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Never been industrialized: a tale of African structural change

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Never been industrialized: a tale of African structural change

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Abstract. Africa is a case of structural change without industrialization and without diversification. Agriculture's decline was matched by an increase in services and non-manufacturing industry, with manufacturing remaining low and stagnant throughout the post-colonial period. To what extent do these patterns of structural change account for the weak growth dynamics observed in the continent? We provide evidence that what is damaging for growth in Africa is not the expansion in services, but rather the reallocation of economic activity from agriculture to non-manufacturing industry. Because non-manufacturing industry is mainly mining, our results point to a form of resource curse.

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JEL classification: O11, O14, O25

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1. Introduction

Africa has never been industrialized, at least not in the conventional sense. Certainly, the share of agriculture in total GDP has significantly declined since independence. But this decline has been associated with an increase in services (the dominant sector) and non-manufacturing industry (mostly mining). Manufacturing, instead, has always been marginal, with a GDP share stagnating around 10%. At the same time, productive structures in the continent have shown a tendency to become more specialized at higher income levels. All this is in sharp contrast with the experience of many other developing countries. The obvious question is then: to what extent are these peculiar patterns of structural change responsible for the weak growth performance of the continent? Or more generally, what is the impact of structural change on the macroeconomic dynamics of Africa? The purpose of our paper is to provide some empirical evidence to answer these and other related questions.

There is quite a large body of academic literature that looks at the relationship between structural change and macroeconomic dynamics. Industrialization, broadly defined as the reallocation of resources away from agriculture and toward manufacturing, has been often portrayed as the key to making the transition from stagnation to growth (see for instance Hansen and Prescott, 2002). Hausmann et al. (2005), Johnson et al. (2006), and Jones and Olken (2005) analyse growth episodes in large samples of countries and find that growth accelerations often take place in the midst a rapid expansion of manufacturing. This positive effect of manufacturing on growth can be explained in two, not mutually exclusive, ways. First, a country with a broader-based manufacturing sector is more likely to take advantage of technological progress than one which specializes in primary-based products. Second, the expansion of manufacturing helps create a middle class that favours the strengthening of institutions. Rodrik (2007) formalizes some of these mechanisms in a model where "non-

traditional" manufacturing activities are the source of productive externalities that promote growth. Other theoretical models dealing with the macroeconomic effects of the shift from the traditional sector to the modern sector include Matsuyama (1992), Echevarria (1997), Fagerberg (2000), Kongsamut et al. (2001), and Wang and Xie (2004). In a recent contribution, Yaki (2008) presents an OLG model where a sectoral shift from traditional agriculture to modern manufacturing interacts with the degree of wealth inequality (which in turn determines the size of the middle class) to explain why some countries have successfully taken-off while some others have not.[1]

The process of de-industrialization, or tertiarisation, which is taking place in several industrial economies, has also attracted considerable academic interest. Earlier contributions by Baumol et al. 1985, Wolff, 1985, and Borjk, 1999 maintain the argument that the rise of services and the corresponding decline in manufacturing worsens future growth prospects. This would follow from the fact that services are typically characterized by lower productivity than manufacturing. Sasaki (2007) provides a formalization of this view within a model of unbalanced growth that includes Baumol's traditional model (Baumol, 1967) as a special case. However, recent evidence reported by Castaldi (2009) and Maroto-Sanchez and Cuadrado-Roura (2009) suggest that several tertiary activities show dynamic productivity growth rates and that growth does not necessarily have to decline because of the rise in services (see Oulton, 2001 for a theoretical formalization). A closely related debate concerns the contribution of IT to productivity and growth revival in the late '90s in the US and other

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[1] Yaki's paper is also related to the vast literature on the interaction between inequality, human capital, and growth, see for instance the seminal contributions of Galor and Zeira (1993), Galor and Weil (2000), and Galor and Moav(2004).

advanced economies, as for instance discussed by Jorgensen and Stiroh (1999), Jorgensen (2001), and Oliner and Sichel (2000).[2]

Another relevant strand of research relates structural changes to stages of diversification. The standard argument in this case is that economies at early stages of development specialize according to their comparative advantage, which most often lies in the agricultural sector. Opening new sectors becomes affordable only when factors accumulate; that is, when income levels increase. Therefore the prediction is that there is a negative relationship between sectoral concentration and per-capita income. In a seminal paper, Imbs and Wacziarg (2003) empirically show that this relationship is effectively negative, but only up to a point. Past a threshold level of per-capita income around US$ 8800, the relationship turns positive. In other words, countries seem to diversify over most of their development path, but once they achieve a rather advanced development stage they start specializing again. Arguably, specialization in high-income economies could reflect demand linkages that make it optimal for firms to cluster geographically[3] and/or a progressive decline in trading costs.

The paradigm of structural change that emerges from all this literature is one where countries sequentially shift from agriculture to manufacturing and then to services while progressively diversifying their productive base as income levels increase. Two simple stylised facts (which we document in Section 2) indicate that Africa does not fit this paradigm. First, declining agriculture since the early 1960s fed into services and non-manufacturing industries, with manufacturing shares remaining stagnant throughout the post-independence era. Second, with the exception of a mild tendency to decline at extremely low levels of per-capita income, sectoral concentration in African countries increases over almost the entire development path. This means that higher income African economies tend to be less (and not more) diversified

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[2] While earlier contributions tend to focus on the US, some recent papers try and estimate the effect of IT on growth and productivity in advanced European economies. See, inter alia, Salvatore (2003), Jalava and Pohjola (2007), Martinez et al. (2008), Antonopoulos and Sakellaris (2009), Dimelis and Papaioannou (2010)

[3] This explanation draws on arguments pioneered by Krugman (1991).

than lower income economies. Therefore Africa is a tale of structural change without industrialization and without diversification. We believe that this makes it an extremely interesting case study.

