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Perspectives on Agricultural, First Mile Roads, Smuggling, Migration Infrastructure



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Food Crops are Cash Crops: a perspective on agricultural policy

Brian Van Arkadie

Abstract

Many conventional interpretations of the record present a dismal picture of agricultural performance. In turn, the view that agriculture has been quite stagnant spurs a search for new approaches to “transforming” agriculture (e.g. through The Southern **Agriculture** Growth Corridor of Tanzania (**SAGCOT**) initiative was launched in 2010 (SAGCOT).

It is true that :

- i. Since the early 1970's, export crop production has performed poorly.
- ii. The gap between rural and urban incomes has widened. (However, this is a virtual universal characteristic of economic growth – from the point of view of poverty reduction the rural-urban income gap is less important than the actual growth in rural incomes – in a dynamic economy fast growth is likely to be associated with both a widening urban-rural gap and growing rural incomes.) and
- iii. The rate of growth of rural household incomes has fallen short of what is desirable and possibly achievable.

Nevertheless, there have been profound changes and significant progress in many aspects of the rural economy, with a realistic economic response to evolving market opportunities and significant progress in living conditions. If this perception is correct, it is misleading to characterize the rural

economy and smallholders as inherently “backward” and unresponsive to potential opportunities (which leads to the view that there is a need for a fundamental change in the “mind-set” of small farmers).

The failure of so many agricultural interventions and projects by government and donors cannot be ascribed to an inherent resistance of small farmers to change. For it is not small farmers who have failed to identify and exploit potential development opportunities, but rather the “experts” who have designed and implemented flawed rural programs.

B: Historical role of agriculture

In settler and plantation economies, development of the smallholder economy was repressed by policies to ensure the continuing supply of cheap labour to the expatriate agricultural sector (e.g. in Kenya). By contrast, colonial economic policy in economies without an expatriate enclave, the rural economy was expected to generate export crops (so-called “cash crops”), which played a key role in generating foreign exchange and fiscal revenue (e.g. Uganda). Tanganyika fell between the two classic colonial models, with a roughly even balance between exports from expatriate controlled farms and plantations and African smallholders.

The emphasis placed on “cash” (i.e. export) crops was partly because of the obvious need to generate foreign exchange to fund imports and revenues to fund the colonial state, but also reflected the reality of a very limited cash domestic food market.

Agricultural research and such interventions to support rural development largely aimed to maximize the growth of export crops, and success or failure in agricultural performance was measured by the growth of export crops. A vocabulary emerged

Much of the material in this essay is taken from a longer piece in a volume edited by David Potts, *Tanzanian Development in an international perspective*, scheduled to be published by James Currey in 2018. Details of the studies cited are not included here for reasons of space but are in the longer version.

where agricultural output was seen as being divided between “food crops” and “cash crops”.

Until the 1970s, the perception of the critical economic role of export agriculture was plausible, as crop exports were the predominant source of foreign exchange and of farmers’ cash income.

The emphasis on the primacy of export crops persisted after Independence, and has sometimes resulted in perverse bureaucratic interventions – for example, measures to prevent farmers from shifting from export crop production to the presumably less desirable production of food crops.

Historically, encouragement of the marketing of export crops was combined with a tendency to discourage trade in food crops in the colonial period based on the notion that local autarky was likely to reduce the risk of famine.

A corollary of the emphasis on export crops was that whereas national statistics on export crop production were quite detailed and comprehensive, data on food crop production was at best highly sketchy. Along with the lack of detail regarding non-export agricultural production, there was little systematic data on the nature and evolution of the non-agricultural rural economy.

C. Technical change and innovation

The process of innovation in Tanzanian agriculture has come mainly through the introduction of new crops and new varieties. This was the case with the colonial promotion of export crops, initially coffee, cotton and sisal, and in the 1950’s and ‘60’s cashew nuts, tobacco and smallholder tea. But although the colonial period involved an acceleration of change, there had been a process of change over the centuries, with such non-indigenous staples as bananas and maize well established before the arrival of the European colonialists. In the period from roughly 1970 on, change has largely been through the introduction of new food crops, the rapid rise in the production of what had been minor food crops and the introduction of new varieties and seeds for existing food crops. The spread of rice production, the rapid growth in citrus production and the commercial exploitation of other fruits, the

introduction of new vegetables and of new varieties (e.g. of tomatoes) have all been part of a continuing process of agricultural change.

Frequently in discussion in Tanzania, slow agricultural progress is attributed to the lack of mechanization (how often has one heard that the backwardness of Tanzanian agriculture is demonstrated by the continuing dependence on the hand hoe), although the essence of the Green Revolution in Asia was the introduction of improved varieties. In Asia mechanization was not a cause, but more a result of the success of the Green Revolution. In most areas of Tanzania, labour is still abundant so that labour saving innovation is not of the essence of progress.

D. Performance of export crops

The diversity of export crops depended on local conditions and the stimulus of international markets. In the end of colonial period export crops were dominated by sisal (in the drier areas on the Coast and central areas), coffee and cotton. In the 1960’s diversity increased, with the rapid expansion of tea, cashew nuts and tobacco. In the 1960’s a number of export crops achieved rates of growth on a par with more recent achievements in South East Asia, now held up as a model. Peasant farmers were quite eager to take up new crops which could increase the value of household incomes. This is illustrated in the following table:

Growth of main export crops: growth rates 1960/62-1967

Commodity	Marketed quantities	Value
Sisal	+0.9	-4.7
Lint cotton	+12.6	+11.9
Clean coffee	+12.1	+14.5
Cashew nuts	+11.7	+17.4
Sugar	+14.0	+13.7
Tea	+9.3	+7.0
Tobacco	+23.2	+17.9
Pyrethrum	+25.4	+27.6

Annual percentage compound growth rates

Source: Background to the Budget 1968-69

The initial decline in export growth in the 1970's had a number of causes. Government interventions in the marketing system were an important negative influence. The Ujamaa program probably had a negative impact, particularly on cashew nuts. Also, at Independence about half of cash crop exports were controlled by non-African farmers, particularly the then largest export, sisal. The nationalization of the sisal industry in 1967, following on from the collapse of the World market in 1965, led to the decline of what had been Tanzania's largest export crop. When a number of coffee and mixed farms were taken over in the early 1970's, the non-African owned sector seemed to have had its day. If one separates out the performance of African export agriculture over the long term the performance is somewhat better than is suggested by the overall data.

By the end of the 1970's, the deep macroeconomic crisis had a further negative impact. Poor incentives for export crops acted as a spur for farmers to look elsewhere for cash income – and that opportunity came from rapidly expanding demand for food products.

Since the improvement in the macroeconomic environment and the reform of the foreign exchange regime, from the late 1980's on there has been a recovery in export agriculture, but the vigorous growth performance of the 1960's has not been repeated. With smallholder cash incomes now being derived from domestic food crop sales more than from export crops, this is hardly surprising.

E: Food crops and the growth of the urban market

With the limited degree of urbanization at Independence, agricultural cash income necessarily came largely from export crops, as there was only a small domestic market. The identification of “export crops” with “cash crops”, and food production as largely subsistence was roughly correct (although even at Independence, there was a larger local trade in food than available data suggested) However, with rapid urbanization farmers faced the choice in seeking cash by producing food for the domestic market, or producing export crops.

Over the past fifty years Tanzanian agriculture has been remarkably successful in providing food not

only to the expanding rural population but also to the rapidly growing urban areas. This is not to say that there have not been problems of food security and nutrition, but these have resulted more from issues of household entitlement and incomes, and from localized climatic conditions, than from overall food supply scarcity.

The population of Tanzania has more than tripled from 12.3 million in 1967 to 44.9 million in 2012, with in an annual growth rate of 2.7 percent. In the 2012 Census, Dar es Salaam was found to have a population of 4.36 million, 10 percent of the total. If account is taken of peri-urban settlements, the total would be significantly larger.

It seems likely that recent growth rates in both the national and urban populations will continue over the medium term. There is little sign yet of demographic transition.

The urban population in Tanzania was recorded as 12,359,930 as of 2011, growing from 528,508 in 1960. Extrapolating 1990-2010 growth over the following 20 years, the total population would rise to around 78 million by 2030, of whom urban dwellers would be 29 million. Of course, it is likely that a demographic transition will set in and birth rates will begin to decline, but this extrapolation suggests probable orders of magnitude. Urban population grew from 5.25% of total population in 1960 to 26.74% in 2011. Under this extrapolation, this could rise to 37% by 2030.

Urban population

Year	Population
1960	528,508
1970	1,068,227
1980	2,719,717
1990	4,811,451
2000	7,593,574
2010	11,783,830
2011	12,359,930

Source: World Bank Staff estimates based on United Nations, World Urbanization Prospects.

The Household Budget data indicate the growing importance of food crop trade as a crucial link between the rural and urban economies. Already, by 1991/92, the sale of food crops far outweighed the sale of so-called cash crops as a source of rural household cash income, and by 2007 food crop sales were more than three times as important as “cash” crop sales. That being so, the persistence of the use of the food crop/cash crop classification in descriptions of Tanzanian agriculture, in official and other sources, is rather peculiar.

The 2007/8 sample census of agriculture estimated that for 61.6% rural households the main source of cash income was sale of food crops. Less than 10% of households reported so-called “cash” crops as the main source of cash income.

Table: Distribution of main sources of household cash income

	Dar es Salaam			Other urban areas			Rural areas			Mainland Tanzania		
	2000	2004	2007	2000	2004	2007	2000	2004	2007	2000	2004	2007
Sales of food crops	1.3	2.8	8.5	20.7	15.8	17.8	46.3	46.0	50.4	41.4	40.8	36.4
Sales of cash crops	1.2	0.8	1.0	8.3	7.4	8.3	20.0	18.7	15.3	12.8	17.2	12.2
Sales of livestock	0.6	0.6	0.6	0.6	0.6	1.8	0.6	0.6	2.7	0.6	0.6	1.7
Sales of timber / cotton	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sales of minerals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sales of other non-farm products	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.0	1.1	0.0	0.0	1.1
Business income	25.9	31.0	21.7	26.8	35.1	23.8	6.1	8.3	7.9	8.8	11.8	12.7
Wages or salaries in cash	40.7	40.7	31.7	31.1	27.9	27.7	0.8	0.8	8.5	13.1	10.2	15.8
Other casual cash earnings	1.8	19.2	8.6	0.9	10.0	3.8	0.0	0.0	1.0	3.8	6.3	2.2
Cash remittances	1.4	0.8	0.0	0.1	0.1	0.8	0.0	0.0	0.0	1.1	0.8	0.8
Fishing	0.7	0.8	0.8	0.0	0.0	1.8	0.0	2.2	2.8	1.8	1.8	2.2
Selling of stock home	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other	1.8	0.5	0.0	1.7	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Household Budget Surveys

In 2007, more than half of Dar es Salaam household incomes (50.8%) went on cash purchases for food – this had declined, it is true, from 53.1% in 2000 (the usual expectation is that as incomes rise the proportion spent on food will decline).

F: Crop Production

The diversity of agricultural conditions has resulted in a diversity in traditional food staples. In some areas (Kagera, Kilimanjaro and Mbeya) various varieties of bananas provided the main source for food and alcohol. In other areas, maize had become the basic staple, displacing such grains as sorghum and millet. Over recent decades, rice has begun to compete as a food staple. Irish and sweet potatoes still play only a supplementary role, but with

urbanization, potatoes are becoming a more significant food staple.

Food staples include maize, sorghum, millet, rice, wheat, pulses (mainly beans), cassava, potatoes, and various types of bananas. In terms of cash sales, maize and rice are the most important, although some other marketed staples are under-reported (e.g. some descriptions of Tanzanian agriculture suggest that bananas are mainly subsistence crops; a cursory observation of Dar es Salaam markets indicates that this is quite false – the banana trade is evidently sizeable even if under-reported).

The crop most sold by farmers is maize, although many small farmers continue to grow maize mainly as a subsistence crop. A larger proportion of farmers who cultivate paddy sell their output.

On the mainland, of the estimated 14.517 million hectares of potentially “usable” land, over 70% was utilized, with the average household cultivating 2 hectares. Annual crops were the dominant use, accounting for 73% of land used (8.756 million hectares).

From the 2007/8 Agricultural Census, the main planted annual crops were:

	Thousand hectares
Maize	4,087
Paddy	907
Beans	750
Cotton	575
Sorghum	569

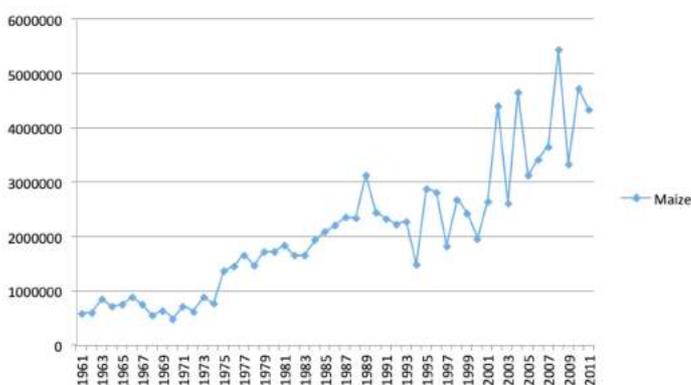
The picture of land pressure was quite varied, with 66% of households using all available land. 37% of households responded that they had sufficient land, while 63% responded that they did not.

Since Independence the worst crisis in food supply came in the early 1970s (1973 – 1976), a period which witnessed a decline in farm production, including that of food crops, mainly due to drought in 1973-1974 and massive displacement of rural people re-located to Ujamaa villages in some areas, (Isinika et al, 2003).

After 1975, subsidized input supply and pan-territorial pricing had positive impacts, while poor marketing arrangements and weak price incentives for export crops led to a switch from export to food crops. This involved both an increase in acreage under food crops and intensification of production. A study by Meertens et al (1996) in Usukumaland provided evidence of crop intensification up to 1991. Other documented examples of intensive food production include application of high fertilizer rates for maize production in the Southern highlands under the Maize project during the 1970's (FAO, 1986; WB, 1994). The adoption of high yielding hybrid maize and improved varieties of Irish potatoes also in the Southern highlands (Isinika 1998), intensive rice cultivation in Shinyanga region (Meertens et al, 1996; WB, 2000), were among other examples of more intensive crop production.

Maize is currently the most important staple in Tanzania. It has been estimated that maize provides as much as three fifths of dietary calories and more than half of utilizable protein to the Tanzanian population, so that maize supply is essential for national food security, and periods of food shortages are typically associated with shortage of maize. Annual volatility of production responds to weather conditions. Over the longer term, the trend in maize production has kept up with population growth, although there have been periods (e.g. the early 1970's and the 1990's) when production growth failed to match population growth.

Maize production in metric tons 1961-2011



Source: FAOSTAT DATA BASE

Paddy: Over the longer term, one of the quiet success stories of Tanzanian agriculture has been the expansion of paddy production. Increases have

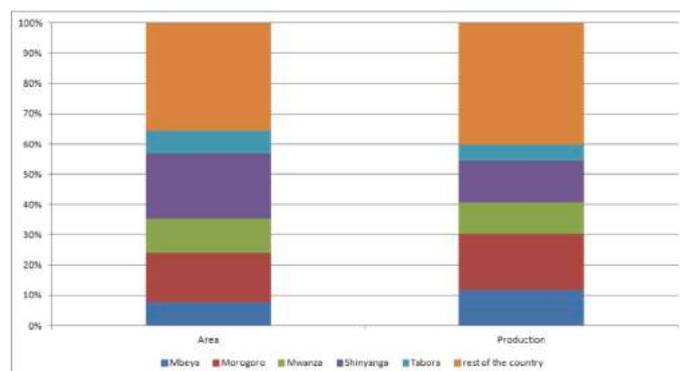
mainly resulted from an expansion in total land planted rather than increases in yield. In the Lake cotton growing areas, rice competes as a source of cash income with cotton, with rice supply is affected by the cotton price and vice versa.

Production has increased in response to the fast growing domestic market rice has high income elasticity and is a convenient cereal for use by the urban household. Rice is mainly produced for the domestic market, although there has been some exporting in recent years. For those farmers able to grow paddy, it is a profitable crop, even if by international standards yields per hectare are low.

According to the Agricultural census of 2007/8, more than 19% of agricultural households grew rice (an increase of a fifth since the 2002/2003 census). Rice production covered approximately 907 000 ha, representing 18 percent of cultivated land. Virtually all rice (99 percent) is grown by smallholder farmers using palatable traditional seed varieties. Rice productivity is lower than in most neighbouring countries and is one of the lowest in the world. Rice is grown within three main ecosystems (Sagcot, 2010) rain fed lowlands (68 percent): average productivity 3.5 mt/ha; rain fed uplands (20 percent): average productivity 1.2 mt/ha; and irrigated rice cultivation (12 percent): average productivity 3.8 mt/ha.

Most irrigated plots are part of small, village-level schemes; however, some are part of large-scale schemes that were formerly state-managed farms (Minot, 2010).

Figure 2: Rice production and producing regions



Source: Ministry of Agriculture

Other grains: Sorghum and millet have continued to play a significant role as a food source and an input for local brewing. However, production has not grown as much as maize and paddy, as the cash market has not expanded in the same way. The decline in relative importance of these traditional grains is unfortunate, in that these grains are more drought resistant than maize.

The central regions of the country stretching from Dodoma to Mwanza account for three-quarters of Tanzania's 500,000 to 800,000t. annual sorghum harvest. Smaller quantities are harvested in the Mtwara region. Almost all of Tanzania's pearl millet is grown in the dry central regions. While both crops are drought-tolerant, pearl millet can better withstand periods of heat stress than sorghum. Pearl millet production is concentrated in the drought-prone areas of Dodoma, Singida, and Shinyanga. The annual harvest is estimated at around 230,000t..

Sorghum and pearl millet are grown almost entirely by small-scale farmers on small plots. Most of these farmers also plant maize. If early-season rains are favourable, a larger area may be planted to maize. If early-season rains are poor, relatively more land may be planted to sorghum or pearl millet.

Despite limited improved crop management, Tanzania's average sorghum and pearl millet yields are among the highest in southern Africa, reflecting the relatively long growing season and favourable soils found in the sorghum and pearl millet production zones. Nonetheless, grain yields could be improved through the adoption of improved inputs. The extension efforts of the NGO Sasakawa Global 2000 suggested that small-scale farmers can readily achieve sorghum yields above 2 t ha through the use of better seed and small quantities of chemical fertilizer (Quinones et al. 1991), but adoption rates for these inputs sharply declined once Global 2000 stopped providing them to farmers. Rural markets generally do not stock improved seed and fertilizer.

The limited commercial market for these crops encourages farmers to maintain a low level of technology and production. Yet the development of

a commercial market is discouraged by the lack of a consistent marketable surplus.

The urban population of Tanzania has become increasingly committed to the consumption of bread made from white flour, which is highly import dependant. White bread is not very nutritious. Discussion with a successful Dar es Salaam bakery indicates that efforts to introduce whole wheat or multi-grain bread are not met with a positive consumer responses.

Wheat production typically accounts for less than one fifth of total domestic consumption. Wheat is the fourth most important staple in the diet of Tanzanians. Wheat accounts for close to 30 percent of total agricultural imports with an average import bill of over \$150 million per year.

Over 90 percent of wheat produced in URT comes from Arusha, Iringa, Mbeya, Kilimanjaro and Manyara regions. While wheat production in the southern highlands is predominantly small scale, production in the northern highlands is mainly on large scale farms.

The effort to boost wheat production through the Canadian mechanized wheat project proved to be economically unviable. Maybe if the same resources had been committed to expanding small and medium scale production the results would have been more positive.

Traditional brewing: A neglected area of study is the production of traditional brews. An important part of the household income, diet (and indeed pleasure) of rural Tanzanians comes from the production and consumption of locally produced alcoholic beverages. Indeed it can be argued that the extraordinary diversity of local brews is a rich part of Tanzania's cultural traditions, And yet little is done to support and promote such activity, with the likelihood that it will be steadily displaced by large-scale commercial brewing.

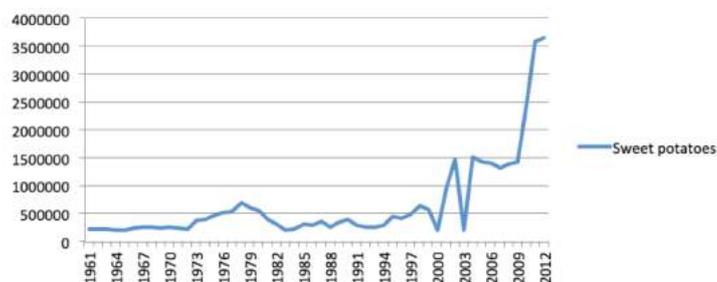
More should be done to record the diversity of local brewing, to improve hygiene and to promote the use of local brews, using locally grown ingredients and providing household incomes to small-scale producers.

Other food crops: A study published recently, Agricultural dynamic and Food Security Trends in Tanzania by Andre Leliverldf, Tim Dietz , Wijnand Klaver, Blandina Kilama and Dick Foeken (Development Regimes in Africa (DRA) Project Research Report 2013-ASC-3) reinforced the view presented in this paper that in recent years there has been considerable growth in food crop production, particularly of minor crops. The study identified sweet potatoes, groundnuts, bananas, sesame, cowpeas, pigeon peas, sunflower and pulses as being particularly successful food crops over the decade 2000-2010.

Sweet potatoes are grown throughout Tanzania (Lake Zone, Western Zone, Southern Highlands Zone, Eastern Zone and Northern Zone), It is a hardy crop with broad adaptability to climate and soils, hence it offers a sustainable food supply when other crops fail. The relative importance of sweet potatoes has increased because of problems faced by other crops (cassava mosaic and brown streak, and banana bacterial wilt, sigatoka, nematodes and weevils). However yields are low due to lack of high quality planting material of improved varieties and disease problems.

According to a McKnight Foundation report (2005), the major limiting factor for increased sweet potato production is the shortage of clean planting materials of superior varieties.

Sweet potatoes production in tonnes (1961-2011)



Source: FAOSTAT

Bananas are a leading staple, in areas where they are grown, used in varying forms cooking bananas (matoke and ndizi), as fruits and for beer brewing (e.g. lubize in Kagera and mbege in Kilimanjaro). They are also a source of actual and potential cash

income, delivering to urban markets and in cross border trade (notably to Uganda).

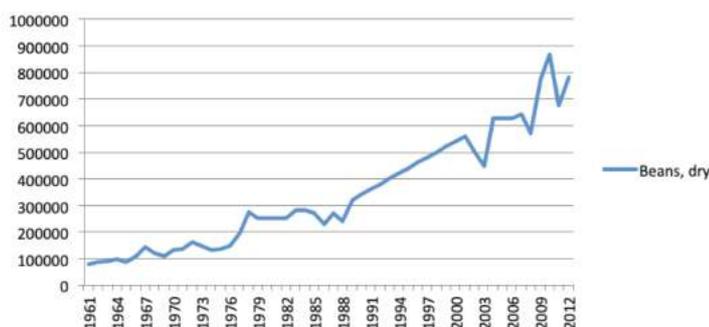
The trade in bananas is large but mainly unreported. Casual observation suggest that cooking bananas marketed in Dar es Salaam on a considerable scale.

Given the actual and potential importance of banana cultivation, it has not received sufficient attention from the agricultural services. This becoming an issue of some importance, as the crop is increasingly susceptible to disease and pests (e.g. the spread of nematodes).

Cassava: The low value to bulk ratio limits the long distance marketing of cassava root. Cassava is particularly produced for home consumption or marketed locally, although it enjoys a lively market in Dar es Salaam during Ramadan. Historically it was seen very much as a famine crop, the colonial authorities promoting it in that role.

Pulses are grown throughout Tanzania, often intercropped with maize. Production has followed an upward trend with considerable fluctuations. Pulses have a high degree of commercialization..

Dry beans production in metric tons (1960-2012)



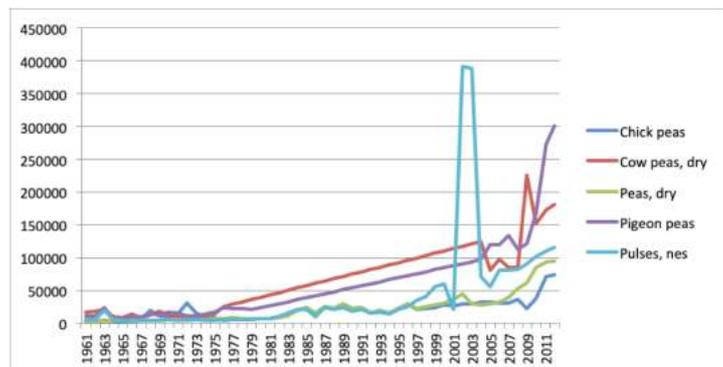
Source: FAOSTAT

The lively expansion in production of beans and pulses in recent years is a highly welcome trend, given their positive dietary contribution.

Vegetables, fruits, citrus, irish potatoes: Personal observation of Dar es Salaam markets over five decades indicates the growth in the quantity and variety of fruit and vegetables supplied to the rapidly growing market. This aspect of agricultural growth is only incompletely recorded in available data. For example, fruits produced as permanent tree crops

are not included in the agricultural census data (the only fruit included is water melon).

Rest of pulses production in metric tons (1960-2012)



Source: FAOSTAT

It is surprising to remember, when in the two citrus seasons Dar is swamped with oranges, that in the late 1960's they were virtually absent from the Dar market (I remember one Israeli advisor suggesting in 1968 that they be imported from Israel)..

Tomatoes are recorded as the largest commercial vegetable crop (as an annual crop they are covered by the Census) . Tomatoes contributed the highest percent of harvested quantity (321,128 tons) to the recorded harvested quantity of fruits and vegetables. (URT 2012). Most vegetables are planted in the long rains, except water melons which are grown more in the short rainy season.

Marketed vegetables include tomatoes, onions, leeks, shallots, chives, sweet peppers, cabbages, Chinese cabbages, lettuce, cauliflower, peas, carrots, cucumber, water melon, string-less beans, peas, mushrooms. eggplants, African eggplants, okra, collards/mustards, green leafy vegetables such as amaranths, nightshades, pumpkin leaves, sweet potato leaves, cassava leaves, and some wild varieties such as wild mushrooms, milk weed etc.. Pineapples, passion fruits, citrus fruits, mangoes, peaches, pears and desert bananas are important marketed fruits.

Production of most horticultural crops is by small scale farmers. Some high value exportable crops such as cut flowers and some vegetables such as green beans, peas, courgettes, baby corns, chilies,

baby carrots, baby leeks etc. are produced by large scale farmers.

For the future, small-scale production is likely to be critical for the supply of domestic markets, and the spread of new crops, improved seeds and new varieties is therefore of great importance.

Livestock products are another area where Tanzania is largely self-sufficient. The urban market for livestock products has grown rapidly, and with rising urban incomes can be expected to growth faster than urban populations, as the demand for meat tends to be income elastic.

From the 2007/08 Agricultural Census, there were about 2.3 million households which kept livestock. In the surveyed households, there 21.281 million cattle,, 15.154 million goats, 5.716 million sheep and 1.584 million pigs. Most livestock (99%) were kept by smallholders. The heaviest concentration of livestock production was in the Northern regions mainly Shinyanga and Arusha with a total of 4.2 million and 2.5 million livestock units respectively, followed by Tabora, Mwanza, Manyara, Mara and Singida with about 2.0 million units each. In the Mainland, there were about 42.6 million chicken of which 96% were local birds, the number of households engaged in more sophisticated production were still relatively minor. Other livestock included stingless bees, which accounted for 76 percent of the farmed bee population and honey was produced by 129 thousand households representing two percent of the household involved in crop production.

The availability of livestock services and infrastructure varies between the type of services and the region. Services are more accessible in urban and peri-urban areas. Regions such as Shinyanga, Mwanza which had large population of livestock, had less access to livestock services than regions such as Dar es Salaam with relatively fewer livestock. Access to livestock services is more readily in regions like Kilimanjaro and Mbeya where farming is more intensive and infrastructure more developed.

In general, small-holders have done remarkably well in expanding production to supply growing urban demand, despite not particularly effective support services. For the future, to continue to supply the

growing market there will be a need for improved livestock husbandry and disease control, requiring improved support services.

Cross Border Trade: Public policy has tended to discourage or even prevent cross-border trade, one result of which there is little reliable data on its extent and composition. As the domestic food trade has developed, not surprisingly some of this trade has spilled over as exports to neighbouring countries.

Recurring efforts to curb cross-border trade in food crops seemed to imply that it was less desirable to sell beans to the Kenyans, than to export coffee to European markets. However, anecdotal evidence suggests significant exports of beans to Kenya, matoke to Uganda (where it is even claimed it reappears in London markets as Ugandan matoke), rice and citrus— in season Tanzania is apparently the main supplier of oranges to the Nairobi market.

Such trade is likely to grow, not least because some of the border regions of Tanzania are nearer to external markets than the main urban markets of Tanzania. Such trade should be encouraged as part of the development of an efficient regional food supply system, as a source of rural household incomes and as just as much a source of foreign exchange as, for example, coffee exports to Europe. Moreover, national food security is likely to be enhanced by the growth of food exports, providing a possible buffer in the domestic market in difficult years.

G: Improvements in the quality of rural life

Given the low levels of rural income and the large and increasing gap between rural and urban incomes, it is easy to conclude that the quality of rural life must have stagnated. This conclusion might easily be arrived at by the new arrival in Tanzania, observing the conditions of rural life for the first time. However, there has been significant if slow improvement. This is evident in the data for improved roofing and other aspects of housing construction, improvements in sanitation, the better provision of social services (e.g. the great increase in literacy), improvements in clothing (e.g. wearing of shoes) and increasing access to the radio.

One area of speculation concerns the possible impact of current innovations on rural life. The extraordinary expansion in the use of mobile phones has demonstrated how a modern technical innovation can transform an aspect of rural living over a short period. The use of mobile phones for the transfer of funds is transforming financial connections between urban areas and the countryside. The introduction and rapid spread of the bodaboda (motor cycle for hire) has greatly increased the accessibility of villages not served with improved roads, both for human carriage and for the transport of goods. Solar energy, although still not very widespread, may hold out a prospect for the extension of electricity in those areas too remote or too sparsely populated to be serviced by the grid in the foreseeable future.

The contrast between fast growth in urban incomes and much slower growth in rural incomes is an almost universal characteristic of development. Agricultural growth and the expansion of rural incomes is more or less limited by biological constraints. And the income of rural labour limited by its excess supply. At this stage of Tanzania's development the best that can be aspired to is steady growth in per capita rural incomes of 1-2% per annum, and in periods of rapid urban growth this is likely to result in an increasing gap between urban and rural incomes. Nevertheless, over a generation this will result in a substantial improvement in rural welfare, and starting from a low base modest improvements can result in a significant change in the quality of rural life.

The emphasis offered in this section on the positive changes in the quality of life in rural areas is not meant to imply that the conditions of rural living are satisfactory. Poverty is still widespread and indices such as infant mortality, malnutrition and endemic diseases indicate that life is often precarious and living very difficult. However, it is important to note the positive developments which provide indications of the potential for further improvement, particularly through the link with urban development provided by the trade in food. This has resulted in increases in rural household cash incomes, which in turn has spurred growth in rural services. For the future, if this pattern of growth persists there seems a

reasonable prospect for a steady improvement in rural welfare.

The increase in the cash income of from agricultural production will be somewhat greater than might be suggested by the growth in agricultural output, which is measured in physical terms. As household members move to the city, those remaining monetize what had previously been household subsistence.

Over the longer term, as the rural urban population shift continues, it can be expected that the supply of rural labour will tighten and rural wage rates will rise.

However, such a virtuous path is not inevitable. A significant part of past growth has come about by bringing more land into production rather than through increases in productivity. Such growth at the extensive margin makes reasonable economic sense while new land is available, but this will become less possible with time – the margin new land being brought into production is likely to be of declining potential fertility. The growth process will only be sustainable by increasing land productivity, either by increasing yields of existing crops or by shifting to higher value crops.

H: Efforts to achieve rural “transformation”

One recurring aspect of official attitudes in agriculture in Tanzania has been frustration with the slow progress perceived to be characteristic of smallholder farming, even to the point of viewing it as essentially stagnant and of low potential. The reaction to such frustration has been to seek out ways to transform agriculture at a leap.

This was true of the colonial Groundnuts scheme, of the commitment to the so-called “Transformation Approach” (endorsed by the first World Bank country report and an important feature of the First Five Year Plan), the Ujamaa initiative, the Canadian wheat program, and SAGCOT.

In the late colonial period the Groundnuts Scheme was a huge and extraordinary flop – this is no longer studied or even much known about. Which is a pity as its forgotten history contains signal lessons of how not to do agricultural development.

The scheme was proposed as a solution to the problem of supplying food oils for the British population, in light of the extreme scarcity of foreign exchange. Officials of the United Africa Company, a subsidiary of Unilever, suggested to the UK government that the problem could be resolved by the cultivation groundnuts in the British colonies. The government authorized £25 million to cultivate 150,000 acres over six years; by the abandonment of the project in 1951, £49 million had been spent. At current prices, the cost of the project was much more than £1 billion. Most of the scheme’s operations were located in southern Tanganyika.

After great difficulties, the first nuts were planted, but when the rainy season arrived, flash floods swept away the workshops and stores, and during the subsequent dry season the clay soils baked into a hard surface impeding harvesting. The original target of 150,000 acres was gradually reduced to 50,000 acres and after two years, only 2,000 tons of groundnuts were harvested. Later efforts to grow sunflowers failed because of a heavy drought.

The project was cancelled in January 1951.

There were many reasons for failure. The belief that mechanized agriculture would be straightforward proved incorrect; the inexperience of the drivers and the harshness of the conditions resulting in the wrecking of many of the tractors. By the end of the summer of 1947, 2/3 of the imported tractors were out of use.

There was an implicit arrogance regarding African farmers. One simple question which was not addressed was why the land chosen was uncultivated – evidently African farmers knew something the scheme planners didn’t. Such arrogance also led to the failure to consider the alternative of promoting small-holder production of groundnuts and oil-seeds. In the 1950’s and 1960’s Tanganyika smallholders demonstrated extraordinary responses to market opportunities – if the huge sums used had been spent were used to encourage small-farmers, using simple labour intensive technologies that were known to work, it is reasonable to speculate how much more would have been achieved.

