Random Growth in Africa? Lessons from an Evaluation of the Growth Evidence on Botswana, Kenya, Tanzania and Zambia, 1965-1995

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ABSTRACT *Given shortcomings in basic data collection and insufficient resources in preparing official statistics African growth data are unlikely to be very reliable. Estimates of an annual growth rate of 3 per cent may be consistent with a reality between 0 and 6 per cent growth. Although data from international databases are widely used in an expanding literature on African growth there has been no research into how serious these data inaccuracies are. This paper addresses the reliability of the available growth evidence for a selection of countries and offers concrete measures of inaccuracies. It examines the reasons for discrepancies and shows that they can be quite large.*

I. Introduction

A handbook on African statistics states that national accounting practices in African countries 'focus their attention heavily on the main tables, especially the gross domestic product (GDP), and the international agencies reinforce this bias by requesting national statistics offices to provide data for the aggregates long before the preparation is defensible, resulting in figures that are little better than *random numbers*' (Kpedekpo and Arya, 1981: 208, authors' emphasis). Three decades earlier one of the pioneers of development studies warned about the potential pitfalls of producing statistics on developing countries claiming that 'in the hands of authorities, such international comparisons may yield correlations which throw light on the circumstances of economic progress, and they tell us something about the relative inefficiencies and standard of living, but they are widely abused. Do they

not on the whole mislead more than they instruct, causing a net reduction in human knowledge?' (Seers, 1952: 160).

Despite these concerns very little research has been undertaken on the reliability of official African statistics. Limited work was carried out under the auspices of OECD on the measurement of the non-monetary economy (Blades, 1975) and on GDP level estimates (Blades, 1980). However:

> the GDP per capita growth rates published by developing countries have never been examined for their reliability [and] it seems unlikely that in developing countries GDP real growth rates have errors of less than 3 per cent attached to them. An estimated year-to-year increase of 3 per cent may mean anything from no growth at all to an increase of 6 per cent. (Blades, 1980: 72)

The issue of data quality is best approached by examining whether the data are valid and/or reliable (Ariyo, 1996). The first question is whether national income is correctly measured. There is generally an element of under coverage in all national accounts, but in African countries this is a problem of larger importance, especially given the magnitude of non-monetary transactions and own-production in the large and important rural sector (van Arkadie, 1971/1972). Furthermore, both in urban and rural areas all types of economic transactions are often not recorded because of the combined effect of the state's lack of capacity of record keeping and the small scale and informality of these transactions (MacGaffey, 1991). The question is whether this element of mismeasurement of national income is consistent through time and space, that is, whether the measure is reliable. This is not likely to be the case. There have been important changes in national accounting practices, and most importantly the resources available to national statistical offices. Initial estimates after independence did not generally include, or included only very modest estimates for, the unrecorded or non-monetary economy. These were improved when series were rebased in the 1970s. Structural adjustment, the growth of the importance of the urban informal sector and a general shortage of resources in the state administration created problems in the 1980s and 1990s. Moreover there was significant variation across countries with regards to the relative strength of the state administrations and the extent of collapse and decline in the 1980s. Some countries have now implemented informal sector surveys, others have not. In some countries state and parastatal activity was very important. Some economies rely on a diverse mix of small scale farmers, whilst elsewhere national income is drawn largely from one natural resource for which the price is determined in world markets.

In conclusion, one has both validity and reliability issues with official African data. This might cause serious problems for cross-country and inter-temporal growth comparisons. To gauge exactly the seriousness of this problem is complicated by the fact that there is no direct way of knowing the extent and variation of the 'unrecorded' element through time and space. This paper first (Section II) examines how these data problems are manifested in official statistics to get a measure of the timing, size and cause of data inconsistencies. Section III then considers why this matters for the interpretation of African growth. The conclusion offers guidance to scholars using historical data to interpret economic change in Africa.

II. Accuracy in Growth Reporting

In this paper the sample of Botswana, Kenya, Tanzania and Zambia is chosen because they form an interesting set of countries to compare. The countries are clearly associated with certain 'negative' and 'positive' features of African countries identified in the literature. Botswana is one of the few African growth successes, cited as support for 'growth promoting policies' (Samatar, 1999; Acemoglu et al., 2003; Maipose and Matsheka, 2008) , while the dismal experience of Zambia is a standard example of African failure attributed to 'economic mismanagement' (Bates and Collier, 1995; Anderson and Morrissey, 2006; Mwanawina and Mulungushi, 2008). Botswana is heavily dependent on revenue from diamond mining and Zambia is similarly dependent on copper earnings. Kenya's relatively good growth performance is widely thought to be underpinned by its commitment to 'capitalist' development (Barkan, 1994; Bigsten and Durevall, 2008; Mwega and Ndung'u, 2008), whilst its counterpart Tanzania is seen as suffering the results of a failed 'socialist' development experiment (Barkan, 1994; Mwase and Ndulu, 2008). Yet both are peasant economies producing a variety of cash crops for the world market and food for the domestic market. Thus, this small group of countries represents a wide range of factors perceived to be important for African economic growth in the post-colonial period (Ndulu et al., 2008a, 2008b).

This paper considers four sources of evidence: the official data as published by the national statistical agencies; the World Development Indicators published by the World Bank (WDI, 2003); the Penn World Tables (Heston et al., 2006, henceforth PWT); and the OECD data (Maddison, 2003). The latter three are the most widely used sources for empirical growth studies. The recently published two-volume study on African growth (Ndulu et al., 2008a, 2008b) uses estimates from PWT, WDI (2003) and Maddison (2003) interchangeably (see for instance Ndulu et al., 2008a: Figure 1.1 and Table 1.4). The reporting of data sources by the international organisations leaves a lot wanting. These series are all loosely based on national account data files, but on which series and how these series are assembled in continuous constant growth time series is not clear. The international database series bridges years when no official data were published and over different base years. The only satisfactory way to deal with inconsistencies in the data and to gauge the effects of revisions is to consult the primary source: the official national accounts data. The advantage of using the national accounts is that they come with guidelines and commentaries. When the underlying methods or basic data for the assembly of the accounts are changed, these changes are usually reported. The inconvenience of the national accounts evidence is that it is not readily downloadable. The publications have to be manually collected, and then the process of data entry and interpretation follows. This study is based on a research visit to the statistical offices of the four countries. In each country reports and handbooks on methodology were collected. This information was supplemented by consultation with representatives of the respective central statistical offices.