Our analysis will focus on the impact of structural change on the growth performance of Africa. More specifically, we want to see whether structural change affects growth after controlling for other fundamental determinants of long-term development. Therefore, we will not employ *shift-share* analysis, which would be useful for an accounting exercise whose objective is to break down overall growth in contribution from the reallocation of resources between sectors and contribution from the increase in productivity within sectors. Instead, we will estimate a regression model where growth in African countries is regressed on a vector of control and variables that measure the strength of sectoral reallocations. In this respect, our work is also related to the empirical literature on the causes of the African "growth tragedy" (see Easterly and Levine, 1997; Bloom and Sachs, 1998; Collier and Gunning, 1999; Nunn 2007 and 2008; Sachs and Warner, 1997; Artadi and Sala-i-Martin, 2003; and Bhattacharyya, 2009). However, while this literature often acknowledges that Africa tends to specialize in low productivity activities, it does not formally study the effect of structural change on growth. A notable exception is the paper by Wells and Thirlwall (2003). They provide a test of Kaldor's growth laws across African countries. In so doing, they estimate a regression of growth on the share of manufacturing. Yet, our methodological approach sharply differs from theirs in several respects. First of all, we do not simply use sectoral shares as regressors, but construct a more sophisticated measure of sectoral shift. Second, we account for the potential endogeneity of sectoral shifts through instrumental variables. Third, we specify our model to include various possible determinants of growth in addition to the measure of sectoral shift. Fourth, we explore different estimators, including a three-stage system estimator, in order to check the sensitivity of our results.

Focusing on Africa is certainly interesting and relevant, but it also involves some considerable data limitations that ought to be acknowledged upfront. Sectoral employment data at the 1 or 2 digit level of disaggregation are not available for many African countries on a panel basis.[4] Therefore, we have to make two pragmatic choices. First of all, we use value added shares, and not employment shares, to measure the size of each sector. Second, we conduct our investigation at a rather aggregate level and look at three macro-sectors: agriculture, industry, and services; industry is further disaggregated into manufacturing and non-manufacturing (which includes mining, construction, and public utilities). The first choice is probably quite acceptable. While several of the theories of structural change explicitly refer to sectoral shift in employment, value added is rather commonly used as an alternative measure of sector size. The second choice is admittedly more drastic. In fact, it is well known that shifts might take place within macro sectors (i.e. from traditional to modern agriculture or from labour-intensive to capital-intensive manufactures) rather than between macro sectors. Still, the disaggregation we employ has the merit to match the simplified representation of an economy with three types of goods (agriculture, manufacturing, and services) that is often used in the theoretical analysis. Furthermore, our two pragmatic choices do allow us to cover satisfactorily almost the entire African continent (up to 51 countries out of 53).

The rest of the paper is organised as follows. In section 2 we present the key stylised facts concerning structural change in Africa. Section 3 presents the econometric analysis and the results. In section 4 we engage in further discussion and interpretation of the results and we try to set the African experience within a broader development context as well as suggest

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[4] Previous literature has often made use of ILO and UNIDO databases. Unfortunately, these databases cover only a limited number of African countries. For instance, in the ILO database, there are only 17 African countries (plus St. Helena) and for only five of them annual observations are available over a sufficiently long period of time. In order to grasp the extent of data limitations for Africa, consider that in their analysis of stages of diversification, Imbs and Wacziarg (2003) use the ILO and UNIDO data and have a sample size of 99 countries, but only 20 of them are African.

some implications for the role of services in development. Section 5 concludes. Variables definition and data sources are provided in the Appendix.

2. Structural change in Africa: stylised facts

This section documents a few basic stylized facts by looking at the co-movements between pairs of relevant variables in the panel of African countries. Because we do not want to impose stringent parametric assumptions on the form of the relationships, we follow Cleveland (1993 and 1994) and fit locally weighted polynomial regressions for the variables of interest. More specifically, consider two variables y and x, i.e. the value added share of manufacturing (y) and per-capita GDP (x). Data are structured as a panel of m cross sections and t years. We stack cross-section so to obtain for each variable a string of $N = m \times t$ datapoints. For each data point x_n, with $n = 1, 2....N$, we fit a regression $y_i = \alpha + b_1 x_i + b_1 x_i^2 + \cdots + b_1 x_i^k + \varepsilon_i$ using only a subset of observations (y_i, x_i) that lie around x_n and giving smaller weights to observations that are more distant from x_n. A smoothed curve representing the relationship between y and x is then traced out from the fitted values of the N local regressions evaluated at x_n. A relevant property of the smoothed curve is that its shape at high values of x is not affected by data points corresponding to low values of x.[5]

Figure 1 shows fitted lines from local polynomial regressions of sectoral value added shares on real per-capita GDP. It appears that the sectoral composition of GDP undergoes some significant changes as per-capita GDP increases. The share of agriculture sharply declines while the share of industry increases. However, much of this rise in industry seems to occur

[5] In implementing the procedure, we use a bandwidth span of 50%; that is, each local regression includes only 50% of all sample observations. We also set the degree of polynomial of the local regression equal to one. The weighting system is such that observations that are relatively far from the point being evaluated get small weights in the sum of squared residuals of the regression. In fact, we experimented with different bandwidth spans (30%, 40%, and 60%) and different degrees of polynomial (2 and 3) and results appear to be quite consistent. We also repeated the exercise by giving each observation in the local regression the same weight and, again, the fitted lines look quite similar to those reported in this paper.

outside the manufacturing sector. In fact, the share of manufacturing remains generally very low at all levels of per-capita GDP. Services instead are the dominant sector over almost the entire range of per-capita GDP. Note however that much of the increase in services occurs at the very early stages of development.