Towards the end of the colonial period, the idea of providing a short-cut to more rapid development resulted in the so-called “Transformation Approach” that was to be contrasted with the slow moving “Improvement Approach” to accelerating agricultural growth. This was designed by the colonial authorities, endorsed by the World Bank in the first report on The Economic Development of Tanganyika, and was incorporated into the First Five Year Plan, with the commitment to develop seventy settlement schemes and the creation of a special ministry dedicated to this approach. That approach was mostly unsuccessful and was drastically scaled down in 1965/66.

The belief in the need to “transform” smallholder agriculture was one of a number of strands in the thinking that led to the Ujamaa village programme. The large-scale Canadian wheat project was another instance of an effort to by-pass smallholder agriculture through a large scale mechanization programme, which turned out to be economically non-viable.

The thinking guiding the current Southern corridor programme and some recent donor (G7) initiatives also seems to be influenced by the idea that there is a large-scale alternative to ensuring future food supply. There is one critical point to be made here.

Suppose that large-scale mechanized food production were successful, it would not make much contribution to food security. The problem of food security in Tanzania is not a matter of overall food supply but of household entitlements and therefore of household incomes. The families facing food insecurity are those with low incomes. If national food supply were enhanced by large-scale production displacing the small-scale producer, this would cut off one plausible avenue to rural poverty reduction and would reduce rural food security.

This is not to say that large-scale production cannot play a positive role in stimulating smallholder production. There has been symbiotic development through outgrowing, for example in tobacco, pyrethrum, tea and sugar. Where larger scale operators can run efficient processing facilities and

provide a market for smallholder output, models can develop to be mutual benefit of both.

i. The future of agriculture

Underlying agricultural capacity: Tanzania has always seemed to be a relatively sparsely populated country, even today after generations of rapid population growth. It is therefore not difficult to believe that there must be a store of unexploited arable land, leading to some claims that as little as 11 per cent of potential arable land is currently farmed. Such statements can easily lead to visions of rapidly expanding agriculture acreages, possibly through large scale mechanized development.

However, in reality there is wide variability of agricultural potential and the hospitality of the environment, as is evidenced by the diversity of rural population density in Tanzania. The economic potential of arable land depends not only on fertility but on many other factors. Availability of water is a critical constraint in many areas (e.g. in those central areas of Tanzania which achieve substantial food surpluses in years of good rainfall, but that may only be one year in three or four). Access is important; the potential of south west Tanzania was only slowly exploited because of its remoteness from national markets. Remoteness is not only a matter of access to major transport systems, but also local access through all-weather feeder roads. In the short-term, exploitation of land is also limited by inhospitable living conditions (e.g. malarial mosquitos, or trypanosomiasis bearing tsetse).

Over the medium term, readily cultivable land will become scarcer, so that the improvement of land productivity will become more important (e.g. through improved irrigation, use of purchased inputs, improved seeds and more valuable crops). How far will government be able to enhance this process?

The government apparatus: In the British colonial period, Tanganyika had been ruled by a modest bureaucratic apparatus. Steps to begin to develop a local cadre to take over came very late, and in the years following Independence, the weak bureaucracy was buffeted as a result of self-induced instability. During the implementation of the Arusha

Declaration, top civil servants were called on to staff the greatly expanded State sector. Continuing changes in the government structure, with “decentralization”, followed by the abolition of district government, the shift of agricultural marketing to the cooperatives, only to be followed by their abolition and then revival, and the challenges of implementing Ujamaa all took their toll.

A system which was already weak was hit by the negative economic conditions from 1973 onwards, leading to an erosion of incentives. By the early 1980’s, the civil servant’s joke that “the government pretends to pay us, and we pretend to work” had a ring of truth. When “structural adjustment” was implemented from 1985 onwards, too little attention was given to the steps need to enhance government capability.

The general debility of government was reflected in the erosion of field capacity in the agricultural sector. Budget limitation prevented field staff contacting their potential clients and left gaps in the staff. Moreover, frequent reorganisations of both the extension and research services eroded already weakened capabilities.

Suggestions that government or donor should do this or that useful thing must be tempered by a realistic assessment of the potential of the organizational apparatus. The weaknesses of the government itself are possibly most obvious, but in relation to rural development donors have hardly done better. Dependant on short-term “expert” missions for project design, unwilling to make the stable long-term commitment necessary to develop agricultural research, slow to recognise and respond to failures, with little institutional memory and too susceptible to the fashions embodied in novel vocabulary that beset the donor community, their poor performance is hardly surprising.

Grassroots contact between the government agricultural service and smallholders is intended to be through the extension service, and in the last few years government has been making efforts to boost effectiveness by recruiting more extension workers.

However, the extension service in Tanzania does not have a good record of productivity.

A fundamental issue with the agricultural service is a deep-seated tradition that its primary function is, at worst, to direct the farmer and in general pass down information from the top. This approach should be transformed, with the first task of the service being seen as monitoring the needs of the farming community and passing up information regarding farmers’ needs and the constraints they face.

A second issue relates to accessibility. There is no point in employing extension staff if the means are not available for them to visit their clients, and in the past budgetary constraints have limited staff movement. With the improvement of local transport infrastructure it should be possible for extension staff to move through the countryside on motor bikes. It will only make sense to expand staffing in pace with the availability of funds to provide transport support, for example by the widespread provision of motor bikes and fuel.

The third issue relates to effective extension “messages”. Offering conventional advice on field practice (e.g. spacing; early planting) is rarely productive – farmers have heard it before and if such advice is ignored it is because it is often irrelevant. Extension is likely to be productive if it responds to the real needs of farmers and provides knowledge of new seeds and crops and highly specific help with handling crop pests etc. For such productive advice to be available, extension has to be the final link in a two-way chain, backed up by effective research and input supply.

In recent years government has made efforts to rebuild the extension service, but needs to go much further in thinking through how it can aid the development of smallholder farming, rather than again chasing illusions of “transforming” agriculture and making big breakthroughs through large scale mechanized agriculture.

Agricultural investment: In exploring possible options for future government intervention, the possible role of public investment needs to be clarified. The most important on-farm investments are made by farm households, and are very incompletely recorded in

official data. The key public investment role is to provide the conditions which encourage on-farm investment, most notably those which make it profitable to produce more output. In this regard, it is important to note that some of the most important government investments for agriculture do not fall under the budgets of the agricultural ministries – particularly investments in all-weather roads, to provide ready market access. To assess public expenditure commitment to agriculture by the size of the budgets of the agricultural ministries is simple naïve.

Marketing: The history of agricultural marketing in Tanzania has demonstrated that the institutional structure is at least as important as price policy in determining incentives. Large scale, monopolistic state trading did not work well for the farmer in Tanzania. Monopolistic state marketing had a poor record in handling payments and managing crop storage and sales. Arguably, the move to single channel agricultural marketing was the worst economic mistake made by the government of President Nyerere. Repetitive and misguided government interventions to control, restrict and even eliminate the “middle man” reflected a failure to understand the traders’ positive contribution.

Given the evident importance of agricultural trading as the link between farmer and market it is surprising that traders do not receive more positive recognition. However, it is much easier to cast the trader as villain than hero. This is not unique to Tanzania – the trader labelled as a parasite is an easy target for populist politics. If the trader is seen as exploitative and parasitic, it is not surprising if policy-makers seek a short cut to improving the lot of the farmer by eliminating the private trader. In the initial post-colonial period, suspicion of traders also had an ethnic motivation most private traders were ethnically of Asian origin.

Restraints on rural trade had roots in the colonial period. Colonial ordinances restricting intra-district food trade were enacted before the Second World War, as local self-sufficiency was seen as countering the risk of famine. Export marketing boards were initiated by the colonial authorities in the 1940’s. The justification offered was the need to stabilize prices.

However, the export marketing boards by accumulating sterling balances during periods of commodity boom, were also a useful mechanism for UK Balance of Payments management, given British balance of payments problems at that time.

During the colonial period, cooperative trading had developed, but was mainly effective for standardized products with long shelf-lives – particularly for cotton and coffee. Initially, in the case of the KNCU in the 1920’s, the colonial authorities had opposed the development but after the Second World War, British colonial policy had supported cooperative development. The cooperatives had not only been successful in processing and trading, but also took on development tasks, such as supporting access to higher education.

The government, after Independence, supported the extension of the cooperative model throughout the country, enforcing the displacement of local traders by the cooperatives, resulting in the virtual disappearance of the local Asian duka-wallahs who had been the mainstay of the local trading system. The previous mix of small traders, co-operatives and private wholesalers was replaced by single channel marketing system, through a chain running from the primary co-operative, through the co-operative union to a marketing board (later a crop authority), with monopoly at each stage.

The effort to extend the co-operatives beyond the thriving voluntary institutions created a quite inefficient system. Already, by 1967, weaknesses in the cooperatives had occasioned a Presidential commission of enquiry. There was an oscillation between the promotion of marketing co-operatives and constraining them, to the point of abolition (1973-82), with the amalgamation of local marketing functions, the previous activities of the Marketing Boards, and some of the extension responsibilities of the Ministry of Agriculture under Crop Authorities.

Marketing inefficiency became a prime cause of the deterioration in agricultural incentives. The management at the various levels was not subject to the discipline of competition, or to stiff sanctions from above or democratic control from below. By the end of the 1970’s the system had become quite

ineffective – most infamously in often delaying payment for produce supplied for long periods. In addition an over-valued exchange rate in effect taxed export agriculture heavily by the end of the 1970's. Even when exchange rates were adjusted, initially the benefit to farmers was limited, given marketing inefficiency.

When faced with the need to reform, Mwalimu had little faith in the potential efficacy of private trade. When it was proposed to abolish the NMC monopoly on food trade, the President honestly felt that would lead to a collapse in the food trade and to food riots. However, when trade was liberalized, the response of local traders was impressive, and very quickly a network of traders emerged that effectively supplied food to Dar es Salaam.

Given the apparent effectiveness of food trading networks, the most important future agricultural policy need is to promote such trading and to avoid interventions that disrupt or discourage traders (e.g. “rent-seeking” policy controls harassing transporters).

i. What is to be done?

Recognition of the primacy of food production: One simple, but clear conclusion of arising from the discussion above is the need to recognise the prime importance of commercial food production. The anachronistic discussion between “food” and “cash crop” production should be dropped from official vocabulary and statistical descriptions. The performance of agriculture should be increasingly judged by its success in feeding the population and priorities for research and the development of infrastructure adjusted in light of this recognition.

Future role of public interventions: Given the rather poor record of public (government and donor) interventions in agriculture it would not be difficult to come to a “free market” conclusion that a laissez-faire approach might be better than misguided government interventions and failed donor investments. However, the successful mix of government and market initiatives have facilitated “Green Revolutions” elsewhere, for example in many Asian countries.

This suggests that the key future role for public support is through effective applied research – that is providing the basis for a flow of knowledge that farmers need but cannot supply for themselves. Only with effective research support will the resources spent of extension become productive.

There can be no question that Tanzania has some good agricultural researchers and also has access to the research of CGIAR organisations, some of which have branches in Tanzania. However, activity is fragmented. Reviews of the agricultural research effort in Tanzania indicate a number of weaknesses:

i. The resources devoted to agricultural research (e.g. as a percentage of agricultural GDP) are on the low end of international practice;

ii. The sector has suffered from institutional instability – for a long period research was a parastatal activity, it was then reincorporated into the Ministry of Agriculture and has now once again been hived off under autonomous bodies;

iii. Finance has been unstable – for a long period research was over-dependant on donor finance, which was volatile and did not provide the comprehensive, predictable and long-term support needed for operation of an effective national research programme.

iv. For a decade, measures to control public expenditure resulted in a block on recruitment to the agricultural research service. In recent years as staff recruitment actively resumed, the long gap in recruitment had resulted in a scarcity of top level (Ph.D. level), who had drifted off to international jobs and University posts – efforts have been made to fill the gaps by bringing retirees back into service

Agricultural research is a lengthy process, requiring efforts over a number of years plant breeding for example, requires commitment over many years for the development of improved varieties. The gaps resulting from the chequered history of the research programmes left Tanzanian farmers without limited access to improved seeds.

From the early 1970's until 1990 the government was responsible for national seed production and

distribution, through the Tanzania Seed Company Ltd (TANSEED), established in 1973 to produce certified seed and to provide seed extension, dissemination, and advisory services. However, TANSEED was beset with problems of insufficient transport and funding, lack of humidity-controlled warehouses, and inadequate seed drying equipment, resulting in seeds with low germination rates, but at prices much greater than unimproved seed.

Government liberalized the seed industry in 1990. After liberalization, a number of foreign and domestic private seed companies entered the seed sector to produce, distribute, and market improved seed, which concentrated on hybrid and composite maize seed, leaving a gap in the availability of improved seeds for other food crops. There have, of course, been a number of initiatives by international NGO's to support innovation in agriculture, and some of these have been successful, but such piecemeal and fragmented efforts are no substitute for a comprehensive national program. This is clearly an area in which new efforts need to be made by government.

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Measuring Road Condition of the First Mile

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Abstract

The efficiency of rural transport is important for improving financial and time costs in the delivery of produce and for reducing post-harvest losses. Many crops lose value as they are transported over rough roads and suffer time delays in getting to the market. The pattern of transport varies between seasons with many roads becoming impassable, which results in slower transport and increased costs. There is growing recognition that rural infrastructure needs to be planned together with transport services to minimise transport costs, reduce crop wastage and gain the maximum advantage for farmers.

TRL is undertaking research in Tanzania and Kenya on moving harvest along the primary transport segment, or 'First Mile', from farm to established road access. This project is concerned with the cost-beneficial improvement of access, by assessing the condition of these primary road segments to determine the effect on crop damage and wastage. The condition assessment is being carried out using a variety of high-tech methods, in addition to traditional visual surveys being assessed from DashCam videos of the road. A quantitative assessment of road roughness was measured using three methods, maximum comfortable achievable vehicle speed, smartphone apps and accelerometers. Accelerometers were placed in both passenger and goods vehicles; in amongst the produce when vehicles are loaded. The accelerometer data was analysed, along with socioeconomic data, to gain a greater understanding of First Mile access problems that will result in recommendations for improvement.

Keywords—First Mile; road condition; accelerometer; access

I. INTRODUCTION

The issue of the relationship between crop damage and road condition is a largely under-researched area, although some previous studies have been undertaken on the topic [0], [2], [3]. IFRTD also carried out two pilot studies covering the transport and marketing of onions in Kenya [4] and tomatoes in Tanzania [5]. This work considered the potential

exploitable benefits of smallholder farming productivity, and the impact that improved access to rural markets can have for local smallscale economies in Kenya, Tanzania and across Sub-Saharan Africa.

The current 'First Mile' research project under the UKAid funded Research for Community Access Partnership (ReCAP) intends to extend the evidence base for the benefits associated with access improvements to small-scale farmers, and the potential impact that those benefits have on food security and poverty reduction on a much wider scale.

The efficiency of rural transport is important for improving financial and time costs in the delivery of produce and for reducing post-harvest losses. Many crops lose value as they

are transported over rough roads and suffer time delays in getting to the market. The pattern of transport varies between seasons with many roads becoming impassable, which results in slower transport and increased costs. Farmers normally bear the brunt of these losses. There is growing recognition that rural infrastructure needs to be planned together with transport services to minimise transport costs, reduce crop wastage and gain the maximum advantage for farmers.

The project team worked with counterparts from the Ministries, Departments and Agencies (MDAs) in both countries to select sites, within the context of their own investigations from previous projects conducted in Kenya and Tanzania. Two sites were selected each in Kenya and Tanzania where farmers, local transporters and local infrastructure specialists were consulted. The condition of farm access roads was also measured, so the effect of the road condition on the transport of produce and subsequent damage could be estimated.

The focus of this paper is the measurement of road condition and the monitoring of crop damage as a result of this condition. A number of different methods were employed to achieve this, as discussed later in the paper. At present the results are still being finalized, but will be incorporated into the final paper before the conference date.

II. BACKGROUND

Steyn and Pretorius [1] note that vibrations generated by Vehicle-Pavement Interaction (V-PI) are one of the major factors that cause damage to crops. The objective of their paper was to quantify the vibrations a truck and the produce it carries have to endure due to different road conditions when travelling from farm to collection point or market distributors in main cities. The vibrations were measured using accelerometers placed at different places within the truck cargo, and one of the conclusions was that accelerations were higher at the rear of the truck regardless of the cargo or the suspension type. Measurements were taken on unpaved and paved roads, with the unpaved roads being deemed to cause more damage. This is not surprising, but it is nevertheless an important finding, although the measurement of road condition on paved and unpaved roads was not directly compared. This is of course difficult to do as the nature and features of the deterioration are quite different.

The study was limited to damage caused by transportation, and did not consider damage that resulted from postharvest handling or the temperature and maturity of the fruit. It is however a useful reference to help understand the mechanism of physical damage to crops during transit. The paper focuses on the measurement of vibrations at different positions on the

truck and different vertical positions within the palletised container. Different road conditions were also considered.

A study on the analysis of road conditions [2] identified three major frequencies:

- to 5 Hz. This range represents the body bounce of the truck;

- 5 to 20 Hz. This range represents the axle hop response, and
- 20 Hz. This is the response from the structure, road roughness and drive train.

Not surprisingly, the study concluded that the most damage to cargo, especially fresh produce, would occur on unsurfaced roads at high speeds. Some of the main conclusions were that:

- 2-ton trucks produced lower vibration levels and damage as compared to 6-ton trucks.
- The severity of vibration levels increased with vehicle speed
- The laterite road conditions were the most severe vibration-producing surfaces, followed by concrete and asphalt roads.
- The damage to fruit was highest when travelling on unpaved roads, as compared to concrete highways, and asphalt roads produced the lowest vibration damage.

A study on road and rail in Belgium [3] also found that asphalt roads produced the least vibration, whilst cobblestones were worst. This research is the least relevant to the 'First Mile' project, but there are still interesting aspects of this research that can inform the 'First Mile'.

III. RESEARCH

The research TRL is currently undertaking in Tanzania and Kenya is focused on moving harvest along the primary transport segment, or 'First Mile', from farm to established road access. This project is concerned with the cost-beneficial improvement of access, by assessing the condition of these primary road segments to determine the effect on crop damage and wastage. There were four areas of interest, two in each country. They are summarised below:

A. Kenya:

- 1) Meru:

Main crop, French Beans. French Beans are largely an export crop so quality is paramount. Beans need to be transported as quickly as possible to collection centres, where they can be refrigerated and transported on for export. The main modes of

transport from farm to collection centre in Meru are headloading and backloading. This is because the available access roads have washed out and are no longer accessible to vehicles. Two of the roads are possible for motorcycles and animal carts to pass, but the cost of transportation on these two roads is very high, so the farmers persevere with manual transport. In this case Meru was not the best example for road condition monitoring.

2) Machakos:

Main crop, French Beans. Again, most of the crop from Machakos is for export. The access roads from the farms to the collection points are generally in reasonable condition, with some variation, depending on the season. A combination of animal carts, motorcycles/bicycles, small trucks, pickups, wheelbarrows and headloading are used for transporting the crops, so road condition is a significant factor in the quality of the crop when it is assessed by the buyers at the collection point.

B. Tanzania:

1) Matola:

The main crop is potatoes, which suit the high altitude and cooler conditions. The collection system in this area of Tanzania is not so well developed as that in Kenya. There are no formal collection points, the farmers generally tend to take their crop to the roadside and wait for a transporter/buyer to collect. All farmers in Matola used headloading to transport their crop to the collection point.

2) Madeke:

The main crop here is pineapples, which grow at slightly lower altitudes. The situation in Madeke is similar to Matola in that there are no formal collection points and the farmers bring their produce to the main road for collection. Some farmers have started to construct their own shelters, but they are very basic and just enough to keep the sun off the produce. In Madeke the farmers use a combination of Ox cart, motorcycle, animal cart and headloading to transport their pineapples to the collection points along the road.

Focus group discussions, household surveys of farmers and interviews with transport operators and

local experts were the main source of information to determine the agricultural situation and identify the problems present on the 'First Mile' in all four locations.

IV. OVERALL ROAD CONDITION

Roads and the associated water crossing structures are an expensive asset to construct. Although most farm roads are rural and carry few vehicles per day, and may not warrant the application of bituminous pavements in the short term, they can be a significant cost to local road organisations. Nevertheless, infrastructure from farm to market or first collection point needs adequate strength and serviceability required for the purpose. To make this link cost effective in providing year-round access it is important to consider the philosophy of using construction materials that are "fit for purpose". This means making the best use of materials that are locally available. It can be a fine balance to use materials in a way that they are neither sub-standard nor wasteful in excess of the standards demanded by their engineering task. Therefore the normal philosophy for constructing such roads is to construct them with earth or gravel; apply spot improvements in sections likely to encounter seasonal problems; use simple tools and equipment and use methods that can be easily implemented and maintained by the community.

Hindson [6] defines two main classifications of earth roads; village roads and market roads. A village road is the smallest, cheapest road or track, which may run from one small village to another or to a farm, a small settlement, a school or a dispensary. A market road on the other hand would run to a market, a food-buying depot, a rural development scheme or other important rural centre where traffic might amount to ten or twenty vehicles a day.

He acknowledges that at this level, it may be expensive to gravel the whole road, and thus proposes using earth for such roads and only spot gravelling areas where water may pond and soften the surface. The author discusses at great length various approaches to keeping water off the road, including elevating the carriageway at least 30 cm above the surrounding land or the side drain. This ensures that the road is mostly dry all season, thus

facilitating all-season truck access. As a country develops, village roads may turn into market roads, so village roads should therefore not be located on steep gradients (gradients more than 1 in 12) where loaded trucks going to the market may not be able to climb in wet and slippery conditions.

Water crossings are a potential weak point in rural roads. They are vulnerable to washout during periods of heavy rain, especially if they become blocked with debris, and are subject to erosion even in times of light rainfall. Due to their nature water crossings are invariably at the low point of the road, so water tends to collect on the surface if it is not maintained at the recommended camber and the water is not able to flow freely from the surface. In addition, in tropical areas especially, vegetation tends to grow more and higher close to the water source, increasing shade on the road surface and preventing it from drying out. These factors will soften the surface over time and cause deterioration near the water crossing.

Given the conditions in the study area, where the majority of farmers in both countries use manual labour to carry their crop to the collection points, the condition of the road can have more effect on the time taken to transport the crop, rather than damage to the crop through the roughness of the road. Delays incurred between picking and packaging at the collection point can have a significant effect on the quality of crops, especially those that are vulnerable to temperature. In Meru, for example, if the access roads had been constructed properly then a vehicle could transport crops from farm to collection point in about 10 minutes, but at present the average time taken by manual labour is two to three hours.

A. Road condition assessment

For the purposes of measuring road condition and how it affects crop damage, the districts of Madeke in Tanzania and Machakos in Kenya were used as examples. These districts have a variety of vehicles using the access roads from farm to collection point. The travel from collection point to market was also considered, as these roads tend to take larger trucks but are still susceptible to poor road condition, which can cause crop damage. In Machakos the main

road is paved and in good condition, but in Madeke it is a gravel surface that is vulnerable to damage in the wet season.

The condition assessment was carried out using a variety of means:

- Traditional visual surveys using a drive-through methodology, with the engineer and a technician in a 4WD vehicle. The vehicle will stop at structures such as culverts to allow the engineer to exit the vehicle and inspect them. A representative sample of roads was assessed using this methodology, as it is generally deemed to be the most accurate after a walk-through survey, which are seldom undertaken on existing roads due to the excessive time taken and consequent high costs.
- DashCam videos of the roads, taken by the enumerators and assessed in the office by the engineer. This was used to assess all roads, as well as to clarify any issues and audit any conditions that were disputed. The limitations of this method include the accurate assessment of structures, for example to determine the condition of a culvert it is necessary to inspect the inside of the culvert to see if it is obstructed or damaged. The underneath or inside of structures are not visible from these videos, although major damage can be noticed.
- Road roughness is usually measured in terms of the International Roughness Index (IRI). IRI is a standardised roughness measurement related to those obtained by response-type road roughness measurement systems, with recommended units: metres per kilometre (m/km). It is a ratio of accumulated suspension motion of a vehicle (inches, mm, etc.) divided by the distance travelled by the vehicle during the test (miles, km, etc.) [7]. It therefore follows that roads with high IRI will have a high detrimental effect on vehicle suspensions and the goods they carry.

New methods of measuring road condition and roughness are being developed all the time. In 2006 some research was carried out using the internal diagnostic tools in mine haulage trucks to determine the condition of the gravel roads that lead to mines in South Africa [8]. In 2011 some research was carried out in the Philippines [9] using artificial

neural networks to provide condition ratings of roads with only traffic and inventory data. Research in 2018 in Poland [10] used three-dimensional analysis of liner accelerations of vehicles to measure road conditions.

A quantitative assessment of road roughness in the study areas was measured using three methods:

- ▶ Maximum comfortable achievable vehicle speed. The World Bank scale for speed against condition was used for this assessment [7]. The DashCams recorded speed on all roads, with the maximum and average speed recorded for each video, as well as continuous speed display throughout the videos.
- ▶ Smartphone app (RoadLab) developed by the World Bank to measure IRI using the accelerometer and gyroscope within the
- ▶ smartphone [11]. Other apps have been developed for the same purpose, but the World Bank app was used because it is freely available to download. The results from some of these apps are variable as they depend greatly on the vehicle speed, how and where the vehicle is driven and the vehicle details (weight, suspension, tyre pressures, etc.), so the RoadLab results were used as a double-check only.
- ▶ Individual accelerometers were placed in goods vehicles; in amongst the produce when the vehicles were loaded. These are switched on when they are placed, then retrieved and switched off when the vehicle reaches its destination.

The subject of this research is unpaved roads, most of which in the study area are earth, with the main access roads being gravel in Tanzania and paved in Kenya. The measurements with the accelerometers were predominantly taken on earth roads that linked farms to collection points. Some were taken on main gravel access roads, but readings were not taken on paved roads.

Readings were taken in May 2018, immediately following the wet season. This is when most of the roads were in a poor condition as they had been damaged during the rains and had not yet received

any maintenance. This situation was similar in both Kenya and Tanzania.

B. Type of transport

Following the first round of data collection it was found that the majority of farms were using manual labour to transport goods to the first collection point. There were a number of reasons for this:

- In some cases the access roads that had been constructed with the purpose of facilitating the transport of produce to the collection point or market, were either completely washed out or were in such bad condition that access by vehicles was not possible. This includes vehicles such as motorcycles and animal carts. The worst examples were in Meru where the roads were constructed at too steep a gradient in very erodible soil, leading to rapid deterioration. The roads were clearly not designed to specification and suffered as a result.
- In some cases the vehicular transport was simply too expensive, and the most cost effective solution was to transport the produce manually. This is even the case in places where the vehicular transport takes approximately 15 minutes, and the manual labour takes 2 to 3 hours. Farmers made the decision to use manual labour here, even though they appreciated that the crop (beans) suffers from a prolonged time unrefrigerated. It is assumed that the additional cost through damage by delayed refrigeration is less than the additional cost of paying for motorised transport.
- There was in some cases a cash flow problem for the farmers, which meant that they did not have available cash to pay for vehicular transport. This is exacerbated by the fact that payment often arrives two or three weeks after the crop has been delivered to the collection

point and the payment has been agreed. Linked to this is the fact that at the Meru site, the farmers were often paid less than the agreed price, with the buyers claiming that when the crop reaches the market or the holding depot it is downgraded in quality and the price is consequentially reduced. The knowledge that this is probably going to happen

means that farmers are reluctant to spend more on transport than they need to.

The main problem associated with manually carrying crops to the collection point are mainly the time it takes and the additional exposure to the sun. In the case of crops that are vulnerable to high temperatures or exposure to weather, such as French Beans, the extra time in the sun whilst being transported manually can increase the rate of deterioration of the crop. Typically, French beans are cooled at the collection point and transported quickly to their final destination to maintain quality.

In Meru there is a regular problem of late delivery to the collection point due to the unreliable transport service provision. The transporter's vehicle is usually scheduled to leave at 6pm, so if deliveries to the collection point are late, it can delay the transport, or the transport leaves without them. Either way there is additional damage to the crop.

V. RESULTS

The aim of the road condition measurement is to differentiate between access roads in terms of road condition, to see if it has a bearing on crop deterioration and if so, by what magnitude. Other factors also have to be considered, such as the road length, with access roads varying between 100 m and 7 km in length. If a crop is transported on a 7 km road of poor condition, it is likely to suffer considerably more damage than on a road of 100 m. In this context the measurement could be considered in terms of accessibility, which would take into account both the surface condition and the length of the road.

From focus group discussions it was learned that communities would be willing to participate in road maintenance in order to keep roads open and facilitate the passage of goods to collection points. They were unwilling to do this without some instruction in the technical aspects of road maintenance, but would happily attend on-site training to learn about the basics of how a road can be maintained.

A. Results

The traditional visual condition surveys were used to calibrate the surveys from DashCam videos. This was used to form a baseline against which the accelerometer readings can be compared.

It is accepted that unpaved roads will give variable and unpredictable results of roughness using equipment, apps and even visual surveys. Therefore some reference readings were taken using the accelerometer on very good and good condition bituminous surfaced roads (IRI was determined with visual surveys and the RoadLab app). The results of this survey can be seen in Table 1.

Table 1: Surveys on paved roads

IRI m/km	Measurement		Road surface condition
	Vert. Acceleration m/s ²	Vehicle speed Km/hr	
1.0	0.13	30	Very Good, new asphalt overlay
1.0	0.16	80	
3.0	0.22	8	Good, bituminous surfaced road
3.0	0.28	17	
3.0	0.34	30	
3.0	0.43	80	

These results are very consistent and show a steady increase of vertical acceleration with an increase in speed. It should be noted that the IRI was derived from a combination of visual assessment and RoadLab, and was estimated to the nearest whole integer. This shows that roughness readings using an accelerometer must be compensated for speed.

Measurements were taken on the unpaved access roads in Machakos, Table 2. The surface condition of the road was determined using visual condition surveys from visual surveys and DashCam videos, with the result indicated on a scale of 1 to 4, derived from the following scale:

- 1 = Good: IRI 5 – 10
- 2 = Fair: IRI 10 – 15
- 3 = Poor: IRI 15 – 20
- 4 = Bad: IRI > 20

The visual reports noted that there were little differences between the access roads, all were given a poor condition, except for No. 5 which was classed as fair and was the only road with no bottlenecks.

However, the vertical acceleration did not show any difference to the other roads. Access road 4 did have a higher number of bottlenecks, and a significantly higher maximum vertical acceleration. The three main roads showed similar results, although main road 3 showed the lowest acceleration and facilitated the highest speed, suggesting it was in better condition. Overall these results are inconclusive, but it should be noted that speeds were very low.

Table 2: Machakos roads

Machakos Roads	Factors			Vertical acceleration	
	Surface condition	Mean speed	Bottle- necks	Mean	Max
Access 1	3	15	1	0.9	5.5
Access 2	3	15	1	0.7	5.5
Access 3	3	15	1	0.7	6.5
Access 4	3	20	3	0.8	9.7
Access 5	2	20	0	0.7	6.6
Main rd. 1	2	15	1	0.8	6.9
Main rd. 2	2	15	2	0.8	6.5
Main rd. 3	2	25	3	0.6	6.7

Table 3: Madeke roads

Madeke Roads	Factors			Vertical acceleration	
	Surface condition	Mean speed	Bottle- necks	Mean	Max
Access 1	3	<15	6	0.8	5.8
Access 2	3	<15	5	0.9	7.2
Access 3	3	<15	2	0.7	3.6
Access 4	3	<15	2	1.2	6.4
Access 5	3	<15	2	0.7	5.7
Access 6	3	<15	2	1.0	7.9
Access 7	3	<15	0	0.7	3.4
Access 8	3	<15	5	1.0	9.1
Main rd	2	50	0	0.5	3.9

Similar measurements were taken on roads in Madeke, in Tanzania, Table 3. The achievable speed was lower at consistently less than 15 k.p.h. Quite a wide range was experienced in vertical acceleration, given that the roads were all rated as ‘poor’. Again the visual surveys all rated the roads as in similar condition. The number of bottlenecks seems to make

little difference to the overall vertical acceleration, although it is noted that the road with no bottlenecks did have the lowest maximum vertical acceleration, which is not surprising as it would be logical for the bottleneck areas to produce high maximum vertical accelerations. For the access roads the results were similar to Machakos in Kenya.

The one main road surveyed was classed as in good condition, and had an unusually high achievable speed of 50

k.p.h. Unsurprisingly the vertical acceleration was low and there were no bottlenecks, although the maximum reading was 3.9, which is similar to the best condition access road. It can therefore be assumed that the higher speed can produce a high vertical acceleration, even over relatively modest bumps. Again this highlights the need for calibration of the vertical acceleration readings with respect to speed.

Measurements were also taken in Machakos on loaded and unloaded vehicles, Table 4, with the accelerometer placed within the crops being transported in loaded vehicles. This was in order to try and determine the vertical acceleration of the actual crop while it is being transported.

Table 4: Machakos loaded and unloaded vehicle measurements

Machakos Vehicle / Route / Loading	Surface type	Vertical acceleration	
		Mean	Max
Car: Canal rd. – Loaded	Gravel/Earth	0.7	8.8
Car: Canal rd. – Not Loaded	Gravel/Earth	0.7	6.6
Motorcycle: Canal rd. – Loaded	Gravel/Earth	1.7	14.8
Truck: To Kithimani – Loaded	Gravel/Earth	1.6	11.6
Truck: To Nairobi – Loaded	Bituminous	0.6	6.9
Car: To Nairobi – Not Loaded	Bituminous	0.7	3.6

These results showed that the loaded motorcycle transport exhibits the highest vertical acceleration, closely followed by a loaded truck. Cars seem to show less acceleration on unpaved roads. One

surprising result is that the loaded car showed a higher maximum vertical acceleration than the unloaded car, whereas logic would suggest that the loaded vehicle would move or ‘bounce’ less when going over a bump. The unloaded car on a bituminous surface showed even less vertical acceleration, which would be expected. Also the loaded truck shows significantly less vertical acceleration on the surfaced road.