The WDI (2003) data are GDP estimates in constant 1995 US dollars. The PWT data used here are real GDP expressed in international 2000 prices (using the chain method) from the International Comparison Programme. The data from Maddison (2003) are annual GDP estimates in international dollars based on

Table 1. Correlation matrix for Botswana

	Botswana	WDI	PWT	Maddison
Botswana	1.00	0.72	0.26	0.38
WDI	0.72	1.00	0.48	0.75
PWT	0.26	0.48	1.00	0.79
Maddison	0.38	0.75	0.79	1.00

Note: Simple correlations between reported annual growth rates (see Online Appendix) for the four series.

Table 2. Correlation matrix for Kenya

	Kenya	WDI	PWT	Maddison
Kenya	1.00	0.50	0.27	0.78
WDI	0.50	1.00	0.90	0.54
PWT	0.27	0.90	1.00	0.32
Maddison	0.78	0.54	0.32	1.00

Note: As for Table 1.

Table 3. Correlation matrix for Tanzania

	Tanzania	PWT	Maddison
Tanzania	1.00	0.13	0.77
PWT	0.13	1.00	0.15
Maddison	0.77	0.15	1.00

Note: As for Table 1; WDI excluded because it only starts in 1988 for Tanzania.

Table 4. Correlation matrix for Zambia

	Zambia	WDI	PWT	Maddison
Zambia	1.00	0.83	0.48	0.90
WDI	0.83	1.00	0.61	0.92
PWT	0.48	0.61	1.00	0.52
Maddison	0.90	0.92	0.52	1.00

Note: As for Table 1.

1990 prices. To obtain internationally comparable estimates the PWT and Maddison (2003) data have been adjusted for purchasing power parity (PPP) prices using the Geary-Khamis method, while the WDI data are adjusted using the Atlas method. The Online Appendix provides details and references to technical discussions of the differences between these methods and sources. The metric that will be compared here is percentage annual growth. While the international databases publish series from the 1960s onwards, the national statistical agencies do not publish estimates before independence. This means that

comparative growth evidence analysis based on published national accounts can be made from 1965 onwards. 1995 was chosen as an end year because that was the latest year data were available for all series for all four countries when this field research was conducted.

There are issues that complicate the comparison between the national accounts data and the other series. These are important findings in themselves. There are gaps in the official national accounts of Zambia and Botswana, and for Tanzania WDI does not report any data before 1988. Thus, when the international database compilers are faced with these gaps in the data, different methods are applied to fill the gaps:

> For many countries, the constant series are in different base years, and there are gaps in the series. Where possible, we apply the growth rates from previous national accounts series to the missing data. In other cases, the current price series that existed for a country in 1985 is very different from the current price series today for the same years, resulting in significantly different deflators between PWT versions. We use the latest available series, and users can check for themselves if there are major differences that arise from the underlying countries' national accounts data. (PWT6.2: Technical Documentation)

We are comparing four different sources of evidence. Three of them are expressed in international prices; we can thus compare growth estimates derived from two different types of PPP adjustment. All three international sources are based on national account files, produced by the national statistical agencies. These data have been collected from national statistical agencies, but disseminated and altered by the OECD, the World Bank and others in an essentially non-transparent process (for the end user). The three international databases have in common that they provide national income estimates expressed in one comparable series (i.e. at constant prices) back to 1960 (or 1950 in the case of Maddison (2003)). The official series are not continuous; they are spliced from different base years, with three or four different series covering the period back to independence. We are comparing derived growth rates from these level estimates, and the discrepancies in growth reporting derive from differences in methods of expressing the levels in international prices, filling in gap years, harmonising the original data series across different base years or simply from random errors. A review of the different methods of creating international comparable data issued the following warning:

> Perhaps the overriding message is to exercise caution, particularly with comparisons between countries whose economies are very different, and particularly with the national accounts data provided by countries whose statistical capacity is weak. On the former, there are deep conceptual difficulties that cannot be resolved by collecting better data. On the latter, it must always be remembered that the international accounts are no better than the national accounts of the participating countries. (Deaton and Heston, 2008: 43–44)

At face value we have no criteria for choosing which of the sources is the most correct. The correlations between the growth series presented in Tables 1–4 get us

closer to such a judgement. When one of the four series is very different from the other three, this suggests that there is something wrong with that specific series. The extent of mismatch between these sources of growth is a powerful indicator of how accurate any given source of evidence is, and as such it tells us the extent to which an annual growth rate conveys correct or meaningful economic information. Remember that each one of these sources of evidence is supposed to give us a truthful picture of the rate and timing of economic change in the given country. The lack of correlation between four types of evidence that are supposed to relate to exactly the same process using the same indicator is striking.

