exchange Rate
2001		2.37
2002		2.44
2003		2.98
2004		3.18
2005		5.25
2006		5.08
2007		1.78
2008		4.34
2009		2.46
2010-present		4.83
Period		Real Effective Exchange Rate
2001-2003		2.55
2004-2006		4.65
2007-2009		3.65
2010-Present		4.83

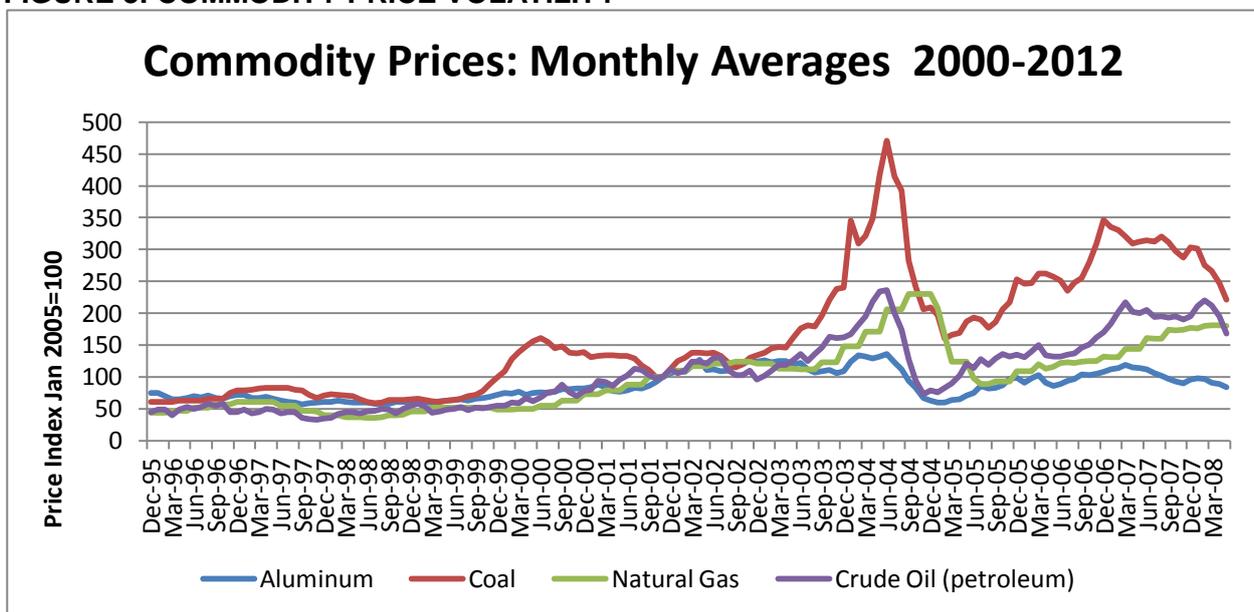
Source: Biggs 2011

What is important about high exchange rate volatility, as we highlighted in section 1, is that it can increase deadweight costs in the economy and harm investment, innovation, and productivity growth. Above all, however, it has negative effects on tradables. Risk averse exporters in Mozambique are adversely impacted by volatility, particularly in the absence of low-cost hedging mechanisms. Where volatility has its greatest effect is on the composition of trade – even when

aggregate trade flows remain relatively stable, or decline only slightly, high exchange rate volatility can cause meaningful changes in the export basket. Raddatz (2011) found that exchange rate volatility matters relatively more for products that lack a “natural hedge” and are therefore more exposed to volatility. A natural hedge against exchange rate volatility, which is provided by a negative correlation between a product’s international price and the country’s nominal exchange rate, is shown to influence a country’s export patterns, even after controlling for other standard determinants of export composition, such as factor content of trade and export patterns of countries with similar levels of income. The reason for this outcome is that products and sectors with international prices that are negatively correlated with the country’s exchange rate have relatively more stable prices in local currency than do other products and sectors. Given that fluctuations in local currency prices matter for incentives for trade and resource allocation, especially in countries like Mozambique with less developed financial markets unable to hedge and bear elevated risk, these goods become relatively more important in the country’s export basket following sustained periods of exchange rate volatility.

Risks of volatility-related effects are apt to grow larger as Mozambique’s export basket shifts from aluminum towards coal and natural gas. As figure 3 and table 3 indicate, during the last decade coal and natural gas prices have been much more volatile than aluminum prices – gas by a factor of 2 and coal by a factor of more than 3. Coal price volatility over the decade even eclipsed high volatility oil prices, with an average standard deviation for the 2000-12 period of .59 as against oil’s standard deviation of .30. This represents a dramatic increase in the volatility of coal prices compared with the past. Over the past 50 years up to the early 2000s, coal had an average standard deviation of annual world price fluctuations of just .11, while oil averaged 0.36.

FIGURE 3. COMMODITY PRICE VOLATILITY



Source: IMF External Data- Primary Commodity Prices as produced by The Commodities Team of the Research Department.

Table 3. Commodity Price Means and Standard Deviations 2000-2012

Period	Mean				Standard Deviation of Indexed Prices			
	Aluminum	Coal	Natural Gas	Crude Oil (petroleum)	Aluminum	Coal	Natural Gas	Crude Oil (petroleum)
Jan. 2000- Dec. 2004	66.65	83.16	49.53	51.05	6.49	29.66	7.50	10.72
Jan. 2005- Dec. 2008	107.64	189.35	127.18	127.84	18.21	94.96	41.61	39.42
Jan. 2009- Jun. 2012	92.44	256.51	139.18	155.72	15.38	52.49	33.85	40.71

Source: IMF External Data- Primary Commodity Prices as produced by The Commodities Team of the Research Department.

To some degree the effects of increased price volatility on the economy will be mitigated by price-sticky contracts of producing companies. For example, current electricity export contracts are long-term and generally do not permit large price fluctuations and Mozal operates on the basis of term contracts (although shorter in duration than electricity) with standard escalation clauses. Coal and gas companies conduct business in a similar manner. Perhaps more important for mitigating the effects of volatility will be various microeconomic government policies to minimize exposure to the risk of short-term volatility, such as hedging in futures markets and indexing contracts with extraction companies, as well as macroeconomic management of monetary and fiscal policy to avoid pro-cyclicality. There will be several types of volatility policymakers will have to manage – the short-term volatility just discussed, medium-term swings of the sort associated with Dutch Disease, and the more predictable volatility due to geology and depletion of resources over time. We will discuss these policy issues in greater detail in the last section.

SENSITIVITY OF THE REAL EXCHANGE RATE TO COMMODITY PRICES AND CAPITAL FLOWS

A key element of the adverse effects of a foreign exchange windfall is real appreciation of the exchange rate, as we detailed in our earlier discussion of Dutch Disease. Hence, in order to understand how Mozambique’s coming resource boom might impact the economy, it is important to examine the reaction of the metical to the types of shocks a foreign exchange windfall will generate. Typical boom-related shocks can originate from commodity price spikes and rising export quantities, as well as escalating capital inflows, generated by international investment in new discoveries.

How sensitive is the metical to such shocks? Is the metical a “commodity currency” similar to the floating currencies of some other commodity exporters, such as Australia and New Zealand? That is, is the metical a currency that appreciates when prices of the commodities Mozambique produces are strong on world markets and depreciates when they are weak, such that commodity price shocks explain a significant portion of exchange rate movements? Also, how responsive is the metical to demand-side shocks and supply-side shocks, such as international transfer

payments and productivity differentials? Can movements in the metical be explained by international capital flows – foreign direct investment, aid flows, and other transfers, which increase the net foreign asset position of the country – or do productivity differentials with Mozambique’s trading partners play a large role in determining long-run exchange rates? Lastly, has there been an element of momentum to some recent exchange rate movements, or can they be explained by economic fundamentals?

To answer these questions, we develop a model of real exchange rate determination following Frankel (2007). Our model concentrates exclusively on determinants of long-run equilibrium, leaving aside short-run deviations of the current real exchange rate from this long-run equilibrium. Short-run deviations are generally the result of financial flows in response to interest rate differentials and shifting bond market risk-premiums. As Hassan and Simione (2010) argue in their study of the exchange rate in Mozambique, however, such financial aspects of exchange rate determination are much less relevant for low-income countries with embryonic financial markets. In economies like Mozambique’s, trade in goods is the primary driver of exchange rates rather than financial market speculation or hedging; and the central bank actively influences monetary variables. Hence, the purchasing power parity (PPP) model of long-run exchange rate determination, with its roots in goods markets, represents an adequate model for our purposes in this case.

The long run equilibrium real exchange rate is given by a version of PPP:

$$\text{RER} = \frac{EP^*}{P}, \text{ or in log form: } \text{rer} = e + p^* - p, \text{ (1)}$$

where e = log of the nominal exchange rate, in meticals per dollar;

p = log of the Mozambican price level (M-CPI);

p^* = log of the foreign price level (F-CPI).

Price indices at home and abroad are defined as Cobb Douglas functions of traded goods TG and non-traded goods NTG: $p = \alpha p_{NTGM} + (1-\alpha) p_{TGM}$, (2)

where α is the weight placed on non-traded Goods in the Mozambican basket.