A similar exercise was carried out on roads in Madeke in Tanzania, Table 5, where pineapples are the main crop. This data shows that the vertical acceleration on the earth road was higher than on the gravel road for unloaded cars. However, the loaded trucks showed little difference.

The sample sizes of these tests are too small to draw any conclusions. They do however highlight the need for further research into the ability of loaded and unloaded vehicles travelling on poor roads to transport crops without damage.

Table 5: Madeke loaded and unloaded vehicle measurements

Madeke Vehicle / Route / Loading	Surface type	Vertical acceleration	
		Mean	Max
Car: Main road – Not Loaded	Gravel	0.5	3.9
Car: Access road – Not Loaded	Earth	0.9	6.1
Truck: Access road – Loaded	Earth	0.6	5.4
Truck: Main road – Loaded	Gravel	0.6	6.9
Truck: Main road – Loaded	Gravel	0.7	13.1
Car: Main road – Loaded	Gravel	0.7	8.0

Some other interesting results were found from the household surveys and other investigations carried out as part of the research. For example, it was clear that the farmers had a very different perception of the road maintenance issues than the transporters, Table 6. The transporters’ view of the problems is very much focused on issues with the road surface, such as mud, slipperiness and water crossings; issues that would affect vehicle movement. Vegetation, gradient and narrowness did not seem to be concerns at all. However, the farmers considered

steep gradient to be the major problem, with narrow tracks and slippery surface close behind.

This perhaps shows a lack of knowledge or understanding of the vehicles used and their capabilities by the farmers. It could also reflect a high usage of human and animal transport, which are much more common for farmers, but which are not usually provided by transporters. For example gradient would be difficult for headloading or backloading, but assuming it is not more than about 12% it should be no problem for a motorised vehicle. For the issue of narrow tracks, it is presumed that transporters simply do not use narrow tracks, so they do not see them as a problem, whereas farmers would like the narrow tracks to be widened so that the transporters could use them.

Table 6: Perception of road access problems

Bottleneck/maintenance issue	Farmers		Transporters	
	No. of responses	% of responses	No. of responses	% of responses
Vegetation too dense	14	4%	0	0%
Thick mud when wet	43	13%	23	29%
Slippery surface	68	21%	27	34%
Gradient too steep	99	30%	0	0%
Difficult waterway crossing	21	6%	30	38%
Path/track too narrow	82	25%	0	0%

Another interesting finding is that almost all farmer respondents perceived the road condition as having had, at some point, negatively affected the condition or value of their produce, Table 7.

Table 7: Effect of road condition on produce value

Question	Yes		No	
	No. of responses	% of responses	No. of responses	% of responses
Has the road/track condition ever negatively affected the condition or value of the produce?	113	97%	3	3%

The research was also able to take readings before and after the rainy season to monitor any potential changes in condition on the main access roads, which are further to the access roads which make up the First Mile, Table 8.

The first table is from Machakos in Kenya. Using vertical acceleration it shows a significant deterioration of the road condition from before the rainy season to after the rainy season. Although there are only two examples, the results do seem to be quite consistent. They highlight how much the condition of gravel roads can change in a short time.

Table 8: Condition before and after the rains

Machakos Gravel Main Road Access	Before rains		After rains	
	Mean	Max	Mean	Max
Main access from Sofia	0.8	6.9	1.2	8.7
Main access from Sofia	0.8	4.9	1.3	11.1

A similar exercise was carried out in Matola in Tanzania, which measured a main gravel road three times; three months before grading and compaction, immediately afterwards and some weeks following, Table 9. Again these results seem to be quite consistent, and seem to show a regular cycle of deterioration and rehabilitation throughout the year.

Table 9: Matola access through the seasons

Matola Road access	3 months before grading and compaction		Immediately after grading and compaction		6 – 8 weeks after grading and compaction	
	Mean	Max	Mean	Max	Mean	Max
Main gravel road, Njombe to Matola	0.7	9.1	0.4	3.4	0.5	6.1

These results show firstly that it is difficult to obtain reliable roughness values on unpaved roads that are in poor and bad condition, mainly because the speed for measurement is too slow. It is likely to be as effective to carry out visual assessments where speeds of only 20 k.p.h. or less are possible. Accelerometers were used as it was recognised that many roads would not allow speeds more than the threshold for RoadLab smartphone IRI to record measurements, i.e. 25 k.p.h. However, the accelerometer results were not clear enough to be able to work out an IRI equivalent, especially for the worst condition earth roads.

Accelerometers placed in loaded and unloaded vehicles showed accelerations to be higher on

unpaved roads, and particularly with loaded vehicles. Motorcycles showed particularly high accelerations, which is a concern as they are regularly used for the transport of crops, especially when the roads are too poor for four-wheeled vehicles. This would leave crops that are particularly vulnerable to bruising as risk when being transported by motorbike.

There is also a clear mismatch between the farmer’s perception of road access problems and that of the transporter. To some extent this can be explained by different levels of knowledge of the capability of vehicles and a focus on the current modes of transport in use in the study areas. This seems to suggest a gap in knowledge and a potential to gain from awareness-raising in this area. Regardless of the access issues, it seems that all parties are convinced that road conditions do have an effect on the quality and price of the produce being transported. Where access roads are poorly constructed and maintenance is neglected, the conditions can change rapidly through the seasons. It is unlikely that remote farm access roads will receive the level of maintenance they require, so alternative solutions need to be considered that involve the community, transporters and local road engineering experts together for a sustainable solution.

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He has also worked on projects in Kenya, Nigeria, Uganda and Zambia including to establish road research centres in Zambia, Mozambique, South Sudan, Ethiopia



Trade and Smuggling of African Gold to UAE: the Cases of Libya and Sudan

Professor Roman Grynberg, Dr Jacob Nyambe and Mr Fwasa Singogo[1]

Abstract:

The paper examines the trade in gold from two African countries, Libya and Sudan which are according to the United Arab Emirates (UAE) import figures, the two largest gold exporters to the UAE from the African continent. In the case of the former almost no gold is mined in Libya and yet it is reported to have exported 81 tonnes in 2016 and Sudan which is the second or third largest gold producer on the continent, reportedly exports gold to the UAE, based on 2016 prices at the lowest price of any African gold exporting country. The paper also considers the role of the UAE in the global gold trade and the need for improved compliance with minimum standards to assure that conflict gold does not find a ready market in Dubai.

Keywords: Gold, smuggling, UAE, Libya, Sudan

1. Introduction

With the end of the apartheid wars in southern Africa and the resolution of many of the 20th-century conflicts in West Africa and the partition of Sudan into North and South, the last decade has seen an almost unprecedented growth of gold exports from African countries. This expansion has been both in terms of volumes and the number of countries engaged in gold production and exports. This growth has been both of large scale mining (LSM) and just as significantly in artisanal and small scale gold mining (ASGM). The former is well documented under the reporting requirement of mining majors to their respective stock exchanges. However, ASGM which is commonly an informal and undocumented activity is far less well known though is growing in volume.

African gold exports to the markets in the UAE have increased considerably while a large number of statistical and trade anomalies appear to have arisen that require detailed examination.

There are several cases of countries emerging over the last few years as smuggling hubs in the African gold mining sector. This is attributed to the regulatory weaknesses in the ASGM sector, and this has seen an increase in smuggling and trade with tax havens like the UAE/Dubai. Precise data on the volume of exports of the most significant export item of many African countries are either inconsistent or in some cases non-existent. Even a relatively developed country like South Africa does not have one consistent database on gold production and exports, and there are inconsistencies between the estimates of various South African and international agencies (UNCTAD, 2016; Eunomix, 2016; Eunomix, 2017) [2]. When gold production and trade in the rest of the continent is considered below the reliability of production and export data deteriorates markedly.

The purpose of this paper is to investigate, to the extent that public data permits, the trade in gold from two exceptional cases. The two most significant are the cases of Libya and Sudan which have exported 81 tonnes and 62 tonnes of gold to the UAE respectively in 2016. The case of Libya where there was virtually no gold mining activity in the country, and yet, according to UAE data, it was the continent's largest exporter to UAE. Sudan on the other hand if one includes ASGM production is recognised as being the third largest producer of gold on the continent in 2016 after South Africa and Ghana and the second largest exporter to the UAE. Just as significantly as we shall see below Sudan is

reported to have exported gold and gold doré at prices well below not only the annual average gold price but also well below the minimum price of gold for that year. The issue of trading gold from Sudan at prices well below global averages has been raised in various IMF Article IV Consultation reports[3]. Estimates are made of losses of export revenue to Sudan from the gold smuggling and undervaluation to the UAE. The estimated losses and sale at what appears to be low prices create a large pool of rents earned by traders as well as the Central Bank of Sudan.

Table 1
2016 Estimates of African Gold Production and Exports by Data Source (Mtpa)

GFMS - Gold Mine Production In Africa	Comtrade - UAE Import of Gold from Africa	World Bank – Gold production by country
South Africa 145.7	Libya	81.517 South Africa 63.212
Ghana 94.1	Sudan	62.580 Ghana 61.68
DRC 60.4	Ghana	54.577 Burkina Faso 21.82
Mali 49.8	Mali	41.069 Mali 20.111
Tanzania 49.7	Guinea	31.194 Mauritania 18.56
Burkina Faso 40.9	Egypt	30.243 Tanzania 15.688
Zimbabwe 21.8	Tanzania	26.270 Guinea 14.92
Ivory Coast 22.6	Nigeria	21.208 Cote D'Ivoire 7.74
Guinea 19.6	Togo	12.000 DRC 7.31
Egypt 17.1	Uganda	9.994 Egypt 5
Sudan 15.5	Benin	9.990 Zimbabwe 3.33
Ethiopia 12.0	Cameroon	9.939 Senegal 2.82
Mauritania 7.6	South Africa	7.218 Ethiopia 1.5
Namibia 7.6	Senegal	5.394 Namibia 1.4
Senegal 6.8	Rwanda	4.882 Botswana 1.08
Zambia 4.6	Chad	4.668 Morocco 0.72
Other 18.9	Niger	4.337 Liberia
Total Africa 594.9	Madagascar	4.056 Eritrea
	Liberia	3.310 Total 246.9
	Burundi	2.841
	Others	18.853
	Total	446.140

Sources: GFMS data: GFMS Thomson Reuters. (2018). *GFMS GOLD SURVEY 2018*. Thomson Reuters. UK, London. NB GFMS data is drawn only from publicly listed gold mining companies and hence the discrepancy between GFMS and other sources. GFMS does not include ASGM output. **UAE Total imports:** DMCC <https://www.dmcc.ae/gateway-to-trade/commodities/gold> **Comtrade data:** extracted from the Comtrade statistical database. **World Bank:** World Bank (2017) *Transfer Pricing in Mining with a Focus on Africa: A Reference Guide for Practitioners*, Washington. This total is of what is categorised as producing mines output

Table 1 above sets out the estimates of gold production and trade by country from three different sources. The first is the GFMS Reuters survey, a highly reputable source in the minerals circles but one weakest in terms of the ASGM sector[4]. The second is the reported imports of the UAE of gold from African countries and the third is based on the World Bank mining database. In the case of the UAE data, this is largely but not exclusively from ASGM sources, though as we shall see below Libya's

massive exports of gold are not from any mined source. The World Bank database is entirely predicated on large scale mining projects.

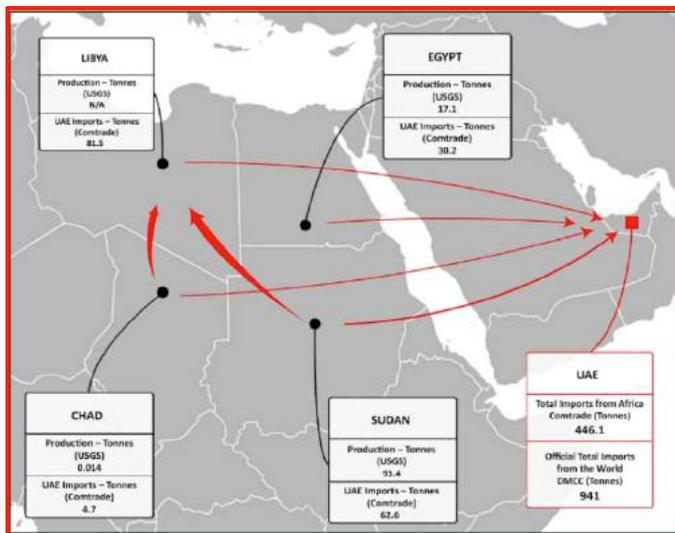
Smuggling of gold is by no means confined to the above cases but is prevalent across several countries and regions across the continent as well as globally (Blore, 2015; Martin & Taylor, 2014)[5]. The prevalence of gold smuggling in and from countries such as Mali, DRC and Sudan should be of concern not only to those countries but to all contiguous African countries which have become conduits for this illegal trade. The research indicates that a network of illegal gold trading is occurring across the continent from conflict and fragile states experiencing instability. These gold flows are often associated with money laundering and other illicit activities. Part of the driving force for the smuggling stems from the difference in export tax rates which should be harmonised. African countries would also benefit from an improved and harmonised and vastly improved system of gold trade recording.

The following brief analysis is based on Comtrade data for UAE imports of unwrought gold, i.e. HS7108.12. Indeed this is the same gold trade data source that has come in for heavy criticism from various governments including that of South Africa (SARS, Friday, 29 July 2016; Eunomix, 2017). The data is based on regional imports into UAE of gold from Africa [7]. There are numerous reasons that the analysis below should be tempered with scepticism in light of the recognised weaknesses of Comtrade data for commodities from Africa (UN Comtrade, 2016; Kar, 2009; United Nations, 2004; Ajayi, 1998) [8]. First, a large part of the gold imports into UAE are doré, and hence the volumes of imports are subject to the assumption that the volumes being declared at the UAE border and assayed by exporters (and sometimes by importers) at the border are correct[9].

Moreover, in some cases, these volumes may be incorrectly entered by customs officials. This is common in commodity trade throughout Africa. Second, the dollar value of imports that are declared might be undervalued by the importer though there is little immediate financial incentive as there are no taxes in the UAE on gold. There is however one

Map 1

Trade Production and Smuggling of Gold from Libya, Sudan and Egypt (2016 volumes)



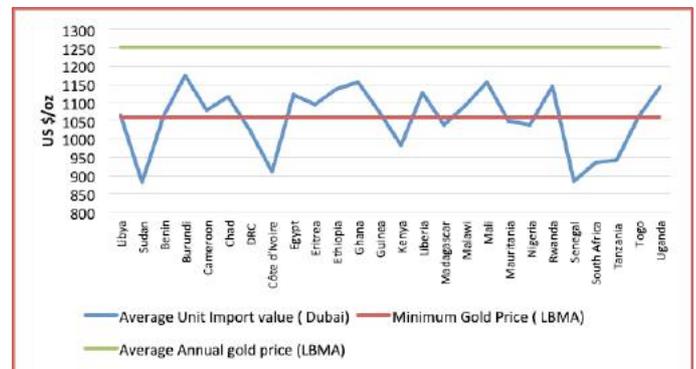
possible explanation of the anomalous volume of exports to the UAE. All four countries (Chad, Egypt, Libya and Sudan) constitute a zone of political instability and civil conflict. As a result, the export of gold in volumes well beyond reliable estimates of production of gold may be the disposal of gold as savings by private citizens from North East Africa to a relatively stable and tax-free environment in the UAE.

2. Smuggling from Africa: North African routes

The smuggling and trade routes of gold entering the UAE is depicted in Map 1 above. What it shows is that Libya is responsible for some 9% of total UAE imports in 2016. The map portrays the production and import of gold from four contiguous African states- Libya, Sudan, Egypt and Chad. There has existed a trade in Sudanese, i.e. Nubian gold with Egypt since the pharaonic era but there is no evidence that it is Sudanese gold that explains Egyptian export levels to the UAE that are well beyond known levels of production. It should be of considerable concern to the UAE concerned about the regions due diligence procedures. This is particularly so, given that Libya produces virtually no gold and Egypt is reported to export gold to the UAE in volumes that exceed estimated national production levels in 2016.

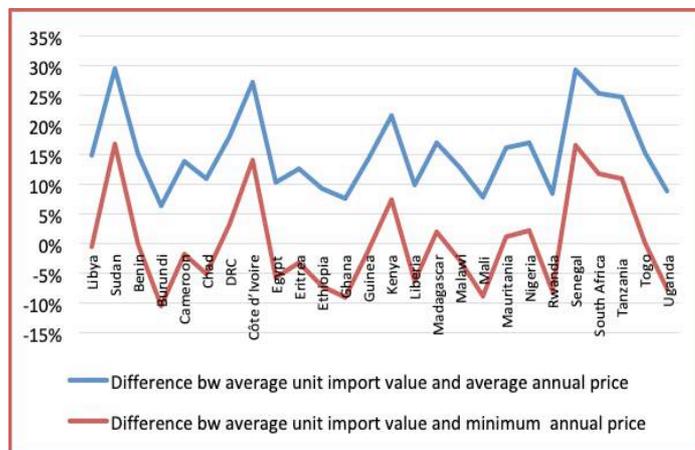
Figure 1

Comparison of Gold prices and Unit import values for 2016 – Top 26 African exporters to the UAE (ranked by volume of imports)



Given these data limitations, can one draw firm conclusions from unit import values of gold entering the UAE? There are some reasons why this data may be somewhat more accurate than other data used in the analysis of IFF. First, the data comes from one jurisdictional source only, the UAE and second, there is no obvious tax or financial incentive for gold importers or exporters to present inaccurate data on imports as is the case of other high tax jurisdictions. Third, the various data sources available present a remarkably consistent picture of African countries selling gold in substantial volumes and at unit import values below the average price in 2016 which is the latest year for which data is available[10]. The data also presents a picture of unit import values, in many cases being well below the minimum gold price of that year. Not one country in Africa sold gold to the UAE in 2016 that was above the average gold price. This outcome is shown in Figure 1 above. This may be explained by the fact that when selling doré there usually is a 1-3% refining charge and a marketing charge which is normally less than 1% for bars. The low unit import value which is below the average price for 2016 could merely be a result of unfortunate timing of sales. The outcomes are remarkably similar for all countries even those countries like Libya which is Africa’s biggest exporter of gold to the UAE in 2016 at 81 tonnes and Sudan at 62 tonnes in 2016 which by early 2018 had expanded production to such an extent that it rivals both Ghana and South Africa as the continent’s largest gold producer[11].

Figure 2
Gold Margins for 2016 - Top 26 African exporters to the UAE



Source: Comtrade and author's calculations

i. Libya

Libya and Sudan are the two most important cases of gold trading and smuggling to the UAE. Libya produces virtually no gold and has no operating large scale mines, yet UAE recorded some 81 tonnes of imports from Libya in 2016. In 2016 gold was Libya's second largest export after oil.[12] In 2011 when the Libyan civil war began Libya sold some 27 tonnes of the country's official reserves.[13] However, since that time has sold or exported a total of some 171 Tonnes of gold which made the country Africa's largest exporter to the UAE [14]. The origins of the gold which has been exported from Libya to UAE are unknown and could have been, at least in part, smuggled from sub-Saharan Africa as well as Sudan to pay for the very substantial human trafficking of sub-Saharan African nationals occurring through Libya[15]. There does exist some evidence of ASGM activity in Libya, but volumes are considered very small.[16] In neighbouring Chad (Tubiana & Gramizzi, 2017)[17] there are significant ASGM gold deposits in the north of the country and Libya may well be a smuggling route of preference rather than returning such gold to the capital N'Djamena. Furthermore, smuggling of gold from the mines in various parts of Darfur [18] in Sudan and used in order to pay for the transport of refugees from the war-torn region has been cited as one case of trans-boundary shipment of gold for people smuggling. However, Libya is not a known gold smuggling entrepot to the UAE.

However, it is difficult to imagine that such a large volume of gold over a period of five years could come from mined sources in Libya or its immediate neighbours. It is more probably part of the much vaunted 140-tonne stock held by the former Libyan dictator Muammar Gadhafi [19] and disposed of into the UAE markets by various 'governments' in Libya or by the various warlords that have controlled different parts of the country since the death of Gadhafi in October 2011. The leaked Hilary Clinton email alleges that the motivation of the French government in leading the Libyan intervention was:

'Qaddafi's government holds 143 tons of gold, and a similar amount in silver. During late March 2011 these stocks were moved to SABHA (south-west in the direction of the Libyan border with Niger and Chad); taken from the vaults of the Libyan Central Bank in Tripoli. This gold was accumulated before the current rebellion and was intended to be used to establish a pan-African currency based on the Libyan golden Dinar. This plan was designed to provide, the Francophone African Countries with an alternative to the French franc (CFA). (Source Comment: According to knowledgeable individuals this quantity of gold and silver is valued at more than \$7 billion. French intelligence officers discovered this plan shortly after the current rebellion began, and this was one of the factors that influenced President Nicolas UNCLASSIFIED U.S. Department of State Case No. F-2014-20439 Doc No. C05785522 Date: 01/07/2016 Sarkozy's decision to commit France to the attack on Libya. According to these individuals, Sarkozy's plans were driven by the following issues:

- A desire to gain a greater share of Libya oil production,
- Increase French influence in North Africa,
- Improve his internal political situation in France,
- Provide the French military with an opportunity to reassert its position in the world.
- Address the concern of his advisors over Qaddafi's long term plans to supplant France as the dominant power in, Francophone Africa.

This leaked Hilary Clinton email has become the source of many web-based conspiracy theories. The

veracity of the email has not been denied but what subsequently occurred in France has shaped the discussion. Former President Sarkozy has been indicted for illegally receiving Euro 50 million in campaign contributions from Gaddafi to support his 2008 reelection bid [20]. While this indictment did not occur until 2018, the circumstances of the rebellion against Gaddafi and his suppression of the rebellion must have provided domestic political reasons, if it were needed, for the French military intervention in Libya. This would ultimately see the death of Gaddafi and with him a secret of French domestic politics. The UN Security Council has undertaken considerable research into what has happened with the assets of the Gaddafi regime, but it has not tended to focus on gold but rather upon other assets of the regime (United Nations Security Council , 2017) [21].

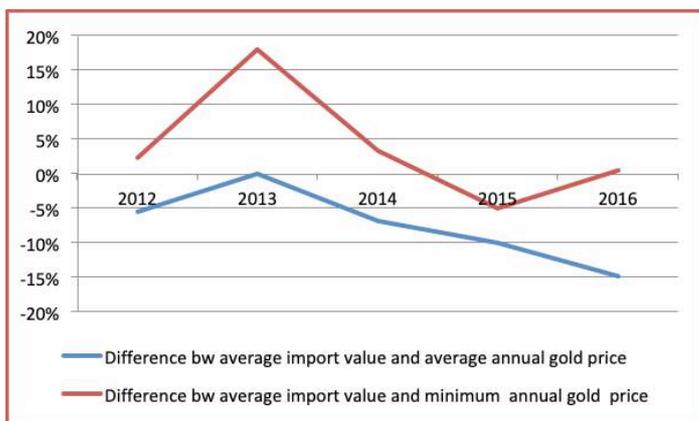
that Libyan dinar was a gold coin[22]. There is a further issue that pertains to the Libyan exports, and that is the price received for what was almost certainly not doré bars. Figure 3 above shows the unit value of Libyan gold exports to the UAE.

ii. Sudan

Gold production in Sudan is widely distributed and occurs in over 13 provinces[23] in an estimated 40,000[25] mines which employ over 1 million people [25](Dr Fatima, 2017). In this mostly ASGM sector gold production which remains only very lightly regulated and is not a significant source of revenue for the government because of what is seen, even by government estimates as widespread smuggling of gold. The occurrence of gold at the very geographic periphery of the country in the Nubian Shield makes for ready smuggling across the Red Sea to Saudi Arabia, to Egypt, or Dubai. Other areas such as Darfur make for more smuggling routes into other neighbouring countries like Libya as well as to Dubai via Khartoum. Map 2 below depicts the occurrence of gold are widespread and distributed close to borders.

Figure 3

Gold Margins for Libya-UAE Trade (2012-2016)



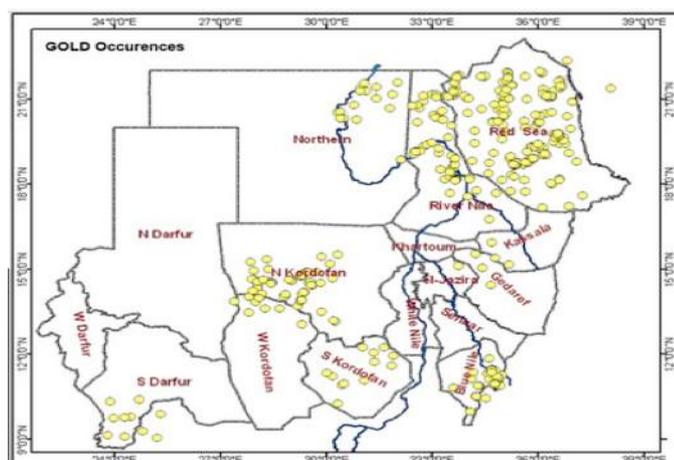
Source: Comtrade and author’s estimates

In 2016 when some 81 tonnes of gold were imported from Libya by UAE, the gold was sold on average at the minimum price for that year and 15% below the LBMA average gold price. These low prices for Libyan gold that was almost certainly already refined as virtually no doré is produced in Libya should be a concern to UAE authorities given the prospects of money laundering activities by human traffickers.

Given the long years of conflict that have followed the death of Muammar Gaddafi the gold sales into the UAE may also be, in part, explained by the sales by private Libyan citizens during the years of conflict starting since 2011. This is particularly so given that

Map 2

Occurrences of Gold in Sudan



Source: Mineral Deposits of Sudan 2013 – Extracted from Minerals potential and resources in Sudan by Dr Yousif Elsamani

Based on early results from the first quarter of 2018, Sudan’s production had expanded to such a degree that it may emerge as Africa’s largest gold producer by the end of 2018 though, based on previous years’ estimates it is still normally ranked as the third largest producer after South Africa and Ghana.[26]

Sudan has estimated that virtually all production comes from the ASGM sector[27]. Some larger mines are being developed[28] (Dr Fatima, 2017) but by and large, the industry is associated with small mines with all the attendant social, environmental and health problems experienced in the sector (Benkenstein, 2012; UNEP, 2013)[29]. The actual volume of gold production and exports from Sudan is an unknown, and the estimates available from different normally reliable sources suggest very substantial smuggling of gold. Table 2 below shows that the volume and value of gold exports by Sudan are considerably less than the amount that the UAE claims that it imports. The GFMS data indicates that gold production is low and declining over time and no source provides data which is remotely consistent with other sources. Given the widespread use of ASGM in Sudan and other countries in west and central Africa, the GFMS data is becoming progressively less accurate over time given its exclusion of ASGM gold which is smuggled out of the country[30].

Official Sudanese government estimates of gold production are at wide variance with the external estimates. GFMS estimates, based as they are on gold production of listed firms, can be dismissed and the USGS estimates of gold production are primarily based on the official government estimates. It can be seen from the table above that production in 2016, the last year for which data is available, was 94.3 tonnes and this is expected to rise substantially in 2017 and 2018 given the expansion of production that is occurring in ASGM and LSM. It is doubtful that given the wide geographic dispersion of ASGM mining in Sudan that these estimates are accurate given the level of smuggling and therefore should be treated with the necessary measure of scepticism. Indeed gold production could be considerably larger than current estimates (Onour, 2018).

In order to understand gold production and exports from Sudan, it is necessary to understand the byzantine rules of gold trade that are used by the Government of Sudan. The government of Sudan has a multiple exchange rate system whereby gold is purchased at the parallel exchange rate in order for the government to obtain some of the forex benefits of the gold mining industry. To do this the

government prints money which has fueled inflation. [31]

Table 2
Gold Production and Exports from Sudan by Data Source

Year	GFMS-GOLD MINE PRODUCTION	IMF		Comtrade - UAE Import of Gold		USGS	GoS
	Volume (Tonnes)	Exports, f.o.b. (mil US\$)	Volume (Tonnes)	Value (mil US\$)	Volume (Tonnes)	Mine output (Tonnes)	Production (Tonnes)
2012	27.9	2,158	46.1	3,188.4	69.1	46.1	45
2013	20.1	1,048	24.8	1,820.9	44.3	70.0	70
2014	21.5	1,271		1,856.8	51.1	73.3	70
2015	16.5	726		1,294.1	38.4	82.4	82
2016	15.5	1,044		1,772.7	62.6		93
Total	101.5	6,247		9,932.90	265.5		360

Sources: GFMS 2018 Gold Survey, Sudan 2014, 2016 and 2017 Article IV consultation reports, the Comtrade database and USGS 2015 Sudan Mineral Industry data. **NB:** more recent comparisons are not included as recent IMF reports do not have this data. The 2016 GOS figures stem from a Presentation by The Republic Of The Sudan Ministry Of Minerals, by Dr Mohamed Abu Fatima, GRAS Director General, UK-Sudan Trade & Investment Forum, 12-12, 2017 <https://www.developingmarkets.com/sites/default/files/1.Ministry%20of%20Minerals.pdf> downloaded September 2018. The USGS estimates are the same as the Government of Sudan estimates.

The government sells the gold in Dubai and uses the forex earnings used to buy dollars which are then made available to importers at the lower official exchange rate. This creates the potential for rent-seeking behaviour and the underpricing of gold exports. Whether under-valuation of exports is occurring through the CBOS or just through private exporters is unknown. The IMF has estimated losses to Sudan stemming from how gold is traded. In 2016 losses were equivalent to 1% of GDP (equivalent to 576.49 million USD).

Table 3
Losses by Central Bank of Sudan from Gold exports (%GDP)

	2013	2014	2015	2016	2017(p)
Losses	0.6	0.7	0.4	1.0	1.8

Source: IMF (2017) Article IV Consultation Report 17/364 (Sudan), p8. <https://www.imf.org/en/Publications/CR/Issues/2017/12/11/Sudan-2017-Article-IV-Consultation-Press-Release-Staff-Report-and-Statement-by-the-Executive-45456> downloaded September 26, 2018 (%GDP)

These multiple exchange rate policies stem from what has been the collapse of Sudan's oil export sector with the secession of South Sudan as well as the sanctions that were placed on Sudan until October 2017. Gold has now replaced oil as the largest export sector of the economy, yet it has been a poor revenue substitute because of the dominance of ASGM production. This has meant that the government has faced severe revenue and forex generating issues.

Given that many of the mines are located near the different borders and the existence of virtually unregulated ASGM production then there are definite limits to any enforceable government policy on gold purchases. In 2018 the Central Bank of Sudan was reported to have taken over all gold exports from Sudan[32]. This should not necessarily be seen as a defence of good governance as Sudan has consistently sold its gold at well below the world market price. This has been alluded to in several earlier IMF Article IV consultation papers[33] (IMF , 2014) and is consistent with more recent Comtrade data in table 4 below. In 2016 the unit import value of Sudanese gold in the UAE was at a 31% discount to the average price and a 15% discount to the minimum 2016 price.

There have been various estimates made of the extent of smuggling from Sudan and the most recent estimates based on econometric analysis suggest that some 34% of Sudan's gold is smuggled out of the country[34]. The difference between what is recorded in the IMF Article IV consultation report (\$6.2 billion in exports over the period 2012-2016) and the UAE import data (\$9.9 billion over the period 2012-2016) suggest that the level of smuggling and misreporting together are close to 60% of the value of 'official exports'.

Table 4 sets out various estimates of undervaluation of Sudan's gold exports for two years for which IMF and Comtrade data exists. Based on Comtrade data Sudan exports to UAE far more gold than the entire country officially exports. The export volumes in the official IMF Article IV data is significantly below the UAE import data, which is to be expected given the amount of smuggling. The unit values of the IMF estimates and Comtrade are, however, remarkably

similar and both indicated that Sudan exported gold and unit values well below the world price in the years for which IMF undertook the analysis. The IMF, apparently concerned by the reported unit export values of gold, nevertheless ceased to publish this type of analysis after 2013.

Table 4
IMF Export and Comtrade UAE Unit Import Values of Gold

		US\$ (mil)	Tonnes	Average Unit Export value	Minimum Gold Price	Average Annual gold price	Difference bw average export value and average annual price	Difference bw average import value and min. annual price
IMF	2012	2,158	46.1	1454.95	1540	1669	13%	6%
	2013	1,048	24.8	1313.69	1195.25	1411	7%	-10%
		US\$ (mil)	Tonnes	Average Unit Import value	Minimum Gold Price	Average Annual gold price	Difference bw average import value and average annual price	Difference bw average import value and minimum annual price
Comtrade	2012	3,188.4	69.1	1434.92	1540	1669	14%	7%
	2013	1,820.9	44.3	1279.53	1195.25	1411	9%	-7%

Sources: Sudan 2014 Article IV consultation report and Comtrade database. **NB:** more recent comparisons are not included as recent IMF reports do not have this data.

ASGM vs LSM

It remains possible but certainly challenging for countries to monitor, regulate, control and tax ASGM activities when mines are widespread and remote as in Sudan. Sudan is transforming its economic base from dependence on oil exports before the separation of South Sudan in 2011 and the gold export economy that has emerged in the north in the wake of the partition of the country and the decline of oil. The economic transformation of Sudan from its dependence on large scale oil production and hence a relatively knowable if volatile source of export and government revenues, to the current situation where both export and government revenues from ASGM are precarious and dependent upon highly distortionary government economic policies towards gold exemplifies the problems facing ASGM. The government of Sudan faces a situation where it is just not possible to extract tax revenues from the mining sector because of the porous borders and relative ease of smuggling. The

more the government attempts to compensate for the loss of oil revenues by taxing gold production the more it pushes the ASGM sector towards smuggling and other nefarious activities.