The discrepancy between the Penn World tables and the official data appears to be large, while the data provided by the OECD (Maddison, 2003) and the World Bank correlate better with the official data (Tables 1–4). In terms of the overall coherence between the national data and the other sources the Zambian data have higher correlations (Table 4). As shown in the Online Appendix, the estimated growth rates in any given year vary between data sources. The highest correlation observed is between the OECD data and WDI on Zambia, with 0.92. The highest correlations in the growth data on Kenya (0.75) and Tanzania (0.53) are lower. The WDI and PWT agree to a considerable extent on Kenya (0.9), but not for Botswana (0.47) and Zambia (0.61). The OECD and the PWT data are seemingly unrelated in the case of Kenya (0.31) and Tanzania (0.15), while the data show a higher level of agreement, though not a satisfactory one, on Zambia (0.51) and Botswana (0.78). The agreement on growth rates for Tanzania is poor, for Botswana and Kenya it is moderate, while for Zambia it is better. In general, based on these four case studies, one source of data cannot be said to better than another. The correlations indicate that if one is interested in growth in any given year for one of these countries what one finds will vary depending on which source one has chosen.
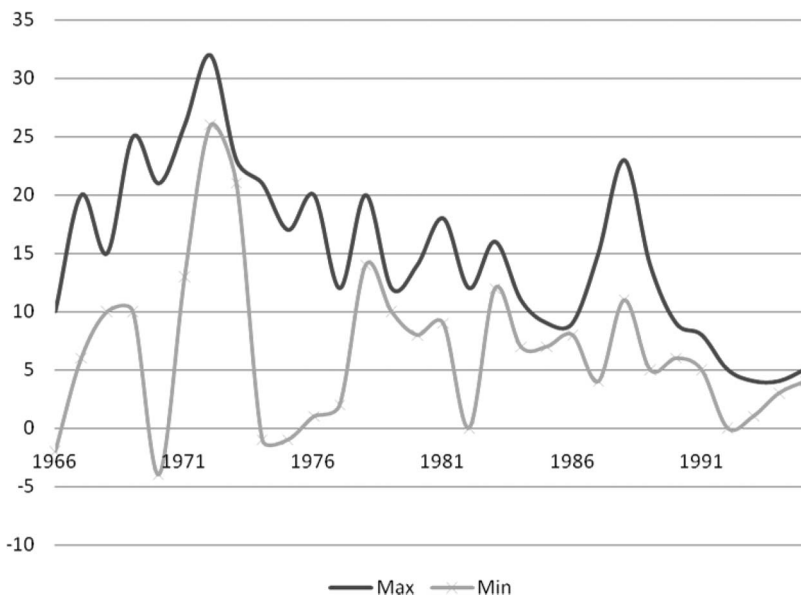
Another way to measure the degree of disagreement on economic growth in these four countries is to investigate the actual discrepancies in the data (the differences between alternative estimates) and the timing of them. Figures 1–4 display the maximum and minimum value of GDP growth from the alternative data sources for each country in each year over 1966–1995. The differences between the two lines represent the annual potential 'error' in the data. Tables 5–8 report two measures of data discrepancies averaged over sub-periods for each country. The 'error range' is the difference between the highest and lowest estimates of average annual growth in each period (this smoothes out some discrepancies in the annual data), while the 'mean error' is the period average of the annual errors.

In all four countries there is a considerable element of error. The difference between the highest and the lowest estimates of period average growth, or the error range, is highest in Botswana, at 4.4 percentage points over 1966–1975 and 1.7 points over the entire period (Table 5). Not in a single year do the four sources agree (see Online Appendix Table A3) and annual discrepancies are marked (Figure 1). This is striking, but does not establish to what extent the difference is unacceptable or statistically important. Small random discrepancies are not the issue, but systematic differences are of concern, as are large random errors that inadvertently bias the results. Between 1966 and 1970 the error range was almost 10 percentage points in Botswana, and the mean error for these early periods was even higher. This is probably explained by gaps in the official data in this period; the errors reflect how

Table 5. Accuracy in growth reporting: Botswana 1965–1995

	WDI	Botswana	PWT	Maddison	Min	Max	Error range	Mean error
1966–1970	11.0	16.8	7.0	10.0	7.0	16.8	9.8	14.2
1971–1975	18.2	16.2	17.2	18.6	16.2	18.6	2.4	12.2
1976–1980	12.2	9.0	13.2	13.2	9.0	13.2	4.2	8.6
1981–1985	10.0	11.2	7.6	10.0	7.6	11.2	3.6	7.3
1986–1990	11.8	12.2	9.2	10.4	9.2	12.2	3.0	7.2
1991–1995	4.0	3.4	4.6	3.4	3.4	4.6	1.2	2.6
1966–1975	14.6	16.5	12.1	14.3	12.1	16.5	4.4	13.2
1976–1995	9.5	9.0	8.7	9.3	8.7	9.5	0.9	6.2
1966–1995	11.2	11.5	9.8	10.9	9.8	11.5	1.7	8.5

Note: The first four rows are averages of annual estimates from the four sources. The error range is calculated as the difference between the highest and the lowest average annual growth rates in each period. Mean error is the average annual error for the period. Averages derived from annual data (see Online Appendix).

Figure 1. Annual error range in GDP growth rate, Botswana 1965–1995.

different sources 'guesstimate' or interpolate growth differently over this period. Between 1974 and 1977 there were economic shocks both domestically and externally (drought and petroleum prices) and the way the data have picked this up seems to differ. The official data report no or negative growth in 1974 and 1977, while the other sources indicate rapid growth. In the other two periods of large discrepancy 1981–1982 and 1987–1988, it is driven by relatively low PWT estimates of growth, while the other sources report high growth. The disagreement is higher at the beginning of the period and narrows in the latter half of the period. Between 1978
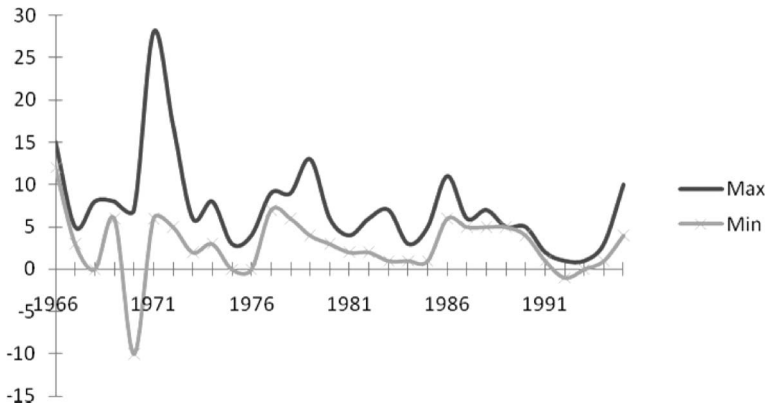
Figure 2. Annual error range in GDP growth rate, Kenya 1965–1995.