The same weights are assumed in the foreign country for simplicity.

$$p^* = \alpha p_{NTGF} + (1-\alpha) p_{TGF}. \text{ (3)}$$

Combining (1), (2) and (3),

$$\text{rer} = e + p^* - p = e + [\alpha p_{NTGF} + (1-\alpha) p_{TGF}] - [\alpha p_{NTGM} + (1-\alpha) p_{TGM}].$$

$$= (e + p_{TGF} - p_{TGM}) + \alpha [(p_{NTGF} - p_{TGF}) - (p_{NTGM} - p_{TGM})]. \text{ (4)}$$

The first term in equation (4) can be understood as the terms of trade, the relative price of traded goods produced in the foreign basket in terms of traded goods produced at home. To examine the question of whether the metical is a commodity currency, we proxy the terms of trade for

Mozambique by using the exogenous commodity terms of trade, which is the real price of Mozambique's largest commodity export, aluminum, (ral), in log form. For commodity-exporting economies, where commodities constitute a significant share of exports, the world price of commodities has been found to have a strong effect on real exchange rates (Chen and Rogoff 2003; Cashin et.al. 2004; Isard 2007; Ricci et. al. 2008). Cashin et. al. included Mozambique as one of the 58 countries in their study, which examined data for the period 1980-2002. They concluded that the metical did not follow the pattern of a commodity currency during these years, as the prices of Mozambique's key commodity exports at the time (cotton, sugar and Maize) were not significantly correlated with real exchange rate movements. However, as we will discuss in greater detail below, the composition of Mozambique's exports has changed dramatically since the early 2000s, when the exports of "Mega projects" became increasingly important. This raises the crucial question of whether determinants of the real exchange rate have changed and, if so, what this change may portend for the effects of a future resource boom. In addition, if we find a robust connection between commodity export prices and exchange rates, the finding would have important implications across a variety of policy issues, not least concerning questions such as Mozambique's competitiveness and how to implement inflation targeting.

The second term in equation (4) is the relative price of non-traded goods in terms of traded goods, foreign versus Mozambique, with weight α . Real appreciation occurs when the relative price of non-traded goods rises more rapidly in Mozambique than in its foreign trading partners. This can arise in two instances that we examine in our study: (1) in the case of supply-side shocks, such as the so-called Balassa-Samuelson relationship, when the rate of growth in productivity (measured by income per capita) is higher in Mozambique than in foreign trading partner countries and (2) in the case of demand-side shocks, such as international transfer payments, when there are international capital inflows in the form of foreign direct investment, or foreign aid, or other types of wealth transfers. In both of these situations, because prices of tradable goods are tied to world prices by the Law of One Price, shocks due to rising productivity growth rates (generally concentrated in the traded goods sector) or shocks due to the transfer effect¹⁰ will tend to push up prices in the non-traded goods sector (via a labor supply adjustment) and cause real exchange rate appreciation.

Therefore, in the Balassa-Samuelson case: $(p_{NTGF} - p_{TGF}) = \beta(\text{income per cap}) F$ and $(p_{NTGM} - p_{TGM}) = \beta(\text{income per cap}) M$.

And in the case of transfer effects: $(p_{NTGM} - p_{TGM}) = \gamma(\text{net foreign assets}) M$

Thus our regression model of long-run real exchange rate determination will investigate the impact of three variables on long-run equilibrium: commodity terms of trade (real price of aluminum), Balassa-Samuelson effect (relative income per capita), and transfer effects (net foreign assets), as presented in equations (5), (6) and (7) below.

¹⁰According to Obstfeld and Rogoff (1996), a "transfer effect" occurs when a transfer of wealth from the foreign to the home country raises spending on home non-tradables: home wages rise, the home export sector declines due to reduced profitability, and the foreign export sector expands. The home terms of trade improve, and the home real exchange rate appreciates. The latter is due to an increase in the price of non-tradables, due to higher wages.

$$rer_t = \mu ral_t + t \quad (5)$$

$$rer_t = \mu ral_t + \alpha \beta [(income\ per\ cap)\ F - (income\ per\ cap)\ M]_t + t \quad (6)$$

$$rer_t = \mu ral_t + \alpha \beta [(income\ per\ cap)\ F - (income\ per\ cap)\ M]_t + \gamma (NFA)_t + t \quad (7)$$

What is important here is that these variables are hypothesized to have persistent effects on the long-run PPP equilibrium real exchange rate. Thus, rather than moving back to PPP equilibrium reasonably quickly, the conjecture is that these real economic variables cause persistent deviations from equilibrium that can have important economic implications. As we pointed out earlier in our discussion of Dutch Disease, such persistent deviations from equilibrium, which can occur in a resource export windfall, are not necessarily considered a misalignment of the exchange rate, rather these deviations can be thought of as fundamental changes that shift the economy to a new, comparative advantage-based equilibrium. However, while it may not be considered a misalignment, there certainly can be economic consequences resulting from this new equilibrium, in terms of economic growth and winners and losers in income distribution.

A GRAPHICAL EXAMINATION OF THE DATA CORRELATIONS

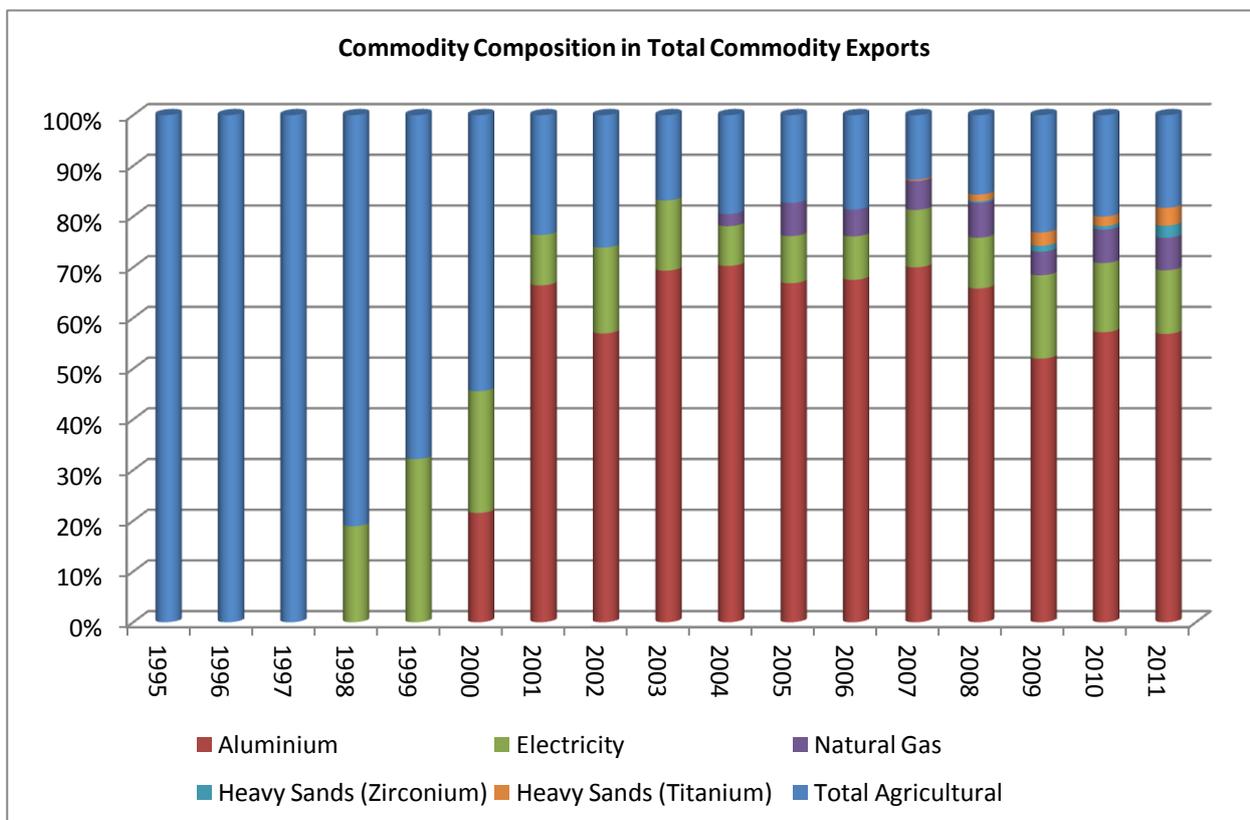
From a macroeconomic perspective, Mozambique can be described as a low-income, small, relatively open economy, with a nascent financial market that has extremely limited connections with global capital markets. In terms of monetary and exchange rate policies, Mozambique has been operating under a flexible exchange rate regime for well over a decade (although there has been some intervention by the authorities from time to time). It can also be described as “commodity economy,” because of the large share primary commodities occupy in production and exports. Like most low-income, developing countries, commodities represent more than 95 percent of total merchandise exports, although one could plausibly argue that aluminum, which makes up about 60 percent of Mozambique’s exports, is a manufactured product. We treat aluminum in this study as a commodity export because of its commodity-like properties and because of its world market pricing characteristics.

The composition of Mozambique’s exports has changed considerably since 1998, when electricity, and then Mozal I in 2000, started production and exports. Agriculture’s share of merchandise exports over the decade declined from 100 percent to about 20 percent, while the share of Mega project commodities rose to about 80 percent. This changing composition of trade, and the rising dominance of aluminum after 2000, is presented in Figure 4. Considering the increasing share of aluminum over the decade, together with the growing importance of other mega projects in exports (natural gas, heavy sands, electricity), it is useful to revisit the issue of the metical’s sensitivity to swings in world market commodity prices, as we noted above. To keep it simple, we concentrate on the extent to which world prices of aluminum impact Mozambique’s real exchange rate.¹¹ The Real exchange rate is computed as a geometric average

¹¹ Aluminum had, by far, the largest weight in exports during the decade; also, it was difficult to obtain a consistent series of world prices and trade weights for the other Mega commodity exports, particularly for commodities such as

of the nominal exchange rate, weighted by the consumer price index in Mozambique, and its partner trading countries. The Real price of aluminum is the nominal price, deflated by the price of manufactured exports from OECD countries.