In most cases what is seen in Sudan is not in any way exceptional for the experience of other developing countries with ASGM. Regulating and controlling the ASGM sector has been challenging, and most governments have merely preferred to see large scale mining by large transnational companies even though this constitutes a substantial loss of employment for its citizens. When ASGM is seen from the perspective of the Ministries of Finance and Minerals, the sector is invariably seen as a cost centre for a government that is environmentally destructive[35] (Benkenstein, 2012; UNEP, 2013) as well as creating severe social and gender issues [36] (Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development (IGF), 2018; Doris, et al., 2017; Hinton, et al., 2003).

In Sudan, the government has seen little benefit and significant economic as well as environmental costs from the ASGM sector. In 2011 the IMF concluded that (IMF, 2013) [37], 'the gold sector is estimated to account for less than 0.1 percent of total tax revenues in 2011'. This minuscule contribution of what is now the economy's largest sector to the revenue along with the prevalence of smuggling along with, substantial environmental, social and gender problems means that the single contribution of the sector is its widespread employment generation.

Three factors combine to create significant impediments to effective policies towards gold and gold mining. The first and undoubtedly the most important is the extreme difficulty that a geographically large country like Sudan, like so many others, has with dealing with a large number of producers. The second reason stems in no small part from smuggling which stems from not only the nature of the ASGM sector but attempts by the government to tax gold mining and assure that it contributes to the national revenue. The third comes from the very nature of ASGM where there are large numbers of producers spread over large parts of the country. The existence of smuggling and trade malfeasance such as export undervaluation result in

prices received for gold in Sudan that, as we have seen are below the global average and minimum prices.

The analysis below presents a counter-factual of the Sudanese balance of payments as well as of national tax revenue under the assumption that Sudan's gold mining is:

- (I) Based on a relatively small number of large scale mines which are manageable in terms of production, tax liabilities and exports
- (II) The government receives forex based on the average annual LBMA price of all gold produced minus 4% of estimated value for final refining and trading margin in Dubai.
- (III) The government imposes royalties and company taxes that are consistent with good practice in the industry [38].

Thus the losses estimated are the economic price the country pays for creating a large number of jobs (estimated to be 1 million) in the ASGM sector in Sudan and continued smuggling as well as the underpricing of gold. It is the virtually complete absence of an effective regulatory framework in the ASGM sector that makes it possible to conclude that Sudan was losing some \$3.4 billion in forex earnings from the gold sector in 2016. Assuming the government was able to control exports of gold and assure that transaction went through the CBOS then the trade deficit would decline from some 7.3% GDP in 2016 to 2.8% GDP. Gold export earnings would rise from the estimated US\$ 1.8 billion in 2016 to \$3.6 billion. In other words, the country trade imbalance would approach sustainable levels if good governance in gold production and trade can be assured.

The forex losses to Sudan from its current mining and trade model is predicated on ASGM with smuggling, and consistent undervaluation of exports is most evident when one creates a revenue counter-factual case. Here we assume that the government collects as what was suggested by the IMF no revenue from gold mining. The study assumes that with LSM in the formal sector it can collect 7% royalty, and lastly a company tax payment equivalent to 4%-6% of gold sales.

Figure (4 a)

Actual Sudan Balance of Trade and Counter-factual balance

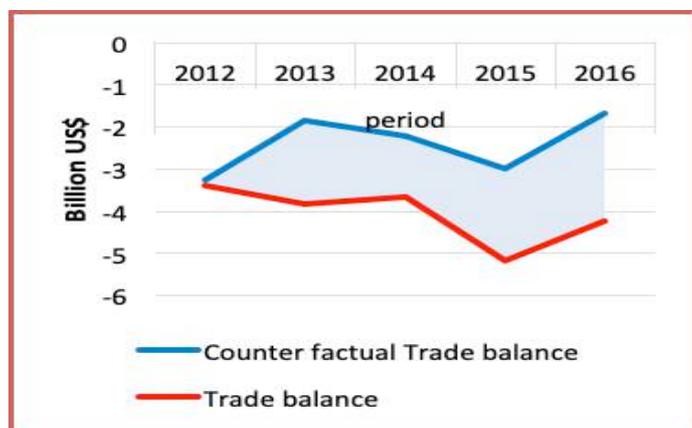
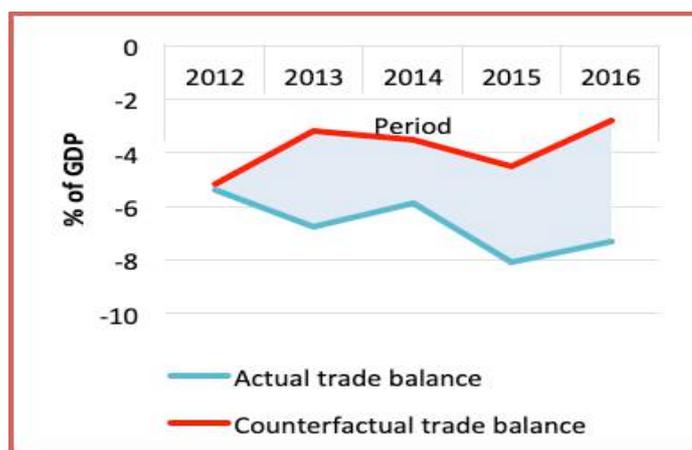


Figure (4 b)



Source: Various IMF article IV consultation reports and authors estimates.

The two figures below present the increase in government revenue that would accrue if LSM firms, like those which operate around Africa also operated the Sudanese gold mines. The implicit assumptions regarding good governance in such a scenario are indeed heroic. While an adequately managed gold mining sector would not solve all of Sudan's fiscal deficit issues, it would dramatically decrease the size of the fiscal deficit significantly.

DMCC Due Diligence

The UAE through the Dubai Multi Commodities Centre (DMCC) conducts a policy of responsible sourcing of gold which is supposed to minimise the trade in gold from conflict zones[39]. The responsible sourcing of gold, however, has not halted

the importation of gold from Libya and Sudan. There is also an increase in the volume of gold coming from the Great Lakes Region where exports to the UAE from countries neighbouring the Eastern DRC are in such volumes that they cannot possibly be from local mines whether ASGM or LSM. Table 5 below shows the increasing dependence of the UAE on gold from countries in conflict and what we have termed countries that are trade anomalies, i.e. where exports to the UAE are far higher than any estimates of gold production. The UAE estimated that 944 tonnes of gold were imported to Dubai in 2016 with some 143 tonnes coming from Libya and Sudan.

Figure 5 (a)

Sudan Fiscal Deficit – Actual and Counterfactual Cases (US\$ billions & %GDP)

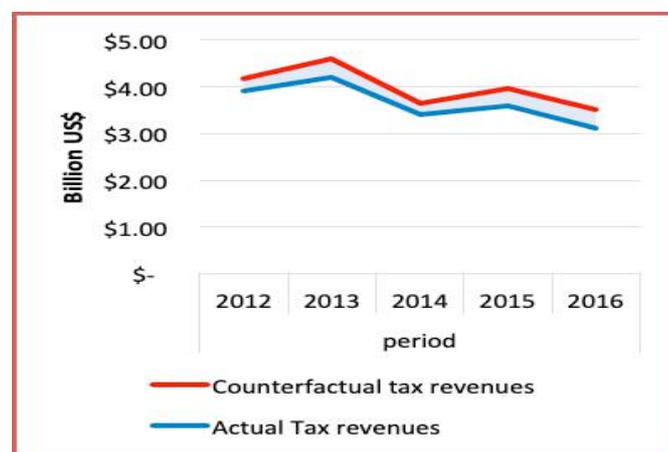
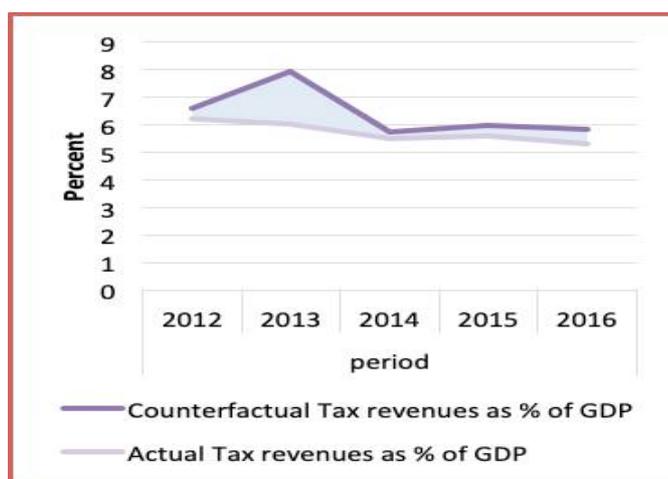


Figure 5 (b)



Source: Comtrade, IMF Article IV consultations and authors estimates

Adding to this, the reported exports from Uganda, Rwanda and Burundi to the UAE of 18 tonnes the figure rises to 17% of total UAE gold supply[40].

The amount of gold smuggled from eastern DRC to UAE using these three countries as entrepots from DRC does not include potential smuggling from DRC to neighbouring Tanzania. The dependence on gold from conflict countries and countries which are trade anomalies in gold has risen from 17.2% at the beginning of the period to 31% in 2016. Many of the countries involved in trade with UAE are reported to export quantities that are well over any estimates of production such as Nigeria, Benin, Uganda and Rwanda amongst others. This trade requires a detailed forensic investigation by DMCC and international anti-money laundering authorities.

Gold that arrives in Dubai from Africa entered the Emirates in small volumes and is carried in personal luggage. There exist what are at least nominally fairly stringent UAE customs regulations that govern this trade. Importers are required to declare the content at the border, and in the absence of a foreign assay test the importer is required to complete one before the gold is released to the importer to bring into the country[41]. However, the small volume of personal imports that come from many countries in Africa is not the principle route for Sudanese gold which has entered through two principal sources. In 2012, when NGO estimates were available, they indicate that 'about 77% of the 57 tonnes of gold originating from Sudan was exported to Dubai by an arm of the Sudanese government known as the Sudan Financial Services Company (SFS)[42]. The remaining 23% was sold by private companies incorporated in the United Arab Emirates or Sudan, which subsequently exported it to Dubai. Most of this gold from Sudan was sold to one refiner in Dubai: Kaloti[43]. This refiner is discussed below.

The gold doré or dust can enter the market either directly through one of the refiners involved in the industry or be sold to individual traders in the Dubai 'gold souk'. These buyers act as intermediaries that will then on-sell gold imported from Africa and elsewhere to one of the refineries which will then be able to sell on the Dubai gold exchange as 'Dubai Good delivery'[44]. Buyers in the souk wishing to sell their gold on to a Dubai refiner are required to keep a record of the nature and origin of their gold purchases in order to satisfy the due diligence requirements of the refiners. However, the practice of classifying the gold as scrap by gold buyers and

the "don't ask, don't tell" practice, weakens the due diligence practice. Even more worrying is the laxness of compliance with the due diligence process by significant players in the supply chain (the refiners). Blore (2015) notes that while some refiners were open to discussions on their purchase verification procedures, others were not.

Table 5
UAE Total Imports of Gold, - Dependence on Conflict

Total Imports of Gold in metric tons					
	2012	2013	2014	2015	2016
UAE	837	1103	959	794	941
UAE Imports of Gold in tons from Conflict countries in Africa					
	2012	2013	2014	2015	2016
Libya	19.3	10.3	38.6	40.3	20.5
	(1)	(1)	(1)	(1)	(1)
Sudan	49.1	46.3	51.1	38.4	51.6
	(46.3)	(39)	(39.50)	(32.45)	(51.45)
DRC	0.4	0.6	0.8	1.2	0.6
	(3.4)	(17)	(33)	(37)	(38)
UAE Imports of Gold in tons from "Anomaly" countries in Africa					
	2012	2013	2014	2015	2016
Burundi	3.0	5.1	3.2	4.6	2.8
	(9.5)	(9.4)	(9.5)	(9.5)	(9.5)
Benin	1.1	1.1	0.7	0.8	1.0
	(1)	(1)	(1)	(1)	(1)
Cameroon	5.0	5.6	8.7	10.4	8.8
	(13.3)	(13.6)	(13.3)	(13.6)	(13.1)
Chad	0.7	1.9	4.2	2.0	4.7
	(1)	(0.034)	(0.034)	(0.034)	(3.14)
Egypt	0.5	0.3	3.7	2.0	20.2
	(8.2)	(13.3)	(13.7)	(13.7)	(13.3)
Liberia	5.6	3.3	3.1	3.2	3.3
	(9.0)	(9.4)	(9.4)	(9.5)	(9.5)
Madagascar	4.0	3.6	5.8	4.0	4.3
	(9.2)	(1)	(1)	(1)	(1)
Mali	29.1	49.8	39.9	46.9	41.1
	(41.0)	(41.4)	(40.5)	(40.5)	(41.0)
Niger	0	1.2	2.4	4.9	4.3
	(19.7)	(13.2)	(9.7)	(13.3)	(19.0)
Nigeria	7.8	6.3	9.0	15.3	21.2
	(4.3)	(8.3)	(7.2)	(7.5)	(7.5)
Rwanda	0	0	0.2	2.0	4.9
	(1)	(1)	(0.2)	(0.3)	(0.3)
Togo	1.1	1.0	1.9	0.844	0.026
	(28.4)	(21.3)	(20.0)	(15.4)	(15.4)
Uganda	1.2	1.1	1.0	2.9	3.0
	(9.000)	(9.000)	(9.000)	(9.000)	(9.000)
Total	181.9	173	188.1	205.1	211.8
	(134.7)	(175.7)	(188.2)	(202.2)	(215.8)

Source: DMCC <https://www.dmcc.ae/gateway-to-trade/commodities/gold> and Comtrade database. In parenthesis are production figures from USGS.NB, It is worth noting that USGS states that Benin may have produced gold (either as undocumented artisanal or byproduct production), but available information was inadequate to make reliable estimates of output levels. Whereas, USGS has no data for Libya as like may sources production is believed to be none existent or very low. On the other hand, USGS state that data reported by the Government of Togo as exports predominantly include artisanal gold mine production transiting Togo from neighbouring countries and, to a lesser extent, domestic artisanal mine production. Data may include gold from other artisanal sources.

Gold and Anomalies

The single most revealing development with regard to the Africa-UAE gold trade over the last few years has been the case of Kaloti, the largest refiner in the UAE responsible for \$12 billion of trade and gold refining[45] which has been allegedly involved in several extremely high profile incidents of what is considered commercial impropriety in the gold trade. Ernst and Young undertook a management report in 2013, and the results indicated that there were numerous lapses in the proper governance of the gold value chain by Kaloti[46] (Global Witness , 2014). Kaloti was allegedly involved in some incidents, of which the importation of some 4 tonnes

of Moroccan gold which had been coated in silver to evade Moroccan export regulations is one[47]. However, the issue of greatest relevance to the current research is the assertion that Kaloti accepted 57 tonnes of Sudanese gold for refining purposes even though it is considered high risk by its standards[48]. Similarly, Kaloti had a practice of accepting gold from 'call customers' without carrying out any enhanced due diligence. The value of these call customer trade amounted to \$5.2 billion in 2012. The consultant who had undertaken the original due diligence was removed and the same year Ernst & Young (E&Y) later released a study stating Kaloti was in compliance with the requirements of the DMCC's Practical Guidance for Market Participants in the Gold and Precious Metals Industry[49] (Ernst & Young, Nov, 2013). This was followed up by Grant Thornton who undertook a new study the following year and gave Kaloti a clean bill of health[50] (Grant Thornton, Aug 2014). The following year Kaloti was delisted by the DMCC from the Dubai good delivery list[51]. The consultant for the original E&Y study Mr Rihan was removed and in 2018 was reported to be suing Ernst and Young[52]. This brings into question the role that is played by the major consulting and accounting firms in assuring the proper maintenance of the value chain.

Conclusion

Until 2000 most African gold came from the mines of the Witwatersrand in South Africa as has been the case for well over a century. Much smaller volumes came traditionally from Ghana with some ASGM activity occurring throughout the continent. Overall, gold mining was an economic activity conducted mainly by some of the world's largest transnational mining companies, and a regulatory mechanism existed that assured that exports and revenues would accrue to the South African and Ghanaian states. However, with the end of some of the many conflicts in Africa that had plagued the continent and by extension the mining sector in the 20th-century gold is now being produced in considerable volumes in many non-traditional source countries such as Sudan and the countries of West Africa. The trade in gold out of Africa was in the past almost entirely conducted by these transnationals and through the Rand Refinery in South Africa which remains one of the primary vehicles for the formal trade in gold

through the LSM sector. However, there has been a fundamental transformation with gold mining. It is becoming decentralised and informal with new destinations beyond South Africa and the London markets. Exports have increasingly shifted to Dubai in the UAE and away from traditional destinations such as Switzerland and the United Kingdom.

Libya's situation as a failed state faced with a cycle of internal conflict and ruled de facto by warlords and multiple governments creates a myriad of ills. Gold, after oil, is now Libya's second largest export and yet there are no operating large scale mines and very few ASGM activities. The export of a reported 81 tonnes of gold in 2016 by Libya to the UAE cannot be readily explained by mine production. Total gold exports to the UAE from Libya since the collapse of the Gadhafi regime in 2011 was 174 tonnes. This raises the obvious question of the origins of such volumes of gold from a country which has never in modern times been a gold producer of any significance. We have suggested several hypotheses, and that is all a prudent economist can do with the current state of knowledge. The most immediate was the disposal by governments or warlords of Gadhafi's accumulated 140 tonnes of gold. There appears to be anecdotal evidence that gold from the ASGM in northern Chad is finding their way into Libya and that gold from Darfur in Sudan is being used to facilitate the trade in refugees and illegal migrants to Europe. The last explanation is that private citizens faced with long years of civil conflict have been melting Gadhafi's gold dinars and selling them in order to maintain their living standards.

Sudan's experience, on the other hand, typifies much of what has happened to African gold production over the last decade. Production is decentralised with an estimated 1 million people employed in ASGM in Sudan. Regulating the trade and production in 13 provinces has yet to prove successful, and governments by and large have not generated any significant revenue. Moreover, without the costly two-tiered exchange rate system there would almost certainly be no official export earnings from the sector as gold would tend to be smuggled to the UAE in even higher volumes. Unit import values of gold tend to be well below the LBMA average price as well and on occasion below the minimum price. The potential for substantial

nefarious rents to be earned by government officials would appear to be considerable. The study has conducted a counterfactual exercise of what export and tax revenues would be generated if Sudan were to conduct the mining activities based on a properly managed LSM and not a decentralised and de facto unregulated ASGM. While not an economic panacea to all of Sudan's economic woes it would significantly reduce fiscal and trade deficits in a country still reeling from the loss of the oil sector following the partition of Sudan in 2011.

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11. See: <http://www.sudantribune.com/spip.php?article65841>
12. See: <https://atlas.media.mit.edu/en/profile/country/lby/>
13. See: World Gold Council reserve statistics of official gold reserves from <https://www.gold.org/data/gold-reserves>
14. This according to Comtrade data from 2012 to 2016. The 27 tonnes sold in 2011 is not included in this figure as it

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 38. Counterfactuals were based on the author's calculations. It was assumed that all production was exported. This saw gold sales exceed what was reported as exports ("of which: gold") from IMF consultation reports. The difference was then added to the actual exports, while imports remained unchanged. The difference between the counterfactual exports and imports giving the counterfactual trade balance. The royalties and company tax counterfactual on the other hand were based on the assumption that close to no revenue was generated according to IMF consultation reports. Sudan has a small number of gold mining companies who are required to pay a royalty rate of 5-7% and a business profit tax of 15% (Dr. Mohamed Abu Fatima. (2017). Sudan Minerals Potential and Investment Opportunities. The Ministry of Sudan. Downloaded 2018 from: <https://www.developingmarkets.com/sites/default/files/1.Ministry%20of%20Minerals.pdf>) in comparison to thousands of artisanal miners who pay close to nothing. Counterfactuals were based on the author's calculations of averages from AngloGold Ashanti (Rest of Africa - RoA), the Kinross group, Gold Fields group and Newmont of company taxes as a portion of gold sales - AngloGold Ashanti (RoA) excluded South African mines as they are marginal and disaggregated African data was readily available in comparison to the other mines where group data was used as African mine data was not disaggregated. After that based on the actual values (Tax revenues and nominal GDP), the respective counterfactuals were derived.
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- i. Description of the contents (Dust, Nuggets, Dore, etc.)
 - ii. Net weight of the contents
 - iii. Gross weight of the shipment
 - iv. Value of the contents
 - v. Description of the container(s)
 - vi. The Consigner and Consignee
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43. Illegal 'blood gold' - from war-torn Sudan to your phone Khadija Sharife 11 May 2016 <https://mg.co.za/article/2016-05-11-the-missing-paper-trails-of-sudans-gold> downloaded October 2018. The Sudan Financial Services company is 99% owned the CBOS and 1% Ministry of Finance.
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50. See: Grant Thornton, Independent reasonable assurance report (ISAE 3000) to Kaloti Jewellery International DMCC. Downloaded from: <http://www.kalotipm.com/userfiles/file/GTASSURANCE-REPORT.pdf>
51. The DMCC did not public provide specifics as to the delisting. See <https://www.thenational.ae/business/dmcc-removes-kaloti-from-dubai-good-delivery-list-over-gold-sourcing-1.34979> and Dubai Good Delivery List. Downloaded from: https://www.dmcc.ae/application/files/2114/9138/7908/DGD_List-Gold_Alphabetical_-_October_2016_Final.pdf
52. See: <https://www.theguardian.com/business/2018/jan/21/ernst-young-whistleblower-suing-gold-audit-dubai>, though some sources state he resigned. See: Gold market breaches 'covered up' from <https://www.bbc.com/news/business-26341072>. He is suing for the "unlawful, unprofessional, and unethical" conduct relating to E&Y's its audit of Kaloti who have been accused of money laundering and buying gold from conflict zones See: <https://www.theguardian.com/business/2018/jan/21/ernst-young-whistleblower-suing-gold-audit-dubai>, <http://uk.businessinsider.com/whistleblower-sues-ey-alleged-corruption-2018-1> and <https://www.gulf-times.com/story/575762/Gold-firm-whistle-blower-who-fled-Dubai-sues-Ernst>

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Intra-African migration and structural transformation

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Introduction

This chapter aims to contribute to a better understanding of the economic, trade and social dimensions of the relationship between migration and structural transformation in Africa. The first three sections highlight that migration is associated with primarily positive but also negative economic effects in sending and receiving countries in many regions of the world. With regard to Africa, differing stages of regional integration on the continent, coupled with limited and localized progress in structural transformation, warrant a closer examination of how migration can generate greater development benefits. Insights are provided on where opportunities exist in different sectors in Africa.

The fourth section uses findings from the previous chapters to make the case for evidence-based migration management, providing a preliminary identification of policy levers at the national, regional and continental levels that can contribute to an optimal distribution of the benefits of intra-continental migration in origin and destination countries. The conclusion notes that for Africa to achieve the 2030 Agenda for Sustainable Development and set a path for achieving the objectives laid out in Agenda 2063, such policy levers should be integrated with measures that aim to influence the perceptions of persons and households of labour market opportunities and expectations of higher earnings abroad.

There are ongoing efforts to advance the migration agenda at the continental level in Africa, and progress has recently been made on defining a continental-level migration action plan. Prior to this, the African Common Position on Migration and

Development and the Migration Policy Framework for Africa, both adopted by the Executive Council of the African Union in 2006, provided the most comprehensive policy vision for regional migration on the continent. The Migration Policy Framework states that “it is clearly known that well-managed migration has the potential to yield significant benefits to origin and destination States” (African Union, 2006). Yet little is known of how such benefits may be distributed across countries and how, if at all, they can contribute to the structural transformation of countries. Furthermore, media reports of mounting xenophobia in some destination countries and discouraging prospects for growth in others have raised concerns of potential setbacks associated with the liberalization of labour mobility. Such incidents cast a shadow over the many other successful migration stories in Africa.

Afwerki met Mamadou, one evening in Johannesburg, at a gathering organized by a pro-immigration civil society group run by an acquaintance of his. He was struck by Mamadou’s explanation about the plight of immigrants like him. Meeting at the end of the evening, Afwerki told Mamadou that he studied IT in Kenya thanks to the money that his uncle, Feiven, who lives in America, sent for his schooling. He did internships in the Nairobi’s “Silicon Valley”, moved to Rwanda, worked hard and some years later, landed funding from a venture capital firm to create his own company. He is now at the helm of a successful Pan-African digital media company, and is proud to be counted among the country’s most successful entrepreneurs. “Had my uncle not fled Ethiopia during the troubled times of the 1970s, his and my path might not be what they are today”, Afwerki said. He now delves into philanthropy and because of his own story, is particularly sensitive to the plight of immigrants.

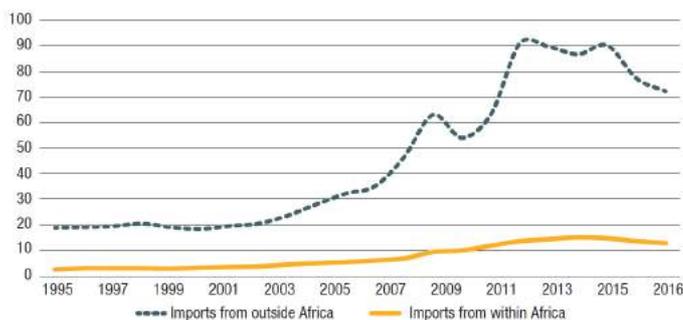
This Pan-African journey serves as a backdrop to explaining the relationship between migration and structural transformation.

4.1 International migration and structural transformation: For better or for worse?

Contemporary evidence of the economic impact of international migration shows that in receiving countries, the evidence of net gains of GDP per capita is mixed in the short term and positive in the long term, as income per person and living standards improve (Alesina et al, 2016; Jaumotte et al, 2016; Ortega and Peri, 2009). Organization for

Economic Cooperation and Development (OECD) data indicate that migration is neither a burden nor a panacea (OECD, 2017). The impact of cumulative waves of migration over 50 years in OECD countries

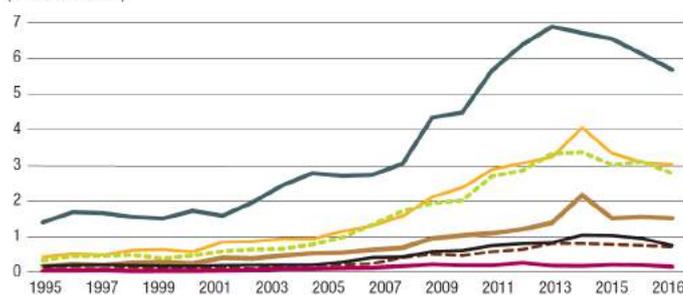
Three-year average food imports from outside Africa and within Africa
(Billions of dollars)



Source: UNCTAD calculations, based on the UNCTADstat database.

is estimated to be close to zero on average. Cross-

Three-year average bilateral food imports by regional economic community
(Billions of dollars)



Source: UNCTAD calculations, based on the UNCTADstat database.

country evidence shows that it rarely exceeds 0.5 per cent of GDP in either positive or negative terms, except in Luxembourg and Switzerland, where the net benefit of migration is shown to be about 2 per cent of GDP (Liebig and Mo, 2013). With regard to potential fiscal impact, overall, the integration of migrants into formal job markets increases their net contributions in taxes compared to the amount they receive in benefits. Furthermore, the fiscal

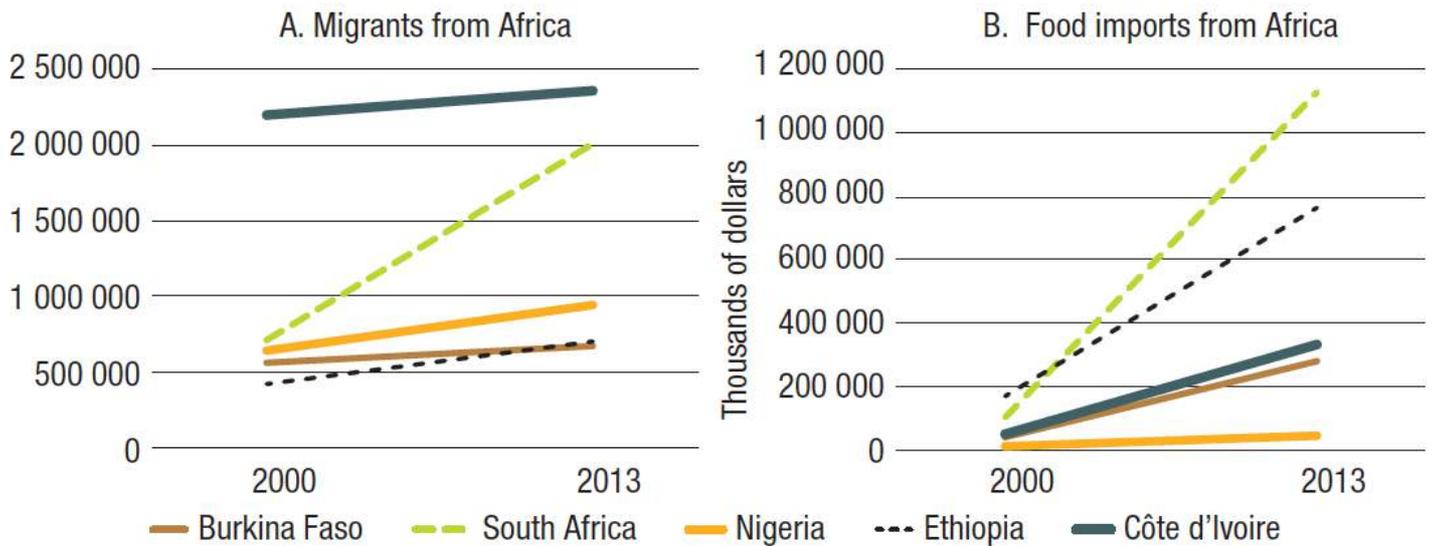
contributions of migrants are not negatively correlated with educational levels, that is, lower educated migrants also contribute more than they receive in benefits.

In 2013, there were over 59 million migrants in the Asia and Pacific region, who were predominantly temporary labour migrants. Migration is generally found to be economically beneficial to both sending and receiving countries in the region, contributing to higher GDP growth in receiving countries and benefits in terms of remittances in sending countries (United Nations Economic and Social Commission for Asia and the Pacific, 2014). With regard to the impact of migration on sending countries, evidence from Africa, Latin America, South Asia and other regions suggests that remittances reduce the depth and severity of poverty and indirectly stimulate economic activity (Adams, 1991; Adams, 2009; Ajayi et al, 2009; Anyanwu and Erhijakpor, 2010; Fajnzylber and Lopez, 2008; Gupta et al, 2007; Lachaud, 1999). Similarly, the evidence of the impact of international migration on global poverty is generally positive (Ndiaye et al, 2011; World Bank, 2006).

With regard to the interface between migration and regional integration, there are similarities and differences between trends in regions worldwide. For example, in developed economies, the European Union enlargements in 2004 and 2007 led to greater scope for labour mobility within the European Union and the European Free Trade Association and to improvements in the adjustment capacity of labour markets. It is estimated that as much as one quarter of asymmetric labour market shocks of varying intensities over time and across countries may be absorbed by migration within one year (Jauer et al, 2014). In 2002–2012, migrants accounted for 70 per cent of the increase in the workforce in Europe (Stuchlik and Poptcheva, 2015).

As in most regional economic communities in Africa, migrants from countries in the Association of Southeast Asian Nations are mostly low-skilled workers, and account for about 80 per cent of the total migrant stock in the region. The share of migrants from within the Association increased from 60 per cent in 1990 to 70 per cent in 2013, and 88 per cent of migrants travelled between five corridors out of 57 identified for intra-Association migration

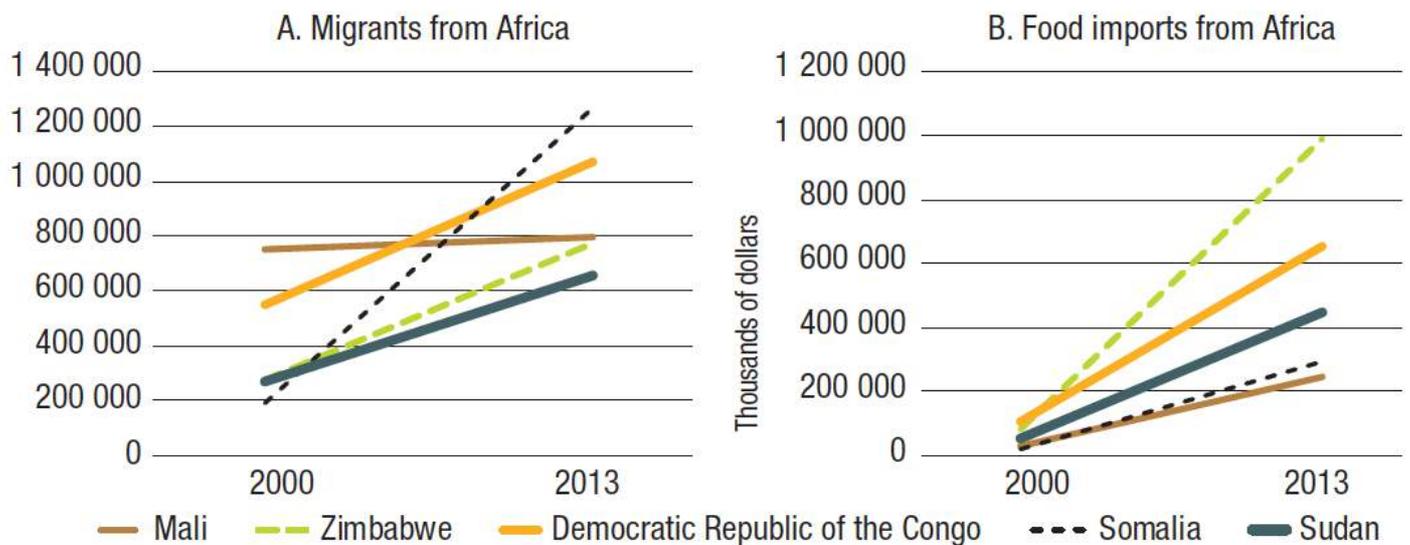
Top receiving countries by (a) migrants from Africa and (b) food imports from Africa



Source: UNCTAD calculations, based on the UNCTADstat database.

