Commodities and Linkages:

Industrialisation in Sub Saharan Africa

Mike Morris
mike.morris@uct.ac.za

Raphael Kaplinsky
R.Kaplinsky@open.ac.uk

David Kaplan
david.kaplan@uct.ac.za

MMCP Discussion Paper No. 13

October 2011

Making the Most of Commodities Programme (MMCP)

(The authors are grateful for considerable assistance provided by Judith Fessehaie and Masuma Farooki)

Centre for Social Science Research P·R·I·S·M

University of Cape Town · iYunivesithi yaseKapa · Universiteit van Kaapstad

Development Policy and Practice

The Open University

MAKING THE MOST OF COMMODITIES PROGRAMME

Like many other developing economy regions, Africa is benefitting from a sustained boom in commodities prices. Received wisdom has been that commodities production is an inherently enclave activity and that it undermines the viability of industry. The Making the Most of Commodities Programme challenges this negative view of the commodities sector. It's research analyses the determinants of backward and forward linkages, identifying policy responses which will broaden and deepen them. In so doing it contributes both to achieving sustainable growth and the spreading of benefits to a wider population. By incorporating younger researchers, building a research network, and dialogue with policymakers, the MMCP also seeks to build analytical and policy capacity, and to influence policy outcomes.

The MMCP focuses on a diverse range of commodity sectors in a number of African economies, as well as on key infrastructural determinants of effective linkage development. A number of common factors are identified which will increase linkages beneficially and which lend themselves to policy intervention - the role of ownership, the nature and quality of infrastructure, the national system of innovation, spillover of skills to and from the commodities sector, linkages in regional economies and the nature and consistency of policies directed towards the commodities sectors.

The MMCP country/commodity Discussion Papers are:

1. *'Linkages in Ghana's Gold Mining Industry: Challenging the Enclave Thesis', Robin Bloch and George Owusu,*
2. *'Chinese Construction Companies in Angola: A Local Linkages Perspective', Lucy Corkin*
3. *'Development and Knowledge Intensification in Industries Upstream of Zambia's Copper Mining Sector', Judith Fessehaie*
4. *'The drive to increase local procurement in the Mining Sector in Africa: Myth or reality?', Chris Hanlin*
5. *South African Mining Equipment and Related Services: Growth Constraints and Policy, David Kaplan*
6. *Linkages in Botswana's Diamond Cutting and Polishing Industry', Letsema Mbayi*
7. *The Nature and Determinants of Linkages in Emerging Minerals Commodity Sectors: A Case Study of Gold Mining in Tanzania, Vuyo Mjimba*
8. *Enhancing Linkages of Oil and Gas Industry in the Nigerian Economy, Ademola Oyejide and Adeolu Adewuyi*
9. *'The contribution to local enterprise development of infrastructure for commodity extraction projects: Tanzania's central corridor and Mozambique's Zambezi Valley', Dave Perkins and Glen Robbins*
10. *'The Tropical Timber Industry in Gabon: A Forward Linkages Approach', Anne Terheggen*
11. *'Backward Linkages in the Manufacturing Sector in the Oil and Gas Value Chain in Angola', Zeferino Teka*
12. *'"One Thing Leads to Another" – Commodities, Linkages and Industrial Development: A Conceptual Overview', (Revised) Mike Morris, Raphael Kaplinsky, and David Kaplan*
13. *'Commodities and Linkages: Industrialization in Sub Saharan Africa', Mike Morris, Raphael Kaplinsky, and David Kaplan*
14. *'Commodities and Linkages: Meeting the Policy Challenge', Mike Morris, Raphael Kaplinsky, and David Kaplan*

The MMCP is a collaborative research and policy programme between Policy Research in International Services and Manufacturing (PRISM), Economics and CSSR, University of Cape Town and, Open University. The International Development Research Centre of Canada is the principal funder, with additional funding from the William and Flora Hewlett Foundation, Harry Oppenheimer Institute, and Open University. Further information and other Discussion Papers can be downloaded from:

http://commodities.open.ac.uk/discussionpapers or www.cssr.uct.ac.za/prism/publications

Abstract

In a complementary Discussion Paper (MMCP DP 12 2011) we set out the reasons why we believe that there is extensive scope for linkage development into and out of SSA's commodities sectors. In this Discussion Paper, we present the findings of our detailed empirical enquiry into the determinants of the breadth and depth of linkages in eight SSA countries (Angola, Botswana, Gabon, Ghana, Nigeria, South Africa Tanzania, and Zambia) and six sectors (copper, diamonds, gold, oil and gas, mining services and timber). We conclude from this detailed research that the extent of linkages varies as a consequence of four factors which intrinsically affect their progress – the passage of time, the complexity of the sector and the level of capabilities in the domestic economy. However, beyond this we identify three sets of related factors which determined the nature and pace of linkage development. The first is the structure of ownership, both in lead commodity producing firms and in their suppliers and domestic customers. The second is the nature and quality of both hard infrastructure (for example, roads and ports) and soft infrastructure (for example, the efficiency of customs clearance). The third is the availability of skills and the structure and orientation of the National System of Innovation in the domestic economy. The fourth, and overwhelmingly important contextual factor is policy. This reflects policy towards the commodity sector itself, and policy which affects the three contextual drivers, namely ownership, infrastructure and capabilities. As a result of this comparative analysis we provided an explanation of why linkage development was progressive in some economies (such as Botswana) and regressive in others (such as Tanzania). This cluster of factors also explains why the breadth and depth of linkages is relative advanced in some countries (such as South Africa), and at a very nascent stage in other countries (such as Angola).

'Commodities and Linkages: Industrialization in Sub Saharan Africa', Mike Morris, Raphael Kaplinsky, and David Kaplan, MMCP Discussion Paper No 13, University of Cape Town and Open University, October 2011.

ISBN: 978-1-77011-251-3

FOREWORD

*Making the Most Commodities Programme (*MMCP)/Africa results from a unique, cross-cutting collaboration by the University of Cape Town and the Open University with the International Development Research Centre (IDRC). The MMCP builds and consolidates on other IDRC supported research on Asian Drivers and their relations with Africa by expanding the research program to focus on the growth and boom in global commodity demand. The resulting data and analysis provided opportunities for vibrant and high quality capacity building processes which was an integral part of the core research process, as is evidenced in the various Discussion Papers.

These discussion papers offer new information that will help Sub Saharan African (SSA) countries to maximize the potential linkage opportunities emanating from the production of commodities so as to promote sustainable industrial growth, and ensure widespread access to the fruits of this growth. The analysis will help decision-makers integrate and target efforts to increase the returns from extractive natural resources and promote mutual benefits between partner countries. The findings are aimed at academics, policy makers and high level technical officers working on African industrialisation, including those focusing on Asia-Africa trade relations. The findings have also enhanced our understanding of the dynamics that SSA countries experience in management of their natural resources and the significant threats these pose to their governance, macroeconomic management, and industrial development. The MMCP also makes recommendations for developing countries to incorporate into local and regional decision-making and how governments can respond to development challenges associated with natural resources. This publication therefore encapsulates an area of critical importance to resource rich, but often poor, countries in SSA.

The MMCP's approach, based on innovative ideas and integrated research, created exceptionally strong links with industry and public stakeholders, hence the potential for widespread application in other developing countries. These final synthesis discussion papers ensure that decision-makers in Africa have the appropriate tools and information to minimize the potential costs of the boom in commodities prices and to maximize the opportunities to build industrial linkages to lead commodity producers. In achieving these objectives, the team applied a distinctive and innovative policy dissemination process. This involved taking the research results and policy proposals to forums where policy makers were present, not just in Africa, but in the UN system and the International Financial Institutions in Europe and North America. In doing this they contribute to a policy agenda which will ensure that new opportunities for SSA commodities will not bypass decision-makers, and countries will not have to lose significant amounts of wealth as new natural resources are exploited. The MMCP process has also played a major role in capacity development in SSA – in total seven of the young researchers in this project will have obtained their PhDs as a direct consequence of their participation in this programme. Moreover, links have been established with research institutions across the continent which will no doubt endure in future research collaborations.

I am confident that the information contained in this document will assist SSA countries to develop strategic responses to the boom in commodity prices and improve the management of their natural resources. I therefore hope that decision-makers will see the value of the analysis and apply the findings to inform future decisions. On behalf of the International Development Research Centre (IDRC), I wish to extend our sincere thanks to the lead researchers involved in this effort, the University of Cape Town and the Open University, as well as all participating institutions and stakeholders that contributed to the development of these Discussion Papers.

Paul Okiira Okwi, *Senior Programme Officer, International Development Research Centre*

CONTENTS

1. INTRODUCTION

The strengthening of the industrial sector lies at the heart of the development agenda. The success of China and other emerging economies in expanding their manufacturing sectors and enhancing their economic growth rates over the past two decades is suggestive of the fruits to be obtained from this development path. However, the challenge facing many developing economies in promoting industrialisation in the modern era is a complex one. On the one hand, the foundations of the success of China and other newly emerging economies were built on decades of import substituting industrialisation. This route to promoting industry is now heavily restricted by the trade-policy liberalisation which has accompanied deepening globalisation. On the other hand the export-intensive route which has underwritten the success of the first- and second-tier Asian economies is circumscribed for new entrants precisely because of the success of China and other successful exporting economies. Global markets for manufactures are now intensely competitive, making it not just very difficult for new entrants in external markets, but also in competing with imports in their domestic markets.

In recent years, commodity exporting economies have benefited greatly from a sustained increase in the price of their exports and there are reasons to believe that commodity prices will remain robust in the medium-term, and perhaps in the long-term too (Morris et al, 2011a). There are great dangers to relying on these resource rents. The capital intensive nature of many commodities sectors limits employment and concentrates income, thus often confining the fruits of exploitation to a narrow segment of society. Moreover, despite the confidence which these economies may justifiably have in sustained high prices for commodities, prudence dictates that a diversified economy is more robust and less vulnerable to the shocks which confront monoculture economies, particularly in the commodities sectors which have experienced, and will almost certainly continue to experience severe price volatility. One route to industrial development in these commodity exporting economies arises from the possibilities of building linkages into and out of commodity production. It is this agenda which the Making the Most of Commodities Programme addresses.

In an earlier Discussion Paper 12 (Morris et al, 2011a) we set out the reasons which lead us to believe that linkage development from the commodities sector – particularly with regard to backward linkages – needs to be looked at in a new light. We argued that in the current era of globalisation, the strengthening of linkages to the commodities sector presents an important and attractive avenue for industrial development. In particular we challenged the conventional wisdom in the Resource Curse literature that the exploitation of commodities undermines the viability of industrial activity. We observed that the association between low levels of industrialisation and high dependency on commodities was to a significant extent determined more by the absence of capabilities in commodity-dependent economies than by the inherent conflict between the simultaneous and synergistic expansion of both sectors. We drew this conclusion both on a basis of a review of historical evidence in economies such as Australia, Sweden, Norway and the USA, and an understanding of the factors driving outsourcing in the modern transnational corporation. In this latter respect we argued that contrary to the widespread belief that commodity-exploiting lead producers sought to promote enclave import-intensive

activities, the reality is that lead commodity firms have strong incentives to increase the level of outsourcing in general, and near-sourcing in particular in their non-core activities. This provides a substantial opportunity for a win-win alliance between lead commodity firms, existing and potential suppliers, national governments and supporting institutions.[1]

In addressing this agenda, it is important to recognise a series of architectural factors which determine the nature and feasibility of linkages. First, a key distinction needs to be made between forward and backward linkages since they are differentially affected by a transition in the structure of the global economy. The scope for forward linkages has in some important respects been narrowed by improvements in global logistics which allow for the greater reaping of scale economies in transforming commodities into final outputs. By contrast, changing strategies of industrial organisation have led lead commodity firms to emphasise the virtues of external supply of inputs into their operations, initially from the lowest cost global supplier, but also over time to lowest cost local suppliers. Second, within forward linkages there is an important distinction to be made between the processing of commodity output (broadly-speaking which occurs in the same or related sectors), and the beneficiation of commodities. For example, sawing timber into wood is a much small linkage jump and requires different capabilities than those required to make electric motors which use copper wire. Third, in both forward and backward linkages an important distinction needs to be made between breath and depth. The former applies to the range of inputs and degree of spend on inputs into the commodities sector and the multiplicity of users and share of sales going to local customers for the commodity. The depth of linkages reflects the degree of value which is added in these linkages. Fourth, in principle, the degree of linkages is affected by a series of non-contextual factors – the complexity and scale of the processes involved in commodity production, the size and resource-endowments of different economies, and the passage of time. However, in addition to these general factors, there are also a series of contextual factors, which affect the linkage outcomes in particular contexts, and at particular points in time. Fifth, linkage development cannot be conflated with local ownership (a frequent occurrence in the policy domain). Many linkages arise when local suppliers and processors are owned either by firms incorporated abroad, or by foreign nationals resident domestically. Sixth domestic value added in commodities value chains is not synonymous with the extension of linkages. In some cases, value added may be increased within the lead commodity exploiting firm. Although this may be an important contribution to economic growth, we only consider the linkage part of the domestic value added story, that is, those cases where increasing value added occurs outside of the lead commodity exploiting firm. This is because we believe that sustainable industrialisation is built on the back of a growing inter-firm division of labour. Finally, industrial development through the exploitation of linkages will often take some time to develop, and only when there is some degree of government support. This raises important issues of trade-offs and time-preference in industrial policy.

[1] A recent mapping exercise of mining supply chain development activities identified a number of initiatives undertaken by oil and mining companies. These initiatives, nevertheless, were neither widespread nor developed according to best practices, leading the report to conclude that ‘opportunities for local content partnerships are currently being missed in the mining sector’ (Prescott, 2009).

We are in a new phase of globalisation. At the same time, the desire of African governments to promote linkages from the commodities sector is not new. These previous efforts by governments to promote local content have by and large, achieved very limited success. However, in the light of these changes in the nature of globalisation, we believe strongly that historical experience cannot be used as a guide to the promotion of linkages in the current era. We further believe that there are unrealised opportunities in the current era and that there is the real possibility of increasing linkages, particularly backward linkages. This arises as a consequence of considerable shared interest between lead commodity firms and host governments and that policy and policy processes therefore need to be recast. The question is the degree to which the lead commodity firms and African governments have recognised these opportunities and the extent to which they have been embodied in concrete policies and practices. In turn, the development of these new shared visions needs to be rooted in an understanding of what actually occurs on the ground in Africa's commodity sectors. This is an area of considerable collective ignorance. Although there are a great many declarations of the nature, degree and drivers of linkages from Africa's commodity sectors, there is a virtual vacuum of concrete evidence to inform policy. It is this knowledge gap which the MMCP seeks to fill.

In this Discussion Paper we report our research findings on the extent and determinants of linkages in and out of the commodities sector in eight SSA countries (Angola, Botswana, Gabon, Ghana, Nigeria, South Africa Tanzania, and Zambia) and six sectors (copper, diamonds, gold, oil and gas, mining services and timber) (Table 1). In addition to these sectoral studies, we undertook two sets of studies on infrastructure in order to highlight the role which this sector plays in both vertical and horizontal linkages into the commodities sector. The first of these two studies was on the Central Corridor in East Africa. The second focused on Chinese firms operating in infrastructure in Angola and their propensity to source inputs locally. We also commissioned a study on the determinants of linkages as seen from the perspective of the mining companies. These findings are based on detailed primary research undertaken between 2009 and 2011 by a group of African researchers working to a common methodology.

We begin with a statement of the core hypotheses which has driven our research enquiry, seeking to understand the nature and determinants of linkages into and out of the commodities sector. This is followed in section 2 where we report our findings on the depth and breadth of linkages to the commodities sectors in our sample countries. In section 3 we interrogate the four factors which we hypothesise, based on initial pilot research, as determining the extent of these linkages. In the final section we conclude the comparative analysis laying the foundations for a policy agenda (set out in Discussion paper 14, Morris et al, 2011b) which needs to be pursued in order to deepen and broaden linkages between the commodities and industrial sectors in SSA.

1.1. Core research hypotheses

Based on a reading of related literatures (the commodities sector, core competences, global value chains, and supply chain development – see Morris et al, 2011a) and after reviewing the results of pilot studies in each of our main research terrains, two

sets of core hypotheses guided the research. These hypotheses, discussed in more detail in Sections 3 and 4 below are as follows:

1. As a natural outcome of market forces, there will be:

    i. Linkages from lead commodity producers in the commodities sector to input suppliers (backward linkages) and to commodity processors (forward linkages).
    ii. These linkages will be a function of the age and the scale of the sector in the country in question
    iii. In the hard and energy commodity sectors, backward linkages will be more prominent than forward linkages; the soft industrial commodities sector (e.g. timber) will be characterised by both forward and backward linkages

2. The breadth and depth of linkages will be affected by:

    i. The nature of ownership of lead-commodity firms and their suppliers and end users
    ii. The nature and quality of infrastructure
    iii. Capabilities, skills of the local suppliers and potential suppliers as well as the technological support that they receive through the National System of Innovation
    iv. Policy development, management and implementation

These represent an ambitious set of hypotheses on the nature and determinants of linkages into and out of the commodities sector. Their substantiation or negation provides a comprehensive framework for the development of policies designed to enhance linkages and to promote economic diversification. However, as we will see, our capacity to provide a detailed and rigorous analysis of these factors was severely hampered by the uneven nature of data availability and research access, a problem affecting not just the MMCP research programme, but all research on the commodities sectors, especially hard and energy commodities.

1.2. Methodology, sectoral coverage and resource-dependence in the sample economies

In choosing a sample of sectors and countries in which to examine the determinants of linkages between the commodities and industrial sectors we were guided by the need to work with a sample of observations which provided the capacity to generalise our research results. In so doing, we took the following factors into account.

- We are aware of the substantial differences between soft industrial commodities on the one hand and hard and energy commodities on the other. For this reason and in order to cover the range of commodity types, we included a study of the timber industry, two studies on the oil-sector (and four on hard commodities (copper, diamond and two studies on gold).

- Since our *a priori* reasoning suggested that there were reasons why there might be differences in the linkage-potential between backward and forward linkages, we ensured the inclusion of both sectors primarily involving backward

linkages (six studies) and those in which forward linkages are prominent (two studies).

- Since country differences and the elapsed time of commodity exploitation are almost certainly significant determinants of linkages, we researched the same sector in two economies (gold in Ghana and Tanzania).

- In many cases the greatest possibilities for input provision lie in the local acquisition of services, and for this reason we covered services providers in some of the studies (IT services in Nigeria, engineering services in Zambia).

- Since regional factors may also determine the breadth and depth of linkages, research focused on Southern (Botswana and South Africa), Central (Angola and Zambia), Eastern (Tanzania) and Western (Gabon and Nigeria) Africa.

- China's resource hunger is potentially a game-changer in the SSA commodities sector, and for this reason we researched the role played by state-owned Chinese firms in Angola's infrastructure sector, in Zambia's copper sector, and in Gabon's timber sector. In doing so, we set out some key differentiating features regarding China's role as an investor and final market customer.

- Given the critical role of infrastructure in the commodities sector, we not only considered this issue in each of the individual sector studies, but also commissioned a study specifically focusing on one of the largest regional infrastructure programmes in Africa, namely the Central Development Corridor stretching from Tanzania to the Great Lakes region.

- Many of the key decisions on local sourcing reflect the way in which lead commodity producers organise the exploration, construction and management of their operations in the commodities sector, and for this reason we also commissioned a study of the different modalities of firm-sourcing policy in the hard commodities sector. These various considerations and their relevance to individual sectors and countries are summarised in Table 1, which also identifies the links to the relevant MMCP Discussion Papers.

Table 1: Core characteristics of MMCP studies

		Establishment Period of the Commodity Sector	Linkage type	Commodity type	Emerging economy relevance	MMCP Discussion Paper
Angola	Offshore-oil	Mid 1990s	Backward	Energy	China	No. 11
Botswana	Diamonds	1960s	Forward	Hard		No. 6
Gabon	Timber	Early 1960s	Forward	Soft	China, Malaysia	No. 10
Ghana	Gold	Late 19thC	Backward	Hard		No. 1
Nigeria	Oil	1950s	Backward	Energy		No. 8
South Africa	Mining capital equipment and specialist services	1880s	Backward	Hard		No. 5
Tanzania	Gold	1998	Backward	Hard		No. 7
Zambia	Copper	Early 20thC	Backward	Hard	China, India	No. 3
Angola	Infrastructure	>2004	---	---	China	No. 2
East Africa	Infrastructure	>2005	---	---		No. 9
Cross-sector	Sourcing modalities	---	Backward	Hard		No. 4

(http://commodities.open.ac.uk/discussionpapers;www.cssr.uct.ac.za/prism/publications)

In each of these studies, sample selection was designed to promote the generalisability of research findings. In some cases there were only a limited number of firms operating in a given activity, and sample selection was easy – "target the whole population". In other cases, however, there was virtually no available information on the population of existing input providers, processing and beneficiating firms, and in this it was more difficult to ensure a representative selection of sample firms. Thus samples were selected through a variety of methods (random, purposeful, stratified and snowball sampling methods).

We are confident that, overall, they are representative of the total populations in each of our sectoral-studies. In Angola, the sample covered 100 percent of control lines contractors, 82 percent of flow-lines contractors, and 57 percent of oil operators. The Botswana study interviewed 63 percent of the population of cutting and polishing firms. The logging/processing companies interviewed for the Gabon study covered between 50 percent and 70 percent of the total concession area. Zambia's sample of mining companies represented 70 percent of copper volume production, while the sample of suppliers covered 53 percent of firms based in Kitwe, Lusaka and Ndola. In Nigeria, the sample represented one-third of the total population, and 50 percent of local suppliers in the sub-sector of research enquiry. The analysis of the South African mining services sector involved was based on ten firm-interviews plus interviews with business organisations supplemented by firm-level survey data. The Central Development Corridor (Tanzania and Mozambique) was based on the use of secondary material and interviews with key industry informants. Table 2 provides a summary of the research population in the core sectoral studies.

Table 2: Summary of sample size and composition for sectoral studies

	Lead commodity producers	**Suppliers/ Processors/ Beneficiators**	**Public/private institutions, key informants**
Angola infrastructure	9 SOEs	44 private firms (suppliers/contractors)	108 institutions
Angola/oil	8 oil firms	13 oil services companies (suppliers) 28 large scale and SME suppliers	9 institutions
Botswana		6 suppliers, 12 cutting & polishing firms	14
Gabon	20 logging/processing firms	8 suppliers	9
Nigeria	15 oil firms	115 suppliers	Unspecified
South Africa		12 supplier firms	5 institutions. 2 industry associations
Tanzania	3 mines, 3 exploration firms	8 suppliers	9
Zambia	8 mining companies	50 suppliers	17

In each case data was collected though semi-structured interviews. Interviews were conducted on the basis of a questionnaire which included both open-ended and closed-ended questions. All the studies also made large use of secondary data, including company reports, reports and publications by independent consultancies, sectoral organisations, international organisations, macroeconomic and trade databases, journal articles,

conference papers and industry publications.

However, despite our attempts to utilise a rigorous, common and structured methodology, without exception, all of our studies (although to varying degrees) encountered substantial problems in accessing the data required to document what was being observed. There were a number of factors undermining our attempts to obtain optimal datasets. In some cases, the respondents themselves did not collect the relevant data. This was evident, for example, in the case of some of the gold mining firms in Tanzania. In other cases, the lead-firms did appear to have the data which we sought, but were reluctant to share the information with our researchers. Research access was also very uneven between countries. In Angola, Botswana and Nigeria the majority of firms who were approached agreed to participate in the study. By contrast in Tanzania the barriers to research access were formidable, in part because the government was revising its policy towards the mining sector and the lead mining firms were concentrating on keeping a very low profile.

A source of bitter comfort is that whilst research access proved to be at best sub-optimal and at worst very difficult, it is clear from our review of the literature on linkages from the commodities sector (particularly that with regard to hard and energy commodities and that focusing on SSA) that we have been able to gather a unique body of primary empirical material. This primary material is predominantly qualitative in nature, and that is unfortunate since in the best of worlds it would be valuable to have been able to bring considerably more quantitative material to support our findings. On the other hand, there is often an illusion that numbers reflect reality.[2]

We draw three conclusions from this review of methodology therefore. First, the scale of our ambitions, as reflected in the hypotheses outlined above, is much greater than our capacity to evidence them in a comprehensive and rigorous manner. Second, however imperfect our evidencing may be, it is an improvement by a considerable margin on what is known about the commodities sector in any of the countries in which our research was conducted. And, third, despite the difficulties we encountered in our research, we are confident that we have been able to capture the reality of the breadth and depth of linkages into and out of the commodities sectors which we have researched, and the factors which determine the nature and scale of these linkages.

1.3. The depth and breadth of linkages to the commodities sectors in our sample countries

Determining the extent of linkages into and out of the commodities sector requires a focus on five sets of factors. The first is the *breadth* of linkages. On the input side, this refers to the share of the inputs of the commodity producer

[2] For example, the official figures on employment in Botswana's mining industry which are used in the ILO and UNIDO databases to facilitate international comparison show a doubling of the labour force between 2008 and 2009 from 84 to 173 workers. This is despite the fact that Botswana not only produces almost forty percent of global diamond output, but that its mining sector also produces nickel, cobalt, copper, coal, soda ash, salt and gold!

that are acquired locally. On the output side, what proportion of commodity production is processed by local firms. Ideally this will reflect a combination of value and volume data. The second factor is what we refer to as the *depth* of linkage, that is, the extent of domestic value which is added to locally-acquired inputs or locally processed/beneficiated outputs. As will be seen from our research results, there are a great many cases where what appears to be a "local product" is in fact merely an input imported by a local trader, rather than by the lead commodity firm. The local content is limited to the importer's margin and is close to zero. Third, there is the need to command *linkages in the whole value chain*, that is, how far down and up the chain the analysis goes. Ideally, it would be helpful to plot the degree of value added not just in the first tier of suppliers and processors but in the second, third and other tiers where domestic value added is significant. Fourth, and finally, is the question of depth and breadth of *horizontal linkages*, that is, the extent to which, as a direct consequence of linkages from the commodity sector, domestic value is added into inputs for or outputs from other related sectors. We should bear in mind that in reality there are often tiers of links, which include both vertical and horizontal links. Fifth production occurs in the context of value chains, so domestic value added needs to be seen in the context of value added in the whole chain rather than in a particular link under enquiry.

Evidencing this conceptual discussion of the breadth and depth of linkages requires a daunting degree of detailed evidence. Indeed, even with complete access to the books of firms involved in the chain (assuming that all firms keep books, that they only keep one set of books and that these records are accurate!), it would be an extremely time-consuming task to accurately measure these numbers. The imperfect world encountered by our researchers' means that our evidence is a long way from this ideal type. As we shall see it is only partial, and despite our best attempts to collect data on the same indicators in all of the sectoral studies, this proved to be an insuperable task. Therefore, our recounting of the depth (the accretion of local value added) and breadth (the percentage of spend which is local) of linkages in each of our case-study countries is partial and uneven.

2. THE DEPTH AND BREADTH OF LINKAGES

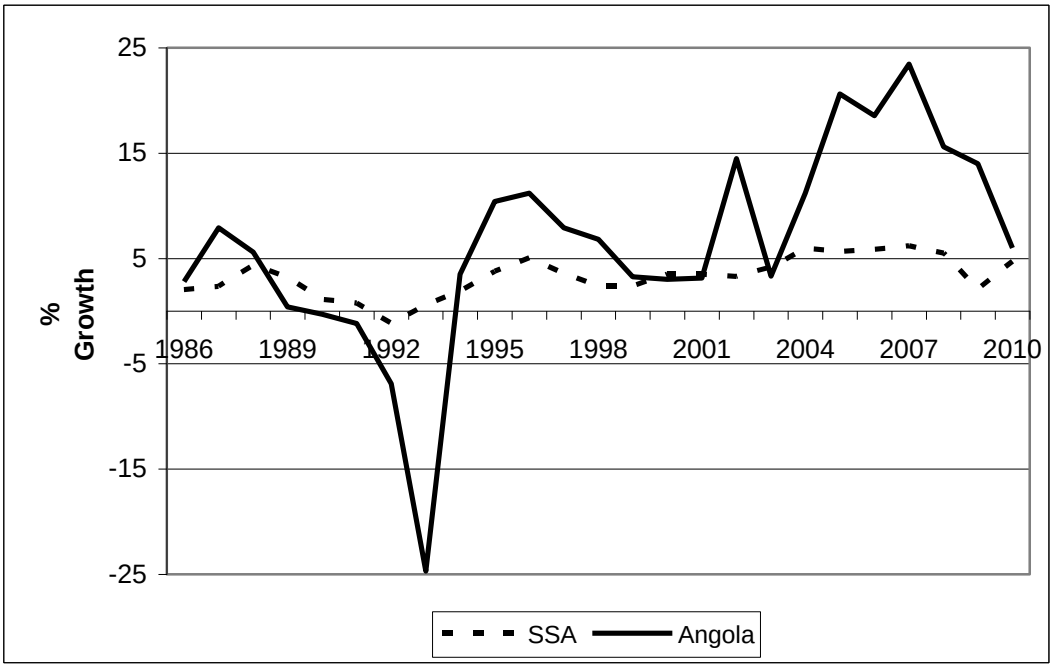
With the above caveats in mind, we can now consider the evidence on the breadth and depth of linkages in eight country case studies – equipment provided to the offshore oil-industry in Angola; the cutting and polishing of diamonds in Botswana; inputs into copper mining in Zambia; inputs into the gold mining sector in Tanzania and Ghana; the processing of timber in Gabon; the sourcing of fabrication and construction; well construction and completion; and control systems and equipment and IT services inputs into the Nigerian oil industry; and mining equipment in South Africa.

2.1 Backward linkages into offshore oil production in Angola

Angola achieved independence from Portugal in 1975, but rapidly descended into civil war. This war continued until 2002 and was a source of major social,

political and economic disruption. What had been a relatively diversified economy during the colonial period, with a spread of economic activity in a variety of agricultural and mining sectors, collapsed into a bifurcated economy, with the cash economy being centred around the capital city Luanda, and the interior of the country retreating into semi-subsistence production. Economic decline was particularly marked during the height of the war between 1988 and 1994, and despite growth reviving in the mid-1990s, it was only after the end of the civil war in 2002 that the current rapid trajectory of economic growth was established (Figure 1). Until recently Angola's growth rate was below the average for SSA but after the commodities boom in 2003-2004, Angola's growth rate decisively exceeded that across the continent.

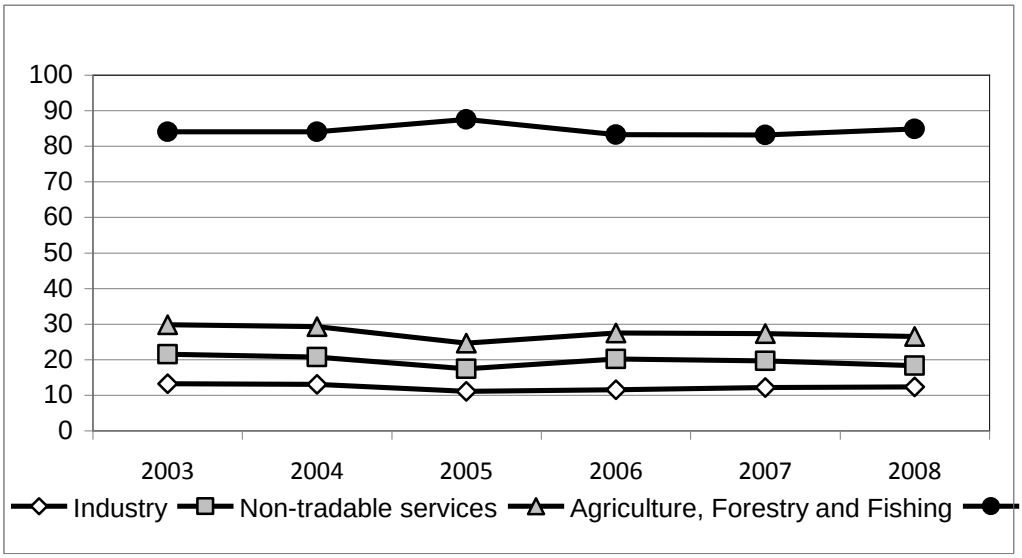
Figure 1: Annual GDP growth rate, 1986-2010 (%)



Source: World Development Indicators data online. <http://data.worldbank.org/data-catalog/world-development-indicators> (accessed July 2011)

The key to the revival of Angola's growth over the past two decades has been the discovery of offshore oil. Exploration of these deposits took off in earnest in the mid-1990s, and the first major offshore well started production in 1999. Angola possesses the 15th largest oil reserve in the world and the second largest reserves in Africa after Nigeria. By 2010 it had become the 15th largest oil producer in the world. As a consequence of the growth of the oil sector and the collapse in economic activity in other sectors, the Angolan economy has become increasingly dominated by oil. The oil sector not only accounts for more than half of GDP (Figure 2), but also is the primary contributor to government revenues, accounting for more than 60 percent of total government revenue (Table 3).

Figure 2: Sectoral composition of GDP, 2003-2008 (%)



Source: Teka (2011); MIND (2009)

Table 3: The share of oil and mineral rents in GDP and public expenditure, 2000-2011 ($ and %)*

Year	Gov. oil rents (USD Billion)	Oil rents (% of GDP)	Oil revenue (% of gov. expenditure)
2000	---	63.3	64
2001	0.5	50.8	66
2002	1	48.8	68
2003	1.06	48.3	66
2004	2.2	53.7	58.3
2005	2.7	65.1	45
2006	3.7	60.8	52
2007	21.2	61.3	61
2008	37.1	67	58.2
2009	17.2	38.6	60
2010	25.3	--	61
2011	--	--	62

* The data includes (i) royalties (oil production and oil transaction taxes); (ii) share of profit in production sharing agreements (iii) revenue from consumption tax on petroleum derivatives and (iv) (iii) limited revenues from the awarding mining rights;

Source: MINFIN (2011); World Development Indicators (2011)

The Petroleum Activity Law (Law 13/76 of 1976) assigned sole ownership of Angola's hydrocarbon resources and mining rights to the Angolan state. The state manages the sector through Sonangol, which is the concessionaire of the country's oil industry and the sole owner of concession rights. Other investors can only participate in the oil extraction sector in partnership with Sonangol. But Sonangol's ambitions go beyond merely holding property rights over oil deposits. It also sees itself as an active investor both in oil extraction and in the forward processing of oil, and models itself on other National Oil Companies such as Petrobas in Brazil. In addition, as will be shown below, Sonangol is also involved in, and responsible for, driving backward linkages, and in particular those involving locally-owned firms.

National ownership of resources and concession rights gives the state (through Sonangol) significant bargaining power across the oil and gas value chain. Amongst other things, the government has used this leverage to advance what it sees as national interests (in this case not just the localisation of value added, but also the localisation of ownership) in the oil sector through local content policy.

The decrees of 1982 and 2003 and the Petroleum Activity Law of 2004 instituted two main drivers of local content. The first was a series of requirements to ensure the employment of Angolan nationals in the oil industry and in the linkages which feed into and out of the oil extracting sector. Inter alia this policy mandates (i) preferential employment of Angolans unless a lack of competent Angolan labour can be proved (iii) at the renewal of every contract and on annual basis, companies must submit a plan to recruit and train Angolan workers to meet the employment targets set by the government, and (iii) companies are required to pay a levy toward the development of Angolan human resources. Oilfield producers must contribute US15 cents of a dollar per barrel produced per year, associate operators (oil companies without operator status) must contribute $200,000 per year, and oil service companies must contribute amounts agreed bilaterally with the Ministry of Petroleum. Table 4 below shows the targets set out by the government for the Angolanisation of the oil sector's labour force.

Table 4: Angolanisation Targets

Levels (Grades)	1985	1987	1990
Up to Grade VI (Unskilled/Semi-Skilled)	100%	100%	100%
Grades VII-XI (Mid-Level Technicians)	50%	60%	70%
Grades XII-XIII (Higher Level Personnel)	--	50%	80%

Source: Teka (2011)

The second factor driving Angola's local content programme is the preferential treatment of national firms in the supply of goods and services. National firms are defined as firms having more than 51 percent of share capital owned by Angolan citizens. The key rule is that of exclusivity, which requires that all goods and services not requiring high capital value (the decree does not specify this in detail) and lacking in-depth and specialised know-how (again, this is left unspecified) must be sourced from national firms unless the price of these local inputs is more than 10 percent higher than the price of imports.

Between 2004 and 2010 total investment in the Angolan oil industry was $69bn, with a further $15bn invested in supportive infrastructure and $1.2bn in the marketing link in the value chain. $52bn of this investment was directed to the construction and support of the offshore oil industry, all of which in principle could have resulted in local linkages. In reality the only linkages of significance (that is, where there was some semblance of domestic value added) was in two components of the SURF (sub-sea umbilicals, risers and flow-lines) sub-sector.

Sub-sea umbilicals are cables that enable communication between sub-sea production systems (exploiting subs-sea wells) and rigs (production systems) on the surface and control centres on the shore. Flow-lines (whose main

components are risers and manifolds) enable a two-way flow of crude from sub-sea to surface and lubricants from surface to sub-sea production systems. This sub-sector (SURF) accounted for one fifth of total investment over the period (Table 5).

Table 5: Investment in the offshore oil production sector, 2004-2010 ($bn, %)[3]

Oilfield segments	Capital Expenditure ($bn)	Share (%)	Local links
Engineering	4	8	Services
Procurement, construction & installation	4	8	Systems construction
Systems, equipment, piping & valves	2	4	Systems sale & construction
Sub-sea umbilicals, risers and flow-lines (SURF)	11	21	Manufacture, sale & services
Sub-sea production systems	6	11	Systems sale & installation
Sub-sea services	1	2	Construction & services
Rigs & drilling	12	23	Drilling services
Drilling systems	3	6	Contracting & services
Downhole & well	8	16	Equipment sale & services
Decommissioning	1	2	Services
Total	52	100	

Source: Teka (2011)

Interviews were conducted into the nature and extent of value added in these two sub-sectors with eight oil producing companies, four control line suppliers and nine flow-line suppliers. One of these firms produces control-lines in Angola in a joint venture with Sonangol, and two firms assemble flow-lines in Angola. Table 6 shows the composition of cost structures in the domestic manufacture of flow-lines and control-lines. The bulk of costs – almost two-thirds of the total - was made up of intermediate products and raw materials. Next in importance was expenditure on labour. Together these two inputs accounted for 84 percent of total costs. Only 6.2 percent of expenditure was on machinery. This breakdown of expenditure reflects the fact that in both of these sub-sectors, the primary activity is assembly (although control-lines production does also involve a degree of design and transformation of raw materials through the use of carousels). Turning to the last column of Table 6, it is evident that the only items procured locally were consumer goods i.e. basic goods and services (accommodation, catering, cleaning, human relations management, stationery, etc) and labour. But even here much of the value of these products which were procured locally was in fact largely made up of imports. For example, basic goods and services include computers, paper and furniture, none of which are produced domestically.

