AN AFRICAN GROWTH MIRACLE? OR: WHAT DO ASSET INDICES TELL US ABOUT TRENDS IN ECONOMIC PERFORMANCE?

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Abstract

Using changes in the possession of household assets over the past 20 years, several recent papers have argued that economic performance in Africa was better than suggested by national income data and income poverty statistics. We scrutinize these claims and first argue that trends in assets are only biased proxies for trends in incomes. In particular we show that the relationship between growth in assets and growth in incomes is extremely weak; instead, we find evidence of asset drift using macro and micro data which is consistent with the claims we make about possible biases in the use of asset indices. As a result, we find no evidence supporting the claim of an African growth miracle.

Key Words: Asset index, GDP growth
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1 Introduction

Until recently, the conventional wisdom on poverty and growth in Sub-Saharan Africa was that until about 2000, per capita economic growth in Sub Saharan Africa had been flat on average, and negative in some countries, while only a few countries posted positive per capita growth rates. As a result, absolute income poverty rates stagnated at very high levels (e.g. Chen and Ravallion, 2010) between 1980 and the early 2000s, ensuring that Sub Saharan Africa (SSA) has been by far the poorest continent, in per capita terms, since the 1990s. In recent years, things have changed somewhat for the better as growth rates in SSA have averaged around 5% since the early 2000s, leading (with population growth still above 2% per year), for the first time, to sustained per capita growth in the region. This improvement has been a result of a favorable external environment (improved terms of trade, debt relief and enhanced aid flows) as well as better macroeconomic management (e.g. IMF, 2010). As a result, there has also been a small reduction in poverty rates (Chen and Ravallion, 2010), but the level and pace of poverty reduction has remained disappointing, also due to the fact that higher growth appears to have been associated with rising inequality in many contexts. Despite these recent improvements, the general impression from available income and income poverty statistics is that SSA, on average, experienced decades of stagnation and regress between the mid 1970s and the early 2000s, from which it has only partly recovered since then.

Three recent papers challenge this conventional wisdom of generally low growth and poverty reduction in Africa. Xavier Sala-i-Martin and Maxim Pinkovskiy (2010) and Alwyn Young (2010) both find that economic growth in Africa has been remarkably high and led to significant reductions in poverty; similarly, in an earlier set of papers, Sahn and Stiefel (2001, 2003) also found that poverty reduction and growth has been much faster than suggested using GDP and income poverty statistics. Interestingly, the three papers differ widely in their approaches but lead to similar conclusions.

Sala-i-Martin and Pinkovskiy (2010) focus on available income statistics and focus on income growth and income poverty in their analysis, but come to conclusions that are much more favorable than presented above. They estimate income distributions from aggregate statistics, e.g. GDP per capita and the GINI coefficient. They find that most African countries started a growth spurt already around 1995, which led to a tremendous decline in absolute income

poverty. On average, both according to the $1 and $2 definition, poverty rates fell by around 10 percentage points between 1995 and 2006. The reduction of poverty happened broadly across all African countries and cannot be explained by the performance of a small subset of large countries or geographic and historical characteristics. While these results are interesting, the numbers of Sala-i-Martin and Pinkovskiy should be interpreted with great caution for two reasons: First, the method does not allow attaching any level of significance to the estimates and are highly dependent on the rather crude and often inconsistent data we have available on income distribution (e.g. Gruen and Klasen, 2008). Second, the approach taken only uses income distribution information but not mean incomes from the household surveys, which is taken from the national accounts instead. As there is a large, and in many cases, widening discrepancy between survey means and per capita incomes, this procedure delivers the much larger rate of absolute poverty reduction compared to the 'official' World Bank figures (e.g. Ravallion and Chen, 2010) which rely entirely on survey data to estimate income poverty (and thus also use the survey means). There is a large debate on this discrepancy as well as reliability of using per capita incomes as proxies for survey means, also in the context of other regions (e.g. Milanovic, 2005, Bhalla, 2004; Deaton and Kozel, 2005). While there are arguments for using per capita incomes as well as survey means, most of the studies suggest that particularly for the use of income poverty, using survey means might be more appropriate as most underestimation of incomes or expenditures in households is likely to be more concentrated among upper income groups. If that is the case, the survey incomes are likely to be appropriate for the assessment of income poverty; consequently, the pace of poverty reduction detected by Sala-i-Martin and Pinkovskiy might be substantially overestimated. This debate covers now rather familiar ground and is hotly debated in the literature, and we will not contribute further to this in this paper.

Sahn and Stiefel (2001, 2003) and Young (2010) are methodologically more similar, and take a rather distinct approach to the question from the conventional literature that uses income statistics from national accounts and household surveys. Instead, they used asset indices from Demographic and Health Surveys as proxies for welfare. Using this, Sahen and Stiefler (2001, 2003) find that they point to much larger improvements than suggested from income poverty statistics. When expressing poverty in terms of asset ownership, poverty is also seen to have declined substantially, already in the 1990s and much before the recently observed growth spurt in Africa. Young (2010) uses the same data source but a rather more complicated procedure to

estimate (per capita) economic growth in Africa (see below). Also using the Demographic and Health Surveys (DHS) to estimate household consumption consisting of (1) durable goods, (2) housing conditions, (3) children's nutrition and health, and (4) household time and family economics, he finds that household consumption (a proxy for per capita consumption) in Sub-Saharan Africa has been growing at an average annual rate between 3.2 and 3.8 percent since 1990. This is three and a half to four times higher than the figures that are reported in international income statistics (e.g. the Penn World Tables) or the national accounts from individual countries. The results are, according to Young (2010) not driven by any of the product groups, for each of the product groups the growth rate in the DHS data is at least twice as high as the growth rate in the international macroeconomic statistics. As a result, Young suggests that the income statistics from SSA are deeply flawed and strongly underestimate income growth there. Using his approach, he can detect an "African growth miracle" from 1990-2004 with growth in real consumption using his asset index approach not inferior to his non-Africa sample[4].

Using asset indices to proxy for levels and trends household consumption might, however, be subject to four biases. First, preferences for certain assets might rise over time as assets become more prevalent and part of "normal" living conditions. This might particularly relate to assets such as media and telecommunications (e.g. TVs and telephone, including mobile phones). Second, relative prices can lead to a demand shift favoring some assets at the expense of other household expenditures. Again mobile phones are probably the best example of an asset whose relative price has declined dramatically over recent years. Third, the DHS surveys do not record age and depreciation of assets and thus might overestimate the value of assets as they are accumulated over time. Lastly, the provision of some assets (such as access to piped water and electricity) are in many poor countries a result of specific government policies to extend these services (often at highly subsidized rates). Thus while the possession of these assets might indeed be welfare enhancing and should be reflected in broader (multidimensional) measure of well-being, it does not imply that an income-based measure of prosperity has also improved.[5]

In this paper, we use information from DHS surveys of African and non-African countries from about 1990 to 2010 to assess the relevance of these criticisms in light of the findings by

[4] His non-African sample includes countries from Latin America, East, South, and Central Asia including some of the fast-growing Asian economies (but excluding China, Korea, Malaysia, Thailand).

[5] The new multidimensional poverty measure developed by OPHI and used by UNDP, for example, reflects water, sanitation and education access (UNDP, 2010).

Young and Sahn and Stiefel. In particular, we will investigate to what extent the correlation between asset and income growth has indeed been different in Africa than elsewhere, as argued by Young. Moreover, we will use micro income surveys from African and non-African countries to determine to what extent there has been asset drift at particular real income levels which might be related to the four concerns raised above.

We find that indeed there has been considerable growth in asset ownership in African households, not dissimilar to the growth observed in households elsewhere. But we first note that inter-temporal data on asset holdings in Africa is only available for a non-random sample of countries which have, according to GDP and GNI statistics, performed above average in the period under consideration. At the same time, we find that the relationship between asset growth and per capita income growth is very weak in African and non-African countries (where the concerns about national accounts data might be less serious). More seriously, we find evidence of 'asset drift', i.e. that assets accumulate at the household level even in the absence of income growth, suggesting that several of the biases discussed above might indeed be empirically relevant. As a result, we suggest that it is not reliable to estimate income growth using asset indices and have therefore no reason to suspect that the 'traditional' view of per capita growth and poverty reduction in SSA (pointing to stagnation and regress until early 2000s, followed by some income growth and moderate poverty reduction thereafter) is incorrect.

The paper is organized as follows. The next section briefly reviews the methodology by Young (2010) before it describes the construction of asset indices, while section 3 presents our empirical analysis and section 4 concludes.

2 Methodology

2.1. Young's Approach

We will briefly discuss Young's methodology here to point out the key drivers of his results. The methods by Sahn and Stiefel are very closely related to what we do below so that they do not need to be separately discussed. Young first shows that, under certain assumptions about the income elasticity of demand, the ratio of the growth rate of a certain asset, normalized by the standard deviation across countries of asset ownership should provide a proxy for the growth rate of real income in a country, divided by the cross-country standard deviation. Using this relationship, he then finds that growth (normalized by the standard deviation) in assets in African

countries has been as high or higher in African countries as countries outside of Africa for a broad range of assets ranging from household durables to indicators of children's health, housing indicators, or enrolment, employment, marriage, or birth indicators. And this rate has been more than twice as high as per capita growth rates from the national accounts. The discrepancy is much lower in non-African countries. In a second step, using educational achievements as a proxy for income and calculating the relationship between assets and education, he then estimates that the source of the discrepancy is largely related to higher growth in income (proxied by assets) than a smaller cross-sectional variation. Thus his conclusion that consumption growth (as proxied by asset growth) has been much larger than per capita income data suggest, leading to his finding of the African growth miracle.

