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The impact of structural change on productivity growth and inequality

The case of Sub-Saharan Africa

PhD student:

Maurizio La Rosa

Tutor:

Prof. Matteo Lanzafame

PhD program Supervisor:

Prof. Edoardo Otranto

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Contents

Foreword

There has been a renewed interest among scholars towards the growth perspectives of Sub-Saharan Africa. This interest has derived from the positive growth performance of the region during the years 2000, driven by the boom in commodity prices of the period. Given the dominant part played by the biggest countries in the region in terms of GDP (Nigeria and South Africa alone account for more than 50% of the GDP produced in the region) it is evident that African countries heavily depend on their natural resources endowment and are prone to commodity shocks. Besides, the region is populated by a large number of tiny countries, whose contribution to the regional GDP is extremely small. Analysing the growth performance of the region as an aggregate fails completely to take into account the economic structure of these countries. However, there is often a problem of data availability when addressing the study of the economies of Sub-Saharan African countries: apart from the overall GDP and large-sector disaggregations, the World Bank and other international institutions are not able to provide reliable data on a number of important economic variables (unemployment, for instance). However, this has not stopped researchers from trying hard to address the question of underdevelopment in Africa, since it involves the lives of hundreds of millions of people. Recently, it also directly involves developed society, when immigration trends are concerned.

The question of African underdevelopment has often been studied within the general framework of the growth studies originated by the neoclassical theory of economic growth, having in mind the question of convergence and estimating the significance of an African dummy in growth regressions (Barro, 1991).

A number of studies has also tried to identify the main factors affecting the African growth performance and they are revised in the first paragraph of Chapter 1 of the thesis. The idea of the deep determinants is very useful in the African context and it has generated meaningful studies highlighting the geographical, social and institutional specificities of African countries as well as the ways in which they affect economic growth.

Recent studies have concentrated on the condition of structural underdevelopment of Sub-Saharan African countries. The large dimension of the agricultural sector and the large contribution of the natural resources (oil, minerals) to overall GDP have proved to be serious constraints rather than opportunities for the development of the region. Studies on the matter are revised in the second part of Chapter 1, while Chapter 2 provides a three-sector analysis that shows the dimension of the agricultural sector (large in terms of employment shares, small in terms of value added share) and how the manufacturing sector is not expanding in terms of structural transformation, while the services are the sector with the largest productivity in the majority of the countries in the sample. This has also led many authors to hypothesize a different path for structural transformation for Sub-Saharan African countries, rather than the one that has led to rapid industrialisation and dramatic GDP per capita growth in already developed countries.

The population growth dynamics are a very relevant element to be taken into account when studying African development perspectives. Population growth is still high in the region and this implies that GDP per capita grows more slowly than perhaps desirable. They are taken into account in both the analyses of Chapter 2 on structural change and Chapter 3 on inequality.

The question of inequality is another important element of the overall picture of the region. While it is an important factor in the analysis of any economy, because it involves the question of granting equal possibilities to anyone independently of their social belonging, it assumes greater relevance for Africa as it is intertwined with the problem of extreme poverty, life expectancy and child mortality. Chapter 3 tries to assess if structural change is relevant in addressing the question.

CHAPTER 1 - REVIEW OF RELEVANT LITERATURE ABOUT THE GROWTH AND STRUCTURAL CHANGE PROSPECTS OF SUB-SAHARAN AFRICA

Abstract

In this chapter we propose a review of relevant economic literature focused on the development prospects of Sub-Saharan Africa. A remarkable effort by the literature on economic growth and development has been that to identify the factors that determine the dramatic differences existing between developed and underdeveloped countries. The literature that has studied Africa has described the peculiar characteristics that make growth in the region particularly tricky, which are well identified by the distinction between proximate and deep determinants of economic growth. Our focus is then directed to the process of structural transformation. Structural change has been necessary in the past experience of developed countries to improve productivity and drive economic growth. Sub-Saharan Africa seems to lag behind in the process and part of the renewed interest in African growth prospects is centred on the dimension of the agricultural sector, on the need to foster agricultural productivity and on the benefits that would derive from it.