The time profile of the structural change is presented in Figure 2, where fitted lines are drawn from local polynomial regressions of sectoral shares on the time trend. The decline in agriculture has occurred progressively since independence and it has been matched by a corresponding increase in industry and services. However, within industry, manufacturing has remained rather stagnant and on average just around 10% of aggregate GDP throughout the five decades of independence.

Taken together, Figure 1 and 2 provide a first stylised fact: structural change in Africa occurs without industrialization, whereby industrialization we mean a significant rise in the share of manufacturing. The expansion in the industry sector that we observe is mainly the consequence of the rise in mining.

INSERT FIGURES 1 AND 2 ABOUT HERE

Figure 3 displays the relationship between the degree of sectoral concentration of the economic structure and the level of per-capita GDP. Concentration is measured by the Herfindhal index $H = \sum_{q=1}^{3}(s_q)^2$, where s is the value added share of sector q and $q =$ agriculture, industry, services. As mentioned in the previous section, using more disaggregated data and a larger sample of countries, Imbs and Wacziarg (2003) find a U-shaped relationship, with a turning point at approximately US$ 8800. Instead, we obtain an almost linearly upward sloping fitted line. There is indeed a very small decrease in concentration at very low levels of per-capita GDP, but this is rapidly reversed and the

turning point occurs at around US$ 150. The figure is therefore indicative of a second stylised fact: the average African countries specializes (rather than diversifies) over almost its entire development path. We should also add that in the course of specialization, agriculture is the sector that progressively disappears.

INSERT FIGURE 3 ABOUT HERE

The first two stylised facts suggest that in Africa agriculture has fed into services and non-manufacturing industry. Figure 4 provides some additional evidence on the strength of this "feeding-effect". The fitted lines are obtained from the regression of the change in the sectoral share of sector j (with j = manufacturing, services, industry) on the change in the sectoral share of agriculture. As expected, the fitted lines for services and industry are significantly downward sloping, meaning that an increase in the shares of these two sectors corresponds to a decline in the share of agriculture. Moreover, the fitted line for the service sector is steeper, thus suggesting that a decline in agriculture is more closely associated with an increase in services than in industry. The line for manufacturing is instead flat around 0. This confirms that there is little reallocation of value added from agriculture to manufacturing. The inverse correlation between changes in agriculture and changes in industry must occur because of the reallocation of value added from agriculture to mining and other non-manufacturing industry. Therefore, out third stylised fact is that the value added from declining agriculture feeds primarily into services, to some smaller extent into non-manufacturing industry, and to an almost negligible extent into manufacturing. An important corollary observation to be drawn from Figure 4 is that there is no evidence of significant non-linearities in the correlations between changes in sectoral shares.

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Taken together, our stylised facts indicate that structural change in Africa does not fit the structural change paradigms portrayed by the literature. In Africa, structural change involves no significant industrialization, increasing specialization at higher income levels, and the reallocation of value added from agriculture to services and non-manufacturing industry. What does all this imply for economic growth? Before we undertake some more formal econometric analysis to answer this question, let us consider the simple summary statistics in Table 1. These are average growth rates for different subset of African countries over the period 1960-2008. Each subset is defined by the intersection of two groups: (i) countries with increasing (or decreasing) share of agriculture and (ii) countries with increasing (or decreasing) share of any of the other sectors. The number of countries in each subset is reported next to the average growth rate. Thus for example, there are eight countries that over the period 1960-2008 have experienced an increase in the share of agriculture and an increase in the share of manufacturing. The average annual growth rate in this subset of eight countries is -0.65%.

The data in the table provide some interesting insights. First of all, positive growth is generally observed in association with declining agricultural shares. This suggests that in the 13 countries where agriculture has increased, transformation from traditional to modern farming has not occurred. Second, given a decline in agriculture, countries with increasing services have achieved the highest average growth rate. The growth rate of countries with increasing manufacturing is the second highest and about one percentage point lower than the

growth rate of countries with growing services. Therefore, sectoral reallocation from agriculture directly to services, without passing through manufacturing, does not necessarily hurt growth relative to a more conventional process where agriculture feeds into manufacturing. Finally, the growth rates associated with increasing industry are quite low in general (in fact, they are the lowest in each column) and lower than the growth rates associated with increasing manufacturing. Given that in Africa the expansion of non-manufacturing industry mostly takes the form of rising mining (oil and other natural resources), this might be indicative of some form of resource curse. One might also be more specific and note that the most negative growth rate occurs when increasing industry is associated with increasing agriculture. As already noted, the expansion in agriculture does not seem to be accompanied by a transformation from traditional to modern farming and generally determines negative growth. This means that increasing agriculture implies lower levels of development and hence that the resource curse is probably more pronounced at the early stages of development.

3. Econometric analysis

In this section, we present a formal econometric analysis of the effect of structural change on growth. We empirically represent structural change by the correlation between change in the share of agriculture and change in the shares of the other sectors in each country. The obvious alternative would be to simply use shares of sectors as regressors. However, because we are interested in understanding how different patterns of sectoral reallocation affect African growth performance, correlations between changes in sector shares seem to be a more appropriate explanatory variable. Of course, the process of structural change is endogenous to economic dynamics, meaning that correlations between changes in sectoral shares are

endogenous to growth. We will therefore have to identify a suitable instrument for our explanatory variable.