[3]The study focuses on the SURF segment

Table 6: Local content in domestic manufacture of flow lines, control lines (%)

Types of inputs	Share of operating expenditure	Description	Source	
			Import	Local
Production Machinery (Amortisation cost)	6.2%	Carousels, reelers, pipe pincers, loaders, rollers, stalk racks, cranes, etc.	✓	--
Intermediate materials	64.2%	Carbon & stainless steel, brass, inconel, monel, polyethylene, services, etc	✓	--
Raw-materials		Metal, steel, copper	✓	--
Labour (skilled/unskilled)	20%	Engineers, managers, welders, etc.	✓	✓
Basic General Services	5.4%	Lease (rental cost of buildings/facilities)	--	✓
Basic General Services	2.5%	HSE, catering, cleaning, security, civil construction, labour recruitment, lease	--	✓
Basic General Goods	1.4%	PPE, IT & electronic equipment, office furniture, stationary, etc	✓	--

Source: Teka (2011)

Focusing on the labour component of domestic value added – which accounts for one-fifth of the total expenditure in domestic manufacturing – it is evident that between 2003 and 2009, there was a significant increase in the Angolisation of the labour force. Although most of the local labour employed is unskilled and semi-skilled, there has been a marked increase in the percentage of Angolan citizens in skilled operations. There are ambitious targets for the Angolisation of this skilled cadre of labour by 2014.

Table 7: Local labour content in manufacture, 2003/4-2014

Period	Control lines (%)		Flow-lines (%)	
	Basic/mid-skilled	Higher-skilled (Engineers)	Basic/mid-skilled	Higher-skilled (Engineers)
2003/4	80	0	70	5
2009	90	17	72	20
2014	90	52	85	35

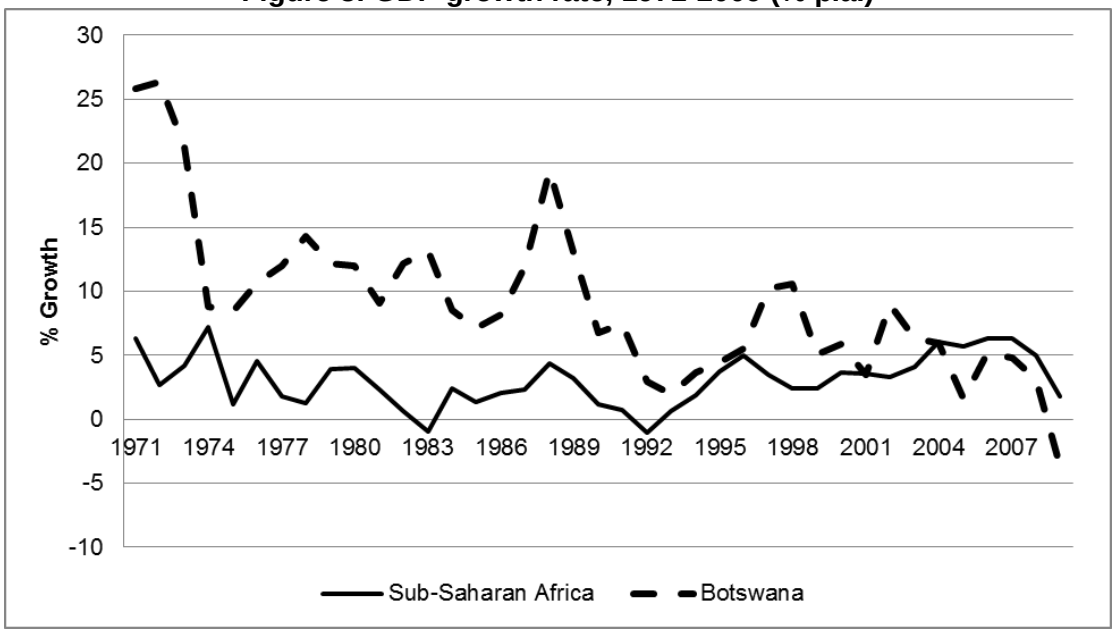
Source: Teka (2011)

2.2 Forward linkages in the diamond sector in Botswana

Botswana is a geographically large country roughly the size of France or Texas with a small population of 1.9 million. Over two-thirds of the drought-prone country is desert, semi-desert or scrub and does not lend itself to settled agriculture. It does, however, have a large pastoral sector and exports beef to the EU. But unlike the more verdant New Zealand, if Botswana were predominantly a pastoral economy it would not be able to provide its population with a high standard of living. Yet in 2010, Botswana's per capita income (of $8,180) ranked it as a middle-income country. This relatively high per capita income was a result of four decades of sustained economic growth

(Figure 3), and for much of this period Botswana ranked, with China, Korea and Singapore, as one of the world's most rapidly growing economies.[4]

Figure 3: GDP growth rate, 1971-2009 (% p.a.)



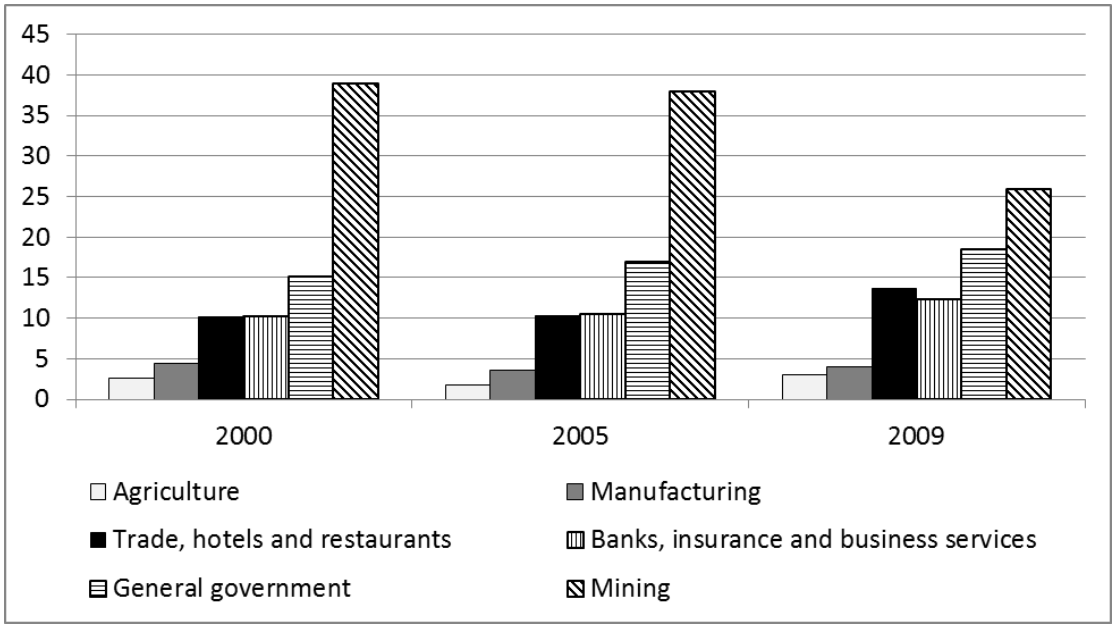
Source: World Development Indicators data online. <http://data.worldbank.org/data-catalog/world-development-indicators> (accessed July 2011)

The driver of this rapid economic growth and the resulting high level of per capita income in Botswana has been the production of diamonds, a precious stone yielding large resource rents, particularly to countries such as Botswana with easily accessible surface deposits of high quality stones. Diamonds were first discovered in Botswana shortly after independence in 1966, and large scale production began in 1971. Currently Botswana accounts for more than one-quarter (by value) of global diamond production. In the context of a virtually non-existent manufacturing sector and a poorly endowed agricultural sector, the contribution of diamonds to Botswana's GDP (Figure 4) and to government revenues (Figure 5) has been very significant. Currently the sector contributes more than 40 percent of GDP and more than half of all government revenue.

However, the contribution of this bounty of nature to the economy is not without its problems. For one thing, the sector employs only a small proportion of the labour force, and the capacity of the population to share in the resource rents depends largely on the continuation of a relatively un-corrupt and efficient government. But more problematically, the low cost surface diamonds which have hitherto sustained the industry will be exhausted. Unless new deposits can be found within two decades, Botswana faces a major squeeze on incomes. For these reasons the government has committed itself to a programme of diversification, based on the extension of production linkages form the diamond sector.

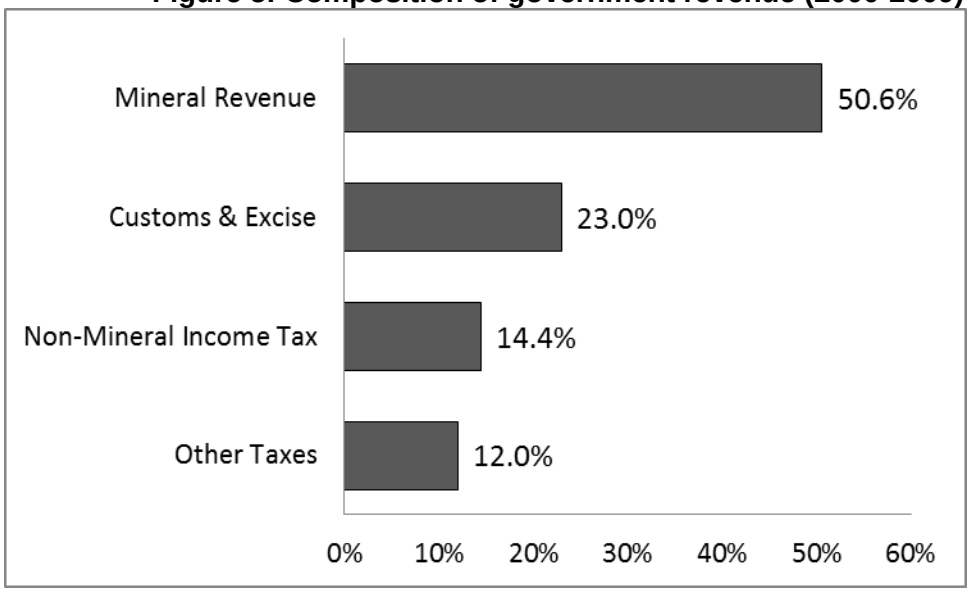
[4]Botswana was one of 13 countries identified in the World Bank Growth Commission (Spence Report) as having sustained growth of over 7% for more than 25 years.

Figure 4: Percentage contribution to gross domestic product by selected economic activities



Source: Mbayi (2011)

Figure 5: Composition of government revenue (2000-2009)



* Diamonds account for more than 90 percent of mineral revenues

Source: Mbayi (2011)

The long-recognised need to diversify out of the heavy dependence on mining had previously led the government to promote the development of a cutting and polishing industry in the early 1980s, mainly as a way of increasing employment. At the time De Beers, the global mining company which dominated production in Botswana and the sale and marketing of diamonds in the global economy, did not support the government's ambitions. De Beers argued that cutting and polishing activities were not economically viable in Botswana. Mild pressure from government on DeBeers led to the start of three cutting and polishing factories between 1980 and 1990. However none of these factories ever reported a profit. Some observers believed that these

losses were artificially achieved through transfer pricing by De Beers in order to avoid pressures for further processing, but this is an untested assertion. Whatever the reality of the reasons limiting this truncated programme of forward linkages during the 1980s, Botswana's opportunity to ratchet up the pressure for forward linkages came in 2005 when De Beers' 25 year mining license was due for renewal. The government had a great deal of bargaining power due to De Beers's reliance on production from its 50-50 joint venture with Debswana. Debswana supplied around 60 percent of De Beers's global supply of rough diamonds. The government insisted that in order for De Beers to renew its mining license for another 25 years it should help Botswana to create a viable and globally-competitive cutting and polishing industry. De Beers gave in to the government's demands realizing that it could no longer hold back beneficiation in Botswana and signed the new mining contract.

After the new contract was signed the Government invited the world's leading cutting and polishing companies to establish factories in Botswana and in the process to transfer cutting and polishing skills to local citizens. 16 of these companies were selected and licensed to operate in Botswana. DeBeers and the government then established the Diamond Trading Company (DTC) in 2008 which, like Debswana, is a 50-50 joint venture. DTC Botswana is responsible for the sorting and valuing of Debswana's production (replacing the Botswana Diamond Valuing Company). It also controls the supply of diamonds to the 16 cutting and polishing companies and is responsible for supporting the development of the cutting and polishing industry. The new agreement required DTC Botswana to release diamond to the local manufacturing industry to a value of at least $500 mn a year and to develop targets for this to grow over time. It was also tasked with the creation of at least 3,000 jobs in the development of the cutting and polishing industry. The agreement includes a penalty clause for non-performance, so in marked contrast to the previous attempt to promote beneficiation, De Beers has a vested (and financial) interest in making the programme a success. The 16 cutting and polishing companies, known as Sightholders, are only assured rough diamond allocations on the condition that they hire and train locals with cutting and polishing skills.

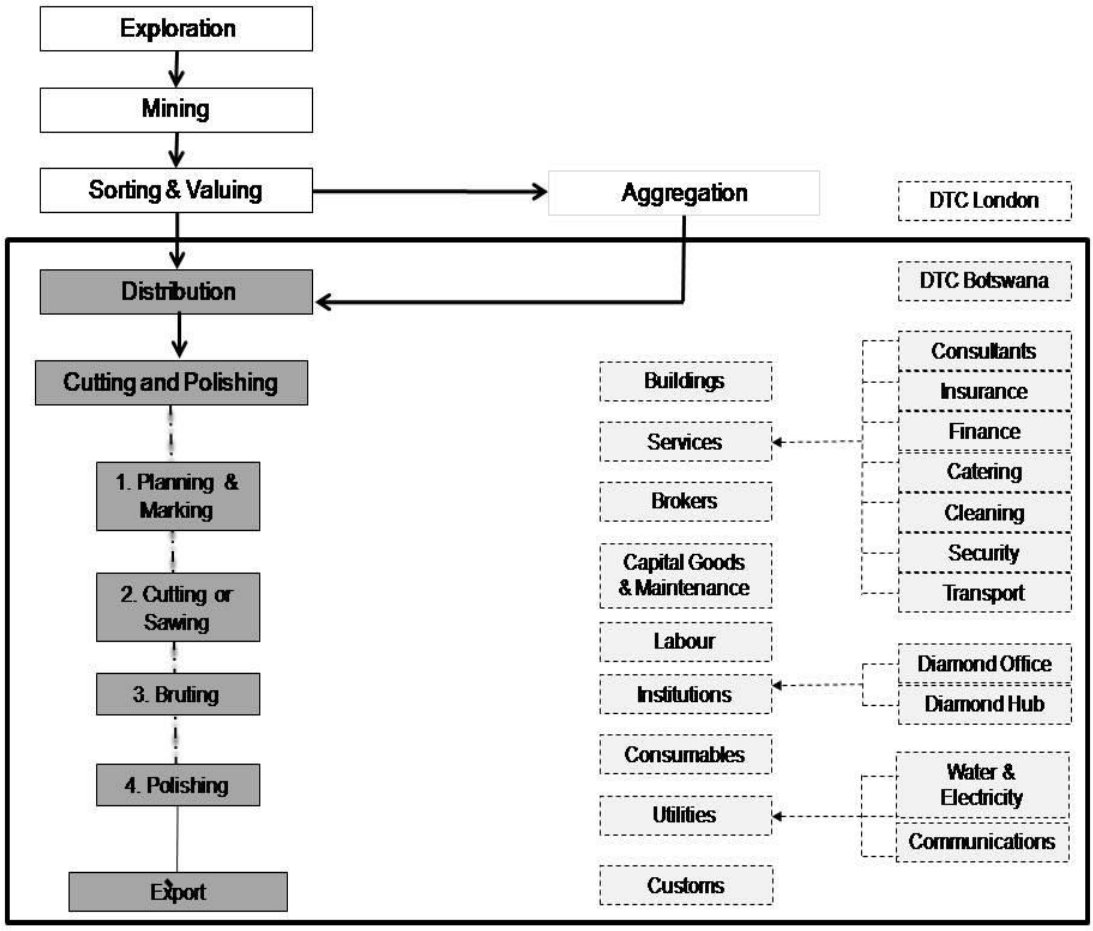
The Government has established a Diamond Office to support government's primary objective of beneficiation in Botswana diamond industry. This office focuses on building strategic alliances, developing infrastructure and providing a favourable fiscal regime. The government's vision for diamond beneficiation is supported by multi-faced strategy aiming to create downstream competencies in the value chain in the cutting and polishing industry, jewellery manufacturing industry, diamond trading industry and ancillary businesses (Figure 6). The first part of the beneficiation strategy, and the only one to be systematically addressed by 2010, was the creation of a viable cutting and polishing industry. Policies designed to enhance competences further down the chain (for example, in jewellery manufacture[5] and trading) are still under development.

[5] To date two of the Sightholders have started jewelry manufacturing factories in Botswana in 2011

The 2005 agreement between the Government and DeBeers included agreements on sales and distribution, in which the 5-year sales agreement stated that all Debswana production would be sold to DTC London (a wholly owned DeBeers entity), whilst the distribution agreement stated that aggregation, which had taken place in London for over a century, would be moved to Botswana. Aggregation involves the mixing of all DeBeers' supply of diamond regardless of origin into parcels that meet the demands of each of DeBeers' customers or Sightholder. Although DeBeers agreed to have this process moved to Botswana, by the end of 2010, when the sales agreement ended it had not done so. DeBeers offered many reasons for this including the financial crisis and inadequate infrastructure in Botswana. When the sales contract ended at the end of 2010 it was extended for another three months because DeBeers and the Government had not reached an agreement on the new sales contract.

In September 2011, DeBeers and the Government finally signed a new sales agreement after long negotiations. Its bargaining power over the control of diamond supplies meant that the Botswana government was able to over-rise the concerns of De Beers and to ratchet-up the promotion of linkage development exert and in particular to allow government to also enter the marketing links in the value chain. Thus, the ten-year sales agreement (signed in mid 2011 was backdated to January 2011) requires that by the end of 2013 DeBeers will finally implement the previously agreed on relocation of aggregation. This relocation of aggregation will have considerable spill overs on many industries like transport, finance and hospitality because the worlds diamond industry will now go to Gaborone instead of London to buy diamonds from DeBeers. In addition, the agreement provides for an independent sales channel for 10 per cent of Debswana's production, which will increase to 15 per cent over five years, whilst the rest of Debswana's production will be sold to DeBeers/DTC London. Further, the 2011 agreement stated that more diamonds will be made available in the local cutting and polishing industry but no figures have been stated to date. The Government will also license two or three additional Sightholders in Botswana to start new cutting and polishing factories. Thus, as a consequence of this new agreement, linkage development in Botswana's diamond value chain is likely to increase, both in terms of depth and breadth from the levels recorded in our survey conducted in 2010.

Figure 6: Botswana's Downstream Value Chain



Source: Mbayi (2011)

Hence, there is clear evidence of substantial forward linkages in Botswana's diamond industry, driven by government policy rather than by market forces. The issues at stake are therefore whether this will be a globally competitive industry in the future, and how much of these forward linkages reflect real domestic value added. In exploring these issues we interviewed 12 of the 16 cutting and polishing firms and six of their suppliers.

It is as yet too early to determine whether Botswana's cutting and polishing industry will be globally competitive. At first glance, the answer seems negative, since labour costs per carat of cut-diamond in Botswana are much higher than either India or Botswana (Table 8). However, there are three reasons to suspend judgement on this count. First, whilst Botswana's labour costs are indeed higher than China and India, they are much lower than those in Belgium and Israel, both of which have long-established cutting and polishing industries. These high cost centres manage to maintain their presence by focusing on larger and more valuable stones, and leaving the low wage economies (India and China) to produce cheaper stones. Botswana is targeting a mid-level quality of cutting and polishing, above the small stones produced in China and India, and below the highly specialised stones produced in Europe. Second, it is dangerous to make static cost judgements, particularly in a skill-intensive sector. The question is not so much whether

Botswana's current production costs are high, but whether they will remain high in the future. Heavy investments in training by the government, and the need for firms to invest in skills (since, to some extent, they have no alternative but to cut and polish in Botswana), suggests that wage costs in Botswana may be a moving frontier as domestic skills improve. And, third, new technologies are being introduced which substitute for the long-accumulated tacit skills which have historically dominated this industry. As in the introduction of computer-numerical-controlled machine tools in global metal industries in the 1990s, these technological innovations offer the possibility of newcomers circumventing skills barriers which had historically excluded them from competitive production.

Table 8: Industry and Botswana government estimates on the range of cost per carat in Botswana relative to some centres ($)

	Industry	Government
Botswana	45 - 120	35 - 90
India	35	10
China	20 –25	17
Namibia	45 –100	-

Source: Mbayi (2011)

A further issue is the extent to which the forward linkages in the diamond sector involve domestic value added. If the complete diamond value chain is considered, most of the product's final value accrues after mining, and particularly in jewellery manufacturing and retail (Table 9). Nevertheless the sorting and valuing, and cutting and polishing stages which Botswana aims to command in the short- to medium-run are substantial, accounting for an additional 33 percent of the value generated in mining. A significant (but unmeasured) component of these additional processing costs is the cost of labour. If the projected development of marketing capabilities – as proposed in the 2011 legislation and included in the "Marketing and retail" category in Table 9 - bears fruit, the degree of domestic value added may increase significantly within the next decade.

Table 9: Value Addition in the Diamond Pipeline

Stage of Global Value Chain	% of original value
Producer Selling Value	100
Sorting and Valuing	115
Cutting and Polishing	127
Polished Dealing	133
Jewellery Manufacturing	166
Marketing and Retail	320

Source: Even-Zohar (2007)

Since the cutting and polishing industry began in 1982, 16 cutting and polishing firms ("sight holders") have established operations in Botswana. 14 of these firms were set up after the new agreement with Debswana in 2005. (An additional two firms will locate in Botswana after the 2011 Agreement with De Beers). They employ more than 3,000 people, most of whom are citizens (Table 10) an important outcome given the high rate of unemployment in the economy (estimated at 30 percent of the labour force). The monthly salaries are in the range of $150 to $600 ($2=Pula12), which is above the minimum

wage for the manufacturing industry. Most of these firms own their premises, suggesting a long-term commitment to Botswana and continuous investment in local procurement.

Table 10: Ownership and employment patterns in twelve cutting and polishing firms

Origin of Parent Company	Est.	% Local Employ.	Salary Range*	Own or Rent Premises
Belgium	1982	90%	-	Own
	1990s	97%	P1300 – P3000	-
	2007	95%	P1000	Rent
	2004	95%	P1000	Own
Israel	1990	95%	P1500	Own
	2007	80%	-	Rent
	2007	95%	P900 – P3000	Own
	2007	n/a	n/a	Own
India	2007	80%	-	Rent
	2007	85%	P1000 - P4000	-
South Africa	2007	83%	-	Own

Source: Mbayi (2011)

The direct employment of around 3,000 people in the cutting and polishing firms results in an annual wage bill of over $135 m (Table 11). The portion of the wage bill accruing to the 210 expatriates employed in the industry is almost double the proportion of the wage bill going to the 2,730 local citizens who are employed. In addition to these 3,000 employees in cutting and polishing, employment is also created in second-tier supplier industries.

Table 11: Direct employment and wages and salaries, 2010

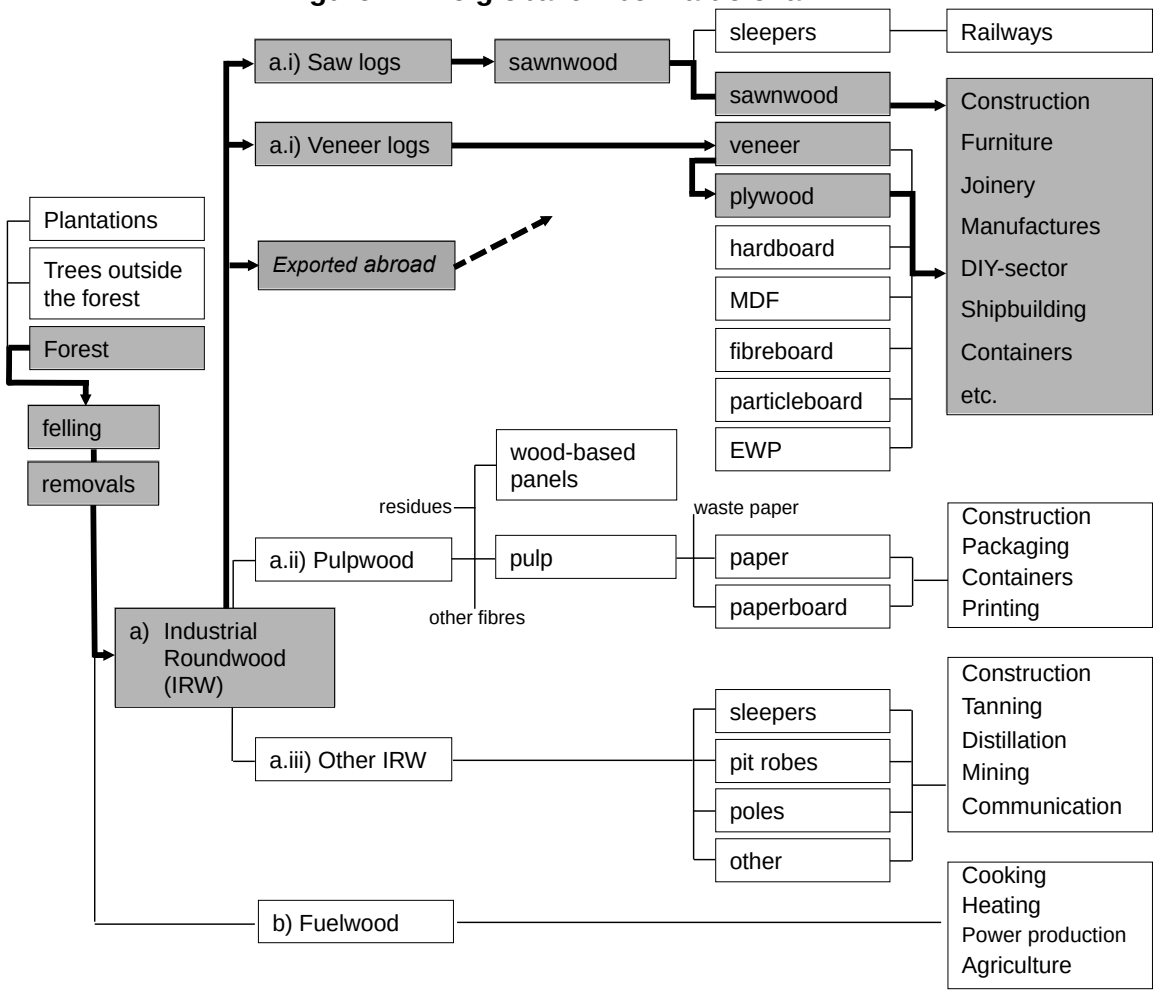
	Employees/ Total employment	Employees	Average Monthly Wage ($)	Annual Wage Bill ($)
Total employment	**100%**	**3000**	…	**$22,628,064**
- Factory	91%	2730	…	$7,268,160
- Middle Management	7%	210	…	$7,799,904
- Top Management	2%	60	…	$7,560,000
Total Locals Employed	**93%**	**2790**	…	**$7,928,064**
- Factory	96%	2678	$200	$6,428,160
- Middle Management	4%	107	$1,167	$1,499,904
- Top Management	0%	0	…	$0
Total Expatriates Employed	**7%**	**210**	…	**$14,700,000**
- Factory	20%	42	$1,667	$840,000
- Middle Management	50%	105	$5,000	$6,300,000
- Top Management	30%	63	$10,000	$7,560,000
Gross Salaries and wages as % of total costs (excluding rough diamonds)	…	…	…	15% - 45%

Source: Mbayi (2011)

2.3 Forward linkages into the timber sector in Gabon

Based on an ubiquitously-grown soft commodity (wood) and feeding into a range of both basic and income elastic goods (furniture and construction), the timber value chain is well developed in a wide range of countries. Figure 7 shows the range of links in this value chain, from the plantations of timber through intermediate products. In recent decades the industry has become more integrated into the global economy. A key development was the introduction of flat-pack furniture during the 1990s, an innovation which reduced the cost penalties involved in shipping bulky and relatively low value products. The result was that, increasingly, furniture production was gravitating to the site of log-production, and away from the site of final markets. This transition in timber processing was intensified since many wood products are labour-intensive in production and often also involve noxious environmental emissions. Further, government policies in many low income countries specifically fostered the timber processing industry as an entry point into industrialisation since this is a sector with relatively few technological or scale barriers to entry.

Figure 7: The global timber value chain



Notes: Grey text boxes highlight the three dominant products produced in Gabon; EWP = engineered wood products, MDF = medium-density fibreboard, DIY = do-it-yourself;

Source: Terheggen (2011)

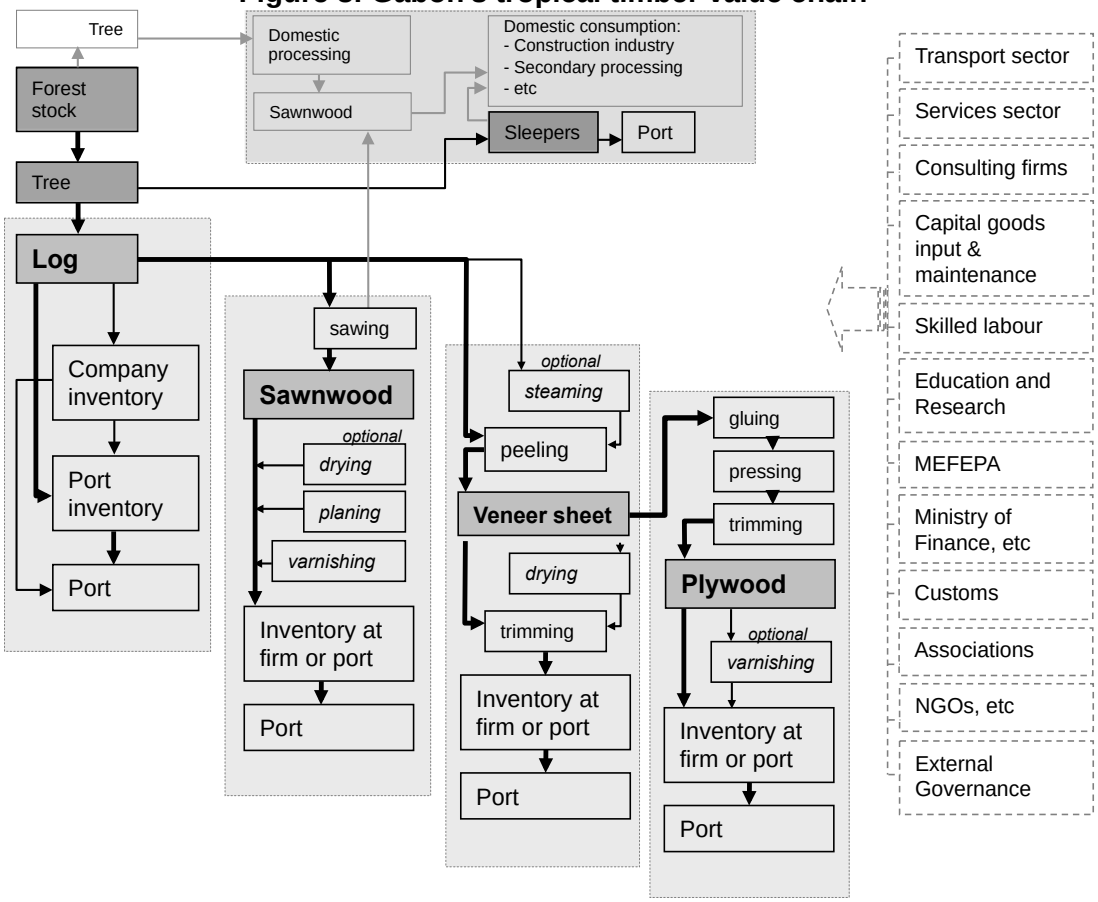
Tropical timber fills a specialised niche in this global industry. Its timber takes a long time to grow, has a distinctive appearance, is “hard”, and is in short supply. It therefore tends to sell at a premium, particularly for species such as mahogany and ebony where there are growing pressures to halt the depletion of global stocks and to limit supplies to renewable plantations. The share of tropical timber in global timber production is around 15 percent, with the largest five producers accounting for 70 percent of the total. Of this, Brazil accounts for 20 percent, Indonesia for 16 percent, Malaysia for 16 percent, India for 15 percent and Nigeria for five percent. Although Gabon only accounts for three percent of global tropical timber production, It consumes very little of this output domestically and is the seventh largest tropical log exporter.

Situated on the African West Coast between the Congo and Cameroon, Gabon is sparsely peopled, with a total population of 1.9 million. Although it has a relatively high per capita income for the region ($7,240 in 2008) much of the population lives in poverty. GDP of $14.4bn in 2008 was dominated by highly concentrated income streams from oil production. In 2008, around 80 percent of total export earnings and 65 percent of government revenue were derived from the oil industry. But these resource rents are poorly distributed. In addition to oil, Gabon possesses valuable deposits of manganese, copper and precious stones. Logs, the third largest export after oil and manganese, accounted for 6.2 percent of total exports in 2008 (OECD, 2009). Gabon has around 23 million hectares of forests, which cover nearly 85 percent of its total land mass, making it the second most heavily forested African country. Although historically timber was the major sector in Gabon’s cash economy, it has become overshadowed by the oil sector, and now accounts for less than three percent of GDP. It is, however, the second largest employer after the state, absorbing an estimated 28-30 of the active labour force (much of this is part-time employment).

Extraction and exportation of tropical timber on an industrial scale began around 1900, and until the late 1990s timber was predominantly destined for France, and other EU markets. Since then, exports to China have grown and (in round-wood equivalent volume) exceed those to the EU. In 2001 the government introduced legislation designed to provide both for a sustainable timber industry and to encourage forward linkages. The Forestry Code (*Loi N^{o} 016/01 Portant Code Forestier*) of 2001 included four major features. The first was the termination of the state-owned company’s (SNBG, *Société Nationale des Bois du Gabon*) monopoly over the commercialisation of the dominant species Okoumé and Ozigo. The second was the introduction of a sustainable forest management system, and the third saw the introduction of a higher degree of transparency to combat corruption and illegal logging. The final component of the Forestry Code was designed to promote the domestic processing of logs. It established a target of domestic processing, specifying a target of 75 percent by January 2012. Since progress in meeting the 75 percent processing target for January 2012 was slow, at the beginning of 2010 the government announced a log export ban.

Two key factors led to the introduction of the Forestry Code. First, Gabon's oil reserves are finite and oil production peaked in 1996/7. This led the government to target economic diversification in general, and the adding of value to raw materials in particular. The second factor was pressure from a series of external agencies, including the IMF and the World Bank (Gabon's largest creditors), European governments and European buyers of tropical timber and wood products. The fact that the historically dominant buyers from Europe were happy to see primary processing occurring at the site of logging removed a potential obstacle to this policy-induced promotion of forward linkages. Even though progress in meeting the January 2012 target was slow, the timber value chain in Gabon has seen a deepening of forward linkages (Figure 8).

Figure 8: Gabon's tropical timber value chain

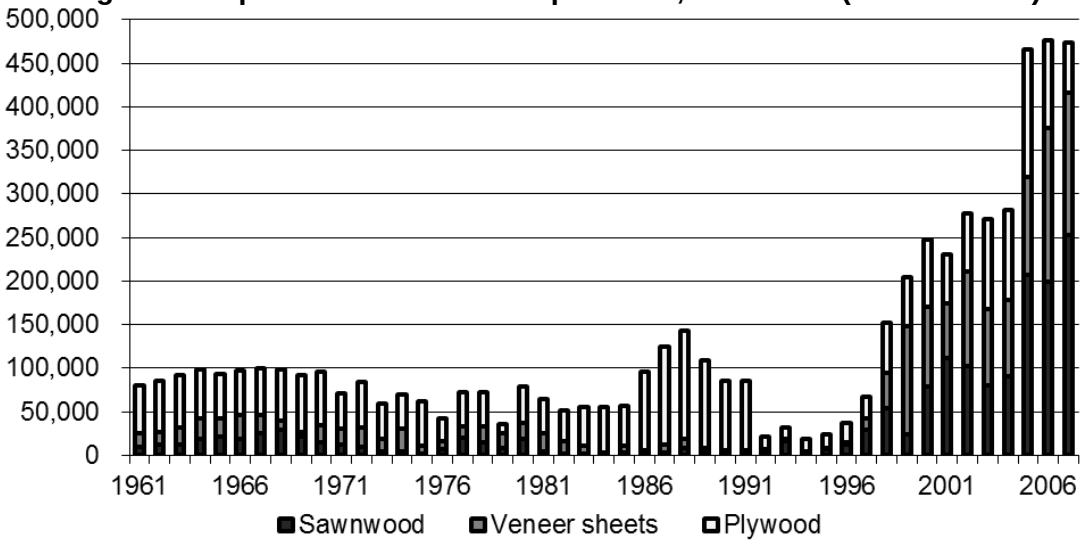


Note: Dashed lines text boxes give examples of actors external to the value chain

Source: Terheggen (2011)

In the early years market-led exports were relatively small and stable (hovering between 50,000 and 100,00 cubic metres p.a.), but after the late 1990s, and particularly after the introduction of the Forestry Code in 2001, exports of processed timber products grew rapidly, exceeding 450,000 cubic metres in 2005. However, despite this growth, in terms of round-wood equivalents, this export of processed timber was only 33 percent of total timber exports in 2007 (Figure 9). Whilst European buyers have imported a growing proportion of processed timber products, Chinese buyers almost exclusively buy unprocessed logs.