JEL classification – O10; O40; O55
Keywords – Sub-Saharan Africa, Economic development, Growth prospects

1.1. Determinants of poor growth in Sub-Saharan African economies

i. Deep and proximate determinants of growth

An interesting perspective from which to look at the African growth performance is the one provided by Rodrik et al. (2004), who distinguish between deep and proximate determinants of economic growth. The authors try to give a new contribution to the study of economic growth, dominated by the neoclassical Solow-Swan model (Solow, 1956; Swan, 1956) and updated by the endogenous growth models proposed by Romer (1986) and Lucas (1988). In their paper they ask: if growth is the result of factor accumulation and productivity-rising technological progress (proximate determinants), why do some countries succeed in doing this while others do not? To answer they identify three (deep) factors that determine which societies will accumulate and innovate and hence grow faster than the others: geographical position, integration with the world economy (trade openness) and institutions. The analysis presented in Rodrik et al. (2004) draws on a large number of similar comparative growth studies (i.e., among all others, Sachs (2001) and Acemoglu, et al. (2001), but the invaluable insights of Collier and Gunning (1999a and 1999b) are even more relevant) and contribute to the literature producing a clear classification and examination of the main causal links between these factors and growth. In particular, the authors take great care in dealing with the econometric issues affecting this type of studies. For instance, while geography is mostly exogenous and poses little identification problems, institutions and trade integration can, by a relevant (and hence potentially confounding) extent, be endogenously influenced by each other and by the growth process: trade integration can result from improved institutions (promoting policies aimed at removing barriers to trade and keeping a flexible exchange rate) or from increased productivity (production would then satisfy more than the domestic needs); better institutions, on the other hand, can be imported (like technology) when a country has an improved international integration, or can result from the growth process when it shifts the *de facto* political power from the rent-seeking parts of society towards the most productive ones, fostering policies promoting entrepreneurial and trade opportunities. The identification strategy that Rodrik et al. (2004) rely upon to disentangle the causal links between the deep determinants of economic growth and growth itself uses the instruments in Acemoglu et al. (2001) and Frankel and Romer (1999), but embeds them in a broader econometric framework. Their estimates suggest that institutions rule over geography and integration. Though simple OLS regressions of growth against each determinant yield positive and significant coefficients (hence geography[1], integration[2] and good institutions are associated with increases in growth), after instrumenting institutions and integration through the instruments proposed by Acemoglu et al. (2001) and Frankel and Romer (1999) respectively, the 2SLS estimates of the full model show that only institutions keep a positive (largely significant) coefficient, while geography and integration become negatively (though insignificantly) associated with growth.

ii. Deep determinants of growth in Sub-Saharan Africa

The idea of the deep determinants seems particularly fit to study less developed countries. While developed countries are provided with good institutions, better geography and operate integrated in a common global market, developing countries are endowed with bad institutions often inherited by the colonial era, suffer from their geographical position and the negative effects it has on agriculture and health, and show difficulties in integrating in the world market. This results in failing to accumulate

[1] Distance from the equator.

[2] Ratio of trade to GDP.

physical and human capital and to implement new technology that could result in higher productivity. This latest aspect is one often stressed by authors studying the growth opportunities of Africa. East Asian countries have been able to take advantage of trade openness. Johnson et al. (2010) show that countries that have escaped poverty in the past (and East Asian countries are the most part of it) have been characterized by the association of rapid growth and growth in exports. Collier and O'Connell (2006) share this same idea, but they consider that, while Africa was better placed than Asia in the '60s (just after independence) and seemed to have a better growth potential, institutional adverse shocks stopped the process of modernization to restore a process of extraction of wealth, this time in favour of its own political elite, rather than colonial countries. This reading of the story fits well with the theory of institutions proposed by Acemoglu et al. (2005). Rather than protecting private properties and thus encouraging capital accumulation, private initiative was constrained by the use of institutions by the political elite, focused on keeping their power, which guaranteed them with their wealth. Johnson et al. (2010) as well stress that if property rights are insecure for the majority of the population and there exist the concrete risk of expropriation by the state, by elites or because of high political instability then institutions are bad. If instead property rights are protected entrepreneurs will invest in physical capital and households will invest in human capital, hence the process of capital accumulation can take place. They also stress that countries can start growing without good institutions, but institutions must improve for growth to be sustainable.