3.1. Model specification

Our econometric framework is nested within a standard growth regression model:

$$(1) \quad g_c = \alpha_0 + \alpha_1 z_c + \boldsymbol{AW_c} + \varepsilon_c$$

where c denotes a generic country in Africa, g is the annual rate of per-capita GDP growth averaged over the period 1960-2008, z is the correlation between annual change in the value added share of agriculture and the annual change in the value added share of any other sector, $\boldsymbol{W}$ is a vector of other potential determinants of long-term growth, ε is a stochastic term, and α_0, α_1, and the vector $\boldsymbol{A}$ are all parameters to be estimated.

Because the model is going to be estimated as a cross-section, a total of at most 51 observations will be available. This means that the specification of the set of controls $\boldsymbol{W}$ must be sufficiently parsimonious to guarantee that there are enough degrees of freedom left for reliable statistical inference. Driven by this necessity, our basic specification includes: ethnic fragmentation, distance from equator, a dummy variable for UK legal origin, and the log-level of per-capita income at the beginning of the sample period. Individually, each of these variables has been considered as a potential fundamental cause of growth and development in previous studies (see for instance Easterly and Levine, 1997; Hall and Jones, 1999; Acemoglu et al. 2001; Alexeev and Conrad, 2009; Bhattacharyya, 2009). Jointly, the four controls are found to explain much of the cross-country variation in the quality of institutions and governance (see La Porta et al.1999). Moreover, these controls are clearly exogenous and

therefore do not pose problems of instrumentation (as instead other measures of institutional quality, for instance, would).

As previously noted, our structural change variable is likely to be endogenous to the growth rate. This implies that model (1) ought to be estimated using a two-stage instrumental variables procedure (2SLS). The critical issue is then to identify a valid instrument; that is, an instrument which is (i) strongly correlated with structural change and (ii) uncorrelated with the error term in equation (1). To this purpose, we first run preliminary OLS regressions of our empirical proxy z on a few potential determinants of structural change. From these regressions we will identify the variables that appear to explain most of the variation in z and use them as instruments in the two-stage estimation of model (1). We will then submit our instruments to a battery of test to assess their exogeneity and relevance.

We consider three possible determinants of structural change. One is population density. The rise of a modern service sector is likely to be facilitated by the existence of demand externalities that can arise from the geographical clustering of population. In this respect, population density should make the negative correlation between share of agriculture and share of services stronger in absolute values. Conversely, higher density should make the correlation between services and industry (including manufacturing) less negative or even positive. The second determinant we look at is resource abundance, as measured by the value of oil reserves in a country. Greater resource abundance would lead a country to specialize in mining at the expense of manufacturing and services. The expectation is therefore that higher values of the oil reserve variables make the correlation between agriculture and industry more negative and the correlations between agriculture and services/manufacturing less negative (or even positive). Finally, a third important factor affecting the pattern of sectoral reallocation has to relate to the physical configuration of the territory. A higher quality soil would probably favour the transformation of agriculture from traditional to modern and

reduce the extent of reallocation away from agriculture and towards manufacturing. While the argument is intuitively appealing, the empirical measurement of soil quality can be quite difficult. However, we rely on a set of dummy variables reported by Acemoglu et al. (2001) for deserts, steppes, desert dry winter, and dry steppe wasteland.

The results of the preliminary OLS regressions are shown in Table 2. In the remainder of this paper we will refer to the variable *z* as *service correlation* (to indicate the correlation between changes in the sectoral share of agriculture and services), *industry correlation* (to indicate the correlation between changes in sectoral share of agriculture and industry), or *manufacturing correlation* (to indicate the correlation between changes in the sectoral share of agriculture and manufacturing). For each of these three versions of the variable, we report two sets of estimates. The first (columns I, II, and III) only includes population density and oil reserves as potential determinants of structural change. The second (column IV, V, and VI) also includes the soil dummies. In order to assess the goodness of fit of the regression, we also provide the F-statistic of joint significance of the regressors and the standard R^2

As can be seen from the table, population density and oil reserves have the expected sign and are generally statistically significant. The oil dummies instead do not seem to add much in terms of ability of the regression to explain cross-country variance in structural change patterns. Based on these regressions we therefore choose to instrument structural change by population density and oil reserves. Both these variables appear to be exogenous to economic growth, but a more formal test of exogeneity will be performed. The last thing to note at this stage is that the estimated coefficients of the regression of *service correlation* are almost exactly the opposite of the estimated coefficients of the regression of *industry correlation*. This should not come as a surprise: the shares of agriculture, industry, and services must add-up to one. Therefore, in aggregate, changes between shares must cancel out.

INSERT TABLE 2 ABOUT HERE

3.2. Results

Model (1) is estimated separately for each of the three versions of our structural change variable *z*, namely *service correlation, industry correlation,* and *manufacturing correlation*. The first stage of the estimation of model (1) consists in a regression of the structural change variables on the instruments (population density and oil reserves) and the other exogenous controls (ethnic fragmentation, initial income, UK legal origin, and distance from equator). We report these first stage estimates in Table 3. We are particularly interested in the partial R^2 statistics and the associated robust F-statistics reported at the bottom of the table. The partial R^2 is a measure of goodness of fit of the first stage regression obtained by partialling out the other exogenous controls. Rejection of the null hypothesis of the associated F-test can therefore be taken as evidence that population density and oil reserves are relevant instruments for structural change (see Baum et al. 2003).[6] In fact, the restuls of the first stage seem to provide broad support to our choice of instruments. Population density and oil reserves remain both individually and jointly significant, meaning that they are indeed relevant. The other exogenous regressors play a relatively marginal role in explaining structural change.