It is beyond the scope of this paper to review and comment on this paper in detail. While many aspects of the paper are extremely carefully derived and executed, clearly some questions arise. First, the paper assumes a constant income elasticity of demand for the assets used. As discussed above, this might be problematic as this elasticity might particularly change over time and be affected by the 'asset drift' arguments we raise above. There are also questions to what extent educational attainment can be used as a way to link assets with incomes, given that much education depends on public policy, educational quality is highly uneven, and there are questions about whether the expansion of education in Africa has actually had much affect on lifting income growth rates. In this sense, the critique by Pritchett (2001) about the lack of an impact of educational expansion on income growth might apply. Lastly, it is not clear whether using educational attainment is well-suited to assist in the calculation of the standard deviation of incomes given the bounded nature of the indicator. But ultimately the paper's results are critically affected by the trends in asset ownership in Africa (compared to elsewhere) and this is what we will focus on in the analysis below.

2.2 Constructing an Asset Index

We follow the approach of Filmer and Pritchett (2001) and Sahn and Stifel (2003) to construct an asset index. The main idea of this approach is to construct an aggregated one-dimensional index over the range of different dichotomous variables of household assets capturing housing durables and information on the housing quality that indicate the material status (welfare) of the household:

$$A_i = b_1 a_{i1} + b_2 a_{i2} + \ldots + b_k a_{ik} \quad (1)$$

$$a_{ik} = \beta_k c_i + u_{ik} \quad (2)$$

for i =1, ..., N households and k =1, ...K household assets. A_i is the asset index, the a_{ik} refer to the respective asset of the household *i* recorded as dichotomous variables in the DHS data sets, and the b_k are the weights for each asset that are used to aggregate the indicators to an one-dimensional index. In the model, the ownership of an asset *k* of household *i*, identified by a_{ik}, is a linear function of an unobserved factor, which in our case is material welfare c_i. The relationship between the asset *k* in c_i is given by β_k plus a noise component u_{ik}, where both terms have to be estimated (Sahn and Stifel 2000).[6]

For the estimation of the weights and for the aggregation of the index, we use a principal component analysis as proposed by Filmer and Pritchett (2001). The first principal component is our asset index.[7] Principal component analysis is a technique to identify those linear combinations from a set of variables that best capture the common information behind the variables. This means that we assume that household assets and housing characteristics explain the long-term wealth of a household measured by the maximum variance in the asset variables.

The principal component analysis is structured by a set of equation where the asset variable is related to a set of latent factors:

$$\begin{aligned} \tilde{a}_{1i} &= v_{11}A_{1i} + v_{12}A_{2i} + \cdots + v_{1k}A_{ki} \\ &\ldots \\ \tilde{a}_{ki} &= v_{k1}A_{1i} + v_{k2}A_{2i} + \cdots + v_{kk}A_{ki} \end{aligned} \quad (3)$$

where the $\tilde{a}$ are the k asset indicators (the *a*'s in equation 1) normalized by their mean and their standard deviations; *A* are the *k* principal components and *v* are the weights that relate the principal components to the ownership of the asset (Filmer and Scott, 2008). After the weights *v* have been estimated, the inversion of the equation system (3) yields the following set of equations:

[6] The model is based on the following assumptions: (i): households are distributed *iid*; (ii): $E(u_i|c_i)$=0; (iii): $V(u_i) = Diag\{\sigma_1^2, \ldots, \sigma_K^2\}$.

[7] An alternative way to estimate the weights for the assets to derive the aggregated index is a factor analysis employed, for example, by Sahn and Stifel (2001). However, the two estimation methods show very similar results.

$$
\begin{aligned}
A_{1i} &= b_{11}\tilde{a}_{1i} + b_{21}\tilde{a}_{2i} + \cdots + b_{k1}\tilde{a}_{ki} \\
&\cdots \\
A_{ki} &= b_{1k}\tilde{a}_{1i} + b_{2k}\tilde{a}_{2i} + \cdots + b_{kk}\tilde{a}_{ki}
\end{aligned} \tag{4}
$$

The equation for the first principal component is the equation with the highest variance. The weights that are used to aggregate the asset variables into a one-dimensional index are given by the set $(b_{11}, b_{21}, \ldots, b_{k1})$. The asset index is calculated for each individual, weighted by the household size.

3 Empirical Analysis

3.1 Data

To illustrate our approach we use Demographic and Health Survey (DHS) data for 160 DHS surveys from 33 African and 34 non-African countries (see Appendix Table 1). For 42 countries we have more than one observation allowing us to calculate changes in asset indices which will then be used in the analysis further below. The DHS are undertaken by *Macro International Inc., Calverton, Maryland* (usually in cooperation with local authorities and funded by USAID) and started in 1984. They provide detailed information on child mortality, health, fertility, as well as household assets (household incomes or expenditures are not included). To date, DHS data is available for 84 developing countries for several years – resulting in more than 240 large scale household surveys. The data are self-weighted national survey of women aged between 15 and 49. The average sample size is about 5,000 to 6,000 women, some are surveys are even larger than that.

The DHS include a household member module and an individual recode for women of reproductive age. The household member recode lists all member of the household. At the household level, the DHS provide information on basic demographics, education and on the possession of household assets. Although the DHS are not completely standardized across time and countries, the design and coding of variables (especially on assets and dwelling characteristics) are generally comparable.

We use the following variables to construct an asset index: radio, TV, refrigerator, bike, motorized transport, capturing household durables and type of floor material, type of wall

material, type of toilet, and type drinking water capturing the housing quality and we calculate the asset indices separately for each country and period. Table 1 shows means of asset possession across the surveys and also presents the scoring factors (weights) to be used for the construction of asset indices. We use three approaches to generating the asset indices. One uses the total sample to generate weights. When using this approach, we can compare an individual country's performance in terms of levels and trends in assets with respect to this international and inter-temporal standard. One might worry, however, that such an approach glosses over changes in the importance of certain assets as proxies for income over time. For example, owning a radio might be more closely correlated with household wealth in the early parts of the survey than in the later ones where, arguably, a radio has lost importance as medium of access to mass media (while the role of a TV might conversely has increased). We therefore also generate weights just using the first observations from the early 1990s, and weights using the last observations, usually around 2002-2005. As can be seen in Table 1, the impact of these three procedures on the scoring factors (weights) is quite small. While it is true that the relevance of radios, sanitation, and piped water as signs of household wealth have declined and the importance of owning mobile phones and cars has increased, the differences in scoring factors are not very large and, as we find below, do not greatly affect our results. In Table A.1 of the appendix we report descriptive statistics for every country-year observation including the average value for each component of the asset index and GDP per capita.

We use DHS data to construct an asset index at the household level. The DHS data are available for more than 40 countries within at last two and up to four waves per country between 1990 and 2010. Further, we use data on real GDP per capita (chain index) from the Penn World Tables 7.0.

In a second step, we approach the question of asset drift using micro data. The main motivation for doing this is to avoid the use of possibly problematic national accounts data. We therefore want to ask how the relationship between asset holding and real incomes looks like at the micro level, where we have arguably more confidence in the reliability of the income data used. Using data for Zambia and Indonesia as examples (to be augmented by more examples in the future versions of the paper), we therefore ask whether possession of assets is increasing over time at different parts of the income distribution, holding real incomes constant. For example, if we keep the income level of the 25^{th} percentile of households in Zambia in 1996 fixed in real

terms, we ask whether households with that same real income in 2006 hold the same, fewer, or more assets. If they hold more assets, this would be evidence of asset drift, possibly related to the four issues discussed above.

3.2 Results

In Table 2 we compare the growth rate of the asset index and the growth rate of GDP per capita. The DHS surveys are roughly available every five years, and the survey years differ by country. We thus calculate the average annual growth rate of the asset index and its components between two survey years. We do the same for GDP per capita. Here we take GDP per capita PPP chain series from the Penn World Tables 7.0 that corresponds to the respective DHS survey years. We have growth rates of the asset index and of GDP per capita for 42 county-year observations, 25 of which are for African countries.

The average annual growth rate of the asset index is 1.6 percent, while the average annual growth rate of GDP per capita is about 3.5 percent. It turns out that it does not make a difference whether the weights for the asset index are based on the first survey, the last survey or the full sample. In all cases, the average annual growth rate of the asset index is around 1.6 percent. Both for the asset index and for GDP per capita, African countries have higher growth rates than non-African countries for the sample period. The growth rate of the asset index was about 1.8 percent in African countries while it was 1.3 percent in non-African countries. The growth rate of GDP per capita was 3.7 percent for African countries and 3.1 percent for non-African countries in the sample period.

As some of these figures might appear rather surprising, a few explanations are required. First, the reported income growth rates in Sub-Saharan Africa seem to confirm the claim of high economic growth (with possibly associated large poverty reduction) there since the early 1990s. But caution is required as this is substantially influenced by the sample of countries for which more than one DHS is available. To show this, the figures below show regional average of GDP per capita growth and GNI per capita growth (both in constant PPP terms) for the period 1994 to 2006 which roughly corresponds to the years of survey coverage. Using these indicators, regional per capita growth was only 1.7% or 2.2%, respectively.[8] This comes closer to the

[8] This is using the most favorable time period. Starting earlier would lead to even smaller reported GDP growth rates.

impression we have on income growth in Africa, which was low up until the late 90s and has picked up since then. The important message from this is that the DHS, which also form the core of the analysis in the papers by Young and Sahn and Stiefel, present a selected sample of more successful African economies. This is not too surprising as countries that are in serious economic troubles, or even face civil conflict, are unlikely to be able to field a DHS.[9]

Conversely, one may wonder why real GDP growth in the non-African sample is 'only' 3% per year. Again, sample selection issues play a role. For one, China is excluded. Moreover, many of the fast-growing Asian economies (including Malaysia, Thailand, Korea) are also not included. Lastly, these are all unweighted averages.