The paper by Rodrik et al. (2004) investigates the effects of the deep determinants on the growth performance of a large sample of advanced and emerging economies. Thus, while generally establishing the predominance of institutions over geography and integration, it has little to say about the specific channels through which these three determinants have interacted to determine the African performance. A number of other papers have succeeded in identifying geographical, institutional and policy characteristics that typically pertain to the African experience.

Sachs & Warner (1997) express an optimistic view over African growth prospects. Their paper accounts for the dismal performance between 1965 and 1990 when African GDP per capita fell from 60% of the average of the rest of the developing world to 35%. They capture, however, a few signals that will be partly responsible for the improved performance begun in the mid-1990s, improved policies in particular. In order to explain African poor growth during the period of interest they perform a Barro regression where they control for a set of relevant variables: policy variables including trade openness; geography-related variables (percentage of population living in tropical climates, natural resources endowments, fraction of landlocked countries); variables capturing the quality of African institutions; active population growth (in the effort to capture the effect of the delay in the start of the demographic transition in Africa); life expectancy at birth (with its multiple possible interpretations: the variable can capture 1) the disease burden consistent with the geographical position of African countries, particularly the high percentage of population living in the tropics, 2) the quality of public health, hence relating to policy choices, 3) and over both, a measure of human capital).[3] As it is clear from the set of variables they use, the deep determinants later identified by Rodrik et al. (2004) are very relevant in the framework by Sachs and Warner (1997) and the authors conclude that the Sub-Saharan African slow growth process partly depends on natural factors (limited access to the sea, natural resource abundance and tropical climate), partly on poor economic policies (trade openness, government saving and market-supporting institutions) and partly on demographic factors such as life expectancy and population growth.[4]

[3] Usually, a Barro regression estimates the convergence hypothesis starting from the classical Solow model and augmenting it by relevant explanatory variables (i.e. human capital).

[4] This conclusion is a bit startling when compared to the findings of Sachs (2001). Here the author shows a correlation between geography and economic development indicating that countries in temperate zones are much more developed than countries in tropical zones. Contrary to other authors' view, he believes that this does not stem from the effects of colonisation since decades after independence have not produced the expected changes in less developed countries. Hence he presents a series of ideas that could provide valuable explanations for this divergent path in the world distribution of income. His explanations are related to the geographical and ecological characteristics of the tropics, which undermine growth opportunities: 1) agricultural productivity is lower in the tropics than in temperate zones. This is caused by the fragility of the soil because of rainfall and high temperatures, by the action of parasites and plant diseases that seriously affect monocultures, by scarce water availability in conditions of evapo-transpiration; 2) health in the

Collier and Gunning (1999b) too investigate Africa's dismal performance in the post-colonisation era. They begin their analysis with a retrospective view on the African development path during the first half of the last century. They note that, according to Maddison's estimates, Africa had grown more rapidly than Asia until 1950 and its growth was even quicker right after independence and until 1973. Then the situation reversed and Africa's performance halted while Asian economies continued their development process. Collier and Gunning (1999b) produce a detailed (narrative) analysis of the heterogeneous factors that reversed Africa's growth path. They suggest a double classification of policy or exogenous ("destiny") factors and of domestic and external factors. The explanations for Africa's poor growth performance lie in the combinations of these two categories, such that they distinguish: domestic destiny, domestic policy, external destiny, external policy. These are defined as follows:

- Domestic destiny: it includes factors already analysed in Sachs and Warner (1997) like demographics (mainly the delay in the activation of the demographic transition due to the persistence of high mortality and high fertility. Even though basic public health has reduced mortality rates this has not been sufficient to switch to a low mortality – low fertility regime), geography-related factors (low population density due to adverse climatic conditions with its negative effects on transport costs and ethnic fractionalisation, high natural resource endowment leading to the appreciation of the exchange rate thus making the manufacturing sector less competitive[5]), poor soil quality[6];
- Domestic policy: here the authors provide an analysis consistent with the institutions theory later proposed by Acemoglu et al. (2005)[7]. They detail the way in which African political regimes have operated during the 1970s and 1980s. Despite their countries being characterized by relevant agricultural sectors, African governments were direct expression of the "*educated, urban-resident population, with few agricultural or commercial interest*". Governments became closer and closer to autocracy, expanding the public sector needed to guarantee controls over private activity. Following Acemoglu et al. (2005), we could say that elites changed the institutions in order to reinforce the *de facto* political power that granted them with the instruments to defend their interests and the interests of the (minority) social groups that sustained them. They built public employment and payment structures following social connections rather than ability, thus lowering the quality of the public services offered (as a result, poor transportation infrastructure, insufficient power supply, bad telecommunications and unreliable courts with consequent contract enforcement problems increased risks for firms, while poor education and public health systems handicapped households). Bad institutions came along with bad economic policies ranging from price controls, heavy regulations on firms' activities and financial markets, constraints to private trade.
- External destiny: the most relevant element in this category is related to the geographical characteristics of African countries. A large part of the African population lives far from the coast and from navigable rivers. Hence export costs are high. Also, most of the countries are landlocked, thus adding political barriers to problems of distance.
- External policy: relevant negative external policy choices have been those related to the exchange rate and to trade barriers. Exchange rate overvaluation was the norm, to favour the preference of the elites for cheaper imported goods. Export tariffs were higher than in other regions of the world in order to sustain the growth of the public sector, while import restrictions were probably kept to allow

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tropics is worse because of the prevalence of infectious diseases (malaria, bacteria, etc.) facilitated by moist, high-temperature environments; 3) the location of energy resources could also explain this divergent path, since industrial development has been quicker in the proximity of coil deposits (this constraint should play a less relevant role nowadays given that many African countries are endowed with relevant oil resources). The ecological divide can also explain the lack of technological change and the delay in the demographic transition (hence improved human capital) that are important proximate determinants of growth in the classical growth models. In the view of the author the experience of colonisation as well can be explained by the economic and health weaknesses affecting peoples living in the tropics.

[5] Compared to the extractive sector, the manufactures are more human capital-intensive and potentially productivity enhancing, hence more important for sustainable growth experiences and development.

[6] This is one of the geography-related factors later underlined by Sachs (2001) as leading to low agricultural productivity in Africa.

[7] This paper owes a lot to Acemoglu et al. (2001), hence the two analyses are also much closer in time.

room for corruptive practices to overcome those same restrictions. These policies were particularly disadvantageous for manufacturing firms, forced to produce for small domestic markets and thus unable to exploit economies of scale nor to be exposed to significant competition while at the same time East Asian countries benefited from breaking into international markets[8].

This analysis clearly falls within the boundaries of the theory of the deep determinants of economic growth since it tries to explain Africa's growth through aspects related to geography, institutions and international market integration. The way in which the authors stress the importance of the economic policy choices in determining the (constraints to) firms' opportunities for activity and for entering the international markets supports the institutional view by Acemoglu et al. (2005) and is consistent with the conclusions of Rodrik et al. (2004) that institutions are the main factor explaining countries' growth performance.

The analysis by Collier and Gunning is even more detailed in a slightly earlier paper (Collier and Gunning (1999a). The starting focus in this study concerns the persistence of a significant African dummy in African growth regressions controlling for a typical set of determinants (both deep and proximate). In order to provide some insights on the reasons why the variables usually included in African growth regressions cannot fully explain the African performance, they provide a detailed analysis of the channels through which these determinants affect the economy at the aggregate level and at the level of manufacturing firms and rural households. They use a number of previous analyses, case studies, surveys and reports to build a comprehensive understanding of the African economic environment. Much of the analysis at the aggregate level follows Collier and Gunning (1999b), though here they skip the classification based on domestic and external policy and destiny. The microeconomic analysis describes the ways in which rural households and manufacturing firms react to high risks, lack of social capital, poor public services, lack of financial depth and lack of openness to trade. These are the variables that, as is generally agreed, are mostly responsible for the poor African performance, though lack of financial depth is only important at the household level. Much of the analysis is consistent with the aggregate level assessment, although the authors underline that the ways in which high risks, lack of social capital and poor infrastructures affect the economy at the level of households and firms is badly proxied in aggregate growth regressions. As a final assessment of the African economic performance until 1990, the authors identify policy and institutional factors leading narrow elites to rule their countries undermining the markets and exploiting public services to benefit ethnic groups and reinforce their leadership. This has lowered the returns on assets and increased risks in economic activities, leading investors and human capital abroad and leading firms to turn from trying to capture investment opportunities to adopting more conservative but less innovating risk-reduction strategies.