FIGURE 4: COMMODITY COMPOSITION EXPORTS



Beginning with a visual representation of the correlations in our data, figure 5 plots the logarithms of the quarterly series for the real effective exchange rate and the real commodity price for the period 2000-quarter 1 to 2012-quarter 1. The graph suggests that there has been an association between real aluminum prices and the real exchange rate over the period. The real metical appears to track the real world price of the commodity with a lag. The observed correlation between the two variables, however, is not particularly tight, until the end of the decade, and the magnitude of their swings are not, on the whole, similar. But, the metical appears to decline (with a lag) when real aluminum prices are declining, and appreciate as world prices pick up.

Figure 6, shows that the real exchange rate is also correlated with relative real GDP per capita, and the metical in this case appears to track relative real output quite closely. This correlation could be explained as a reflection of the Balassa-Samuelson effect, which exerts supply-side upward pressure on the real exchange rate, as we noted above. Alternatively it could be

heavy sands, which contain a number of different minerals. Hence, we could not construct a complete trade weighted price index of Mega exports and thus limited our analysis to an examination of real aluminum prices.

explained as a manifestation of monetary theories of the nominal exchange rate, which predict that growth in real income raises the demand for money and causes a nominal appreciation of the currency. The fact that both real aluminum prices and relative real output are correlated with the real exchange rate tells us that we could have some difficulty distinguishing the effect of commodity prices from that of productivity on movements in the real metal.

FIGURE 5. REAL EXCHANGE RATE AND REAL ALUMINUM PRICE INDEX

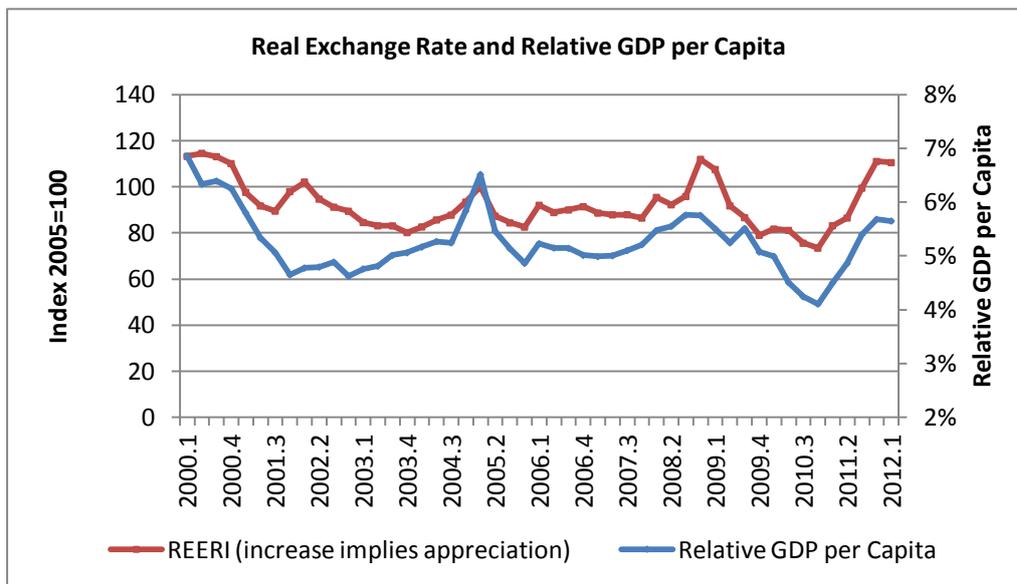


FIGURE 6. REAL EXCHANGE RATE AND RELATIVE REAL OUTPUT PER CAPITA

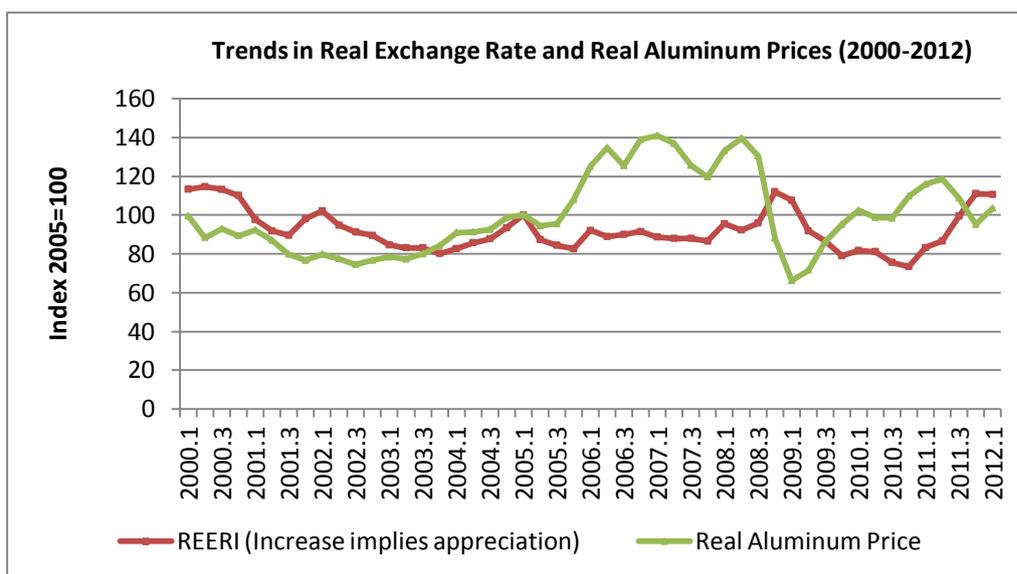
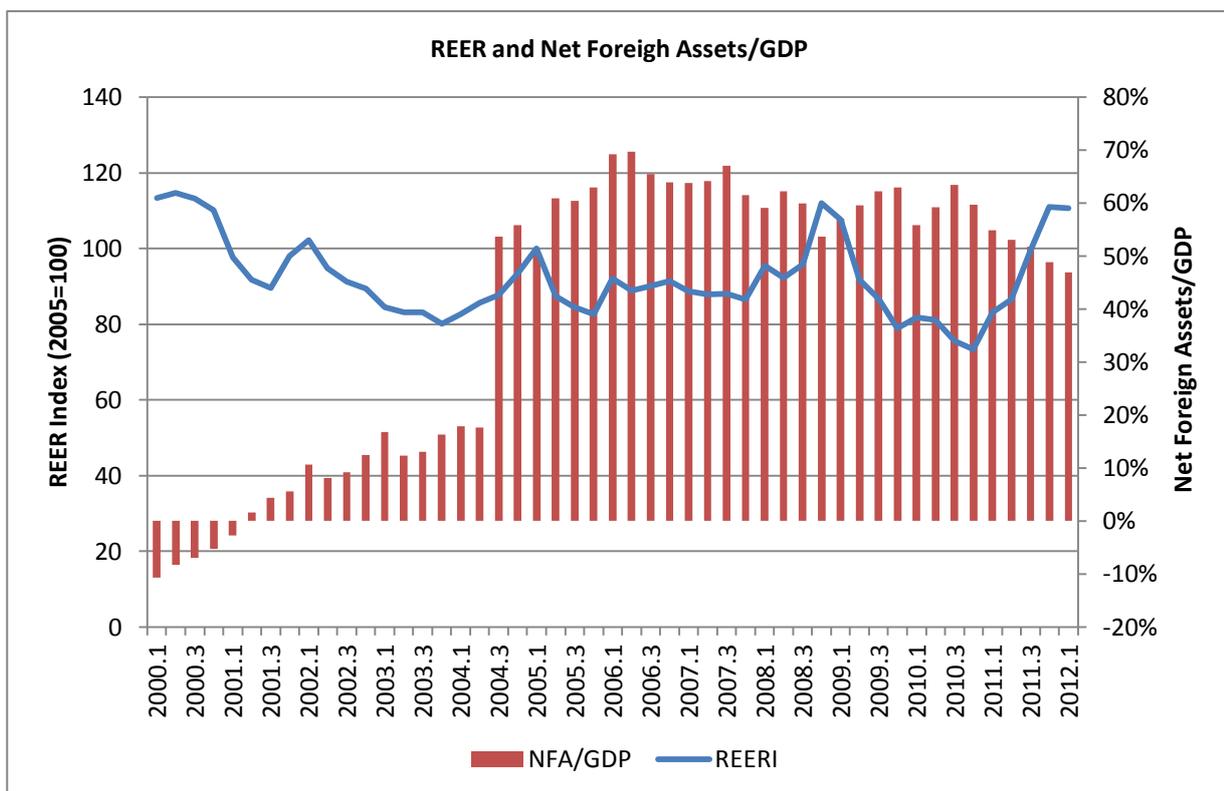


Figure 7 plots the observed association between the real exchange rate and the ratio of net foreign assets to GDP. The net foreign assets ratio reflects the demand-side impact of international capital transfers on the real exchange rate. Substantial international capital inflows have occurred over the decade. Beginning in the third quarter of 2004, there was a significant jump in the net foreign assets ratio from around 15 percent of GDP to more than 50 percent.

Thereafter the ratio averaged about 60 percent of GDP to the first quarter of 2010, and then began to tapered off to just over 40 percent in the first quarter of 2012. Despite this significant increase in net foreign assets to GDP over the period, one cannot discern an obvious visual correlation with the real exchange rate. One possible reason is that the big jump in NFA in 2004 is partly due to a significant decrease in foreign debt due to a World Bank/ IMF debt forgiveness program and thus does not represent an increase in demand-side factors. Another reason may be that the observed increases in net foreign assets due to capital inflows were accompanied by a rise in leakages from the economy in the form of imports and profit remittances by mega investors, reducing the potential impact of capital transfers on the exchange rate.