Figure 9: Export volumes of wood products, 1961-2007 (cubic metres)



Source: ForesSTAT data online <http://faostat.fao.org>(accessed January 2011)

Aside from the timber, local content in the Gabonese timber industry and in the processing sector is largely confined to labour. It is estimated that wage costs account for up to a quarter of total production costs in a vertically integrated logging-processing company. Other major cost items are capital goods (20 percent), transportation (14 percent), customs (22 percent), and taxes (10 taxes). Most of the machinery and transport is made up of imports. But even this overstates the domestic value added component of costs (excluding the resource rents derived from ownership of timber), since Gabon has an acute shortage of skilled labour and of unskilled labour too. As one company observed: "We would like to fill our senior positions with Gabonese, but …we cannot find skilled labour in Gabon". Consequently a high proportion of the skilled labour force, and 16 percent of unskilled labour was made up of migrants, many of whom repatriate their salaries abroad (Table 12). Senior management is most often sourced from Europe and/or Asia (depending on the ownership of production), whereas foreign labour in administrative positions, in transportation, and in production/processing (labourers) is mostly made up of migrant labour from other Central African countries.

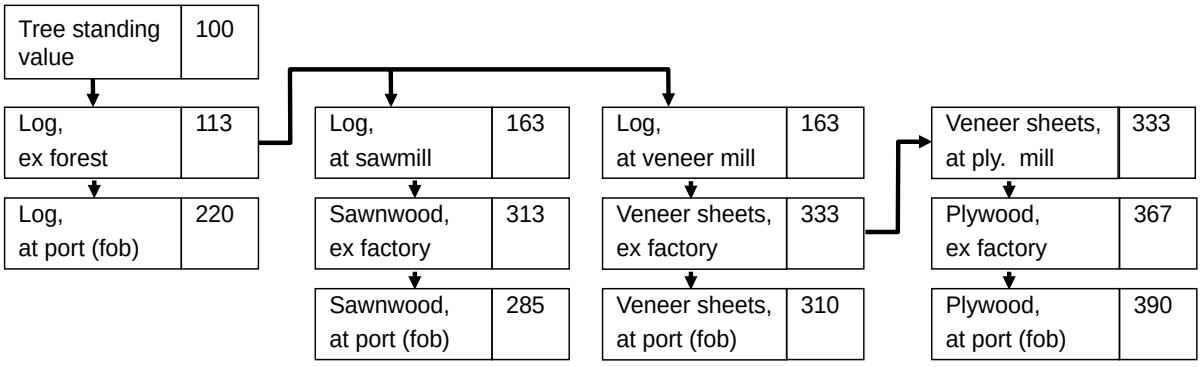
Table 12: Distribution, origin and cost of labour (percent, Euro)

	Distribution	**Origin**		**Cost**
	(percent)	*(percent)*		*(euro)*
		Gabon	Foreign	
Management	7	24	75	5,700
Technicians	4	59	41	1,600
Administration	6	87	13	700
Labourers	74	84	16	300
Transport	6	70	31	800
Environment & Social	2	74	26	600

Source: Terheggen (2011)

An index of the value of logs and processed wood products after their respective points of production (ex-forest or ex-factory) as well as the point of exportation (at port, fob), provides an overview of the accretion of value-added throughout Gabon's tropical timber industry (Figure 10). The value chain starts at the forest level where the standing value of a tree is assigned an index value of 100 points. Once the tree is felled, cleared of its branches and transported to the landing site (log collection point in the concession area) there is an increase in its value to 113 index points. The transportation from the landing site (ex-forest) to the port results in an index point value of the same log of 220 points. Similarly, the sawn logs (with an index of 163) result in a fob price of sawn-wood with an index of 285, of veneer sheets of 310 and of plywood of 390.

Figure 10: Intra-chain value-added distributions



Source: Terheggen (2011)

To some extent, the slow progress in meeting the Forestry Code objectives is a function of processing inefficiency. Exported as logs, Gabonese producers are able to command the highest share of resource rents, since Gabon is a privileged supplier of many tropical species, particularly Okoumé[6], which is prized because of the ease with which the bark can be peeled. However, to the extent that processing is inefficient by global standards, some of these resource rents are dissipated. Processing may increase domestic value added, but will lead to lower levels of profits. And insofar as these profits are invested productively and the returns to this investment stay in Gabon, it may be that the social interest is best met without the beneficiation of Gabon's timber wealth.

It is difficult to compute these variables, in part because of problems with research access, and in part because most logging companies produce different types of wood, and have a different product mix in the share of log exports, sawn-wood, veneer and plywood. The simulation in Table 13 shows what the levels of surplus would be if production was entirely concentrated in any one of these four product families. Whilst this is a highly artificial simulation, since the only accord with reality are the firms exporting raw logs

[6] Okoumé grows in 70-80% of Gabon's forest and in much smaller volumes in neighbouring countries. There are no perfect substitutes although Meranti (an Asian species) is a second-best option.

alone, it suggests that inefficient timber processing in Gabon does lead to an erosion of resource rents.

Table 14 simulates output value and factor utilisation if the same quantity of wood is exported exclusively in the form of logs, sawn-wood, veneer sheets or plywood. The simulations also calculate the resultant earnings of foreign exchange, employment figures and investment requirements, taking into account processing conversion rates of logs. It shows that foreign exchange earnings are highest if the timber is exported as logs, and lowest if exported as sawn-wood. There would be a significant gain in employment if the logs were processed domestically, but since the production of veneer sheets and plywood are both relatively capital intensive, this employment gain would come at a considerable capital cost.

Table 13: Outcome of simulation – fixed quantity of log inputs (3.43m cubic metres round-wood)

Item	Unit	Log	Sawn-wood	Veneer	Plywood
RWE Input [a]	CUM	3,430,000	3,430,000	3,430,000	3,430,000
Real Output [b]	CUM	3,430,000	1,370,000	1,750,000	1,490,000
Foreign exchange [c]	USD m	1,050	750	1,170	1,190
Employment [d]	number	7,400	21,000	22,500	47,100
Capital [e]	USD k	39,900	74,800	428,700	730,400
Capital productivity		146.4	31.2	6.9	3.5
Labour productivity		465.1	65.4	77.8	31.7
Capital intensity		5.4	3.6	19.1	15.5

Source: Terheggen (2011)

Notes:
- a RWE = roundwood equivalent
- b Converted using average rates of conversion for Gabon based on interview data, when necessary adjusted for species mix and final destination, at fixed RWE input levels
- c Prices weighted for species mix and averaged over the period 2003 until 2007; extracted from Commodity Price Statistics (www.unctad.org) accessed November 2009 and July 2010
- d Based on 2004-2006 sectoral employment averages extracted from Nguema (2007) and production data retrieved from ForesSTAT (http://faostat.fao.org) accessed November and December 2009; corrected for domestic skill deficiencies (20% reduction of simulated employment figures)
- e Based on 2003 capital depreciation costs across sectors as stated in Odysée Développement (2005),converted into USD using the average 2003 exchange rate (http://data.un.org)

It is dangerous to base this assessment on static comparative advantage, and a further simulation was thus conducted based on the assumptions that processing rates reach global standards, that skilled labour is available in Gabon hence suspending the 'skill deficiency' variable applied in the first simulation, and that capital costs decrease by 20 percent. In this case, there are still seeming costs to forward linkages and there is little difference in the foreign exchange earned from the various products, and the capital costs of employment creation are diminished.

Table 14: Outcome of simulation – fixed quantity of log inputs (3.43m cubic metres round-wood), adjusted output, employment and capital variables

Item	Unit	Log	Sawn-wood	Veneer	Plywood
RWE Input [a]	CUM	3,430,000	3,430,000	3,430,000	3,430,000
Real Output [b]	CUM	3,430,000	1,910,000	1,810,000	1,630,000
Foreign exchange [c]	USD m	1,050	1,030	1,210	1,300
Employment [d]	Number	9,200	33,000	28,700	62,200
Capital [e]	USD k	31,900	70,700	352,900	615,800
Capital productivity		162.6	40.8	7.7	4.0
Labour productivity		372.1	58.0	62.9	26.1
Capital intensity		3.9	2.4	13.8	11.1

Source: Terheggen (2011)

Notes:
- a RWE = round wood equivalent
- b Converted using **global** average rates of conversion, when necessary adjusted for species mix and final destination, at fixed RWE input levels
- c Prices weighted for species mix and averaged over the period 2003 until 2007; extracted from Commodity Price Statistics (www.unctad.org) accessed November 2009 and July 2010
- d Based on 2004-2006 sectoral employment averages extracted from Nguema (2007) and production data retrieved from ForesSTAT (http://faostat.fao.org) accessed November and December 2009; numbers **not** corrected for skill deficiencies
- e Based on **80%** of the 2003 capital depreciation costs across chains as stated in Odysée Développement (2005),converted into USD using the average 2003 exchange rate (http://data.un.org)

These simulations are, as observed, artificial. But they are helpful in highlighting four important characteristics of forward linkages, both in Gabon's timber industry and in other sectors and in other countries. First, if beneficiation is inefficient by global standards, there can be high costs to any resulting employment creation. Second, these costs can diminish over time if there is progress in domestic processing efficiency. However, this progress has to be assessed relative to the moving global frontier, rather than to historic levels of inefficiency. Improvements in absolute factor productivity may be more than outweighed by a faster rate of technological progress in competing countries. Third, the high cost of log processing in Gabon is not just a function of processing efficiency in the downstream industry itself. It also reflects a general systemic inefficiency, for example in the poor quality and high cost of infrastructure. And, finally, the logic of foregoing beneficiation in order to maximise profitability and future investment only makes sense if this surplus is used productively and is not wasted in other inefficient ventures or repatriated abroad. In the Gabonese context none of these assumptions can be made with confidence, and hence despite the Forestry Code promoting inefficient production, attempts to force the pace of deepening forward linkages may despite the erosion of potential resource rents may the least worst policy alternative given the prevalence of corruption in Gabon.

2.4 Backward linkages into the gold sector in Ghana

Gold has been produced for over 1,000 years in the territory of the Ancient Kingdom of Ghana, the Gold Coast Colony and post-independence Ghana. After South Africa, Ghana is the second-ranked African gold producer. Large-scale industrial gold mining in Ghana dates back to the last quarter of the 19th century. After a period of decline under government control in the nationalist era in the 20 years from the early 1960s, the industry was restructured and modernised under the post-1983 Economic Recovery Programme (ERP), which prominently featured a revised mining code, the Minerals and Mining Law (PNDCL 153) of 1986.

Since the mid-1980s, gold mining has seen sustained increases in foreign investment, output, and export volumes. Between 1980 and 2000, production increased by 700 percent. In 1999 gold comprised 97 percent of mineral exports, and became the country's leading contributor to overall exports. After a brief interruption during a period of gold price weakness at the turn of the century, production expansion resumed. Facilitated by a further revised mining code that was consolidated in the Minerals and Mining Act 703, 2006, $3bn was invested in the industry 2006 and 2009. In 2009, gold exports exceeded $1bn, and accounted for 43 percent of Ghana's exports (Table 15). Mining's contribution to Gross Domestic Product, of which gold still represents some 95 percent, was 5.8 percent in 2009, up only a percentage point from 1990, but still higher than Ghana's other main export commodities, cocoa (3.9 percent) and forestry (3.2 percent). Total employment in the large scale mining sector fluctuated, falling from a peak of nearly 20,000 in 1995 to 17,332 in 2009. This fall reflected a period of sustained productivity-enhancing investment. Given the rapidly escalating price of gold in the context of the post-2002 commodity boom and global economic uncertainties, investment in the mining sector has grown significantly in recent years, and looks likely to continue growing in the future.

Table 15: Ghana Gold Mining - 1990, 1995, 2000, 2005, 2009

Year	1990	1995	2000	2005	2009
Production oz	541,147	1,715,867	2,457,152	2,138,944	3,119,823
Contribution to GDP (%)	4.8	5.6	5.6	5.0	5.8
Export Value	$304m	$647m	$702m	$946m	
Share total exports (%)	19	44	36	34	43
Employment Total	N.A.	19,557	15,120	13,766	17,332
Mining Leases Granted	3	4	2	2	6
Prospecting Licenses Granted	37	23	4	22	72
Reconnaissance Licenses Granted	1	42	1	31	21
Small-Scale Gold Licences Granted	0	0	9	21	66

Source: Ghana Minerals Commission

By 2009, Ghana had become the world's ninth largest producer of gold, accounting for 3.8 percent of global production, up from 2.6 percent five years

earlier. The Birimian and Tarkwaian gold belts (known as greenstone belts) which characterise the western half of Ghana and which host gold mineralisation that contains both hard rock and placer (alluvial) gold deposits continue northwards and westwards into the broader region. Ghana is thus simultaneously at the forefront of an expanding West African industry, as production increased significantly in the neighbouring countries of Mali, Burkina Faso, Guinea, Mauritania and Cote d'Ivoire.

Ghana has eight large mines, all of which are owned and managed by five international producers. It also possesses a small number of far smaller producers; and a significant contribution of registered semi-formal, small-scale producers which generate around 10 percent of national output (triple the level of 20 years ago). In addition there is substantial, albeit unmeasured production from the unregistered, informal and technically illegal small-scale artisanal miners known as *galamsey*, whose activities spread through gold mining areas and which employ in an estimated range of 50,000 to 200,000 people.

The Minerals and Mining Law of 1986 is the core legislation which frames the operations of the industry. A key component of the ERP, it constituted the first-ever Ghanaian legislation that was specific to mining. This law was amended with the Minerals and Mining Amendment Act of 1994 (Act 475) after the re-establishment of civilian democratic rule in 1992. Act 475 has subsequently been amended with the Minerals and Mining Act of 2006 (Act 703). Act 703 is a comprehensive law that covers virtually all aspects of mining, namely, ownership of minerals and the cadastral system; mineral rights; royalties, rentals and fees; dispute resolution; reconnaissance licenses; prospecting licenses and; mining leases. Other areas include surrender, suspension and cancellation of mineral rights; surface rights and compensation; industrial minerals; small-scale mining; and administration and miscellaneous provisions.

Act 703 seeks to promote a localisation policy and facilitate the local content of the industry to maximise the benefits of mining for the Ghanaian economy. In this regard, it provides for the following measures:

- A 10 percent government stake in all large-scale gold mining companies without any financial contribution;
- The reservation of small-scale mining for Ghanaian citizens;
- Gold mining companies are to give preference to "made in Ghana" products, to public corporations and service agencies located in the country, and to employment of Ghanaians;
- Gold mining companies are required to submit detailed programmes for the recruitment and training of Ghanaian personnel;
- Clause 50(3) of Act 703 specifically calls for eventual "localisation" of mining staff. It defines "localisation" to mean a training programme designed towards the eventual replacement of expatriate personnel by Ghanaian personnel

Besides restructuring the law governing the operations of the mining sector the Minerals and Mine Law of 1986 sought to strengthen mining support institutions under the Mining Support Program. The main aims of this programme were to develop the capacity of mining support institutions to enable them to promote investment in the sector and to develop mechanisms for enhance productivity and financial viability.

As a consequence of the very long history of gold mining in Ghana, and particularly the demand arising from the rapid expansion of the industry after the mid-1980s, there has been a gradual development of a supplier industry. Ghana's leading Business Directory, the Surf Yellow Pages Ghana (2010 edition), indicates a large population of companies involved in supporting the mining sector, the vast majority of which are concerned with gold mining. Some 300 companies are listed under the three categories of mining companies, mining equipment, and mining services. The first-tier suppliers include global mine construction companies such as Lycopodium, and a strong showing by a number of well-known, international OEM companies (Atlas Copco, Boart Longyear, Sandvik, Liebherr, Mantrac/Caterpillar), input suppliers (Carmeuse Lime Products, Castrol, Maxam, African Explosives) and agents and distributors (Barbex Technical Services, Riepco).

Local firms feature more prominently amongst the smaller first tier- and second-tier suppliers. These are primarily in the metals and metalworking (Tema Steel), chemicals and plastics (Riepco, Interplast), civil engineering (Engineers and Planners), business services (KEK Insurance Brokers) and logistics (Allship Logistics) fields. While not presently members of the Ghana Chamber of Mines, a number of other locally-owned companies (such as Western Forgings, Tropical Cable and Conductor, and Wire Weaving Industries) also provide inputs to the mines.

The major gold mines claim a large number of local suppliers. For example, Golden Star Resources lists several hundred suppliers, of which 60 are "active suppliers" (defined as 12 or more orders a year). Gold Fields, Anglo Gold Ashanti, Chirano, and Newmont list a total of 521 suppliers. These claims are supported by Chamber of Mines data on the distribution of mining revenues. This demonstrates a large aggregate spend by producing companies making up some 20 percent of revenues ($467m) on local purchases, to which a further 18 percent ($428m) on fuel and power must be added. Imported consumables comprise 16 percent of the total, and capital expenditure (largely in capacity expansion, the majority of which is imported plant and equipment), 29 percent (Table 16).

Table 16: Local Linkages in Ghanaian Gold Mining: Ghana Chamber of Mines producing members 2008: Distribution of funds

Classification	Amount (million $)	%
Employees	175	8
Capital Expenditure	669	29
Direct payments to Govt.	146	6
Mining Host Communities	12	1
Local Purchases (excluding Fuel/Power)	467	20
Local Purchases (Fuel/Power)	428	18
Loans	52	2
Imported Consumables?	376	16
TOTAL	**2,325**	**100**

Source: Ghana Chamber of Mines

A striking feature of this supplier development, which supports the conclusions that this has been a largely market-driven process of outsourcing and specialization, is the geographical concentration of suppliers in mining supply industrial districts. Of the firms listed in the directory of suppliers, at least 80 percent, are located in Greater Accra, in Accra itself or in the adjacent port/industrial city of Tema. The only other metropolitan area with a substantial number of suppliers is Takoradi in the Western Region (Kumasi, the large metropolitan commercial and political capital of Ashanti Region, is seemingly under-represented as a locale for mining supply).

The Chamber of Mines Supply Manager's Sub-Committee has identified 27 product categories (Table 17), presented in the box below, which are either already being manufactured in Ghana, or should be assessed for "import substitution potential." Annual spend on these Ghanaian-owned suppliers is estimated at $120m, and the aim is to increase this to $200m in the longer term. The Chamber is seeking to move from a sourcing policy based on percentage value of procurement spend to one based on targeting products (services are not included) which are being, or likely, can be made in Ghana.

Table 17: Feasible products for future near-term backward linkages

1	Activated Carbon	15	Conveyor Rollers, Idlers & Pulleys
2	Yelomine Pipe	16	Steel Products, including fabrication
3	Rock-bolts and Split-sets	17	Tyre-retreading
4	Caustic Soda	18	Heavy Duty Electric Cables
5	Explosives Manufacturing, including Ammonium Nitrate	19	Metal or PVC Core Trays
6	Ventilation Ducting	20	Chain Link Fencing, Wire Netting, Barbed Wire, Welded Mesh, Expanded Mesh, Concrete Mesh, Razor wire and Panel Mesh
7	Ammonium Sulphate	21	Motor Re-winding
8	Mill Liners	22	Plastic Sample Bags
9	Grinding Media	23	Calico Bags
10	General/Specialty Lubricants	24	Bullion Boxes
11	HDPE & PVC Pipes	25	Reversed Engineered Specialty Products
12	Overalls & Work Clothes	26	Cupels & Crucibles
13	Cement and Cement products	27	Wood Products
14	Quicklime and Hydrated Lime		

A number of mines have introduced programmes designed to increase local content, particularly from communities based close to the mines. This includes the purchase of goods and services such as construction, maintenance, catering, landscaping, haulage, transportation and security. In 2002 the Ghana Minerals Commission mandated all mining companies to assist their host communities to develop local linkages.

All large mining companies in Ghana have set up departments and units to deal with this. In some cases to demonstrate their commitment, foundations have been set up which tie mining production and revenue to funds for local community development. A case in point is Gold Field Ghana Limited's (GFG) Foundation which was established in 2004 to promote and fund community development projects within the Tarkwa and Damang catchment area of the company's operations under an initiative titled the Sustainable Community Empowerment and Economic Development (SEED) programme. The main objective of the GFG Foundation is to promote the development of the company's primary stakeholder communities. The Foundation's work is funded by a contribution of one US dollar for every ounce of gold sold by the company, as well as a deduction of 0.5 percent of pre-tax profits. Based on this funding contribution, increases in the price of gold and in company profitability imply that there will be growing funds for community development projects. In addition, other companies providing mining support services to Gold Fields Ghana are also encouraged to contribute, either in cash or kind, to the Foundation's activities. Table 18 shows the contributions made by the GFG Foundation to various sectors in its primary catchment area.

Table 18: GFG Foundation: Percentage Expenditure on Sectors and Total Contribution (in US Dollars) on Community Development Projects, 2002-2009

	Financial Year								Total	Total
Sector	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**(%)**	**($'000)**
Education	57	8	57	35	31	25	36	25	**31**	**2808**
Health	21	64	8	27	3	3	5	2	**12**	**1060**
Water & Sanitation	9	17	11	19	13	17	16	11	**14**	**1315**
Agriculture	-	-	6	1	23	45	31	33	**24**	**2213**
Others	13	11	18	18	30	10	12	29	**19**	**1710**
Total ($'000)	**474**	**721**	**362**	**915**	**1380**	**1391**	**1932**	**1931**	**100**	**9107**
Projects not funded by GFG Foundation										**1382**
Grand Total										**10,489**

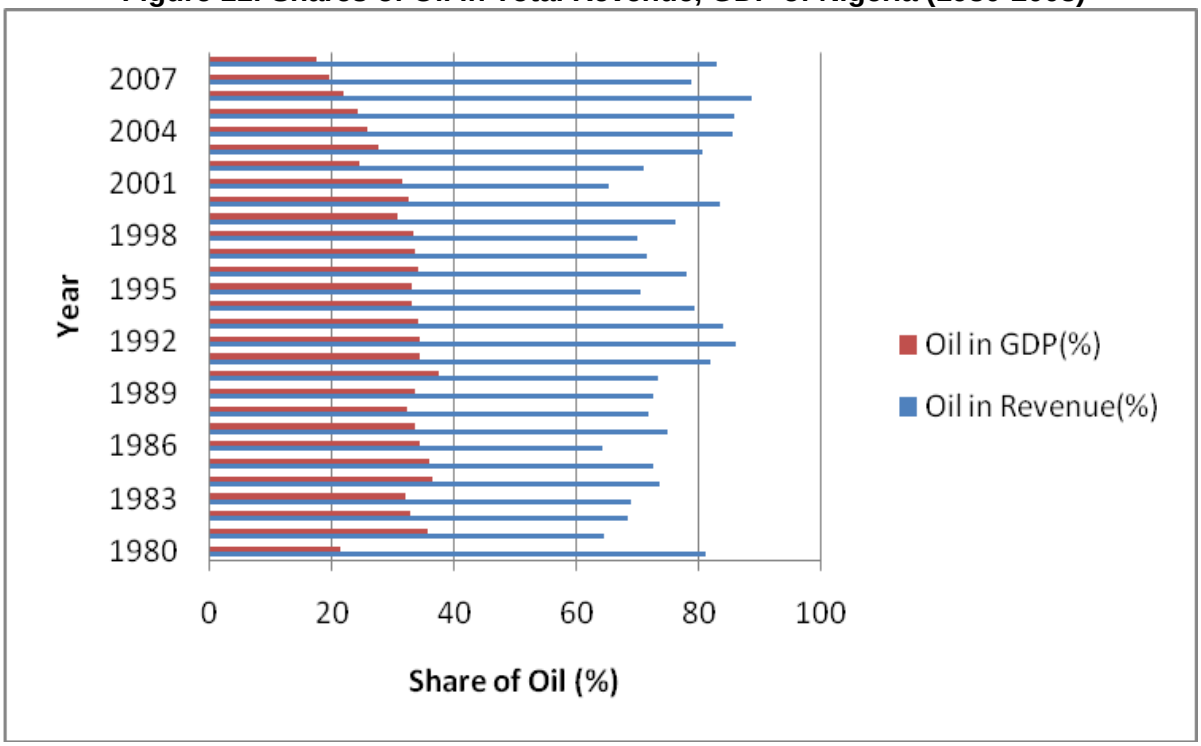
Source: Gold Fields

Newmont has a Foundation for local development, funded by a contribution of one US dollar for every ounce of gold sold by the company as well as a deduction of one percent of pre-tax profits. Golden Star Mining Company has established the Golden Star Development Foundation (GSDF) to promote and fund development projects in its operational areas. Projects funded by GSDF in 2008 included the establishment of an educational scholarship scheme; provision of educational infrastructure (school building); health infrastructure (including medical supplies) and a community electrification project.

2.5 Backward linkages into the oil sector in Nigeria

Nigeria has a well-established oil and gas extraction industry following the discovery of commercial quantities of oil in 1956. But it was not until the end of the Nigeria civil war (1970) that the oil industry began to play a prominent role in the economy. By 1982 the oil sector was providing more than 60 percent of total government revenue, and although this share has fluctuated with volatile oil prices, it has consistently remained above 60 percent. The contribution of the oil industry to Nigerian GDP has been significant over the years, exceeding 20 percent since the early 1980s, and in some years accounting for more than one-third of GDP (Figure 11). The downturn in this share of GDP between 2004 and 2007 was interrupted by the increase in oil prices in 2009 and 2010 (although up-to-date GDP figures are not available). The likelihood that oil prices will remain high in the future ensures that the oil and gas sector will continue to play a dominant role in the economy.

Figure 11: Shares of Oil in Total Revenue, GDP of Nigeria (1980-2008)



Source: Central Bank of Nigeria Statistical Bulletin (2009)

In 2010, Nigeria was the 10th largest global oil producer, and until recently (when Algeria became the largest producer), the major oil-exporting economy in Africa. Reserves at the end of 2007 were 36.2 billion barrels, 2.9 percent of the global total. Nigeria's downstream oil industry is made up of four refineries with a capacity of 438,750 bbl/d. But a series of problems - fire, sabotage, poor management, poor maintenance and corruption - have meant that the refineries often operate at less than 40 percent of full capacity. This has meant that despite being a major exporter of crude oil, Nigeria is also a significant importer of petroleum. Policy attention is focussed on increasing this downstream processing capacity.

Despite this focus on forward linkages, there has been a long history of local content policy designed to deepen backward linkages. This started with the Petroleum Act of 1969 which contained a section on the protection for indigenous Nigerian firms and a section on human capacity development. The joint operating agreements (JOA) and the production sharing contract (PSC), between the Nigerian government and the foreign oil companies in 1991 and 1993 included measures to promote local content by explicitly recognising that this might require the industry to pay more for local inputs than for imports. Policies introduced in 2005 moved beyond price-premia and involved the issuance of 23 directives by the Nigerian government mandating the use of selected local services and mandating the sourcing of low-tech on-shore supply of goods and services to indigenous firms.

Partly as a natural working-out of market forces, and partly as a consequence of these local content policies, estimates of local content in the oil and gas industry has risen sharply, particularly over the past decade. Local content rose from 3-5 percent in the 1970s to 20 percent in 2004 (UNCTAD/CALAG, 2006). In 2005, the Nigerian Government set a local content target of 49 percent for 2009 and 70 percent for 2010, but these targets were not met. In 2009, local content had only reached a level of 39 percent. Despite this failure to meet the 2010 target, Nigeria has made significant progress. Nevertheless, Nigeria's level of local sourcing is much lower than countries such as Brazil, Malaysia, Venezuela and Norway, all of which achieve local content levels of between 45 and 75 percent (UNCTAD/CALAG, 2006). Local content levels are however much higher than in other SSA oil-exporting economies such as Angola – see Section 4.1 above.

Nigerian policy has long recognised that local content – i.e. the percentage of spend procured domestically – is not the same as local value added (i.e., it is not just the breadth of local content which is important, but also its depth):

> *"the quantum of composite value added to, or created in the Nigerian economy through the utilization of Nigerian human and material resources and services in the exploration, development, exploitation, transportation, sale and processing of Nigerian crude oil and gas resources resulting in the development of indigenous capabilities, while encouraging foreign investment and participation, without compromising quality, health, safety and environmental standards" (NNPC, 2009)*

Most recently, the Nigerian Content Act (2010) seeks to speed up the indigenisation of the industry, privileging not just domestic supply, but domestic supply by Nigerian firms:

> *"Nigerian independent operators shall be given first consideration in the award of oil blocks; oil field licenses, oil lifting licenses and in all projects for which contract is to be awarded in the Nigerian oil and gas industry. In the bidding for any license, permit or interest and before carrying out any project in the Nigerian oil and gas industry, an operator shall submit a Nigerian content [plan] to the board*

> *demonstrating compliance with the Nigerians Content Act. Finally, the award of contract shall not solely be based on the principle of the lower bidder; where a Nigerian indigenous company has capacity to execute such job, the company shall not be disqualified exclusively on the basis that it is not the lowest financial bidder, provided the value does not exceed the lowest bid price by 10 percent".*

The capacity to increase local content clearly follows from the quality of domestic capabilities. In 2003 a detailed study of the industry suggested that the gap between the needs of the oil and gas sector and local capabilities was smallest in seven sectors, namely in fabrication and construction; well construction and completion; modification, maintenance and operations; transportation; control systems and ICTs: design and engineering; and consultancy (Heum *et al*., 2003).

In he light of this assessment, our study of backward linkages into the oil and gas industry focused on three of these sub-sectors - fabrication and construction; well construction and completion; and control systems and ICT. We chose these three sectors since they covered a range of competences and represented a discrete and researchable set of companies. We interviewed 15 of the 45 large foreign- and locally-owned producing firms, most of whom had Head Offices in Lagos, and 115 oil and gas industry suppliers clustered around the two oil cities of Port Harcourt and Warri (accounting for half of all known supplying firms in these regions). These cities were chosen since they were the major centres where oil prospecting, exploration, production and refining occur and local serving firms have concentrated. A multi-stage sampling technique was used in the case of oil firms' suppliers. In the first instance, the population was stratified into the two regions (Port Harcourt and Warri) and each of the cities was further stratified into wards. Using the raffle variant of simple random sampling, 50 percent of suppliers firms were selected in each ward.

What is the evidence on local sourcing which emerges from this focus on the three sub-sectors feeding into the oil industry? Beginning with data derived from the oil sector companies, nine of the 12 interviewed firms estimated that they purchased more than half of all their goods and services from local suppliers (Table 19). This considerable commitment to local purchasing exists despite the fact that procurement decisions (including of consumables) are largely taken by the Head Office (which is generally outside of Nigeria),

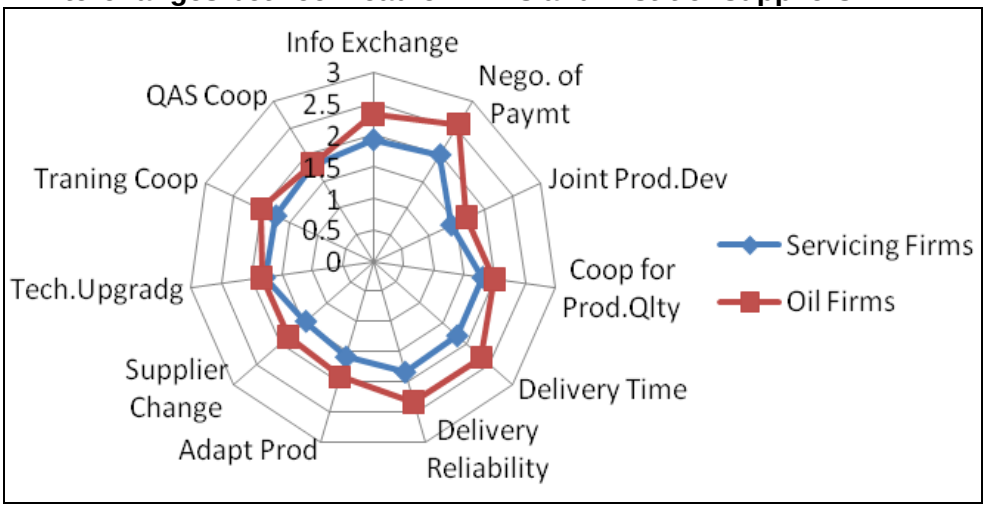
Table 19: Share of inputs from local suppliers/outputs sold to local processors

	Frequency	Percentage
Backward linkages:		
Goods: Up to 50%	3	25
51%-75%	5	41.7
Above 75%	4	33.3
Services: Up to 50%	3	25
51%-75%	9	75
Forward linkages		
Up to 50%	5	41.7
51%-75%	4	33.3
Above 75%	3	25
Locus of decision making		
Who is in charge of supply management?		
Local office	0	0
Head office	12	100
Does this include consumables?		
Yes	10	83.3
No	2	16.7

Source: Oyejide and Adewuyi (2011)

Despite this high level of local sourcing, much of this occurs on an arms-length basis, suggesting that there is considerable leeway for the promotion of better links between the oil firms and their suppliers. Figure 12 shows the result of asking the same question of both the oil firms and their suppliers about the nature of their interchanges on a range of factors which are important in achieving systemic value chain efficiency. On a scale of 1 ("not at all") to 3 ("constantly") each of the parties were asked to score the quality and frequency of their contacts. It is clear that as a general rule, the oil firms tend to rate their linkage with their servicing firms higher than the suppliers for all of these modes of interaction. The gap in perceptions was greater with regard to payment negotiations and delivery reliability and delivery frequency. But it is interesting that with regard to quality – a critical success factor in the oil industry – there was a close alignment in the perceptions of the oil firms and their suppliers.

Figure 12 Alignment of perceptions on the frequency and quality of interchanges between lead oil firms and first-tier suppliers



1=No contact, 2=Occasional contact 3=continuous contact

Source: Oyejide and Adewuyi (2011)

This misalignment in perceptions between the oil firms and their suppliers exists despite the fact that most of the large oil firms have active supplier development programmes (Table 20). It is clear, however, that the International Finance Corporation supplier development programme does not appear to be seen as useful by the oil companies. Further, although the oil companies believe that they have reasonably close relationships with their first-tier own suppliers, this does not extend down the supply chain. Only one of the 12 lead commodity producers said that it provided support to second-tier suppliers.

Table 20: Supply chain development programmes

	%
1. Provide assistance to suppliers in meeting up with standards	
Yes	75
No	25
2. Have a strategy for supply development for local business	
Yes	75
No	25
3.Participate in IFC suppliers development programme	
Yes	8.3
No	91.7
4.Keep relationship with firms that provide input to suppliers	
Yes	8.3
No	91.7

Source: Oyejide and Adewuyi (2011)

The lack of contact between lead commodity producers and second and third tier suppliers raises the associated question on the depth of local content provision. In other words, are local sources merely a front for the importation of goods and services? Table 21 provides data on the local purchasing by 80 first-tier suppliers to the oil industry in the three sub-sectors. They reported substantial levels of local content in their own purchases. Taken as a whole, 55.1 percent of 80 first-tier supplying firms purchased more than half of their services from local second-tier suppliers. This level of local sourcing was highest in the fabrication and construction sub-sector and in the well-construction and completion sub-sector. In these two sub-sectors 45.5 percent and 41.1 percent respectively source more than 75 percent of their inputs locally. The significance of this data is that it suggests a considerable depth to backward linkages in the Nigerian oil and gas industry. That is, unlike the experience of “local supply” in many of SSA’s commodity sectors, where “local” represents merely the localisation of the importation function, in the Nigerian oil and gas industry a large measure of “local supply” does indeed reflect local value added.

Table 21: Share of local content in purchases by first-tier suppliers to the oil and gas industry (%)

Sector	**0-25%**	**26-50%**	**51 -75%**	**76 -100%**
Control system & ICT	31.6	21.1	21.1	26.3
Fabrication & construction	13.6	22.7	18.2	45.5
Well construction & completion	20.6	20.6	17.6	41.1
Others	40	40	20	-
Total	22.5	22.5	18.8	36.3

Source: Oyejide and Adewuyi (2011)

2.6 Backward linkages into mining equipment and services in South Africa

The large scale exploitation of minerals in South Africa dates back more than 150 years to the discovery of diamonds, and subsequently during the 1870s to the discovery and exploitation of deep deposits of gold ore. South Africa not only possesses the most developed mining and mining supply industry in SSA, but in some important respects also stands out as a world-leading producer, of individual minerals and in the contribution of mining to the economy as a whole. It also possesses extensive forward linkages from the commodities sectors, not just in the processing of many ores, but especially in the processing of soft industrial commodities. South Africa possesses a well-developed industrial sector the origin of which rests in mineral extraction and the development of extensive linkages to this sector. South Africa thus provides a cogent challenge to one of the central tenets of the Resource Curse theory, that is, that resource-exploitation undermines industrial activity.

In recent years, mining has seen a decline in its share of GDP (from 8.8 percent in 2000 to 6.3 percent in 2010). Its share of exports (41 percent in 2010) remained roughly stable over the decade, but fell and then rose in tandem with global commodity prices (Table 22).

Table 22: Share of Mining and Quarrying in South Africa GDP and Exports, 2000-2010 (%)

Year	Value Added In GDP	Exports
2000	8.8	39
2001	8.5	39
2002	8.3	37
2003	8.4	33
2004	8.1	32
2005	7.8	32
2006	7.3	33
2007	6.9	32
2008	6.3	33
2009	6.1	39
2010	6.3	41

Source: Value Added GDP values from South Africa Statistical Yearbook (2011). Exports values from http://apps.thedti.gov.za/econdb/rapportt/rapstruc.html

In the early years, economic policies with regard to mining had two main thrusts. The first was to provide a favourable environment for mining investors. This, in turn, entailed keeping costs down, notably the wage costs of African miners. At the same time, there was a second thrust that entailed a number of policies which sought to advance backward linkages. Prominent in the past were policies of tariff protection that provided support for domestic industry.