Second, one may also be surprised that the growth rate of the asset index in the countries in our sample (whether African or not) is actually lower than the average GDP per capita growth rate. This is largely due to the way we generate the asset index where all assets are standardized to have a mean of 0 and a standard deviation of 1. This procedure has the advantage of making the assets more comparable with each other, but particularly reduces the impact of fast-growing assets where the standard deviation is rather large. To see the heterogeneity of individual asset growth, appendix table 1 shows that some assets, particularly ownership of TV, car, phones (including mobile phones), motorbikes are very fast in many countries. The standardization procedure should not affect the correlation analysis that we perform below, however.[10]

Next, we look at the correlations between the growth rate of GDP per capita and the growth rate of the asset index. In Table 3 we report regression results with the average annual growth rate of the asset index as dependent variable. The independent variables include the annual growth rate of GDP per capita, an African dummy, the interaction of the Africa dummy and the growth rate of GDP per capita as well as the level of the asset index.[11] The first regression only includes the growth rate of GDP per capita and a constant. The constant is significantly different from zero while the coefficient of GDP per capita is not. This means that the growth rates of the asset index and of GDP per capita are practically uncorrelated. Thus, the

[9] Of course, one may wonder about the reliability of the GDP figures from these countries as well.

[10] In a robustness check, to be completed for the next version of this paper, we will also examine how asset index growth looks like if we do not use the standardization procedure and/or examine subsets of assets.

[11] Please note that we use the current level of the asset index and not the initial level. While the initial level would be more appropriate for a convergence regression, it has the downside that the time difference between two surveys is not identical across countries and years. Treating initial levels for four-year periods, five-year periods and six-year periods equally would bias the result (more than taking current levels).

growth of the asset index is a bad predictor for the growth of GDP per capita and vice versa. The significant constant term would imply an asset drift, that is a base growth of the asset index even without any growth of GDP per capita. In the second regression we include a dummy for Africa and its interaction with GDP growth. Both terms are insignificant, the constant term is still mildly significant at the ten percent level. This means that also for African countries, asset growth is a bad predictor for GDP growth. Further, if an asset drift exists (represented by a significant constant term) then it is not stronger for African countries than for other countries. In the final two specifications we also include the level of the asset index. Now nothing is significant anymore, suggesting that we are unable to explain the growth of assets in any real way.

In Tables 4 and 5 we report results of similar regressions with the average annual growth rate of the components of the asset index as dependent variables: Radio, TV, phone, electricity, fridge, car, motorbike, bike, floor material, toilet and education. In Table 4 we only include the growth rate of GDP per capita, in Table 5 we also include an Africa dummy and its interaction with GDP growth. Please note that the number of country-year observations is larger than in Table 2, because we only calculate the asset index if all components are available. The most limiting component is the telephone with only 56 country year observations for growth rates. In Table 4 the coefficient of the GDP growth rate is never significant, and all constant terms except for motorbike, floor material and toilet are significant at the one or five percent level. Also in Table 5, the coefficient of the GDP growth rate is insignificant except for radio (which suggests that radios are an inferior good). Neither the Africa dummy nor its interaction with GDP per capita show a significant coefficient. The constant term is significant for TV, phone, electricity, car, motorbike and education. To sum up: There is no evidence for a correlation between the growth rate of GDP per capita and the growth rate of the components of the asset index. And there is some evidence for an asset drift, that is a base growth of assets at zero GDP growth, for most components of the asset index. This is particularly the case for radios, TV, telephones, electricity, refrigerator, cars, motorbikes, bikes, and education, although not always significantly so. Asset growth and GDP growth are also uncorrelated for African countries, and the asset drift is not stronger or weaker in African countries than in other countries.

Figures 1 and 2 visualize the regression results. The figures show scatter plots of the growth rate of the asset index and the growth rate of GDP per capita. The dashed line is the 45

degree line (the hypothetical case of perfect correlation between the two variables). The gray area is a 95 percent confidence band around the linear fit of the asset index growth rate and the GDP per capita growth rate. In Figure 1 we show the results for the full asset index. Again, it does not make any noticeable difference whether the first year weights, the last year weights or the full sample weights are taken to calculate the asset index. Two observations are important: The confidence band could include a flat line. That means that there is no statistically significant correlation between asset growth and GDP growth. The confidence band is greater than zero for rates of GDP growth between zero and about 7.5 percent. Since this interval covers most observations, we interpret this as evidence for an asset drift.

Figure 2 looks very similar, however instead of the full asset index we have the components of the asset index on the vertical axis. The two basic observations are the same as before: All confidence bands could fit a flat line. All confidence bands are greater than zero on some interval, but never smaller than zero. For TV and telephone this observation is particularly apparent, here the confidence band is greater than zero for almost the entire range of GDP growth that has observations. In contrast, the confidence band for radio covers the zero for almost the entire observation period. To sum up: There is no evidence for a correlation between the growth rate of asset index components and GDP growth. There is also evidence for a drift of the components of the asset index. The drift is stronger/more visible for more modern assets.

So far, our analyses were based on aggregate GDP data from the Penn World Tables. We now turn to an analysis at the micro level with countries for which we have asset data and expenditure data. For Zambia we have survey data for 1996, 1998, 2004 and 2006. Assets in the asset index include motorbike, TV, video, radio, fridge, phone, sewing machine, stove, piped water, electricity, flush toilet and education. The asset index is thus quite similar to the asset index in the previous analysis. For Indonesia we have survey data for 1993, 1997, 2000 and 2007. The asset index is somewhat different due to a different level of development, assets include motorized vehicles, appliances, savings, jewelry, electricity, phone, piped water, flush toilet, fridge, number of rooms and floor material. In Tables 6 and 7 we report descriptive statistics for all assets and survey years. A few points are worth noting. In Zambia, an economy that shrank until the early 2000s, after which substantial growth set in, possession of some assets has increased substantially, including phones, videos, TVs and motorbikes. For other assets including education and household access to electricity, water, and flush toilets, the trends are

rather unclear. In Indonesia, an economy that has been growing strongly in the period (with the interruption of 2 years due to the Asian financial crisis), all kinds of assets seem to have grown substantially.

In Tables 8 and 9 we report the development of certain assets for constant levels of household expenditure. To this end we calculate the expenditure level at the 25^{th}, 50^{th} and 75^{th} percentile in the first survey (1993 for Indonesia and 1996 for Zambia). We then look at the assets of households that are close to this level of expenditure in the later surveys. Thus, we keep the expenditure level constant and look at the asset development over time. We will now go through the development of each asset. In Indonesia we observe a rather strong increase of motorized vehicles over time at all three expenditure levels, while it only increases at the highest expenditure level in Zambia. For appliances there is an expenditure gradient in Indonesia, but within each expenditure group the numbers are fairly constant at a high level with only modest increases over time. Different in Zambia, there we see strong increases in TV, video and radio ownership over time. For electricity we observe increases from very low levels in both countries to almost universal coverage in Indonesia and coverage of about two thirds in Zambia. Particular for Zambia there is practically no expenditure gradient for electricity visible. Electricity is a good example for asset development that is rather independent of expenditure development. The same is true for telephones. In the first surveys hardly anyone owned a telephone, while in the last survey in Indonesia and a sizeable fraction in Zambia owned a telephone. Like we already note for electricity, also telephones spread rather independently from expenditure development. For piped water and flush toilets the picture is very different. In Indonesia ownership of both assets increases strongly over time, and again we could conclude that the development of these assets is independent of expenditure development. In Zambia we do not see much improvement over time at a given expenditure level. Here the development of piped water and flush toilet seems to go hand in hand with the overall expenditure development, since we observe a strong expenditure gradient for these two variables. The other assets are only available for one of the two countries and it is thus difficult to compare their development. To summarize, the general picture that emerges from this analysis is the following. First, there are some assets which increase regardless of income levels and trends. This appears to be most clearly the case for phones (including mobile phones). Here preferences and relative prices are surely important factors that affect this development and they seem to operate about as much in countries with low and high

growth. Second, some aspects seem to be highly erratic and quite unconnected to income levels, including access to water and electricity as well as education. Clearly, this is more driven by public policy than by income levels or trends, preferences, or prices. Third, it is not entirely clear whether one can identify any asset in the two countries that would appear to proxy income well and not be affected by the biases mentioned above. Such as asset should have a strong income gradient (i.e. richer households are more likely to own it), and not change much over time for the same level of real incomes. Possible candidates might be the quality of the floor material, or the number of rooms in Indonesia and refrigerators in Zambia. But it is hard to really say this with any certainty at this stage. One should examine this using more surveys from more countries.

4 Discussion and Conclusion

In this paper we have investigated to what extent one can use asset indices and the growth of these indices (or that of individual assets) as proxies for GDP growth. This is of importance as a cross-validation of possibly poor income and income poverty statistics in Africa. It is also of importance as asset growth rates have been used to suggest that Africa has been growing much faster than suggested by income and income poverty statistics. In this still rather preliminary paper, we come to the following most important conclusions: First, the evidence of high asset growth in Africa is partly based on the availability of DHS data from a selected sample of more successful African economies. This selected sample therefore overestimates economic performance in Africa. Second, there is evidence of asset drift, both in Africa as well as elsewhere. This is particularly the case for more 'modern' assets such as TVs, telephones (including mobile phones) and the like. Using growth in these assets to proxy for income growth will overestimate economic performance. This evidence is present when using aggregate trends as well as when linking assets to real income levels using micro data. Third, growth of assets and growth of incomes are hardly correlated at all, neither in Africa nor elsewhere. This is due to the combination of issues raised above, including the role of prices and preferences, public policy, and asset accumulation. Thus at this stage, it appears difficult to infer any clear statement that would link asset changes to per capita income changes. Consequently, we have no real basis for supporting the claim of an African economic growth and poverty reduction miracle.