FIGURE 7. REAL EXCHANGE RATE AND NET FOREIGN ASSETS



FORMAL EMPIRICAL RESULTS

Establishing simple visual correlations helps us get a feel for the available data, however, we have to turn to a formal empirical analysis for more clear-cut conclusions. Since we are dealing with time-series data, the first step in this process is to address the issue of how best to model a small sample of data with near unit root behavior. Our short sample of fewer than 100 quarterly observations rule out any meaningful test of stationarity. Hence, we follow Chen and Rogoff (2004) and rely on the considerable empirical evidence suggesting that real exchange rates are stationary, possibly with a trend. The same has been found true for commodity prices (Borensztein and Reinhart 1994; Cashin, Liang and McDermott 2000). Ruling out non-

stationarity/stochastic trends a priori, we focus on the case where real exchange rates and real commodity prices, as well as the other variables, are treated as stationary, possibly with trends.¹²

The fully estimated model is as follows (quarterly data for the analysis includes the period 2000-quarter 1 to 2012-quarter 1):

$$\begin{aligned} \text{Ln } reer_t = & \alpha + \beta_1 \text{Ln } ral_{t-2} + \beta_2 \text{Ln } [(\text{income per cap}) F - (\text{income per cap}) M]_t \\ & + \beta_3 \text{Ln } reer_{t-1} + \beta_4 \frac{NFA}{GDP_t} + \beta_5 \text{trend}_t + u_t. \end{aligned}$$

Where

$\text{Ln } reer_t$ is the log of the real effective exchange rate of the metical, computed as a geometric average of the nominal exchange rate, weighted by the consumer price index in Mozambique, and its trading partner countries.

$\text{Ln } ral_{t-2}$ is the world price of aluminum, deflated by the price of manufactured exports from OECD countries. It is intended to proxy the exogenous terms of trade, and so is expressed in real form. The variable is also lagged two quarters to capture the effect of sticky pricing in Mozal's contracts with its buyers. Mozal is the only aluminum exporter, therefore, its contract terms and export prices (which are adjusted only at regular intervals and do not fluctuate instantaneously with spot prices on world markets) have an important impact on the terms of trade, resulting in lagged transmission of commodity prices to the exchange rate. Our results show an insignificant contemporaneous impact of aluminum prices on the real exchange rate, while a two quarter lag provides the best fit.

$\text{Ln } [(\text{income per cap}) F - (\text{income per cap}) M]_t$ is the log of the ratio of Mozambique's GDP per capita relative to that of its most important trading partners. As noted earlier, this controls for supply-side effects, such as the Balassa-Samuelson relationship, which captures differential rates of productivity growth between Mozambique and its trading partners.

$\text{Ln } reer_{t-1}$ is the log of the real effective exchange rate of the metical, included to capture the idea of a dragging anchor or momentum elements.

$\frac{NFA}{GDP_t}$ is the quarterly ratio of net foreign assets to GDP. Net Foreign Assets are calculated as the sum of net international reserves of the Bank of Mozambique, plus other net foreign assets including debts in foreign currency (medium and long term liabilities). As we discussed above,

¹² We did consider alternatives, including testing for unit roots in both the real exchange rate and the real commodity price index, and applying co-integration methods, as robustness checks for our results. The results we obtained were much weaker. If one includes the entire time period from 1995-2011, one can accept the hypothesis of a unit root (non-stationarity) in both the real exchange rate and real aluminum price series. However, for the shorter time period (2001-2011), when aluminum became the dominant export, the sample size is too small to apply these techniques in a robust manner. The trace statistics indicated co-integration with a restricted trend, but dropping/adding a few observations changed the results, indicating non-robustness of the specification.

this variable controls for demand-side effects, such as foreign direct investment flows, foreign aid and other international transfer payments.

We estimate this full model in four stages, beginning first with estimates, in model 1, of the commodity price elasticity of the real exchange rate treating both series as stationary with a linear trend. The OLS coefficient estimates are reported in the first column of table 4 below. We find that real commodity prices have a significant (at the 90 percent level) impact on the real exchange rate: a 10 percent increase in the real commodity price leads to a 1.8 percent appreciation of the real effective metical. This estimate is somewhat lower than elasticities found in other studies of more advanced and emerging market countries, where elasticity estimates average around 0.5 (Coudert, Couharde, and Mignon 2008). We also find that there are no severe problems of serial correlation in the error terms in this model, according to the Durbin-Watson and Breusch-Godfrey serial correlation LM tests.¹³

Model 2 augments model 1 by including the lagged value of the real exchange rate as an additional explanatory variable. This lagged endogenous variable exhibits high significance, suggesting the presence of either a momentum element or dragging anchor phenomenon in the exchange rate, or possibly the exclusion of (serially correlated) determinants. The Breusch-Godfrey LM test shows that the inclusion of a lagged endogenous variable reduces concerns about serial correlation further. The coefficient on the real commodity price increases in significant to the 99 percent level, however, introducing this lagged dependent variable reduces the magnitude of its coefficient. The commodity price elasticity of the real exchange rate declines from .18 to .13, such that a 10 percent increase in the price of the commodity now leads to a 1.3 percent appreciation of the real exchange rate.

In models 3 and 4, we control for demand-side and supply-side shocks by augmenting the regressions with relative GDP per capita and the net foreign assets ratio. Results indicate a significant positive Balassa-Samuelson effect in model 3, showing the importance of supply-side effects on real exchange rate determination. As a result of the inclusion of relative GDP per capita in the regression, the magnitude of the coefficient on real commodity prices declines. Evidently, and not surprisingly, real income is collinear with commodity prices. But the two

¹³ The strength of this commodity-currency relationship, particularly using the real aluminum price index, has been questioned in comments by BOM because a large share of Mozal's revenues do not accrue directly to the banking system or the economy. As we noted earlier in this study, the impact of these mega-projects in terms of taxes and profits to the Government and incomes to citizens in Mozambique have been relatively small for various reasons, even though aluminum exports represent more than 50% of exports and total mega-projects contribute more than 90% of exports. Reflecting on this issue, it can be argued that, since the real aluminum price (world price of aluminum, deflated by the price of manufactured exports from OECD countries) is a proxy for the terms of trade, another way to interpret the significance of the commodity-currency coefficient is that it is picking up the impact of commodity price shocks not just to aluminum but to all commodities, as they do tend to fluctuate, to some degree, together. That is, the real aluminum price is acting in some measure as a broader commodity price index of all Mozambique's commodity export prices. In this case, we are still left with the conclusion that a major determinant of Mozambique's long-run real exchange rate is commodity price shocks.

variables do not knock out each other when they compete side-by-side. Finally, in the fourth and full specification model, augmented with the net foreign assets to GDP ratio, all the coefficients remain significant, the coefficient on net foreign assets is, unexpectedly, negative and significant, and the magnitude and significance of the real commodity price coefficient increases. Given the sharp increase in net foreign assets after 2004, shown in figure 7, a dummy variable was included in the regression to account for this structural break. Inclusion of this dummy variable changes the sign of the coefficient of the net foreign assets ratio and reduces its significance – the NFA/GNP coefficient is shown to be positive for the 2004 to 2011 period, but it is not found to be significant. This could be due to multicollinearity issues, as NFA/GDP is correlated with real aluminum prices (the correlation coefficient is 0.59), which is significant at 1% level. However, dropping real aluminum prices from the equation did not change the results – again, when competing side by side these two variables do not cancel each other out. In fact, controlling for demand-side shocks via the net foreign assets ratio positively influences the magnitude and significance of the estimate of the commodity price elasticity of the real exchange rate. One should conclude from all of this that it is difficult to sort out the precise impact of NFA on the real exchange rate, given the available data, and thus its influence will have to await further study.

Table 4. Regression Results

	Model 1	Model 2	Model 3	Model 4
Intercept	3.76*** (0.43)	0.84** (0.48)	3.85*** (0.61)	3.93*** (0.76)
lnreer (t-1)		0.69*** (0.10)	0.38*** (0.12)	0.32*** (0.11)
ln(real commodity price)	0.18* (0.10)	0.13*** (0.05)	0.10** (0.05)	0.17*** (0.06)
Ln(relative GDP ratio)			0.51*** (0.13)	0.52*** (0.11)
Net Foreign Assets/GDP (2004-2011)				0.06 (0.09)
Net Foreign Assets/GDP				-0.20*** (0.08)
Trend	-0.002** (0.001)	-0.001 (0.001)	-0.00 (0.003)	0.001 (0.000)
N	49	49	49	49
Regression Rsq	0.08	0.59	0.63	0.71
Durbin Watson	1.62	1.89	1.58	1.68
LM Test (AR2)	3.91	1.39	5.79	4.55
Prob>LM	0.14	0.51	0.06	0.11

Note: Correlation corrected standard deviations in parenthesis.

***significant at 1%; ** significant at 5%; * significant at 1%.

DW Test (~ 2) shows no serial correlation in Models 2-4

Why might one find NFA/GDP to have a negative sign in the regression on the real exchange rate, as we did for the whole period under review? Several factors may be driving this result.