iii. Improvements in the institutional framework of Sub-Saharan Africa

There has been a general perception of Africa as an extremely risky economic environment and this is probably the main reason why, despite investment being low and potential returns high, private capital flows to Africa have remained low. Following the pressure of international organisations such as the World Bank and the International Monetary Fund, since the 1990s many African governments have undertaken a reform path that could hopefully change the perception of Africa as a highly risky

[8] This element is particularly underlined in a later paper by Collier and O'Connell (2006), as well as in Johnson et al. (2010). The first paper focuses on the dysfunctional syndromes that have undermined Africa's performance mostly by "[…] *closing off the opportunity to break into manufactured exports at the crucial time before Asia established economies of agglomeration* […]". The authors also suggest that opportunity may now have been lost: "[…] *coastal Africa has* [perhaps] *missed the boat. Whereas in the 1980s Africa could have broken into global markets, now that Asia is established, Africa has no comparative advantage in labor costs to offset its disadvantage in the lack of agglomeration.*" In the second paper the authors show that countries that have escaped poverty in the past have been characterized by an association between rapid growth and rapid growth in exports (especially manufactures). Hence they suggest that African countries should try to go through the same path in order to achieve sustained growth. Now that Africa's growth, recently driven by the commodity boom, is slowing down because of the terms-of-trade shock the question of the development of the manufacturing sector is more relevant than ever.

environment. Macroeconomic reforms aiming at improving the exchange rate flexibility, removing barriers to trade and strengthening the fiscal policy have been easier to implement than improving infrastructures and institutions. A recent Regional Economic Outlook (April 2016) by the IMF, focuses on the slowing down of African performance due to the deterioration of the terms of trade on commodities (minerals and oils), thus acknowledging that African growth is still driven by the extractive sector while manufactures lag behind. The macroeconomic policy suggestions of the report are still consistent with the analysis by Collier and Gunning (1999b), since the IMF suggests that African countries keep the exchange rate flexible and implement sound fiscal policies in order to preserve the reserves accumulated during the years of the commodity boom (reserves that countries were using to reduce the infrastructural gap). Also, the Report analyses the improvements in financial depth thanks to the creation of pan-African banks and the implementation of financial services based on mobile technologies that are helping the financial inclusion of rural households. As suggested by Collier and Gunning (1999b), though, financial depth has not proven to be significant for growth at the aggregate level, nor has it been perceived as a limit to activity by manufacturing firms, while it has constrained the capacity to cope with risks by rural households.

Since the suggestions of the IMF Regional Outlook are in line with Collier and Gunning (1999a), it seems that African countries have made but little progress since the 1990s and that there is still need and scope for macroeconomic reforms. A possible analysis could try to assess if and by how much the determinants of African growth identified by Collier and Gunning (1999a) have improved and if this improvement has played any role in the growth of the continent. Also, the outlook suggests that many African countries have been trying to improve their infrastructures, hence it could be useful to understand by what extent public services (enhancing both physical and human capital) have improved and if the impact on growth of that improvement can be measured. A further assessment could concentrate on the quality of African institutions. Has it improved since the 1990s? If African countries have improved within these respects its credibility should have also improved while its perception as an extremely risky economic environment decreased, thus attracting more private capital than in the 1990s. Is this the case? From a graphical analysis of the growth rate of Africa, it seems that the continent has started a positive growth path. Will it be sustainable? Assessing the general environment can give suggestions on its sustainability. Such an analysis could be compounded by estimates of the potential output of African countries, another instrument which could give suggestions on the scope for growth in Africa. Also, have recent growth accelerations in Africa been associated with any significant change in the growth determinants identified by Collier and Gunning (1999a) as to reinforce their causal link with growth? This assessment could also tackle the heterogeneity problem that affects growth in Africa. Various authors (Collier and Gunning (1999b) among them) have stressed that studying Africa as a whole makes little sense. When growth in African countries is so dispersed, initial condition so diverse, it is hard to draw meaningful conclusions from growth regressions averaging so different growth experiences.