Currently, a major thrust of government policy with respect to mineral products is to promote downstream beneficiation. Beneficiation features strongly in the National Industrial Policy Framework and in the Industrial Policy Action Plan (IPAP). The IPAP envisages minimum beneficiation levels

for ten "selected commodities." These commodities are not specified, but presumably involve all of the major mineral products. Thus, the IPAP Key Action Programme 12.5.1, specifies

> *Setting minimum beneficiation levels for key commodity chains. Nature of the intervention: The Department of Mineral Resources (DMR) to establish and define minimum levels of beneficiation for each of the 10 selected commodities. This will lay the foundations to create specific value chains, including in 5 instances up to the fourth level of minerals value addition.*
>
> *Our natural comparative advantage in the underlying resource-based industries along with additional factor endowments (especially relatively inexpensive electricity costs) provides us with an opportunity to be competitive in downstream value addition. The end-game is to acquire a competitive position as far down the value chain towards finished product production as is possible.*

However, this is not the only approach driving the development of industrial policy. The International Panel on Accelerated and Shared Growth Initiative for South Africa (ASGISA) argued that

> *..both theory and practice provide reasons to question the presumption that downstream processing is an appropriate development path. The skills and other inputs required to process raw material and market finished products could be very different from those required to mine or grow them….Moreover…as transportation costs have declined, and global markets have become more integrated, the advantage of proximity to raw material production has diminished. (Hausmann, Klinger and Lawrence, 2008:1)*

Leaving aside the current policy debate on whether to promote forward or backward linkages from the commodities sector in the future, past developments have meant that insofar as South Africa has a globally competitive industrial structure in the hard commodities sector, this is to be found in regard to backward linkages, particularly mining equipment and specialist services. This comparative advantage can be evidenced in a number of ways.

The first is with regard to innovative capabilities in general, and patents in particular. The quantity and quality of South African mining and related technologies were assessed utilising 1976-2006 USPTO patent data from the United States Patent and Technology Office (USPTO).[7] South Africa has a considerable number of patents. Mining related technology patents make up a much larger share of South Africa's total patenting activity than for other comparator countries which have significant mining industries and are considered to be at the technology frontier (Table 23).

[7] The data and analysis on South African patents were provided by Professor Lee Bransetter to a World Bank Study entitled "Closing the Skills and Technology Gaps in South Africa."

Table 23. All Patents and Mining Technology Patents at the USPTO 1976-2006; South Africa and Comparator Countries.

	All Patents	Mining Tech. Patents	Share (%)
South Africa	3151	142	4.51
United States	1,587,915	7,882	0.5
Australia	16,283	311	1.9
Canada	65,580	853	1.3
Global total/average	3,189,941	17,098	0.54

Note: A patent belongs to the "Mining Related Technologies" cluster if it belongs to one of the following 3-digit USPC classes: 299 - Mining or In Situ Disintegration of Hard Material, 051 - Abrasive Tool Making Process, Material, and Composition, 023 - Chemistry: Physical Processes, 037 – Excavating, 075 - Specialized Metallurgical Processes, 172 - Earth Working
Source: United States Patent Office database. 1976-2006.

Patent quality can be assessed by examining the number of citations received. In aggregate, South African patents receive fewer citations than patents in the comparator countries. By contrast, South African mining and related patents receive more citations than patents of comparator countries. By this measure, the value of South African patents is higher than for comparator countries. Randomly matching each South African patent to a similar American, Canadian, or Australian patent gives somewhat weaker results. The average number of citations for a South African mining technology patent is likely to be less than that of a similar Canadian or US patents. However, a South African mining patent is more cited than that of a comparable Australian patent.

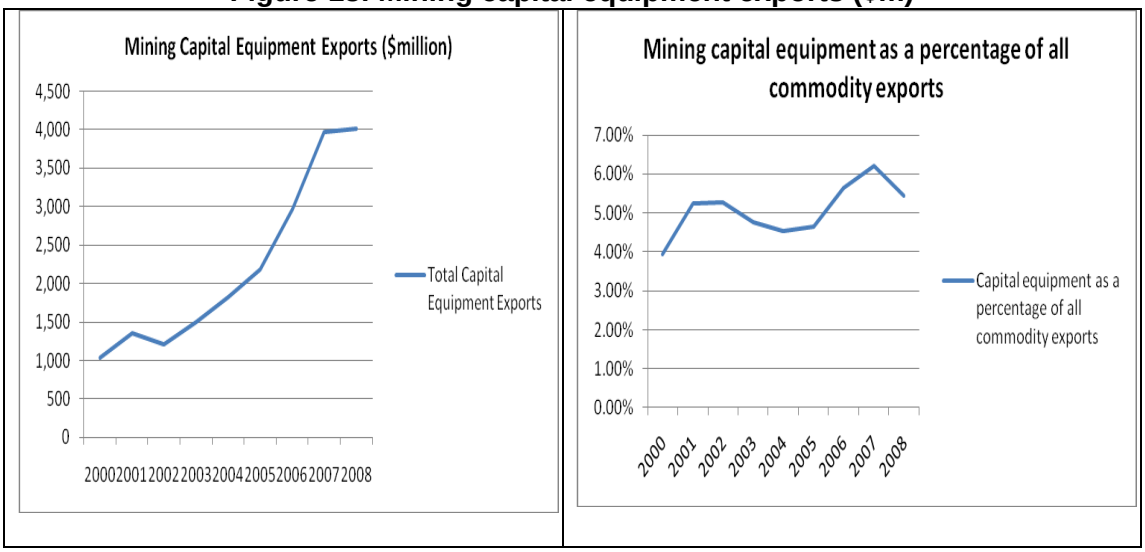
A second indicator of the development of world class backward linkages from South Africa's hard commodities sector is the share of this sector in external trade. The level and particularly the growth of exports of mining equipment and specialist services is one clear manifestation of global competitiveness. This is particularly so in the light of the fact that these exports have not benefited from any specially designated state support. Exports can be divided into two broad categories. The first category is exports related to new projects – new mines or mineral processing activities. The second category is the after-market – to existing mines or mineral processing activities. The latter is much more critical, but the competitive edge to supply to the after-market is often secured through firms being engaged in projects from the outset.

The determination of specifically mining exports is a complex issue. Since trade data is categorized by product rather than by customer, it is very difficult to determine precisely what is destined for mining as opposed to other markets. The South African Capital Equipment Council (SACEC) has assessed, (for South Africa) at an eight-digit HS level, which capital equipment products are destined for the mining sector. SACEC categorization has been used in the data below. Currently exports of mining capital equipment are running at approximately $4bn. Exports have been growing rapidly – in nominal terms quadrupling since 2000.[8] Figure 13 shows both the absolute level of mining capital equipment exports and the share of these

[8] Prior to 2000, there were a number of changes in the definition of products which make it difficult to construct a clear time series.

exports in total exports. This shows a rapid rise in exports between 2000 and 2007 and a largely stable share of total exports.

Figure 13: Mining capital equipment exports ($m)



Source: Calculated from COMTRADE database accessed through WITS online <https://wits.worldbank.org/WITS/WITS/Restricted/Login.aspx> (accessed February 2011)

For all capital equipment, South African imports exceed exports by a large margin – in 2008 and 2009, imports were three times larger than exports. In respect of mining equipment, however South Africa is a net exporter. But this overall positive trade balance reflects a negative trade balance with the rest of the world, but a strong positive trade balance with Sub-Saharan Africa (Table 24). The dense network of mining production and services companies results in a high local value added for this sector – estimated at approximately 90% (Kaplan 2011).

Table 24: South Africa Mining Equipment Exports, Imports ($'000), 2005 -2009

	2005	2006	2007	2008	2009
Trade with World					
Exports	3,292,256	4,721,750	6,200,709	6,742,700	4,130,184
Imports	3,173,526	4,285,689	5,987,691	6,174,743	3,668,875
Trade Balance	118,730	436,061	213,081	567,957	461,309
Trade with SSA					
Exports	786,793	1,025,801	1,494, 146	1,935, 971	1,542,666
Imports	10,972	13,423	15,317	24,485	32,232
Share of Total Exports	24%	22%	24%	29%	37%

Source: Calculated from COMTRADE database accessed through WITS online <https://wits.worldbank.org/WITS/WITS/Restricted/Login.aspx> (accessed February 2011)

Much of these exports result from the global expansion of South African mining houses which then utilise their existing supplier base in South Africa. African countries – notably in the Southern Africa region – are the major markets for South African exports of capital goods. Eight of the top ten destination countries are Africa and all except Nigeria are located in the sub-region. Unfortunately, the services export data do not allow for mining

services to be isolated. But, net export earnings are likely to be substantial and significantly positive.

Beyond this aggregate data, more specific enquiry supports the conclusions that the South African supplier industry has developed globally-competitive capabilities on the basis of its experience in serving the domestic mining industry. South Africa is a world leader in a host of mining equipment products. These include spirals for washing coal; pumping up water; hydropower; tracked mining; underground locomotives; ventilation; shaft sinking; turnkey new mine design and operation, and many others. The area where South African expertise is particularly advanced and is at the global frontier is in deep level mining and associated competencies. South Africa is much weaker in so-called “yellow metal” areas – such as mining vehicles – where scale economies are critical and where large TNCs dominate. There are also examples of horizontal linkages, where competences were built in other sectors and then applied to mining, for example, transport and haulage equipment where South Africa has leading global products (Morris et al, 2011a). Similarly, as in the case of hydraulic equipment, there are also cases where the mining sector provided the initial source of demand and successful domestic firms then branched out to serve the needs of other sectors.

Focusing on the depth and breadth of backward linkages in South Africa it is possible to draw six conclusions. First, South African mining activities have, from a very early stage, required the utilisation of advanced technologies and systems. This has in large part been a consequence of the geological specificity of mining deposits in South Africa, particularly the need to mine at great depths. Second, the local deployment of such technologies and systems combined with a particular structure of the South African mining industry and state directed policies, allowed for the early development of considerable local technological expertise. State policies have been critical in the past. Government provided not only tariff support but also financial and technological support to local industry. Linkages with the National System of Innovation have been important for the mining sector and also for local industry. Third, the technological content of mining and mining related activities everywhere has increased significantly over the last two decades as a result of a number of factors – including increased globalisation, market segmentation and the changing role of TNCs and the engagement of generic technologies, particularly IT. Fourth, the significantly enhanced technological content of mining related activities coincided with two critical changes in South Africa: the decline of mining output for some minerals, notably gold, and the end of apartheid in 1994. As a result, South African mining firms have engaged in substantial expansion abroad. This, in turn, has created significant opportunities for exports of mining related equipment and services. Fifth, South Africa has a significant cluster of firms in mining equipment and related services which are at the global technological frontier. This is evident in respect of exports, intellectual property and leading products and companies. Indeed, this cluster is the only significant area of industrial activity where South Africa is located at the global technological frontier. Sixth, South Africa’s competitive position is being undermined – both at the “lower”

manufacturing end and the "higher" end of R&D and new product development.

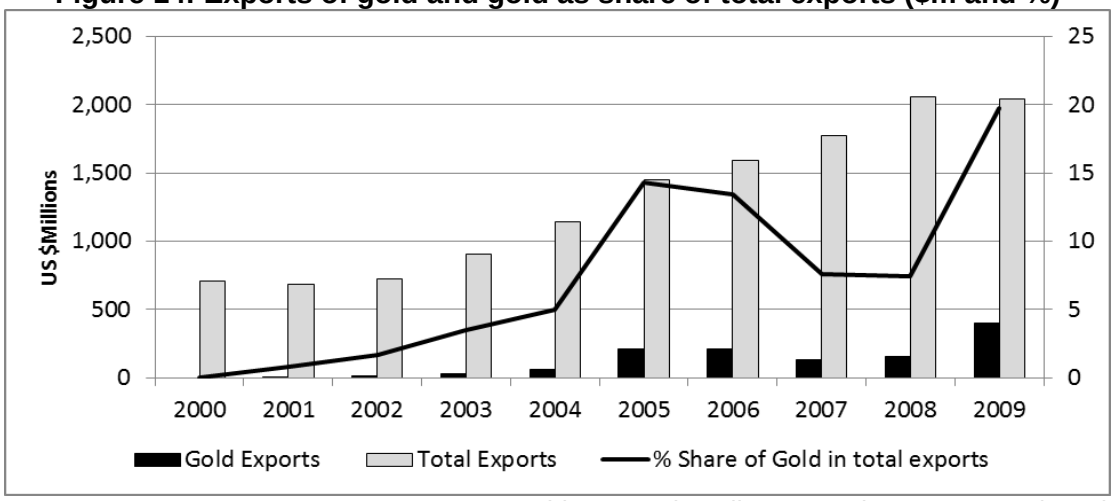
2.7 Backward linkages into the gold sector in Tanzania

Historically gold production has been dominated by a few large producers. For many years, South Africa accounted for more than 60 percent of total global production. Recent decline in its production and the rise in production in other countries have meant that in 2010, the world's largest gold producer was China, followed by the USA and then South Africa. Beyond a group of eight large gold producers (together accounting for almost one-half of the global total in 2010), are a clutch of around 90 smaller producers. Tanzania, with production capacity of 50 tonnes in 2009 fits into the second tier of producing countries, along with Argentina, Bolivia, Brazil, Chile, Colombia, Ghana Kazakhstan, Zimbabwe, Mali, Morocco, Mexico, Papua, and the Philippines

Since Independence in 1961, Tanzania has had a stuttering growth experience. For much of the 1980s and 1990s, economic growth was slow. Average annual growth between 1988 and 1993 was 1.1 percent (less than the rate of population growth), which compared poorly with that for SSA as a whole (2.7 percent). However, since the late 1990s, economic growth has revived. Between 2000 and 2010, the economy grew at an annual rate of 6.8 percent, above the average for SSA as a whole (4.6 percent).

One major factor underlying this revival in growth was the development and expansion of Tanzania's gold mining industry. Following the onset of production in 1998, there are now six active gold mines in Tanzania, and gold has emerged as the country's leading foreign exchange earner. Gold exports more than trebled between 2000 and 2010, exceeding $2bn in 2010 and accounting for more than 20 percent of total exports (Figure 14). However, the low-tax regime introduced to foster the gold industry meant that the contribution of the gold sector to total government revenue was only $46.5m in 2004-5 (the most recent year for which data is available), contributing only 1.4 percent of total government revenue.

Figure 14: Exports of gold and gold as share of total exports ($m and %)



Source: World Economic Indicators and COMTRADE (2010)

Access to the country's mineral resources which is governed by the Mining Act of 1998, was in a process of revision in 2010[9]. This 1998 legislation represented a radical departure from the 1979 Act which had previously restricted access to mineral deposits to the state. The new policy opened the mining sector to local and foreign private sector investors. It reserved two sets of activities for firms wholly-owned by Tanzanian citizens - Primary Prospecting Licences (PPL) and Primary Mining Licences (PML). However, these local firms may then sell these rights on to foreign firms at a later stage if they enter into joint ventures with local partners. Whilst licences for other activities which are issued to foreign firms require proof of both technical and financial capacity and capabilities, these requirements are not specified for wholly-locally owned firms. Section 10 of the 1998 Mining Act has provisions that allow the Minister of Minerals and Energy to negotiate and grant tax exemptions and environmental impact assessment exemptions with individual investors, without being restricted by other legal requirements. The Mining Development Agreements (MDA) is designed to provide large investors with the assurance of stability in long-term mining projects. A MDA is negotiated and granted in addition to other incentives provided to all investors, such as depreciation allowances of 100 per cent, repatriation of capital and profit directly related to mining, exemption of import duty and Value Added tax (VAT) on equipment and essential materials.

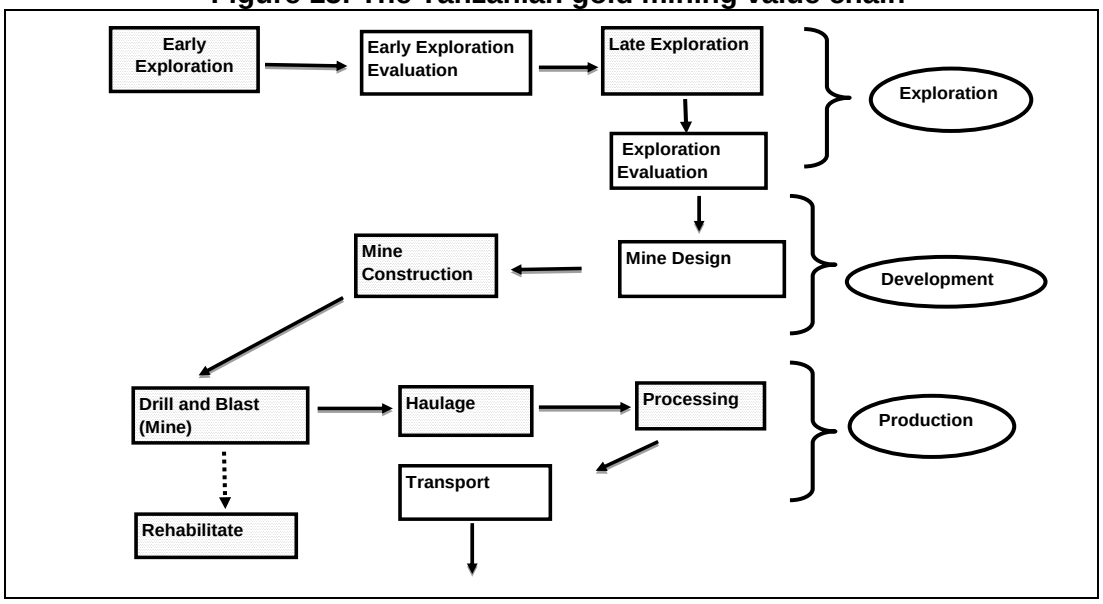
Government policy recognises the need to develop linkages into and out of the gold mining sector. However, other than the exclusive primary prospecting and mining rights granted to local citizens, there are no other elements of the legislation which target local content or which restrict the capacity of the mining firms to import their inputs.

In examining the breadth and depth of backward linkages into the Tanzanian mining sector we interviewed a range of firms across the value chain, including seven representatives from the three large-scale mining firms, four exploration firms and 12 representatives from eight suppliers to the mines. As noted earlier, however, research access in general, and the ability to collect numerical data in particular was especially difficult in Tanzania, given the heated political debate accompanying the revision of the Mining Act in 2010 when our research was conducted.

The structure of the gold mining value chain in Tanzania is shown in Figure 15. It consists of three primary sets of activities – exploration, the development and construction of the mine, and the operation of the mine. Our analysis of backward linkages focuses on linkages into the production and exploration sub-chains.

[9] This research was carried out before the Tanzanian Parliament legislated a new Mineral Act in April 2010.

Figure 15: The Tanzanian gold mining value chain



Source: Mjimba (2011)

Linkages to local provision of inputs into both these sub-chains are weak. In the exploration link of the chain, the three large-scale mining firms active in Tanzania have their own in-house greenfield exploration department. AngloGold Ashanti (AGA) has an exploration branch with head offices in Johannesburg, South Africa and its exploration team in Tanzania comprises both Tanzanian citizens and expatriate staff. A similar pattern exists for Resolute and Africa Barrick. Nevertheless, each of the large mining houses also out-sources part of their exploration activities (Table 25). Consequently there are a range of exploration firms operating locally. But with two exceptions, all of these are foreign-owned and draw their inputs from abroad (Table 26).

Table 25: Outsourced and in-house activities in exploration sub- chain

Service/Process	In-house	Outsourced
Target generation	Y	N
Area selection	Y	N
Geophysical work	N	Y
Laboratory work	N	Y
Quality assurance and quality control	Y	N
Drawing up contracts	Y	N
Reserve estimation	Y	N
Logistics	N	Y
Data capture and processing	Y	N
Drilling	N	Y

Source: Mjimba (2011)

Table 26: Gold exploration firms active in Tanzania.

Firm	Head quarters	Ownership structure (shares)		Service scope	Works location in Tanzania
Canaco Resources	Canada	0	100	Junior explorer	Magambazi
Zari Exploration	Tanzania	Majority	Minority	Junior explorer	Imweru and Lupa
Curries Rose Resources	Canada	0	100	Junior gold explorer	SusiRiver and Mabele Hills
Shanta Gold	Guernsey	0	100	Gold exploration and development	Lupa gold field, Mgusu and Singida
Kibo Mining plc	Republic of Ireland	0	100	Gold and Nickel deposit exploration and development	Itetemia, Luhala and Morogoro
Helio Resources Corporation	Canada	0	100	Junior gold explorer	Saza and Makongolisi
Sub-Saharan Resources N.L.	Australia	0	100	Mineral exploration and development	Nyanzaga
Macquarie Harbour Mining Limited	Australia	0	100	Mineral exploration	Miyabi and Igurubi
African Eagle Resources Corp	United Kingdom	0	100	Mineral exploration and development	Miyabi
Peak Resources	Australia	0	100	Mineral exploration and development	Imweru
MDN Exploration	Canada	0	100	Gold and base metal Exploration and development	Ikungu, Isambara, Mnekezi, Vinyoza and Msasa projects
Tan-Zoz Exploration	Tanzania	Majority	Minority	Junior explorer	Not indicated
Gold Finders	Tanzania	100	0	Junior explorer	Not indicated
Tanzimex	Tanzania	100	0	Junior explorer	Kinyambwiga

There are a limited number of local linkages from these first-tier exploration firms to second-tier suppliers. The linkages are limited to relatively simple geophysical and geochemical exploration works such as ground based magnetic surveys and exploration, drilling; and general services such exploration logistic services,

Source: Mjimba (2011)

The structure of suppliers providing geochemical services – that is the collection and analysis of rock samples – is somewhat different in that three sets of activities are also provided by state-owned Tanzanian firms (Table 27). These are the Geological Survey of Tanzania (GST) (which engages in geological mapping, surveys and analysis), and STAMICO and SEAMIC (both providing drilling services). These three locally owned providers have been operating for many years and reflect the pre-1997 environment in which the state had exclusive control over the gold mining industry.

Table 27: Exploration geochemical works goods/services providers in Tanzania

Firm	Head Office	Service scope	Ownership structure (shares)		
			Local	Foreign	Public
GST	Tanzania	Geological mapping, geophysical and geophysical surveys and analysis	100	0	100
STAMICO	Tanzania	Drilling (scope and range not ascertained), mineral exploration and property consultancy and Joint Venturing	100	0	100
SEAMIC	Tanzania	Geological mapping, geochemical and geophysical surveys and analysis	100	0	100
Tan Zoz	Tanzania	Drilling (scope not ascertained)	Majority	Minority	0
Gold Finders	Tanzania	Stream sediment, soil and rock chip sampling	100	0	0
Capital Drilling	Singapore	Surface diamond core, high air capacity, reverse circular, grade control, heli-portable diamond, deep directional core orientation, air core, geotechnical, coal and coal-bed methane drilling services.	0	100	0
Layne Drilling Tanzania (formerly Stanley Mining Services)	Australia	Rotary air blast (RBA), kit bit, reverse circulation, diamond, directional and grade control drilling services.	0	100	0
Africa Mining Services (Owned by Ausdrill	Australia	Reverse circulation, surface diamond, directional, RBA and air core drilling services	0	100	0
Major Drilling	Canada	Surface and underground coring, directional, reverse circulation, geotechnical coal and coal-bed methane drilling services	0	100	0
ALX Chemex	Australia	Sample preparation and analysis	0	100	0
SGS Laboratories	Italy	Sample preparation, analysis and turnkey surveys	0	100	0

Source: Mjimba (2011)

Local content in the geochemical services link in the exploration sub-chain is very low and is largely limited to local labour inputs. For example, all drilling equipment and components used in Tanzania are imported without any local value addition. The maintenance of the machinery is effectively a closed system with the drilling firms dealing directly with machinery and spare manufactures who service their global operations. Two such firms with worldwide operations supplying drilling machinery and spares are Atlas Copco and Sandvik Mining and Construction. Both have established subsidiaries in Tanzania to service equipment used in the large mines. Typically, they source specialised skills from their global labour force rather than from Tanzania. Local sourcing of manufactured inputs is only at an embryonic stage. For example, containers for rock samples (which have to be made of inert and durable materials) are imported from South Africa and Australia. In 2010, local suppliers began producing these containers in small volumes.

The exploration sub-chain also draws on geophysical services (Table 28). Here, too, foreign-owned firms dominate and almost exclusively draw their skills form their global labour pool rather than from Tanzania. There is, however, one locally-owned firm which participates in this sub-sector, providing ground-based magnetometer surveys.

Table 28: Geophysical work service providers active in Tanzania

Firm	Head Office	Service scope	Ownership structure share	
			Local	Foreign
Fugro Airborne Survey	South Africa	Airborne geophysical surveys	0	100
Geophysics GPR	Zimbabwe	Ground based geophysical surveys	0	100
Geoimage	Australia	Satellite imagery and geo-spatial solution provider (Quick bird images)	0	100
Jigsaw Geosciences	Australia	Geological mapping	0	100
UTS Geophysics	Australia	Airborne magnetic surveys	0	100
Gold Finders	Tanzania	Ground magnetometer surveys	100	0

Source: Mjimba (2011)

A similar story of very limited local purchases emerges in the case of the production link in the gold value chain. The major local purchase is of liquid fuel required for the heavy drilling and earthmoving equipment used in gold mining. Liquid fuel is imported and reaches the mines at great cost due to the poor quality of infrastructure. A group procurement manager illustrating the point observed that;

> '*If you think about your Caterpillar truck,… … your average fuel consumption* [during typical mining operations] *is about between 95 litres to 100 litres per hour and you can work it out if you have 30 trucks, 24 hours a day , 360 days a year.. …… that excludes the loaders.'* (Interview, November 2009).

The maintenance and repair of the heavy equipment which is utilised in the mine is generally outsourced, but to the global firms which supply this equipment for the global operations of the mining companies. Caterpillar operates as Mantrac with local branches in Dar es Salaam, Mwanza, Tanga and Moshi. The firm offers a range of comprehensive repair and maintenance contracts to the mining (and other) sectors. The Mwanza workshop services the country's gold mining sectors. Komatsu operates as Pan African Mining Services Tanzania Limited, with maintenance and repair contracts with individual mines. There were almost no changes in this sourcing structure between 2005 and 2009 for a range of goods reflecting varying degrees of technological content (Mjimba, 2011). These data are also interesting since they shows the heavy presence of South African and Australian suppliers. Both countries have developed mining industries and have, over the years, seen the emergence of significant backward linkages.

2.8 Linkages into the copper sector in Zambia

Zambia has a long history of copper mining, dating back to the early twentieth century. Soon after independence in 1964, the copper mines were nationalised, and later consolidated into the Zambia Consolidated Copper Mines (ZCCM), majority-owned by Government (60 percent of equity), with a minority share owned by Anglo American Corporation (27.3 percent). Copper mining generated the bulk of government revenues in the early post-independence period. From the mid-1970s, Zambia's copper mining sector came under mounting pressures from plummeting world prices and low levels of re-investment. Consequently, production levels fell sharply.

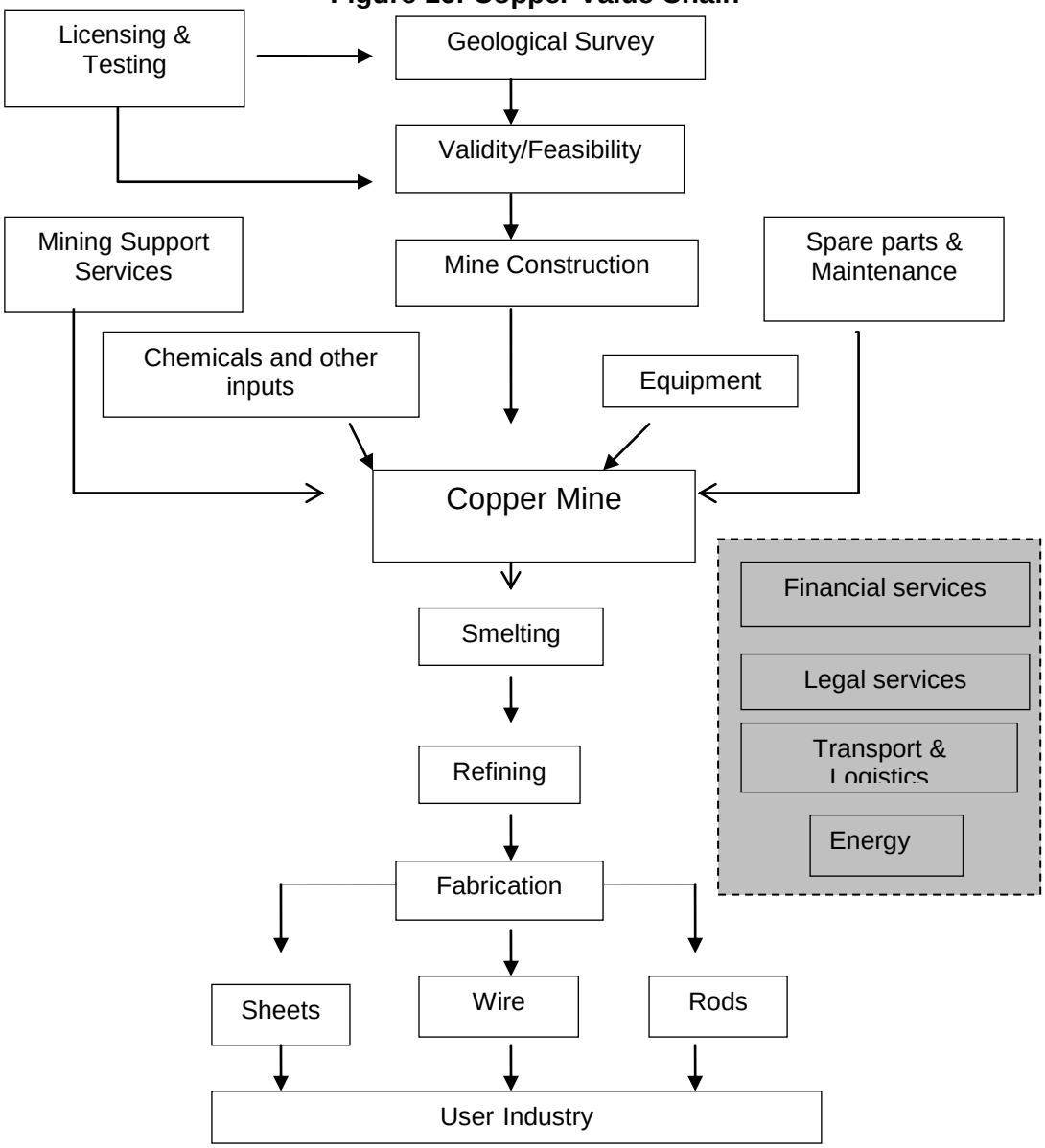
The Structural Adjustment Programmes (SAP) introduced in Zambia during the 1990s resulted in the gradual privatisation of the mines, a process all but completed by 2001. Policies towards the mines were subsumed under the general provision of the SAPs, and no specific mining vision was adopted, either during the SAPs or subsequently. Inter alia, as a consequence of the absence of a vision towards the mining sector, there are currently no provisions in any of the legislation which explicitly target backward linkages and local content. Only the bilateral Development Agreements with each mining company envisaged an effort from the mine to use local suppliers, but these were not legally binding commitments.

In 2009, Zambia was the largest African and the 7th largest global copper producer, accounting for 3.3 percent of global output. Reserves are such that even without new discoveries, copper mining can continue at current rates for 60 years. In 2000, Zambia's copper exports were valued at $474m, but a combination of increasing production and rising prices resulted in export receipts rising rapidly to almost $4bn in 2009. In recent years copper has accounted for between 74 and 83 percent of Zambia's total exports, and for 9.1 percent of GDP in 2009. However, as a consequence of the liberal fiscal regime accompanying privatisation, virtually none of the resource rents accruing from copper mining in Zambia have gone to the government. That is, whereas copper mining had contributed an average of 45 percent of government revenues between 1965 and 1975, it made virtually no direct contribution to government revenues during the post- 2002 price boom (Bova, 2009). The low revenue stream was due to the very generous fiscal regime included in the bilateral development agreements. Moreover alleged transfer pricing, whereby copper was sold by the mining companies to their subsidiaries at prices well below market prices, further lowered the corporate taxable basis. (Al Jazeera, 18 June 2011).

There is considerable breadth to both forward and backward linkages in Zambia's copper value chain (Figure 16). Focusing on forward linkages, copper is mostly exported in refined form, representing a number of value added stages after mining (cathodes) (Figure 17). In recent years there has been substantial investment to increase productive capacity in downstream processing, including the construction of two new smelters (one of $310m by a Chinese firm, and a smaller investment by an Indian firm). In addition a Swiss-Canadian firm invested $190m to expand an existing smelter to 850,000 tons per annum, making this the largest copper smelter in Africa and

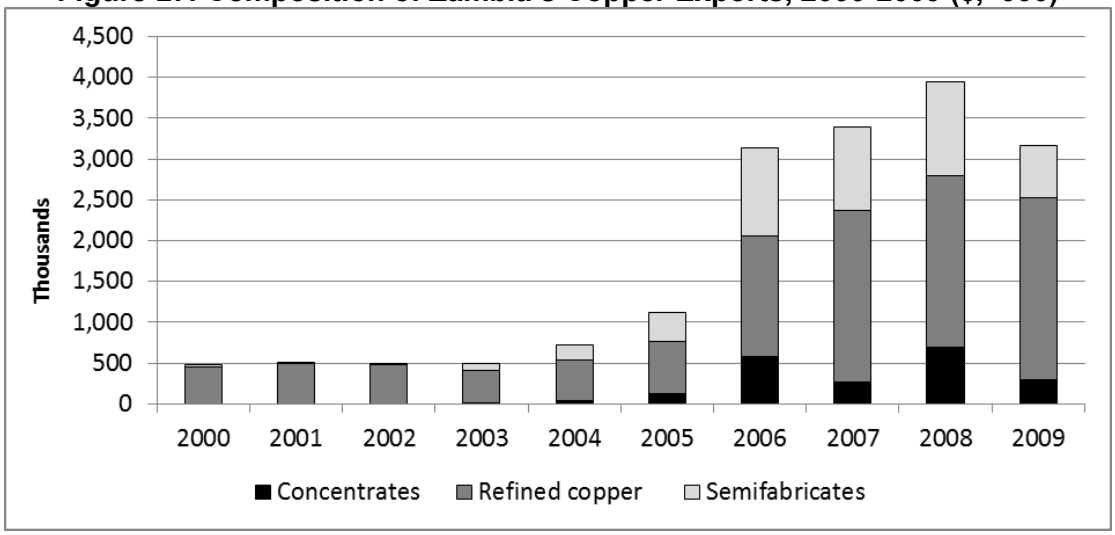
the fifth-largest in the world. Further downstream processing into semi-fabricates takes place, but this linkage is thin. Semi-fabricates represents the first stage of processing for refined copper, and feed into the construction and manufacturing sectors. Zambian exports of semi-fabricates include copper plates, sheets and strips, and copper wire, and export values increased substantially over the years, though official figures are inconsistent.[10]

Figure 16: Copper Value Chain



[10] COMTRADE, which sources data from the revenue and customs authority, records exports of engineering products totalling more than $1bn in 2008. For the same year, Zambia Development Agency data record exports of only $210.5m, This latter (and lower) figure) is almost certainly more reliable as it is directly sourced from the company.

Figure 17: Composition of Zambia's Copper Exports, 2000-2009 ($, '000)



Notes: concentrates includes ores, concentrates, unrefined. Source: COMTRADE

This downstream processing of copper ore is currently almost exclusively undertaken by one company, which is a subsidiary of a large American metal processing conglomerate. It is important to note that as a sectoral characteristic, competitiveness in semi-fabricates manufacturing is not typically determined by proximity to the mines, but by labour cost and access to infrastructure. Semi-fabricates manufacturing, therefore, faces the same, substantial challenges that the manufacturing sector suffers in Zambia in general. However an on-going $800m investment by a Chinese firm in the Chambishi Multi-Facility Economic Zone will deepen forward linkages by building large-scale semi-fabricates manufacturing capacity.

There have also been substantial backward linkages to the mining sector. From data supplied by the Kitwe Chamber of Commerce and Industry and the mining companies it is possible to estimate the total population of suppliers to be around 200 firms. (Of these, 50 were interviewed, in addition to eight of the 14 large and small-scale mines). This estimate comprises established formal-sector industrial suppliers. Before the late 2000s, there were also a number of informal traders, but many of these exited the industry (see below).

The breadth of linkages from the mines, particularly the larger mines, is significant. Large mines procure between 60 percent and 86 percent of inputs from the local supply chain, whereas small mines procure between 35 percent and 80 percent (Table 29). This procurement reflects the purchase of goods and services required for the operation of the mines, rather than for their construction. The smaller mines are less mechanised and mainly consist of small, open-pit operations. Therefore their demand for specialised capital equipment such as hydraulic equipment, pumps and valves, is low but the degree of local sourcing figures is high because, rather than importing equipment and spares, small-scale mines often hire equipment from local firms.

Table 29: Local sourcing as % of total spending among selected mining companies

	Share of local sourcing
Large-scale mine A	82%
Large-scale mine B	86%
Medium-scale mine C	60%
Small-scale mine D	Equipment and spares: • 10% purchased from local suppliers • 90% directly imported Consumables: • 60% purchased from local suppliers • 40% directly imported
Small-scale mine E	Production costs are disaggregated as follows: • 80% on equipment and consumables – purchased from local suppliers • 10% food • 10% labour
Small-scale mine F	Supply chain: • 25% is directly imported (mainly spares) • 75% purchased from local suppliers (but 70% are purchased from importers)
Small-scale mine G	Supply chain: • 80% purchased from local suppliers • 20% directly imported

Source**:** Fessehaie (2011)

The first-tier suppliers, who are mostly based in the Copperbelt, fall into three categories. The first are manufacturing firms producing a wide range of inputs, such as metallurgical, plastic and rubber products, engineering products, paints and foundries. In 2010, there were less than 40 of these firms operating. With the exception of one large steel foundry, they are relatively small-sized. The local value added content of these suppliers tended to be substantial, but most of the firms in this category are finding it increasingly difficult to compete with imports from South Africa and China. In 2010, for example, two engineering companies and two foundries were exiting or had just exited the mining supply chain.

The second group are medium and large-scale services providers, predominantly subsidiaries of TNC OEMs, large distributors and representatives of specialised, capital-intensive firms (such as drilling companies and providers of specialised transport). Value added amongst this set of suppliers is significantly lower than among the manufacturing firms, but some of them operated in skills-intensive sectors, such as specialised engineering services. Approximately 150 firms operate in this category, and most are competitive and profitable enterprises, with their services being highly valued by the buyers.