First, Egert, Lahreche-Revil and Lommatzsch (2005) argue that such a negative link between net foreign assets and the real exchange rate, which is found in several transition countries and in a set of small, open OECD countries, is connected to the need for real exchange rate depreciation in the long-run to service a high stock of foreign liabilities through an improved trade account. So higher levels of net foreign assets (once the desired stock is reached) require higher payments on these foreign liabilities. This is not a likely explanation for Mozambique, in that it is in a phase of development where it is moving towards a desired stock of foreign assets because its high growth potential cannot be financed only by domestic savings. The use of foreign savings implies the accumulation of foreign liabilities. Mozambique is not yet at the stage where the desired stock of net foreign assets is reached and a large outflow of payments is required to service these liabilities. It may be, however, that the significant debt relief program that influenced the NFA/GDP ratio in 2004 and thereafter had a similar impact to the events in more developed countries. Second, higher international inflows of capital over the decade in Mozambique have been linked to a sizable rise in leakages from the economy in the form of mega investor imports and profit remittances, reducing (or turning negative) the potential impact of transfers on the exchange rate. Third, an alternative explanation for the negative sign is that it might be related, in part, to the composition of net foreign assets. Some studies (Combes, 2011) have shown that it is not total capital inflows that impact the exchange rate, but the composition of the inflows. Portfolio investments (e.g., stocks, bonds and other financial instruments) are found to have the highest impact, while FDI and other transfers, which are prominent in the case of Mozambique, are found to have much less influence on the real exchange rate. Of course, this only accounts for a reduced impact not a negative impact. Studies such as Pontines and Siregar (2004) and Kaminsky and Reinhart (1999) present alternative formulations of the exchange rate pressure index.

Lastly, there is the possible influence of exchange rate intervention. If BOM is actively intervening to manage the exchange rate, it is not completely flexible to respond in a predictable way to the foreign capital inflows. We examine this issue of exchange rate intervention further following an approach presented in Combes (2011).¹⁴

We calculate an index of exchange market pressure

$$EMP_1 = \% \Delta e_{i,t} / (\% \Delta e_{i,t} + \% \Delta f_{i,t}),$$

Where

$$\Delta e_{i,t} = abs \left(\frac{er_{i,t} - er_{i,t-1}}{er_{i,t-1}} \right),$$

¹⁴ Alternative, and more sophisticated, formulations of the exchange rate pressure index are presented in Pontines and Siregar (2004) and Kaminsky and Reinhart (1999), however, we did not have the data to pursue these alternatives .

$$\Delta f_{i,t} = \frac{abs(RES_{i,t} - RES_{i,t-1})}{MB_{i,t-1}}$$

RES measures the reserve assets, and MB measures the monetary base. If the exchange rate is a pure float, and the monetary authority does not intervene to build up reserves in response to inflows of capital, we would expect the EMP index to equal 1. On the opposite end, if the exchange rate is fixed, the EMP index would be zero. Intermediate values of EMP index are related to degrees of exchange rate flexibility and monetary interventions. The net foreign assets ratio and results of the estimation of the EMP index are presented in the table 5.

Table 5 Measures of Exchange Rate Flexibility 2000-2012

Period	Net Fgn Assets/GDP	EMP Index
2000-2002	2%	0.44
2003-2005	37%	0.36
2006-2009	63%	0.31
2010-Present	57%	0.65

Table 5 shows that the metical has not floated fully freely since 2000 – it has been floating, as Calvo and Reinhart (2002) say, “with a life jacket,” as in many other developing countries. BOM has clearly been intervening over the period, reducing exchange rate flexibility (although it should be noted that, according to the BOM it does not, as a matter of policy, explicitly target the exchange rate). However, the degree of flexibility appears to have increased somewhat in the past two years as the EMP measure jumped up to .65 in the 2010-present period.

Summing up, we find that momentum effects (captured by the lagged real exchange rate), terms of trade (proxied by real commodity prices), supply-side productivity differentials or the Balassa-Samuelson effect of rising prices of non-tradables, and net foreign assets are major determinants of long-run equilibrium real exchange rates in Mozambique. Most important, the metical does appear to fit into the category of a commodity currency (although the effect is comparatively weak today), as the real world price of commodity exports does have a significant and stable influence on Mozambique’s real exchange rate – a 10 percent increase in the real world commodity price in our full model results in a 1.7 percent real appreciation. This finding does not come as a complete surprise, as commodity price shocks (both export and import) have long been recognized as of great importance to low-income countries that rely heavily on primary commodity production. However, it does underscore the fact that one of Mozambique’s key vulnerabilities in the coming resource boom will be sensitivity of the real exchange rate to commodity price shocks. Today, with aluminum as the chief commodity export, commodity price elasticity of the real exchange rate is relatively low. As other commodities, such as coal,

natural gas, and perhaps oil, become much more important in the composition of exports, this could change substantially. Higher trade volumes of these commodities, and the fact that they exhibit much higher price volatility than aluminum, will surely influence future exchange rate responses to world commodity price shocks.

The fact that we find a highly significant influence of supply-side shocks via relative GDP per capita is a decisive acceptance of the importance of the Balassa-Samuelson effect. On the other hand, we only have a few tentative conjectures for the significant influence of demand-side shocks on the real exchange rate via net foreign assets. More work is needed on this issue to sort out what is going on. Finally, for time-series estimation, our sample size is rather small with just 49 quarterly observations, making it difficult to carry out a robust analysis of long-term determinants of the real exchange rate.

QUALITY OF INSTITUTIONS

Another significant vulnerability in the coming resource boom is the quality of Mozambique's institutions. As noted earlier, natural resource booms have been found to influence the nature and quality of a country's institutions, and this impact has been shown to be one of the main channels through which resources curse growth and long-run development. The outlook for low-income countries with weak institutions before the resource windfall is particularly worrying.

Table 6. Governance Indicators Mozambique 1996-2010

	1996	1998	2000	2002	2003	2004	2005	2006	2007	2008	2009	2010
VOICE & ACCOUNTABILITY												
QUALITY SCORE	-.32	-.10	-.15	-.18	-.02	-.04	-.00	-.09	-.08	-.08	-.06	-.12
COUNTRY RANK	40	46	46	44	46	47	39	45	47	47	47	45
AVG. Q SCORE SSA	-.73	-.70	-.69	-.65	-.61	-.64	-.63	-.57	-.58	-.60	-.62	-.62
POLITICAL STABILITY												
QUALITY SCORE	-.16	-.02	-.16	.13	.19	-.07	.06	.48	.31	.35	.53	.32
COUNTRY RANK	43	46	39	47	50	42	48	61	55	57	64	57
AVG. Q SCORE SSA	-.62	-.62	-.62	-.64	-.56	-.50	-.55	-.49	-.54	-.55	-.54	-.55
GOVERNMENT EFFECTIVENESS												
QUALITY SCORE	-.47	-.39	-.43	-.43	-.54	-.56	-.51	-.59	-.49	-.43	-.44	-.47
COUNTRY RANK	53	41	38	39	34	32	36	31	37	42	40	39
AVG. Q SCORE SSA	-.74	-.72	-.72	-.72	-.72	-.76	-.81	-.81	-.79	-.78	-.78	-.80
REGULATORY QUALITY												
QUALITY SCORE	-.54	-.29	-.16	-.30	-.50	-.46	-.62	-.52	-.51	-.47	-.37	-.37
COUNTRY RANK	27	37	43	42	32	35	25	31	31	36	39	41
RULE OF LAW	-.75	-.70	-.67	-.68	-.70	-.74	-.77	-.73	-.75	-.74	-.72	-.71
QUALITY SCORE	-.83	-.81	-.74	-.67	-.73	-.63	-.70	-.64	-.59	-.60	-.59	-.50
COUNTRY RANK	23	22	29	30	27	32	32	31	33	33	34	37
AVG. Q SCORE SSA	-.75	-.73	-.72	-.71	-.73	-.77	-.77	-.72	-.73	-.74	-.74	-.74
CORRUPTION												
QUALITY SCORE	-.36	-.35	-.40	-.46	-.60	-.64	-.55	-.58	-.53	-.46	-.39	-.39
COUNTRY RANK	40	41	42	38	34	29	37	34	36	40	42	42
AVG. Q SCORE SSA	-.60	-.62	-.57	-.58	-.63	-.67	-.68	-.63	-.61	-.61	-.61	-.60
AVERAGE TOTAL QUALITY SCORE (MOZAMBIQUE)	-.45	-.33	-.34	-.32	-.37	-.40	-.39	-.32	-.31	-.28	-.22	-.25
AVG. TOTAL QUALITY SCORE (SSA)	-.70	-.68	-.66	-.66	-.66	-.68	-.70	-.66	-.67	-.67	-.67	-.67

Source: Worldwide Governance Indicators, World Bank 2011

Table 5 presents the World Bank's Governance Indicators for Mozambique 1996-2010, together with average quality-of-institutions scores for sub-Saharan Africa. These indicators measure the strength of a country's institutions as perceived by its citizens, public and private entities, and NGO's along a number of dimensions, including:

- Voice and Accountability (extent to which citizens participate in selecting government, freedom of expression, association, and media);
- Political Stability (likelihood government will be over thrown by unconstitutional or violent means);

- Government Effectiveness (quality of public services, quality civil service, and quality of policy formulation and implementation, creditability of government commitment of such policies);
- Regulatory Quality (ability of government to formulate and implement sound policies and regulations);
- Rule of Law (extent to which agents have confidence in and abide by the rules of society, and quality of contract enforcement, property rights, police, courts, and likelihood of crime and violence);
- Corruption (extent to which public power is exercised for private gain, including both petty and grand forms of corruption and capture of state by elites and private interests).

Quality of governance scores for each category are measured in units ranging from -2.5 to 2.5, with higher values equivalent to better governance outcomes. The country rank scores are measured for 213 economies, with higher country rankings indicating better governance outcomes compared with other countries. Table 5 also includes a total strength-of-institutions score for Mozambique, as well as regional average quality-of-institutions scores for sub-Saharan Africa.