INSERT TABLE 3 ABOUT HERE

We can now turn to the core of our econometric results. Table 4 reports the second stage estimates of model (1). In the last raw of the table we show the Sargan test-statistic and the

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[6] Because there is only one endogenous regressor in model (1), the partial R^2 is equal to the Shea's partial R^2.

associated p-value. It appears that the null hypothesis that the overidentifying restrictions implied by our choice of instruments cannot be rejected at usual confidence level. Although this test might not be conclusive, it does suggest that our instruments are exogenous, in addition to being relevant. All in all, the available evidence indicates that we have used valid enough instruments.

Consider now the estimated coefficients. To start with, a couple of interesting results emerge with respect to the control variables. The non-significant coefficient of initial per-capita income implies that there is no evidence of conditional convergence (or even divergence) in the African continent. The negative growth effect of ethnic fractionalization discussed by Easterly and Levine (1997) shows up quite clearly in our model. Also in line with previous studies is the finding that UK legal origins promote growth. Most of African legal systems originates from either the English Common Law or the French Commercial Code. As argued by La Porta et al. (1999) the English Common Law was meant to protect the parliament and property owners against the abuses of the King. On the contrary, the French Code has developed more as an instrument used by the sovereign to control economic life. Institutions and governance systems that have evolved from the English Common Law tend to be of a higher quality and more conducive to financial development. This explains the positive coefficient of the UK legal origins dummy.

The structural change variables appear to be both statistically and economically highly significant. In line with the conventional paradigm, the coefficient of *manufacturing correlation* is negative: the more negative the correlation between changes in the share of agriculture and changes in the share of services is, the faster the rate of growth will be. In other words, when value added is being reallocated from agriculture to manufacturing, growth accelerates. However, the coefficient of *service correlation* is also negative, meaning that a reallocation away from agriculture and towards services (without necessarily passing

through manufacturing) does not necessarily retard growth. There is quite a sizeable numerical difference between the two coefficients. To some extent, this might be due to the fact that *service correlation* has a much higher mean (in absolute value) and larger standard deviation than *manufacturing correlation*. Correcting for this difference in the scale of the two variables, the marginal effect of *service correlation* is larger, in line with the preliminary evidence from Table 2.

The positive coefficient of *industry correlation*, which is clearly the counterpart of the negative coefficient of *service correlation*, indicates that the sectoral shift from agriculture to overall industry is not conducive to faster growth. However, because reallocation to manufacturing is growth-enhancing, one can conclude that what is negative for growth is the decline in agriculture combined with the rise in non-manufacturing industry. As mentioned already a few times, non-manufacturing industry in Africa tends to be dominated by mining, so that in the end, our regression results establish a form of resource curse for the continent.

INSERT TABLE 4 ABOUT HERE

3.3. *Sensitivity analysis and robustness checks*

We perform three main checks of the robustness of our result. First, we re-estimate our regression model including only time-invariant variables; that is, excluding initial per-capita income. Second, we re-estimate the model using the limited information maximum likelihood (LIML) estimator. In fact, even though the first stage diagnostics and the Sargan test provide support to our choice of instruments, weak instruments is still a concern with instrumental variable estimation and bias in the two stage least squares cannot be ruled out. The LIML estimator does not have such a bias and it is therefore important to see whether our results

survive when we use this estimator. Third, we estimate model (1) as a system of three equations. In practice, because our structural change variable z is threefold, model (1) incorporates three versions of the same growth equation:

$$(2a) \quad g_c = \alpha_0^{ser} + \alpha_0^{ser} ser_c + \boldsymbol{A^{ser}W_c} + \epsilon_c^{ser}$$

$$(2b) \quad g_c = \alpha_0^{ind} + \alpha_0^{ind} ind_c + \boldsymbol{A^{ind}W_c} + \epsilon_c^{ind}$$

$$(2c) \quad g_c = \alpha_0^{man} + \alpha_0^{man} man_c + \boldsymbol{A^{man}W_c} + \epsilon_c^{man}$$

where *ser* is the *service correlation*, *ind* is the *industry correlation*, and *man* is the *manufacturing correlation*. The estimates in tables 3 and 4 assume that each of the three versions of model (1) is estimated separately from the others. However, if there residuals are correlated across equations, then estimating the three versions jointly as a system is more efficient. To this purpose, we use the GMM estimator described in Wooldridge (2003). As well known, other system estimators (including the traditional 3SLS) can be viewed as special cases of the GMM estimator.

Table 5 summarizes the results of these additional checks. For each of the three structural change variables we report the estimated coefficients from model (1) without initial per-capita income (top three rows), the estimated coefficients from system estimation (middle three rows), and the estimated coefficients from LIML estimation (bottom three rows).[7] It is clear that the pattern of results is robust: *service correlation* and *manufacturing correlation* always have a negative and statistically significant coefficient.

All in all, our econometric analysis suggests that the pattern of sectoral change matters for growth in Africa. Consistent with the conventional view, a strong negative correlation

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[7] In an attempt to save some space, we do not report the estimated coefficients of the other control variables. They are qualitatively very similar to those in tables 4. The full set of estimated coefficients is however available from the authors upon request.

between changes in the value added share of agriculture and changes in the value added share of manufacturing increases growth. That is, a shift away from agriculture towards manufacturing creates the basis for growth accelerations. However, a reallocation from agriculture to services without passing through manufacturing is also conducive to growth and its marginal effect might even be stronger than the marginal effect of the reallocation from agriculture to manufacturing. In the end, what seems to worsen macroeconomic dynamics is a sectoral shift from agriculture to non-manufacturing industry. Given the prominent role of mining in non-manufacturing industry, this latter finding establishes a form of natural resource curse for Africa. The next section will provide further interpretations of these results from a policy perspective.