Table 6. Accuracy in growth reporting: Kenya 1965–1995

	WDI	Kenya	PWT	Maddison	Min	Max	Error range	Mean error
1966–1970	5.8	8.2	2.6	7.6	2.6	8.2	5.6	6.4
1971–1975	10.0	5.0	11.4	4.2	4.2	11.4	7.2	9.2
1976–1980	6.4	5.6	5.8	6.4	5.6	6.4	0.8	4.2
1981–1985	2.6	4.2	2.2	3.0	2.2	4.2	2.0	3.5
1986–1990	5.6	5.2	6.6	5.6	5.2	6.6	1.4	1.8
1991–1995	1.4	3.2	1.6	1.4	1.4	3.2	1.8	2.4
1966–1975	7.9	6.6	7.0	5.9	5.9	7.9	2.0	7.8
1976–1995	4.0	4.6	4.1	4.1	4.0	4.6	0.6	3.0
1966–1995	5.3	5.2	5.0	4.7	4.7	5.3	0.6	4.6

Note: As for Table 5.

and 1995 annual error range reaches double digits 'only' three times (1982, 1987 and 1988). From 1990 onwards the series all use the same base year, and the error range falls to 1.2 points. In general, PWT provides the minimum estimates of average period growth rates while national or Maddison have the highest estimates.

In Kenya (Figure 2) the mean error is lower, but still considerable at 4.6 percentage points (Table 6) between 1966 and 1995. This high average is driven by a very large discrepancy in the reported annual growth rates between 1970 and 1972 (seen here for 1971–1975). For these two years there are two competing versions of growth (Online Appendix Table A4). If one trusts WDI or PWT, the economy shrank in 1970 (by 5 or 10% respectively) and then grew very fast through 1971 and 1972 (22 and 17% and 28 and 17% respectively). However, if one is more inclined to trust the official or the OECD data instead, the annual rate of growth was stable between 5 and 7 per cent during those three years. There seems to be an error common to both WDI and PWT which explains the spike in the error range those years. A second spike in 1979 is caused by PWT, when growth is reported as 13 per cent, while the official and OECD data agree on 4 per cent growth. The pattern of

higher disagreement in the early period in Botswana is repeated in the case of Kenya. The latest official series was based in 1982 which may explain why the error in the series narrows earlier. There is no evident consistency in which sources provide the lowest or the highest estimates.

For Tanzania the mean error for the whole period is lower at 3.6 percentage points (Table 7). The error is not evenly distributed, and in contrast with the other countries except Zambia, the discrepancies in the data are higher towards the end of the period (Figure 3). The WDI does not report growth data for Tanzania before 1988. In 1987 PWT recorded a GDP growth of 20 per cent followed by a negative growth of 33 per cent in 1988. This is due to a mistake in the data, and is also the reason why WDI does not report data before 1988 as reported in a study on Tanzania published by the World Bank (Ndulu and Mutalemwa, 2002: 51). The annual growth rate recorded in 1987 was due to an inclusion of the informal sector while the negative growth rate recorded in 1988 was a change in the statistical method when a World Bank mission judged that existing estimates for agricultural and manufacturing sectors were too
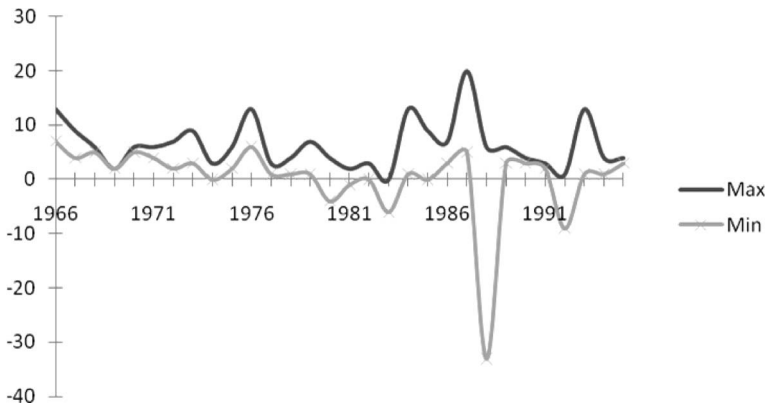

Figure 3. Annual error range in GDP growth rate, Tanzania 1965–1995.

Table 7. Accuracy in growth reporting: Tanzania 1965–1995

	WDI	Tanzania	PWT	Maddison	Min	Max	Error range	Mean error
1966–1970	–	6.0	5.8	6.0	5.8	6.0	0.2	4.2
1971–1975	–	4.6	3.8	4.2	3.8	4.6	0.8	2.4
1976–1980	–	3.2	4.4	3.0	3.0	4.4	1.4	3.4
1981–1985	–	0.8	4.2	0.4	0.4	4.2	3.8	1.0
1986–1990	–	5.6	0.2	3.8	0.2	5.6	5.4	3.2
1991–1995	1.8	2.2	2.2	2.0	1.8	2.2	0.4	7.6
1966–1975	–	5.3	4.8	5.1	4.8	5.3	0.5	3.3
1976–1995	–	3.0	2.8	2.3	2.3	3.0	0.7	3.8
1966–1995	–	3.7	3.4	3.2	3.2	3.7	0.5	3.6

Note: As for Table 5.

high. As for Kenya, there is no evident consistency in which sources provide the lowest or the highest estimates.

For Zambia the average annual error range over the whole period is 3.6 percentage points, the lowest in our sample (Table 8). The gap in the series increases at the end of the period (Figure 4). Accounting practices changed in the late 1990s as a delayed response to a structural change similar to that experienced in Tanzania, and the discrepancies in the data arising from this are clearly visible. The other years when the discrepancy was particularly large, 10 and 9 per cent in 1970 and 1976, coincides with the change of base year in the official data. The PWT most often provides the maximum estimates of average period growth rates, but otherwise there is no clear pattern.

Note that the error ranges reported in tables and referred to above are percentage points. This tends to overstate the proportional error in high growth countries like Botswana, while it understates the error in a low growth country like Zambia. Table 9 represents proportional error as the mean error expressed as a ratio of the average of annual growth estimates reported from the four sources for the relevant
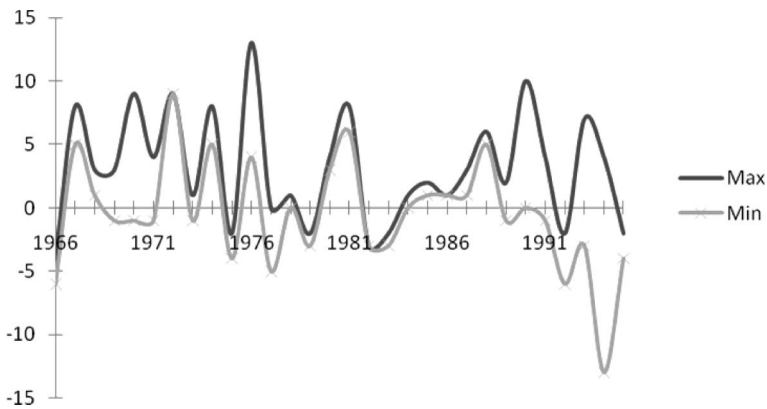

Figure 4. Annual error range in GDP growth rate, Zambia 1965–1995.