Mozambique scores relatively poorly in institutional quality in just about all categories of governance, indicating substantial institutional weakness across the board. Particular areas of concern appear in government effectiveness and rule of law, while areas of relative strength can be observed in voice and accountability and political stability. On the bright side, institutional quality, on average, has improved substantially over the last 15 years. The average total quality score, although still quite low, has increased about 40 percent since 1996. But improvement in voice and accountability, political stability, and regulatory quality are responsible for just about all of this progress, there are no gains to speak of in the quality of government effectiveness and corruption, while marginal improvements have been made in the quality of rule of law. Also, comparatively Mozambique is doing much better in terms of quality of institutions than the average for sub-Saharan Africa, as seen by the average quality scores for SSA in all categories in table 5.

The fact that government effectiveness, corruption, and rule of law continue to be the weakest areas of governance in Mozambique is worrying because of the “point-source” resources Mozambique will be exporting in the coming boom. As we noted earlier, all the research on the resource curse highlights the fact that “point-source” resources, such as gas, mineral coal, mineral sands, which are easily controlled and managed by government, are a particular problem for countries lacking strong institutional capability. This does not augur well for Mozambique in the future.

The government has begun to adopt some initiatives that make a start in addressing these issues, such as the Extractive Industry Transparency Initiative, which makes payments of dividends and royalties by extractive companies to government public information. But many informed citizens in Mozambique continue to complain that, to date, contracts with mega projects have not been negotiated or managed with a great deal of transparency. Also, more generally, Mozambique has

a nascent democracy, where the central government continues to have a fragile hold on the whole system and local governments have limited capability to manage quality institutions and economic affairs. On the whole, this is not the ideal starting point for managing a coming resource boom, particularly given the experience of other African countries in a similar situation. Low institutional quality will have to be a specific concern in developing policies to address a natural resource curse.

ABSORPTIVE CAPACITY AND NON-TRADABLE PRICES

Mozambique is one of the poorest countries in the world. Following independence, the country suffered a devastating civil war, which destroyed much of its key infrastructure and shattered the economy, and it has spent the past twenty years trying to recover. Today the economy is still fragile and faces the characteristic development problems of low-income countries – market imperfections are endemic, financial markets are not fully formed, human capital is scarce, and institutional quality is low. As such, Mozambique’s capacity to absorb a large resource windfall is extremely limited in the short to medium-run. Spending such enormous revenues (either on consumption or investment) will raise demand for locally produced goods and services and, given Mozambique’s low absorptive capacity, the economy’s response will run, rather quickly, into diminishing returns, reducing the value of this spending. The basic problem is that steep supply curves, particularly for non-tradable goods and factors, will cause spending to result in higher prices, including real exchange rate appreciation, which will crowd out other activities, such as manufacturing and agriculture, rather than drawing more resources into use.

Steep supply curves arise from bottlenecks in the supply of non-tradables due to (a) non-tradables requiring critical amounts of home-grown capital (human and physical) for their production, which is in short supply, and (b) inefficiencies in the business environment that hinder drawing in new resources, such as regulations and other difficulties in acquiring land, delays and costs in importing capital equipment, labor market regulations that reduce hiring and firing flexibility, and institutional weaknesses noted in the last section. Overcoming such bottlenecks and building the economy’s absorptive capacity will take time. Bottlenecks can be avoided to some degree by imports, but not all productive, human and managerial capital can be obtained from abroad, a certain amount of home-grown capital must be accumulated over time. It would also not be politically feasible in Mozambique (or in the best interests of longer-run development) to import all the human and physical capital needed to overcome absorptive capacity problems, as some oil-exporting Gulf States did. Instead, Mozambique would be better off improving conditions for investment in non-tradable sectors. This would involve (a) removing barriers to investment in the business environment, (b) promoting public investment in infrastructure and training, and (c) facilitating imports in strategic investment areas, such as skilled labor to overcome key technical bottlenecks and for training purposes.

Mozambique is weak in most areas concerned with development of non-tradable goods and factors. Only about half of the population aged 15+ is literate and Mozambique has one of the lowest levels of educational attainment in the world – 62 percent of adults did not complete at

any primary school and only 22 percent completed the first level of primary school. In terms of higher education, only .26 percent of the population has a university degree or an equivalent level of education. If we concentrate just on the urban population, things look a bit better. But even in urban centers only 50 percent of the population has any formal education, only 27 percent completed the first level of primary school, and only .43 percent completed university. Hence, on average, human capital is quite low and skilled labor is very scarce.

Low human capital is reflected in low firm-level productivity. Enterprise surveys carried out by the World Bank and others indicate that, while there are large productivity differentials between sectors and different sized firms, on average, firm-level labor productivity, as measured by value added per worker, is comparatively low in Mozambique. One World Bank study of industrial performance found, for example, that Mozambique had the lowest labor productivity in a sample of eight sub-Saharan African countries (Mozambique Industrial Performance and Investment Climate 2002, CTA and World Bank, 2003; World Bank Investment Climate Survey 2009). Studies find that productivity in agriculture is also comparatively low. Of course, productivity is not just about human capital. Inadequate infrastructure, underdeveloped financial markets, and the business environment also play an important part.

Focusing first on the business environment, Mozambique's rank in the World Bank's "Doing Business Report" has improved somewhat in the last couple of years, but it continues to be positioned near the bottom of the list of countries with poor business environments (World Bank 2011). Its global competitiveness index, as measured by the World Economic Forum, also languishes around the lower rungs of the competitiveness ladder compared with its peers (World Economic Forum 2010). Financial constraints register as one of the worst elements in this lackluster business environment, and, according to the 2011 Doing Business Report, this feature of the business climate has actually deteriorated in the past few years. Firms complain in surveys that both cost and availability of credit are problems (World Bank Investment Climate Survey 2009).

In terms of infrastructure, Mozambique has tremendous needs in all areas – roads, railways, ports, air transport, water and sanitation, irrigation, power, and communications. These infrastructure needs significantly reduce the country's productive potential. A comprehensive study of the country's infrastructure requirements forecasts that public infrastructure needs alone will necessitate sustained annual investment of \$1.7 billion over the next decade, about 25 percent of projected GDP (Dominquez-Torres and Briceno-Garmendia (2011). Perhaps the greatest public infrastructure challenge is in the transport sector. Achievements in constructing transport corridors have provided regional connectivity and links with mining, as well as links between key production centers and ports, but connectivity among urban centers and economic clusters is limited, as there is a lack of linkages that connect parallel corridors to each other. Mozambique has just completed a much needed north-south national road, but the country has limited links among the several east-west corridors, and developing full connectivity will require sustained large investments over decades. In addition, Mozambique lags behind the rest of the SADC region in accessibility of the rural population to domestic markets. Improving accessibility will be an enormous challenge, given the size of the country and infrastructure needs. Lastly, the country has a huge maintenance challenge ahead keeping up with rapidly expanding road and rail networks. Maintaining the system will not only place a financial burden on the public sector, it

will also entail an enormous management burden, which will require a good deal of capacity building.

Even at this preliminary stage of the coming resource boom, absorption constraints are already beginning to show up in rising prices of non-tradables, particularly in urban centers. Skilled labor and real estate provide good examples. Interviews for this study found that local companies in Maputo are already finding it much more difficult to keep educated employees as employment opportunities expand with rising foreign direct investment. Firms reported that monthly salaries for skilled people have risen in the past few years more than 300 percent and the growth rate of wages for skilled labor is accelerating. Real estate prices have begun to rise rapidly too. Estate agents report that rentals are increasingly difficult to find and housing prices in the favored areas of Maputo are rising 50 percent a year. One property-owner who rents his house in Matola stated that a few years ago he could not rent his house, but this year he had many offers and now rents it for \$6000 a month. Speculators who have seen the impact of natural resource windfalls in other countries are also actively beginning to bid up land prices in expectation of what is to come.

The important issue to highlight here is the sluggish nature of the adjustment to these price increases. Bottlenecks are already beginning to appear. Increasing foreign investment, even at this early stage, is causing housing demand in prime locations to outstrip supply in urban centers. Part of the reason for sluggish supply response is low productivity in the construction industry. It can take two to three years to construct a large house in Maputo, while in the US or Europe it would take three to four months to build a similar structure. It is not just the task-level efficiency of construction workers that slows things down, it is also the fact that building materials are not standardized (e.g. window, doors, etc. are generally one-off, custom made for each house, rather than built by standard design on an assembly line), construction methods are not up to date, land can take time to obtain, and financing is inadequate. Finance is a problem because of the high cost of finance and because of low construction productivity. It is just too costly at current interest rates (and collateral requirements) to carry a construction loan for a house that takes two to three years to build, and make a profit. All of these factors reduce the supply response to rising housing prices.

Current price developments in markets for skilled labor and housing illustrate the effects of absorption constraints, and they warn of the problems Mozambique will face when the full force of the coming resource windfall hits. For example, given the problems we see today, what would happen in the future if increases in boom-related public infrastructure investment were to coincide with increases in private sector boom-related investment in housing construction? This rise in investment would surely lead to a construction boom and a rapid increase in the price of non-traded inputs. The value of public expenditure would be reduced as a result and this decrease in infrastructure investment would cause other bottlenecks in the economy – in port capacity and port congestion, for example, or perhaps in traffic congestion. Sector effects accumulate into economy-wide changes in relative prices, including higher wages and higher prices of local goods and services relative to the price of foreign goods. This causes an appreciation of the real exchange rate, and is the source of Dutch disease and crowding out of non-resource exports.