4. Discussion

The stylised facts and econometric results documented sections 2 and 3 induce three main reflections on the role of services in the process of development. First of all, we hypothesize that structural change without industrialization might not be an exclusive African prerogative. Mandeville and Kardoyo (2009) emphasize that in the knowledge-based economy (KBE) era, developing countries may be able to leapfrog the standard linear patterns of structural change that advanced countries historically progressed through. At the very least, the structural change pattern of development seems to have become more fluid in the KBE era. Some countries, such as China, continue to resemble the traditional patterns of reallocation from agriculture to manufacturing. But India, for example, has by passed manufacturing and moved straight to services. Indonesia, instead, appears to have moved from agriculture to manufacturing and services simultaneously. It is likely that emerging roles for ICTs and services in the economy are driving these changes. Thus, ICTs may have become key

enabling industries in both advanced and developing economies in the KBE era. For instance, the explosion of diffusion of mobile phones in Africa since 2000 will have hugely impacted on connectivity in the economy, thereby facilitating self-organised entrepreneurial and innovative activities in services (see Rooney et al. 2003), including development of new categories of services.[8]

Second, while the above ideas, perhaps, help explain the predominance of services in African economies since the KBE era began in mid 1990s, it remains to be explained why services were also the dominant sector at the beginning of the 1960s. Perhaps, the pattern of colonial rule in Africa was associated with relatively high levels of urbanisation and therefore high levels of activity in the services sector. Perhaps, aid dependency coupled with growth of the public sector, in the immediate post-colonial period, explains both the large size and the rapid growth of the service sector in the 1960s and early 1970s.

Third, given the qualitative and quantitative importance of the service sector in African (as well as several non-African) economies, policymakers ought to devote some attention to increasing the efficiency in this sector. Here we point to the complementarities and interdependencies between services and both manufacturing and mining activities. Manufacturing and mining development require efficient transport, telecommunications, finance, business services, wholesale service, construction services, human capital (health and education), and governance services such as robust property rights, contract law and security/police services. Foreign direct investment in manufacturing and mining may obscure these necessary complementarities by bundling many of these services into the process. Succesful long term development from FDI partly proceeds by unbundling some of these services, as well as manufacturing skills and activities, into the wider economy.

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[8] According to the April 17-18, 2010 issue of "The Economist" Magazine (pages 23-33), Kenya leads the world in money transfer via mobile phone.

5. Conclusions

In this paper we study the effect of structural change on growth in Africa. First of all, we document a few stylised facts concerning the pattern of structural change in the continent. It appears that Africa is a tale of structural change without industrialization and without diversification. The five post-independence decades are characterised by a sharp decline in agriculture matched by an increase in services and non-manufacturing industry. Manufacturing has instead remained low and stagnant throughout the period of observation. These reallocations resulted in a positive relationship between the degree of sectoral concentration and the level of per-capita income; in other words, the average African country specializes (rather than diversifies) over almost its entire development path.

Then, we move on to the formal analysis of the impact of these patterns of structural change on growth dynamics. To this purpose we estimate a growth regression model, using the correlation between changes in the share of agriculture and changes in the share of the other sectors as our measure(s) of structural change. After controlling for a number of other potential determinants of long-term growth, we find that reallocation from agriculture to services is not an obstacle to growth, even without going through the manufacturing phase of structural transformation.[9] What really seems to retard growth is the reallocation from agriculture to non-manufacturing industry. Because non-manufacturing industry in Africa is dominated by mining, we argue that our results also establish a form of resource curse for the continent.

The above results stimulate a number of reflections on the role of services in the process of economic development. We flag some of these reflections in section 4 and we believe that

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[9] It would seem that in the KBE era, services can be associated with growth in both advanced and developing economies.

further theoretical and empirical analysis of the hypothesis put forward in that section is a very promising avenue of future research. We also stress the importance of including issues relating to the service sector in the policy debate on structural transformation. While few would challenge the merits of promoting the emergence of a dynamic manufacturing sector, the focus on industrialization should not distract attention from the issues of increasing efficiency in the service sector and supporting the transformation in the agriculture sector from traditional to modern farming.

Appendix: Variables definition and data sources

Name of the variable (and short name used in some tables)	Definition	Data sources
Value added share of: - Agriculture - Industry - Manufacturing - Services	Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. Agriculture corresponds to ISIC divisions 1-5. Industry corresponds to ISIC divisions 10-45. Manufacturing corresponds to ISIC division 15-37. Services correspond to ISIC 50-99.	World Bank (2009)
Per-capita GDP	Per-capita GDP in constant US dollars (base year = 2000)	World Bank (2009)
Herfindhal index	Measure of sectoral concentration computes as the sum of the squared value added shares of industry, agriculture, and services	Authors' computation based on World Bank (2009)
Service correlation (ser_correl)	Correlation coefficient between changes in the value added share of agriculture and changes in the value added share of services	Authors' computation based on World Bank (2009)
Industry correlation (ind_correl)	Correlation coefficient between changes in the value added share of agriculture and changes in the value added share of industry	Authors' computation based on World Bank (2009)
Manufacturing correlation (manu_correl)	Correlation coefficient between changes in the value added share of agriculture and changes in the value added share of manufacturing	Authors' computation based on World Bank (2009)
Population density (pop_den)	Midyear population divided by land area in square kilometres.	World Bank (2009)
Oil reserves (oilres)		Acemoglu et al. (2001)
Soil_1	Dummy variable taking value 1 for steppe (low latitude) land	Acemoglu et al. (2001)
Soil_2	Dummy variable taking value 1 for desert (low latitude) land	Acemoglu et al. (2001)