In addition to these formal-sector suppliers (approximately 40 local manufacturing firms and 150 TNC OEM subsidiaries) there is a third and more numerous category of very small scale suppliers, with very low levels of local content. Most of the few hundred firms in this category - characterised by low entry and exit barriers - are widely referred to as “briefcase businessmen”

because they operated ‘out of a briefcase’. They engage in small scale importation of supplies, often securing contracts in an illicit manner and with no value added in after-sale services. After the 2008 copper price crisis, most of the copper mines restructured their supply chains, and eliminated these largely inefficient suppliers, drastically reducing their number. However, not all of these suppliers are informal and transient. Some agents and distributors provide stockholding and back-up services, often developing agreements with sole manufacturers abroad and slowly graduating into sole distributors. but as in the case of the “suitcase businessmen”, other than importation and stockholding, no value is added to the chain.

Although the local acquisition of inputs represents a substantial spend by the mines. this needs some qualification. First, in some cases, the level of outsourcing is illusory, since as in the case of the “briefcase businessmen”, the suppliers are merely importing intermediaries. Second, the level of outsourcing has fallen in recent years, as mining firms have internalised activities which were previously bought-in. For example, one mine had outsourced the maintenance and operation of loaders, but weak local capabilities and the criticality of these operations led to the vertical re-integration of this activity. Third, Chinese and Indian firms, who are the latest investors, have a shorter history of supply chain management and therefore tended to outsource a smaller proportion of their input needs. For example, the Chinese mining houses developed in-house engineering, electrical and mechanical services and built a foundry. Moreover, when one of the largest OEMs downsized its workforce due to the economic crisis, the Indian mine employed the skilled workforce and built in-house capabilities in its own mine.

A key factor leading to the thinning out of the Zambian supply chain was the privatisation of the mines. This dramatically changed the rules of the game. The new mines previously owned by TNCs with long experience in mining, required efficient supply chains, operating at the technological frontier and within acceptable costs and lead times. They were not legally bound to maximise local outsourcing, and they operated in a period in which they had to undertake large expenditures to re-capitalise the mines, despite the fact that copper prices were low during this period. In these circumstances, buyers shifted from local suppliers to cheaper imports, especially from South Africa, but also from Europe, Canada and Australia. Within the supply chain, major changes took place. Local manufacturers had to compete with foreign investors locating production, or often only distribution facilities in Zambia, as well as with imports. Lacking, amongst other things the technological capabilities and economies of scale of competitors, and no longer protected by high import tariffs, they found it increasingly difficult to compete with the quality and prices of foreign suppliers. Consequently, in the early 2000s, manufacturers were exiting the mining supply chain, replaced by services providers, both Zambian and foreign-owned. Only a fraction of the latter engaged in value-added services. Moreover, and as part of a global trend, many first-tier OEM suppliers established a direct presence in the Copperbelt, in order to tighten control over the quality of the goods and services provided to the mines, and to increase revenues streams from highly-profitable after-sale services (Table 30).

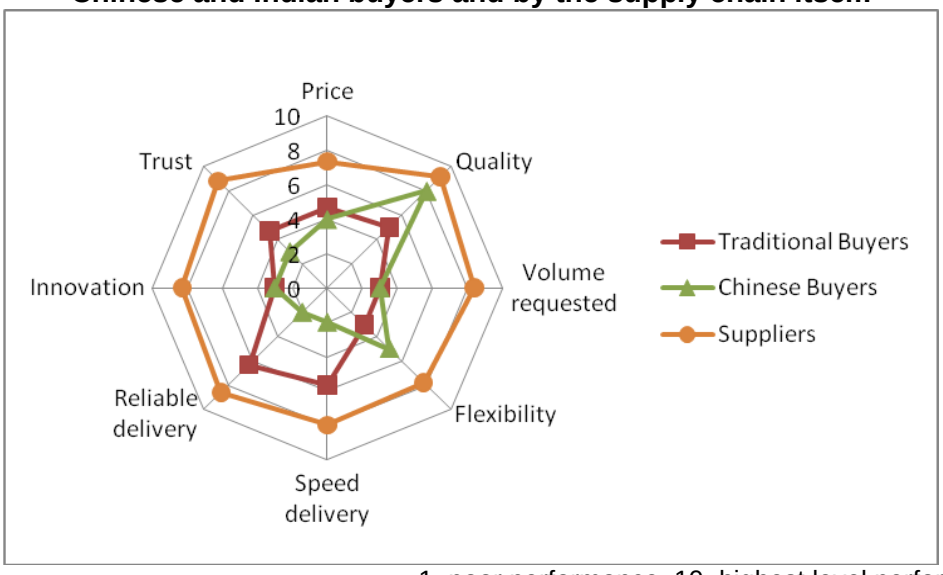
Table 30: Key participants in the copper mining supply chain

During nationalisation	Post-privatisation
Large number of state-owned and privately-owned manufacturers (providing specialised mining components, spares and consumables	Importers. A large number of briefcase businessmen (now disappearing),agents and distributors. of components, spares and consumables)
Independent agents and distributors of capital equipment (some locally owned)	OEMs subsidiaries (only distribution and after-sale services)
Specialised services providers	Specialised services providers
Some OEMs with manufacturing capabilities, for capital equipment	Privately-owned manufacturers, mostly Zambian-owned (providing consumables and protective equipment)

Note: In term of the category of firms dominating the supply chain (in numbers)
Source**:** Fessehaie (2011)

The diminishing capability of local suppliers in the context of the rising technological complexity of mining is reflected in the judgements of two sets of buyers – the "Northern/traditional" investors (including South African buyers) and the new emerging country investors from China and India. These different groups of buyers rate the capabilities of local suppliers differentially (Figure 18). The "Northern" buyers have over the years established relationships with their supply chains which have led them to identify, and work with a relatively stable set of suppliers. By contrast the newer entrants tended to have more arms-length relationships with their suppliers and to have less confidence in their capabilities. The Chinese, and particularly the Indian, mines tended to place more emphasis on price in their negotiations with suppliers. It is notable, and this reflects international experience in environments of immature supply chains, that the suppliers had a much higher confidence in their capabilities than did the buyers.

Figure 18: Comparative rating of supplier capabilities by traditional buyers, Chinese and Indian buyers and by the supply chain itself.



1=poor performance, 10=highest level performance
Source**:** Fessehaie (2011)

3. DRIVERS OF LINKAGES

One of the central contentions of our earlier conceptual analysis (MMCP DP 12) was that the prevailing view that there were few linkages from the commodities sector was inaccurate. We also postulated that there would be a trajectory of increasing linkages as a consequence of market forces as lead commodity firms outsourced non-core activities. Moreover, we hypothesised that the breadth and depth of linkages and the speed of linkage growth would be a function of the sector, the capabilities in the economy, scale, and the passage of time. The small sample of sector and country studies and the limited availability of data means that these contentions cannot be verified statistically. Instead the analysis employed here is largely qualitative in nature, and therefore the assessment on the extent of linkages and their trajectory, the impact of specific drivers of linkages and the interaction between these drivers will inevitably be a question of judgement. This qualitative assessment of the depth, breadth and trajectory of linkages in the eight country studies is presented in Table 31.

A range of experiences can be identified from our case-studies. Beginning with the breadth and depth of linkages, at the one extreme lie Angola, Botswana and Tanzania. In each of these countries linkages are very thin, although there seems to be a more positive trajectory in Angola and Botswana than in Tanzania. At the other extreme is South Africa, where there is a very broad spectrum of linkages, with considerable depth, in some cases of a globally-leading character. There are also, less substantial, but well developed linkages in Zambia, Nigeria and Gabon.

Table 31: Summary of findings on the breadth, depth and trajectory in linkages from commodities to other sectors in eight SSA economies.

Country	Sector	Linkage type	Establishment Period of the Commodity Sector	Breadth of linkage	Depth of linkage	Horizontal linkages	Trajectory of linkages
Angola	Offshore-oil	Backward	Mid 1990s	Thin	Thin (labour only)	None	Increasing depth
Botswana	Diamonds	Forward	1960s	Thin	Thin (labour only	None	Increasing depth
Gabon	Timber	Forward	Early 1960s	Thick	Transformation of commodities	None	Resistance to shallowing
Ghana	Gold	Backward	late 19th Century	Beyond thin	Some transformation and knowledge intensive services	Not known, but probable	Increasing breadth and depth
Nigeria	Oil	Backward	1950s	Approaching thick	Knowledge intensive services	Not known, but probable	Increasing breadth and depth
South Africa	Mining capital equipment and specialist services	Backward	1880s	Thick	Transformation of commodities and knowledge intensive services	Substantial	Shallowing
Tanzania	Gold	Backward	1998	Thin	Thin	Unlikely	Static
Zambia	Copper	Backward	Early 20th Century	Approaching thick, but diminishing	Approaching thick, but diminishing		Shallowing

It is notable that linkages were often limited, and the extent of the depth was thinner than the breadth of linkages. In Angola, Botswana and Tanzania, the only effective addition to value was the labour content, although in two of these countries (Angola and Botswana) there was an increasing depth to these skills. In South Africa and Nigeria there is also evidence of horizontal linkages, that is, competencies developed in meeting the needs of the resource sector are also applied to meet the needs of other sectors.

As will be shown in Section 4 below, there are a variety of factors which explain these linkages, but the duration of commodity exploitation emerges strongly as an explanatory factor in this summary table. South Africa, where large-scale mineral exploitation stretches back for more than a century is a clear indicator of this at one extreme. The depth and breadth of linkages in Zambia and Nigeria (particularly when contrasted with the pattern of linkages in the same sector in Angola) also shows a positive association with time, as does the pattern of linkage in the gold sectors of Ghana and Tanzania. Gabon, too, reflects the deepening of linkages over time. On the other hand, despite the diamond industry having a fifty year history in Botswana, linkages only really began to develop after 2005.

One of the contentions emerging from the review of the linkage literature was that backward linkages hold more potential than forward linkages, particularly in the hard and energy commodities sectors. However, the small sample of studies does not make it possible to draw a robust conclusion on this issue.

Finally, the trajectory of linkages was not always positive. In some countries – Angola, Botswana, Ghana and Nigeria - there are signs of linkage growth. By contrast, in other countries the degree of linkages is static. This is the case for Tanzania as well as in Gabon where the tendency for linkages to become shallower has only been arrested due to government fiats limiting the export of logs. In the two most advanced cases of linkages – South Africa and Zambia – there is evidence of a shallowing of linkages.

In analysing the determinants of this linkage development, we seek to go beyond the observation that, as a broad general rule, the breadth and depth of linkages will be a function of time. Other factors will affect the extent of input provision and use of outputs, the value added during the course of these linkages and the direction and pace of linkage development. Four primary explanatory factors emerge from our detailed sectoral enquiry, namely

1) The nature of ownership of lead-commodity firms, and their suppliers and customers
2) The nature and quality of infrastructure
3) Capabilities, skills and the National System of Innovation
4) Policy development, management and implementation

In addition to these four core determinants of linkages we also explored the impact of proximity to a regional hub as a facilitator or blocker of linkage development. However, outside of a few isolated cases, this did not surface as a significant influence on the breadth and depth of linkages.

3.1 The nature of ownership of lead commodity producers, and their suppliers and user customers

The firm is a heterogeneous entity, and although each firm is individual with particular competences and business strategies, there are important structural features which influence the behaviour of firms in general, and with regard to linkage development in particular. In our research we hypothesised that a key differentiating factor in firm behaviour was ownership. In pursuing this issue, we distinguish between three different ownership attributes. The first of these is whether the firm is locally incorporated or of foreign origin. The widely held view is that locally-owned firms are more deeply embedded in the local economy, have greater familiarity with local suppliers and customers, know their way around the institutional infrastructure and, crucially, that they are more committed to local development than footloose, foreign-owned firms. Each of these characteristics has a potential effect on linkages, with the likely outcome that locally-incorporated firms are more prone to participate in linkage-intensive chains.

Second, a subsidiary component of the nationality of ownership is that as a reflection of their particular country of origin, foreign-owned firms may behave differently with regard to linkages. For example, the nature of equity markets in the home countries may predispose firms to operate with particular time horizons and attitudes to risk. Thus, it is argued that Chinese firms, with greater access to patient capital, with higher internal savings rates and being "guided" by the central and provincial governments, are more likely to be involved in the slow process of supplier development than are their northern competitors (Farooki and Kaplinsky, 2011). They are also likely to be backed, at least in the African case, by support from the Chinese government which is engaged in the construction of industrial processing zones in a number of African countries[11].

Third, and beyond the nationality of ownership are a series of firm-specific attributes. The importance of this factor was prefigured by theories of imperfect competition in the 1930s (Chamberlin, 1933) and developed further by Hymer (1976). Subsequently Dunning built on these firm-specific attributes in his widely-used eclectic framework for explaining foreign direct investment (FDI). Dunning (2000) argued that whilst FDI was a reflection of country-specific factors (reflecting particular endowments) and the decision by the firm on which competences to internalise, it also reflected the specific attributes of individual firms. (Dunning's eclectic theory is widely referred to as the OLI framework – **O**wnership, **L**ocation and **I**nternalisation as determinants of FDI). Thus, individual firms act in very different ways even though they operate in the same industry and same environment. This individual behaviour will reflect a number of conditioning factors, including their pioneering or follower character in the industry, their particular bundle of competences and the strategic visions of their leadership.

[11]China's Ministry of Commerce (MOFCOM) is supporting the development of six (possibly seven) economic and trade cooperation zones in Zambia, Egypt, Nigeria, Sierra Leone, Mauritius, Uganda and Ethiopia.

The relative importance on linkage development of these three ownership factors – foreign/national, origin of home country and firm-specific attributes – will vary as to how they impact four different actors in the chain. The first of these are their influence on buyers in the chain. There is considerable evidence that buyers play a crucial role in the extent and nature of outsourcing in global value chains (Gereffi, 1994; Kaplinsky and Morris, 2001). The second concerns the ownership character of the lead commodity producing firms, the companies which mine minerals, extract oil and grow the major soft industrial commodities. The third reflects the influence of ownership on suppliers to lead-commodity firms, and the fourth is the influence of ownership on the users of commodities.

The various country and sectoral studies we have undertaken evidence the relevance of these factors in different ways. The evidence is partial (for reasons discussed above) and the interaction between these factors varies across sectors and countries. Nevertheless, it is possible to draw on various studies to illustrate the influence of ownership of linkage development.

Foreign ownership of lead commodity firms as a determinant of linkages
With the exception of South Africa, in none of the other seven economies under investigation were there locally-owned lead commodity firms with international operations. This has an important bearing on linkages, since firms operating in a global environment have invariably learned to introduce structured programmes of supply chain development as part of their purchasing function. TNC lead commodity producers in Zambia, Ghana and Nigeria all reported that they had supply chain development programmes in keeping with their global practice.

However, two factors undermine this policy commitment by TNCs to supply chain development. The first is that as a consequence of lead commodity producers committing themselves globally to long-term trust-intensive relationships with their suppliers, they have adopted a global-sourcing-follower-supply policy (Barnes, Kaplinsky and Morris, 2004). This requires first-tier suppliers (and often, as first-tier suppliers replicate this commitment, to second-tier suppliers as well) to locate their operations in close proximity to the lead-purchaser in all its global operations. This motivates local supply, but not by local firms. And, second, firms with global operations tend to recruit purchasing managers from abroad. Particularly when these managers are working in remote and hostile environments, they have little feel for local conditions. Typically they will work on an eight-week-on-two-week-off rota. The first week of this involves settling down, and the last week preparing for their return home, leaving only a narrow window in which they can develop relations with local suppliers. Moreover, a consequence of the large groupings of expatriates living together in remote sites where they have little or no knowledge of the local economy, there is a sense of segregation. This often leads to an antipathy towards anything local, which translates into scepticism about the abilities of local employees and potential suppliers. Further, many purchasing officers are monitored by their ability to deliver within budget and within agreed time scales. Moving to new suppliers is a move into the unknown and there are potentially negative effects on performance.

An example drawn from the Tanzanian gold mining sector exemplifies these problems. The TNC has declared a strong global commitment to local sourcing and an equally strong commitment to this in their Tanzanian operations. However, the reality is often rather different, due to the “sociology of purchasing” rather than to duplicitous statements by senior management. Local suppliers find that the purchasing systems which are used and mandated by Head Office are too cumbersome. There is a great deal of paperwork, and the timescales allocated to supply once a Purchase Order has been issued are unrealistic. Typically, payment of invoices takes over 60 days, which is often too large a financial exposure for local suppliers to cope with, particularly when they are small scale firms and inflation is high. Moreover, many potential suppliers reported that they had experienced corrupt practices in the purchasing department of this mine (which, in 2011 had to close for some months due to its own staff stealing its fuel supplies!).

By contrast, the TNC oil companies in Nigeria have been operating for some time, and have been subject to intense and prolonged criticism in their home countries on the lack of spill-over in their Nigerian operations. As part of their response to these criticisms, they have introduced structured supply chain development programmes. As was shown in the discussion of the depth and breadth of linkages above, this has resulted in frequent and often close contact with suppliers, and rapidly deepening local content. It is notable that in both of these cases, the nature and extent of linkages are a direct function of the foreign ownership of these lead commodity producers.

Reflecting the political pressures which have built up to promote linkages, - both in the host and home countries - many of the lead mining companies have instituted local procurement as part of their Corporate Social Responsibility (CSR) programmes. In 2002 the Ghana Mining Council mandated all mining companies to adopt CSR programmes to assist their host communities (Tememg and Abew 2009).The resulting CSR initiatives have not only improved mining company-host community relationships, but more importantly, have provided critically needed social and physical infrastructure which otherwise lay within the mandate of local and central (state) governments. CSR programmes promoting local supply have also been introduced by mining companies in Tanzania, and it is CSR rather than efficient mine operations which seems to be driving what limited local sourcing exists, particularly that involving near-sourcing.

In Angola, it is the national ownership of the lead oil extracting firm which explains the growth of backward linkages. Sonangol, the state-owned company which dominates the oil sector, is explicitly tasked with promoting backward linkages. As a consequence of this commitment it initiated, and is a 50-50 partner in a joint venture supplying control-lines to the sub-sea oil sector, an enterprise which is beginning to go beyond assembly to include the transformation of materials into the final product.

Foreign ownership of supplier firms as a determinant of linkages

Moving beyond ownership of lead commodity firms, the nationality of

ownership also surfaces as a factor affecting the capacity of suppliers to respond to the opportunities for local sourcing. Almost 80 percent of the suppliers in the Nigerian oil services sector are nationally-owned, and a further 6 percent were joint ventures with foreign firms (Table 32).

Table 32: Ownership characteristics of oil service suppliers in Nigeria

Characteristics	Control system & ICT	Fabrication & construction	Well construction & completion	Other sector	Total
Ownership Status					
nationals only	84.2	86.4	70.6	100	78.8
multinational	21.1	9.1	17.6	-	15
joint ventures	-	4.5	11.8	-	6.3
Year Of Registration					
1970 - 1980	-	4.5	17.6	-	8.80
1981 - 1990	21.1	31.8	14.7	40	22.5
1991 - 2000	5.8	18.2	8.8	20	13.8
2001 till date	36.8	18.2	26.5	20	26.3
not indicated	26.3	27.3	32.4	20	28.8
Company Listed					
yes	21.1	13.6	17.6	-	16.3
no	78.9	86.4	82.4	100	83.8
Educational Status of Major Owner					
none	-	-	-	-	-
secondary (O/A levels)	-	9.1	-	-	2.5
diploma	15.8	9.1	5.9	-	8.75
degrees	84.2	81.8	94.1	100	88.8

Source: Oyejide and Adewuyi (2011)

Two sub-sectors - fabrication and construction, and well construction and completion - had the highest degrees of national ownership, mostly established before the 1990s. Control system and ICT showed the highest presence of multinationals. Very few of the national suppliers were listed and almost all the major owners had university degrees. Hence, even though the Nigerian legislation on local content does not specify local ownership, *de facto* most of the suppliers in these sub-sectors are owned by local entrepreneurs. Accompanying policies to increase access to capital and create mid- and high- level skills enabled locally-owned enterprises to enter these supply links,

The origin of foreign ownership as a determinant of linkages

There are clear indications that the origin of foreign ownership has an important bearing on linkages, particularly in the case of the Chinese, Indian and Brazilian firms who have become recent investors in Africa's resource sectors. This difference emerges both with respect to the ownership of production facilities and in regard to the role of different nationalities of buyers. We begin with the production side of this equation.

The ownership structure of the Zambia mining sector is diversified and includes Northern (Canadian, Australian and European), South African, Chinese and Indian mining companies. The national origins of these companies helped to shape value chain governance, and in so doing, affect the incorporation of local suppliers in these chains. The origin of foreign ownership mattered in three ways. First, China's policy towards outward FDI –

the “going-out policy” – shaped the strategic behaviour of Chinese mining firms, which tended to be less risk averse and more countercyclical in nature than their northern counterparts (Buckley *et al.*, 2007; Cheung and Qian, 2009; Davies, 2009; Yao *et al.*, 2010; Ren *et al.,* 2010). Thus, while global FDI flows fell in 2008 and 2009 and northern FDI in Zambia’s mining sector stagnated, the Chinese mining companies in Zambia responded counter-cyclically. Backed by soft budget constraints and strategic intent to command access to resources, not only did Chinese mining firms expand their presence in Zambia, but at the same time, and backed by Chinese aid, a large industrial park was established as a future base for suppliers into the mines. During the same period, the Northern-owned mines sought to cut costs rather than to increase capacity, and in the process, reorganised their supply chains. Only the Chinese and South African mines did not cut production, investment and development projects. Nor did they retrench workers.

A second indicator of home-country ownership determinants was that whilst the Northern-TNC firms worked independently of government and saw supply chain development as part of their corporate agenda, Chinese buyers relied heavily on Government-to-Government intermediation to promote linkages. On the one hand this is leading to the construction of a $800m industrial zone designed in part to promote supplier development to the mines. On the other hand, the Chinese firms focused less than their northern partners on the development of supply chain development capabilities in their purchasing departments.

Third, Chinese, Indian and Northern mines differed in the governance of their supply chains. In general, Northern and South African buyers actively sought to outsource activities outside of their core competences. By contrast, Chinese and Indian buyers were more reluctant to do so. When they did, and when local firms did not meet their expectations, instead of promoting capabilities in their suppliers, they tended to bring back and internalise these supplies. Partly as a consequence, or perhaps also as a partial cause, of this greater self-reliance Chinese and Indian buyers were less embedded in the local business community (Table 33). What this meant was that whereas the entry barriers were high for supplies participating in value chains governed by the traditional northern TNCs, once they were in these chains, contact was relatively frequent and the support provided by the buyers helped the suppliers to upgrade their capabilities. By contrast, entry barriers for local suppliers into Chinese and Indian firm governed value chains were low, but exit was frequent and minimal support was provided to suppliers. There was also a difference in the behaviour of Chinese and Indian firms, with the former more anxious to promote long-term relations with suppliers, and to build relations of trust. The Indian mining house was disproportionately focused on the price of its inputs rather than on quality.

Table 33: Selection of new entrants in the supply chain

Supply chain	Main selection criteria	Secondary selection criteria	Entry barriers for suppliers
Northern TNC buyers	Historical relationships	Increasing reliance on auditing to cut briefcase businessmen. Selective auditing.	High entry barriers for new entrants
Chinese buyers	Extensive auditing	Trust built with considerable effort	Low entry barriers for new entrants
Indian buyers	Ensure a large suppliers' base	Increase competition between new and regular suppliers	Low entry barriers for new entrants
Small buyers (both foreign and small)	Shopping around for suppliers	Trial and error	Low entry barriers for new entrants

Source: Fessehaie (2011)

The distinctive nature of Chinese firms operating in Africa as procurers of local supplies was also evident in Angola. Here, too, a determining factor was the mode of entry of Chinese firms, linked closely to China's "going out" policy and its strategic search for access to Africa's resources. Between 2004 and 2007, China's Exim Bank extended a total of $ 4.5bn in oil-backed credit lines to the Angolan government. In July 2010, the Angolan Minister of Finance confirmed that negotiations were underway to finalise a further $6bn from China Exim Bank to assist with Angola's reconstruction. Most of the Chinese investors that gained access to the large-scale China Exim Bank contracts in Angola were SOEs or large "national champion" private companies. The key determinant of their sourcing behaviour, therefore, was not private or state ownership, but whether they operated through China Exim Bank credit line. These credit lines tied a minimum of 50 percent of procurement of the total contract value of the project to imports from China for loans obtained outside the realm of the China-Angola agreement and 15 percent of Chinese procurement for loans within the terms of the agreement. In reality the degree of imports from China was very considerably higher than the minimum of 15 percent. Local purchases of Chinese firms involved in the construction of infrastructure were limited to basic materials such as cement, bitumen, stone and sand, and occasionally paint, corrugated iron and timber. In many cases – for example, cement - even some of these were imported form China. One Chinese SOE reported that its local purchases were less than five percent of its annual spend and these are all very basic, low value products (such as gravel and charcoal). Many of these large scale Chinese investors also made extensive use of semi-skilled migrant labour from China.

Where there were backward linkages, these predominantly involved an incoming Chinese supply chain. This happened either through vertical integration or outsourcing. Some Chinese companies began setting up their own factories to manufacture bricks and building inputs made from locally available materials such as wooden door frames, windows and balustrades. Chinese brick-making machinery has often replaced Angolan equipment. Locals only supplied emergency shortfalls. This also extended to basic consumables such as vegetables. Much of this outsourcing was to smaller

private Chinese companies in Angola which distributed Chinese products and services required for the construction industry.

However, not all Chinese firms act in the same manner, and the operations of large SOEs and “national champion firms” was distinctively different from small and medium sized Chinese firms. Chinese SOEs tended to be more risk averse than private companies and only moved into overseas markets with state support. Indeed, they only entered the Angolan market under China Exim Bank financing. They avoided pursuing other projects funded by the Angolan Government or international donors. By contrast, private Chinese companies did not receive such support from their government. They ventured into Africa because of high domestic competition or because they saw market opportunities and were, as a general rule, much more likely to draw on local suppliers than their large-sized government-backed SOE counterparts.

The experience of Gabon with respect to forward linkages tends to reinforce the conclusion that the engagement of Chinese and other emerging economy investors in SSA may reduce the extent of linkages from the commodities sector, in this case with regard to forward linkages. Over the past two decades, French timber firms have made large investments in the processing of timber, including in sawmilling, veneer and plywood manufacture. These investments were partly a consequence of their longevity in Gabon, partly because wage costs were higher in France than in Gabon (since timber processing is a relatively labour-intensive industry) and partly because they had responded to the requirements of the Forestry Code to process timber domestically. By contrast, the new Asian-based entrants into the timber industry – from Malaysia and China – were almost wholly focused on log extraction. Their forward linkages were minimal (Table 34). It is notable that the nationally owned firms too were reluctant to engage in forward linkages.

Table 34: Ownership and forward linkages in the Gabon timber sector sub-sector activities and final markets (n = 15)

Ownership / Activity	China			MY		EU					Gabon		
Logging													
Sawn-wood													
Veneer									*				
Plywood													
Log export share [a]	70%			70%		38%					90%		
Log export destination [c]	CN	CN	CN	CN	CN	EU	CN		CN	CN	CN	CN	CN

a share of total log production exported unprocessed
b share of total log production channelled into linked processing sub-sectors
c CN=China, EU=Europe, SA=South Africa is the respective main export destination for logs and processed wood products

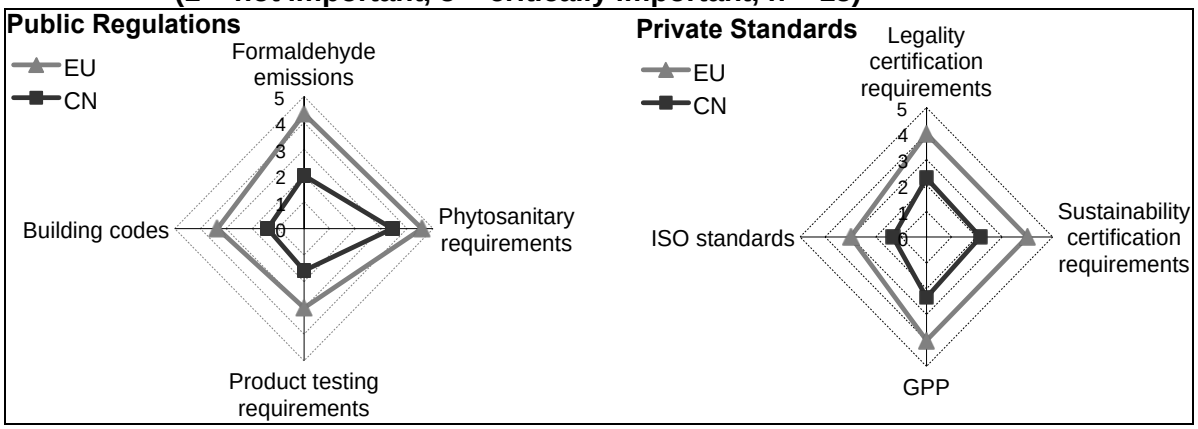
Source: Terheggen (2011)

The distinctive character of Chinese presence in Africa’s resource sector and its impact on linkages also surfaces in relation to the role of Chinese buyers. This distinctive role predominantly reflects the character of the Chinese final

market, comprising a set of much lower-income users than those in northern markets. In Gabon, where there has been a major reorientation in the destination of exports this has had profound implications for forward linkages, as well as for the nature of production in the commodity sector itself. As was shown in the earlier discussion of the breadth and depth of linkages, the market for Gabon's timber products has shifted very markedly from an earlier exclusive focus on the EU (and predominantly to France) to a situation where in 2010, the value of timber exports to China was approximately the same as exports to the EU. However, whereas exports to the EU increasingly comprise processed timber – sawn-wood, veneer and plywood - Chinese buyers are almost entirely interested in unprocessed logs. A subsidiary factor impacting negatively on forward linkages is that Chinese buyers tend to be less interested in timber quality, more willing to take a variety of species and to be almost wholly preoccupied with price. Moreover, there have been a number of occasions when Chinese buyers reneged on contracts or required a readjustment of prices downwards after the timber had been delivered. This has exacerbated the problems faced by Gabonese firms seeking to establish themselves in the industry.

A further attribute of the Chinese market is that it is less concerned with producers meeting environmental and sustainability standards than the European market. This applies both to the standards set by buying firms themselves (reflecting the critical success factors in their final markets) and standards set by governments. This difference in the requirements of buyers has implications for backward linkages, in this case for service providers assisting logging and timber processing companies to meet standards in the production activities. It also has implications for horizontal linkages, since international experience shows that the capacity of service providers to assist producers with quality and environmental standards in one sector can be applied across a wide range of industries (Figure 19).

Figure 19: European and Chinese buyers' public and private standards (1 = not important, 5 = critically important, n = 15)



Note: GPP=Green public procurement; ISO standards=ISO 14001
Source: Terheggen (2011)

There is thus evidence across a range of countries (Angola, Gabon and Zambia) and sectors (construction, copper and timber) that China's growing presence in Africa's resource sector has considerable implications for both

backward and forward linkages. Chinese firms – particularly, but not exclusively the large SOEs operating under the aegis of Exim Bank "aid" (the so-called "Angola mode") – seem to operate with a higher degree of internalisation than do the northern firms which have historically dominated the commodities sector in Africa. On the forward linkage side, the similarity of labour costs in China and Africa (at least by comparison between Africa and Europe) and the relative insensitivity of Chinese buyers to low environmental and ethical standards, has also meant that forward linkages have been lower than those associated with northern firms operating in Africa's resource sector.

However, it is an open question whether these differences reflect the new vintage of Chinese investment, or are a consequence of the mode of financing of Chinese firms and the nature of the Chinese final market. To the extent that the sourcing behaviour of Chinese firms reflects their lack of experience rather than factors intrinsic to Chinese political economy, then there might be expectations that the behaviour of Chinese firms with regard to both forward and backward linkages will become increasingly similar to that of their northern competitors. There is evidence that some degree of convergence is indeed occurring. In Zambia, the Chinese supply chain was becoming more quality-driven for critical supply inputs. In this, it was becoming more similar to the Northern and South African supply chains. Also, recently the Chinese mining company announced that a suppliers development programme will be launched for the newly-acquired mine. In Angola, private Chinese companies are increasingly sourcing local inputs and labour. Private firms were driven by profit-maximisation and, as the cost of importing labour and goods from China increased, responded by broadening their supply base to local labour and firms. It is however too early to conclude that the reality of operating in Africa's resource sector will lead to a closer degree of convergence between Chinese and northern firms. Many of the factors driving these differences – the mode of firm-financing, the nature of final markets and differences in wage costs – will continue to play a role in the determination of both backward and forward linkages for some years to come.

Firm-specific attributes and their impact on linkages

When individual firms shape whole industries or are major participants in an industry, they may play a disproportionate role in the development of linkages. The capacity of a firm to shape an industry is evident in the case of diamonds, where DeBeers has for many decades coordinated a cartel limiting the supplies of diamonds onto the market. For much of this period, DeBeers has thus acted as a playmaker in the global diamond value chain, controlling upstream linkages through its command over the downstream segments of the chain. This gave it the capacity to shape the final demand for diamonds and, in so doing, to determine the capabilities required by the cutting and polishing firms beneficiating diamonds.

The irony of DeBeers command over the global diamond industry is that it has now itself become the tool of another party controlling access to diamonds, the Botswana Government since it, rather than DeBeers controls the major source of high quality and low cost global diamond supply. It has used this

power to force a joint venture on DeBeers (Debswana) and to use this to begin a process of broadening and deepening linkages. In the long run, this may lead to a switch the in the location of a key forward linkages in this sector from Europe and Asia to Botswana.

Although not all industries are dominated by a single firm as is the case of diamonds, there are other cases where individual firms have distinctive strategies which shape the structure of value chains, and hence the degree of linkages, in particular contexts. An example of this is the gold industry in Tanzania and the DRC. In earlier discussion we showed how a verbal commitment by a large mining firm in Tanzania to increase backward linkages had little content in reality. By contrast, a Canadian firm, BANRO, which is building the first of four planned mines in neighbouring DRC appears to have taken a much more thorough approach towards increasing backward linkages. Before mining operations start, BANRO is gathering intelligence on the capacities of local and regional suppliers to provide inputs into the mine. Their procurement officers are engaging with local suppliers and have, for example, travelled to each of the regional urban areas to determine the availability and quality of products that they will require during the operational cycle of the mining operation. For example, 100 percent of the fresh produce used to feed its mine staff will be obtained from local producers in South Kivu Province, which is not the case in the adjacent Tanzanian gold mines. However, this positive picture is tempered by the fact that during the construction phase, the main contractor was from South Africa and therefore there has been significant benefit to the South African economy from this project. In Tanzania, the major contractors were outside of Africa, and most of the materials were sourced from Australia, Europe and North America.

Firm-specific differences on sourcing are also evident within the Tanzanian gold mining industry. The Golden Pride Mine contracts the drilling, blasting, loading and hauling function to a third party, Caspian (Tanzania) Limited. The decision to contract out the drilling, blasting, loading and hauling services was driven by the need to reduce the ‘burden’ of heavy investments in earth moving equipment. In contracting out these functions to a third party the mine has however retained the core function of determining the drilling sites and drilling techniques and patterns as dictated by ore geology. By contrast a second mine retained the bulk of drilling and blasting in-house, arguing that there is little capacity in the Tanzanian economy to draw on. A third mine adopted a case-by-case approach to its drilling, blasting, loading and hauling operations, as it does routinely in its global mining ventures.

In Angola, the single backward linkage into the offshore oil sector is the supply (through the assembly and some manufacture) of flow-lines and control-lines. Oil producing companies tend to source this equipment as adjunct packages to the installation of sub-sea production systems through Engineering, Procurement, Construction and Installation (EPCI) turnkey contracts. By outsourcing the entire supply to sub-sea production systems contractors, oil companies reduce transaction costs and the risks associated with asset-specific technologies. In general, flow-lines and control-lines contractors are subcontracted by sub-sea production systems contractors.

This has limited market access for independent flow-lines and control-lines manufacturers. With Angolan local content policy assigning preference for joint-venture companies, a manufacturer of control-lines which in the past been locked out of the Angolan market grasped the opportunity provided by investing in a joint-venture with Sonangol, the Angolan State National Oil Company. As one of its senior management observed,

> *Local content for us is a legal motivation. Why [is this firm in a] joint-venture with Sonangol? Without it, it was hard to have contracts. That is why we chose to do joint-venture and enter the umbilical cable [control lines] manufacturing in Angola because it was a niche market despite all the technical difficulties to make it. Everybody who heard of it was sceptical. But we have now made it a reality. We had the experience of bidding for tenders but not winning not because we lacked in any technical requirement but because we did not have the local content advantage… (Teka 2011, page 39)*

In Ghana, Newmont appointed dedicated staff within the Ahafo mine procurement department with the task of maximising local sourcing of goods and services. This staff identifies capacity gaps, which will then be addressed within the joint Newmont–IFC Ahafo Linkages Program (ALP). In 2009, 50 local companies received over $4m worth of contracts, representing a 200 percent increase between 2006 and 2007, and more than 200 businesses were registered for the mentoring program. Moreover, the mining company developed an innovative import-substitution program for materials to control erosion during mine rehabilitation. Rather than importing non-biodegradable plastic sheeting from China, Newmont developed local capacity within womens' cooperatives to produce jute mats. The final outcome included a reduction in long-term costs of supply, creating sustainable income generating activities and improved environmental management (as the bark used for the mats was a pest for local farmers, and the materials used are biodegradable). To conclude, Newmont committed to maximise local employment linkages, publishing a legally binding agreement with the community inclusive of targets for local employment over an agreed timescale (Prescott, 2009).

A final example of ownership-specific attributes is that of Vale of Brazil, currently ranked as the world's largest mining company. Vale is a very large and diversified company one of whose divisions is a large construction company with extensive experience of building infrastructure in Brazil and other emerging economies such as Angola. It is Vale which has the main contract for the development of the Moatize coal concession in Mozambique. The exploitation of the coal deposits requires the building of a railway. Vale's prior experience in both coal mining and railway construction, particularly in a low income economy environment, places it in a advantageous position to not only successfully complete this venture, but to do so by also utilising local inputs.