Further research should try to examine more closely whether there are some assets which are closely linked to income and less prone to the biases mentioned above. For this, more analysis at the micro and macro level of the type produced here will be required. Secondly, we are currently unable to distinguish among the various biases that render asset-based income proxies possibly unsuitable to study trends in incomes. Sorting out these biases (i.e. relative prices, preferences, public policy, and age and accumulation issues) is an important area for further investigation. Lastly, while these asset indices might not be suitable proxies for income trends, they might indeed be more useful as proxies for multidimensional well-being indicators. If interpreted in that sense, possibly one may argue that well-being in Africa has improved by more than suggested by income data. But if that was the aim of the exercise, one should try to identify assets that are particularly good proxies of well-being rather than looking for assets that proxy income well. This would be a different, but similarly worthwhile research exercise.

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Tables and Figures

Table 1: Scoring factors of asset index

				Total sample	First year	Latest year
Asset	**Mean**	**SD**	**N**	**Scoring factor**	**Scoring factor**	**Scoring factor**
Owns radio	0.579	0.494	1,927,621	0.393	0.401	0.337
Owns TV	0.441	0.496	1,932,150	0.826	0.840	0.831
Owns refrigerator	0.292	0.455	1,870,275	0.781	0.828	0.782
Owns bike	0.283	0.450	1,835,633	0.050	0.089	0.048
Owns car	0.117	0.321	1,803,855	0.280	0.176	0.316
Owns motorbike	0.078	0.268	1,841,863	0.428	0.472	0.422
Piped drinking water	0.329	0.470	1,939,267	0.596	0.673	0.589
Owns electricity	0.566	0.496	1,904,439	0.790	0.830	0.779
Owns phone	0.309	0.462	1,513,699	0.712	0.734	0.756
High qulaity of fllor material	0.549	0.498	1,749,964	0.667	0.538	0.636
Flush toilet	0.296	0.456	1,871,614	0.581	0.740	0.557
Mean years education of adult household member	6.135	6.605	1,669,088	0.723	0.755	0.728
Percentage of the covariance explained by the first principal component				0.375	0.408	0.372
Eigenvalue of first principal component				4.501	4.900	4.466

Source: Demographic and Health Survey; calculation by the authors.

Table 2: GDP per capita and asset index growth by region

	Total sample (%)	First year (%)	Latest year (%)
Total		42	
Asset index growth	1.603%	1.610%	1.630%
Real GDP per capita growth		3.457	
Africa		25	
Asset index growth	1.825%	1.842%	1.850%
Real GDP per capita growth (PWT)		3.71%	
Regional GDP per Capita growth (WDI)		1.72%	
Regional GNI per Capita growth (WDI)		2.16%	
Non-Africa		17	
Asset index growth	1.277%	1.270%	1.307%
Real GDP per capita growth		3.0596	

Source: Demographic and Health Survey; calculation by the authors.

Table 3: Regression results

VARIABLES	(1) Asset Index Growth	(2) Asset Index Growth	(3) Asset Index Growth	(4) Asset Index Growth
gdp_growth	0.00845	-0.210	0.0122	-0.250
	(0.125)	(0.232)	(0.127)	(0.245)
ssa		-0.00422		-0.000150
		(0.0125)		(0.0147)
gr_ssa		0.304		0.335
		(0.276)		(0.284)
ai_mean_pooled			-0.000377	0.00131
			(0.00166)	(0.00244)
Constant	0.0158**	0.0192*	0.0178	0.00982
	(0.00599)	(0.00988)	(0.0110)	(0.0202)
Observations	42	42	42	42
R-squared	0.000	0.040	0.001	0.048

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4: Regression results

VARIABLES	(1) Growth Radio	(2) Growth TV	(3) Growth Phone	(4) Growth Electricity	(5) Growth Fridge	(6) Growth Car	(7) Growth Motorbike	(8) Growth Bike	(9) Growth Floor Material	(10) Growth Toilet	(11) Growth Education
gdp_growth	-0.0570	-0.317	0.905	0.0438	0.338	0.0161	0.343	-0.105	0.181	0.138	-0.157
	(0.137)	(0.310)	(1.022)	(0.189)	(0.238)	(0.300)	(0.224)	(0.212)	(0.419)	(1.078)	(0.130)
Constant	0.0132**	0.0668***	0.201***	0.0286***	0.0268***	0.0503***	0.0152	0.0280***	0.00690	-0.0218	0.0216***
	(0.00542)	(0.0123)	(0.0452)	(0.00734)	(0.00959)	(0.0126)	(0.00917)	(0.00861)	(0.0165)	(0.0416)	(0.00507)
Observations	88	87	56	87	82	75	78	82	86	85	88
R-squared	0.002	0.012	0.014	0.001	0.025	0.000	0.030	0.003	0.002	0.000	0.017

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 5: Regression results

VARIABLES	(1) Growth Radio	(2) Growth TV	(3) Growth Phone	(4) Growth Electricity	(5) Growth Fridge	(6) Growth Car	(7) Growth Motorbike	(8) Growth Bike	(9) Growth Floor Material	(10) Growth Toilet	(11) Growth Education
gdp_growth	-0.473**	-0.487	-0.104	-0.0286	0.406	-0.821	0.166	-0.0901	0.149	0.963	-0.364
	(0.219)	(0.531)	(1.695)	(0.351)	(0.436)	(0.569)	(0.415)	(0.387)	(0.762)	(2.024)	(0.232)
ssa		0.0358	0.129	0.00667	0.00822	-0.0368	-0.0252	0.0258	-0.0408	0.147*	-0.0104
		(0.0250)	(0.0882)	(0.0158)	(0.0205)	(0.0282)	(0.0200)	(0.0185)	(0.0348)	(0.0881)	(0.0107)
gr_ssa		0.328	1.045	0.122	-0.0859	1.156*	0.201	0.0600	-0.0418	-0.952	0.297
		(0.647)	(2.084)	(0.418)	(0.523)	(0.671)	(0.494)	(0.462)	(0.913)	(2.384)	(0.282)
Constant	0.00744	0.0492**	0.152**	0.0255**	0.0218	0.0790***	0.0317*	0.0124	0.0295	-0.110	0.0286***
	(0.00822)	(0.0196)	(0.0630)	(0.0127)	(0.0164)	(0.0240)	(0.0165)	(0.0153)	(0.0279)	(0.0710)	(0.00847)
Observations	88	87	56	87	82	75	78	82	86	85	88
R-squared	0.252	0.079	0.129	0.010	0.027	0.040	0.055	0.053	0.033	0.044	0.031

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 6: Asset means and scoring weights in Zambia

	1996	1998	2004	2006	Total sample
Asset	**Mean**	**Mean**	**Mean**	**Mean**	**Scoring factor**
Motorbike	0.018	0.058	0.051	0.059	0.389
TV	0.310	0.309	0.328	0.367	0.809
Video	0.079	0.099	0.165	0.176	0.694
Radio	0.606	0.603	0.594	0.630	0.437
Refrigerator	0.154	0.154	0.119	0.119	0.715
Phone	0.058	0.045	0.122	0.367	0.605
Sewing machine	0.170	0.153	0.093	0.071	0.339
Stove	0.269	0.260	0.228	0.237	0.834
Piped drinking water	0.528	0.457	0.388	0.383	0.644
Elctricity	0.303	0.295	0.701	0.645	0.523
Flush toilet	0.313	0.276	0.242	0.245	0.763
Mean years education of adult household member	8.879	7.726	8.026	8.349	0.678
Percentage of the covariance explained by the first principal component					0.408
Eigenvalue of first principal component					4.897

Table 7: Asset means and scoring weights in Indonesia

	1993	1997	2000	2007	Total sample
Asset	**Mean**	**Mean**	**Mean**	**Mean**	**Scoring factor**
Owns motorized vehicle	0.329	0.467	0.433	0.567	0.499
Owns appliances (tv, radio, etc.)	0.738	0.765	0.769	0.871	0.593
Owns savings	0.235	0.248	0.291	0.261	0.440
Owns jewerly	0.498	0.580	0.607	0.546	0.417
Has electricity	0.695	0.847	0.904	0.962	0.593
Owns telephone	0.044	0.566	0.574	0.742	0.710
Has piped drinking water	0.044	0.251	0.267	0.218	0.370
Has flush toilet	0.321	0.440	0.484	0.656	0.661
Owns refrigerator	0.000	0.119	0.146	0.282	0.525
Number of rooms	4.837	5.023	5.304	5.339	0.634
High quality of floor material	0.617	0.680	0.739	0.803	0.621
Percentage of the covariance explained by the first principal component					0.315
Eigenvalue of first principal component					3.462

Table 8: Asset growth conditional on initial expenditure level in Indonesia

	25th percentile (of 1993 real household expenditure)				50th percentile (of 1993 real household expenditure)				75th percentile (of 1993 real household expenditure)			
	1993	1997	2000	2007	1993	1997	2000	2007	1993	1997	2000	2007
Owns motorized vehicle	0.268	0.354	0.354	0.375	0.337	0.412	0.425	0.478	0.394	0.458	0.419	0.541
Owns appliances (tv, radio, etc.)	0.602	0.506	0.640	0.639	0.707	0.662	0.704	0.767	0.794	0.766	0.798	0.866
Owns savings	0.112	0.063	0.077	0.043	0.171	0.125	0.166	0.095	0.295	0.184	0.188	0.166
Owns jewerly	0.397	0.463	0.428	0.370	0.439	0.515	0.521	0.403	0.562	0.578	0.584	0.533
Has electricity	0.517	0.680	0.813	0.856	0.658	0.788	0.866	0.939	0.786	0.878	0.873	0.964
Owns telephone	0.004	0.266	0.303	0.483	0.011	0.368	0.446	0.596	0.022	0.560	0.571	0.733
Has piped drinking water	0.004	0.096	0.132	0.090	0.011	0.123	0.147	0.143	0.022	0.149	0.209	0.176
Has flush toilet	0.137	0.178	0.180	0.340	0.192	0.195	0.260	0.411	0.369	0.362	0.395	0.565
Owns refrigerator	0.000	0.010	0.007	0.043	0.000	0.003	0.010	0.045	0.000	0.028	0.070	0.137
Number of rooms	4.406	4.325	4.759	4.812	4.683	4.501	4.967	5.161	5.078	5.009	5.418	5.590
High quality of floor material	0.416	0.400	0.541	0.499	0.542	0.519	0.607	0.664	0.666	0.663	0.706	0.785