As the examples of skilled labor and housing indicate, production of non-tradables requires inputs of home-grown capital (e.g., teachers and trainers to upgrade worker skills; land, skilled construction workers, and local finance to improve housing supply, and so on), as well as a supportive business environment to facilitate investment. Adjustment might be speeded up if key constraints can be relaxed, to some degree, by imports. But this will have to be considered carefully. For skilled labor, strategic targeting will be important in identifying key constraints and selectively using imported skilled labor to develop local capacity. For products, building materials for example, there will be a good deal of pressure for tariffs, quotas, and domestic content restrictions to make sure that the resource boom benefits local producers. It will be important, however, to make sure that critical inputs to investment in non-tradable sectors are not subject to a lot of restrictions, as the central objective should be to facilitate a speedier supply response to try to reduce the severity of potential negative spillover effects from the boom.

4. POLICY OPTIONS FOR MANAGING THE COMING RESOURCE BOOM

The negative effects of natural resource exports observed around the world, as well as the economic vulnerabilities we have underscored in this study, should not be interpreted as a foregone conclusion that dooms Mozambique to failure. The important question a resource-rich country must address is what policies to adopt to magnify the benefits of its resources and increase chances for successful development. We turn now to a discussion of policy options for managing the coming resource boom.

To inform the discussion of policy alternatives, let's begin with the known facts about revenues from natural resource exports and Mozambique's economic capacity to absorb these resources. First, revenues from natural resources result from depleting a finite stock of resources, hence they are fundamentally temporary. Furthermore, these revenues will be highly uncertain, as commodity prices are highly volatile. These distinctive characteristics of resource revenues indicate the importance of saving some portion of the revenues (a) to provide for future generations, as they are also entitled to a share of the country's resource endowments and (b) to smooth out and sustain increases in consumption, as declines in consumption are costly, economically and politically. Coping with the "commodity cycle" will therefore be an important policy concern.

Second, Mozambique is a low-income, capital-scarce country that needs to raise consumption to address poverty and to increase investment in public goods, such as education, health, infrastructure, and institutional capacity, to put the country on a sustained higher growth trajectory. Allocating resource revenues to consumption and to finance such domestic investments is thus a policy priority.

Third, Mozambique's current capacity to rapidly absorb windfall resource revenues is quite limited. The investment process in the country, at present, is not capable of delivering high returns on very large volumes of investment, as managerial and physical bottlenecks will depress marginal earnings on these investments. Supply curves in non-tradable sectors are quite steep due to scarce home-grown capital, low productivity in production, a poor business environment, weak institutional capacity, and inadequate infrastructure. And capacities associated with effective governance and economic management are nascent. These facts also mean that negative spillover effects of the resource boom, such as Dutch Disease, are apt to be stronger. Accordingly, policy options for managing the boom will be constrained by absorptive capacity and a need to moderate Dutch Disease effects.

What are the policy options under these conditions? What is the best way to manage resource revenues to raise consumption, sustainably, and increase domestic investment, while coping with inevitable revenue volatility and the other adverse effects of booming resource exports? The answer to this question has to involve a mix of spending options, as well as risk management interventions to cope with volatility and moderate the adverse effects of Dutch Disease.

RAMPING-UP DOMESTIC INVESTMENT IS THE TOP PRIORITY

The main overarching focus of revenue management in a country like Mozambique should be to raise domestic investment to much higher levels, both public and private, in order to increase economic growth and, in so doing, boost consumption. One of the chief reasons many countries with large endowments of natural resources often continue to grow slowly is underinvestment in tangible and intangible assets that are public goods. Moreover, since Mozambique's economy is capital-scarce, investment should notionally concentrate on accumulating assets by investing domestically not by investing outside the country in foreign financial assets. On average, investment returns in a capital-scarce country should be a lot higher than returns in capital-abundant world markets. This would seem to rule out policy options such as a sovereign wealth fund, which is generally set up to invest revenues in financial assets abroad. However, policy options are not so clear-cut, as we will discuss below.

Implementing this overarching priority to raise the domestic investment rate, however, involves some complications. First-off, using revenues to rapidly accumulate domestic assets in Mozambique today is hampered by a poor domestic investment process, which will severely constrain potential investment returns. Until this condition is improved and investment capacity in the economy can be built up, there is probably no other practical policy option than to buy some time by accumulating resources in a Sovereign Wealth Fund (SWF), or possibly something with a broader focus that could be called a Natural Resource Fund (NRF), which could invest both abroad and domestically. Both Funds are a form of national savings, which ensures that the gains of the booming sector are partially shared with the rest of the Mozambican community. Resources in the NRF could be accumulated in foreign assets to start with, and then as local investment capability improves, investment priorities could shift more into accumulating domestic assets. Care has to be taken not to allow the overseas investment operations of the NRF to become counter-productive, such that, instead of buying time, these operations delay improvements in the absorptive capacity for investment. Commodity Funds, such as SWF and

NRF, should be transparently and professionally run, with rules to govern the payout rate and with insulation of the managers from political pressure in their pursuit of the social well-being of the nation. Also, explicit safeguards would have to be implemented to make sure that the Fund is not raided by politicians. The ultimate safeguard, of course, is transparency and the fact that the government has signed on to The Extractive Industry Transparency Initiative is a positive indication for the future.

Second, if resource revenues are to be allocated principally to domestic investment, there is no practical alternative to the government playing the principal role. The private sector will have an important part too, but it does not have the incentive to make the public goods invests in infrastructure and other areas that are required, although it can participate in these ventures. Government's lead role would have to include an effort to (a) develop a strategic plan to prioritize public investments to obtain high social returns and (b) fiscal rules to impose limits on spending from the NRF, so that the investment process of decisions and implementation does not go downhill and spending is not pro-cyclical. Public sector capability to formulate, implement, and evaluate investment projects would also be required. But perhaps most important, government's role in raising the investment rate should also involve policies to stimulate more private sector investment. Public sector-led investments in infrastructure and other public goods will be complementary to private sector investment activity and thus will pro-actively stimulate more private domestic investment, as public infrastructure improvements increase investment opportunities and raise investment returns. In addition, government will have to use resource revenues to improve the investment environment. This means improving the quality of institutions and other elements of the investment climate, such as the regulatory regime, tax administration, and management of public infrastructure, to encourage more private investment activity.

DIRECT DISTRIBUTIONS TO CITIZENS: ANOTHER IMPORTANT OBJECTIVE

It is clearly important in Mozambique that some fraction of the resource revenues get into citizens hands as soon as possible. Given the level of poverty in the country, it is important to raise consumption straight away (as the value to society of consumption now is higher than consumption in the future), and this increment to incomes would unquestionably finance some high-return private sector investments. Direct distribution of a portion of resources would also reduce some of the risk of public misuse of resources and would help to establish the principle that these resources belong to the citizens of the country and are being used to benefit everyone and not just a small elite. But it needs to be stressed that direct transfers of resource revenues to citizens should be limited to only a portion of the revenues because (a) given the volatility of revenues, consumption should be raised slowly to avoid future costly roll-backs and (b) private citizen's spending choices alone will not necessarily lead to efficient consumption or investment in a situation where there are important requirements for direct public investment in health, education, and infrastructure.

Implementing direct transfers to citizens is not an easy matter in Mozambique, however, and addressing the implementation problem would take some time. The country does not have a

complete system of citizen registration and all citizens are not in the tax system. Hence, it would be difficult to make direct transfers via tax reductions, as other resource-rich countries have done. The question remains, would it be technically feasible under these conditions to make direct distributions? As Gelb and Majerowicz (2011) argue in their study of the possibility of direct distributions in Uganda, in a situation with no infrastructure set up for general institutionalized direct distributions, a program running through several layers of government – central, district, municipal – would certainly incur substantial “leakages”. But establishment of a good system is not an impossible task. Several governments have successfully introduced broad-based, direct distribution systems, including South Africa (pensions, child allowances, disability payments), Pakistan (low-income females, flood relief), Andhra Pradesh (social transfers, employment guarantee payments), and Bangladesh (social transfers). Following in the footsteps of these experiences, Gelb and Majerowicz recommend that the most efficient approach would be to use new technology, including biometric identification, smartcards and electronic payments into mobile bank accounts, to make direct distributions to households through the banking system. A national registration, or ID system, would be needed to implement this program. Such a national ID scheme would also produce added benefits beyond the direct distribution program, such as providing a foundation for improvements in the tax system, for carrying out poverty reduction, education, and health strategies, and for extending financial access to traditionally under-banked citizens.

COPING WITH VOLATILITY

How best to manage the commodity cycle will be an important risk-related concern in managing windfall resource revenues. Volatility of commodity prices is a prime reason why many resource-rich countries experience poor economic performance. There are two kinds of volatility that require attention: (a) the longer-run, and more predictable volatility of depletion of the natural resource base and (b) the short-term volatility connected with world market fluctuations in commodity prices. Managing longer-term volatility associated with the uneven time profile of revenues due to resource depletion is largely a matter of making high-return investments in domestic assets that increase future incomes, and saving a portion of windfall revenues for future generations. The experiences of many commodity producers show that they generally save too little, on average, and especially in the booming segment of the commodity cycle. Therefore, institutions, such as the SWF or NRF, which insure that a portion of export revenues are saved during booms, is one of the most important ways to cope with volatility (possibly assisted by rules to help manage the cyclically adjusted budget surplus).