Note: Top receiving countries based on the classification in World Bank, 2013, and the World Bank Global Bilateral Migration database.

Top sending countries by (a) migrants from Africa and (b) food imports from Africa



Source: UNCTAD calculations, based on the UNCTADstat database.

Note: Top sending countries based on the classification in World Bank, 2013, and the World Bank Global Bilateral Migration database.

(United Nations Department of Economic and Social Affairs, 2013b). As a result, 97 per cent of intra-Association migrants travelled to only three countries, namely Malaysia, Singapore and Thailand. As in Africa, countries in the Association of Southeast Asian Nations are in the process of defining a regional-level migration policy. It is therefore likely that the Association is not harnessing the full potential of the free flow of labour.

Such variations in regional experiences make it difficult to draw firm conclusions on a constant and predictable relationship between migration, regional integration and economic gains.

4.1.1 Investigating a pro-trade effect: Trends in migration and regional food trade

Trade can improve food security by increasing access to more affordable and diversified food items. In

Box 4 Testing the relationship between migration and structural transformation: Empirical approach

The aim of the empirical analysis is to explore the linkages of intra-African migration with the economy, using different measures of structural transformation.

First, the migration effect on the share of manufacturing and services value added in the share of GDP, on per capita GDP and on the employment share of manufacturing and services are examined. The analysis is limited to the availability of migration data and employs a panel data model using country-level intra-African migrant stock data and 10-year intervals, starting in 1970. Standard fixed effects and system-generalized method of moment estimations are applied, together with various control variables such as investment share, intra-African trade, education and conflict. In order to examine transmission channels, the interaction with education and differences in manufacturing and political instability are controlled for.

Second, intra-sectoral productivity changes in structural transformation are examined, and the results show that the bulk of structural transformation in countries in Africa comes from intra-sectoral productivity growth rather than intersectoral productivity growth. In order to measure intra-sectoral productivity growth, the analysis follows McMillan et al (2014) and Timmer et al (2014) and decomposes growth in average labour productivity over 10 years into intra-sectoral productivity gains and gains from the intersectoral reallocation of resources. The obtained contribution of intra-sectoral productivity growth is used as a dependent variable in the regression models (see Trenzcek, 2016). The analogy to classical growth regression is retained and factors of labour mobility or migration, investment rates and trade variables are included. The model estimates a linear-log and tests the impact of migration on various sectors, with attention to migration-receiving sectors such as agriculture, construction, mining, manufacturing and services. Data on sectoral productivity is based on the Groningen Growth and Development Centre, 10-Sector database, which provides estimates based on national statistics for 11 countries, namely Botswana, Ethiopia, Ghana, Kenya, Malawi, Mauritius, Nigeria, Senegal, South Africa, the United Republic of Tanzania and Zambia, starting in 1965. Sectoral productivity growth at the start of each decade is regressed on migrant stock and additional variables. Testing for sources of endogeneity and providing several robustness checks gives evidence of a positive link in various dimensions between migration and structural transformation is provided.

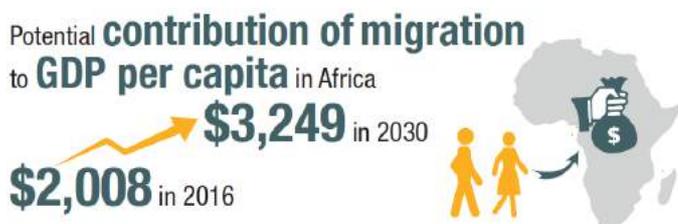
Sources: Groningen Growth and Development Centre 10-Sector database; McMillan et al (2014); Timmer et al (2014); Trenzcek (2016).

particular, under the right conditions, regional trade helps enhance the better functioning of commodity markets (UNCTAD, 2015a). In addition, increasing imports from a regional market can contribute to overcoming periodic food shortages and thereby reduce food insecurity. However, despite a slight increase in 1995–2012, regional food trade remains low compared with the volume of trade between Africa and the rest of the world (figure 14).

Figure 1

Figure 2

Regional food imports have been on the rise in all



regional economic communities, with the largest increases observed in SADC, CEN-SAD and COMESA (figure 15). Intra-African food imports have experienced the same upward trajectory as

migration levels. SADC CEN-SAD COMESA ECOWAS IGAD EAC ECCAS

Beyond the possible positive association with food security, this trend also indicates that increased migration happens concomitantly with a pro-trade boost (see section 4.2).

An examination of the patterns of food trade on the continent also constitutes a test of the pro-trade effect of migration. Diaspora networks in receiving countries are likely to boost demand for products produced at home, such as specific food items. Given the assumption that emigrants have a higher income in receiving countries, the amount of exports from sending countries will increase and, thereby, financial flows to the sending country will also increase. Food imports from within Africa have increased in the main receiving countries, at times at much faster rates than the rate of immigration from other countries in Africa (figure 16).

In contrast, sending countries have experienced a much smaller growth rate of intra-African food imports, a difference that likely reflects existing disparities in agricultural productivity levels between

some sending and receiving countries (figure 17). In Zimbabwe, for example, agricultural value added per worker is only 4 per cent of agricultural value added in South Africa.

4.2 Intra-African migration and structural transformation: Testing the relationship

The survey of the wide-ranging literature on structural transformation processes in chapter 1 highlights three key features, namely productivity gains, a shift of labour from agriculture to manufacturing to services and rising GDP per capita. In Africa, varied patterns and trends in countries make it difficult to characterize structural transformation from a continent-wide perspective. In addition, the declining share of employment in agriculture has often been to the benefit of the services sector (UNCTAD, 2015b). Notwithstanding this diversity, some standard patterns may be expected. As the relative importance of different sectors and activities of an economy changes over time, the shares of low-productivity agriculture and the low value-added extractive sector should decline, while those of manufacturing and high-productivity services increase.

Recent findings suggest that the year 2000 was a turning point for Africa, as structural transformation has since contributed positively to overall productivity growth on the continent (McMillan et al, 2014). Structural transformation is not automatic, however, and three factors determine whether it will contribute to overall productivity growth. First, commodity-dependent economies are at a disadvantage, as the larger the share of natural resources in exports, the less opportunity there is for productivity-enhancing structural transformation. High productivity minerals and natural resources remain enclave sectors that cannot absorb the surplus labour from agriculture. Second, in theory, with an appropriate policy framework in place, currency undervaluation may remain a tool for promoting tradable industries. Third, the facilitation of an easy flow of labour across firms accelerates the process of structural transformation (McMillan et al, 2014).

There are various ways of empirically asserting that structural transformation is under way. The empirical investigation on which this section draws makes use of the following measures of structural

transformation: GDP per capita; share of manufacturing value added and employment shares in manufacturing and services; and intra-sectoral productivity growth. It singles out specific measures of migration and addresses limitations in estimation methods that challenge the robustness of the findings. Such challenges include the bidirectional relationship between migration and economic upgrading. On the one hand, migration should positively influence changes in economic structure. On the other hand better economic prospects also trigger immigration. Similarly, a prolonged recession may encourage increased emigration. Box 4 presents a summary of the empirical approach to migration and structural transformation. Details on Data, econometric strategy, estimation methods and results are provided in Belaid and Slany (forthcoming)

Estimation results indicate that intra-African migration positively impacts structural transformation in destination countries. The results show that a 1 per cent increase in the number of immigrants may be associated with a 0.26–0.43 per cent increase in manufacturing value added. In addition, the investigation of transmission channels of migration indicates that there is an additional effect on structural transformation from educated immigration, that is, a higher level of education in the origin country rather than in the destination country. The estimated elasticity coefficients of migration variables imply reaching GDP per capita of \$3,249 in 2030, with a compound annual growth rate of 3.5 per cent from 2016. In 2016, in Africa, average GDP per capita was \$2,008.

Additional analysis of the relationship between migration and labour productivity indicates that immigration is positively associated with productivity increases. An increase of 1 per cent in the number of immigrants leads to intra-sectoral productivity growth of 0.07–0.17 percentage points over 10 years. This positive effect increases in magnitude and significance when the model includes only sectors that have experienced relatively high migration in the past, namely agriculture, construction, mining, manufacturing, trade in services and other services. Given the estimated elasticities, if immigration continues to grow by a 10-year average of 54 per cent, or the average growth rate in 1990–2000 and

2000–2010, then, in the coming decades, average intra-sectoral productivity growth will accelerate by an additional 0.5 per cent. This implies a growth take off for countries with the lowest labour productivity.

In contrast, if emigration continues to grow without linkages to local economies, that is, other economic sectors, including manufacturing and construction, then countries with high levels of emigration risk experiencing a downward trend in productivity. It is therefore essential for migration policies that target immigration and emigration to be complementary. Migration policies that directly complement the requirements of economies in Africa are central to meeting the needs of job markets.

Intra-African emigration has a weaker and less definite effect on structural transformation in origin countries. The effect is positive in manufacturing value added in most specifications,

Migration could boost productivity growth in

agriculture, construction, mining and services



Turning to the effect on sending countries, it appears that intra-African emigration has a weaker and less definite effect on structural transformation in origin countries. While the effect is positive on manufacturing value added in most specifications, there seems to be a negative correlation with the share of labour in manufacturing and services, and within-sector productivity growth.¹⁹ It should be noted that immigration and emigration show a positive yet there is a negative correlation between the share of labour in manufacturing and services and intra-sectoral productivity growth. This may be driven by the net receiving countries, namely Ethiopia, Ghana, Kenya, Nigeria, South Africa and the United Republic of Tanzania. The main sending countries in the sample, namely Botswana and Zambia, show relatively low absolute numbers of emigration (see box 4). The estimates are therefore not representative for the continent. In addition, the estimate of emigration becomes smaller and/or insignificant when the analysis is restricted to sectors

with high migration intensity. Immigration and emigration show a positive correlation and should not be examined separately. This is also relevant with regard to migration policies. The preliminary results are indicative of the complex dynamics between migration and productivity in Africa, yet should be refined through additional research. In addition, with regard to effects on origin countries, trade and economic channels may not be the most prominent transmission mechanisms, yet there is some evidence that return migration brings knowledge and skills that can spur productivity. For example, migration, if utilized productively, may facilitate investments in new activities for farmers due to increased liquidity through remittances and income security (Wouterse and Taylor, 2008).

The results on the positive effects of migration on destination countries are in line with other studies on the economic impact of migration (see, for example, Bove and Elia, 2017). For example, OECD and ILO (2018) estimate that migrant contribution to GDP was 19 per cent in Côte d'Ivoire in 2008; 13 per cent in Rwanda in 2012; 9 per cent in South Africa in 2011; and 1 per cent in Ghana in 2010. The contribution of immigrants to value added exceeds their population share in employment in Côte d'Ivoire and Rwanda. Overall, immigration is unlikely to depress GDP per capita (OECD and ILO, 2018).

However, despite findings of a positive effect of immigration on structural transformation, given the complex nature of migration realities, challenges in isolating the causal relationship likely remain. Section 4.3 details how the limited impact of productivity enhancements on job creation may be related to the relative scarcity of good-quality skilled manufacturing jobs in most countries in Africa.

4.3 Escaping a lack of choice: Locating opportunities for intra-African migration

4.3.1 Switching narratives: Africans on the move

In 2011, the “Africa rising” narrative in global business circles culminated in the publication of an oft-discussed report entitled “Lions on the move” (McKinsey and Company, 2011). More recent research shows that although there have been setbacks in oil-based economies, the continent is still very much open to trade, investment and enterprise development opportunities. One survey showed,

however, that when business audiences were asked to guess the number of companies with revenues above \$1 billion operating in Africa, answers ranged from 50 to 100, and were far from the correct number of 400, with a combined annual income of \$1.2 trillion (Leke et al, 2016), among 700 companies with annual revenues of more than \$500 million listed in Africa. In addition, in most sectors, these companies are growing more quickly and becoming more profitable than their global peers. Only 30 per cent of revenues are earned by companies that operate in the natural resources sector, and around two fifths of the 400 companies are publicly listed, and less than 30 per cent are multinational corporations (Leke et al, 2016).

Intra-African migration based on inter-State differences in skills endowments is gaining prominence. For example, within EAC, Kenya remains the leading receiving country, with migrants originating mostly from outside Eastern Africa, yet it is also the main sending country to Eastern and Southern Africa. Chapter 3 emphasizes the migration of highly skilled labour from Kenya to Rwanda and the United Republic of Tanzania, supported by the national migration policy framework of Rwanda (see box 2).

Africa is the only region with a growing share of the world's youth, and this lends urgency to the need to locate opportunities for labour absorption (see chapter 1). The capacity to harness the benefits of increased economic growth in Africa is based on the demographic dividend, as seen in economies in East Asia and South-East Asia (Bloom and Williamson, 1998; Mason, 2001; Mason, 2007), rests upon a sustainable and job-intensive path of structural transformation. Imperfect flows of information and little use of evidence from private sector consulting firms by development stakeholders in the public sphere in Africa make it difficult for migrants to locate job opportunities. For example, Cape Town, South Africa, has an unemployment rate of 23 per cent in its formal labour force, and is one of six cities in a study of 22 in which the growing rate of unemployment is an ongoing challenge (World Economic Forum, 2017).

Sections 4.3.2–4.3.5 provide an overview of business opportunities on and for the continent and identify

the scope to change the continent's narrative from lions on the move to Africans on the move.

4.3.2 Competitive advantages in agriculture

Agriculture in Africa has historically attracted large flows of foreign workers in countries such as Côte d'Ivoire (see chapter 2). The sector's pull factor remains strong overall, leading investment promotion agencies to rank agriculture as the sector likely to attract

the highest levels of foreign direct investment, followed by food and beverages and utilities (UNCTAD, 2017b). However, despite ongoing emphasis on its potential and amid concerns with regard to land acquisition in the order of millions of hectares of arable land by large investors in some countries, agriculture continues to suffer from underinvestment. In addition, only a small proportion of existing foreign direct investment projects in the sector are under implementation (UNCTAD, 2017b). Furthermore, agriculture in Africa remains a low-productivity sector.

Constraints to agricultural growth and to the development of related value chains in Africa range from low yields to poor infrastructure, low levels of access to finance for agricultural production and processing and difficulties in abiding by international standards (UNCTAD, 2015a). In addition, overvalued exchange rates in gas and oil-exporting countries have harmed the development of the agriculture sector in Africa. In the late 2000s, some countries, such as Nigeria, began to undertake a reversal of the neglect of agriculture. Other countries, such as Ghana, continue to deal with the impact of the exploitation of oil discoveries on the agriculture sector.

Notwithstanding such constraints, the agriculture sector in Africa remains an area with a high potential for job creation and, possibly, the absorption of foreign labour. To create jobs and build vibrant regional value chains, Africa should seize opportunities in becoming a key player in the global agriculture sector. The global population is expected to grow from 7.3 billion people in 2015 to about 8.5 billion in 2030. Estimates from a study by the Food and Agriculture Organization of the United Nations show that net land under crops may need to increase by some 70 million hectares by 2050, and

that some 80 per cent of the projected growth in crop production in developing countries will come from intensification in the form of yield increases, at 73 per cent, and higher cropping intensities, at 6 per cent (Alexandratos and Bruinsma, 2012). However, the expansion of arable land will remain an important factor in the growth of crop production in many countries in Latin America and sub-Saharan Africa (Alexandratos and Bruinsma, 2012).

Locating opportunities on the continent is important, as projections show that there is great diversity of land availability and quality among countries and subregions. In sub-Saharan Africa, countries constrained by land scarcity or minimal capacity to expand food production, yet with growing populations, are likely to turn to either trade or migration. In particular, countries in which agricultural resources are limited due to predominantly semi-arid conditions and little irrigation potential, and in which the population is expected to greatly increase by 2030, are likely to be among those from which emigration will be highest in the future. The population of the Niger, for instance, is projected to grow from 14 million in 2006 to 58 million in 2050, an increase of over fourfold, and is therefore likely to be subject to incompatibilities between its population growth and agricultural potential (Alexandratos and Bruinsma, 2012). Similarly, although the socioeconomic profiles of countries in Northern Africa are generally more advanced than those in sub-Saharan Africa, they have limited potential for further job creation in the agriculture sector as there is little prime arable land. Of the 13 countries that account for 60 per cent of the 1.4 million hectares with the best quality land, five are in sub-Saharan Africa, namely Angola, the Democratic Republic of the Congo, Madagascar, Mozambique and the Sudan (Alexandratos and Bruinsma, 2012). The remaining countries are unevenly distributed across different regions.

Producers in Africa are favourably positioned to serve regional markets and displace imports from outside the continent. The labour absorption capacity of the agriculture sector cuts across different farm sizes. Smallholding farmers are essential for the continent's food security and prove to be competitive when provided with an enabling environment (UNCTAD, 2015a). Without discounting

the potential benefits from large-scale farming models, there is no evidence that such models are either necessary or particularly promising for Africa; instead, making agriculture in Africa competitive requires the right mix of policies, strong institutions and a significant rise in good quality investments (World Bank, 2009).

In line with these findings, several private sector-led efforts have identified agriculture as a leading sector in the attractiveness of Africa for investment. It is recognized as a forefront sector for smart development and as one of the areas in which innovation is most needed on the continent. One review of the potential of agricultural value chains in Angola, Ghana, Kenya, Mozambique, Nigeria, Sierra Leone, the United Republic of Tanzania, Zambia and Zimbabwe highlights their potential for agricultural development and uncovers the diversity in their profiles in many crops and associated value chains (PricewaterhouseCoopers, 2015). Similarly, potential exists in cassava, cotton, maize, rice, soybeans and sugar in the Guinea Savannah zone in sub-Saharan Africa, which encompasses approximately 600 million hectares of land, and has strong agricultural development potential, despite poor soil quality. Less than 10 per cent of this zone is in agricultural use, yet nearly 400 million hectares can be used for agriculture. The region cuts across many countries and underpins the livelihoods of more than one quarter of all farmers in Africa. Much of the untapped potential lies in Mozambique, Nigeria and Zambia (World Bank, 2009).

The importance of the agriculture sector in job creation is well-recognized by many Governments in Africa. For example, the agricultural transformation agenda of Nigeria aimed to create 3.5 million jobs in 2012–2015 in the cassava, cocoa, cotton, rice and sorghum value chains and to increase farmer incomes by \$2 billion. The agenda is credited with leading to the creation of some 2.7 million jobs within its first year and to a decline in the country's annual food import bill by \$5.3 billion (PricewaterhouseCoopers, 2015). The country has recently committed to prioritizing economic diversification away from oil. If the sector and its value chains continue to grow at similar speeds or faster, and if it concurrently fulfils its potential as a strong and vibrant economy, with dynamic

manufacturing and services sectors, there may be scope to absorb its large labour force. Countries with different demographic endowments, that is, with similar potential but with risks of labour shortages given smaller populations, such as the Congo, may attract foreign labour.

4.3.3 Optimizing opportunities in manufacturing requires well-coordinated regional-level industrial policies

Industrialization remains a central element in bringing about productivity gains and other benefits such as democratization processes through a well-organized workforce (Rodrik, 2015). The neglect of policies aimed at developing the manufacturing sector in Africa partly explains the delay in structural transformation on the continent (UNCTAD and United Nations Industrial Development Organization, 2011). Recent findings have further highlighted the sector's potential and high propensity for productivity enhancement, a central element in structural transformation. For example, data on formal enterprises, regardless of whether products are exported, shows that manufacturing is

characterized by a propensity for the convergence of labour productivity levels (Rodrik, 2015). In other words, possibilities for convergence in labour productivity in manufacturing industries are independent from the vagaries of the global economy.

Competitive threats from companies from abroad and a strong ability in technology upgrading enable manufacturing firms in the formal sector to operate efficiently, thereby facilitating their integration into global production networks. The small share of employment in the sector in sub-Saharan Africa explains why convergence in productivity levels has not expanded to the rest of the economy in low-income countries. Furthermore, as most manufacturing activities that employ advanced technologies do not employ as much labour, the positive effects from productivity enhancements in the sector on the rest of the economy remain limited (Rodrik, 2013). This major limitation partly explains why changes in other parts of the economy remain necessary to set countries on a sharper upward path of structural transformation (McMillan and Rodrik, 2011). Many countries in Africa appear to have

Box 5 Manufacturing below the radar: Profit maximization, locals and foreign labour in Nigeria

Opportunities for manufacturing in Africa are not necessarily evident. They are however arising more and more often, in sometimes unexpected ways. The following account, originally reported in the Harvard Business Review, gives a taste of what can happen when investments are made by Chinese companies:

Sun is from Wenzhou, a mid-sized city in south-eastern China. Nearly 4,000 years ago, the lustrous, pale green glaze called celadon was invented in Wenzhou, which became the birthplace of Chinese ceramics. In the 1970s, however, times were tough. After elementary school, Sun dropped out and started working. In 1978, Wenzhou was the first city in China to establish private enterprises. Sun worked his way up through several leather-processing factories and eventually saved enough to start his own leather manufacturing business. But by the late 2000s, costs were climbing at an alarming pace, and he knew he needed to move out of China. A friend suggested he think of Nigeria.

He went for a five-day visit. "Immediately all these poor people were asking for money," he told me. "But then I realized there are a lot of rich people, too, and although it's hard to make it in this market, it's just as hard for everyone else as it is for me." Back in China he called an acquaintance at the customs authority and asked him what was the heaviest, most expensive product to ship being exported in large quantities to Nigeria. The answer? Ceramics.

After that single visit, Sun devoted about \$40 million to building a ceramic tile factory in Nigeria. It runs around the clock and employs nearly 1,100 workers, a thousand of them locals. Electricity is unreliable and costly, but business is good. Nigeria, with its relative lack of competition and booming demand, allows Sun to earn a 7 per cent profit margin, compared with the 5 per cent he earned in China. In manufacturing, margins are often razor thin, and a 2 per cent bump is substantial.

Sun's story is not unusual. According to data from the Ministry of Commerce of China, privately owned Chinese companies are making more than 150 investments a year in the manufacturing sector in Africa, up from only two in 2000. The real figure is probably two or three times as large. Scholars doing fieldwork on the topic routinely encounter Chinese companies that have not been captured by government data.

Source: Excerpted from Sun (2017).

skipped manufacturing development in their economic development processes, yet projections of the move away from low-technology manufacturing in China have revived ambitions to increase the sector's attractiveness. The move up the technology ladder in China has shown the possibility of creating about 100 million labour-intensive manufacturing jobs in low-income countries.

Competition for investment attraction is strong. At the global level, only a few countries in Africa are seen as cost competitive, compared with countries in South-East Asia (Hallward-Driemeier and Nayyar, 2017). In addition, only a few countries in Africa have managed to position themselves as key players across a sample of value chains, including Ethiopia, Lesotho and Kenya. However, disparities in labour costs between these countries are likely to result in differing levels of attractiveness. More generally, a few countries have made substantial progress in recent years in improving their business environments. Only three sub-Saharan Africa countries are among the top 100 in the World Bank ease of doing business ranking for 2018, namely Mauritius, 25; Rwanda, 41; and Kenya, 80 (World Bank, 2018). Furthermore, only three countries were among the top reformers, namely Malawi, Nigeria and Zambia. Finally, many reform activities pertain to the construction sector (Dinh et al, 2012; Hallward-Driemeier and Nayyar, 2017).

The difficulties that countries in Africa face in competing in global manufacturing are compounded by concerns related to the impact of artificial intelligence and automation on supply chains worldwide. New and fast developments have amplified the perceived risk of premature de-industrialization in Africa. Recent findings show that low-income countries are not immune from the risk of a loss of competitiveness in manufacturing associated with the changes related to the fourth industrial revolution (Rodrik, 2013; United Nations Department of Economic and Social Affairs, 2017b). UNCTAD (2017c) notes that, to date, robotization has had a relatively small direct effect in most developing countries and that, given their lack of diversification and technological upgrading, this is unlikely to change in the near future. The distributional effects of robotics are likely to be diverse and depend on a country's stage in structural transformation, position

in the international division of labour, demographic developments and economic and social policies. In studies evaluating the future of manufacturing in developing countries, textiles, transport equipment and electronics are identified as the best-performing sectors based on the following criteria: scope to employ low-skilled workers; share in the overall economy; labour productivity; trade levels; and scope for innovation and diffusion (Hallward-Driemeier and Nayyar, 2017). Such studies state that despite the growth of new technology, opportunities in the low-technology, labour-intensive production of goods for regional trade remain high in low-cost locations.

Manufacturing opportunities in Africa lie primarily in serving the growing domestic market and regional markets. Estimates show that Africa could nearly double its output from \$500 billion in 2011 to \$930 billion in 2025, three quarters of which could come from meeting domestic demand, mostly in food, beverages and similar processed goods (Leke et al, 2016). Considering the pro-trade effect of bilateral migration flows and the channels through which migration can increase trade and wealth, Africa should accelerate regional integration commitments, including provisions on labour, to make the most of such opportunities.

Finally, locating opportunities for attracting foreign labour is difficult, as the size of the informal sector is such that insights on the actual size, scope for growth and areas of skills shortages need to be the focus of dedicated studies. For example, an analysis of investment by China in Nigeria suggests that workers from abroad may account for about 10 per cent of over 1,000 employees in small-scale factories on the continent (box 5).

4.3.4 Services sector: Strong growth potential

Low-income countries in Africa are among those affected by early de-industrialization due to fewer opportunities for industrialization than experienced by early industrializers (Rodrik, 2015). Other reasons for this trend include the squeezing out of manufacturing in such countries, in the face of competition from imported goods, and exposure to the decline in the relative prices of manufacturing goods. This trend has contributed to services becoming the lead sector in many countries in Africa (UNCTAD, 2015b).

Table 20

Immigration patterns and dynamics of change in structural transformation variables

Level of immigration	Agricultural value added per worker (constant 2010 dollars)		Manufacturing value added (percentage of gross domestic product)		Services value added (percentage of gross domestic product)	
	Past 10 years	Present	Past 10 years	Present	Past 10 years	Present
High (> 300 000)						
Côte d'Ivoire		High		Medium		Medium
South Africa		High		Medium		High
Nigeria		High		Medium		Medium
Ethiopia		Low		Low		Medium
Burkina Faso		Low		Medium		Medium
Kenya		Medium		Medium		Medium
Cameroon		Medium		Medium		Medium
Uganda		Low		Medium		Medium
United Republic of Tanzania		Low		Medium		Low
Chad		High		High		Low
Sudan		High		Medium		Medium
Congo		Medium		High		Low
Ghana		Medium		Medium		Medium
Rwanda		Low		Low		Medium
Guinea		Low		High		Medium
Gabon		High		High		Medium
Democratic Republic of the Congo		Low		High		Low
Zimbabwe		Low		High		Medium
Medium (> 100 000)						
Burundi		Low		Medium		Medium
Liberia		Low		Low		Low
Benin		Medium		Medium		Medium
Mali		Medium		Medium		Medium
Libya		High		Low
Senegal		Low		Medium		High
Gambia		Low		Low		High
Malawi		Low		Medium		Medium
Mozambique		Low		Medium		Medium
Togo		Medium		Medium		High
Central African Republic		Low		Medium		Medium
Niger		Low		Medium		Medium
Djibouti		Low		High
Low (< 100 000)						
Botswana		Medium		High		High
Mauritania		Medium		High		Low
Sierra Leone		Medium		Medium		Low
Zambia		Low		Medium		Medium
Egypt		High		High		Medium
Angola		High		Medium
Algeria		High		High		Medium
Namibia		High		Medium		High
Morocco		High		Medium		Medium
Tunisia		High		Medium		Medium
Swaziland		High		High		Medium
Guinea-Bissau		Medium		Medium		Medium
Eritrea		Low		Medium
Comoros		Medium		Low		High
Cabo Verde		High		Low		High
Madagascar		Low		Medium		Medium
Sao Tome and Principe		Low		Low		High
Equatorial Guinea		Medium		High		Low
Mauritius		High		Medium		High
Seychelles		Medium		Low		High
Somalia		Low		Low
Lesotho		Low		Medium		High

Source: UNCTAD calculations, based on the UNCTADstat database and the Agricultural Market Information System database of the Food and Agriculture Organization of the United Nations.

Notes: Categories are as follows:

Agricultural value added per worker: > \$2,000, High; > \$800, Medium; < \$800, Low; Manufacturing value added: > 25 per cent of GDP, High; > 10 per cent of GDP, Medium; < 10 per cent of GDP, Low; Services value added: > 60 per cent of GDP, High; > 40 per cent of GDP, Medium; < 40 per cent of GDP, Low.

Wholesale and retail, financial and health-care services are among the sectors identified as having a strong growth potential in most countries in Africa (Leke et al, 2016). Such developments include a burgeoning technology sector. More than 100 technology hubs have been set up in Africa in the past decade, and there is potential to deepen their growth in centres such as Cape Town, South Africa, and Kenya, referred to as the silicon savannah of Eastern Africa. Technology has also been transforming teaching and training in Africa through the delivery of educational content via mobile and online channels. New fields of growth continuously emerge in the technology industry. For instance, successive technology conferences in recent years have highlighted shortages in data science at the global level. Countries with an existing lead in technology and the digital economy could invest in public-private training in these fields. To embrace such potential, technology hubs in Africa require investments in improving access to the Internet, power and roads. Furthermore, start-ups in Africa should have greater exposure to technical expertise and benefit from more regulatory support from Governments.

The growth of services sectors in Africa in recent years has shed light on the potential for intersectoral linkages. Services play a central role as a connecting point between different industries. This role can be further developed at national and regional levels and can, in turn, help make commodity-based industrialization services a new trigger for intra-African migration. Finally, services sectors offer scope for inclusive job creation. In the tourism sector, services are credited with a strong multiplier effect in creating jobs for women and youth (UNCTAD, 2017a; UNCTAD 2017b). The continent possesses few centres of excellence for training the required labour, and the services and tourism sectors can offer scope for the intra-African migration of skilled workers and for pooling resources for regional-level internationally competitive training centres. Prospects for the greater development of financial services are good, as it was the top sector with regard to foreign direct investment project numbers in Africa in 2015 (fDi Intelligence, 2016).

Business services are experiencing the same upward trend; the number of foreign direct investment projects in this sector in Africa grew by 80 per cent in 2016 (fDi Intelligence, 2016). Ghana and Kenya are among the top performers. Other sectors such as logistics have also experienced growth. For example, Mozambique attracted the largest number of foreign direct investment projects in 2016. Such emerging different competitive advantages in countries offer scope for opportunities in cross-border movements of skilled labour, as other countries on the continent enter similar fields in the future.

4.3.5 Innovation and entrepreneurship should be at the centre of all national and regional initiatives

Increasing evidence of the disruptive effect of artificial intelligence and automation fundamentally question the static assumptions on which many empirical models are based and alter the predictive power of projections on job and wage gains and losses of twentieth-century industries. More than ever, as elsewhere in the world, innovation will play a central role in shaping the ability of countries in Africa to adapt to the kind of structural transformation needed for sustainable development in the twenty-first century. Many economies in Africa have skipped the traditional step of manufacturing to embrace opportunities in services as the main contributor to GDP. However, services alone are not enough to absorb the growing working age population in Africa. Rather, countries should make the most of gearing investments towards green, technology-intensive yet labour-generating industries in agriculture, manufacturing and services. Immigration patterns and dynamics of change in structural transformation variables are shown in table 20.

As emphasized in numerous studies and reports, priority cross-cutting conditions related to access to affordable and reliable energy, infrastructure and social development need to be met before the continent can unleash its full potential in agricultural development, manufacturing and services. In addition, low, albeit growing, rates of research and development in countries in Africa underline the scale of efforts required to embark on multisectoral industrial development. On the one hand, the lack of appropriate policy frameworks on the continent is a constraint for business. On the other hand, the

Box 6 (continued)

With regard to institutional arrangements, the white paper acknowledges that the effective implementation of an international migration policy depends on the establishment of an intergovernmental and intersectoral institutional machinery, with strong coordination and accountability mechanisms. This would steer proactive recruitment approaches based on a list of the skills and businesses required for national and sectoral priorities, strategies and plans. Specific elements are as follows:

- Portability of social benefits: The white paper recommends that provisions be made for the delivery of social security and the portability of social benefits for qualifying international migrants.
- Time-bound special work visas for SADC nationals: Based on bilateral agreements between States, SADC nationals would be given a work visa for a prescribed period. The political decision on the number of visas to be offered would be informed by empirical evidence of labour market dynamics. To this end, the white paper recommends investigating the feasibility of a sector-based approach, whereby visas would be granted to work only in a specific sector.
- Multiple entry long-term visas for SADC traders: The positive role of cross-border traders in promoting intra-African trade would be supported through the granting of such visas.
- Harmonization of regional-level governance frameworks on refugees: The white paper suggests that a bilateral and multilateral approach should be taken with origin countries of asylum seekers, as well as with transit countries and countries that could accommodate refugees for resettlement. Options in this regard include voluntary repatriation, resettlement to a third country and the integration of refugees into communities in South Africa.

Such elements provide avenues for better qualifications management at the continental level. For example, the proposed residence visa for international students could generate positive effects for both the economy of South Africa and origin countries. The tertiary education system in South Africa is internationally recognized as including centres for excellence. Gaining education and work experience in South Africa could lead to a possible win-win outcome. In a virtuous scenario, graduates would contribute to the destination country, send remittances to origin countries and return to benefit origin economies, equipped with know-how, contacts and capital. In addition, if graduates are recruited by multinational companies, this policy measure could act as an incentive for employers to invest in the capacity-building of African staff graduating in South Africa. Such companies could then reap the benefits from training such staff members and by facilitating their movement in Africa, rather than having to recruit skilled workers from outside Africa.

limited legacy of legal and regulatory frameworks requiring high levels of compliance can be an opportunity for entrepreneurs to be frontrunners in investing in innovative and agile companies.

4.4 What needs to be done and who needs to do what?

The African Common Position on Migration and Development (2006) should be integrated into the new generation of national migration policies. Migration is an issue that warrants action and collaboration at the national, regional and continental levels. The Migration Policy Framework for Africa cites the Abuja Treaty (1991) that, in founding the African Economic Community, urged member States to adopt employment policies that allowed the free movement of persons, including workers, within the Community, which entailed “strengthening and establishing labour exchanges aimed at facilitating the employment of available skilled manpower of one member State in other

member States where there are shortages of skilled manpower” (African Union Executive Council, 2006). Over 10 years after the adoption of the Migration Policy Framework, it is time to define concrete actions for the facilitation of managed migration on the continent and determine who should do what.