Table 9: Asset growth conditional on initial expenditure level in Zambia

	25th percentile (of 1996 real household expenditure)				50th percentile (of 1996 real household expenditure)				75th percentile (of 1996 real household expenditure)			
year	1996	1998	2004	2006	1996	1998	2004	2006	1996	1998	2004	2006
Motorbike	0.013	0.006	0.005	0.004	0.020	0.024	0.012	0.014	0.009	0.025	0.030	0.041
TV	0.031	0.052	0.092	0.119	0.149	0.164	0.242	0.314	0.409	0.420	0.546	0.610
Video	0.002	0.004	0.017	0.018	0.012	0.012	0.069	0.066	0.055	0.076	0.224	0.286
Radio	0.353	0.365	0.496	0.557	0.510	0.561	0.603	0.652	0.672	0.731	0.716	0.750
Refrigerator	0.006	0.006	0.008	0.013	0.038	0.036	0.047	0.048	0.166	0.169	0.156	0.158
Phone	0.003	0.001	0.008	0.103	0.010	0.004	0.043	0.285	0.047	0.036	0.145	0.617
Sewing machine	0.072	0.063	0.045	0.027	0.106	0.098	0.068	0.064	0.178	0.172	0.111	0.090
Stove	0.015	0.015	0.024	0.026	0.083	0.086	0.115	0.125	0.339	0.327	0.340	0.415
Piped drinking water	0.149	0.136	0.205	0.169	0.330	0.308	0.302	0.290	0.628	0.571	0.513	0.503
Elctricity	0.018	0.037	0.673	0.607	0.091	0.129	0.664	0.577	0.395	0.372	0.700	0.666
Flush toilet	0.034	0.057	0.049	0.054	0.142	0.133	0.128	0.140	0.377	0.331	0.351	0.353
Mean years education of adult household member	7.070	6.116	6.514	6.823	7.776	6.902	7.441	7.865	9.120	8.122	9.047	9.382

Figure 1: Asset index growth versus GDP per capita growth

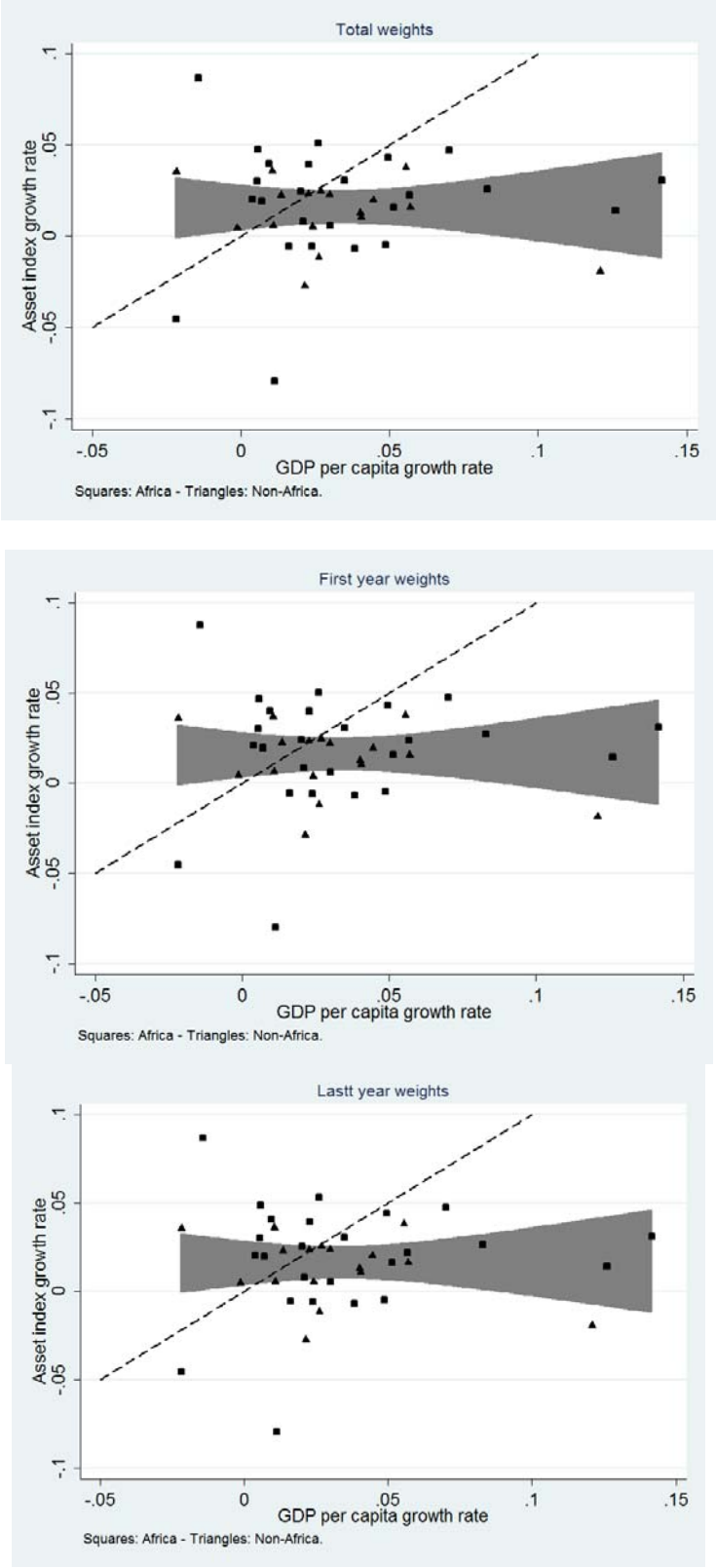
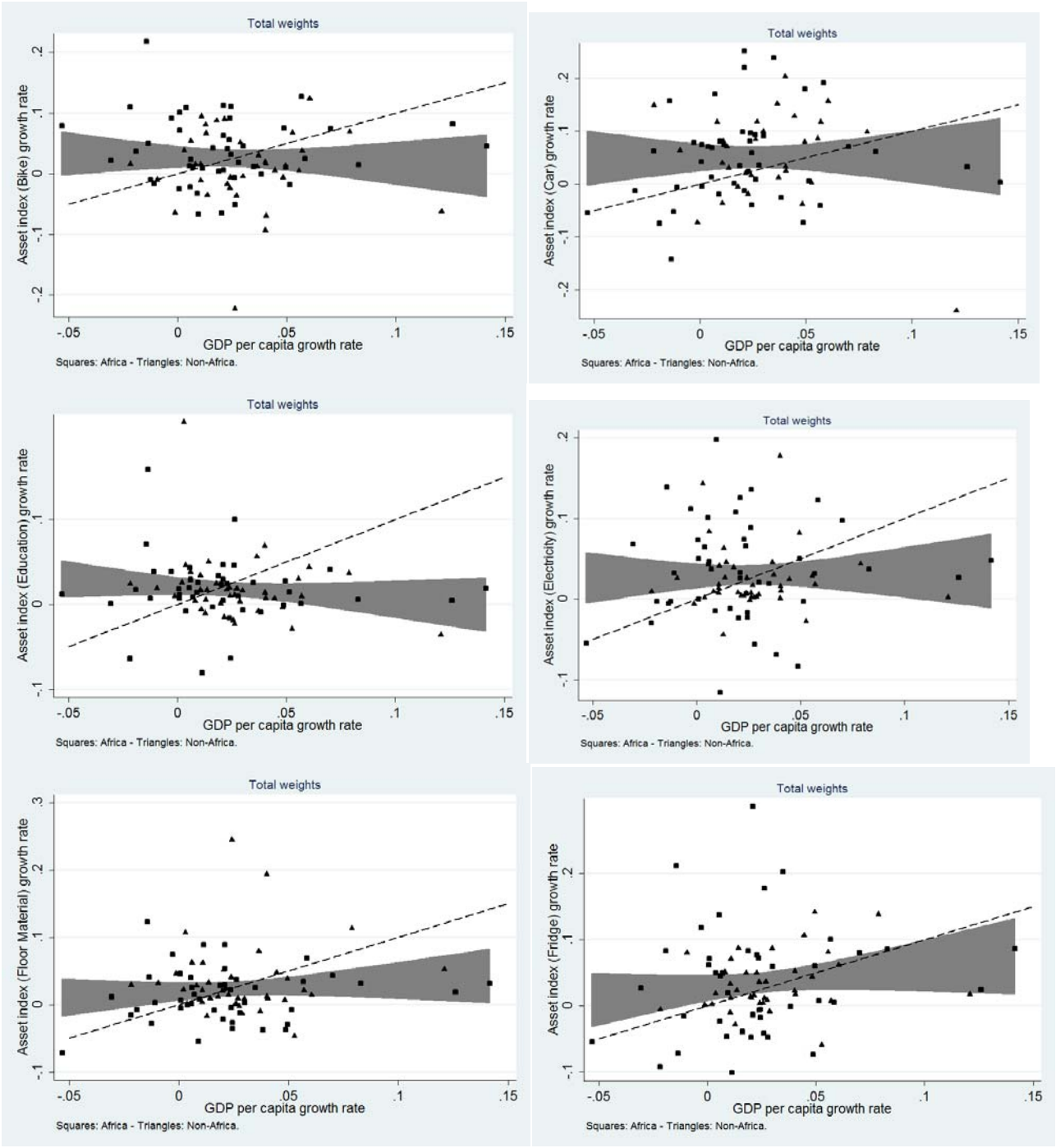
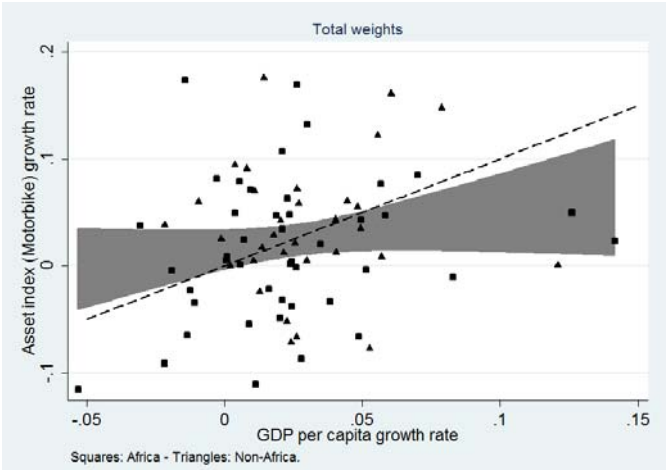