General lessons on the role of ownership in promoting linkages

In discussing the influence of ownership on the breadth and depth of linkages from the commodities sector, it is important to distinguish between what we

refer to as the localisation (that is, a deepening of domestic value added) and the indigenisation (that is, an increase in the share of national ownership) of linkages. A clear finding which emerges from our case-studies is that in most cases governments treated them as equivalents. It is *assumed* that national ownership will lead to a greater breadth and depth of linkages. We do not have a great deal of evidence to support or contradict this assertion. We found some cases where the pressures for indigenisation have led to an increase in the breadth of local sourcing, as in the case of Zambia's "suitcase businessmen" and the importation of basic consumables in Angola. But this has reflected a process of the outsourcing of the purchasing function from the lead-firms rather than a deepening of value added. Indeed in this Zambian case, the consequence of the indigenisation policy has been to weaken capabilities in the supply chain.

A second conclusion to have emerged is that the lead commodity firms which drive commodity exploitation are predominantly foreign-owned or foreign controlled (through joint ventures and technology agreements). This seems unlikely to change in any material way in the near future. The only exception is South Africa. Insofar as the national ownership of lead-firms has a bearing on linkages, we have found this to be of marginal significance, outweighed by the importance of local content policies. For example, the depth of linkages in Nigeria is much higher than that in the same sector in Angola, and this reflects not just the passage of time, but also the existence of long-lived policies on local content in Nigeria. Even in Angola, in flow-lines linkage development arises from local content policies rather than local ownership policies (although local ownership does have a bearing on the localisation of control-line production). In Botswana, the development of forward linkages arose from the capacity of the government to limit the supply of diamonds to DeBeers rather than from its 50 percent share of the joint venture which allocates these diamonds. In the DRC the government has been able to strategically use its control over large deposits of copper, coltan and cobalt to force resource-hungry Chinese SOEs to commitment to large investments in local infrastructure, in the development of local skills and in supplier development (Kaplinsky and Farooki, 2009), It is too early, however, to determine whether this contractual commitment will be reflected in real outcomes of linkage development.

A third finding is that the commodities sector tends to follow a model which is replicated in many global industries. This is the "global-sourcing-follower-supply" model in which the lead commodity producer in the value chain expects its first-tier global suppliers to satisfy their needs locally in their global operations. Hence OEMs such as Caterpillar follow the mining firms into their operations in Africa, adding value locally, but with a very limited extension of the domestic supply chain into the second- and third-tiers. Locally-owned firms tend to be confined therefore to the provision of low-technology and non-scale intensive inputs to the lead commodity producers (for example, security and fresh food), and in a limited way as second and third-tier suppliers to the global OEMs who follow the lead commodity producers and locate close to commodity extraction. The exception here is South Africa, with a well-

developed set of locally-owned first-tier suppliers, even in technology- and scale-intensive inputs.

Fourth, the development of backward linkages to the commodities sector in Africa can in principle reflect two separate processes. On the one hand it might result from the domestic supply of previously-imported inputs. In other cases it might be a result of the outsourcing by the lead commodity firms of non-core inputs. Our primary conclusion on this issue is that to the extent which we observe an increase in backward linkages, this reflects the substitution of imports rather than an increase in outsourcing by lead commodity firms.

A fifth conclusion to emerge from our case-studies is the distinctive and heterogeneous character of Chinese lead-firms rapidly-growing presence in Africa's commodities sectors. Unlike northern countries where the Washington Consensus has led to the separation of aid, trade and FDI in Africa, China's growing presence in Africa's resource sector has been characterised by a process of strategic bundling, in which access Africa's resources has been achieved through complementary aid and FDI. A further distinctive characteristic is the low level of domestic content in Chinese involvement in the commodities and infrastructure sectors. In infrastructural investments in Angola, Chinese firms tend to have much lower levels of local content than do northern and Brazilian and South Africa firms. But this is not always the case. In Zambia, Chinese lead-firms appear to be very willing to use local suppliers, but they do not invest in the upgrading of their suppliers in the same way as northern and South African lead commodity producers, and are more prone to delisting weak suppliers. As an extension of this, whereas Chinese firms are prepared to source from existing local suppliers, this does not extend into the mobilisation and promotion of locally-owned suppliers. Moreover, increasingly the locally-based suppliers are .Chinese-owned, that is they are following the follower-supply model of lead northern firms, but not just with respect to technology- and scale-intensive inputs provided by first-tier suppliers, but also in relation to the provision of relatively simple inputs which are characteristically supplied by second- and third-tier suppliers. The industrial processing zones under construction in Zambia and other African countries are a vehicle for the promotion of this model. In Sudan, the Chinese lead oil firms have nearly 100 Chinese supplying firms with them to Sudan, employing 4626 people (Suliman and Badawi 2010).

However, Chinese firms are not homogeneous, and there are signs that independent private sector firms operate differently to state owned firms. These private sector firms are more deeply imbedded in African economies, and appear to show a greater willingness to source locally, and from locally-owned firms. However the evidence on this is only suggestive of this difference, as is the evidence that there may be a growing convergence in the behaviour of Chinese lead commodity producers with those of northern investors.

A sixth conclusion which is evidence in two case-studies (but corroborated in other cases in other countries), concerns the "ownership" of final markets and

access to financial capital. In Gabon, when the final market and buyers shift from Europe to China, there was a profound change in the nature of production processes in the timber value chain and in a considerable weakening of forward linkages. In Angola, “ownership” of Chinese government aid by large Chinese SOEs resulted directly in thin backward linkages, since this aid was tied to the use of China-sourced inputs.

Finally, an important component of ownership which affects the nature, breadth and depth of linkages from the commodities sector are firm-specific attributes. Individual firms have specific capabilities and trajectories and are inserted differentially into the global value chains. Therefore not all firms operate in the same way, even when they produce in the same sector and the same country, and have the same country of origin as their competitors. There is widespread evidence of this ownership-related factor, including in backward linkages in Angola, the gold mining industry in Tanzania and the DRC and the diamond industry in Botswana. De Beers is a distinct firm in the diamond industry and it is this distinctive character which has given the Botswana government the capacity to drive through a programme of forward linkage development. There is nothing unique to the significance of these firm-specific characteristics, but our findings suggest only a relatively limited number of cases where African governments have used the opportunity of firm-specific strategic needs to further the development of backward and forward linkages.

3.2 Infrastructure

Infrastructure plays a critical role in promoting economic growth. Just as an efficient infrastructure can promote competitive production, so a poorly-developed and unreliable infrastructure can become a major obstacle to economic life. Infrastructure can take various forms. It can be “hard” and embodied in road and rail transport, utilities (energy and water) and telecommunication networks. In each of these cases the effectiveness of infrastructure development is a function of reliability, quality of provision and the cost to the user. But there is also a compendium of “soft” infrastructure. This reflects the efficiency and cost of the administrative and regulatory regime which supports the productive sector. These characteristics of efficient infrastructure bound all economic activity. But they are particularly important for commodities producers and their suppliers and processors since, at least in the SSA context, the overwhelming bulk of commodities are exported and hence infrastructure plays a crucial role in reaching the market and in providing the necessary inputs for production. Four sets of factors are important in determining the role played by infrastructure in the development of linkages into and out of the commodities sector.

First, the nature of the commodity has a significant impact on the development of infrastructure in a number of ways. Commodities produced and exported in bulk and in great volumes require large scale transport infrastructure to move their mined outputs. Lead commodity firms are more likely to be able to cover the costs of such infrastructural investment. This has externalities for the local economy as the infrastructure is also available for

firms supplying inputs to these mines and this impacts positively on linkage development. Two examples of the positive infrastructural externalities generated by such bulk commodities are the coal producing regions in the Mozambique Zambezi Valley Corridor (Perkins and Robbins, 2011), and the Zambian Copperbelt (Fessehaie, 2011). On the other hand, for high-value, low volume exported commodities, such as gold and diamonds, the need for large scale rail transport networks is less important to export output, and critical infrastructural issues often concern security rather than cost or extension of physical infrastructure. In a context of poor public provision, lead mining firms will make different strategic choices regarding the extent of private investment to source imports and operate the mines (Perkins and Robbins, 2011). For those linkages involving knowledge intensive services, the key elements of infrastructure are likely to be telecommunications, security and air transport, whereas the provision of tangible inputs into the commodities sector and the processing of the output of the commodities sector are most likely to require hard infrastructure such as roads and rail.

Second, the nature of the infrastructure has important implications for the development of linkages. Some infrastructure is highly specific to a particular commodity producer, and has very low potential for positive spill-overs which might facilitate the growth of backward, forward or horizontal linkages. This is, for example, the case with regard to oil pipelines, which facilitate only the export of oil. In other cases, as for example the TanZam railway line between Zambia's landlocked Copperbelt and the port of Dar es Salaam in Tanzania, the infrastructure has the capacity to meet the needs of multiple users, both feeding into and out of the copper mines, and feeding into and out of other sectors of the economy.

Third, it is important to distinguish between the infrastructural needs of the lead commodity firms and those of the firms involved in backward and forward linkages to the commodities sector. If infrastructure in a commodity exporting developing country is primarily or solely focused on meeting the requirements of the commodity lead firm, then experience shows that it is likely to result in enclave infrastructural development, which will hamper the ability of local suppliers or processors to link in and participate effectively in the country's commodities value chains. That is, firms providing inputs into the commodities sector and using the output of the commodity sector may require very different forms of infrastructural support. By contrast, in other cases, the physical infrastructure can also serve the needs of other sectors, users and producers - this is widely referred to as 'corridor development'. Perkins and Robbins (2011) provide examples of this contrast between enclave infrastructure and corridor development in their discussion of infrastructure projects in Tanzania and Mozambique's Zambezi Valley project. In the latter case horizontal linkages are more likely to develop out of the vertical backward and forward linkages with the commodities sector.

Fourth, by its nature, infrastructure is a public good. In many cases, it is not used up in consumption. For example, a road can be utilised by many different consumers, and for a substantial period of time. This makes it difficult – although not always impossible – for investors in infrastructure to

appropriate the fruits of their investments. Another public good characteristic of infrastructure is that there are network effects. That is, to be delivered at low unit cost, infrastructure requires many users to spread the costs of network construction, as in the costs of fixed-line telephony, sanitation and sewerage. Given the high unit costs of operation with a small number of users, this creates difficulties in investing in the infrastructure despite the profit potential of operations when many users are connected to the network. Further, in many cases infrastructure is very capital intensive and requires large sums of investment, putting such investments beyond the reach of an individual investor, or even often groups of investors. Moreover, infrastructure often has to be available before an economic activity can take place, rather than to be provided to support what is already in place. For example, a mine needs a road before production can proceed. Whilst this road can, and often has to be upgraded after the mine is in operation, it is a necessary precursor to commodity extraction. For all of these reasons, it is common for infrastructure to be provided by governments rather than by individual investors. However, the provision of infrastructure often spans national boundaries so that even if the fruits of investment can be reaped, this requires a decision-making and distributive arrangement which involves at least two and often more than two national governments.

These four factors all emerge as significant determinants of linkages into and out of the commodities sector in our eight country-studies, albeit to different degrees. These differences reflect the character of particular commodities and particular economies. In discussing these contextual factors and analysing their impact as facilitators of or barriers against infrastructure and linkage development we will begin by considering the role played by infrastructure in the oil sector (Angola and Nigeria). This is a sector which is often seen as a quintessential enclave activity, wholly dedicated to commodity exports and with few externalities to the surrounding economy. In addition, by holding the commodity constant, it is also helps to explain the importance of country-specific factors. We follow this with a discussion of the role played by infrastructure in Zambia, Mozambique and Gabon where in each case high volume commodity exports have spurred the development of infrastructure with high externalities for other sectors. We conclude with a discussion of the experience of diamonds in Botswana and gold in Ghana and Tanzania. They share a highly valuable and low volume output, affecting the nature of forward linkages. In the case of gold, the contrast between Ghana and Tanzania highlights the importance of country-specific differences.

Oil: enclave infrastructure with different linkage outcomes

The oil industries in Angola and Nigeria are classic cases of enclave infrastructural development but with very different linkage outcomes. In both countries the oil firms' required the construction of purpose-built terminals to bulk-load and export oil form offshore production wells. In both countries the poor development of national infrastructure - where in other contexts (such as oil development in the North Sea) oil producers could assume reliable local supply – led the lead oil firms to create insulated oil terminals and invest directly in the supply of key infrastructural inputs such as power and water. Hence suppliers firms that were located within the oil terminals and supplying

goods and services to the oil companies had access to a functioning physical and services infrastructure which gave them a competitive advantage over suppliers located outside the terminals. The manufacturing and services suppliers outside these oil terminals involved in backward and forward linkages lacked the scale and resources required to provide efficient infrastructure and had to overcome major cost penalties arising from highly inadequate infrastructure provision. In Nigeria, as a result of effective state action many of these local external suppliers managed to survive and link to the oil industry, whereas in Angola only suppliers within the enclave oil terminals were able to engage in backward linkages.

In both countries the provision of national infrastructure was hindered by conflict. This was particularly the case in Angola which experienced nearly three decades of civil war and the virtual collapse of most forms of hard and soft infrastructure. According to the African Development Bank, 80 percent of Angola's transport infrastructure was not operational in 2009 (BMI: 2009:6). The World Bank, in its 2010 Logistics Performance Index ranked Angola as 142nd out of 155 countries (Arvis *et al*, 2010). Customs, Infrastructure and Logistics Quality and Competence were the worst three performing indicators. Business Monitor International (2009) places Angola at the bottom of its ranking of infrastructure in Sub-Saharan African countries. Only 10.4 percent of Angola's roads are paved although rapid on-going road construction by Chinese firms will result in a much higher proportion (24 percent) in the near future (MOFCOM, 2010).

In Angola, the two sets of firms involved in the supply of control lines and flow-lines leased their premises in one of the eight major oil terminals within an industrial park located along the Kwanza Basin in Lobito where the country's major offshore blocks are located. This was because public infrastructure was inadequate to allow for reliable and cost-effective supply from sites outside of this industrial park. In contrast local second- and third-tier SMEs outside the terminal had to face the challenges posed by poor and unstable electricity and water supply, inefficient customs services and lack of access to financial and ICT services. This severely hampered their ability to develop supply linkages to the oil companies. For similar reasons, in the Angolan construction industry the large Chinese companies provided their own water and electricity, whereas the smaller Chinese and national construction firms suffered from lack of access to reliable and low costs access to these key inputs.

In Nigeria, although the general state of infrastructure was poor, the lead oil companies in the oil enclaves found infrastructure generally adequate to their needs (Table 35). Telecoms and water utilities were rated as adequate or very adequate and transportation received a mean score from respondents of 4.5 (on a scale of 1 to 5). The exception was power and internet functioning which remained inadequate even for the lead oil producers.

Table 35: Infrastructure performance assessment by oil firms in Nigeria

	Very adequate	Adequate	Can't say	Inadequate	Very inadequate	Mean
Public power supply/electricity	8.3	16.7	-	58.3	16.7	2.42
Water supply	16.7	58.3	-	8.3	16.7	3.41
Telephone and communication	16.7	75	-	-	8.3	3.92
Internet services	16.7	33.3	-	50	-	3.17
Transportation	58.3	33.3	8.3	-	-	4.50

Note: Very inadequate =1, inadequate = 2, can't say = 3, adequate = 4, very adequate = 5.
Source: Oyejide and Adewuyi (2011)

It is significant that supplier firms outside the enclave oil terminals were much less satisfied with the quality and cost of infrastructure provision, particularly in regard to transport, energy and internet services (Table 36). Public supply of energy was the largest inhibiting factor, with 84 percent of suppliers indicating that provision was either inadequate or very inadequate. Furthermore they also regarded the conditions of public power and water supplies as deteriorating, while those of the telephone/communication, internet services and transportation were improving. Outside of the oil terminals themselves, the provision of electricity is so poor and unreliable in Nigeria that most industrial firms provide their own power to run operations through petrol-fed generators. This is a major cost constraint on their ability to be competitive, since the unit cost of private power is roughly ten times that of the cost of public electricity.

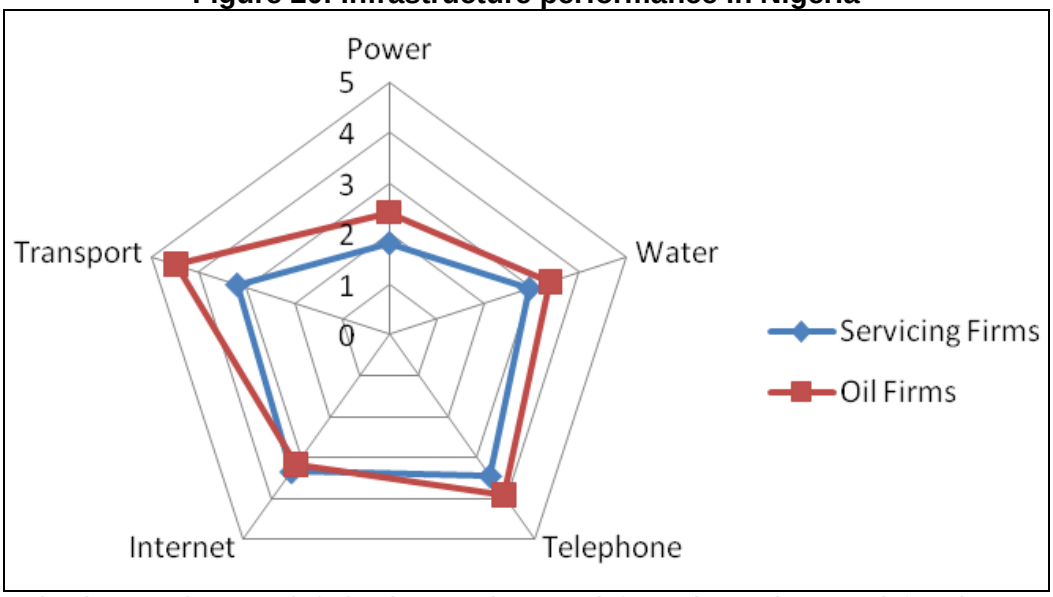
Table 36: Infrastructure performance assessment by suppliers to oil industry

	Very adequate	Adequate	Can't say	Inadequate	Very inadequate	Mean
Public power supply/electricity	1.3	5	10	41.3	42.5	1.81
Water supply	10	40	8.8	18.8	22.5	2.96
Telephone and communication	10	57.5	8.8	13.8	10	3.44
Internet services	8.8	55	6.3	21.3	8.8	3.34
Transportation	8.8	46.3	11.3	25	8.8	3.21

Note: Very inadequate =1, inadequate = 2, can't say = 3, adequate = 4, very adequate = 5.
Source: Oyejide and Adewuyi (2011)

This differential experience between lead commodity producers and their suppliers is reflected in the views of oil firms and suppliers on their satisfaction with infrastructure provision. The former are systematically less negative about the infrastructure available with the exception of access to the internet (Figure 20).

Figure 20: Infrastructure performance in Nigeria



Very inadequate is scored 1, inadequate is scored 2, can't say is scored 3, adequate is scored 4, and very adequate is scored 5.

Source: Oyejide and Adewuyi (2011)

Corridor infrastructure in Zambia, Mozambique and Gabon

In Zambia, Mozambique and Gabon, the need to transport high volumes of bulky commodities led to the development of roads and rail, in the first two countries, and water-based transportation, in the latter. Whilst in Gabon infrastructure is poor and seriously inadequate in supporting forward linkage development, in Zambia relatively well-developed transport infrastructure has led to a level of industrial agglomeration facilitating near-sourcing by lead copper firms. Mozambique represents a different case of prospective infrastructural development. It is implementing an integrated plan to coordinate mining investment, infrastructural development and promotion of businesses and agricultural activities in Northern Mozambique through the Zambezi Valley corridor. In each of these cases, meeting the needs of the lead commodity producing firms also provides infrastructure for firms and farmers in other sectors.

Policy and public provision have been crucial in the development of infrastructure in Zambia. This public provision has a long history. Historically, copper mining in Zambia spurred the development of a rail line from South Africa through Zimbabwe to the Copperbelt and through to the Congo and to Lobito Bay in Angola. In the 1970s the Chinese funded the construction of the TanZam railway linking the Copperbelt to Dar es Salaam. At that time, and for many years after, this was China's largest external aid project. Further, to meet the demand of the mining industry for low-cost electrical power and energy, the Kariba Dam and the hydroelectric power stations on the Zambezi and Kafue Rivers were developed. However, the decline of the mining sector between the early 1980s and 2005 negatively affected the maintenance and expansion of infrastructure, which is now available at comparatively high cost. Transport prices for the route from Lusaka to Durban in South Africa were $6 per tonne/km in 2007, against $5 in China and $3.50 in Brazil. Three factors help to explain these high transport costs in the North-South Corridor (World

Bank, 2009). First, there are long border crossing delays, especially on the Chirundu Border with Zimbabwe. It was estimated that a 20 percent reduction in border crossing time would reduce transport prices to the importers by 10-15 percent. Second, fuel prices are high - almost 80 percent of the fuel prices in Zambia were constituted by taxes and levies, which meant that 40 percent of total transport costs were linked to taxation (World Bank, 2009). And, third, the quality of physical infrastructure was poor due to lack of investment from Government or private mines.

Poor infrastructure represented a cost penalty to both forward and backward linkage firms. To address this issue, the Zambia government, together with other neighbouring countries, launched the North-South Corridor Programme in April 2009. This ambitious programme aimed to reduce transport costs for two main routes, from the Copperbelt to Dar es Salaam, and from the Copperbelt to Durban. This would be achieved by rehabilitating physical infrastructure and improving the regulatory regime (reducing cross-border clearing procedures, harmonising transit and transport regulations, and simplifying administrative requirements). The programme aimed to involve the expanding extractive industries in Zambia and the DRC as key drivers (North-South Corridor International Financing Conference, 2009). The first concrete step to implement the programme took place in 2009, when Zambia adopted the One-Stop Border Post Act, the legal foundation for the joint administration of the Zambia-Zimbabwe border post.

In terms of corridor development policy, Mozambique is far ahead of any other country in the region. Based on its positive experience with the Mozal gas facility, Mozambique sees the coal mining operations in and around Tete in north-west Mozambique as an opportunity to combine a complementary set of resources – minerals and inexpensive power - into a range of possible industrial development projects. Mozambique wants to avoid “enclave” development of coal mining operations, and maximise backward, forward and horizontal linkages, by promoting “feeder” infrastructure servicing the agricultural, forestry and agro-processing sectors. Three originally distinct but currently integrated development corridor initiatives are being pursued: the Beira, Nacala and Sena-Zambezi Spatial Development Initiatives (SDIs)

In light of these objectives, the Mozambique Government is actively pursuing efficient transport solutions which avoid meeting only the demand of the mines. This is taking place in partnership with the private sector. The key investor in the Moatize coal concession, the Brazilian firm CVRD (Vale), has been increasingly involved in the development and management of the railway required for the transport of bulk volumes of coal. (As we saw above, Vale is not only the world’s largest mining company, but has extensive presence in the infrastructure sector too). In order to facilitate such partnership, the government has reformed its regulatory framework, terminated an unsatisfactory railway concession, made resources available for co-funding and facilitated coordination between mining companies. This decisive approach, adopted by the Government of Mozambique at the highest level, is not common and displays a high level of commitment. In Mozambique the Cabinet has approved the establishment of the Mozambique SDI

Programme in the Ministry of Transport and Communication with implementation to be co-managed with the Ministry of Planning and Development. The SDI Programme has already commenced with a range of sector-scoping studies to deepen the understanding of the range of economic development possibilities that exist on the corridors that make up the Programme. These will, in turn, inform future infrastructure development strategies.

In the timber sector, there are three ways (road, rail, water) of transporting logs and wood products, each with different unit costs. Gabon has the poorest road network density of the Central African region (around 30 metre per square kilometre). Road infrastructure is not only limited in length but also of poor quality and poorly maintained. The high costs of road transportation are a direct result of inadequate transportation networks, poor maintenance of existing roads and road congestion. Transportation via railways with the Trans-Gabonese railway is limited as it consists of a single track running from Franceville (in the Southeast of Gabon) to the industrial centre Owendo in Libreville (the capital located in the Northwest of the country).The river is the cheapest mode for the plantation owners but this has had major impact on the development of general infrastructure, since it is really only suitable for the transport of a limited variety of species, and wholly unsuitable for other products including timber products produced through forward linkages from log production. The existing harbour infrastructure, designed for Okoumé logs that float, is unable to handle increasing volumes of wood products. As a consequence, the costs for domestic transportation of logs and wood products made up a substantial part of total production costs varying between 14 percent and 25 percent.

The Gabonese Government is not geared to counter these infrastructural obstacles to commodity exploitation and (especially) for linkages from the commodities sector. Vital services in the industry are the responsibility of poorly funcitoning, inefficient and corrupt state monopolies such as SEPBG (Société des Parcs à Bois du Gabon) handling log and wood product transportation at the port, and Comilog (a mining company), which acquired the rights to manage the Trans-Gabon railway. Despite the termination of other state-owned monopolies, like the energy and water company SEEG, the private monopolies do not appear to operate with greater efficiency than the public monopolies which they replaced.

Gold and Diamonds: A tale of two different infrastructure outcomes

Tanzania and Ghana are countries where gold extraction is associated with very different outcomes on linkages and patterns of infrastructural development. In Ghana, backward linkages are relatively well-developed, and public provision of infrastructure is generally good. By contrast, in Tanzania, linkages are weak and the quality of infrastructure is poor.

In Ghana, resource-rich areas such as gold mining areas have continued to receive government investments to develop their infrastructure. The success of the mining sector in recent decades is widely attributed in part to the huge investments in infrastructure in mining areas made by government with

support from the World Bank/IMF and other international donors (Owusu 2001; Aryeetey et al. 2009). The enhanced infrastructure in gold mining areas, particularly that of the road network and ICT, also broadened and deepened consumption (final demand) linkages, and has supported the physical connectivity that allow backward linkages to operate. Due to improved infrastructure, notably air transport, roads, and power supplies, many gold mining support companies have now located their headquarters in Accra and many of the mining companies and lead OEMs have located regional offices in Ghana. The benefits such a situation produces in terms of job creation, demand for services/goods and other benefits to the national economy and a region such as Accra where no gold is mined is apparent.

In Tanzania, the gold mines are located in remote areas with very weak infrastructure. This places a particular burden on the input side, where machinery and equipment is often both costly and bulky and where extensive supplies of energy are required to operate equipment. By contrast, gold is a high value low volume product and is easily transported by air to South Africa for beneficiation. The very poor quality and high cost of transport infrastructure to the mines severely constrains the operations of the lead mining firms, and this is not only a problem of hard infrastructure. In 2011 one of the largest mines had to close down operations for some months since much of its stored fuel had been stolen by its own staff! Mining companies also suffered severely from long delays in customs clearance, often accompanied by high levels of corruption. The weak provision and in many cases the non-provision of publicly supplied energy and other utilities has also meant that the mining houses have to provide these services themselves, not only involving a high pecuniary cost, but also a high cost in terms of managerial attention. Mining companies consistently complained about the negative impact of inadequate, unreliable and poor infrastructure on their operating cost. All of these factors were of compounded significance for suppliers to the mining industry. Many of the locally-owned supplying firms, and potential suppliers, lacked the resources and the scale to provide for their own infrastructure needs. There is no doubt that weak infrastructure is one of the major factors holding back backward linkages in the Tanzanian gold mining sector. Partly as a consequence of this weak infrastructure, the Tanzanian gold mining industry remains a largely enclave activity, in significant contrast to Ghana where both the breadth and depth of linkages are growing.

In response to these widely-acknowledged problems, the Central Development Corridor (CDC) was planned to connect the Tanzanian maritime Port of Dar es Salaam with its Great Lakes hinterland. The objective was to crowd-in investment into the agriculture, fisheries and aquaculture and tourism sectors. By providing transport and energy infrastructure, these sectors would help the region's growth and diversification processes. However, Tanzania never mainstreamed the CDC vision into effective policies and effective policy delivery. Moreover, there were enormous backlogs in implementation, lack of funding from the Government and its donors, institutional capacity bottlenecks and failure to coordinate with neighbouring countries.

The Botswana diamond beneficiation industry is a case where adequate infrastructure provision contributes to the development of forward linkages. This is partly due to the highly specific nature of the commodity, involving the transport of very high value products in very small volumes. In order to guarantee the security of this high value commodity, a diamond security transfer facility was completed at the Gaborone International Airport and a high security exclusive road was constructed, connecting the airport and the diamond hub.

Most of the forward-linkage diamond beneficiating firms were located in the Gaberone area and were easily able to take advantage of the available infrastructure. However, whilst water supply is reliable in Gaberone, the firm located in Serowe suffered from less reliable water supply. A significant amount of Botswana's electricity – up to 40 percent at times – has been imported from South Africa and other neighboring countries. This has opened Botswana to insecurity of supply given the power supply shortages that South Africa's electricity utility has experienced over the past few years. Since cutting and polishing equipment and technology is dependant on electricity, most firms have installed back-up generators. Internet has been unreliable in Botswana and slows during peak times. However the government is installing fibre optic cables and expects telecommunication speed and prices to improve in the short-term.

General lessons on the role played by infrastructure in linkage development

Turning to the general lessons learned from this country and sector experience, it is clear that the nature of the commodity affects the types of infrastructure which is required. At the one extreme are the very large-scale coal mines in Mozambique which in themselves will pay for the cost of infrastructure development, but which will have major externalities for other sectors. The diamond industry in Botswana lies at the other extreme with very limited demands for highly specific infrastructure. Between these two extremes lies a range of sectors which to a greater or lesser degree involve externalities for other sectors, potentially positive (as in the case of the Central Development Corridor in East Africa) but also potentially negative (as in the case of the use of rivers to transport logs in Gabon).

It is also possible to observe the impact of infrastructure on the competitive provision of backward and forward linkages into and out of the commodities sector. In general, the low level of public provision in some of the economies such as Tanzania and Angola places severe penalties on all users of infrastructure. However, whilst the lead commodities firms can afford to cover their own infrastructure needs and to solve their own problems, their suppliers and users find this more difficult. This means that whilst the lead commodity producers may wish to increase outsourcing, weak infrastructure forces them to either internalise these non-core value added activities or import from stable foreign suppliers. In general, more cases were found in which suppliers and users were adversely affected by infrastructure by comparison with the lead commodity firms (Angola, Botswana, Tanzania, Gabon and Nigeria) than

where there was little difference in the impact of the quality and cost of infrastructure (Ghana and Zambia).

Political will, government capabilities and capacity to provide for the public provision of public goods emerges as a key factor in linkage development. Botswana is an excellent example a government deciding to use its political will and develop a policy framework in alignment with the lead diamond company (De Beers) as well as international cutting and polishing firms, and in the process to develop an efficient and fit-for-purpose infrastructure. Mozambique shows a similar level of government commitment and decisive action. Tanzania is at the other extreme, an economic environment in which not only is the existing infrastructure inadequate to meet the needs of either the lead commodity producing firms or their suppliers and users effectively, but also where there seems little capacity to make a difference in the future. But even where governments are aware of the need to upgrade the infrastructure required to meet the needs of the lead commodity producers in the commodities sector, in few cases were we able to observe a recognition that attention has to be given to meeting the specific needs of supplier firms providing inputs into the commodities sector.

Finally, on the policy front, a specific issue arises when action is required at the supranational level. This is evident in relation to the Central Development Corridor which links the Great Lakes interior to the East African seaboard. There are enormous potential gains for production linkages from this Corridor, perhaps even greater for horizontal linkages than for backward and forward linkages. However, there appears to be a chronic incapacity of the governments involved in this collective effort to work together in an effective and timely manner. This contrasts sharply with the Southern Corridor in Mozambique, which has potential externalities in Malawi and Southern Tanzania. In this latter case, and partly as a consequence of the nature of the commodity (which in itself will cover the costs of infrastructure development), the primary government in question (Mozambique) and the involvement of an emerging company firm which has deep experience both in mining and infrastructure (Vale), progress seem much quicker and better directed.

3.3. Capabilities, skills and the National System of Innovation

Linkages into and out of the commodity sector require a range of complementary capabilities. Prime amongst these are the skills of their labour forces. But these skills need to be harnessed effectively, so organisation and managerial routines are additional core requirements. Further, since technologies are changing rapidly, firms also require the capacity to identify, effectively assimilate and improve new technology, and this often happens as a precursor to developing their own innovative technologies. This sets out a challenging agenda for individual firms in linking to the commodities sector with efficiency, and there is much which they can undertake on their own to achieve these objectives. But, typically, it will also require the firm – and the ensemble of firms in a value chain - to be supported by a range of public and private sector institutions. These backing institutions are often very local in nature and comprise a “regional system of innovation” (Braczyk, Cooke and

Heidenreich, 1998). They also often have sectoral specificities (a “sectoral system of innovation”, Malerba 2002). But most typically they are assembled on an economy-wide basis and comprise a “national system of innovation”, (Lundvall, 1992; Freeman 1995).

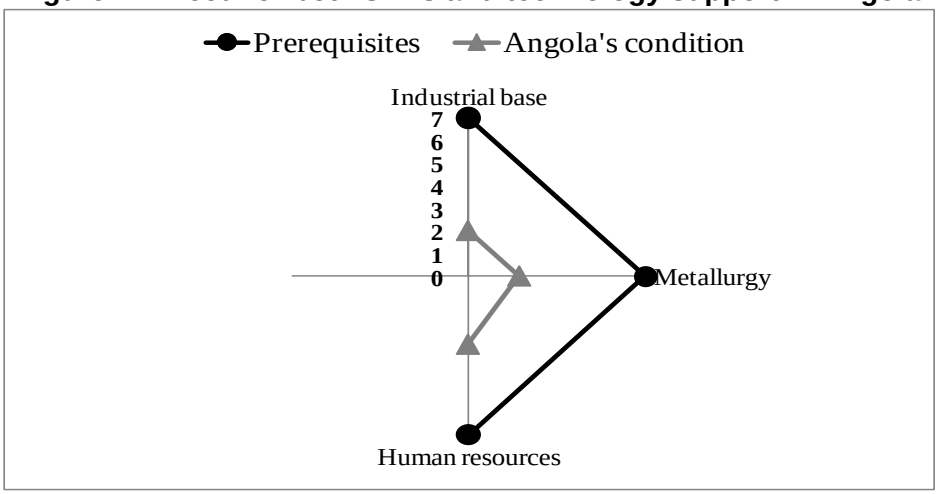
In relation to skills – a number of studies have found strong evidence that a better educated workforce and the increased supply of skills have a major impact on economic growth (Barro, 1999; Hanushek and Woessmann, 2007). Raising education levels raises the productivity of the existent labour force in relation to existing tasks. Further, a better educated labor force is more adaptive and are better able to deal with new routines and technological changes. Thus skills are a core component of innovation of new products and processes and the restructuring of corporate positions in global value chains Managerial skills and the routines which are established within firms are a critical component of the capacity of individual firms to use their endowments of skilled and unskilled labour, their technological capabilities and their equipment to meet the requirements of cometitive production (Teece et al, 1997). In some cases the required skills may be of a very high level nature and be incorporated in R&D. But most typically, competitive production and technical change require the capacity for implementing incremental changes. As countries develop and as firms expand into new products areas requiring new technologies, their need for skills increases. It is a paradox that, in general, the greater the level of capabilities which a firm and country possesses, the more it feels a skill constraint. This reflects their industrial ambition, and because they are competing in a deeper pool of knowledge-intensive production.

GIven the nascent development of industry in much of SSA, the capabilities required to develop linkages into and out of the commodities sectors tend to be at the bottom of the capability ladder. Therefore, in assessing the extent to which capabilities in different countries, and in different sectors, affect the breadth and depth of linkages, our research focused on two basic sets of issues. The first was the provision and mobility of skills. To what extent did skill shortages affect the development of linkages, and how have governments responded with investments in training. Related to these shortages, was there any evidence that the migraton of skills – between sectors domestically and across naitonal borders – affected linkage development? The second set of factors was the extent to which the institutions in the National System of Innovation (NSI) has a bearing on the breadth and depth of linkages into and out of the commoditeis sectors. The nature and determinants of R&D and leading-edge innovation applied only to the development and sustainability of linkages in South Africa’s commodity sectors.

The centrality of skills and technology support in linkage development is illustrated in the case of backward linkages into Angola’s oil industry (Figure 21). First-tier firms supplying control- and flow-line into offshore oil-production were asked to rank their key requirements for deepening supply on a scale of 1-7, and to rate the performance of the local economy on the same scale. They determined that three factors were critical - skills, general industrial

capabilities, and within general industrial capabilities, the specific capabilities of the metalworking sector.

Figure 21: Need for both skills and technology support in Angola



Source: Teka (2011)

Before embarking on this analysis it is helpful to briefly overview the general level of skill development and commitment to high level research training in the eight economies under examination. As can be seen from Table 37, all of the SSA economies are a long way behind frontier economies such as Japan and Sweden with respect to human resource development. Some African economies such as South Africa and Botswana do show progress in many elements of skill development, particularly by comparison with other SSA economies such as Tanzania and Gabon. But even these outlier economies are some way behind Brazil, a resource-dependent middle income economy which in many respects is a role model for African resource economies.

Table 37: Comparative human resource indicators, 2010

	Adult literacy rate (% aged 15 and above)	Expected years of schooling (children)	Education Expenditure (% of GDP)	Mean years of schooling (adults)	Researchers per million inhabitants	Researchers per 000 total employment
Angola	67.4	4.4	..	4.4		
Botswana	84.8	12.4	..	8.9	942[a]	2.5[a]
Gabon	88.2	12.7	..	7.5	380[d]	0.9[d]
Ghana	67.3	9.7	..	7.1	28[b]	0.07[b]
Nigeria	74.8	8.9	..	5.0	119[b]	0.04[b]
South Africa	89.3	13.4	5.1[c]	8.2	815[b]	2.8[b]
Tanzania	73.2	5.3	6.8[c]	5.1	67[b]	0.15[b]
Zambia	71.4	7.2	1.4[c]	6.5		
Brazil	90.0	13.8	..	7.2	1,098[c]	2[c]
Japan		15.1		11.5	6,997[c]	13[c]
Sweden	..	15.6	..	11.6	7,758[b]	14[b]

a = 2005; b = 2009, c = 2007

Source: Adult literacy, expected, mean years of schooling, education expenditure from International Human Development Indictors online <http://hdrstats.undp.org/en/tables/default.html>. Researchers' data from UNESCO data online <http://www.uis.unesco.org/> (accessed July 2011)

All of these components of skill, as well as the character of the NSI, have implications for the efficiency with which the commodities sector operates, and as a factor which facilitates or constrains linkages to and from the commodities sector. In reviewing the evidence of our case-studies, we will focus on four sets of issues – the existence and nature of skills shortages, investments in training to fill these gaps in skills, the flow of skilled labour in and out of the commodities value chain, and the role played (where relevant) by the NSI. As in the case of other drivers of linkages, the evidence is often of a partial nature.