Managing exposure to unpredictable, shorter-term volatility associated with external fluctuations in world prices will require the use of several policy options. At the outset, it should be noted there are a number of policies that have been used in developing countries to deal with commodity price fluctuations, which have not had much success: marketing boards, price controls for consumers, overly heavy taxation of natural resource production, producer subsidies, and cartels. Each of these measures, in its own particular way, has ultimately failed to stabilize the effects of fluctuating commodity prices and, in many instances, has actually increased volatility and instability (Frankel 2011).

Ultimately, it is probably best to accept that commodity prices fluctuate and to look for established devices that will mitigate adverse effects that result from volatility. One option would be to make contract terms with international extraction companies explicitly dependent on future market conditions. The best method for doing this is to index contracts – if world prices increase (decrease) substantially over a specified period, then the contract can stipulate that profits (losses) should be split in a certain way. This up-front arrangement would minimize disputes and citizen discontent, reduce problems that can arise in renegotiation of contracts, which can be costly, and allay the reputation damage that can be caused by renegeing on contracts.

Another option is to hedge revenues through futures contracts, forward markets, and options. But these financial instruments are generally short to medium term vehicles, less helpful for periods when prices remain low long for a long time, and are largely of use to public sector sellers of commodities. In Mozambique, international investors would be doing the hedging, which could help in some measure to stabilize contract-related revenues flowing to government.

Lastly, in accepting that a certain amount of volatility is an inevitable part of being a natural resource exporter, policymakers have the option to decide, ahead of time, which economic variables will be allowed to fluctuate. Collier et. al. (2010) recommend that, among the three available alternatives – consumption, the country's net foreign asset position, and domestic investment – it is best to let investment fluctuate. Allowing a large part of world market fluctuations in commodity prices to whack consumption is costly. Adjustment costs for firms, households, and the public sector, once a particular level of consumption is achieved, can be substantial. And for the government in power it can also be politically problematic to roll back established programs, given a decline in resource revenues supporting these initiatives.

As for the economy's net foreign asset position, it is intuitively appealing to focus on reducing the effects of the commodity cycle by borrowing and lending in international capital markets. Unfortunately, the Stabilization Fund that would be required to substantially smooth out the domestic economy, given the unpredictability of commodity prices and revenues, would have to be so large that it would not be a practical option. There would not be enough resources left after fulfilling the Stabilization Funds needs to maintain current consumption and domestic investment, and the benefits of the accumulated resources would mostly go to future generations. But this does not mean that all stabilization activities should be avoided. Some borrowing and lending in international capital markets should be part of the policy package, but it is not a practical option for extensive smoothing of the economy.

For short and longer-term effects of the commodity cycle the best option is to let investment fluctuate. A fluctuating domestic investment rate is congruent with a considerable amount of stability in productive capacity and output. Moreover, even in well performing economies, investment is more volatile than other components of income, and dealing with these fluctuations is not an enormous problem. As investment capacity is improved in Mozambique, and the investment rate is increased to much higher levels, fluctuations in investment should also be easier to manage, as investment will be a large component of GDP. The important policy concern should be how best to manage the investment process, given volatility, such that the economy can avoid very large sudden drops and increases in investment.

DEALING WITH DUTCH DISEASE

One policy option for dealing with problems of Dutch Disease is to do very little. Exchange rate appreciation and other effects of Dutch Disease can simply be viewed as equilibrium, comparative advantage phenomena that reflect a change in the underlying economic fundamentals in response to a foreign exchange windfall, which, by itself, has benefits. FDI inflows will slow down over time, while revenues from the new discoveries, and inevitable terms of trade shocks, will continue until resources are depleted. Some non-resource tradable activities will decline and some non-tradable activities will prosper. Viewed in this light, Government's role would be to assist in facilitating the adjustment process, but not in stopping or moderating the adjustment caused by Dutch Disease.

This option might be workable in a high-income, advanced economy, where the costs of adjustment are relatively modest, and where there are available resources and expertise to assist in tempering adjustment costs, even though it might be somewhat politically difficult to do so little. But in an economy like Mozambique's, as we have tried to show, Dutch Disease effects on economic growth and on welfare would be much more substantial, and could damage longer-run development prospects, if allowed to get out of hand. Therefore, policymakers will have to be pro-active in taking steps to moderate the effects of Dutch Disease.

One of the most important policies for moderating these adverse effects is the SWF or NRF that invests resource revenues, in the early stages of the resource boom, abroad, to buy time for improvements in absorptive capacity. Investing abroad reduces spending effects in the economy and generates capital exports, which would offset, in part, the impact of FDI capital inflows. Hence, the Fund would moderate exchange rate appreciation and the effects of Dutch Disease. This policy of accumulating foreign assets can be looked at as a special kind of exchange rate protection policy, designed to benefit firms in the lagging, non-resource tradable sectors of the economy in a uniform way, not selectively.

Another way to protect the exchange rate is by accumulating international reserves via foreign exchange intervention by the Bank of Mozambique (BOM).¹⁵ Reserve accumulation would assist in achieving a desired level of moderation of real exchange rate appreciation. Particularly in the early stages of the boom this would be a key part of the policy package, but there are some difficulties with this type of intervention, once the BOM has accumulated enough reserves, as judged by precautionary and monetary criteria, that reduce its desirability as a long-run strategy. When the BOM accumulates foreign reserves to moderate exchange rate appreciation, this operation can lead to rapid increases in the money supply and cause inflation. Thus, even though nominal appreciation has been avoided or reduced by intervention, the inflation produced by intervention can result in real appreciation. To sidestep this problem the BOM has to sterilize the monetary effects of the exchange rate intervention. This involves the BOM selling bonds (or

¹⁵ Accumulation of international reserves by BOM can also be viewed as another way to cope with volatility by saving in boom periods and dissaving in busts.

raising reserve requirements in banks), which withdraws money from the market, and returns the money supply to where it was before intervention.

To additional problems are caused by this operation. First, for the market to absorb the bonds the BOM is selling the interest rate may need to rise, which can have effects on the economy. Second, the interest rate that the BOM receives for its foreign reserve holdings (typically reserves are held by central banks in US treasury bills, which currently earn 1.5 percent) will probably be less than the interest rate it has to pay in the domestic market on the bonds it sells. This is a loss (called a “quasi fiscal deficit) due to intervention and sterilization, and, with a continuous program of intervention to manage boom-related effects, this loss could become quite large and must eventually be paid by the government. To avoid this problem the government must run a fiscal surplus, and then, with the money that it saves because of this surplus, it would buy the bonds that the BOM sells. In this case, the domestic interest rate would not be impacted, but the policy of sterilized exchange rate intervention is now associated with a contractionary fiscal policy. In the end, this reserve accumulation policy by BOM turns out to be very similar to a policy of accumulating revenues in a SWF or NRF. To achieve a desired moderation in real appreciation, both of the policies increase savings, or forgo domestic investment, and both invest abroad.

A third possible exchange rate protection policy would be to reduce net capital inflows by various means when and if they were to become too large. Any policy (for example, controls or taxes) that reduces net capital inflows either by reducing gross inflows or increasing capital outflows will put downward pressure on the nominal exchange rate, or reduce an appreciation that would have occurred, moderating Dutch Disease effects. Alternatively, private entrepreneurs might be encouraged to invest additional capital abroad via, say, tax concessions. In both of these cases, less capital would be invested in Mozambique by foreigners, domestic private investors, or by the government.

Finally, there is the option of moderate the effects of Dutch Disease via some type of selective protection. In general, the policies that can be grouped under this heading are less desirable alternatives. Difficulties of selecting who gets subsidies and tax breaks and implementation problems are numerous. Furthermore, uneven protection can be inefficient and generate a lot of rent-seeking. In addition, there are the general equilibrium effects of selective protection to think about: import protection for some activities (for example, manufacturing) may actually cause additional exchange rate appreciation, which would worsen the Dutch Disease effects on other activities (for example agriculture or tourism). If selective protection is going to be provided to deal with Dutch Disease effects, it is best to apply it across the board to non-resource tradables, as is done in the case of the exchange rate protection policy discussed above. However, there are some difficulties in doing this with measures such as taxes and subsidies. The most formidable problem is that, when one looks at economic activity in detail, it may not always be clear which goods and services are tradable and non-tradable. A domestically produced good or service that depends on domestic demand and supply may also be an imperfect substitute for imports; hence it will also depend on global market prices and the exchange rate. As a consequence, it would benefit from increasing boom-related domestic demand, but also lose from the associated appreciation.

What are the welfare effects of these policies to moderate Dutch Disease? To begin, in all instances some economic agents lose (for example, firms and individuals that would gain from more capital investment in Mozambique on infrastructure) and some gain (for example, firms in the non-resource tradable sector). As a consequence, there is a redistribution of income from losers to gainers in the economy, as well as job gains and losses. Second, policies to moderate Dutch Disease impose costs in the form of potential underinvestment in Mozambique. The benefits from a deliberate policy of using revenues to accumulate foreign assets rather than domestic assets depend on the returns to Mozambique, as a whole, from investment at home versus abroad. If, with the aim of moderating Dutch Disease effects, resource revenues are allocated to lower-return foreign investment over higher-return investment in Mozambique, then these policies result in a “cost of protection”. In essence, it adds up to a cost of protecting tradable sectors (especially non-resource tradables) relative to non-tradable sectors. The argument we make in this study is that the cost of protection that would be imposed by allocating revenues to an SWF or NRF in Mozambique today is low, given the country’s relatively low absorptive capacity. However, this cost will rise as investment capacity improves and, as this occurs, accumulated resources and revenues should be allocated, as a central priority, more and more to raising the domestic investment rate.

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