Soil_3	Dummy variable taking value 1 for desert (middle latitude) land	Acemoglu et al. (2001)
Soil_4	Dummy variable taking value 1 for dry steppe wasteland	Acemoglu et al. (2001)
Legal origin UK (legor_uk)	Dummy variable taking value for countries whose legal system originates from the British Common Law	La Porta et al. (1999)
Distance from equator (lat_abst)	Geogrpahical distance of a country capital city from the equator (in Km)	La Porta et al. (1999)
Ethnic fractionalization (ethnix)	Probability that two randomly selected individuals will not be in the same ethnic group	La Porta et al. (1999)

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Figures

Figure 1: Neighbour Regression Fit of value added shares and per-capita GDP
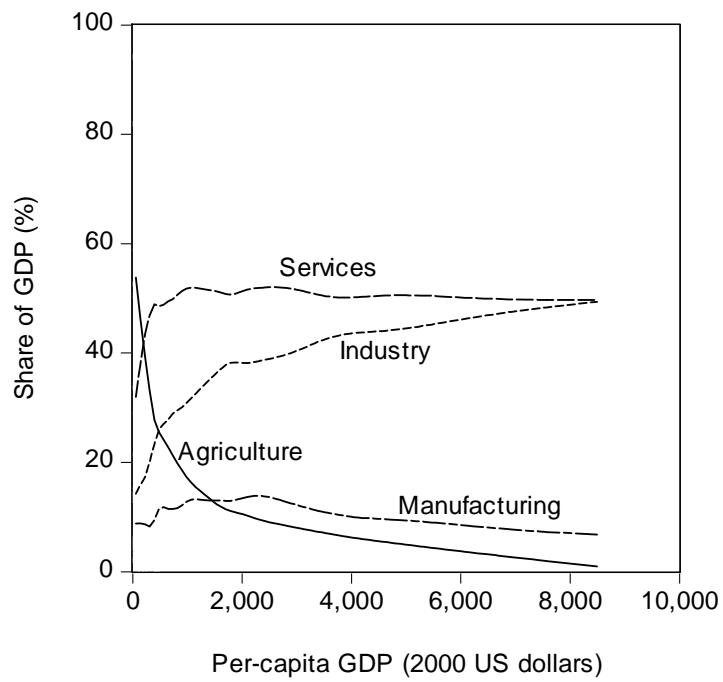

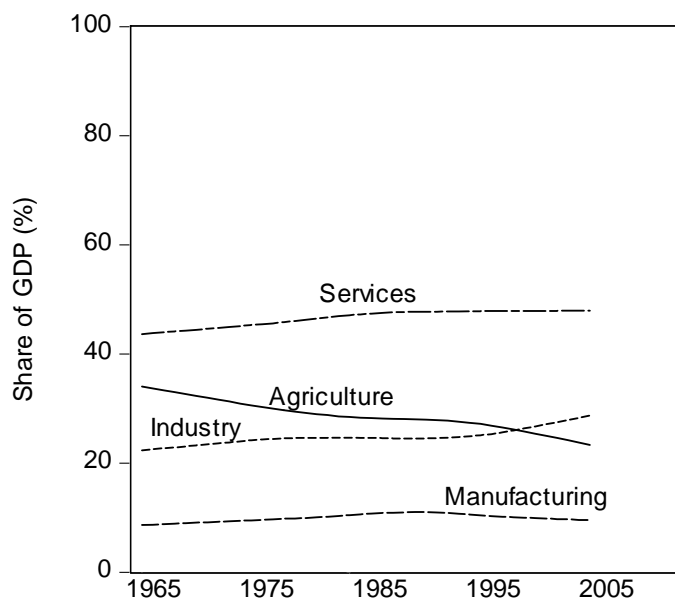Figure 2: Neighbour Regression Fit of value added shares and time

Figure 3: Neighbour Regression Fit of the Herfindhal index of sectoral concentration and per-capita GDP
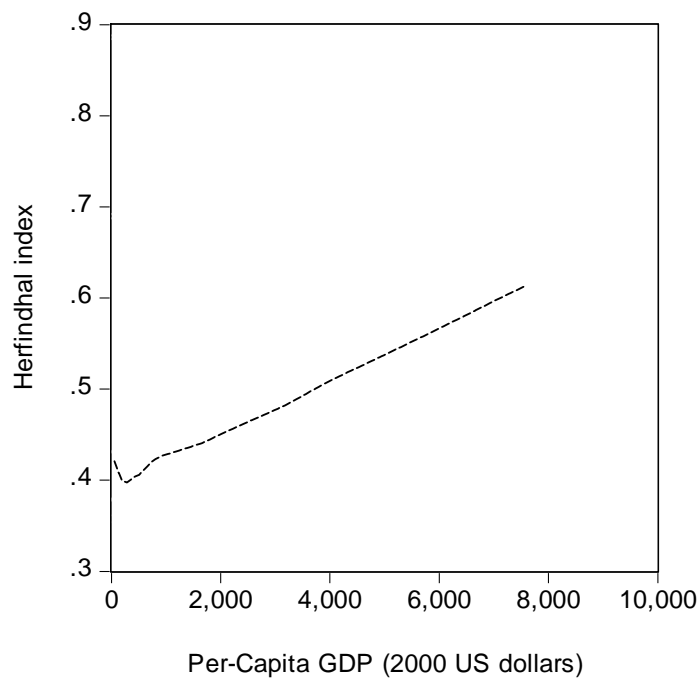