Skill shortages

Skill shortages are pervasive across all of the sectoral studies under review, although the level of skillls in which shortages are experienced varies greatly. In summary, the country-by-country picture is as follows:

In **Angola**, the government has set exacting targets for the growth of locally-employed skill workers. In the oilfield services sector providing control lines to the oil sector, there has been a steady increse in the share of citizens who in 2010 accounted for 90 percent of total employment in the basic and mid-skilled categories, 45 percent of managers, but only 17 percent of engineers (Table 38). The manufacturers of flowlines, which are more recent in origin employ a smaller share of basic and mid-level skilled locals, and a similarly low share of local engineers. Thus, in both of these backward linkage firms, the short-term need for skills is met through the use of migrant labour. A similar pattern of skills shortage was observed in the constructon sector, leading most of the Chinese firms to import skills from China. The Chinese firms reported not just a shortage of skills, but also argued that Chinese labour was used to working at a higher pace and for much longer hours than the Angolan emplyees, frequently at lower wages as well.

Table 38: Percentage Share of Angolans in skills in backward linkages feeding into the Angolan oil sector (2004-2014)

Period	Total Workforce	Local (Angolan) workforce		
		Basic & Mid-Skilled	Managers	Engineers
Control Lines				
2004	50	80	30	0
2009	160	90	45	17
2014*	180	90	60	52
Flow Lines				
2003	-	70	-	5
2009	-	72	-	20
2014*	-	85	-	35

*: projected Source: Teka (2011)

In **Botswana**, where the forward linkage into diamond cutting and polishing is made up almost entirely of labour, skills are *the* key obstacle to the deepening of linkages. In the cutting and polishing sector itself, expatraites made up only 7 percent of the total labour force, but more than half of top management and one-third of middle management. In a seleciton of supplier firms, expatriates made up less than five percent of the total labour force.

In **South Africa** – the country with the most highly educated population in SSA – firms supplying mining equipment and specialist services identified the shortage of skills as a significant constraint. Skills shortages exist at all levels – managerial and artisanal as well as technical levels such as machine operators. The shortage is exacerbated – particularly at the managerial and higher skill levels – by emigration, most significantly to Australia. At the same time, South African firms complain that they are unable to secure skills abroad because they cannot obtain the necessary work permits. Enterprise Survey (ES) data for 2003 and 2007 provide further confirmation of the importance of the skill shortage. In 2003, firms in the capital goods sector cited skills shortage as their most significant constraint. In 2007, skills shortage was identified as the second most important constraint after crime. It is cited by firms as one of the major reasons why they are increasingly relocating the manufacture of products outside of South Africa – notably to China. But firms also cite the skills shortage as impacting on the location of research and development, with South African firms increasingly favouring locating their operations in Australia which offers both better availability of skills and strong linkages with well-endowed publicly supported research institutions.

In **Gabon**, an absence of domestic skilled labour proved to be a major cost penalty to all companies in the timber chain. With their international connections and deeper pockets, large-scale companies found it easier to bear the "skill cost" penalty. Smaller Gabonese-owned companies were most severely affected and found it more difficult to deepen forward linkages. This shortfall in skills led to the recruitment of skills from abroad. Senior positions (management, technicians) were most often filled by labour recruited from Europe and/or Asia (depending on the ownership of production), whereas in administration, transport and in production, skilled labour was sourced from neighbouring Central African countries where wages were approximately one-third or lower than those in Gabon. It is striking that so severe is the skill shortage in Gabon that 15 percent of unskilled labour was migrant (Table 39)

Table 39: Employment categories and country of origin in Gabon's timber value chain (percentage) 2009

	Distribution	Origin	
		Gabon	Foreign
Management	7	24	75
Technicians	4	59	41
Administration	6	87	13
Labourers	75	84	16
Transport	6	70	31
Environment & Social	2	74	26
Total	100		

Source: Terheggen (2011)

In **Nigeria** the labour market constraints on skills appear to be less severe, at least from the perspective of backward linkage firms feeding into the oil sector. Eighty percent of these firms were satisfied with availability of skilled labour, although one-third of firms resorted to recruiting skills from abroad. In

the ICT sector where skill shortages were considered most severe, almost half of the firms recruited from abroad (Table 40). A reflection of the relative absence of skill constraints, 56 percent of firms believed that the Nigerian educational and training system met their needs adequately, although there were sub-sectoral differences with the levels of satisfaction being lower in control system and ICT (47 percent) and higher in the fabrication and construction sector (68 percent).

Table 40: Perceptions of skill availability in firms supplying to the Nigerian oil industry (number and percentage of firms)

	Control systems & ICT	Fabrication & construction	Well construction & completion	Others	Total
Can find adequate skilled labour	84.2	81.8	73.5	100	80
Have to employ skilled labour educated abroad	47.4	31.8	23.5	20	31.3
Share of non-Nigeria skilled labour					
up to 10%	22.2	42.9	50	-	36
11%-20%	55.6	14.3	50	100	44
above 20%	22.2	42.9	-	-	20
Educations/training provided in Nigeria meet company's requirement	47.4	68.2	52.9	60	56.3

Source: Oyejide and Adewuyi (2011)

The training response

In the context of these skill shortages inhibiting the competitiveness of the lead commodities firms and their suppliers and customers, both governments and firms responded with training programmes, albeit to a varying degree.

In **Angola** the supplier firms ran intensive in-house training programmes, involving both on-the-job training and sending labour to affiliates abroad (Table 41). Most of the training abroad is in the USA and Europe (83 percent), but some also occurs in Brazil (25 percent) and South Africa (10 percent). Most of the firms (88 percent) have funded local learning institutions, of which the bulk (54 percent) was directed to the National Petroleum Institute (INP), and 46 percent to other institutions. Nearly half the respondents (43 percent) have collaborated with local institutions in curriculum development. Of these, 83 percent have had such collaborations with the INP

Table 41: Local content and intra-firm training in Angola (% of respondents)

	Yes	No	INP	Various
Do you have in-house training programmes	100	0	--	--
Do you train employees on-the-job	100	0	--	--
Do you train employees abroad	100	0	--	--
Do you have a funding policy for local learning institutions	88	12	--	--
Which local learning institutions have you funded to date	--	--	54	46
Have you collaborated in curriculum development with any local institution	43	57	--	--
Which local institutions have you collaborated with in curriculum development	-	--	83	27

Source: Teka (2011)

Given its single-minded focus on increasing participation by Angolans in the oil industry (which as we saw in the discussion on the depth of linkages reflects the Angolan government's perception of domestic content), there have been extensive developments in training in publicly-funded institutions, particularly those involving secondary and professional levels skills. There is some disquiet in the private sector however that the focus on these skills training programmes was decided without consultation with the oil sector and the private sector in general. Thus, many of the skills being produced do not meet the specific skills gaps which are constraining linkages to the oil sector, especially higher level skills. This criticism is levelled particularly at the National Petroleum Institute (INP) and the Ministry of Industry's professional training programmes. The National Petroleum Institute (INP) was established in 1983 to provide technical and professional training for oil industry workers and it has been supported with funds by oil companies and oil services companies. But since it was established in 1983, the INP has produced a total of only 1,910 graduates at an average of 72 graduates per annum. The Agostinho Neto University, which is the largest, oldest and the only publicly funded university in the country, only produces an average of 32 engineers per annum. Courses in private universities which have been emerging since 1991 following the legalisation of private education are geared mostly toward social sciences (law, international relations, philosophy, etc), and to some extent information technology. The state-owned oil company, Sonangol, has established three corporate training centres, but only one of the three centres involves higher (tertiary) level skills training. The latter's annual enrolment capacity per annum is 480. Thus, despite these different initiatives, the cumulative average of the engineering output by the different higher education institutions is well below the oil sector's needs. Oil companies have estimated that Angola needs to produce around 1,300 higher level technicians (engineers) annually if the targeted rate of Angolanisation of human resources in the oil sector is to succeed.

Moving away from oil to the Angolan construction sector, at the 2006 Forum on China Africa Co-operation (FOCAC) Summit held in Beijing, China's President Hu Jintao announced, as part of an eight-point plan, that China would provide training for African professionals. Chinese small and medium enterprises (SMEs) operating in Angola were encouraged to invest in human resources development. In the construction sector, some of the larger SOEs sent students to China to study engineering and architecture and other relevant skills, but expected them to either work for the SOE on their return or to work n other infrastructure projects in Angola.

In **Nigeria**, almost all the major oil companies investing in Nigeria carry out training programmes and sponsor education through grants of scholarships. A good example is Shell which has made a wide-ranging commitment to training which includes:

- The Shell Intensive Training Programme, introduced in 1998 with the objective of preparing young graduates for employment in the oil industry

- University scholarship grants for about 850 university scholarships annually
- The endowment of Shell Professorial Chairs in 7 universities;
- Youth Development Schemes through which they have trained 355 youths in a range of skills such as welding, pipefitting and carpentry, entrepreneurship and leadership development and conflict management;
- Building of infrastructure that promotes education. For example, in 2004 Shell completed a total of 86 infrastructural projects, including classroom blocks, teachers' quarters and libraries, among others.

However, most of these oil-company sponsored training programmes are designed to meet its own needs, the needs of the oil-extracting sector or wider society. None are specifically focused on enhancing skills in the industries supplying inputs to Shell or other oil companies.

The Nigerian government has made large investments in training to meet the needs of the oil industry. The Petroleum Technology Development Fund (PTDF) was established in 1973 and was given responsibility for developing, promoting and implementing petroleum technology and human resource development. This was to be achieved through research and the training of Nigerian as graduates, professionals, technicians and craftsmen in the fields of petroleum and other engineering areas, geology, geosciences, management, economics and other relevant fields in petroleum and solid minerals industry, both locally and abroad. The PTDF endowment programme has focused on advancing petroleum technology education in six Nigerian Federal Universities, providing an endowment fund of between $66,000 and $400.000 (N10 mn and N60 mn) per university. The PTDF also carries out a number of programmes including an Engineering Design Training Programme (EDTP), a Welders Training and Certification Programme (WTCP), a Local Scholarship Scheme (LSS) and the Overseas Scholarship Scheme (OSS). Between 2001 and 2006, 450 M.Sc and 84 Ph.D scholars were trained in the OSS programme.

Past attempts by government in establishing a national system of innovation also include the establishment of the Petroleum Training Institute (PTI) in Delta State (in 1973), the Federal University of Petroleum Resources in Delta State, and also the National College of Petroleum Studies in Kaduna (NCPS, in 1995). The PTI functions as an educational institution, and also trains lower and middle level manpower to meet the indigenous labour requirements of the oil and gas sector, while the NCPS is trains high level manpower.

In **Tanzania**, the Mineral Policy (1997) called for the establishment of training institutions in relevant core and industry supporting skills, and for foreign investors in the field to train Tanzanians. However, beyond this broad verbal commitment, the Mineral Policy concern with skill development has seen little effective action. The Act did not specify either target levels for training, or a time-scale for the achievement of its (loosely-specified) goals. Moreover, a provision in the act provides the space for each of the large mines to bargain for specific exemptions, and most often this involves Mining Development

Agreements (MDA) which allow for the unrestricted employment of expatriate labour, both for themselves and for their lead suppliers. African Barrick Gold and AngloGold Ashanti, in collaboration with the Tanzanian Chamber of Minerals and Energy (TCME) and Vocational Education and Training Authority (VETA) have embarked on a technical training project, the Integrated Mining Technical Training (IMTT). The programme is specifically designed to train artisans (tradesmen) and is located at the Moshi VETA institute.

Botswana's diamond linkage policy was very effective in aligning skills demand with skills development through mandating and enforcing intensive training at the firm level. Cutting and polishing are very firm-specific skills, which constitute the firms' core competitive advantage. Locals are mostly trained to specialise in a section of the manufacturing process, in order to protect the firms' competitive command over the whole process. Skills were developed by the cutting and polishing factories through a combination of on-the-job training and apprenticeships in the firms other operations. For the companies to operate efficiently they need a low labour turnover in order to justify the investment they make when training their workers. The firms have made a tacit agreement through Botswana's Diamond Manufacturers Association to refrain from poaching each other's workers.

In **South Africa**, training is fairly widespread in the industry, particularly on the part of foreign owned firms. Data from the 2003 Enterprise Survey showed that 76 percent of foreign firms in the sector offered training. However, there are some indications that the number of firms offering training has declined. In the 2007 survey, only 59 percent of foreign firms and 44 percent of domestic firms offered training. Firms regard the Skills Education Training Authorities (SETA) training system as cumbersome and ineffective. Many firms complained about the declining number of mining engineers and the Chamber of Mines described the situation as "dire."

Mobility of skills

The public nature of skill-development arises from the fact that investors in most forms of training are unable to appropriate the fruits of their investment. This means that skills produced by a particular firm may be used by other firms, either by competitors or by firms in other sectors and other countries. It is for this reason that as a general phenomenon, cutting across countries and sectors, there is systematic market failure in skill provision. But not all skill loss is a loss to the economy. The "leakage" of skills from one firm may be a gain to another, helping to diffuse knowledge and skills through the economy. Where skills leak abroad, the loss may have few positive externalities, except in cases where "brain-drain" subsequently turns into "brain-gain" as nationals return home after gaining experience abroad.

In **Nigeria,** skills spill-over from the mining companies to upstream and downstream, industries and into other sectors were significant (Table 42). More than half of the supplying firms were aware of ex-employees who had developed expertise with the company and were now engaged in other sectors. However, an even larger number of firms (69 percent) employed

personnel previously employed by the oil companies. More than 90 percent of the oil firms confirmed they were aware of ex-employees now in other sectors, whilst more than 80 percent stated that they have employed personnel previously employed by their suppliers.

Table 42: Skill spill-overs in backward linkages in the Nigerian oil sector

	Control system & ICT	Fabrication & construction	Well construction & completion	Others	Total
Aware of ex-employees who developed expertise with the company and are now engaged in other sectors	52.6	59.1	61.8	40	457.5
Employ personnel who were previously employed by the oil companies	68.4	72.7	64.7	80	568.8

Source: Oyejide and Adewuyi (2011)

In **Zambia**, soon after privatisation and the retrenchment of staff in the mines, there was an influx of ex-employees from the mines' operations departments into the supply chain. They had acquired technical skills from the operations department and marketing skills and knowledge of the procurement process form the sales departments in the mines. Although these skills spill-overs were of benefit to suppliers, this benefit was seldom considered to be very critical by the firms acquiring these skilled workers and there was little correlation between these spill-overs and the performance of suppliers (Table 43). That is, the degree to which suppliers drew on the ex-employees of mines (about half of all suppliers did so) showed no clear relationship between three types of upstream suppliers, those with a positive growth trajectory, those who were stable and those who were experiencing declining growth and profitability. In total, 24 firms employed personnel who used to work in the mining companies. Slightly more than 50 percent of this group fared well, but one third did not and exited from the supply chain.

Table 43: Zambian suppliers employing ex-staff from the mines

	Positive performance	Static trajectory	Negative performance	Total
Employed staff from the mines	14	2	8	24
Not employed staff from the mines	9	5	7	21
Not responded	3	-	2	5
Total	26	7	17	50

Source: Fessehaie (2011)

In **Tanzania**, there were limited instances in which skills spill-overs took place. For example three exploration firms were established by ex-employees of mining firms. However, these were limited cases. The mining sector offered better wages compared to other sectors of the economy, which anyway offer limited employment opportunities. Instead the mining sector was drawing skills from other sectors. The most notable and acknowledged skills migration was the flow of logistics and purchasing skills moving from other sectors to the mining field. There has however been a significant (although not

systematically recorded) leakage of skills abroad, and there are reports of Tanzanian mining engineers working in the DRC and other countries. (On the other hand, there are also Ghanaian mining engineers working in Tanzania).

In the **Angola** construction sector, skills migration occurred from the Chinese firms operating in the construction sector. Chinese white collar workers left Chinese SOEs to form their own companies and to operate in the Angolan market. An example is a Chinese design firm of which four of the five Directors had previously worked with large SOEs in the construction sector. One Director estimated that links to their previous employer accounted for around 80 percent of their turnover.

In **South Africa** a combination of factors is leading to the leakage of skills abroad. The skills shortage observed has resulted in some companies moving some of their operations overseas. These firms are finding it advantageous to shift their more labour intensive operations outside of South Africa – notably to China. For example, one of the largest South African operations now fabricates 20 percent of needed capital equipment in China whereas previously equipment was produced exclusively in South Africa. Of more concern to the long term future of supply of mining equipment and knowledge intensive services to the mining industry is that some of the major mining companies are locating their research and development activities abroad. The country favoured is almost invariably Australia; with the main attraction being the availability of highly skilled labour and the linkages to well-funded research centres. Moreover, based on individual decisions reflecting the transition to majority rule in South Africa, a significant number of highly skilled workers are moving abroad, a process made easier by the global shortage of mining skills in a context of a sustained boom in commodity prices and the decline in South African mining activity.

But, the picture is not uniformly negative. The decline in local mining output, particularly in gold, has resulted in a number of highly skilled South Africans selling their expertise abroad and/or moving into mining related activities where they can engage their skills and experience. A number or the specialist mining service companies that have emerged in South Africa in recent years have been founded and developed by persons with skills and experience developed in mining and related activities.

Supportive institutions in the NSI

Given the underdeveloped nature of the industrial sectors in most of SSA, in most cases the role which the NSI plays in the existing pattern of linkages from the commodities sector is limited.

In **Angola**, public expenditure in education has increased in recent years reaching nearly eight percent of State budget. But the country's output in terms of research, science and technology remains very weak. Expenditure on education has grown rapidly, from five percent of government expenditure in 2001 to 7.9 percent in 2009 (Table 44). This increasing proportion is of a growing government budget as revenues expanded during the commodities

price boom. The output of R&D expenditures in terms of patents and journal publications barely registers.

Table 44: Education expenditure and research output

Education budget		Research output per million population		
Year	**% share of budget**	**Year**	**Scientific & technical journals**	**Patents granted by USPTO**
2001	5	--	--	--
2002	5.1	--	--	--
2003	6.2	--	--	--
2004	10.4		--	--
2005	7.1	1993-7	--	--
2006	3.8	1995	0.16	--
2007	5.6	2001-5	--	0.01
2008	7.9	2004-5	0.22	--
2009	7.9	2009/10	--	--

Source: MINFIN (2010); GOA (2007/8); UNCTAD (2008)

In **Nigeria** the NSI and its interactions with the oil and gas value chain is more developed than in Angola. This arises from the relatively higher level of education in Nigeria and the depth of investments in the NSI since Independence. This is reflected in the innovative capabilities of the industries supplying inputs into the oil sector, as well as in the source of support for these innovations (Table 45). More than two thirds of the firms interviewed had access to new technology. This resulted from agreements for upgrading and maintenance with their own suppliers and from technology agreements with foreign companies. A smaller proportion of firms – one-third – had developed relationships with universities and local Research and Technology Organisations such as the Petroleum Training Institute and the Nigerian Institute of Welders.

Table 45: Innovative activities amongst suppliers and the sources of innovative support (percent within sector)

	Control system & ICT	**Fabrication & construction**	**Well construction & completion**	**Others**	**Total**
Access to new technology	78.9	81.8	67.6	100	76.3
local innovation/tech agreements with foreign companies	57.9	40.9	44.1	60	47.5
agreements for upgrading& maintenance	63.2	50	58.8	80	58.8
relationship with local research centres or the university	42.1	27.3	32.4	40	33.8

Source: Oyejide and Adewuyi (2011)

In **Ghana**, Research and Technology Organisations have been established over the years including the National Research Council out of which emerged the Ghana Academy of Arts and Sciences and the Council for Scientific and Industrial Research (CSIR); the Noguchi Memorial Institute for Medical Research; the Ghana Atomic Energy Commission (GAEC); the Ghana Standards Board (GSB) and the Cocoa Research Institute. However, despite the existence of these RTOs, in general Ghana's NSI remains weak due to

lack of investment and proper management of S&T, and is specifically weak in relation to institutions focusing on either the needs of the gold sector or its suppliers. Total expenditure on research and development (R&D) as a percentage of GDP is less than one percent.

Tanzania's 1997 Mineral Policy articulates a vision of establishing "centres of technical excellence in various fields for capacity building, and setting up mechanisms for exchange of knowledge and experience" and promoting linkages with universities, colleges, research institutions and industry. This sectoral policy vision resonates with the vision of the Tanzania Commission for Science and Technology. Evidence however indicates that this coalescence of visions is yet to be implemented. First there are no centres of excellence to support the mining industry in Tanzania. The Tanzania Industrial Research and Development (TIRDO) does not include mining sector research in its portfolio, and nor does it target linkages with the mining sector. And, second, there is limited interaction between what institutions do exist in the NSI and the commodities sector. Mining companies reported that their only interaction with the universities was when undergraduate students receiving training from the mines as part of the curriculum and when students conducted firm-sponsored research projects as part of their final year undergraduate studies. An exploration manager with a mining firm characterised these interactions as "minor and inadequate".

Botswana's 2005 National Research, Science and Technology plan focused research into mining bi-product utilisation; research into downstream processing and beneficiation of mining products; research seeking to improve the efficiency of current processing technologies including environmentally cleaner production technologies; ICT research to support process control; and chemical sciences and engineering and research into improved extraction and processing technologies. This plan for the industry is yet to be implemented.

Zambia's total budget allocated for innovation and skills creation was low. Activity-based budgets are available only for 2004, and reveal that on average less than one percent of the total government budget was devoted to innovation and skills in that year. Moreover, most of the allocation was spent on recurrent expenses. This was compounded by very low private sector R&D. Linkages between public institutions in the NSI and the private sectors were almost non-existent. This meant that the research conducted in public institutions was rarely transferred to commercial exploitation. The 1997 Science and Technology Act established a number of institutions, which from 2009 were endowed with a Strategic Research Fund. The latter, however, did not target specific industries. Respondents from the National Technology Business Centre (NTBC), the body responsible for working jointly with the private sector on innovation technology, reported undertaking no project with the suppliers in the Copperbelt.

In **Gabon**, there is a shortage of trained scientists at domestic scientific institutions. For example, the Agricultural and Forestry Research Institute (IRAF), which is part of the National Scientific and Technological Research Centre (CENAREST), has 22 full-time researchers for four departments,

including one in forestry science. The same holds true for educational institutions like the Schools of Forestry at the University of Omar Bongo and the National Water and Forestry School (ENEF) at the University of Masuku. Graduates are reluctant to work in the logging and processing areas. None of the logging and processing companies were familiar with what training programmes existed and were not willing to invest time and financial resources into developing links with these institutions.

In South Africa, the competitiveness of the mining equipment industry is hampered by deteriorating mining-related research capacity at the CSIR and MINTEK. Skilled personnel have been lost and a number of programs closed, particularly at the CSIR. Formerly COMRO – the research arm of the Chamber of Mines – undertook very significant research on behalf of the industry. The CSIR which absorbed COMRO continued to have large scale mining research projects – principally in trackless mining and rock engineering. However, these research programmes had a limited life and currently the capacity at the CSIR has been depleted almost to extinction. It is widely stated in the industry that MINTEK has seen a significant decline in its capacities. The Council for Geosciences is similarly said to be experiencing difficulty and losing staff.

Few of the firms interviewed in mining specialist services and equipment in South Africa had significant links with the Science Councils which fund research – and where they did, these links were becoming more limited over time. Firms make much more use of privately funded research. There appears to have been a significant growth in local research consultancies that serve the industry that undertake research or provide specialist consultancy services. Local firms are increasingly accessing publicly funded research institutions and universities located abroad, particularly in Australia.

General lessons of the contribution of the NSI to linkage development

Capabilities, and the growth of capabilities, are the essential ingredients of a broadening and deepening of linkages between the commodities sector and other sectors of the economy. Beyond this broad and self-evident statement, our research identified two sets of capabilities which were of particular relevance to the lead-commodity firms and to their suppliers and customers. These were skills – their number and quality, the training programmes which created them, and their mobility – and the National System of Innovation.

Across the board, and to varying degrees, the skill constraint was reported as being a critical determinant of linkages. The shortage of skills is not unique to SSA, or to the commodities sector in general. However, it is particularly acutely felt in the SSA commodities sector with the partial exception of the Nigerian firms supplying fabrication and construction; well construction and completion; and control systems and ICT services to the oil industry. It is not surprising, therefore, that the single factor holding back linkage development across the sectors is that which relates to skills shortages. In many cases, governments have set specific targets for the commodities sector on the employment of local skills. Yet, at the same time, despite governments targeting the greater use of local skills in the commodities sector, the levels of

training provided were almost always considered to be very inadequate. The disciplines taught were not attuned to the specific needs of the commodities sector, the levels of training were insufficient and there was generally an inadequate intercourse with the users of skilled labour on what types of skills were required. It is not surprising therefore that in most countries there was simultaneously both the need to import skills from abroad and a loss of domestically-trained skills migrating to other countries. Moreover, and this might be considered fine-tuning given the gravity of the problem, only in Botswana was there any evidence of targeting the specific skill needs of firms supplying inputs into the commodities sector and beneficiating the outputs of the sector.

The picture which emerges with regard to the NSI is perhaps even more striking. Whilst each of our sample countries had institutions in the NSI which nominally addressed the needs of the commodities sector and its linkage firms, it was only in Nigeria and South Africa that there appeared to be any resulting productive synergies. And even here, the formerly world-leading innovative capacity in South Africa's mining support institutions is in danger of bleeding away, with a decline in the quality of mining engineering graduates and the emigration of experienced engineers. Their bidding-away by aggressive recruitment policies in Australia and other countries is graphic evidence of the value of a strong NSI.

3.4 Policy development, management and implementation

Competitiveness is a moving frontier. The confluence of factors which makes a firm, a value chain, a region or a country competitive at a particular point in time seldom endures. Competitors soon enter the fray and the only route to sustaining incomes is to endogenise the ability to learn and change. This is generally loosely referred to as the capacity to innovate which has become the holy grail of both corporate and national policy in recent decades. However, it has become increasingly evident that the word "innovate" is in itself not very helpful. It masks a series of subsidiary processes, each of which has its own particular challenges. At the one end of the innovation cycle is the capacity to "invent", to introduce a new idea for a product, or a process or a way of organising production. In general, this is the "high-tech" end of the innovation cycle. However this stage of invention is in itself not a guarantor of success, as the invention has to be translated into a product or service which consumers find attractive and which produces returns which exceeds the costs of introduction. Thereafter, this useful and valued invention has to be produced, marketed and distributed in a timely fashion, and with due attention to costs, quality and delivery. Together, all of these diverse stages are referred to as "innovation management" a burgeoning field of analysis which recognises that whilst the assembly and coordination of these innovation inputs may not be rocket-science (at least by comparison with the inventive stage) it may indeed be the most difficult stage in the innovative cycle (Tidd, Bessant and Pavitt, 2005).

A further important lesson learned from the analysis of innovation is that the most successful managers of innovation do not see it as a sequential process

which starts with a process of producer-driven invention, which is then subsequently passed through the various links in the value chain until it reaches the final consumer. Instead, the most successful processes of innovation occur when the various parties in the innovation chain interact throughout the innovation process, and where final users play an important role in the pulling, shaping and sometimes moulding of innovations (Gibbons, 2001; von Hippel, 1986).

Our analysis of the role that policies play in the promotion of linkages in the commodities sectors in the African countries under review draws on these insights from innovation theory. We begin by asking the question about the nature of the "invention", that is do governments and firms have a Vision for the promotion of linkages from commodities? From this follow a series of "management of innovation" type concerns – is the vision translated into policies, and are these policies coherent? Are these policies backed by incentives which ensure that they are implemented effectively? And does the government and the corporate sector have the capacity and the will to implement these policies? Finally, there is the issue of reflexivity – do the various stakeholders who relate to the management of linkage policy interact, and do they as a collectivity, display the capacity to adjust policies dynamically?

Angola

The primary focus on local content on backward linkages in Angola has been on the Angolisation of the labour force. A subsidiary concern has been the development of local supply chain to the oil industry. However, to all intents and purposes, the Angolan government has conflated "local value" with local ownership. This is as much an agenda of national identity as one of promoting the development of the local economy through the development of linkages from the oil sector. Targets were set on the proportion of Angolan labour in both the extractive and supply industries, which aimed at 100 percent Angolan labour at basic skills level, 80 percent at mid-skills level and 70 percent at higher skills level. However, an industry-wide assessment carried out in 2004 indicated that while the targets for basic and mid-skills levels were exceeded, the target for higher skills level remained below target.

As we saw in the discussion of the breadth and depth of linkages, a three-tier system has been established for Angolan content in the supply industry (supply of goods and services). Goods and services of low capital and knowledge intensity have to be purchased from national companies. Goods and services with average levels of capital and know-how have to be supplied by joint venture companies between national and foreign companies. Lastly, no preferential treatment is applied to highly-technological and capital intensive goods and services. Local content policy does not identify these products in detail and these are settled by bilateral negotiation between government and the oil industry, providing much scope for discretionary decisions (and bribery) by individual government offices. National suppliers are defined as firms that are fully-owned by Angolan citizens or 51 percent of share capital is owned by Angolan citizens. However, preferential treatment applies only to inputs supplied at a premium of less than 10 percent over the

cost of imports. These provisions apply to all contracts above $150,000. It is notable that there appear to be no provisions forcing the degree of local content in these domestically-sourced inputs, and hence in most cases local content has only minimal local value added.

This policy environment suggests a broad, but poorly specified vision on linkages. That is, government knows what it wants (more local participation and ownership), but this is weakly translated into policies designed to promote any depth in backward linkages. Sonangol has responsibility for implementation, together with the Ministry of Petroleum But there is a limited institutional and support base to realise these targets.

There are a range of problems in the implementation of the local content policy. The allocation of inputs in the three tiers of technological complexity (Table 46) – which appear to have been arbitrarily determined - underestimates the technology and capital content of most of the products the policy designates to be of average technology and capital levels. Moreover, the national training institutes are focussed disproportionately on mid-level technical skills. Finally, there is a lack of coordination and integration between industrial policy and policy towards the oil sector. Industrial policy is the responsibility of the Ministry of Industry, whilst policy towards the oil sector (including with regard to backward linkages) is the responsibility of the Ministry of Petroleum and Sonangol. There are no joint-working arrangements in policy design and implementation between the Ministry of Industry and Sonangol and the Ministry of Petroleum. Consequently, there is a lack of policy coordination between industrialisation policy (as far as incentives and capability development programmes are concerned) and oil sector policies.

Table 46: Categories of preferential products since 2003

Exclusive to local firms	Exclusive to joint-venture firms
Food stuffs & Catering, Transportation of equipment & materials, Supply of technical materials (IT & electric equipment, etc), General Cleaning & Gardening General maintenance of equipment & vehicles, Operation and management of supply points (service stations), Retailers of lighting oil, gas & lubricants, and Transport of goods from terminals to supply points	Purchase/processing of geographical data; Vertical, directional, horizontal drilling of wells & completion; Geological control of drilling (mud logging); Production tests; Operation & maintenance of oil production installation; Operators & managers of terminals; Manufacture of plastic/synthetic fibres for the oil industry; Drilling, production material, etc

Source: Teka (2011)

For example, Business Development Service Centres (BDS) are a public-private business capacity development initiative intended for local SME development in the different sectors of the economy. It is an initiative between the Angolan government, UNDP and Chevron (American oil producing company and the oldest operator in the Angolan oil market). This initiative is implemented by Chevron in collaboration with other oil operators and Sonangol without any involvement from the National Private Investment Agency (ANIP) or the Ministry of Industry. Moreover, Sonangol (as the public sector partner) only recognises but does not support the initiative with any

tangible incentives comparable to the ones offered to local firms in the concession market.

Botswana

The Government of Botswana has a particularly well-developed vision for the development of forward linkages from the diamond mining industry. This sector specific policy is rooted in the National Development Plan (2006 and 2009), which identified six strategic objectives to guide the future development of the economy - education, innovation, agriculture, medical, transport and the diamond industry. It is intended that there will be strong links between these strategic interventions. For example the diamond hub will be supported by the education hub which will produce skills for the different industries in the diamond hub, whilst the innovation hub will attract business to perform research for the industry and the transport hub will ensure that the all the necessary transport infrastructure needed by the industry is in place.

This is not the first time the Botswana Government has targeted downstream beneficiation. Faced with the likely exhaustion of low-cost near-to-the-surface diamond mines, attempts were made in the early 1980s to promote a cutting and polishing industry. De Beers did not support the government's ambitions at that time, arguing that cutting and polishing activities were not economically viable in Botswana. But after political pressure was exerted on De Beers, three cutting and polishing factories were started between 1980 and 1990. However government policy at that time was not backed by clear monitoring or strong sanctions and none of these factories ever reported a profit or showed any signs of expanding. Although this early attempt was a failure, it proved to be an important learning experience.

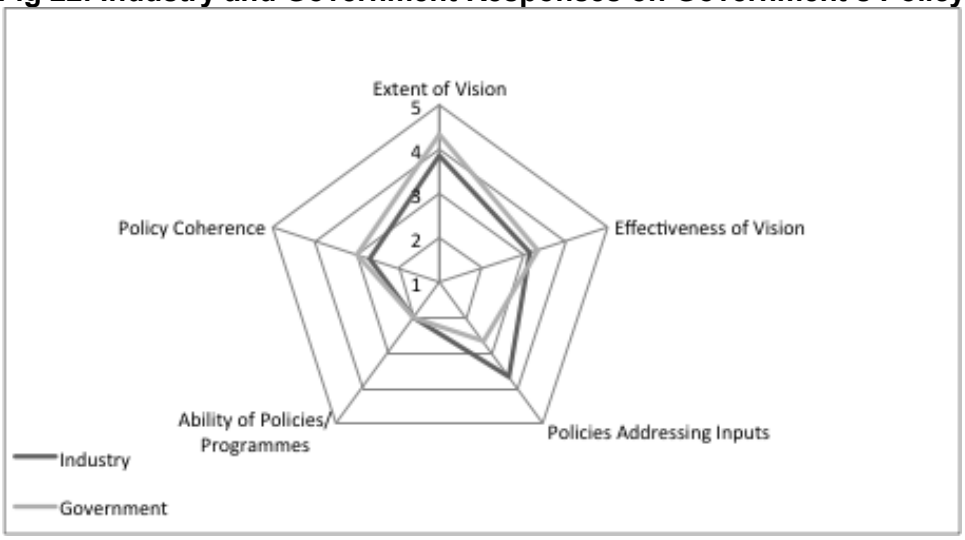
After employing consultants to map the value chain and determine an appropriate path to deepening forward linkages, an ambitious Vision for diamond beneficiation was developed in 2005, this time backed by clear supportive policies and by strong sanctions. An opportunity was provided for this Vision by the expiry of De Beers 25-year diamond mining lease. The fact that De Beers sourced more than half of its diamonds from Botswana through a 50-50 joint venture with the government (Debswana) gave the government significant bargaining power. As part of the new agreement a 50-50 joint venture between the government and De Beers, the Diamond Trading Company (DTC) Botswana was established and clear performance targets were set. The agreement stipulated that these sales and employment targets should be reached by 2010, the penalty clause for non-performance for De Beers were such that the employment target was met rapidly. In 2010, $482m of rough diamonds were sold to the 16 sight-holders by the DTC Botswana and according to the agreement at least 80 per cent of the rough diamonds have to be cut and polished domestically.

In order to implement this strategy, the Botswana Government established two sector specific institutions, the Diamond Office and Diamond Hub. The Diamond Hub is the sector executive agency tasked with the practical implementation of policy. To this end the Diamond Hub has implemented five policies designed to provide a favourable business environment for the

industry. The first is a reduced corporate tax rate (15 percent rather than 25 percent) for the cutting and polishing firms. The second provides for the fast-tracking of Work Permit applications for skilled labour used to train locals, and for labour visiting to maintain and repair their equipment. The third is an exemption from paying the economy-wide training levy if firms have their own training programmes (which have to be accredited with the Training Authority). The fourth is an exemption from paying taxes on polished diamonds exports and the fifth is that the sight-holders do not have to pay import duties on their technology imports. The Diamond Office is responsible for the inspecting diamond exports, issuing Kimberley Process[12] certificates and, together with DTC, for monitoring the activities of the companies by undertaking six-monthly audits.

Thus the government has a clear vision, backed by policies which embody both negative sanctions (exclusion from rough diamond supply) and positive sanctions (exemption from work permits, import duties and lower taxes). What happens on the ground, and does the government have the capacity to implement and monitor these policies? It is only five years since the programme was introduced, but the trajectory is in general a positive one. Based on interviews with three senior government respondents and seven senior industry managers (five of the 13 Sight-holders and two brokers), it seems that there is a clear dialogue between the public and private sector, since in general both sets of respondents weighted the coherence of the Government's vision and policies similarly (Figure 22). Moreover, as one senior private sector executive observed, "Policy is working with and not against the industry, the culture is very open and we can recommend things to the Diamond Hub". The major difference in perspectives was that the private sector felt that government policies were more promoting of backward linkages than did the government officers themselves.

Fig 22: Industry and Government Responses on Government's Policy



Sample size: 3 government respondents, 7 industry respondents (5 manufacturing firms and two brokers). Key: 1 – Not at all, 2 – Slightly, 3 – Moderate, 4 – Very and 5 - Extremely

Source: Mbayi (2011)

[12]The Kimberly Process Certification Scheme certifies diamond rough exports and imports in over 70 member countries to confirm that they are from conflict-free sources.