Figure 2: Asset growth versus GDP per capita growth

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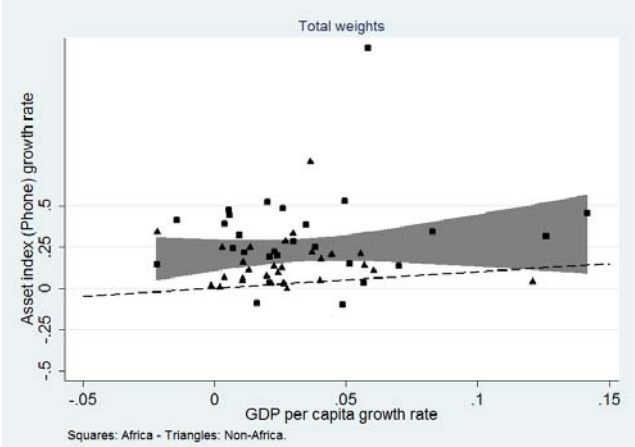
.1
.2
-.05
0
.05
.1
.15
GDP per capita growth rate
Squares: Africa - Triangles: Non-Africa.


Total weights
Asset index (Phone) growth rate
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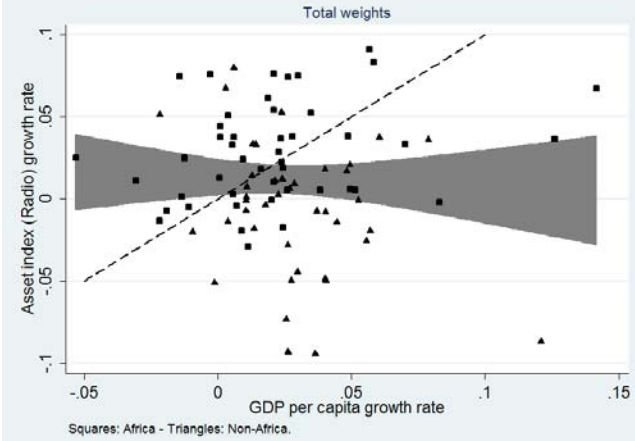
.25
.5
-.05
0
.05
.1
.15
GDP per capita growth rate
Squares: Africa - Triangles: Non-Africa.


Total weights
Asset index (Radio) growth rate
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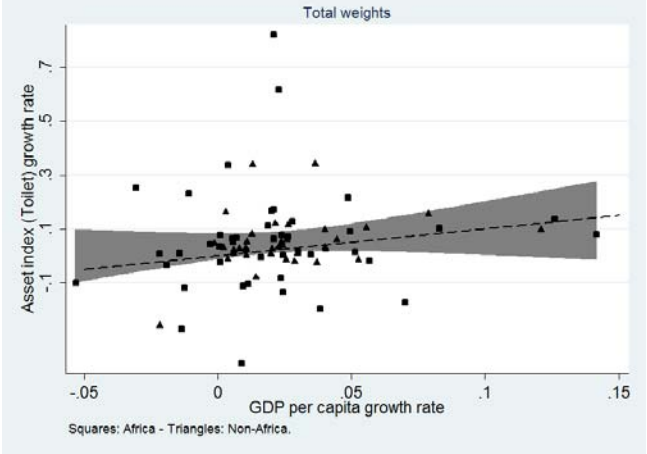
-.05
0
.05
.1
-.05
0
.05
.1
.15
GDP per capita growth rate
Squares: Africa - Triangles: Non-Africa.


Total weights
Asset index (Toilet) growth rate
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.1
.3
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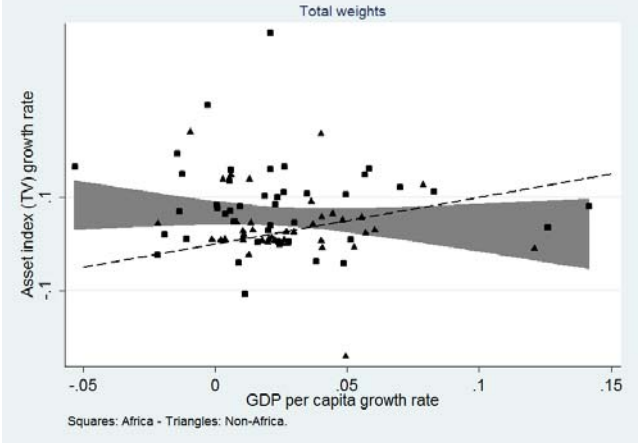
-.05
0
.05
.1
.15
GDP per capita growth rate
Squares: Africa - Triangles: Non-Africa.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Asset index (TV) growth rate
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0
.1
-.05
0
.05
.1
.15
GDP per capita growth rate
Squares: Africa - Triangles: Non-Africa.

Appendix

Table A1: GDP per capita and assets by country year

Country	Year	Real GDP per capita	Owns radio	Owns TV	Owns refrigerator	Owns bike	Owns car	Owns motorbike	Piped drinking water	Owns electricity	Owns phone	High qulaity of fllor material	Flush toilet	Years of education
Albania	2009	6643	0.45	0.99	0.94	0.08	0.27	0.19	0.66	1.00	0.96	0.94	0.96	9.38
Angola	2007	4355	0.59	0.40	0.21	0.08	0.12	0.18	0.14	0.32	0.38	0.41	0.23	na
Armenia	2000	2566	0.39	0.87	0.74	0.02	0.24	0.06	0.85	0.99	0.61	0.45	0.59	10.76
Armenia	2005	4541	0.25	0.83	0.81	0.00	0.24	0.04	0.95	1.00	0.74	0.58	0.93	8.92
Azerbaijan	2006	6319	0.45	0.95	0.75	0.01	0.18	0.07	0.51	0.99	0.73	0.14	0.40	10.48
Bangladesh	1993	844	0.25	0.08	na	na	na	0.17	0.04	0.18	na	0.10	0.10	2.90
Bangladesh	1996	859	0.32	0.11	na	na	na	0.19	0.05	0.23	na	0.12	0.11	3.46
Bangladesh	1999	966	0.34	0.22	na	0.02	na	0.21	0.08	0.38	0.02	0.20	0.14	4.35
Bangladesh	2004	1159	0.32	0.26	na	0.02	na	0.24	0.08	0.44	0.06	0.19	0.12	3.80
Bangladesh	2007	1290	0.24	0.34	0.10	0.04	0.01	0.25	0.07	0.51	0.36	0.24	0.29	4.52
Benin	1996	1087	0.53	0.09	0.04	0.21	0.03	0.45	0.07	0.13	na	0.49	0.01	2.34
Benin	2001	1194	0.71	0.15	0.06	0.25	0.04	0.45	0.30	0.21	0.04	0.56	0.03	3.25
Benin	2006	1229	0.72	0.21	0.05	0.35	0.04	0.41	0.32	0.26	0.22	0.56	0.03	3.12
Bolivia	1994	2979	0.81	0.52	0.26	na	na	na	0.55	0.62	0.10	0.54	0.31	6.41
Bolivia	2003	3278	0.82	0.60	0.29	0.05	0.12	0.46	0.78	0.72	0.17	0.65	0.32	7.75
Bolivia	2008	3744	0.85	0.68	0.34	0.09	0.16	0.38	0.78	0.79	0.59	0.68	na	8.00
Brazil	1991	6363	0.73	0.55	0.49	0.03	0.12	0.26	0.59	0.74	na	0.82	0.60	9.99
Brazil	1996	6830	0.86	0.63	0.74	na	0.26	na	0.69	0.93	na	0.86	0.40	6.42
Burkina Faso	1992	671	0.55	0.10	0.05	0.34	0.04	0.62	0.11	0.12	na	0.45	0.03	3.01
Burkina Faso	1998	775	0.61	0.10	0.05	0.27	0.03	0.75	0.07	0.11	0.03	0.36	0.01	1.75
Burkina Faso	2003	860	0.64	0.12	0.05	0.25	0.02	0.77	0.08	0.12	0.03	0.42	0.23	1.56
Cambodia	2000	1068	0.39	0.27	0.01	0.21	0.02	0.46	0.04	0.17	0.03	0.07	0.11	3.26
Cambodia	2005	1560	0.47	0.49	0.02	0.33	0.04	0.65	na	0.21	na	0.11	0.23	4.29
Cameroon	1991	1762	0.59	0.20	0.15	0.07	0.07	0.14	0.15	0.40	na	0.52	0.08	4.51
Cameroon	1998	1633	0.57	0.22	0.14	0.07	0.06	0.12	0.15	0.50	0.03	0.53	0.36	6.24
Cameroon	2004	1799	0.64	0.22	0.11	0.07	0.05	0.16	0.12	0.46	0.02	0.50	0.35	5.87
CAR	1994	645	0.44	0.03	0.02	0.04	0.01	0.12	0.02	0.03	0.01	0.12	0.01	3.04
Chad	1996	720	0.37	0.03	0.02	0.06	0.02	0.13	0.05	0.04	0.01	0.07	0.13	1.95
Chad	2004	1238	0.49	0.08	0.03	0.10	0.04	0.24	0.11	0.09	0.02	0.09	0.03	2.26
Colombia	1995	5272	0.87	0.81	0.59	0.07	0.11	0.41	0.76	0.91	0.34	0.77	0.67	8.10
Colombia	2000	5817	0.87	0.82	0.63	na	na	na	0.85	0.95	0.49	0.86	0.69	6.80
Colombia	2005	6662	0.67	0.83	0.65	0.12	0.08	na	0.76	0.96	0.48	0.85	0.00	8.62
Colombia	2010	na	0.72	0.87	0.71	0.22	0.10	0.32	0.72	0.95	0.90	0.85	0.00	8.68
Comoros	1996	1100	0.51	0.10	0.09	0.01	0.05	0.02	0.22	0.29	0.03	0.48	0.23	3.03
Congo, Dem. Rep.	2007	227	0.45	0.15	0.04	0.01	0.01	0.22	0.09	0.17	0.23	0.98	0.08	6.33
Congo, Rep.	2005	2189	0.60	0.27	0.11	0.02	0.03	0.05	0.57	0.33	0.37	0.62	0.20	9.20
Cote d'Ivoire	1994	1397	0.53	0.21	0.12	0.11	0.04	0.26	0.24	0.39	na	0.76	0.13	3.35
Cote d'Ivoire	1998	1550	0.71	0.39	0.22	0.12	0.07	0.21	0.41	0.65	0.07	0.88	0.17	4.94
Cote d'Ivoire	2005	1328	0.64	0.33	0.11	0.18	0.04	0.44	0.37	0.53	0.19	0.79	0.18	2.69
Dominican Rep.	1991	4696	0.56	0.50	0.37	0.17	0.08	0.03	0.67	0.75	na	0.83	0.33	9.60
Dominican Rep.	1996	5944	0.61	0.65	0.46	0.14	0.10	0.03	0.55	na	0.20	0.86	0.00	8.62
Dominican Rep.	1999	7089	0.68	0.71	0.55	0.21	0.15	0.04	0.41	0.85	0.27	0.89	0.46	11.93
Dominican Rep.	2002	7659	0.62	0.72	0.57	0.27	0.12	0.02	0.35	0.87	0.29	0.90	0.00	9.39
Dominican Rep.	2007	9341	0.48	0.69	0.62	0.31	0.13	0.01	0.27	0.91	0.65	0.94	0.46	9.35
Egypt, Arab Rep.	1992	3126	0.62	0.77	0.57	na	na	0.15	0.70	0.93	na	0.68	0.29	6.14
Egypt, Arab Rep.	1995	3403	0.63	na	0.55	na	na	0.18	0.71	0.94	na	0.65	0.27	6.18
Egypt, Arab Rep.	2000	3828	0.82	0.89	0.66	0.02	0.09	0.16	0.82	0.97	0.29	0.79	0.35	6.81
Egypt, Arab Rep.	2005	4281	0.83	0.92	0.84	0.02	0.07	0.15	0.90	0.99	0.55	0.85	0.41	7.39
Egypt, Arab Rep.	2008	4817	0.71	0.94	0.90	0.03	0.07	0.11	0.92	0.99	0.62	0.88	0.45	7.73