Box 6 South Africa: Incorporating the integration agenda of Africa into a national migration framework Analysis of historical and contemporary trends in South Africa shows that most migrants work in mining, agriculture, hospitality, construction and domestic services, and that motivation to immigrate to South Africa includes consideration of its status as an upper middle-income country, with wages averaging about five times higher than in SADC partner countries. There have been growing concerns that economic migrants may apply for asylum, thereby creating delays for refugees and burdening public resources. Acknowledging that the discourse on migration in South Africa has been

heated, with “strong emotions, stereotypes and contested statistics”, the white paper on international migration aims to address gaps in the legislation, catalyse efforts by the Government and society at large to manage international migration to achieve the development goals set out in the national development plan and refers to the regional integration agenda in its aim to be Africa-oriented. Policy areas include the management of international migration within the African context to ease cross-border movements for African citizens, to provide a legal route for economic migrants originating from SADC and to address the migration of highly skilled professionals and those with capital.

The white paper emphasizes that a well-managed international migration policy will enable the development of South Africa as well as that of the region. It explicitly positions the international migration policy of South Africa within the African development agenda. In this regard, it gives due consideration to Agenda 2063, the establishment of the continental free trade area and negotiations for a continent-wide visa-free regime. Policies and strategic interventions include international best practice measures such as a points-based system and a residence visa for international students.

Most regional economic communities have established a migration policy framework (see chapter 2). Others are recognizing the need to do so, which requires substantial organizational resources and consultations and a supportive political environment. South Africa has become the primary destination for migrants in all categories from Eastern and Southern Africa and is one of the main destination countries on the continent. To address challenges linked to this status, the Government of South Africa has recently concluded the reform of its migration policy, and insights from the resulting white paper on international migration, adopted in March 2017, the final version of which was published in July 2017, may be useful for countries embarking on the same journey (box 6). Established in a context of soaring unemployment rates, the national policy framework in the white paper situates migration within broader regional and continental contexts by issuing policies that aim to help facilitate the development of markets and industries and the skills base in South Africa, Southern Africa and Africa as a

whole. The Government of South Africa has expressed its will to integrate human rights principles in its approach, a markedly different approach from the history of labour migration in the subregion. A thriving labour-intensive mining industry in the twentieth century led South Africa to become the leading destination for workers from adjacent countries and from across Southern Africa. These labour movements were managed through stringent bilateral agreements that ensured a constant supply of low-cost migrant labour, mostly from Botswana, Lesotho, Malawi, Mozambique,

Table 21
Growth rate prospects for immigration levels

Level of immigration	Immigration growth rate, 2000–2013	Trend in net migration rate after latest observable value	Projection of net migration, 2050
High (> 300 000)			
Côte d'Ivoire	Low	↘	0
South Africa	High	↘	1.5
Nigeria	Low	→	0
Ethiopia	Low	→	0
Burkina Faso	Low	↗	-1.25
Kenya	Low	→	0
Cameroon	High	↗	-1
Uganda	Low	→	0
United Republic of Tanzania	Low	↗	0
Chad	High	→	-0.1
Sudan	Negative	→	0
Congo	High	→	0
Ghana	High	→	-1
Rwanda	Low	→	0
Guinea	Low	→	0
Gabon	Low	↘	1.5
Democratic Republic of the Congo	High	→	0
Zimbabwe	Negative	↗	-1.5
Medium (> 100 000)			
Burundi	High	↘	-2.5
Liberia	High	→	0
Benin	Low	→	-0.1
Mali	Low	→	-3
Libya	Negative	↗	-3.5
Senegal	Negative	↗	-1.25
Gambia	Negative	→	0
Malawi	Negative	→	0
Mozambique	Negative	→	-0.5
Togo	Negative	→	-1
Central African Republic	High	→	0
Niger	Negative	↘	-1
Djibouti	Low	→	0
Low (< 100 000)			
Botswana	High	→	0.5
Mauritania	Low	↗	-1
Sierra Leone	Low	→	0
Zambia	Negative	↗	0
Egypt	High	↗	-1
Angola	High	→	-0.5
Algeria	Negative	↗	-1.25
Namibia	Negative	→	-0.5
Morocco	Low	↗	-3
Tunisia	Negative	→	-1.5
Swaziland	Negative	→	-2.5
Guinea-Bissau	Low	↗	-3
Eritrea	Low	↗	-1
Comoros	Negative	↗	-2.5
Cabo Verde	Low	↗	-0.1
Madagascar	Negative	→	-0.2
Sao Tome and Principe	Low	↗	-2.5
Equatorial Guinea	Negative	↘	0
Mauritius	Negative	↘	-2.5
Seychelles	Low	↗	-2
Somalia	Negative	→	0
Lesotho	Negative	↗	-3

Source: UNCTAD calculations, based on Azose et al, 2016; United Nations Department of Economic and Social Affairs, 2017c; and World Bank Global Bilateral Migration database. Notes: Due to the lack of available data, South Sudan is not included in this sample. Azose et al (2016), in estimating population growth projections, consider uncertainty in projecting international migration, and model migration as an autoregressive process, given difficulties in predicting long-term push and pull factors.

Swaziland and Zimbabwe (Wilson, 1976). In 2017, most migrants from these countries remained low-skilled, and the white paper accordingly notes that the promotion of objectives related to economic growth requires the granting of business, critical skill, study and visitor and/or tourist visas, as these categories of migrants are more likely to start businesses and contribute to a knowledge economy and job creation (South Africa Department of Home Affairs, 2017).

The fact that the white paper devotes comparatively less attention to facilitating the movement of low-skilled migrant workers from the continent raises concerns. In addition, analysts of migration to South Africa have questioned the cost effectiveness of some of the proposals on asylum seekers (Jinnah, 2016; Nshimbi and Fioramonti, 2013). The white paper states that asylum seekers will not automatically acquire the right to work, study or conduct business while their status is being determined, since their basic needs will be met in processing centres, and highlights the difficulties in addressing irregular migration given a lack of return agreements with neighbouring countries on the deportation process (South Africa Department of Home Affairs, 2017). Finally, with regard to institutions, the white paper recognizes that a policy and regulatory framework that ensures effective coordination between sectors and government spheres is lacking, and states that “well-managed international migration will reduce the social costs and public expenditure associated with illegal migration” (South Africa Department of Home Affairs, 2017). This lack of coordination is partly attributed to some governance and administrative capacity deficiencies in the current institutional framework for migration management (Jinnah, 2016).

4.4.1 Skills and lead value chains

There is little information on skills mapping on the continent. Decision-making therefore relies mainly on personal and household perceptions of labour needs and on those of prospective recruiters. In contrast to the historical tradition of bilateral agreements between South Africa and other countries in Southern Africa, such agreements are few in the rest of Africa (see chapter 2). As a result, choices of migration destinations vary, and are not

always reflective of actual labour market needs. For example, Côte d’Ivoire has benefited from low-skilled migration by bridging labour gaps in construction and agriculture, which has also contributed to export-led growth; in contrast, in Burkina Faso, immigrants are found to be overqualified, with little use made of their skills to spur structural transformation (OECD, 2017).

The findings in this chapter and a review of the literature highlight the limited stages of industrial development in Africa and the slow progress in productivity gains. In addition, this chapter notes the geographical distribution of opportunities across different sectors on the continent, and highlights the need for better information on the patterns of labour flows. If designed with due recognition for the varying needs of countries, regional migration policies can set the stage for coordinated industrial policies at the regional level. Examples of related measures include the facilitation of labour flows based on the specific needs of different countries specialized in different segments of the lead value chains identified in the previous sections. The trade creation effect of regional integration in Africa can be further boosted by addressing the management of labour flows at the continental level. This would enable partner States of regional economic communities to benefit from the diversity of their specializations. For example, the cotton-to-textiles industry in Africa is characterized by much higher levels of cotton yields in Western Africa than in Eastern and Southern Africa. In contrast, Eastern and Southern Africa have some dynamic and internationally competitive textile companies. Building on these differences in existing competitive advantages, in the context of a scarcity of public funds, Governments could pool resources and raise private financing for regional centres of excellence that can train creative technology and innovation-oriented workforces.

The findings in this chapter on the positive impact of migration on labour productivity and manufacturing value added, and thereby on structural transformation, reinforce the need to discuss and address intra-African migration in multilateral negotiations. They provide grounds for alternative structural-level solutions beyond the currently dominant project-based approach. From a long-term

perspective, prioritizing support for policies and actions for structural transformation should result in more sustainable impacts on drivers of migration to destinations outside the continent.

However, lessons learned from the impacts of trade liberalization on the unequal growth of productive resources in different countries warrant the need for caution on the potential impacts of the full liberalization of labour flows. The international migration of labour is likely to influence the allocation of productive resources such as skills, entrepreneurial abilities and the ability to undertake research and development. Contemporary evidence on growing intrastate and inter-State disparities shows that without accompanying measures to level the playing field, liberalization measures may reinforce initial states of unequal resource endowment. The free movement of labour may result in the perpetuation of existing inter-State inequalities, as the pull factors in countries depend on the current distribution of resource endowments and perceived labour market opportunities. Skills upgrading and productivity enhancements are key factors for structural transformation, and labour liberalization should not result in locking countries that are abundant in low-skilled labour into corresponding sectoral specializations.

Multilateral intergovernmental negotiations such as those leading to the global compact for migration should acknowledge such challenges and opportunities. From a policy perspective, the challenge is to ensure that cooperation on migration policies at the regional, continental and multilateral levels allows for dynamic changes in the temporal and spatial allocation of skilled and low-skilled labour in countries. Equal opportunities in achieving progress on structural transformation in origin and destination countries in Africa depend on how such allocations evolve over time. To achieve an egalitarian objective, labour, trade and investment agreements should be coherent with national and regional development goals. Investment agreements and investment promotion efforts should be aligned with the respective positions of signatory countries with regard to the labour needs of their target sectors. Furthermore, under the right policy environment, accompanying measures such as mandatory training for local employees and local

procurement obligations in foreign direct investment projects may contribute to the better management of the migration of skilled workers.

The findings in this chapter show that there are not enough opportunities in different sectors and countries in Africa in the short to medium terms to absorb the continent's growing labour force. Remittances from extra-continental migrants will continue to play a role in the achievement of the 2030 Agenda for Sustainable Development in many countries. Emigration rises with income levels, before falling beyond a certain point that corresponds to roughly \$7,500 per capita (Clemens, 2014). Most countries in Africa are below this point, regardless of their migration status, yet are on an upward trend with regard to economic and social development. Emigration from Africa is therefore likely to continue for some years.

4.5 Conclusions: Positioning migrants at the centre of migration policies

Persons and households make migration decisions in response to a wide range of factors that include perceptions of labour market opportunities and expectations of higher earnings and a better future abroad (see chapter 3). Such decisions are the outcome of the interaction between structural forces, proximate circumstances linked to business cycles and household characteristics. Growth rate prospects for immigration levels are shown in table 21. At the aggregate level, uncertainties and shocks at the household and community levels have led to changing patterns of migration in Africa, with rising rates of extra-continental migration. Yet intra-African migration predominates.

Africa has great potential in many sectors, including a global competitive advantage in agriculture and its value chains. However, challenges linked to unemployment and underemployment, as well as a large youth population, make it difficult to identify economies that have ample opportunities for large-scale job creation and capable of absorbing flows of foreign labour. In addition, a prominent share of migrants in Africa move within their own countries, thereby underlining the primacy of creating jobs domestically.

With regard to inter-African migration, the potential for job creation in agricultural value chains,

manufacturing and services highlights the need for regional and continental migration policies to be integrated into regional planning and cooperation in industrial development. Such cooperation is necessary in order to harness the demographic dividend from the continent's young workforce. As illustrated by the example of South Africa, migration policies raise questions about the treatment of different types of migrants, from economic migrants to asylum seekers and international students as temporary workers. Similarly, domestic migration policies face tensions with regard to favouring the attraction of skilled rather than low-skilled labour. Governments should coordinate with the private sector to develop policies and initiatives on aiding the emergence of a talent-driven workforce capable of thriving in an innovation and technology-led world.

The findings in this chapter show that progress on social indicators has continued its upward trend in countries with varying patterns of migration. Optimal policy and regulatory frameworks should be established for migration to fulfil its potential in contributing to economic and social development. This chapter also highlights areas with potential for job creation in different sectors. To make the most of this potential, economies in Africa should accelerate the implementation rates of existing policies and legal frameworks to benefit from the gains of greater regional integration and the free movement of labour at the continental level. Demographic variables accounted for up to one quarter of economic growth in East Asia, yet the outcome from demographic change, rather than being deterministic, was policy dependent. Enabling conditions included successful export-oriented growth strategies, supported by favourable macroeconomic policies (Mason, 2001; Mason, 2007).

The potential of Africa to attract foreign direct investment remains largely untapped. As international businesses emphasize the need to obtain a first-hand understanding of local and regional markets, skilled migrants from Africa should be well-positioned to increase their numbers among the ranks of expatriates across the continent. Increasing the contribution of migration to structural transformation on the continent depends on

translating existing migration policy frameworks and protocols into evidence-based migration management tools at the national and regional levels.

With 12 years remaining before 2030, the next chapter shows the central role that remittances from intra-African and extra-continental migrants play in setting countries on a path towards achieving the Sustainable Development Goals and sustainable structural transformation by 2063.

And finally, it is impossible to fully convey the emotional hurdles that people like Mamadou and Ramatoulaye experience in the face of precipitating circumstances for migration such as the loss of a much-needed source of income. To leave or to stay put. To go as a family, as a couple, or alone. To move to a neighbouring country or farther afield, even across the seas. If gone, to stay away or to come back. As African countries grapple with the challenge of creating 55,000 jobs a day to absorb new job market entrants by 2030, much like Mamadou and Ramatoulaye, would-be migrants spend sleepless nights gambling their lives away. This needs to change. African policies and measures by public and private sector partners in the multilateral system must do their utmost to better inform the decision-making of candidate migrants.

If the global compact for migration leads to the design and implementation of the right migration management policies and tools, there is a chance that Ramatoulaye's dream of celebrating her fiftieth wedding anniversary in style will happen. She dreams that her family reunion back on African soil will coincide with the celebrations of a prosperous African Union as predicted in its Agenda 2063. Her hope is that by then, she and her husband will be able to retire from the family run agro-business that they will have opened in Dakar with savings from their time living abroad. She is adamant that her staff will reflect the diversity of the African countries where their goods will be sent for trading. She plans that Binetou, their first born who by then would live in South Africa, will send them an invitation to a resort in East Africa as a present for their wedding anniversary. Thanks to the benefits of the free movement of persons across the continent and the long-standing effects of the new 2017 Migration Policy of South Africa, Binetou will be luckier than

her father had been, all those years ago. Mamadou and Ramatoulaye dream that all their family will live in the Africa that they want.

Migration and trade are two sides of the same coin: globalization. Migration preceded trade in the history of humanity, but trade preceded migration in the history of multilateralism. The world has proved its capacity to liberalize trade. And yet, trade is not a human right. As preparations for the global compact for migration are under way, the world now stands to be tested on its ability to embrace freedom of movement for all.

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“The *Economic Development in Africa Report 2018* underscores the integral role that well-managed migration can play in addressing Africa's development challenges. African Governments should harness intra-African migration's unparalleled growth in order to maximize its benefits for economic growth and structural transformation.”

Africa's Infrastructure: A Time for Transformation

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The Africa Infrastructure Country Diagnostic covers power, transport, irrigation, water and sanitation, and information and communication technology (ICT)—and to provide an integrated analysis of the challenges they face. Based on extensive fieldwork across Africa, the following main findings emerged:

- Infrastructure has been responsible for more than half of Africa's recent improved growth performance and has the potential to contribute even more in the future.
- Africa's infrastructure networks increasingly lag behind those of other developing countries and are characterized by missing regional links and stagnant household access.
- Africa's difficult economic geography presents a particular challenge for the region's infrastructure development. Africa's infrastructure services are twice as expensive as elsewhere, reflecting both diseconomies of scale in production and high profit margins caused by lack of competition.
- Power is by far Africa's largest infrastructure challenge, with 30 countries facing regular power shortages and many paying high premiums for emergency power.
- The cost of addressing Africa's infrastructure needs is around \$93 billion a year, about one-third of which is for maintenance—more than twice the Commission for Africa's (2005) estimate.
- The infrastructure challenge varies greatly by country type—fragile states face an impossible burden and resource-rich countries lag despite their wealth.
- A large share of Africa's infrastructure is domestically financed, with the central

government budget being the main driver of infrastructure investment.

- Even if major potential efficiency gains are captured, Africa would still face an infrastructure funding gap of \$31 billion a year, mainly in power. Africa's institutional, regulatory, and administrative reforms are only halfway along, but they are already proving their effect on operational efficiency.

Finding 1: Infrastructure Contributed over Half of Africa's Improved Growth Performance

Africa's growth improved markedly in the last decade. African countries saw their economies grow at a solid 4 percent a year from 2001 to 2005. Resource-rich countries, which have benefited from rising commodity prices, demonstrate the highest growth rates. Growth overall still falls short of the 7 percent needed to achieve substantial poverty reduction and attain the Millennium Development Goals (MDGs), however. Infrastructure, significant in Africa's economic turnaround, will need to play an even greater role for the continent to reach its development targets.

Across Africa, infrastructure contributed 99 basis points to per capita economic growth from 1990 to 2005, compared with 68 basis points for other structural policies (Calderón 2008). That contribution is almost entirely attributable to advances in the penetration of telecommunication services. The deterioration in the quantity and quality of power infrastructure over the same period retarded growth, shaving 11 basis points from per capita growth for Africa as a whole and as much as 20 basis points for southern Africa.

The growth effects of further improving Africa's infrastructure would be even greater. Simulations suggest that if all African countries were to catch up with Mauritius (the regional leader in infrastructure) per capita growth in the region could increase by 2.2 percentage points. Catching up with the Republic of Korea would increase per capita growth by 2.6 percentage points a year. In Côte d'Ivoire, the Democratic Republic of Congo, and Senegal, the effect would be even larger.

In most African countries, particularly the lower-income countries, infrastructure emerges as a major constraint on doing business, depressing firm productivity by about 40 percent (Escribano, Guasch, and Pena 2008).

For most countries, the negative effect of deficient infrastructure is at least as large as that of crime, red tape, corruption, and financial market constraints. For one set of countries, power emerges as the most limiting factor by far, cited by more than half the firms in more than half the countries as a major business obstacle. For a second set, inefficient functioning of ports and associated customs clearance is equally significant. Deficiencies in transport and in ICTs are less prevalent but substantial in some cases.

Infrastructure not only contributes to economic growth, but it is also an important input to human development (Fay and others 2005). Infrastructure is a key ingredient for achieving all the MDGs. Safe and convenient water supplies save time and arrest the spread of a range of serious diseases—including diarrhea, a leading cause of infant mortality and malnutrition. Electricity powers health and education services and boosts the productivity of small businesses. Road networks provide links to global and local markets. ICTs democratize access to information and reduce transport costs by allowing people to conduct transactions remotely.

Finding 2: Africa's Infrastructure Lags Well behind That of Other Developing Countries

On just about every measure of infrastructure coverage, African countries lag behind their peers in the developing world (Yepes, Pierce, and Foster 2008). This lag is perceptible for low and middle-income countries in Sub-Saharan Africa relative to

other low and middle-income countries (table O.1). The differences are particularly large for paved roads, telephone main lines, and power generation. For all three, Africa has been expanding stocks much more slowly than other developing regions; so unless something changes, the gap will continue to widen.

To what extent does Africa's current deficit date to a low starting point for infrastructure stocks? Africa started out with stocks that were generally not very different from those in South or East Asia in the 1960s for roads, in the 1970s for telephones, and in the 1980s for power. The comparison with South Asia, which has similar per capita incomes, is particularly striking. In 1970, Sub-Saharan Africa had almost three times the generating capacity per million people as South Asia. In 2000, South Asia had left Sub-Saharan Africa far behind—with almost twice the generation capacity per million people. Also in 1970, Sub-Saharan Africa had twice the main-line telephone density of South Asia, but by 2000, the two regions were even.

Since 1990, coverage of household services has barely improved (figure O.1, panel a). Africa is unlikely to meet the MDGs for water and sanitation. Moreover, on current trends, universal access to these and other household services is more than 50 years away in most African countries (Banerjee, Wodon, and others 2008).

Even where infrastructure networks are in place, a significant percentage of households remains unconnected, suggesting that demand-side barriers exist and that universal access entails more than physical rollouts of networks. As might be expected, access to infrastructure in rural areas is only a fraction of that in urban areas, even where urban coverage is already low by international standards (Banerjee, Wodon, and others 2008) (figure O.1, panel b).

Finding 3: Africa's Difficult Economic Geography Presents a Challenge for Infrastructure Development

Relative to other continents, Africa is characterized by low overall population density (36 people per square kilometer), low rates of urbanization (35 percent), but relatively rapid rates of urban growth (3.6 percent a year), a relatively large number of

landlocked countries (15), and numerous small economies. A further complication is that the continent experiences particularly high hydrological variability, with huge swings in precipitation across areas, seasons, and time, which climate change is likely to exacerbate.

Africa's atomized nation-states are reflected in the region's fragmentary infrastructure networks. Sub-Saharan Africa comprises 48 nation-states, many of which are very small. The bulk of those countries have populations of fewer than 20 million and economies smaller than \$10 billion. International frontiers bear little relation either to natural features (such as river basins) or to artificial features (such as cities and their accessibility to trading channels, such as ports). Intraregional connectivity is therefore very low, whether measured in transcontinental highway links, power interconnectors, or fiberoptic backbones. Most continuous transport corridors are concerned with providing access to seaports, whereas the intraregional road network is characterized by major discontinuities. Few cross-border interconnectors exist to support regional power exchange, even though many countries are too small to produce power economically on their own. Until recently, the whole of East Africa lacked access to a global submarine cable to provide low-cost international communications and Internet access. The intraregional fiberoptic network is also incomplete, but growing rapidly. Because of their geographic isolation, landlocked countries in particular suffer from the lack of regional connectivity.

Both the spatial distribution and rapid migration of Africa's population create major challenges for reaching universal access. In rural areas, over 20 percent of the population lives in dispersed settlements where typical population densities are less than 15 people per square kilometer; hence, the costs of providing infrastructure are comparatively high. In urban areas, population growth rates averaging 3.6 percent a year are leaving infrastructure service providers severely stretched. As a result, urban service coverage has actually declined over the last decade, and lower-cost alternatives are filling the resulting gap (Banerjee, Wodon, and others 2008; Morella, Foster, and

Banerjee 2008). In addition, population densities in African cities are relatively low by global standards and do not benefit from large economies of agglomeration in the provision of infrastructure services. As a result, the costs of providing a basic infrastructure package can easily be twice as much as in other developing cities (Dorosh and others 2008).

Africa's water resources are abundant, but because of an absence of water storage and distribution infrastructure, they are grossly underused. Therefore, water security—reliable water supplies and acceptable risks from floods and other unpredictable events, including those from climate change—will require a significant expansion of water storage capacity from the current 200 cubic meters per capita (Grey and Sadoff 2006). In other parts of the world, such capacity is in the thousands of cubic meters. The cost of expanding water storage is extremely high in relation to the size of Africa's economies, suggesting the phasing of investments, with initial focus on achieving water security for key growth poles.

Table 0.1 Africa's Infrastructure Deficit

Normalized units	Sub-Saharan Africa low-income countries	Other low-income countries
Paved-road density	31	134
Total road density	137	211
Main-line density	10	78
Mobile density	55	76
Internet density	2	3
Generation capacity	37	326
Electricity coverage	16	41
Improved water	60	72
Improved sanitation	34	51

Source: Yepes, Pierce, and Foster 2008.

Note: Road density is measured in kilometers per 100 square kilometers of arable land; telephone density in lines per thousand population; generation capacity in megawatts per million population; electricity, water, and sanitation coverage in percentage of population.

Water also needs to be distributed for agricultural use. In a handful of countries, only 7 million hectares are equipped for irrigation. Although the irrigation-

equipped area is less than 5 percent of Africa’s cultivated area, it produces 20 percent of the value of agricultural production. An additional 12 million hectares could be economically viable for irrigation as long as costs are contained (You 2008).

Finding 4: Africa’s Infrastructure Services Are Twice as Expensive as Elsewhere

Not only are Africa’s infrastructure networks deficient in coverage, but the price of the services provided is also exceptionally high by global standards (table O.2). Whether for power, water, road freight, mobile telephones, or Internet services, the tariffs paid in Africa are several multiples of those paid in other parts of the developing world. The explanation for Africa’s higher prices sometimes lies in genuinely higher costs, and sometimes in high profits. The policy prescriptions for the two cases are, of course, radically different.

Power provides the clearest example of infrastructure with costs genuinely higher in Africa than elsewhere. Many smaller countries have national power systems below the 500-megawatt threshold and therefore often rely on small diesel generation that can cost up to \$0.35 per kilowatt-hour to run, about twice the costs faced by larger countries typically with coal or hydropower-based systems (Eberhard and others 2008).

High road freight tariffs in Africa have much more to do with high profit margins than high costs (Teravaninthorn and Raballand 2008). The costs for

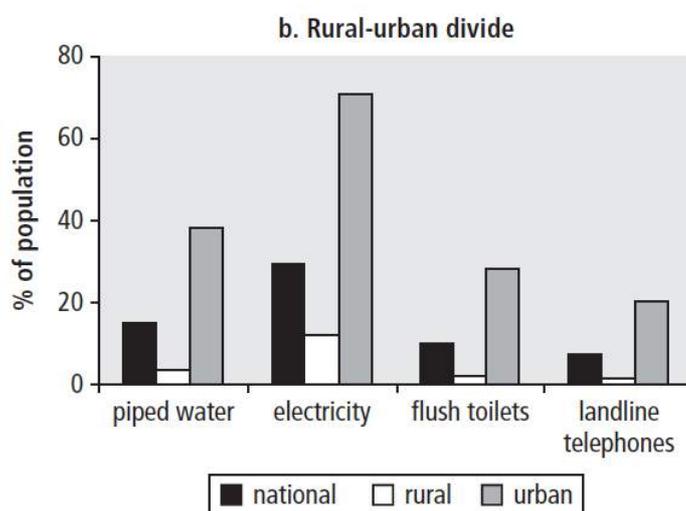
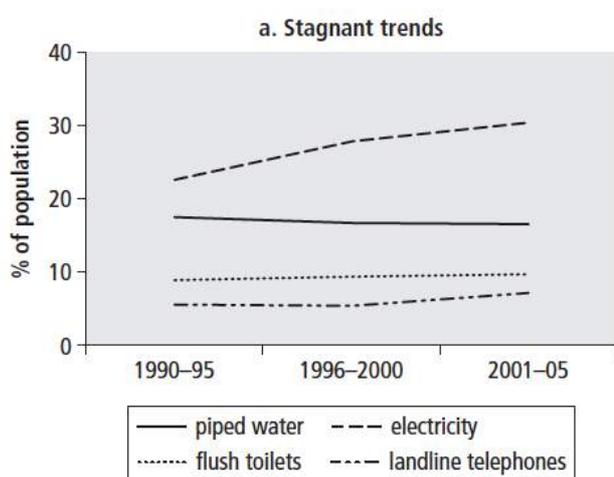
Africa’s trucking operators are not much higher than costs in other parts of the world, even when informal payments are counted. Profit margins, by contrast, are exceptionally high, particularly in Central and West Africa, where they reach 60 to 160 percent. The underlying cause is limited competition combined with a highly regulated market based on *tour de role* principles, which allocate freight to transporters through a centralized queuing method rather than allowing truckers to enter into bilateral contracts with customers directly.

The high costs of international telephony and Internet services reflect a mixture of cost and profit factors. Countries without access to a submarine cable must rely on expensive satellite technology for international connectivity and have charges typically twice those in countries that do enjoy such access. Even when access to a submarine cable is secured, countries with a monopoly on this international gateway still have tariffs substantially higher than those without (Minges and others 2008).

Finding 5: Power Is Africa’s Largest Infrastructure Challenge by Far

Whether measured in generation capacity, electricity consumption, or security of supply, Africa’s power infrastructure delivers only a fraction of the service found elsewhere in the developing world (Eberhard and others 2008). The 48 Sub-Saharan Africa countries (with 800 million people) generate roughly the same power as Spain (with 45 million people). Power consumption, at 124 kilowatt-hours per capita

Figure O.1 Access to Household Services



Source: Banerjee, Wodon, and others 2008.

annually and falling, is only 10 percent of that found elsewhere in the developing world, barely enough to power one 100-watt light bulb per person for 3 hours a day.

More than 30 African countries experience power shortages and regular interruptions to service (figure O.2). The underlying causes vary: failures to bring on new capacity to keep pace with the demands of economic growth, droughts that reduced hydropower in East Africa, oil price hikes that inhibited affordability of diesel imports for many West African countries, and conflicts that destroyed power infrastructure in fragile states. Africa's firms report losing 5 percent of their sales because of frequent power outages—a figure that rises to 20 percent for informal firms unable to afford backup generation. Overall, the economic costs of power outages can easily rise to 1–2 percent of GDP.

A common response to the crisis is to tender short-term leases for emergency power. At least 750 megawatts of emergency generation are operating in Sub-Saharan Africa, which for some countries constitute a large proportion of their national installed capacity. However, emergency generation is expensive at costs of \$0.20–\$0.30 per kilowatt-hour, and for some countries, the price tag can be as high as 4 percent of GDP. Paying for emergency leases absorbs significant budgetary resources, reducing the funds for longer-term solutions.

Figure O.2 Underlying Causes of Africa's Power Supply Crisis

Source: Eberhard and others 2008

Finding 6: Africa's Infrastructure Spending Needs at \$93 Billion a Year Are More than Double Previous Estimates by the Commission for Africa

Meeting Africa's infrastructure needs calls for a very substantial program of infrastructure investment and maintenance:

- Develop an additional 7,000 megawatts a year of new power generation capacity (about half through multipurpose water storage schemes).
- Enable regional power trade by laying 22,000 megawatts of cross-border transmission lines.

- Complete the intraregional fiber-optic backbone network and continental submarine cable loop.
- Interconnect capitals, ports, border crossings, and secondary cities with a good-quality road network.
- Provide all-season road access to Africa's high-value agricultural land.
- More than double Africa's irrigated area.
- Meet the MDGs for water and sanitation.
- Raise household electrification rates by 10 percentage points.
- Provide global systems mobile voice signal and public access broadband to 100 percent of the population.

Implementing such an ambitious program to address Africa's infrastructure needs would cost around \$93 billion a year (about 15 percent of the region's GDP). Some two-thirds of this total relates to capital expenditure, and the remaining one-third to operation and maintenance requirements (table O.3; Briceño-Garmendia, Smits, and Foster 2008).

Table O.2 Africa's High-Cost Infrastructure

Infrastructure sector	Sub-Saharan Africa	Other developing regions
Power tariffs (\$ per kilowatt-hour)	0.02–0.46	0.05–0.10
Water tariffs (\$ per cubic meter)	0.86–6.56	0.03–0.60
Road freight tariffs (\$ per ton-kilometer)	0.04–0.14	0.01–0.04
Mobile telephony (\$ per basket per month)	2.60–21.00	9.90
International telephony (\$ per 3-minute call to the United States)	0.44–12.50	2.00
Internet dial-up service (\$ per month)	6.70–148.00	11.00

Sources: Authors' estimates based on Africon 2008; Bannerjee, Skilling, and others 2008; Eberhard and others 2008; Minges and others 2008; Teravaninthorn and Raballand 2008; Wodon 2008a and 2008b.

Note: Ranges reflect prices in different countries and various consumption levels. Prices for telephony and Internet service represent all developing regions, including Africa.

That cost is well over twice the \$39 billion of infrastructure spending estimated by the Commission for Africa report in 2005. That figure was based on a cross-country econometric study, rather than the more detailed country-level microeconomic modelling (Estache 2005). A more recent update of the cross-country model used for the Commission for Africa report came up with revised estimates in the range of \$80 billion to \$90 billion, much closer to those reported here (Yepes 2007).

About 40 percent of the total spending needs are associated with power, reflecting Africa's particularly large deficits. About one third of the power investment needs (some

\$9 billion a year) are associated with multipurpose water storage for hydropower and water resource management. After power, water supply and sanitation and then transport are the most significant items.

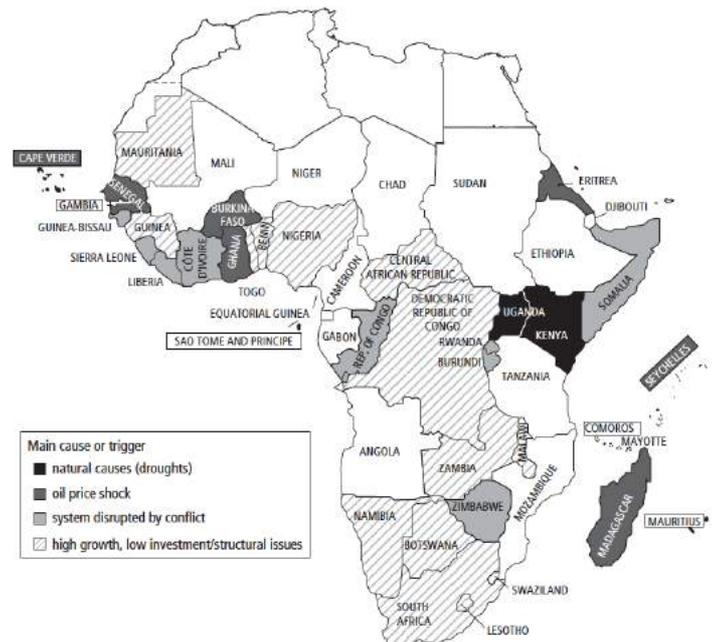
Given recent escalations in unit costs, these estimates are a lower bound. Although the investment estimates here are based on the most accurate unit-cost data available, development agencies are reporting significant cost escalations on projects under implementation. For road projects, these escalations have averaged 35 percent but in some cases have been as high as 50–100 percent. Closer inspection reveals that no single factor explains this escalation. Domestic inflation, tight construction industry conditions, oil price hikes, and inadequate competition for tenders have all played their role, with the last factor by far the strongest.