Figure 4: Neighbour Regression Fit of changes in the sectoral share of agriculture and changes in the sectoral shares of the other sectors.
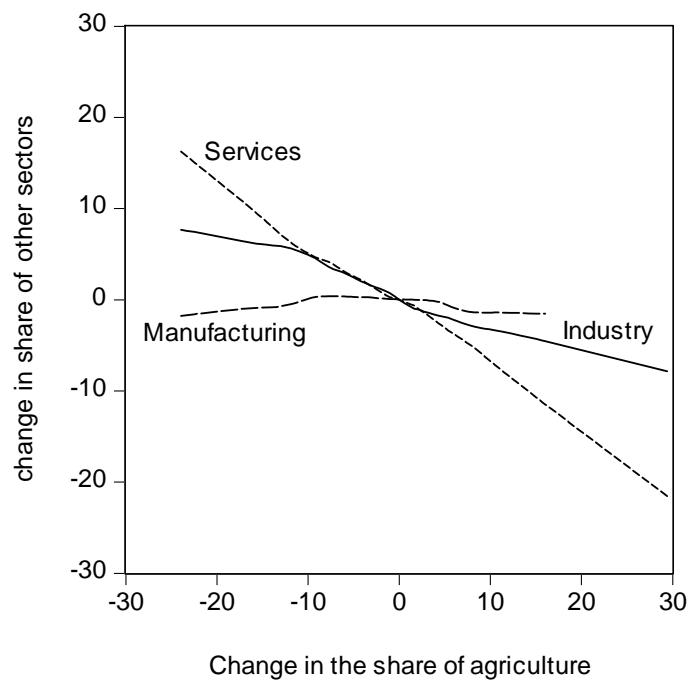
Table 1: Average growth rates in subsets of Africa countries

	Agriculture	
	Increasing	Decreasing
Manufacturing		
- Increasing	-0.653 (8)	2.245 (19)
- Decreasing	-0.961 (5)	1.319 (19)
Industry		
- Increasing	-1.031 (11)	0.919 (7)
- Decreasing	0.657 (2)	1.972 (30)
Services		
- Increasing	-0.942 (4)	3.298 (8)
- Decreasing	-0.696 (9)	1.374 (30)

Notes: The number in brackets indicate the number of countries in each subgroup. Growth rates are averaged across all countries in the subgroup and over the entire period of observation 1960-2008. See text for details on the identification of the subgroups.

Table 2: Preliminary OLS regressions of sectoral change variables

	I Ser_correl	II Ind_correl	III Manu_correl	IV Ser_correl	V Ind_correl	VI Manu_correl
Pop_den	-0.002***	0.002***	0.001	-0.002**	0.002**	0.001
Oilres	0.149***	-0.149***	0.021***	0.15***	-0.15**	0.021***
Soil_1	...	...	...	0.072	-0.071	-0.003
Soil_2	...	...	...	0.258	-0.256	0.012
Soil_3	...	...	...	-0.347	0.347	-0.305***
Soil_4	...	...	...	-0.176	0.176	-0.028
F-test	38.139***	38.133***	8.752***	12.205***	12.198***	3.044**
R2	0.623	0.623	0.276	0.635	0.635	0.303

Notes: *,**,*** denote statistical significance of estimated coefficients at 10%, 5%, 1% confidence level respectively. Estimates of the constant term in the regression are not reported

Table 3: Estimation of equation (1), first stage estimates

	I Ser_correl	II Ind_correl	III Manu_correl
Pop_den	-0.005*	0.005*	0.001*
Oilreser	0.137***	-0.137***	0.017***
Log(per capita GDP)	0.204	-0.207	0.068
Legor uk	0.067	-0.065	0.379
Lat abst	-2.794	2.814	-1.138**
Ethnix	-0.849	0.851	-0.445*
R2	0.855	0.856	0.527
Partial R2 (robust F-stat)	0.7828 (298.602)***	0.7835 (298.288)***	0.3503 (28.245)***

Notes: Per-capita GDP is measured at the beginning of the sample period (around 1960). Equations are estimated on a cross-section of 49 countries. *,**,*** denote statistical significance of estimated coefficients at 10%, 5%, 1% confidence level respectively. For the robust F-stat, *** denotes rejection of the null hypothesis of the test of significance of the excluded instrument at the 1% confidence level. Estimates of the constant term in the regression are not reported

Table 4: Estimation of equation (2), second stage estimates

	I	II	III
Log(per capita GDP)	0.354	0.355	0.377
Legor uk	1.126**	1.229*	1.218**
Lat abst	1.356	1.353	0.263
Ethnix	-2.793***	-2.791***	-3.267***
Ser_correl	-0.433***	..	..
Ind_correl	..	0.434***	..
Manu_correl	..	..	-3.056***
Sargan test (p-value)	0.292 (0.588)	0.295 (0.587)	0.751 (0.386)

Notes: The dependent variable is always the average annual rate of per-capita GDP growth. Per-capita GDP is measured at the beginning of the sample period (around 1960). Equations are estimated on a cross-section of 49 countries. *,**,*** denote statistical significance of estimated coefficients at 10%, 5%, 1% confidence level respectively. For the Sargan test, the p-value refer to the null hypothesis that the overidentifying restrictions are valid.. Estimates of the constant term in the regression are not reported

Table 5: Robustness checks

	I Ser_correl	II Ind_correl	III Manu_correl
2SLS without per-capita GDP	-0.412***	0.412***	-2.957***
System estimates	-0.246**	0.246**	-1.089
LIML estimates	-0.436***	0.436***	-2.736*

Notes : Only the estimated coefficients of the structural variables are reported. Estimated coefficients of the controls in each regression are available upon request. Structural change variables are included one at the time in each regression. See text for details on the different estimation methods. The dependent variable is always the average annual growth rate of per-capita GDP over the period 1960-2008. *, **, *** denote statistical significance of the estimated coefficients at the 10%, 5%, 1% confidence level respectively.