Table 8. Accuracy in growth reporting: Zambia 1965–1995

	WDI	Zambia	PWT	Maddison	Min	Max	Error range	Mean error
1966–1970	1.6	3.2	1.2	1.6	1.2	3.2	2.0	4.2
1971–1975	2.4	2.4	3.4	2.4	2.4	3.4	1.0	2.4
1976–1980	0.4	0.8	2.4	0.4	0.4	2.4	2.0	3.4
1981–1985	0.6	0.6	0.8	0.6	0.6	0.8	0.2	1.0
1986–1990	1.8	3.6	2.0	4.0	1.8	4.0	2.2	3.2
1991–1995	−1.2	−2.4	−0.2	−2.2	−2.4	−0.2	2.2	7.6
1966–1975	2.0	2.8	2.3	2.0	2.0	2.8	0.8	3.3
1976–1995	0.4	0.7	1.3	0.7	0.4	1.3	0.9	3.8
1966–1995	0.9	1.4	1.6	1.1	0.9	1.6	0.7	3.6

Note: As for Table 5.

Table 9. Accuracy in growth reporting: Botswana, Kenya, Tanzania and Zambia

	Botswana	Kenya	Tanzania	Zambia
1966–1970	1.27	1.06	0.44	2.21
1961–1975	0.70	1.20	0.95	0.91
1976–1980	0.72	0.69	1.47	3.40
1981–1985	0.75	1.17	3.33	1.54
1986–1990	0.66	0.31	3.88	1.12
1991–1995	0.68	1.26	2.53	5.07
1966–1975	0.92	1.14	0.65	1.45
1976–1995	0.68	0.72	2.77	5.07
1966–1995	0.78	0.91	1.74	2.89

Note: The 'Accuracy' is calculated as the Mean Error (the average annual discrepancy between sources) divided by the average of the growth rates reported in all sources for the relevant period. Table A7 (Online Appendix) reports accuracy using the Error Range and gives a similar picture.

period. When the discrepancy is expressed in this way it becomes clear that while percentage point errors were large in Botswana that was in part due to its high growth rates and that while the percentage point error range in Zambia seemed small that is partly due to its low average growth. In fact, relative to growth rates averaged across sources, errors in Botswana are relatively low (typically the error is less than period average growth) whereas errors are relatively high, often considerably so, in Tanzania and Botswana. Table 9 confirms the observation made earlier that for Kenya and Botswana the accuracy of reporting is poor in the beginning of the period, while in Tanzania and Zambia the accuracy is poor at the end of the period. The extreme is Zambia in 1991–1995 and 1976–1995, where the mean error is five times the average annual growth across sources. For the period 1976–1995 this is driven by a very low average growth rate at only 0.8 per cent, while in the latter period 1991–1995 the error range reached double digits twice and this high error compared to a low growth rate drives the accuracy ratio here.

III. Does Data Quality Matter? Implications for African Growth Analysis

What are the implications for the debate on African growth? A common way to counter this problem is to note that data errors only relate to singular (annual) observations, and one observation alone does not normally inform an economic performance evaluation. In the long run errors can be hoped to be less important. It is true, in mathematical terms, that one mistake in reporting in one year has less impact on the average growth rate if the average is calculated over many years. The effect of an error further depends on how growth in a period is calculated and whether the error is in the starting or end year for the period. A second source of consolation derives from the hope that an error in one direction is evened out over time by an error in the other direction. It may perhaps appear naïve to hope that the average of a sequence of errors will in the end give an accurate result or at least an estimate with a satisfactory accuracy, but in the absence of better methods this is common practice. In this sample, using three decade averages the conventional

ranking of Botswana as a star performer and Zambia as a dismal performer is not put in any doubt, and while the relative status of Kenya and Tanzania across shorter time periods would depend on which dataset is used for the comparison across the three decades there is still a growth advantage for Kenya in all three sources.

While the empirical growth literature methodology relies on averaged growth rates over the whole post-colonial period or sub-periods in panel studies it is explicitly based on a correlation between certain policy regimes and economic performance over shorter periods. A recent comprehensive study on African growth is provided by the 'Growth Project' of the African Economic Research Consortium (AERC) that combines both cross-section analysis and 26 country cases to explain the African growth record since 1960 (Ndulu et al., 2008a, 2008b). Here periods of sound and unsound economic policies are picked out based on the growth evidence. This type of analysis is extremely vulnerable to measurement problems (as illustrated in Tables 5–8). The study used different sources of growth data interchangeably, and the soundness of the analysis relies on the cross-country and temporal validity and reliability of the data.

According to PWT Botswana had an average growth of 7 per cent in the first five years after independence compared to 5.8 per cent in Tanzania. Thus the difference between Tanzania and Botswana for this period is surprisingly small. In contrast, Maddison (2003) and the official national evidence report a marked difference between the two countries for the same period. In Kenya during the first five years PWT reports growth as low as 2.8 per cent compared to 8.2 per cent in the official Kenyan data. Using national data for Kenya and Tanzania, and comparing it with scholarship applying PWT data on Botswana, one would find that Kenya outperformed Botswana in the early years and that Tanzania grew slightly slower. A comparison of Zambia and Kenya alone, using official data in Zambia and PWT in Kenya, would have Zambia growing quicker. Academic scholarship often relies on different data in different studies, so there is room for miscommunication given the many different permutations in the ranking of these four countries in the period immediately following independence.