Having a vision and complementary policies is of course one important strand of effective policy implementation. But it needs to be backed by the capacity and the will to implement these policies adequately. Here there is agreement between the government and private sector respondents on the integrity of government efforts and, in general the will of government to execute its policy. Not surprisingly, however, government respondents tended to rate their capacities to implement these policies more highly than did the private sector (Table 47).

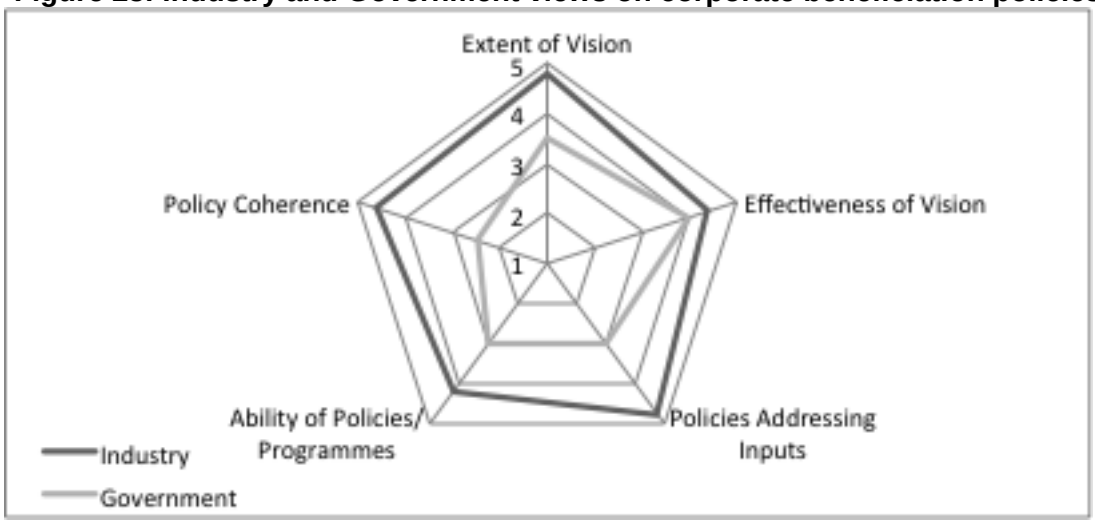
Table 47: Industry and Government responses on Government's Capacity (percent response)

	Government (n=3)		Industry (n=7)	
	Yes	**No**	**Yes**	**No**
Do you think the government has the *capacity* to implement its policies for the cutting and polishing industry?	100	0	29	61
Do you think it *really wants to*?	100	0	86	14
Do you think issues of personal integrity amongst the relevant government officials affect the Government's ability to implement its policies for the industry?	0	100	0	100

Source: Mbayi (2011)

Most often "policy" is seen as an agenda for government alone. Yet it is firms who manufacture rather than the government, so it is also important to interrogate firm-policy in the same way as that of governments. Do firms have a vision, is this backed by consistent "policies" (for example, supply-chain development policies), do these policies have sanctions (suppliers are rewarded or "fined" for poor performance) and do they have the will and the capacity to implement these firm-specific routines? Again, it is of interest to assess the views of both government and private sector respondents on these issues, in the same way as we have done fro government policies. Figure 23 shows a much greater divergence in assessment between these two sets of respondents than was the case for government policies. The private sector believed that it scored highly on all the relevant counts, whilst government officials were more sceptical of these firm-specific capabilities. Neither of the two government officials polled on this issue believed that the firms really wanted to implement their beneficiation strategies, whereas four of the five companies responding to this question believed that the private sector as a whole did indeed want to push through their commitment to cutting and polishing.

Figure 23: Industry and Government views on corporate beneficiation policies



Sample size: 2 government respondents, 5 industry respondents (manufacturing firms)
Key: Where: 1 – Not at all, 2 – Slightly, 3 – Moderate, 4 – Very and 5 - Extremely
Source: Mbayi (2011)

Gabon

Gabon has a clear vision for the broadening and deepening of forward processing. The 2001 Forestry Code established direct local processing requirements in which 75 percent of timber production needed to be processed domestically before exportation by January 2012. Prior to that, beneficiation had largely been driven by the private sector reacting to changes in European consumption patterns. Timber beneficiation is also part of the 2006 Growth and Poverty Reduction Strategy Paper, which aims to develop a private-sector driven diversified economy and to reduce poverty. As part of the 'reform' process, the government issued a Sectoral Programme for Forests, Fisheries and the Environment that, inter alia, focuses on environmental considerations and the maintenance of a sustainable and regulated tropic timber logging and processing industry.

After the entry of Asian firms as serious investors in the timber value chain, the close-fit between government and private sector policies (in which both stakeholders were driving forward linkages) weakened. Between 2004 and 2007, the volume of plywood exports decreased by over 40 percent. In particular Asian-owned and small Gabonese firms concentrated on the export of raw, unprocessed logs to China, contrary to the objectives of the Forestry Code. At the same time, there is evidence to suggest that logging which does occur in parts of Gabon flouts the Code's provision on sustainable logging practices. It was thus clear that the objectives of the 2001 Forestry Code were being undermined by the actions of the private sector. The government responded in August 2010 with a total ban on log exports, a sledgehammer approach whose consequences are as yet unknown.

We can thus observe a policy environment where there is a clear vision (forward linkages and sustainable logging). However, whilst the Forestry Code set explicit targets, rules and incentives, the translation of these into day-to-day routines has been weak. This is a result of government failure, the political economy of Gabon and poor private sector compliance (though

varying by ownership). The response of the government was a heavy-handed sanction with untold economic consequences but even then, weak will and capacities in government threaten to undermine what policy coherence exists.

Ghana

The Government of Ghana has a vision for backward linkages from the gold mining industry which is loosely articulated as giving preference to “made in Ghana” products, to public corporations, to domestically-based firms and to the employment of Ghanaians. Detailed legislation included provisions for local content, but these were not part of a vision for linkage development. It was not backed by specific sanctions and, as an instrument of industrial policy, has had little impact on either the breadth or the depth of linkages. The most detailed of these poorly-specified policies on local content were those which required the mines to submit detailed programmes for the recruitment and training of Ghanaian personnel.

In recent years there has been a groundswell of concern that the mines have been operating as enclaves even though, as was shown in the earlier discussion of breadth and depth of linkages, local content has grown as a consequence of market forces (rather than of government policy). This has led the Ghana Chamber of Mines (GCM) and individual companies to commit themselves to a policy to develop local business through the Local Business Development Programme (LBDP). This programme also overlaps with a series of CSR policies designed to promote near-sourcing into the mines and in so doing to benefit the local communities in which the mines are located.

This is an embryonic policy and does not function effectively, for three sets for reasons. First, there is a lack of coordination between industrial policy and the policy framework affecting the mines. The Investment Promotion Agency which is responsible for industrial policy implementation is, by law, banned from working with the mining and oil sectors. Second, the tariff structure exempts mining companies from import duties on a wide range of inputs. This does not apply however to the mining supply firms, who continue to pay tariffs on the import of their inputs. This has the effect of favouring the importation of inputs rather than in obtaining them from domestic suppliers. And, third, suppliers and service companies, notably SMEs, confront difficulties in accessing finance and generally pay high interest rates. The local banking system also has only a limited developmental capability and SMEs are poorly supported.

Nigeria

Nigeria has a long history of policy development focusing on an increase in backward linkages, and local content legislation dates back to the late 1960s. The first provisions were found in the Petroleum Act of 1969. Later, the joint operating agreements (JOA) and the production sharing contract (PSC) between the Nigerian government and the foreign oil companies in 1991 and 1993 respectively, included provisions for the involvement of indigenous firms in the supply of commodities. In 2005, a Nigerian local content policy involved the issuance of 23 directives designed to promote backward linkages through provisions on the domestic supply of goods and services and the awarding of

low-tech on-shore supply of goods and services to indigenous firms. The government set targets of 45 percent local content in the oil and gas sector in 2009 and 70 percent in 2010. There has thus been a sustained policy environment designed to promote a greater breadth of input provision.

The Vision for the promotion of backward linkages was strengthened in 2011 when The Nigerian Content Act (2010) was enacted:

> *Nigerians independent operators shall be given first consideration in the award of oil blocks; oil field licenses, oil lifting licenses and in all projects for which contract is to be awarded in the Nigerian oil and gas industry. In the bidding for any license, permit or interest and before carrying out any project in the Nigerian oil and gas industry, an operator shall submit a Nigerian content ('Plan') to the board demonstrating compliance with the Nigerians Content Act. Finally, the award of contract shall not solely be base on the principle of the lower bidder; where a Nigerian indigenous company has capacity to execute such job, the company shall not be disqualified exclusively on the basis that it is not the lowest financial bidder, provided the value does not exceed the lowest bid price by 10 percent*.

This strengthening of local content policy was embedded in a wider Vision for the economy as a whole. Vision 2020 specified particular targets and sanctions for the oil sector, including for backward linkages. The First Implementation Plan covered the period 2010-2013 and included provisions for the promotion of private sector investment in both upstream and downstream links of the oil and gas industry and the growth of national content in value added. The very ambitious target was to increase local content in oil and gas from 2 percent in 2009 to 35.5 percent in 2010 and to 70 percent by 2013. Thus, whereas the earlier legislation was focused on national ownership and the breadth of linkages, the 2010 legislation also explicitly targeted the deepening of value added.

These ambitious targets for local content have not been met in the past. This was partly because local capabilities did not allow for production costs at a premium of less than 10 percent above the import price and partly because there was no systematic monitoring of these targets by the Nigerian National Petroleum Company (NNPC). Nevertheless, as can be seen from the comparison of local content in Nigeria compared to other SSA economies (see Section 49 above), there has been a substantial growth in domestic content, at least in the sub-sectors which we have examined. Two-thirds of the Nigerian supplier firms we interviewed said that local content policies had been an important driver of their linkages to the oil and gas sector. Nevertheless despite the general strategic thrust of local content policy, there are significant inconsistencies between different government policies (Table 48). Suppliers to the oil and gas industry reported that there was greatest conflict between deepening their linkages and the need to respond to policies on import tariffs and taxation.

Table 48: Consistency of government regulations with meeting objective of increasing local content (percent)

Regulations	Consistent	No opinion	Inconsistent	Mean
Ownership regulations	37.5	45	17.5	2.20
Labour market regulation	32.5	42.5	25	2.08
Taxes/tax holidays/duty rebates	26.3	36.3	37.5	1.89
Licensing	33.8	41.3	25	2.09
Import tariff	18.8	38.8	42.5	1.76
Business registration and start up	32.5	46.3	21.3	2.11

Source: Oyejide and Adewuyi (2011)

Thus the Nigerian policy environment is one in which the government has developed an increasingly global Vision for the sector over the past decade. The early focus on local content policy has been sustained and is now complemented by a more decisive understanding that localisation does not only refer to ownership of suppliers, but also to the depth of value added. The policy environment has a number of inconsistent elements to it, and has in the past been poorly monitored. Nevertheless, notwithstanding the weaknesses in policy integration and implementation, local content policies have been an important driver of the increasingly broad and deep participation of local suppliers in the oil and gas value chain.

South Africa

South African mining equipment and specialist services activities have developed progressively over many years to serve a long-established local mining industry. Moreover, the scale of mining allowed for local supply firms to exploit economies of scale while the diversity of South African mining allowed local firms to exploit economies of scope with many buyers who found it advantageous to source specialist outside expertise from external suppliers. Further, the extraction and processing of South African minerals presented very significant technological challenges allowing for the development of local expertise and technological capacities. State support took a number of forms including policies to encourage import replacement through tariff protection, extensive support for world-class training in mining engineering and artisanal skills and the development of significant research institutions and funding.

However, in recent years, governmental policies have not been supportive of mining or mining equipment and specialist services. While the prices for South African commodities have risen, by contrast with other countries with a well-developed and diversified mining sector such as Australia, in South Africa mining output remained effectively static. Output growth was constrained by uncertainty over property rights – a combination of government changes to existent mining rights; perceived uncertainty and corruption in the awarding of mining rights and threats of nationalisation. Output was further constrained for some minerals, notably coal, by infrastructural bottlenecks. Not only were ports and rail failing to invest in additional capacity to handle increased tonnage, but there was a deterioration in existing capacity.

In regard to the mining equipment and specialist services sector specifically, government support is very limited. The sector receives no financial support and it does not appear in the technologies identified for support in the Department of Science and Technology's 10 year plan (DST, 2008). The DST has instead chosen to support science-intensive activities – including space science, energy, climate change, biotechnology and human and social dynamics. None of the supplying companies interviewed made extensive use of any of the government technology support programmes for firms. Some companies did claim the R&D tax credit administered by the DST, but the applied nature of the research and design in mining equipment and specialist services meant that many of the expenditures related to applied technology development in mining sis not qualify for support.

Mining equipment and related services was not included in the National Industrial Policy Framework nor in the Industrial Policy Action Plan (IPAP). Instead, industrial policy has focused on beneficiation rather developing backward linkages or extending the technological capacities developed in mining equipment and specialist services laterally into new non-mining markets and products

Tanzania

In the heady post-Independence years of Ujamaa, the Government of Tanzania had grand ambitions for the development of the economy as a whole, and within this, for the exploitation of its natural resources. As part of this, the mineral sector was reserved for the state. Years of successive economic stagnation led to the abandonment of the Ujamaa policies from the mid 1980s, and after some years of policy stagnation, the minerals sector was subject to a major change in policy environment. This reflected a more general process as Tanzanian domestic policy-making capacities were replaced by externally inspired structural adjustment policies.

The 1997 Mineral Policy of Tanzania was an attempt to provide for the development of the minerals sector. Its prime purpose was to attract inward FDI into the mining sector. But beyond a vague commitment to local sourcing, it failed to address either the breadth or the depth of linkages. It articulated a vision of "developing the country's ability to provide essential inputs to the mining sector". However the objectives of these and other sections of the Mineral Policy lacked specific targets. In addition there were no specific positive incentives or negative sanction promoting the achievement of this broad goal. No targets were set and no clear monitoring mechanisms were developed to ensure the local content could be encouraged. The primary concern of local content policy – to the extent that there is any – is one which conflates local content with local ownership. Key steps in the exploration sector are reserved for Tanzanian companies, and (somewhat eccentrically), Tanzanian-control is defined as 100 percent ownership by local citizens, rather than majority ownership.

The failure to develop policies designed to directly promote backward linkages was reflected in similar policy failure with regard to the drivers of linkages which were considered earlier in this Report. Tanzania's infrastructure is in a

woeful state, and recent improvements have been limited. Roads leading to some mines remain unpaved and some mines like the Geita Gold Mine are yet to be connected to the national electricity grid. The supply of utilities supplies is highly erratic and they are of poor quality. Skill development is poor and inadequate. Moreover, to compound these weaknesses, policies are inconsistent. Mines have access to duty free imports of inputs, but this does not apply to their suppliers, who therefore face a double disadvantage – a weak infrastructure, and disadvantageous tariffs on their own imported inputs. Further, each of the new mines strikes bilateral agreements with Government on specific provisions and rather than this resulting in increasing obligations on foreign investors, in general these have led to individual TNCs bargaining for specific exemptions on the employment of expatriates, on tax and on duty free imports. All of these have the effect of reducing rather than increasing backward linkages.

Recent changes to the Mining Act in 2010 contained some provisions which might improve the environment for suppliers to the mines (Perkins and Robbins, 2011). In applications for prospecting licenses and mining licenses mining companies are expected to provide a list of goods and services which might be supplied by local firms. However, no targets have been set, there is a total absence of incentives and sanctions and there are no provisions for monitoring Progress. Finally, exacerbating the situation is a milieu of pervasive corruption, with various provisions in the legislation allowing for individual discretionary decisions, chaotic physical infrastructure and weak soft infrastructure (such as customs clearance). All of this provides ample scope for the exercise of discretion by individual gatekeepers of permits and certification.

Zambia.

As in the case of Tanzania, the early post-Independence policy agenda in Zambia was characterised by a strong commitment to a nationalist agenda. In 1969, Zambia nationalised the copper mines, and placed them under the umbrella of Zambia Consolidated Copper Mines (ZCCM). The long history of mining in Zambia had led to a situation in which there were extensive backwards and forwards linkages. However, economic decline led to stagnation and then a fall in mining output after the mid-1970s. As was the situation in much of continent, the consequences was a series of Structural Adjustment Programmes, reflecting a policy agenda set by parties external to Zambia, and leading to major programmes of privatisation and liberalisation. By 2001, all of copper the mines bar one (KCM) had been privatised. The liberalising of mine ownership was associated with the liberalisation of imports, and this policy environment led to a major increase in the import of inputs and a reduction in backward linkages. In other words a policy environment which had led to the development of extensive linkages, not so much as a consequence of strategic and focused government policy, but as an indirect consequence of policies towards industry, in general, was swept away, removing the incentives for the broadening and deepening of backward linkages.

The economic policy of the years following privatisation was geared towards private sector development. Within this, policy-makers failed to see the potential for private sector development in the localisation of upstream linkages. These were not included in any industrial and private sector development programmes. In 2007, the World Bank, through the IFC, undertook a suppliers' development programme in the Copperbelt Province. This was, and remains, a donor and private sector-funded programme, with little ownership from Government. Staff from the relevant ministries attended only a few initial meetings.

The legal framework for the mining sector privatisation process was set by the 1995 Mines and Minerals Act. The Act liberalised the investment regime and provided for fiscal incentives to be negotiated with each mining company and enshrined in Development Agreements (DAs). The 1995 Act, and later the 2008 Act, granted the mines VAT exemption and eliminated custom and excise duties on all machinery and equipment. The tax regime only applied to the firms holding mining rights, which included the mines but not their suppliers. Suppliers of capital goods, therefore, paid a customs duty ranging from 15 to 25 percent for some goods (unless these goods qualified for preferential regional trade agreements under SADC), plus VAT on all imports. This measure conferred a cost penalty on local suppliers since mining imports were duty free.

All the Development Agreements included provisions for local procurement, to be monitored by an inter-ministerial committee comprising the Ministry of Mines and Mineral Development and Ministry of Commerce, Trade and Industry. However, these provisions were largely disregarded by both the mines and Government, with the exception of a limited IFC-led suppliers' development programme. Poor institutional capacity in the Ministries involved meant that no comprehensive assessment of the supply chain was conducted, nor were monitoring mechanisms established or support programmes designed. This was due, among other reasons, to high staff turnover in the Ministries, lack of clear implementation and monitoring mechanisms and a highly personalised style of management, which built on individual rather than institutional, capabilities.

Thus, Zambia's policy towards linkages in the mining sector involves a poorly-developed vision and an absence of detailed supportive policies embodying either positive or negative sanctions to promote backward linkages. Policies were inconsistent insofar as the policy commitment to linkage development was undermined by trade policies putting local suppliers at a disadvantage. Implementation and monitoring capabilities in government are weak and to the extent that any of the Development Agreements had any specific linkage commitments by individual mines (a rare occurrence) even this was lost when the 2008 Mining Act removed the only legal obligation of the mines to develop local supply chains.

General lessons on the impact of policy on linkage development

We have provided a general framework for thinking about the effectiveness of the policy agenda which might both broaden and deepen linkages into and out

of the commodities sector. The first step is whether government has a Vision which incorporates linkage development. It is our judgement that visions do exist, notably in Angola, Botswana (especially), Gabon and Nigeria. At various times in its long history of mining, the considerable potential for further development of mining equipment and specialist services and the extension of the capabilities developed therein are largely ignored in South Africa. Ghana, Tanzania and Zambia all lack a vision. However, even where visions exist, in some cases this is a vision which is confined to the fostering local ownership (Angola and Nigeria) rather than local value added. This generally results in a situation of “broad” linkages with very little “depth”, that is, where localisation translates into the localisation of the import function.

The second relevant consideration is whether specific policies have been enacted to promote linkages. Here there is more evidence of activity, with countries possessing specific policy instruments (usually on the employment of locals). But these are not embedded in a clear vision for the role of the commodities sector in general, and for linkages in particular. Two extreme examples of this are Angola and Tanzania, both of which reserve some activities for locally owned firms, but where in neither case is this articulated or incorporated in a wider programme to systematically broaden and deepen linkages.

A widespread finding is that many of the policies affecting linkage development are inconsistent and exclusive. A particularly pervasive example is where mining companies are provided with privileged access to duty-free inputs and work permits, and where their suppliers are not. This is a positive disincentive to linkage development.

Too often, to the extent to which a vision or specific policies exist, these statements of intent are not backed by positive incentives promoting desirable behaviour and negative incentives penalising inappropriate behaviour. This is perhaps the major reason why policies do not translate into real-world linkages. A subsidiary reason is that even where incentive structures exist, monitoring may be poor, in some cases through lack of systems, in other cases through lack of capabilities, and in yet other cases because too much discretion given to individual government officers merely provides the scope for corruption. Finally, there is the issue of governments and the private sector going on a journey together. Only in the case of Botswana do we find close interaction between the public and private sectors, although in other contexts such discussions are beginning to emerge as in Ghana through the aegis of the Ghana Mining Council.

So do we have a role model? At the one extreme lies Botswana. It has a clearly defined vision, backed by mutually supportive policies embodying a range of positive and negative incentives and sanctions. Implementing capabilities are still weak, but these appear to be growing over time. At the other extreme is Tanzania, which in a sense is a role model of how not to go about linkage development. It displays an absence of vision, poorly developed policies which when they do exist are often contradictory, and a highly inefficient and which promote a corrupt bureaucratic system. In between are

countries such as Nigeria which are on a positive trajectory of both linkages and appropriate policy development, and Zambia and South Africa whose trajectory and policy capabilities are regressing.

4. CONCLUSIONS

As we pointed out in the Introduction to this Report, in principle there is significant potential for increasing the breadth and depth of linkages from the commodities sector in Africa, particularly with respect to backward linkages. This will provide *direct* opportunities for commodity-exporting economies to make the most of the current commodities boom, and perhaps also allow surrounding non-commodity exporting countries to gain *indirectly* from sustained growth and linkage opportunities in the region. A primary difficulty which stakeholders face in grasping these opportunities is that there is an almost complete absence of data and supporting analyses on the nature and determinants of existing pattern of linkages which can be used to inform actions for the future. It is this knowledge gap which our detailed empirical investigations have sought to fill. Given the difficulties of data-collection in this area, the information which we have gathered on eight countries, on the infrastructure supporting the growth of linkages into the commodities sector and the factors driving corporate decision-sourcing practices is uneven and imperfect. But in the context of a major gap in knowledge it does provide new and important insights to inform policy. So, what are the key conclusions which emerge from our comparative analysis?

First, we have observed some signs of progress in the development of linkages, particularly with regard to backward linkages. Even in Tanzania, perhaps the weakest performing economy in our sample, the pressures for, and the desire to promote linkages show signs of development in recent years. Other economies, notably Botswana and Nigeria, are moving forward at a more rapid pace. But not all African countries are moving forward, and there are signs that to the extent that there is movement in the pattern of linkages in South Africa and Zambia, this may be a regressive rather than a progressive movement.

But, second, although there are widespread signs of growing linkages from the commodities sector, looking under the surface often reveals that it is the breadth of linkages (the percentage of spend which is local) rather than the depth of linkages (the domestic value added of this expenditure) which is expanding most rapidly. In the most extreme cases – for example the “suitcase business men in Zambia” and the provision of basic general goods in Angola – the major consequence of outsourcing is to (inefficiently) move the import function from the lead commodity firms and first-tier suppliers to small scale local entrepreneurs. But this is not always the case, since in other countries (for example South Africa and increasingly in Nigeria), local linkages also show considerable local value added.

Third, as we postulated in our opening analysis, there are some *generic* drivers which explain this pattern of linkages in all sectors and contexts. Many

commodity lead-firms have indeed made the strategic decision to increase outsourcing. This is in response to local content legislation and CSR pressures but also because they no longer wish to take responsibility for what they consider to be non-core operations. Another generic factor is that the possibilities for linkage development very much reflect sectoral and technological characteristics. Whilst almost all commodity production will involve the provision of similar products (such as fresh food and other consumables), producing equipment for offshore oil extraction in Angola provides much greater challenges than does the provision of fresh meat and vegetables to sustain mine workers in Tanzania. Further, there are important differences between economies, as exemplified in the different operating conditions which gold-mining lead commodity producers find themselves operating in Ghana, Tanzania and South Africa. A final generic factor is the passage of time. Those economies with long-lived commodity sectors show deeper levels of linkage development, again as evidenced in the contrast between gold-mining in these three economies.

Fourth, there are a series of *contextual* drivers which explain linkage-outcomes in particular circumstances:

- Skills and the ensemble of institutions which affect the development of firm-level and sector-level capabilities "shouts out" in all of the country-studies as being the single most important determinant of linkage development. This of course reflects a global challenge in an increasingly knowledge-driven world, but its effects are particularly acutely felt in Africa's commodity sectors. They are an important factor explaining why outcomes differ in the same sector in different economies, for example in the provision of knowledge-based services into the offshore oil industries in Angola and Nigeria.

- The nature of ownership affects linkage development. Lead-firms from different countries and selling into different countries appear to operate in different ways. Linkages form Chinese firms are particularly distinctive. In Zambia, their investment expansion has been countercyclical diminishing the harmful impact of market slowdown on suppliers. On the other hand they provide no support to their suppliers. In Angola, Chinese SOEs rely almost entirely on Chinese suppliers, although some of these have relocated to Angola. There are, however, signs that the sourcing criteria of some Chinese investors (notably Chinese private companies) may be converging with those of northern investors. Another major ownership factor is the differential role played by national and foreign suppliers and customers in the commodity value chains. As a general finding, there are strong pressures for local suppliers to be owned by nationals. This has resulted in a pervasive trend to conflate local value with local ownership. In some circumstances indigenisation has not only substituted for localisation of linkages, but has even undermined the development of local linkages, as in the case of Zambia where the outsourcing of importation to "suitcase businessmen" has eroded the position of established local suppliers.

- Infrastructure emerges as a significant contextual driver in the development of linkages. This has particular relevance in the case of backward linkages, most notably in the way in which poor roads undermine the capacity of local suppliers to feed into the Tanzanian gold mines which are some distance from areas of settlement and industry, and in Gabon where the reliance on rivers influences the product mix of exports. But it is not just hard infrastructure which impedes linkage development, since the efficiency with which logistics operate also has a bearing on linkage development. Botswana and South Africa are two economies which show how effective soft infrastructure such as business support and trade facilitation can be in the promotion of linkages.

- Not surprisingly, policy is critical as a contextual factor explaining the breadth and depth of linkages. It has pervasive impact not just in regard to the commodity sector itself, but on the contextual determinants of linkage development, that is ownership, skills and infrastructure. Bluntly-speaking, some countries do this well. Botswana is perhaps the exemplar here, although it is still too early to tell whether this focus and strategic integration will endure and whether it will achieve competitive advantage in the future. At the other extreme are Tanzania and Gabon, where the policy framework acts to impede linkage development. But even in the cases where policy functions well, there is scope for improvement.

A fifth major conclusion which we draw from our empirical studies is therefore that there is considerable scope for enhancing linkage development. This affects reshaping the path of linkage broadening and then the deepening of linkages. We have concluded that the most effective performers, whether in the public or private sector, show the capacity to develop a coherent vision for linkage development, supported by joined-up policy instruments which embody both incentives and sanctions to foster linkage development. In turn these visions and policies need to be backed by appropriate skills, effective institutions and by the real will to make a positive difference. There is a great deal of well-meaning lip service paid to the promotion of linkages, which is not backed by appropriate actions, and it is this which explains the sub-optimal pace of linkage development.

Finally we conclude that the gap between rhetoric and performance arises from a series of misalignments. Firstly, within value chains, lead-firms often fail to back up their strategic commitment to broadening and deepening linkages with appropriate institutional structures. We observed very few cases of the supply chain development functions which characterise many of the leading global manufacturing sectors (such as autos and electronics) and global retailing. Secondly, there is a major misalignment between governments' stated objectives on linkage development, and the institutions and structures which are available to promote linkage development. Too often government industrial policy is misdirected and hence constrained in being able to harvest 'low hanging fruit' and assist firms to build their capabilities so

as to enter lead commodity producers supply chains. In the most extreme cases, government confuses indigenisation with localised value added. Support for linkage development is placed with the ministry responsible for the commodities sector rather than where it belongs, that is the ministry responsible for the development of industry and services relevant to the commodities sector. Thirdly, a final area of misalignment is the pervasive failure of governments, lead-commodity firms and other actors in the commodity value chain to work together with suppliers to build strong linkages. International experience suggests that this misalignment is perhaps the single most important factor constraining the further development of linkages.

Thus we have observed discernible signs of progress in the extension of linkages from Africa's commodities sectors. But we have also observed considerable scope for further development. Even in the best cases, there is room for improvement, allowing Africa to make the most of the commodities boom. What policy actions need to be taken to allow this potential to be realised is the subject of Discussion paper 14 (Morris et al, 2011b).

REFERENCES

Arvis, J. F., M. A. Mustra, et al. (2010). Connecting to Compete 2010: Trade Logistics in the Global Economy - The Logistics Performance Index and its Indicators. Washington D.C, World Bank.

Aryeetey, E., G. Owusu, et al. (2009). An Analysis of Poverty and Regional Inequalities in Ghana. Working Paper Series 27. Washington D.C/New Delhi, GDN.

Barnes, J., R. Kaplinsky, et al. (2004). "Industrial Policy in Developing Economies: Developing Dynamic Comparative Advantage in the South African Automobile Sector." Competition & Change **8**(2).

Barro, R. J. (1999). "Human Capital and Growth in Cross-country Regressions." Swedish Economic Policy Review **6**(2): 237-277.

Bloch, R. and G. Owusu (2011). Linkages in Ghana's Gold Mining Industry: Challenging the Enclave Thesis. MMCP Discussion Paper 1. Milton Keynes and Cape Town, The Open University and University of Cape Town.

BMI (2009). Angola Infrastructure Report Q2 2009 March. Business Monitor International.

Bova, E. (2009). The Implications of Mine Ownership for the Management of the Boom: A Comparative Analysis of Zambia and Chile. NCCR Working Paper 2009/13. Bern, Swiss National Centre of Competence in Research.

Braczyk, H. J., P. N. Cooke, et al. (1998). Regional Innovation Systems: the Role of Governances in a Globalized World. London, Routledge

Buckley, P., A. Cross, et al. (2007). "The Determinants of Chinese Outward Foreign Direct Investment." Journal of International Business Studies **38**(4): 499-518.

Chamberlin, E. H. (1933). The Theory of Monopolistic Competition. Cambridge, Massachusetts Harvard University Press.

Cheung, Y. W. and X. Qian (2009). "Empirics of China's Outward Direct Investment." Pacific Economic Review **14**(3): 312-341.

Corkin, L. (2011). Chinese Construction Companies in Angola: A Local Linkages Perspective. MMCP Discussion Paper 2. Milton Keynes and Cape Town, The Open University and University of Cape Town.

Davies, K. (2009). While Global FDI Falls, China's Outward FDI Doubles. Columbia FDI Perspectives 5. New York, Vale Columbia Centre.

Dunning, J. (2000). "The Eclectic Paradigm as an Envelope for Economic and Business Theories of MNE Activity." International Business Review **9**(1): 163-190.

Even-Zohar, C. (2007). From Mine to Mistress: Corporate Strategies and Government Policies in the International Diamond Industry. London, Mining Communications Ltd.

Farooki, M. and R. Kaplinsky (2011). The Impact of China on Global Commodity Prices: The Global Reshaping of the Resource Sector. London, Routledge.

Fessehaie, J. (2011). Development and Knowledge Intensification in Industries Upstream of Zambia's Copper Mining Sector. MMCP Discussion Paper 3. Milton Keynes and Cape Town, The Open University and University of Cape Town.

Freeman, C. (1995). "The 'National System of Innovation' in Historical Perspective." Cambridge Journal of Economics **19**(1): 5-24.

Gereffi, G. (1994). The Organization of Buyer-Driven Global Commodity Chains: How United States Retailers Shape Overseas Production Networks. Commodity Chains and Global Capitalism. G. Gereffi and M. Korzeniewicz. Westport, CT, Praeger**:** 95-122.

Gibbons, M. (2001). Innovation and the Developing System of Knowledge Production. Paper presented at Centre for Policy Research on Science and Technology_Fraser University Summer Institute on Innovation, Competitiveness and Sustainability in the North American Region, http://edie.cprost.sfu.ca/summer/papers/Michael.Gibbons.html.

Hanlin, C. (2011). The Drive to Increase Local Procurement in the Mining Sector in Africa: Myth or Reality? MMCP Discussion Paper 4. Milton Keynes and Cape Town, The Open University and University of Cape Town.

Hanushek, E. A. and L. Woessmann (2007). Education Quality and Economic Growth. Working Paper No. 4122 (Feb.) Washington D.C, World Bank Policy Research.

Hausmann, R., B. Klinger, et al. (2008). Examining Beneficiation. Policy Brief (May). Cambridge, Massachusetts Center for International Development, Harvard University.

Heum, P., C. Quale, et al. (2003). Enhancement of Local Content in the Upstream Oil and Gas Industry in Nigeria: A Comprehensive and Viable Policy Approach. SNF Report No. 25/03 (August). Bergen, Norway, Joint study by SNF-Institute for Research in Economics and Business Administration.

Hippel, E. V. (1986). "Lead Users: A Source of Novel Product Concepts." Management Science **32**(7): 791-807.

Hymer, S. (1976). The International Operations of National Firms: A Study of Direct Foreign Investment. Cambridge, Massachusetts MIT Press.

Kaplan, D. (2011). South African Mining Equipment and Related Services: Growth Constraints and Policy. MMCP Discussion Paper 5. Milton Keynes and Cape Town, The Open University and University of Cape Town.

Kaplinsky, R. and M. Farooki (2009). Africa's Cooperation with New and Emerging Development Partners: Options for Africa's Development. New York, The United Nations Office of Special Advisor on Africa.

Kaplinsky, R. and M. Morris (2001). A Handbook for Value Chain Research. www.globalvaluechains.org. Falmer, University of Sussex.

Lundvall, B. A. (1992). National Systems of Innovation. London, Frances Pinter.

Malerba, F. (2002). "Sectoral systems of innovation and production." Research Policy **31**(2): 247-264.

Mbayi, L. (2011). Linkages in Botswana's Diamond Cutting and Polishing Industry. MMCP Discussion Paper 6. Milton Keynes and Cape Town, The Open University and University of Cape Town.

Mjimba, V. (2011). The Nature and Determinants of Linkages in Emerging Minerals Commodity Sectors: A Case Study of Gold Mining in Tanzania. MMCP Discussion Paper 7. Milton Keynes and Cape Town, The Open University and University of Cape Town.

MOFCOM (2010). Country Guide to Foreign Investment and Co-operation: Angola, Ministry Of Commerce People's Republic Of China.

Morris, M., R. Kaplinsky, et al. (2011a). "One Thing Leads to Another" – Commodities, Linkages and Industrial Development: A Conceptual Overview. MMCP Discussion Paper 12. Milton Keynes and Cape Town, The Open University and University of Cape Town.

Morris, M., R. Kaplinsky, et al. (2011b). Commodities and Linkages: Meeting the Policy Challenge'. MMCP Discussion Paper 14. Milton Keynes and Cape Town, The Open University and University of Cape Town.

Nguema, V. M. (2007). Case Study on the Impacts of Forest Investment Policies and Practices - The case of Gabon. Yokohama, International Tropical Timber Organisation.

North-South Corridor International Financing Conference. (2009). Lusaka

OECD (2009). African Economic Outlook 2009: Country Profile Gabon. Paris, Organisation for Economic Co-operation and Development.

Owusu, J. H. (2001). "Spatial Integration, Adjustment, and Structural Transformation in Sub-Saharan Africa: Some Linkage Pattern Changes in Ghana." Professional Geographer **53**(2): 230-247.

Oyejide, A. and A. Adewuyi (2011). Enhancing Linkages of Oil and Gas Industry in the Nigerian Economy. MMCP Discussion Paper 8. Milton Keynes and Cape Town, The Open University and University of Cape Town.

Perkins, D. and G. Robbins (2011). The Contribution to Local Enterprise Development of Infrastructure for Commodity Extraction Projects: Tanzania's Central Corridor and Mozambique's Zambezi Valley. MMCP Discussion Paper 9. Milton Keynes and Cape Town, The Open University and University of Cape Town.

Prescott, D. (2009). Mapping Exercise of Mining and Local Content Partnerships, Mining and local content workshop in London, Working paper for Harvard CSRI/ICMM/IFC.

Ren, B., H. Liang, et al. (2010). Chinese Multinationals' Outward Foreign Direct Investment: An Institutional Perspective and the Role of the State. Paper presented at the 4th China Goes Global Conference. Harvard University

Suliman, K. M. and A. A. A. Badawi (2010). An Assessment of The Impact of China's Investments in Sudan. CCS Paper No. 13 Nairobi, African Economic Research Consortium.

Teece, D., G. Pisano, et al. (1997). "Dynamic Capabilities and Strategic Management." Strategic Management Journal **18**(7): 509-533.

Teka, Z. (2011). Backward Linkages in the Manufacturing Sector in the Oil and Gas Value Chain in Angola. MMCP Discussion Paper 11. Milton Keynes and Cape Town, The Open University and University of Cape Town.

Temeng, A. V. and K. J. Abew (2009). "A Review of Alternative Livelihood Projects in Some Mining Communities in Ghana." European Journal of Scientific Research **35**(2): 217-228.

Terheggen, A. (2011). The Tropical Timber Industry in Gabon: A Forward Linkages Approach. MMCP Discussion Paper 10. Milton Keynes and Cape Town, The Open University and University of Cape Town.

Tidd, J., J. Bessant, et al. (2005). Managing Innovation: Integrating Technological, Market and Organizational Change Chichester, John Wiley and Sons.

UNCTAD/CALAG (2006). Creating Local Linkages by Empowering Indigenous Entrepreneurs. African Oil and Gas Services Sector Survey Vol 1-Nigeria. Geneva, United Nations Conference on Trade and Development.

World Bank. (2009). Transport Prices and Costs in Africa: A Review of the International Corridors. Washington D.C, World Bank.

Yao, S. D., D. Sutherland, et al. (2010). "China's Outward FDI and Resource Seeking Strategy: A Case Study on Chinalco and Rio Tinto." Asia-Pacific Journal of Accounting & Economics **17**(3): 313-326.