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Table A1: continued.

Country	Year	Real GDP per capita	Owns radio	Owns TV	Owns refrigerator	Owns bike	Owns car	Owns motorbike	Piped drinking water	Owns electricity	Owns phone	High qulaity of fllor material	Flush toilet	Years of education
Ethiopia	2000	460	0.28	0.06	na	0.00	0.01	0.01	0.11	0.22	0.04	0.14	0.02	2.04
Ethiopia	2005	510	0.41	0.12	0.05	0.00	0.01	0.02	0.13	0.26	0.09	0.19	0.04	2.54
Gabon	2000	11046	0.67	0.40	0.38	0.01	0.10	0.03	0.32	0.62	0.09	0.65	0.34	6.40
Ghana	1993	817	0.41	0.13	0.09	0.01	0.03	0.16	0.15	0.31	na	0.85	0.21	5.56
Ghana	1998	821	0.49	0.19	0.13	0.02	0.03	0.23	0.16	0.39	0.02	0.83	0.30	5.83
Ghana	2003	952	0.71	0.24	0.17	0.02	0.05	0.29	0.16	0.43	0.06	0.84	0.33	5.58
Ghana	2008	1212	0.73	0.39	0.23	0.06	0.06	0.30	0.13	0.55	0.54	0.72	0.51	6.50
Guatemala	1995	5055	0.75	0.40	0.17	0.03	0.09	0.25	0.48	0.53	0.06	0.40	0.23	4.60
Guatemala	1998	5222	0.76	0.42	0.21	0.04	0.11	0.32	0.56	0.60	0.09	0.48	0.27	3.59
Guinea	1999	755	0.56	0.10	0.07	0.05	0.04	0.15	0.15	0.18	0.02	0.43	0.03	1.99
Guinea	2005	870	0.65	0.10	0.07	0.09	0.04	0.26	0.09	0.19	0.06	0.42	0.04	1.77
Guyana	2005	3761	0.75	0.80	0.61	0.08	0.16	0.53	0.43	0.78	0.74	0.70	0.64	13.26
Haiti	1994	1405	0.42	0.19	0.09	0.01	0.04	0.10	0.13	0.35	na	0.56	0.26	6.90
Haiti	2000	1517	0.45	0.16	0.08	0.02	0.03	0.16	0.13	0.27	0.03	0.50	0.42	4.90
Haiti	2005	1359	0.58	0.20	0.08	0.03	0.04	0.17	0.36	0.28	0.15	0.58	0.09	4.22
Honduras	2005	3310	0.86	0.53	0.37	0.02	0.14	0.39	0.57	na	0.38	0.63	0.38	5.54
India	1992	1401	0.44	0.26	0.10	0.10	0.02	0.39	0.22	0.60	na	na	0.25	5.22
India	1999	1848	0.42	0.39	0.14	0.13	0.02	0.44	0.26	0.67	0.10	na	0.29	5.30
India	2005	2557	0.36	0.54	0.23	0.21	0.05	0.45	0.34	0.79	0.32	0.56	0.53	6.34
Indonesia	1994	2953	0.57	0.37	0.08	0.17	0.04	0.43	0.13	0.57	na	0.49	na	5.95
Indonesia	1997	3413	0.60	0.16	0.13	0.22	0.05	0.45	0.17	0.72	na	0.55	na	6.38
Indonesia	2003	3224	0.53	0.59	0.20	0.31	0.06	0.42	0.31	0.84	0.14	0.66	0.54	7.23
Indonesia	2007	3626	0.45	0.65	0.28	0.46	0.07	0.41	0.16	0.86	0.44	0.68	0.56	8.04
Jordan	1997	3815	0.82	0.91	0.84	0.00	0.22	0.09	0.94	0.98	0.37	0.99	0.90	8.74
Jordan	2002	3886	0.76	0.96	0.92	na	0.34	na	0.88	0.99	0.50	1.00	0.85	10.69
Jordan	2007	4410	0.52	0.96	0.94	na	0.38	na	0.79	0.99	0.91	1.00	0.79	9.77
Jordan	2009	4644	0.43	0.98	0.96	na	0.43	na	0.70	0.99	0.97	1.00	0.98	9.96
Kazakhstan	1995	4757	0.55	0.90	0.84	0.10	0.23	0.17	0.68	1.00	0.43	0.29	0.49	12.08
Kazakhstan	1999	4733	0.45	0.93	0.85	0.07	0.26	0.13	0.69	0.97	0.46	0.35	0.58	10.89
Kenya	1993	1092	0.52	0.06	0.03	na	na	0.22	0.19	0.10	na	0.30	0.15	5.38
Kenya	1998	1125	0.62	0.12	0.03	0.01	0.04	0.25	0.21	0.12	0.02	0.34	0.16	6.20
Kenya	2003	1156	0.73	0.22	0.06	0.01	0.06	0.27	0.24	0.20	0.16	0.41	0.22	7.03
Kenya	2009	1206	0.71	0.29	0.08	0.02	0.07	0.28	0.26	0.25	0.60	0.45	0.33	7.45
Kyrgyz Republic	1997	1571	0.42	0.85	0.70	0.04	0.22	0.09	0.54	1.00	0.32	0.17	0.28	10.36
Lesotho	2004	1251	0.51	0.11	0.11	0.00	0.04	0.03	0.14	0.05	0.15	0.55	0.24	5.73
Lesotho	2009	1311	0.58	0.16	0.12	0.00	0.06	0.02	0.16	0.13	0.60	0.58	0.13	7.53
Liberia	2007	403	0.51	0.06	0.02	0.02	0.02	0.04	0.02	0.03	na	0.40	0.17	4.34
Madagascar	1992	843	0.41	0.07	0.03	0.01	0.02	0.04	0.10	0.16	na	0.16	0.38	6.48
Madagascar	1997	787	0.42	0.09	0.02	0.01	0.02	0.05	0.08	0.15	0.01	0.20	0.08	6.72
Madagascar	2004	712	0.69	0.32	0.07	0.02	0.05	0.21	0.19	0.38	0.11	0.44	0.08	7.26
Madagascar	2009	753	0.60	0.18	0.04	0.02	0.03	0.22	0.07	0.21	0.28	0.68	0.05	6.32
Malawi	1992	540	0.39	na	na	0.01	0.02	0.20	0.10	0.06	na	0.20	0.05	3.92
Malawi	2000	544	0.56	0.02	na	0.01	0.02	0.44	0.09	0.06	na	0.21	0.04	4.28
Malawi	2004	518	0.61	0.04	0.02	0.01	0.02	0.42	0.10	0.06	0.04	0.18	0.03	4.42
Maldives	2009	4460	0.86	0.96	0.83	0.32	0.03	0.44	0.08	1.00	0.98	0.99	0.95	10.29
Mali	1995	706	0.57	0.08	0.03	0.16	0.03	0.35	0.06	0.07	0.01	0.20	0.01	1.50
Mali	2001	808	0.68	0.13	0.05	0.19	0.04	0.45	0.09	0.11	0.02	0.00	0.16	1.28
Mali	2006	919	0.70	0.22	0.04	0.29	0.04	0.43	0.10	0.17	0.17	0.23	0.22	2.56
Moldova	2007	2377	0.72	0.74	0.80	0.05	0.25	0.27	0.45	0.99	0.72	0.78	0.60	na

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Table A1: continued.