Zambia performed comparatively well at 3.4 per cent average growth in the period 1971–1975 according to PWT, keeping pace with Tanzania's 3.8 per cent according to the same source. The relative performance of countries differs dramatically in the early 1970s if you compare using different sources for each country. For instance, it might come as a surprise to some that Zambia was not lagging significantly behind Kenya, which in the same period was growing at 4.2 per cent according to Maddison (2003) (but averaging 10% growth according to WDI and 11% for PWT). Comparing Tanzania using national data to Kenya according to Maddison's (2003) series, Tanzania outperforms Kenya during this period. It is usually noted in the literature that it was Tanzania's inability to reform quickly enough after the external shocks of the late 1970s that led to its dismal performance in the early 1980s, as compared to Kenya that handled the adjustment fairly well. On this important historical period, PWT takes the opposite view: reporting growth in Tanzania at 4.2 per cent through 1981–1985 compared to 2.2 per cent in Kenya.

The case studies in Ndulu et al. (2008b) divide the four different countries according to periods of economic performance. For Botswana, Maipose and

Matsheka (2008: 512–513) suggest three periods: 1960 to 1975 for 'initial base-creating' followed by 1975 to 1989 referred to as 'consolidation' and the third period, characterised as a move towards private sector-led development, from 1990 to the present. In Kenya four growth episodes are identified: rapid growth 1960–1974, poor performance 1975–1984, a slight recovery 1985–1989 and a slow-down in growth in the 1990s (Mwega and Ndung'u, 2008: 327). Tanzania is treated by Mwase and Ndulu (2008) under the heading of four decades of episodic growth. There is an element of confusion regarding the identification of the relative periods of growth and performance. At times, the early growth period is referred to as covering 1961–1967 and at other times 1960–1970. The 'strong control regime' lasted from 1970 to 1985 when speaking of growth, but started in 1967 when describing policy change. A move towards a market-based economy in 1985, then a period of weakened commitment to reform followed from 1990, before commitment to reforms again strengthened from 1995 onwards. Mwanawina and Mulungushi (2008: 275) propose that Zambia was characterised by a free-market economy between 1960 and 1968, economic nationalisation in 1969 to 1990 and then the familiar u-turn to market-led development in 1991 and onwards. In a similar fashion episodes of growth and policy are identified in other African countries in order to establish a causal link between the different syndromes (state controls, adverse redistribution, inter-temporal unsustainable spending, state breakdown and syndrome free) and GDP growth rates. The robustness of these causal links can seriously be drawn in doubt when one considers the data inconsistencies reported above.

The PWT data for Tanzania have large statistical errors for the late 1980s. These could easily be misinterpreted. Durlauf et al. (2005: 574) argued that a typical phenomenon among low income countries is negative output shocks; being unaware of the statistical error, Tanzania (1987–1990) is included the 'top 10 list' of output shocks in that paper based on the PWT data (national and Maddison estimates are much higher for that period). A recent paper which used PPP growth rates from the World Bank found that high volatility was a defining characteristic of African economies (Arbache and Page, 2007: 9). Table 9 shows the standard deviation in annual growth rates for each data source and there is considerable variation. One should be careful about drawing any conclusions on any systematic bias deriving from four case studies, but it is quite clear that PWT and WDI seem to have a higher volatility than Maddison and the official data for Kenya and Tanzania. This might suggest that volatility, as suggested in the Tanzania example above, is in part explained by statistical errors.

Arbache and Page (2007: 21) study growth over 15-year periods in order 'to get rid of short-run noises'. This will certainly help; the tables above show that the 'error

Table 10. Growth volatility: standard deviation of annual growth rates 1965–1995

	WDI	Official	PWT	Maddison
Botswana	6	7.6	7.5	7.2
Kenya	5.4	2.9	6.6	3
Tanzania		3	9	2
Zambia	4.3	4.5	4.3	5

range' does decrease as the periods of comparison get longer. In their aggregate study they order countries if they are below or above the median per capita growth (0.71 per cent per annum). The findings here using total GDP growth rates show that over the periods 1966–1975 and 1976–1995 the error ranges in percentage points are between 4.4 and 0.7. This indicates that while there are clearly some countries that performed better than others, a number of countries could probably switch from above to below median performance depending on which dataset is used. In a related paper, Arbache and Page (2008) study growth accelerations or decelerations based on four-year moving averages. This type of analysis would be very vulnerable to data problems as the five-year averages reported above show; in particular, what they define as 'turning points' might for some countries be due to the inclusion of an informal sector survey in the 1990s.

The discrepancies between data on the same variable from different sources confound inferences on comparative growth performance, and the problem is likely to be greater when relatively short periods are compared. This has a general implication for studies comparing growth performance before and after structural adjustment, as illustrated above when studies identify 'policy periods' for comparison. The problems are likely to be most severe for the poorest and most unstable countries, but an important question remains regarding the direction of measurement bias: 'Is this dismal performance just an artefact of the data? I think that, on the contrary, the genuine problems that afflict gathering of economic data in the poorest countries are likely overall to have caused an underestimate of their decline. For the countries that have really fallen apart there are no usable data' (Collier, 2007: 9).

A careful reading of descriptions of data collection methods and an examination of the growth evidence presented in this paper would suggest a different interpretation. Data collected by state agencies in the late 1970s and early 1980s, reflecting the declining performance and capacity of parastatals, captured a falling proportion of agricultural output, largely because less of the crop output was marketed through official channels. This resulted in a growing underestimation of GDP because there was inadequate allowance for subsistence production and consumption and/or unrecorded trade and transport, in African countries where these were a major share of economic activity. The change in economic structure with liberalisation temporarily worsened the accounting and record-keeping problem as comprehensive data were no longer available from state agencies. It was not until new GDP series were constructed in the 1990s that new allowances for informal trading based on informal market surveys were introduced. For example, in the case of Tanzania the series connecting the 1980s with the 1990s are not continuous, and incorporating informal sector estimates in the 1990s gives a sudden upward growth effect. Thus decline in the 1980s is likely to have been overestimated, and the (post structural adjustment) growth in 1990 may be similarly overestimated. In studying economic growth throughout this period it is indeed problematic that no source of growth data can be accepted at face value as being inherently accurate. The structural changes in the economy and the subsequent changes in the definition and method of measuring GDP were so radical that the series should be regarded as disconnected.