The global financial crisis of 2008 can be expected to reduce demand for some types of infrastructure, but it would not hugely alter the estimated spending needs.

Table O.3 Overall Infrastructure Spending Needs for Sub-Saharan Africa \$ billions annually

Planning and social targets rather than economic growth drive a large share of the spending needs, for example, the transport spending needs (which are largely based on connectivity objectives) and the water and sanitation spending needs (which are based on the MDGs). The spending needs with the strongest direct link to economic growth are those for the power sector. However, because of the large investment backlog in the sector, the estimated

spending needs contain a strong component of refurbishment and catchup. Thus, even halving economic growth estimates for the region would reduce estimated power spending needs by only 20 percent. The global recession could also be expected to affect demand for ICT services, as well as trade related infrastructure, such as railways and ports. However, the weight of these infrastructures in the total spending needs is not much more than 10 percent.



Finding 7: The Infrastructure Challenge Varies Greatly by Country Type

The infrastructure challenge differs markedly across African country groups (Briceño-Garmendia, Smits, and Foster 2008). Because of the widely varying circumstances, distinguishing among middle-income countries (like Cape Verde and South Africa), resource rich countries with economies heavily reliant on petroleum or mineral revenues (like Nigeria and Zambia), fragile states emerging from conflict (like Côte d'Ivoire and the Democratic Republic of Congo), and the remaining low-income countries that are neither fragile nor resource rich (like Senegal and Uganda) is helpful.

By far the most daunting infrastructure challenges are those facing the fragile states (figure O.3). The recent conflicts affecting these countries usually resulted in the destruction or dilapidation of their (already modest) national infrastructure platforms. In the Democratic Republic of Congo, about 50 percent of infrastructure assets need rehabilitation. The

fragile states' infrastructure spending needs are especially large, particularly when measured against the size of their economies. Such countries would, on average, need to devote 37 percent of their GDPs to infrastructure spending to build a solid infrastructure platform.

With their difficult environments, they attract relatively little external financing, capturing only 10 percent of overseas development assistance and 6 percent of private capital flows allocated to infrastructure. In addition to their huge financing burden, the fragile states do not use their current resource envelope well; they underspend on maintenance and have inefficient service providers.

Figure O.3 Burden of Infrastructure Spending Needs

Non-fragile low-income countries need to allocate, on average, about 23 percent of their GDPs to build and sustain a basic infrastructure platform, a level difficult to envisage in practice. Therefore, these countries will have to make difficult choices about the prioritization of their infrastructure investments, and most of them have a long way to go in improving the efficiency of operating existing infrastructure. The resource-rich countries are, in principle, much

better placed to meet their infrastructure spending needs, though in practice they have not tended to do so. Resource-rich countries could meet their infrastructure spending needs for a more manageable price tag of about 12 percent of GDP. Moreover, the large royalty payments they received during the recent commodity boom provide a ready source of finance. Yet resource rich-countries actually lag non-fragile low-income countries in their infrastructure stocks and spend less on infrastructure. They have been devoting their added wealth not to infrastructure development but to paying off debts. The governance challenges in a resource-rich environment may thus prevent the transformation of wealth into infrastructure.

Meeting the infrastructure needs of the middle-income countries looks to be much more manageable. These countries should be able to meet their infrastructure spending needs with 10 percent of GDP. They are also much stronger in asset maintenance and institutional efficiency. Their more urban populations also facilitate network rollout.

Finding 8: A Large Share of Africa's Infrastructure Is Domestically Financed

Existing spending on infrastructure in Africa is higher than previously thought, amounting to \$45 billion a year when budget and off-budget spending (including state-owned enterprises and extra-

Infrastructure sector	Capital expenditure	Operation and maintenance	Total spending
ICT	7.0	2.0	9.0
Irrigation	2.9	0.6	3.4
Power	26.7	14.1	40.8
Transport	8.8	9.4	18.2
WSS	14.9	7.0	21.9
Total	60.4	33.0	93.3

Source: Authors' estimates based on Banerjee, Wodon, and others 2008; Carruthers, Krishnamani, and Murray 2008; Mayer and others 2008; Rosnes and Vennemo 2008.

Note: Column totals may not add exactly because of rounding errors. ICT = information and communication technology; WSS = water supply and sanitation.

budgetary funds) and external financiers are taken into account. The latter include the private sector, official development assistance, and financiers that do not belong to the Organisation for Economic Co-operation and Development (OECD). As much as two thirds of this overall spending is domestically sourced: \$30 billion of annual spending is financed by the African taxpayer and infrastructure user, and a further \$15 billion is from external sources (table O. 4).

The public sector remains the dominant source of finance for water, energy, and transport in all but the fragile states. Public investment is largely tax financed and executed through central government budgets, whereas the operating and maintenance expenditure is largely financed from user charges and executed through state owned enterprises. Current levels of public finance are substantially

higher relative to GDP in the low-income states, typically absorbing 5–6 percent of total GDP (figure O.4). In absolute terms, however, spending remains very low, no more than \$20–\$30 per capita a year (Briceño-Garmendia, Smits, and Foster 2008).

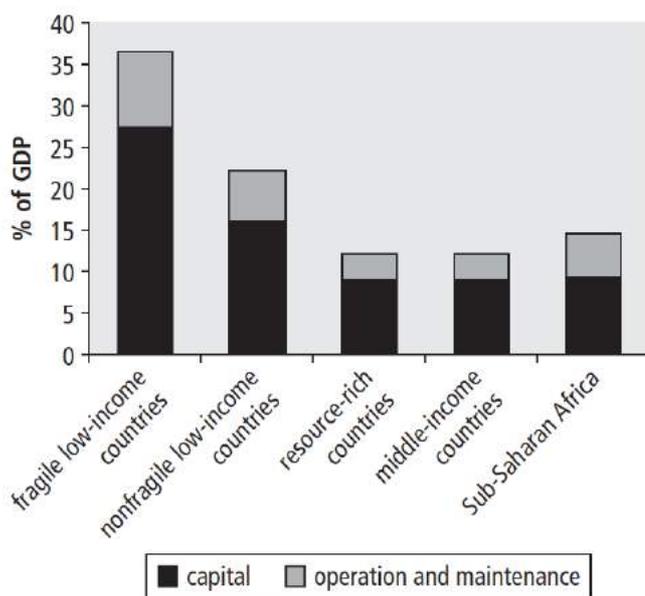
Looking only at investment, one finds that official development assistance, private participation in

infrastructure, and non-OECD financiers together exceed domestically financed public investment (Briceño-Garmendia, Smits, and Foster 2008). The private sector is by far the largest source, on a par with domestic public investment. Much smaller, but still significant, capital flows are provided by official development assistance and, to a lesser extent, non-OECD financiers, such as China, India, and the Arab states. The focus differs markedly in each case. Official development assistance makes an important contribution to water and transport, particularly in fragile states. Non-OECD finance is significant in energy and rail, especially in resource-rich countries. Private participation in infrastructure is heavily concentrated in ICT.

Finding 9: After Potential Efficiency Gains, Africa’s Infrastructure Funding Gap Is \$31 Billion a Year, Mostly in the Power Sector

Addressing a wide range of inefficiencies could make the existing resource envelope go much further—to the tune of \$17 billion a year. This is Africa’s major infrastructure efficiency gap (Briceño-Garmendia, Smits, and Foster 2008).

Figure O.4 Infrastructure Public Spending as a Percentage of GDP



Source: Briceño-Garmendia, Smits, and Foster 2008.

Note: Figures refer to investment (except public sector) and include recurrent spending. Public sector covers general government and nonfinancial enterprises.

First, some countries are allocating more resources to some areas of infrastructure than would appear to be warranted (Briceño-Garmendia, Smits, and Foster

2008). This “excess expenditure” amounts to \$3.3 billion a year overall. The largest share of this excess expenditure relates to public spending on ICT infrastructure that the private sector could provide, particularly in middle-income countries.

Although some of this “overspending” may be justified by phasing or sequencing, at least part of these resources could possibly be reallocated to underfunded sectors. A need exists to monitor infrastructure expenditure more closely against identified needs and priorities and considering expected economic returns.

Second, African countries are typically executing only about two-thirds of the budget allocated to public investment in infrastructure (Briceño-Garmendia, Smits, and Foster 2008). Put differently, public investment could in theory increase by 30 percent without any increase in spending, simply by addressing the institutional bottlenecks that inhibit capital budget execution. Changes include better planning of investment projects, earlier completion of feasibility studies, more efficient procurement processes, and a move to medium-term multiyear budgeting. Increasing capital budget execution to 100 percent could capture an additional \$1.9 billion a year in public investment.

Third, on average, about 30 percent of the infrastructure assets of a typical African country need rehabilitation (figure O.5). This share is even higher for rural infrastructure and for countries affected by violent conflict. The rehabilitation backlog reflects a legacy of underfunding maintenance, a major waste given that the cost of rehabilitating infrastructure is several times higher than the cumulative provides a savings of \$4 to the economy. So some reallocation of resources from investment to maintenance may be warranted, particularly in low-income countries with very low maintenance spending. For roads, an estimated \$1.9 billion of capital spending on rehabilitation could have been avoided with sound preventive maintenance.

Fourth, Africa’s power and water utilities present very high inefficiency in distribution losses, undercollection of revenues, and over-staffing (figure O.6). Utilities typically collect only 70–90 percent of billed revenues, and distribution losses can easily be twice the technical best practice. According to

*Table O.4 Infrastructure Spending on Addressing Sub-Saharan Africa's Infrastructure Needs
\$ billions annually*

Infrastructure sector	Operation and maintenance		Capital expenditure				Total spending
	Public sector	Public sector	ODA	Non-OECD financiers	Private sector	Total	
ICT	2.0	1.3	0.0	0.0	5.7	7.0	9.0
Power	7.0	2.4	0.7	1.1	0.5	4.6	11.6
Transport	7.8	4.5	1.8	1.1	1.1	8.4	16.2
WSS	3.1	1.1	1.2	0.2	2.1	4.6	7.6
Irrigation	0.6	0.3	—	—	—	0.3	0.9
Total	20.4	9.4	3.6	2.5	9.4	24.9	45.3

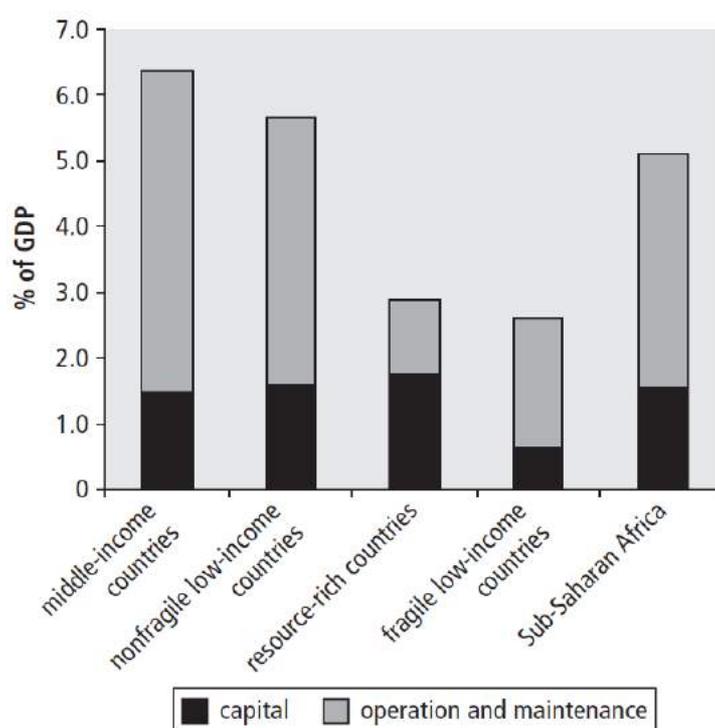
Source: Briceño-Garmendia, Smits, and Foster 2008.

Note: Based on annualized averages for 2001–06. Averages weighted by country GDP. Figures are extrapolations based on the 24-country sample covered in AICD Phase 1. Totals may not add exactly because of rounding errors. ICT = information and communication technology; ODA = official development assistance; OECD = Organisation for Economic Co-operation and Development; WSS = water supply and sanitation. — Not available.

household surveys, about 40 percent of those connected to utility services do not appear to be paying for them, a share that rises to 65 percent for a significant minority of countries. Undercollection is also a problem for some of Africa's road funds (Gwilliam and others 2008). State-owned telecommunication incumbents employ roughly six times the number of employees per connection than do privately operated enterprises in developing countries. For ICT, countries retaining state-owned incumbents are often incurring significant losses from overstaffing that average 0.2 percent of GDP. Similarly, though to a lesser extent, overemployment in power and water utilities ranges from 20 percent to 80 percent over benchmarks in other developing areas. Overall, the revenues lost through these inefficiencies can easily exceed the current turnover of the utilities by several multiples. For power, these losses are also material at the national level, absorbing percent of GDP on the Sub-Saharan African average, or \$3.4 billion annually (Briceño-Garmendia, Smits, and Foster 2008). For water, the absolute value of the inefficiencies is smaller, with the average amount accounting for 0.2 percent of GDP, or \$1 billion a year.

Fifth, underpricing of infrastructure services is substantial. Although African infrastructure charges are high by international standards, so are the infrastructure costs. Even relatively high tariffs can fail to cover more than the operating costs. The revenues uncollected because of underpricing of power and water amount to

as much as \$4 billion a year on aggregate, an implicit subsidy for infrastructure consumers, and that is without taking into account sizable subsidies to large industrial customers that cannot be so readily quantified (Briceño-Garmendia, Smits, and Foster 2008). Because of the very regressive access to infrastructure services in Africa, about 90 percent of those who have access to piped water or electricity services belong to the richest 60 percent of the population (see figure O.9, panel a; Banerjee,



Wodon, and others 2008). Thus, better-off households largely capture any subsidy to residential

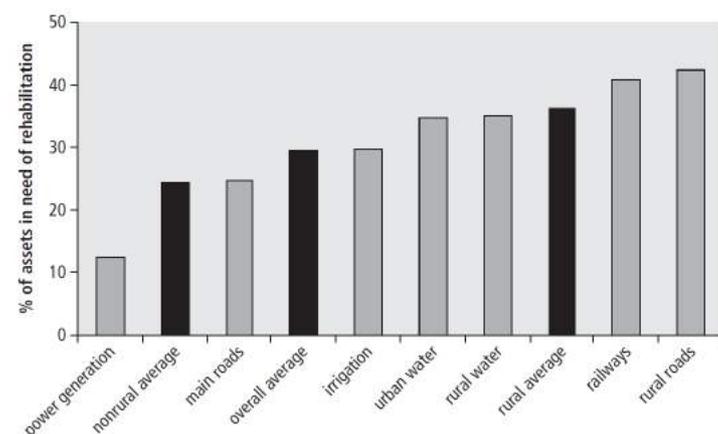
services. In fact, targeting is so deficient that a completely random process for allocating subsidies across the population would perform three times better at reaching the poor.

The overall funding shortfall for meeting Africa's infrastructure needs is given by the difference between estimated infrastructure spending needs and a potential resources envelope that includes existing spending and the potential efficiency gains. Even if all these efficiency gains could be fully realized, a funding gap of about \$31 billion a year would remain (table O.5). This gap can be addressed only by raising additional finance or alternatively by adopting lower-cost technologies or less ambitious targets for infrastructure development.

Looking across sectors, about 60 percent of the funding gap relates to power (figure O.7, panel a). The remainder relates to water and irrigation. There is no significant funding gap for ICT or transport.

Looking across countries, the dollar amount of the funding gap split evenly across income groups. Although the largest financing gaps relate to capital investment, shortfalls in funding for operation and maintenance are substantial, particularly in fragile states. If the infrastructure-financing gap is expressed as a percentage of GDP, the level of difficulty involved in closing the gap becomes immediately apparent. The burden associated with the infrastructure-financing gap is insurmountable for fragile states. They would need to spend an additional 25 percent of GDP on infrastructure to eliminate their infrastructure deficits. Relative to the size of economies, by far the largest financing gaps are in the energy, transport, and water sectors of fragile states (figure O.7, panel b).

Figure O.5 Rehabilitation Backlog



Source: Briceño-Garmendia, Smits, and Foster 2008.

As shown, the size of the funding gap for low-income countries in particular is probably more than they could conceivably raise through available funding channels. For this particularly challenging group of countries, additional measures may need to be taken.

One option is to extend the time horizon for the proposed investment program. Simulations suggest that low-income countries could achieve the proposed investment targets within a period of 20 years without increasing existing spending envelopes, as long as they

fully exploit efficiency gains. One cannot say the same of fragile states, however. They would still require a substantial increase in spending to meet the investment targets in any reasonable time frame, even when inefficiencies are fully captured.

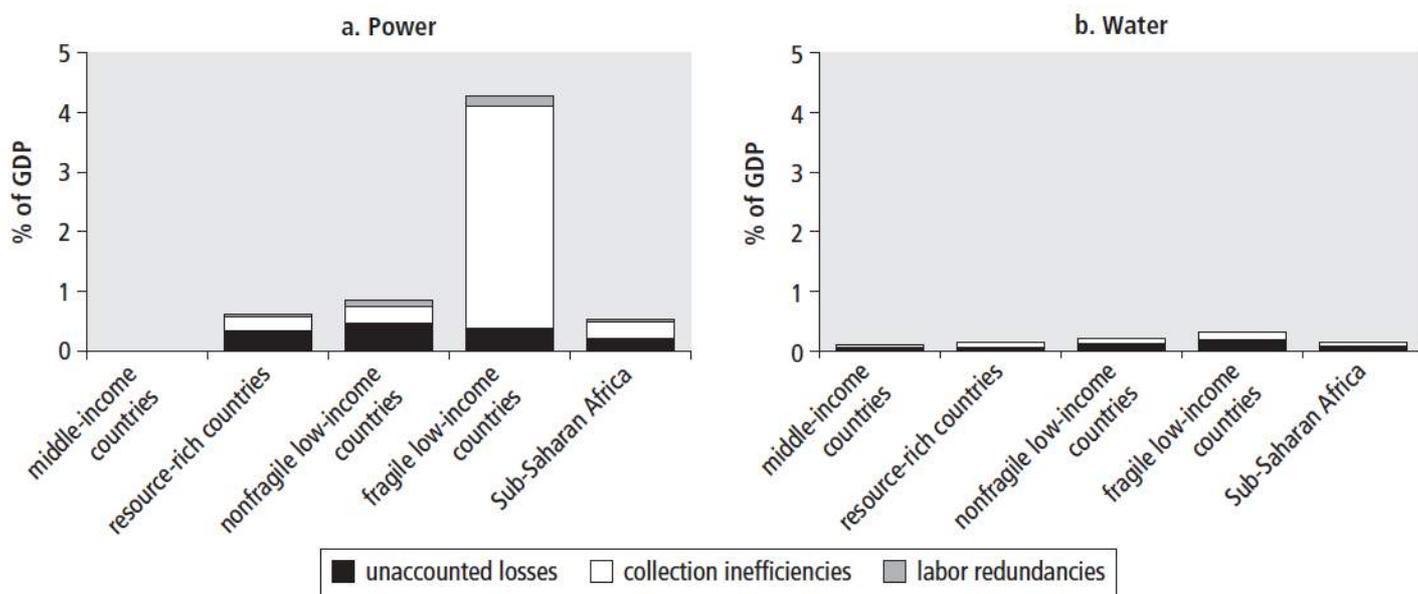
Another possibility is to adopt lower-cost technologies to trim investment needs. Savings of approximately one-third of spending requirements in transport and in water and sanitation are achievable in this way, by adopting lower-cost road designs or lower-end solutions for water and sanitation (such as stand posts and improved latrines). Countries face a stark trade-off between the level of service provided and the speed with which they can serve their entire population.

Finding 10: Africa's Institutional, Regulatory, and Administrative Reform Process Is Only Halfway Along

During the last decade, African states have made concerted efforts toward institutional reform in infrastructure. One could probably fairly say that the institutional reform process is halfway along (Vagliasindi and Nellis 2009). They have made progress, but few countries have a modern institutional framework for these sectors. Overall, the greatest progress has been in telecommunications, whereas transport lags furthest behind (figure O.8). The focus also varies. In telecommunications, the emphasis has been on implementing sector reform, and in water on improving the governance of state-owned enterprises.

Private participation has varied enormously (Vagliasindi and Nellis 2009). Since the mid-1990s, many African countries have experimented with

Figure 0.6 Hidden Costs of Utility Inefficiencies



Source: Briceño-Garmendia, Smits, and Foster 2008.

various forms of private participation in infrastructure, with very heterogeneous results (table O.6).

The private sector has proved willing to invest only in mobile telephones, power plants, and container terminals. The number of mobile subscribers and the share of the population receiving mobile signals increased by a factor of 10 in five years, the result of competition among private operators. Private investors have also provided significant finance for thermal power generation (3,000 megawatts) and for container terminals at ports, even if the volumes fall substantially short of requirements. Toll-road concessions are confined to South Africa; traffic volumes elsewhere are not enough to make such endeavors financially self-sustaining.

In power, water, and railways, the private sector has delivered improvements in operational performance but no new finance. The numerous concessions (and related contractual forms) covering railways, power, and water distribution have not delivered significant investment. Because of a combination of low tariffs and low volumes, none of these businesses delivers cash flows high enough to finance investment. However, these arrangements have often (though not always) been good for operational performance, even if characterized by renegotiation and premature cancellation. A growing area of

experimentation is the multiyear performance-based road maintenance contract with the private sector, which shows promise in safeguarding maintenance activities and keeping costs down.

Some progress has occurred with governance reform of state-owned enterprises, where incentive-based performance contracts and external auditing seem to be paying off. Corporate governance reforms, including the establishment of a somewhat independent board of directors, are becoming more prevalent across sectors, even if few enterprises have full corporatization that includes limited liability, rate of return, and dividend policies. Performance contracts with incentives and independent external audits have become dominant features of the reform process for governance of state-owned enterprises, for both electricity and water. When combined with managerial performance incentives, these measures seem to be having a material effect on performance. The introduction of independent audits has also increased efficiency, for both electric and water utilities.

Evidence on the links between introducing an independent regulator and improving resulting from excessive discretion and overly and the gap between law (or rule) and practice has been wide.

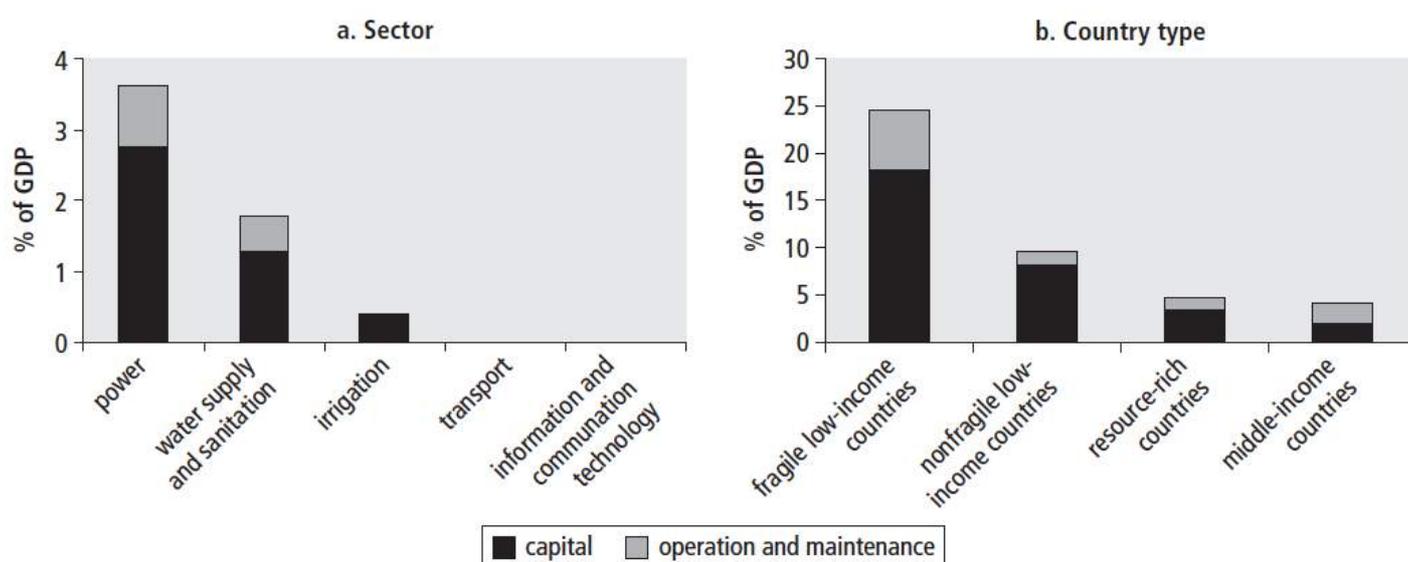
Table 0.5 Finding Resources: The Efficiency Gap and the Funding Gap
\$ billions annually

Item	Electricity	ICT	Irrigation	Transport	WSS	Cross-sector gain	Total
Infrastructure spending needs	(40.8)	(9.0)	(3.4)	(18.2)	(21.9)	n.a.	(93.3)
Existing spending	11.6	9.0	0.9	16.2	7.6	n.a.	45.3
Efficiency gap	6.0	1.3	0.1	3.8	2.9	3.3	17.4
Gain from raising capital execution	0.2	0.0	0.1	1.3	0.2	n.a.	1.9
Gain from eliminating operational inefficiencies	3.4	1.2	—	1.9	1.0	n.a.	7.5
Gain from tariff cost recovery	2.3	—	—	0.6	1.8	n.a.	4.7
Potential for reallocation	n.a.	n.a.	n.a.	n.a.	n.a.	3.3	3.3
Funding gap	(23.2)	1.3	(2.4)	1.9	(11.4)	3.3	(30.6)

Source: Briceño-Garmendia, Smits, and Foster 2008.

Note: ICT = information and communication technology; n.a. = not applicable; — = not available; WSS = water supply and sanitation. Parentheses indicate negative values.

Figure 0.7 Infrastructure Funding Gap by Sector and Country Type



Source: Briceño-Garmendia, Smits, and Foster 2008.

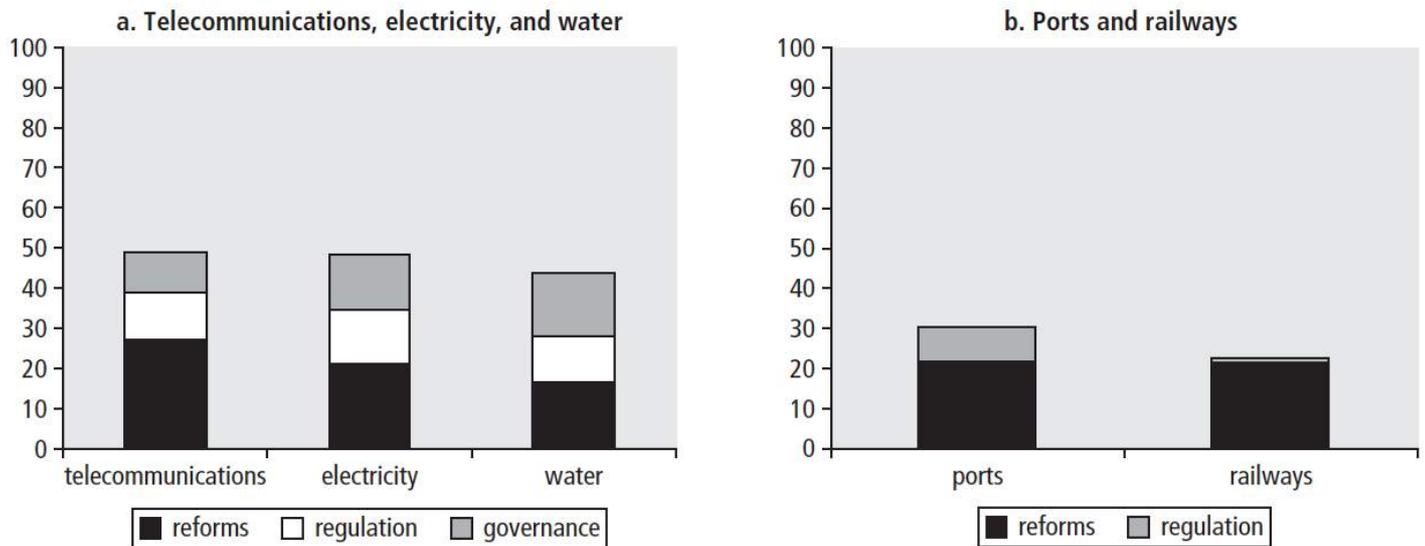
For water, where the vast majority of service providers are state-owned enterprises, no evidence exists of any benefit from regulation. For power and telecommunications, some effect is discernible, but it is far from unambiguous. Weak regulatory autonomy and capacity constraints undermine the credibility of independent regulators. Most African regulatory agencies are embryonic, lacking funding and in many cases qualified personnel.

Key Recommendations

Based on these findings, one can make the following 10 key recommendations:

- Addressing Africa's infrastructure efficiency gap is a pressing policy priority with potential dividends of \$17 billion a year.
- One of the most flagrant inefficiencies is the failure to maintain infrastructure assets maintenance needs to be understood as an investment in asset preservation.
- Institutional reform remains essential for tackling utilities' operational inefficiencies, both through private participation and through governance reforms for state owned enterprises.

Figure 0.8 Institutional Progress across Sectors
percentage score on institutional scorecard



Source: Vagliasindi and Nellis 2009.

Note: See Vagliasindi 2008c for the definition of the *institutional indicators*.

- Institutional reform should also go beyond utilities to strengthen the planning functions of the line ministries and address serious deficiencies in the budgetary process.
- Reforms are needed to get full value from existing infrastructure, where widespread administrative and regulatory bottlenecks prevent facilities from being fully used.
- Regional integration can contribute significantly to reducing infrastructure costs, by allowing countries to capture scale economies and manage regional public goods effectively.
- Development of infrastructure networks needs to be strategically informed by the spatial distribution of economic activities and by economies of agglomeration.
- Infrastructure's social policy needs to be rethought, placing more emphasis on recovering costs from those who can afford it and on recasting subsidies to accelerate access.
- Achieving universal access will call for greater attention to removing barriers that prevent the uptake of services and offering practical and attractive second-best solutions.
- Closing Africa's infrastructure financing gap is critical to the region's prosperity, and the global

financial crisis has only made infrastructure more relevant.

Recommendation 1: Address Africa's Infrastructure Efficiency Gap as a Pressing Policy Priority

The findings presented underscore the magnitude of inefficiency with which Africa spends its current infrastructure resources. Of Africa's overall infrastructure spending needs of about

\$93 billion a year, as much as \$17 billion could be met simply by using existing resources more effectively.

Reaping this efficiency dividend has to be a major policy priority for the region, and efforts to scale up infrastructure finance need to be made in the context of genuine commitments to address efficiency. Pouring additional funding into sectors characterized by high levels of inefficiency makes little sense. However, postponing increases in finance until efficiency improves is not a valid option: the cost to economic growth and human development is simply too high. Rather, development partner efforts to secure additional resources for infrastructure finance must be matched by government efforts to improve their efficiency in using such resources. Parallel progress is needed on both fronts.

Moreover, investment finance is needed in some cases to allow inefficiencies to be captured (for example, where roads must be rehabilitated before they return to a “maintainable” condition or when meters must be installed to improve revenue collection). These kinds of efficiency related investments deserve to be prioritized because of the high returns they typically bring. The current global financial crisis only strengthens the motivation for addressing infrastructure inefficiencies. As African countries begin to feel the pinch of the global financial crisis, and as other sources of funding begin to dry up, measures to improve the efficiency of using existing resources become particularly attractive. Such measures provide an additional internal source of finance at a relatively low monetary cost. Of course, in some cases, significant investments may be needed before efficiency gains can be captured (for example, reducing distribution losses in power or water). In other cases, the economic context of the crisis may simply increase the political cost of taking such measures, such as raising cost recovery or laying off excess employees.

Potential efficiency gains take a wide variety of forms, which are developed in the recommendations that follow. Briefly, they include the following areas:

- Safeguarding maintenance expenditure to avoid wasting resources on the repeated rehabilitation of existing assets, which could save \$2.6 billion a year in avoidable capital expenditure for the roads sector alone
- Reforming institutions to improve the operational performance of utilities and other service providers that are currently wasting
- \$6 billion a year on inefficiencies such as overstaffing, under collection of revenues, and distribution losses
- Addressing deficiencies in the public expenditure framework, where \$3.3 billion a year
- of infrastructure resources appear to be poorly allocated across sectors and low budget execution prevents \$1.8 billion a year of public investment funds from being spent
- Modernizing administrative and regulatory frameworks to reduce bottlenecks that prevent services from being provided effectively across

existing infrastructure networks and impose substantial costs on infrastructure users

- Reaping the economies of scale and coordination benefits associated with regional integration, which in the case of power alone can be as high as \$2 billion a year
- Securing the highest returns from new infrastructure investments by using them to secure economies of agglomeration and to facilitate the development of productive activities along key economic corridors
- Rethinking infrastructure social policy to place more emphasis on cost recovery from those who can afford to pay, and redirecting the current \$4 billion a year of subsidies to accelerate access among lower income groups
- Reducing the costs of meeting key infrastructure targets by adopting lower-cost technologies that provide reasonable levels of service at a price that is affordable to both consumers and the government.

Recommendation 2: Make Greater Effortsto Safeguard Maintenance Spending

The traditional neglect of maintenance expenditure needs to be reversed by rethinking maintenance as asset preservation. One-third of Africa’s infrastructure assets need rehabilitation, indicating that historic neglect of maintenance is endemic. For fragile states and for rural infrastructure, the share of assets needing rehabilitation is much higher. The shortfall in road maintenance spending is costing Africa \$1.9 billion a year in avoidable capital expenditures. In fact, spending \$1 on maintenance can provide a savings of approximately \$4 to the economy.