Country	Year	Real GDP per capita	Owns radio	Owns TV	Owns refrigerator	Owns bike	Owns car	Owns motorbike	Piped drinking water	Owns electricity	Owns phone	High qulaity of fllor material	Flush toilet	Years of education
Morocco	1992	2380	0.85	0.59	0.30	0.12	0.10	0.10	0.42	0.49	na	0.71	0.56	2.86
Morocco	2003	2888	0.81	0.63	0.52	0.11	0.14	0.25	0.58	0.75	0.49	0.80	0.00	3.92
Mozambique	1997	403	0.33	0.05	0.05	0.02	0.02	0.15	0.15	0.09	0.02	0.24	0.04	5.24
Mozambique	2003	561	0.56	0.12	0.08	0.01	0.03	0.32	0.18	0.11	0.02	0.30	0.03	3.13
Namibia	1992	3348	0.65	0.16	0.21	0.01	0.22	0.21	0.33	0.23	na	0.39	0.30	6.77
Namibia	2000	3367	0.72	0.31	0.34	0.02	0.23	0.17	0.50	0.41	0.22	0.56	0.40	6.28
Namibia	2007	4780	0.75	0.33	0.36	0.02	0.22	0.15	0.48	0.41	0.57	0.53	0.43	7.05
Nepal	1996	987	0.38	0.07	na	na	na	0.18	0.11	0.19	0.02	0.00	0.04	3.23
Nepal	2001	1053	0.44	0.14	na	na	na	0.25	0.11	0.26	0.03	0.12	0.15	2.54
Nepal	2006	1068	0.62	0.27	0.05	0.04	0.01	0.31	0.14	0.50	0.09	0.20	0.32	6.62
Nicaragua	1997	1906	0.77	0.49	0.20	0.02	0.08	0.19	0.57	0.65	0.08	0.40	0.19	5.97
Nicaragua	2001	2075	0.80	0.52	0.21	0.02	0.08	0.27	0.00	0.66	0.09	0.44	0.29	5.12
Niger	1992	492	0.42	0.09	0.05	0.05	0.04	0.07	0.10	0.11	na	0.28	0.26	1.54
Niger	1998	519	0.37	0.07	0.04	0.05	0.03	0.06	0.08	0.10	0.01	0.20	0.01	2.26
Niger	2006	535	0.55	0.12	0.06	0.08	0.04	0.13	0.12	0.17	0.13	0.20	0.13	1.49
Nigeria	1999	1105	0.63	0.27	0.16	0.14	0.08	0.24	0.00	0.46	0.02	0.62	0.10	5.64
Nigeria	2003	1776	0.73	0.31	0.18	0.16	0.10	0.33	0.04	0.52	0.06	0.67	0.17	5.79
Nigeria	2008	1963	0.73	0.35	0.14	0.25	0.08	0.24	0.03	0.46	0.46	0.60	0.37	7.57
Pakistan	1991	1940	0.42	0.35	0.20	0.10	na	0.31	0.40	0.71	na	na	0.35	3.18
Pakistan	2007	2292	0.37	0.54	0.34	0.18	0.07	0.39	0.34	0.88	0.44	0.47	0.55	4.32
Peru	1992	3925	0.82	0.60	0.36	0.04	0.11	0.17	0.58	0.67	na	0.49	0.40	7.48
Peru	1996	4819	0.82	0.58	0.28	0.04	0.08	0.22	0.00	0.60	0.14	0.41	0.37	7.00
Peru	2000	5024	0.81	0.60	0.27	0.04	0.08	0.21	0.55	0.62	0.16	0.41	0.41	7.51
Peru	2004	5527	0.85	0.61	0.27	0.04	0.06	0.21	0.00	0.68	0.23	0.99	0.47	7.82
Philippines	1993	2015	na	0.38	0.25	0.06	0.05	0.21	0.26	0.62	na	0.43	0.61	7.76
Philippines	1998	2098	0.77	0.48	0.32	0.11	0.08	0.23	0.32	0.65	0.12	0.50	0.69	7.87
Philippines	2003	2245	0.70	0.60	0.36	0.12	0.09	0.19	0.38	0.74	0.36	0.58	0.00	8.51
Philippines	2008	2961	0.64	0.67	0.37	0.21	0.09	0.23	0.29	0.81	0.68	0.65	0.00	8.91
Rwanda	1992	848	0.36	na	0.02	0.01	0.01	0.07	0.01	0.06	na	0.16	0.02	4.28
Rwanda	2000	662	0.39	0.04	0.02	0.01	0.01	0.08	0.08	0.09	0.02	0.18	0.12	3.63
Rwanda	2005	839	0.47	0.03	0.02	0.01	0.01	0.11	0.03	0.06	0.01	0.15	0.31	3.62
Rwanda	2008	995	0.60	0.05	0.02	0.01	0.01	0.12	0.05	0.09	0.16	0.18	0.01	na
Sao Tome and P.	2009	1681	0.61	0.44	0.24	0.06	0.04	0.14	0.23	0.51	0.46	0.35	0.33	4.60
Senegal	1992	1077	0.71	0.16	0.10	0.03	0.04	0.06	0.27	0.26	na	0.58	0.31	2.42
Senegal	1997	1215	0.65	0.16	0.09	0.04	0.04	0.11	0.22	0.24	na	0.50	0.32	na
Senegal	2005	1465	0.86	0.35	0.17	0.07	0.06	0.16	0.38	0.40	0.14	0.60	0.16	2.67
Sierra Leone	2008	855	0.58	0.12	0.07	0.04	0.02	0.11	0.08	0.15	0.32	0.40	0.21	4.42
South Africa	1998	5576	0.79	0.55	0.47	0.02	0.23	0.17	0.60	0.62	0.26	0.78	0.45	8.08
Swaziland	2006	3380	0.77	0.37	0.36	0.01	0.19	0.10	0.43	0.38	0.63	0.89	0.00	8.15

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Table A1: continued.

Country	Year	Real GDP per capita	Owns radio	Owns TV	Owns refrigerator	Owns bike	Owns car	Owns motorbike	Piped drinking water	Owns electricity	Owns phone	High qulaity of fllor material	Flush toilet	Years of education
Tanzania	1992	683	0.32	0.01	0.01	0.01	0.01	0.22	0.11	0.07	na	0.17	0.03	3.67
Tanzania	1996	675	0.43	0.02	0.02	0.01	0.02	0.31	0.10	0.10	na	0.23	0.03	4.63
Tanzania	1999	719	0.50	0.06	0.05	0.02	0.02	0.37	0.25	0.14	na	0.30	0.04	4.73
Tanzania	2004	825	0.61	0.06	0.04	0.02	0.01	0.40	0.11	0.11	0.09	0.28	0.07	4.90
Tanzania	2008	1135	0.60	0.10	0.06	0.02	0.01	0.43	0.35	0.12	0.31	0.32	0.10	5.23
Timor-Leste	2009	1155	0.35	0.19	0.06	0.12	0.03	0.11	0.17	0.36	0.38	0.33	0.38	5.01
Togo	1998	865	0.51	0.12	0.04	0.10	0.02	0.38	0.04	0.15	na	0.73	0.00	3.40
Turkey	1993	7578	0.77	0.87	0.88	na	0.20	na	0.64	na	na	0.55	0.58	5.21
Turkey	1998	8379	na	0.91	0.93	na	0.25	na	0.62	na	0.77	0.70	0.66	5.80
Turkey	2003	8463	na	0.95	0.94	0.04	0.25	0.18	0.55	na	0.79	0.78	0.77	6.74
Uganda	1995	691	0.43	0.05	0.01	0.01	0.02	0.34	0.05	0.13	0.01	0.25	0.06	5.58
Uganda	2000	821	0.56	0.08	0.04	0.03	0.02	0.36	0.04	0.14	0.04	0.28	0.06	6.11
Uganda	2006	1028	0.58	0.07	0.03	0.03	0.02	0.36	0.04	0.09	0.16	0.23	0.02	5.54
Ukraine	2007	7124	0.70	0.97	0.94	0.10	0.26	0.43	0.61	1.00	0.81	0.56	0.52	12.14
Uzbekistan	1996	1331	0.65	0.92	0.75	0.10	0.22	0.18	0.66	1.00	0.37	0.15	0.32	10.38
Vietnam	1997	1481	0.54	0.51	0.09	0.24	0.01	0.75	0.17	0.78	0.08	0.57	0.29	6.90
Vietnam	2002	1841	0.50	0.70	0.15	0.44	0.01	0.77	0.21	0.88	0.20	0.72	0.39	7.13
Yemen, Rep.	1991	1409	0.69	0.54	0.24	0.02	0.17	0.05	0.00	0.51	na	0.52	0.00	na
Zambia	1992	1110	0.37	0.07	0.06	0.01	0.04	0.19	0.24	0.17	na	0.43	0.21	5.09
Zambia	1996	892	0.41	0.14	0.05	0.01	0.02	0.26	0.14	0.14	na	0.32	0.14	5.13
Zambia	2001	810	0.39	0.15	0.08	0.00	0.02	0.31	0.14	0.14	0.03	0.30	0.12	5.65
Zambia	2007	1794	0.58	0.24	0.13	0.00	0.03	0.41	0.15	0.18	0.29	0.37	0.19	6.84

Source: Demographic and Health Survey, Penn World Tables; calculation by the authors.

Figure A1: Density of Asset indices.