Regarding Tanzania it is noted is that in the PWT series '1988 is treated as a missing observation because the series shows an erroneous massive downward

adjustment in that year' (Ndulu et al., 2008a: 7). The resulting evidence is misleading. The high growth observation (+20% in 1987) was kept, while the misleading low growth (–33% in 1988) was treated as void. In the original series the growth between 1985 and 1995 was measured as averaging almost 2 per cent, but by treating the year 1988 as void the average is 5.4 per cent, thus the resulting data create a fictional rapid post structural adjustment growth recovery.

In Zambia the estimate of total GDP was similarly revised in 1994. According to the new estimates GDP was 13 per cent higher as informal sector activity was incorporated. The Central Statistical Office gave the following warning 'We wish to caution that including the informal sector activity in the Zambia National Accounts may tend to exaggerate the GDP of the nation, relative to other countries or even the previous estimates which mostly excluded it. It must also be recognised that it will be difficult to up-date the sector relation based on indicators in the absence of surveys to monitor the activity in the future' (Republic of Zambia, Central Statistical Office, 1994: 9). Thus while the definition of GDP has increased resulting in a short term adjustment of incomes and bias in growth rate time series, the long term effect is a downward bias. The statistical offices will not be able to recalibrate the estimates of the informal sector annually (estimated at 48% in Zambia in 1994) and will have to rely on rough growth estimates like assuming growth to be proportional to population growth.

An important theme is the concerns voiced in the national accounting method descriptions regarding the difficulty of estimating the size of the informal and subsistence sectors in these economies. The national statistical agencies only get reliable annual information on certain operations. Large-scale manufacturing, state-owned enterprises, large-scale commercial farming, exports and imports and the state's own activities are reasonably well recorded. There are weaknesses related to these data deriving mainly from underreporting to avoid taxation, but there is at least basic statistical data informing the statistical agencies. The remainder of the economy is estimated on various bases. The Zambian Central Statistical Office had two levels of denoting when an estimate is questionable: one asterix denotes 'guesstimate' and two denotes 'guesstimate on a weak basis' (Consolidated National Accounts 1973–1978: Appendix 1). These estimation issues can however be dealt with in more sophisticated analysis.

Based on the reading of national accounting methods in Botswana, Kenya, Tanzania and Zambia (see the Online Appendix for a full list of the documents consulted) some distinct methods of making guesses can be identified. The main differentiation is whether the baseline estimate is grounded in basic data or not. In some cases a sector of the economy is known to consist of one large operator and many small ones and a qualified guess can be made as to how much of the sector is dominated by the large operators for which basic statistical data are available. The statistical office can then assume that the data represent say 60 per cent of the activity in the sector, gross the sector up accordingly, and assume that the rest of the sector grows proportionally. Similar assumptions are made regularly where the sectors are covered by an annual industrial census to adjust for underreporting and non-responding. Here the reported activity would be adjusted upwards on an annual basis assuming proportionality. These methods are not optimal because it is in fact based on guessing, though the guesses might be more or less educated or informed

and thus satisfactory. The assumption of proportional growth does preclude any intra-sector structural shifts. A reduction in activity among the large operators in a sector might very well be a result of increased competition from the smaller operators. This would in particular apply to manufacturing, construction, retail trade, transport and other services, and is particularly relevant when one is interested in the relative importance of formal and informal actors in these sectors.

In other cases the national accountants rely on only sporadic censuses for whole sectors or only one baseline estimate. In these cases the means available to the accountants are projections. If there are two points of observations over time, growth will be assumed to have been smooth through these two points, and it will further be assumed that this growth will continue in similar fashion beyond the last observation point. This is the typical method used for estimating population where one usually relies on one census every decade. The main objection to this method is that there is no way of detecting the point of acceleration or deceleration in growth. One further runs the considerable risk of reporting statistical growth. This problem is accentuated by the fact that one census will differ in quality, reliability and coverage from another. Retrospectively there is little chance of determining to what extent the growth is the result of increased statistical efficiency or whether the change relates to the economy itself. The statistical agency is then left with making a guess as to whether the detected growth between the two observations is reasonable, or whether it is a result of a relative under- or over-estimation at one of the points. The statistical office can accept a break in the time series, or extrapolate backwards to change the initial baseline estimate, or simply smooth the growth between the two points of observation. Figure 5 illustrates the different choices available to the national accountants.

Here the value of a sector of the economy was measured or assumed to be 100 in year 1. The sector was assumed to have been growing at 3 per cent per annum. In year 10 a census was undertaken and the sector measured to be 150. 'Measured' represents how the growth pattern would appear if no action to correct backwards
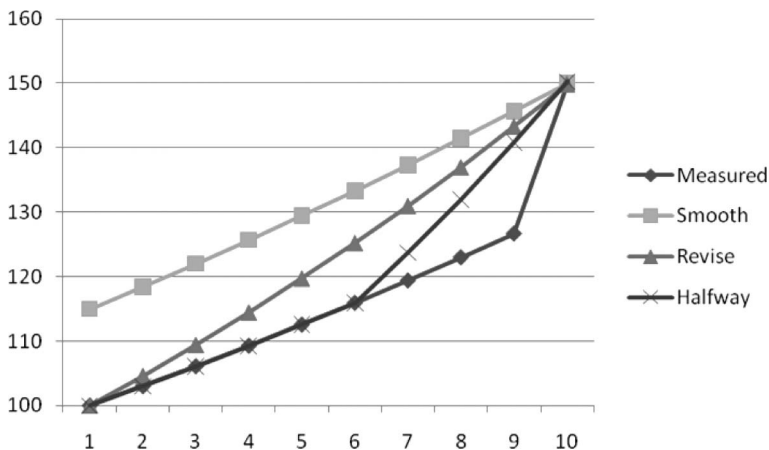

Figure 5. Stylised estimation techniques.

would be taken. 'Revise' is the option taken if the statistical agency chooses to believe that the year 1 baseline estimate was wrong, and that their three per cent growth assumption was correct. 'Smooth' is the choice of changing the annual growth measure when faced with the new year 10 estimate. All these choices have been used at various points in national accounting in the countries studied. The data a scholar uses for evidence for analysis depends on the statistical choice of the accountants, and the evidence obtained in year 9 will be different from the evidence obtainable after year 10. The 'halfway' measure is often opted for, as the agencies are hesitant to revise the series a long way back. This measure was particularly often used in Botswana and Kenya, while in Zambia and Tanzania the offices were willing to accept a break in the series, or wait to include the data when a new constant price series was compiled. The inclusion of new basic data or new estimates, whether they are from 'subsistence', 'informal' or from any other previous 'unrecorded' economic activity does result in random growth effects if a break in the series is not accepted. The case is most radically illustrated in Tanzania and Zambia in the 1990s.