Thus, Africa’s infrastructure financing gap is not only about raising investment capital; a substantial part of it relates to maintenance. Yet maintenance offers one of the highest returns to infrastructure spending, so it may be more helpful to think of maintenance as a kind of investment in asset preservation.

The road sector shows that maintenance can be improved through suitable institutional reforms. Since the mid-1990s, the majority of African countries have established road funds as a means of

Table O.6 Overview of Private Participation in Infrastructure

Infrastructure sector	Extent of private participation	Nature of experience	Prospects
ICT			
Mobile telephony	Over 90 percent of countries have licensed multiple mobile operators	Extremely beneficial with exponential increase in coverage and penetration	Several countries still have potential to grant additional licenses
Fixed telephony	About 60 percent of countries have divested state-owned telecommunication incumbent	Controversial in some cases, but has helped improve overall sector efficiency	Several countries still have potential to undertake divestitures
Power			
Power generation	34 independent power projects provide 3,000 MW of new capacity, investing \$2.5 billion	Few cancellations but frequent renegotiations; power purchase agreements have proved costly for utilities	Likely to continue, given huge unsatisfied demands and limited public sector capacity
Power distribution	16 concessions and 17 management or lease contracts in 24 countries	Problematic and controversial; one-quarter of contracts cancelled before completion	Movement toward hybrid models involving local private sector in similar frameworks
Transport			
Airports	Four airport concessions, investing less than \$0.1 billion, plus some divestitures	No cancellations but some lessons learned	Limited number of additional airports viable for concessions
Ports	26 container terminal concessions, investing \$1.3 billion	Processes can be controversial, but cancellations have been few and results positive	Good potential to continue
Railroads	14 railroad concessions, investing \$0.4 billion	Frequent renegotiations, low traffic, and costly public service obligations keep investment below expectations	Likely to continue but model needs to be adapted
Roads	10 toll-road projects, almost all in South Africa, investing \$1.6 billion	No cancellations reported	Limited because only 8 percent of road network meets minimum traffic threshold, almost all in South Africa
Water			
Water	26 transactions, mainly management or lease contracts	Problematic and controversial; 40 percent of contracts cancelled before completion	Movement toward hybrid models involving local private sector in similar frameworks

Sources: Authors' elaboration based on Bofinger 2009; Bullock 2009; Eberhard and others 2008; Gwilliam and others 2008; Minges and others 2008; Mundy and Penfold 2008; and Swendsen, Ewing, and Msangi 2008.

Note: ICT = information and communication technology; MW = megawatts.

channeling road user charges to network maintenance. Countries with road funds do significantly better at raising adequate maintenance funds as long as the fuel levies paid into these funds are set high enough to provide material financing. Moreover, countries with both road funds and road agencies do significantly better in safeguarding the quality of their road networks. The use of multiyear performance-based contracts for roads has further contributed to the efficacy and efficiency of road maintenance. These findings illustrate that a combination of funding mechanisms, institutional capacity, and contractual incentives is needed to overcome the maintenance challenge.

Donors have traditionally eschewed funding maintenance, arguing it is more sustainable for funding directly from country budgets. The argument is a good one. However, the willingness of donors to fund asset rehabilitation can create perverse incentives for countries to neglect maintenance, because governments face a choice between raising taxes today to finance maintenance or simply waiting a few years to obtain subsidized donor capital for reconstruction. In low-income, low-capacity environments where maintenance is unlikely to be forthcoming, donors may be well advised to take this choice explicitly into account in project design, rather than simply assume that maintenance will happen. One way of doing so is to choose more capital-intensive, low-maintenance technologies. Even if they represent a higher investment cost in the short run, overall life-cycle costs may be lower if reconstruction can be avoided or postponed. As donors move toward sectorwide budget support, they will have a greater opportunity to ensure that maintenance spending is adequately supported in the budget envelope. In any case, as a general principle, the establishment of a sound framework for financing maintenance should be a prerequisite for the funding of major capital programs.

Recommendation 3: Tackle Inefficiency through Institutional Reform

Since the mid-1990s, the institutional agenda has broadened and deepened (Vagliasindi and Nellis 2009). In the 1990s, the emphasis of institutional reform was on sector restructuring and private participation, transplanting to Africa experiences from other parts of the developing world. This approach yielded dramatic results in telecommunications, but elsewhere the benefits were more limited and the experiences more problematic. Even so, private finance to African infrastructure came from nowhere to provide a flow of funds comparable in scale to overseas development assistance.

A more nuanced, less dogmatic perspective on the private sector has emerged. This perspective values private financing in mobile telephony, power generation, and ports, while recognizing its limits in roads, rail, power, and water (see table O.6). Even for

infrastructure where the proven appetite for private finance is very limited, the potential contribution of the private sector to tackling costly management inefficiencies (undercollected utility revenues, low labor productivity, or neglected road maintenance) remains valuable. Indeed, the efficiency gains from such performance improvements are themselves a significant source of sector finance. Moreover, the concept of private participation has undergone significant expansion. More emphasis has fallen on the local (not international) private sector and on hybrid models that experiment with different ways of allocating responsibilities between public and private partners.

Another important way in which the institutional reform agenda has broadened is the greater focus on the quality of governance for enterprises that remain state owned (Vagliasindi and Nellis 2009). The recognition that the private sector will never be a ubiquitous service provider has come with the realization that state-owned enterprises are here to stay. Therefore, it is necessary to recommit to the difficult process of reforming state-owned enterprises.

Renewed efforts on state-owned enterprise reform should favor governance over technical fixes. Fortunately, better governance of state owned enterprises can improve performance. Past efforts at improving utility management focused too heavily on technical issues at the expense of corporate governance and accountability. Future state-owned enterprise reforms seem justified as long as they focus on deeper institutional issues. Key measures include greater decision-making autonomy for the board of directors, more objective selection criteria for senior managers, rigorous disclosure of conflicts of interest, and more transparent, merit-based recruitment processes.

Parallel efforts can strengthen financial and operational monitoring of state-owned enterprises by their supervisory agencies, whether line ministries or ministries of finance. Transparency and accountability of state owned enterprises depend on solid systems of financial management, procurement, and management information. Today, basic operational and financial data on firm performance are not produced, reported, or acted on. Without information or, perhaps worse, without

action on what information is produced, better outcomes cannot be expected. Key measures include auditing and publishing financial accounts and using comprehensive cost-based accounting systems that allow the functional unbundling of costs and a clearer sense of cost centers. After this foundation is in place, contracting mechanisms can improve performance—within the public sector or with the private sector.

Public sector performance contracts need strong performance incentives. Initial attempts to improve African state-owned enterprises through performance contracts with their line ministry or other supervisory agency were minimally effective. Recent efforts in water (Uganda), however, have had a much more positive effect. The key feature of these contracts is to incorporate incentives for good managerial (and staff) performance and, more rarely, sanctions for failure to reach targets.

Creating effective performance incentives in the public sector can be challenging, making management contracts with the private sector a relevant option. Either expatriate or local management teams can be contracted with, each of which offers advantages. Clarity about what a contract can and cannot achieve, particularly given its short time horizons, is essential. At best, a management contract can improve performance in a handful of relatively manageable aspects of efficiency, such as revenue collection and labor productivity. It cannot solve deficiencies in the broader institutional framework; ideally, these should be addressed beforehand. Nor can a management contract raise investment finance or deliver major effects on service quality that require substantial investments or lengthy gestations.

In principle, regulation can do much; but in practice, regulation has proved difficult. Regulators have been set up across Africa, precisely to insulate utilities from political interference while closely monitoring enterprises. Improving regulatory performance is a long-term process to be pursued where private participation and competitive pressures are significant. The challenge of establishing new public institutions in developing countries is often underestimated. Independent regulation requires a strong political commitment and competent institutions and people. Where some or all are lacking,

considering complementary or transitional options that reduce discretion in regulatory decision making through more explicit rules and procedures or by outsourcing regulatory functions to advisory regulators and expert panels may be wise (Eberhard 2007).

Recommendation 4: Include Line Ministries and Budgetary Processes on the Institutional Reform Agenda

Much of the emphasis of recent reforms has been on restructuring the service provider or utility, bringing in private management, applying regulatory oversight, and so on. Little attention has been given to institutional strengthening of the sector line ministries. These line ministries have responsibilities, which, if not adequately discharged, can jeopardize the functioning of the sector. They take the lead in sector planning, participate in the formulation of the public budgets, and execute investments. However, deficiencies exist in all those areas. Unless they are tackled head on, the effect of reforms on service providers will remain limited.

Stronger sector planning is needed in infrastructure line ministries to ensure that the construction of critical new assets begins early enough to come on stream when needed. Too often overlooked or debilitated during the course of sector restructuring efforts, planning is a critical sector function. It is essential to restore this vital planning capability in the line ministries and to develop sound technical methodologies for identifying and selecting infrastructure projects. More rigorous project screening can ensure that infrastructure investments are selected according to their expected returns and are appropriately sequenced and synchronized with one another and with broader development plans to maximize synergies and avoid costly bottlenecks.

A clear example is power generation. Traditionally, planning and procurement of new power infrastructure were the province of the state-owned utility. With power sector reforms and independent power producers, those functions were often moved to the ministry of energy or electricity. The transfer of skills was not always simultaneous, however, so plans were not adequately informed by the complexities on

the ground. In many cases, planning has collapsed. New plants are rarely timely, thereby opening power gaps that prompt recourse to temporary power and discourage investors. When procurement is (finally) undertaken, the authorities may not take the trouble to conduct international competitive bidding. This outcome is unfortunate because a rigorous bidding process lends credibility and transparency to procurement and results in more competitively priced power.

Because domestic public spending finances the bulk of Africa's infrastructure investments, development partners need a broader view of the quality of public spending. Across the infrastructure sectors, most investments are by line ministries through the budgetary process. Shortcomings in the way the rest of the sector budget is allocated and spent may offset development finance that focuses too narrowly on specific project interventions. So donor resources are best-channeled programmatically as budgetary support or through sectorwide projects, and development partners need to take a broader interest in the overall quality of public spending. Thus, infrastructure interventions must be grounded in a broader understanding of the public expenditure framework in each sector.

Ad hoc political priorities with little or no economic screening too often characterize the budgetary process. The annual budget cycle prevents adequate follow-through on the funding of multiyear infrastructure projects. When it comes to implementation, many countries have significant problems with budgetary execution, with procurement bottlenecks preventing the full budget allocations from materializing in actual spending.

Key aspects of the public expenditure framework need to be addressed. The budgeting process needs to move to a medium-term framework and link sector objectives and resource allocations, underpinned by clear sector plans that go down to specific activities and their associated costs. The careful incorporation of maintenance in medium-term sector-planning tools can prevent the growing need for asset rehabilitation. Project appraisal should underpin the budgetary process for public investment to ensure that all investments under political consideration pass at least a minimum threshold of economic viability. Administrative processes that delay the

release of budgeted funds must be overhauled, and procedures for procurement, disbursement, financial management, and accountability must be modernized and streamlined.

Water provides interesting examples of how bottlenecks in the budgetary process can prevent the use of available resources. In West Africa, the binding constraint is not the availability of budgetary resources in many instances but the capacity to disburse them in a timely fashion (Prevost 2009). In Tanzania, steep increases in budget allocations to the sector followed water's identification as a priority in the country's poverty reduction strategy, but disbursements increased at a much slower pace, thus impeding any immediately discernible effect on access (Van den Berg 2009).

Parallel improvements are also needed in the way donor finance is channeled. Given the relevance of external funds, a solid public expenditure management system for African countries requires that donors improve the predictability of their support and streamline and harmonize their procedures. In that sense, a focus on multidonor initiatives that pool funds to provide general budgetary support for a sectorwide program of interventions is preferable.

Recommendation 5: Use Administrative and Regulatory Reforms to Get Full Value from Existing Infrastructure

Africa is failing to get the full development potential even from its existing infrastructure networks. Administrative and regulatory failures create bottlenecks and prevent infrastructure assets from delivering the services they are supposed to. These problems are particularly evident in transport, where high-impact reforms are urgently needed.

Liberalizing the trucking industry can reduce the exorbitant road freight costs in Central and West Africa. The regulation and market structures of the road freight industry, not the quality of road infrastructure, are the binding constraints on international corridors (Teravaninthorn and Raballand 2008). Road freight tariffs, which can reach \$0.08–\$0.13 per ton-kilometer in Central and West Africa, reflect the high profit margins of trucking services

(60–160 percent). The *tour de role* regulatory framework, based on market sharing and centralized allocations of freight, limits vehicle mileage and undermines incentives to improve fleet quality. The alternative is to combine free entry to the market and market pricing with regulatory enforcement of rules for quality and operating behavior. Already practiced in southern Africa, these reforms can reduce road freight tariffs to \$0.05 per ton-kilometer. Without such reforms, further investments in upgrading road network quality will simply lead to higher profit margins for the trucking industry without lowering transport costs for consumers.

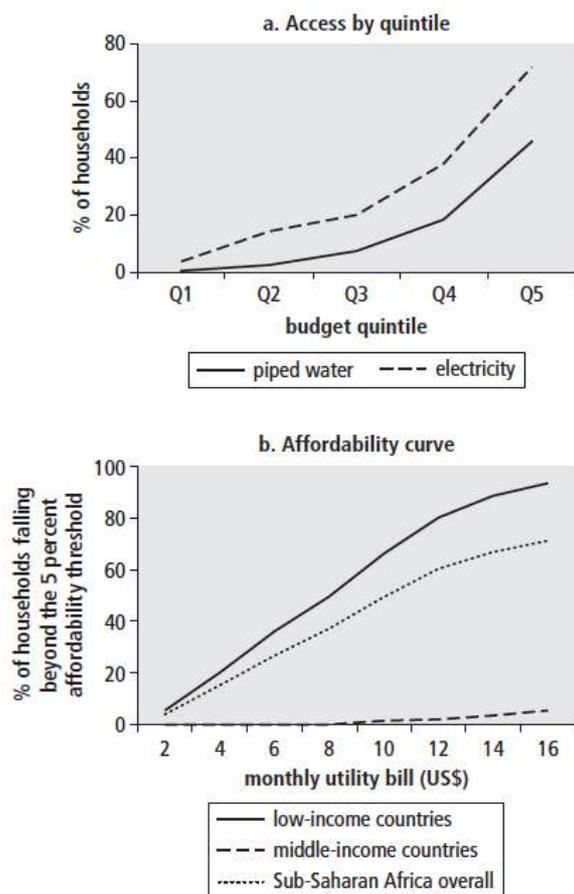
One-stop border posts are essential to avoid extensive delays in transit traffic along international road corridors. Road conditions along Africa's major international corridors are good, with trucks reaching speeds of 50–60 kilometers an hour, but long delays at borders slow effective velocities to little more than 10 kilometers an hour. A journey of 2,500 kilometers from Lusaka, Zambia, to the port of Durban in South Africa takes on average eight days—four days of travel time and four days spent at border crossings. Compare that total with land border-crossing times of no more than half an hour for industrialized countries. The cost of delays for an eight-axle interlink truck has been estimated at about \$300 a day. The investments to develop one-stop border facilities and to modernize customs procedures are relatively modest and would pay back in barely a year. Without such reforms, further investments in the road network will have little effect on overall transit times.

More reliable interconnection services can avoid even longer delays on international rail corridors. Locomotives from one country are generally not allowed to travel on another country's network, mainly because of the inability to provide breakdown assistance to foreign operators. As a result, rail freight crossing borders must wait to be picked up by a different locomotive. These delays can be extensive. A journey of 3,000 kilometers from Kolwezi on the Democratic Republic of Congo border to the port of Durban in South Africa takes 38 days—including 9 days of travel time and 29 days associated primarily with loading and interchange of freight. This delay partly reflects the lack of reliable, well-maintained locomotives, but it also reflects the

absence of clear contractual incentives to service traffic from a neighboring country's network. Reducing such delays would require total rethinking of contractual relationships and access rights linking the railways along the corridor. It would also likely require a regional clearinghouse to ensure transparency and fairness in reciprocal track access rights.

Slow movement of containers and cargo through Africa's ports imposes very high economic costs. Many firms cite bottlenecks at ports as their most pressing infrastructure constraint in countries as diverse as Burkina Faso, Cameroon, Malawi, Mauritius, and South Africa. Container dwell times in East and West Africa are 12–15 days, twice the international best practice of 7 days. Most delays are caused by long processing and administration times and poor handling in congested port areas, rather than by any real limitations in basic quay capacity.

Figure 0.9 Access to and Affordability of Household Services



Source: Banerjee, Wodon, and others 2008.
 Note: Q1 = first (or poorest) budget quintile; Q2 = second budget quintile; Q3 = third (or middle) budget quintile; Q4 = fourth budget quintile; Q5 = top (or richest) budget quintile.

These delays can be very costly. One extra day in port costs more than \$35,000 for a 2,200-TEU (20-foot equivalent unit) vessel in 2006 and proportionately more for larger ships. Shipping lines have responded by introducing “congestion charges”: for a 20-foot container in 2006, ranging from \$35 a day in Dakar, Senegal, to \$420 a day in Tema, Ghana. The solution lies in modernizing customs administration and improving efficiency of cargo handling. The two main bottlenecks within ports are loading and unloading of cargo and customs administration—both need to be addressed simultaneously. Inadequate cranes are part of the problem, but new equipment alone will not deliver better performance unless staff practices are also modernized. Ports with container terminal concessions have boosted handling rates. Modernizing customs administration requires modern information technology and associated database systems. Such soft infrastructure has traditionally been underfunded, contributing to poor port efficiency. Governance issues may also afflict customs administration.

Port and land distribution infrastructure need to be integrated. The lack of an integrated land distribution system, particularly for transit traffic, further impedes container traffic. Making the most progress are dry and liquid bulk exports, where many port facilities are privately owned and integrated within a comprehensive logistics system. Containerized trade, in contrast, is often only skin-deep. Containers are packed and unpacked near the ports, and the benefits of fully integrated multimodal transport corridors associated with container adoption are not secured. As a result, little containerized traffic moves into the landlocked hinterland, and most of those countries' imports are transported as general cargo.

Overall, the transport regulatory and administrative framework needs to promote seamless multimodal transportation networks more consciously. Transport chains can be no stronger than their weakest links, which are usually the interchanges between different modalities—such as road to rail or rail to sea. The weaknesses are partly physical, where no physical connection exists between the modes and no infrastructure is available for transshipment. However, they are also partly institutional, with responsibility for the interchanges not falling clearly

to one modal agency or the other. Finally, they are partly operational, with the government collecting taxes and duties, or staff collecting bribes, slowing movements, and pushing up costs. Even at the sector policy and planning level, Africa's transport modes are too often parceled out across separate line ministries, thereby preventing a cohesive intermodal transport framework from emerging.

Recommendation 6: Pursue Regional Integration to Reduce Infrastructure Costs

Regional integration lowers costs across all aspects of infrastructure. The high cost of infrastructure services in Africa is partly attributable to fragmentary national boundaries preventing achievement of scale economies.

In ICT, power, ports, and airports, regional collaboration essentially provides scale economies that reduce the cost of service. Most African countries are simply too small to develop infrastructure cost-effectively on their own. In ICTs, regional collaboration in continental fiberoptic submarine cables can reduce Internet and international call charges by half, relative to national reliance on satellite communications. In power, 21 countries have national power systems below the minimum efficient scale of a single plant. By sharing large-scale, cost-effective energy resources across countries, regional trade can reduce electricity costs by \$2 billion a year. The traffic flows to most of Africa's national ports and airports are too low to provide the scale economies needed to attract services from major international shipping companies and airlines. Regional collaboration in multicountry hubs can help overcome this problem.

In road and rail corridors and transboundary river basins, collaborative management of these regional public goods reduces the cost. Many of Africa's infrastructure assets and natural resources are regional public goods that cut across national frontiers and can be effectively developed and maintained only through international collaboration. Road and rail corridors need to be managed collaboratively to smooth transport and trade services to Africa's 15 landlocked countries, avoiding the extensive border delays that slow international

road freight to 10 kilometers an hour. Africa's 63 international river basins call for cooperative water resource management and coordinated investments to increase basin yields of food, power, and other economic opportunities, while strengthening environmental sustainability and mitigating the effects of droughts and floods.

Reaping these benefits poses numerous institutional challenges. Among them are mobilizing political will, developing effective regional institutions, setting priorities soundly, harmonizing regulatory procedures, and facilitating project preparation and finance.

Notwithstanding the economic case for regional integration, the mobilization of political will faces considerable obstacles. Regional infrastructure involves a high level of trust between countries, not least because of the implied dependence on neighbors for key resources, such as energy and water. For example, if regional power trade were pursued fully, 16 African countries would import more than half their power needs. A large share of that power would come from fragile states, such as the Democratic Republic of Congo and Guinea.

Regional institutions are needed to facilitate agreements and implement compensation mechanisms. Some countries have more to gain from regional integration than others do. As long as regional integration provides a substantial economic dividend, one should be able to design compensation mechanisms that make all participating countries better off. Benefit sharing was pioneered through international river basin treaties, such as that for Senegal, and could be applied to other regional infrastructure more broadly. Africa has an extensive architecture of regional political and technical bodies, but they have overlapping memberships, limited technical capacity, and limited enforcement powers. Nor do they currently have the capacity to implement crossborder compensation mechanisms.

Moving on regional projects that deliver quick wins is important. Because of the daunting investment agenda, better sequencing and priority setting for regional projects are needed. Political, economic, and spatial approaches have all been widely discussed. Regional projects range from bilateral cooperation

on a transmission line or border post to vast and complex interventions, sometimes with a continental reach. Given the size of the challenges, starting small with projects that deliver tangible high returns and building incrementally on initial successes may be advisable.

Regulatory harmonization needs to go hand in hand with physical integration. Unless regulatory frameworks and administrative procedures are harmonized to allow the free flow of services across national boundaries, physical integration of infrastructure networks will be ineffective. Making progress on regulatory reform has a relatively low monetary cost, but it can have a very high return. A good example is the Yamoussoukro Decision: opening the skies for air transportation across Africa, it has led to greater freedom in the negotiation of bilateral agreements.

Greater efforts are needed to facilitate preparation of complex regional projects, which are particularly costly and time-consuming to prepare. That is especially true when projects are large in relation to the size of the host economy and when they essentially depend on financing from downstream beneficiaries. They also stretch the donor financing systems that are more typically geared toward national investments.

Recommendation 7: Take a Spatial View of Infrastructure Development Priorities

Infrastructure networks are inherently spatial, both reflecting and underpinning the spatial distribution of economic activity. Infrastructure plays a key role in enabling cities to benefit from economies of agglomeration. Transport networks interconnect urban centers with each other and with international trading networks, providing the basis for exchange between the urban and rural economies. Energy, water, and ICT all enhance productivity within urban and rural spaces. Therefore, infrastructure plans and priorities should be strategically informed by a clear understanding of the spatial distribution of economic activity and potential. A clear example of this approach is the Spatial Development Initiative of the New Partnership for Africa's Development (NEPAD).

The spatial lens is a useful basis for prioritization of infrastructure investments and provides insight into cross-sectoral links. Looking at infrastructure through a spatial lens allows identification of the key bottlenecks along various trading corridors, which are typically the highest-return interventions. Cross-sectoral links also become more apparent through a spatial view, shedding light on the need for coordinating interventions across infrastructure sectors and between infrastructure and client economic sectors. An emerging literature suggests that because of synergy effects, the returns from bundling multiple infrastructure interventions in a particular spatial area (Torero and Escobal 2005) or along a given spatial corridor (Briceño-Garmendia and Foster 2009a, 2009b) are higher than those from making the same investments in a spatially uncoordinated manner. In Africa—too often—the limited infrastructure available is thinly spread out, preventing such synergies from being captured.

The urbanization process calls for a regional development perspective on infrastructure that looks at each city and its rural hinterland as an integrated economic unit. Africa is urbanizing fast, creating change that is predictable and beneficial for both urban and rural areas. Prosperity and density go together, as changes in productivity require agglomeration economies, larger markets, and better connectivity. Concentration and urbanization trigger prosperity in both urban and rural areas, and well-functioning cities facilitate the transition from subsistence agriculture by providing a large market for rural products and supporting nonfarm activities. The debate of rural versus urban development should therefore be replaced by the understanding that rural and urban development are closely linked and mutually dependent—and that economic integration of rural and urban areas is the only way to produce growth and inclusive development. In urban areas, deficiencies in land policies and planning have become a huge impediment to extending infrastructure services. African cities are growing fast, but with insufficient infrastructure and poor institutions, most new settlements are informal and not covered by basic services. Urban planning should be strengthened to reduce sprawl, enhance densification, prevent development in precarious environmental zones,

and provide the appropriate balance between public and private land to safeguard key trunk networks. Property rights must be clearly defined so that land markets can function. Cities frequently lack the financial basis to develop the infrastructure critical to their success. The local tax base, though potentially large, is typically unexploited, leaving municipalities reliant on central government transfers, which are too often inadequate or unpredictable.

Large agricultural sectors and rural economies remain central to economic growth and poverty reduction in Africa. Yet the access of rural populations to infrastructure is extremely low. Rural roads and irrigation systems are together perhaps the most pressing of rural

infrastructure needs. The two go hand in hand, and their development should follow the value of agricultural land and the spatial proximity to urban markets. ICT has made huge strides in expanding rural access, with one in two rural Africans now in range of a global systems mobile signal. This platform can contribute to agricultural productivity through simple textmessage extension services, through bulletins on agricultural market prices and meteorological conditions, and as a vehicle for financial transactions. The possibilities are only just beginning to be explored.

Figure O.9 Access to and Affordability of Household Services

Recommendation 8: Rethink Infrastructure Social Policy

Although Africa's infrastructure services are relatively expensive, costs remain even higher than prices, and this lack of cost recovery has major detrimental effects. Underpricing infrastructure services is costing Africa \$4.7 billion a year in forgone revenues. In addition, because of inequitable access to infrastructure services, these subsidies are highly regressive, largely bypassing the poor (figure O.9). The underrecovery of costs impairs the financial health of utilities and slows the pace of service expansion.

Concerns about affordability are usually the pretext for underpricing services but do not bear much scrutiny (figure O.9). A subsistence-level monthly utility bill priced in cost recovery terms typically amounts to \$6–\$10 a month. In the middle-income countries, bills of this magnitude do not appear to present an affordability problem anywhere across the income spectrum. Nor do bills of this magnitude pose affordability issues for the more affluent groups in low-income countries, the main ones to enjoy access to services. Affordability would become a binding constraint in low-income countries only when service coverage starts to exceed 50 percent. Only in the poorest of countries, and those with exceptionally high infrastructure costs, does full cost recovery seem unachievable for today's more affluent consumers. Even in these cases, operating cost recovery should be a feasible objective, with subsidies limited to capital costs. Simulations suggest that raising tariffs to cost recovery would have only minimal effects on poverty rates in most cases.

The affordability of services depends not only on prices, but also on the type of payment arrangements that are made available to consumers. Prepayment (pioneered in the mobile telephone sector) can help households budget their consumption and reduce revenue risks for operators. The same approach is technologically feasible for electricity, and a growing number of power utilities are adopting it.

Subsidies are important, but subsidy design needs major rethinking, with a sharper focus on subsidizing connections, which can be more equitable and effective in expanding coverage. The affordability problems with connection charges are often much more serious than those with use-of-service charges. Moreover, the absence of a connection may itself be a good targeting variable for identifying disadvantaged households, although less so in a low-access environment where coverage may be far from universal, even among affluent households.

An important test of the coherence of a subsidy policy is to see whether it would be affordable for the country under universal access. The existing underpricing of utility services that benefit just a small minority costs many African countries as much as 1 percent of GDP. As countries move toward universal access, that subsidy burden would increase

proportionately, rapidly becoming unaffordable for the national budget. Countries should thus consider how the cost of any proposed subsidy policy would escalate as coverage increases. This test of the fiscal affordability of a subsidy is an important reality check that can prevent countries from embarking on policies that are simply not scalable and will keep coverage low.

Recommendation 9: Find Practical Ways to Broaden Access to Infrastructure Services

Universal access to infrastructure services remains distant for most African countries. The vast majority of African households today lack access to modern power, piped water, sewerage, and even all-season roads that service their communities. The very slow progress in expanding this access since the mid-1990s suggests that universal access to infrastructure is more than 50 years away for most countries in Africa.

This situation calls for a different approach to expanding modern infrastructure services and for greater attention to second-best alternatives. Business as usual will not bring about the acceleration of infrastructure access that Africa needs. Moreover, even if access can be accelerated, many people will have to continue to rely on alternatives to modern infrastructure services for many years to come. Therefore, infrastructure social policies in Africa need to give greater thought to improving and expanding second-best alternatives.

In expanding modern infrastructure networks, closer attention should be paid to the demand side of the equation. The mobile telephone revolution has clearly demonstrated that Africa can widely and rapidly adopt modern infrastructure services. Low charges for initial connection make market entry affordable. Prepayment schemes eliminate credit risk and give customers full control over their spending. Services are well tailored to customer demands. Other network services, notably power and water, have tended to view access as a matter of simply rolling out new networks, overlooking the fact that even where networks are available, the hookup rates are relatively low. They need to pay greater attention to demand-side issues that prevent customers from making connections: connection charges that are much higher than household

incomes, as well as tenure and urban development issues. The most cost-effective way to increase access for many utilities may be through densification programs that increase hookups to existing networks by using greater community outreach to understand better the demand side of the market.

Second-best alternatives can be fine-tuned to provide feasible and attractive infrastructure services to those otherwise unserved. The vast majority of those without access to modern infrastructure services rely on traditional alternatives, such as candles, wells, or unimproved latrines. Although doing the job, these traditional alternatives tend to be inconvenient, inferior, or unsafe. Second-best solutions, such as street lighting, solar lanterns, standposts, and improved latrines, would provide households with superior services at a cost that is somewhat higher than the traditional alternatives but still falls far short of modern services. Puzzlingly, these second-best solutions are not very prevalent in Africa, and even where they exist, they tend to be available primarily to the more affluent.

A key problem seems to be the public-good nature of many of these solutions (such as standposts and street lighting), which makes it difficult for service providers to recover costs and greatly complicates the administration of the facilities. Effective institutional arrangements must be found to support implementation of these alternatives. Another problem is that some of these alternatives, although cheaper, may simply not be cheap enough to be widely affordable.

Recommendation 10: Close the Infrastructure Funding Gap

Notwithstanding the importance of all these efficiency measures, a substantial infrastructure financing gap of \$31 billion a year remains. Such a large shortfall looked daunting even before the onset of the global financial crisis.

As of year-end 2007, many factors had converged to bring about rapid and sustained increases in all major sources of external finance for African infrastructure. Following the Gleneagles Summit, OECD development assistance placed greater

emphasis on supporting African infrastructure. Official development assistance flows almost doubled, from \$4.1 billion in 2004 to \$8.1 billion in 2007. The resurgence of economic growth on the continent led to an upswing in private participation. Since the late 1990s, private investment flows to Sub-Saharan infrastructure almost tripled, going from about \$3 billion in 1997 to \$9.4 billion in 2006/07 (about 1.5 percent of regional GDP). In addition, non-OECD countries— notably China and India—began to take a growing interest in financing infrastructure within a framework of South-South cooperation. Their commitments rose from almost nothing in the early 2000s to finance about

\$2.6 billion of African infrastructure annually between 2001 and 2006. Although disbursements tend to lag commitments by several years, if the record commitments of 2007 are fully honored, the disbursements of external finance for African infrastructure may continue to increase over the next few years.

In the absence of any offsetting measures, domestic infrastructure spending would likely fall, compromising economic recovery and deepening poverty. The existing gap of \$31 billion a year could widen further as public budgets are squeezed, external capital flows decline, and consumer ability to pay user charges is eroded. The ability to construct new infrastructure, address regional bottlenecks, and maintain existing assets would be severely reduced. In Latin America during the 1990s, some 50 percent of the fiscal compression to balance the public books came from cuts in infrastructure spending. In Indonesia following the Asian crisis, public investment in infrastructure fell from 7 percent of GDP to 2 percent. Growth in Latin America and Asia was compromised in a “lost decade.”

Many countries, ranging from China and India to Argentina and Mexico, have used infrastructure-based fiscal stimulus in times of economic crisis. If well targeted to addressing key economic bottlenecks and complemented by policy reforms, infrastructure investments can pave the way for the later resurgence of economic growth. Furthermore, some kinds of public works contracts are labor intensive, creating short-term employment to

alleviate poverty. Although Africa could benefit from such a program, the continent does not have the means to finance it without external support. Estimates suggest that a \$50 billion stimulus package would be needed to offset the impact of the economic crisis on Africa, and that focusing such a package on infrastructure investments would have the largest short-term effect on GDP growth, boosting projections for 2010 to 4 percent, compared with the post crisis

1.7 percent. In the long term, Africa would see a permanent increase of 2.5 percent of GDP (ODI 2009).

Any increase in donor finance for African infrastructure should pay particular attention to the power sector and to the fragile states. Donors have neglected power since the 1990s. Although the private sector can contribute to funding power generation, donors will still need to scale up substantially to address the current crisis in the sector. This scale-up was already under way before the onset of the crisis, with donor commitments that first topped 1 billion a year in 2005 reaching a peak of \$2.3 billion in 2007. Fragile states stand out as receiving less than their fair share of donor finance for infrastructure. Given the magnitude of the financing gap that these countries face relative to the size of their economies, as well as the importance of infrastructure in regenerating their development, a case exists for channeling incremental donor resources in their direction.

Some of Africa’s larger low-income countries have the potential to raise a significant amount of local finance for infrastructure if suitable instruments can be developed. In a handful of African countries, domestic capital markets are beginning to look wide and deep enough to provide significant volumes of infrastructure finance, Nigeria being the most salient example (Irving and Manroth 2009). However, most of this finance takes the form of relatively short-maturity commercial bank lending, often not the best suited for infrastructure projects. A need exists to further develop corporate bond markets and to create regulatory conditions for greater participation by institutional investors in funding infrastructure investments.

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