The example of estimation methodology above illustrates the case of a statistical agency having to harmonise two conflicting pieces of evidence. There are also many cases where no such conflict arises as there is no basic statistical evidence at all. This can relate to whole sectors of the economy. Typically this concerns what is called the 'subsistence economy', but it is also done with regard to other sectors or the small-scale operations within a sector. For these sectors a baseline estimate or guess are complemented by assumptions of growth. Food production, water collection, rural construction and real estate growth are assumed to take a certain value per rural household, and then assumed to grow in accordance with rural population growth. Rural population growth was in all African countries slower than total population growth, and so by definition the rural 'subsistence' sector grew slower than the total population. This represents an in-built bias towards a decreasing GDP per capita. This can be quite serious in countries where this sector is particularly large, as in Tanzania. One of the most important conclusions of World Bank (1981: 3) research on the continent was that food production failed to keep up with population growth. While this conclusion might be plausible, it must be true by definition because the evidence is conditioned in that way.

The concurrence of introduction of new base years for the series, changes in the methodology and the inclusion of new benchmark data at the national statistical agency explain some of the extent of documented inaccuracies in growth reporting. The differences in the reported annual growth rates derive from extrapolations across missing years, and smoothing of data across changes in base years. There is an underlying contradiction between what the providers of national account statistics in the national agencies are aiming at, and the purpose of the growth time series of the international agencies. While the national agency strives each year to give the best estimate of economic change in that year in order to inform current policy makers, the users of international databases are interested in the comparison of economic change over time and space. When the time series disseminated by different international databases are constructed using different national account files and different price data these random growth effects appear.

IV. Conclusion. Lessons for Quantitative Interpretations of African Development

If one studies the comparative effect of the external economic shocks of the late 1970s on African economies, what should one do if one source reports 0.4 per cent growth from 1981–1985 and another reports 4.2 per cent for the same country? And what if, for the same period for another country one source reports a 2.2 per cent growth rate and another source 4.2? Did the first country experience rapid economic decline or did it cope fairly well? Did it perform better than the other country? These are precisely the questions one faces if one compares growth in Tanzania and Kenya between 1981 and 1985. Based on the available growth data it is not clear what the relative economic performances of African economies has been.

The study of accuracy in growth reporting for these countries shows that trusting any source at face value is unwise. In terms of a growth rate of any give year the data can indeed be described as random. It is very unlikely that the state of affairs is much better for most other African countries. It is evident that the variation across the sources of data, which are all in wide use, means that cross-country comparison cannot be conclusive based on growth rates alone. There is scope for wider work on this issue, covering more African economies. To improve the conduct of quantitative economic history in Africa it is critical to be open about which sources have informed the respective works, and it is advisable to double check with other sources for coherence.

Most of the accounting in the countries studied has been done according to convention, and therefore to consider the data 'random' would be wrong. While there are some methodological shortcomings, the foremost limitation of the estimates is the quality and availability of basic statistical data. This means the estimates could not easily be subject to a quick fix to make the estimates better. Such improvements would necessitate better basic statistical data, and it is clear that the national agencies have made the most of the data available. A major shortcoming is that the statistical methods, conditioned by the available data, are not fully standardised across the countries.

In general the Penn World Tables seem to be more often out of line compared to the other sources; this may in part be caused by the PPP adjustment which has some well established growth effects. The errors do seem to appear larger when there is gap in the official series, which indicates that there have been (apparent) growth effects when the different constant official series have been harmonised to one constant price series. Both WDI and PWT contain mistakes when there is a change of a base year in the official data. These two sources are evidently based on the official data series, but are not always successfully harmonised over time. In the evidence on Botswana and Kenya there is observed a trend towards better agreement as one get closer to the present. In the case of Zambia and Tanzania the onset of structural adjustment was far more disruptive both to economic structure and public administration resulting in confusion about which sources to use in compiling economic growth statistics.

The underlying evidence for all these sources is the national accounts data series. The sources differ in annual growth rates because of different methods of harmonising official series over different base years and different treatment of gaps in the series. The natural starting point to answer whether the growth evidence reflects actual economic change in these economies is to examine the national accounting methodologies.

The findings here imply that the definition of GDP changes significantly with the introduction of new base years, and that therefore the efforts of PWT and WDI to generate a harmonious series have been less than successful, and the resulting errors have already been subject to scholarly misunderstanding. While earlier research has hinted at the potential problems of the low quality of the African growth evidence this paper has factually established the extent of the problem. The implication is that a study of economic growth in Africa cannot rely on growth data alone without a serious study of the statistical methods used to assemble the growth time series for African economies.

Monographs on economic growth and development published in the 1970s and 1980s typically made use of national account statistics and other officially published data from statistical abstracts. With the appearance of the international databases, evidence has become readily downloadable, and very few researchers consult the actual publications of the statistical offices. Database data are frequently treated as primary evidence, but they are not. The main problem is the inability to directly check the source and the method used to obtain the data. Srinivasan (1992: 24–25) requested better documentation in the international databases in the interest of 'truth in data retailing' with a specific reference to the World Development Indicators and Penn World Tables. This call has not been heard, but perhaps it is also fair to call upon scholars to be more cautious data consumers. The last empirical work on the quality of African data was done by Blades (1980). One of the resulting reports was justified on the grounds that 'it is not possible to make intelligent use of the published statistics without knowing the estimation procedures used and the assumptions on which they are based' (Blades, 1975: 8). It follows literally that since such care has not been taken, most academic work on economic growth in Africa has been unintelligent. That would perhaps be to draw the implication too far. It might suffice to conclude that the subsequent research has not been properly informed.

Acknowledgements

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