1.2. Structural change perspectives

i. Basic facts about structural change

In the previous paragraph we have explored part of the most relevant literature that has studied the growth process in Sub-Saharan Africa. These studies have often included Africa within frameworks derived by the Solow-Swan growth model, which was, by direct admission of Robert Solow, designed to model the growth path of the USA and of the other developed countries. Theory on the deep determinants of growth has helped identify possible reasons that explain the existing gap between developed and underdeveloped countries, and limiting the analysis to frameworks modelling the proximate determinants of growth may be inappropriate in two different respects: 1) factors accumulation and technological progress may not have been "switched on" in developing countries because of the adverse effects of the deep determinants, hence modelling them provides with little information on the growth performance of developing countries, especially its volatility; 2) proximate determinants are usually modelled without taking into account the specific characteristics of underdeveloped economies such as the role of agriculture, the necessity for a structural change, natural resource advantage, etc. The structural change process, in particular, is crucial in studying development, and is at the basis of the dramatic economic growth that industrialized countries have experienced in the 20th century. Does structural change happen in Africa as well? Does it have the same characteristics that it has had in already developed countries?

To define structural change, it is helpful to cite Lall (1995), who states that as a first approximation structural change can be defined as a process of economic (market) liberalisation leading to a more efficient allocation of resources. The action of markets, if free from distortions, determines the prices of factor inputs according to their accumulation and returns (productivity). This drives the movement of labour from low-productivity agriculture to industry and the services. According to De Brauw et al. (2014) and Duarte & Restuccia (2010), despite any possible peculiar country economic caracteristics, the process of structural change is common to all growing countries: labour moves from low productivity to high productivity sectors.
Tiffen (2003) explains the process from a dual economy perspective. She notices that low-income countries employ in agriculture a proportion of workers which is higher than the proportion of agricultural output over overall GDP. Average agricultural productivity is lower than average non-agricultural productivity, hence agriculture often uses a larger labour force to produce less than the other sectors. Structural change requires that labour force move from agriculture to industry and services, which are usually characterized by higher productivity levels. Tiffen (2003) uses an inverted S-shaped curve to illustrate the process of structural change. This shape shows the hardships of moving from the initial stage, the increasing speed of the change in the sectoral labour shares in the intermediate stage, and the slow stabilization in the final stage where industry and services absorb the majority of the labour force. At the early stages of development agriculture accounts almost entirely for the labour share of the economy. It merely produces for own consumption, since the non-agricultural markets (Tiffen (2003) jointly considers the industrial and services sectors) are extremely small. Without changes in productivity and in the respective markets dimensions, it is hard to escape from such a situation. Tiffen (2003) shows that the typical cause of change may be the contact with an external economy that allows for an increased market for the agricultural sector and for the exchange of technologies. This pushes agriculture to increasing production by exploiting free land and more productive technologies. It also allows farmers to produce out of own consumption and to increase their income, thus allowing them to consume non-agricultural goods. Imported technologies may also be replicated within the economy, thus allowing for the expansion of the industrial sector and the movement of labour out of agriculture. Contacts with the external economy also stimulate transport and trade services. In order for the process to continue it is

necessary that not only industrial and services productivity increases. As Gollin, et al. (2002) suggest, while the increase in agricultural productivity is extremely relevant in the transition from an agricultural to a non-agricultural economy, as the transition happens the productivity in the non agricultural sector determines the successful growth performance of the country. Agriculture must be able to fulfil the needs for food and raw materials of the other (expanding) sectors despite a decreasing agricultural labour share. When industry and services are well established and diversified they can not only rely on the agricultural market (which is rapidly getting smaller): either they can rely on exports, either specialisation allows the industrial and services subsectors to place their goods in the other subsectors. Duarte & Restuccia (2010) use a three sector approach, where the process of structural change is described by a decreasing labour share in agriculture, an inverted U-shaped labour share in industry (this is typical of countries at an early stage of development) and an increasing labour share in services. Their analysis uses sectorial hours worked rather than labour shares, which is maybe a more precise measure of the structure of an economy, but they point out that the process of interest is equally well described by labour shares. They also find that a lag in the process characterizes countries with low relative incomes.[9] This point is relevant because, as suggested by Tiffen (2003) and implied by Bryceson's analysis of the peculiarity of African deagrarianization, Sub-Saharan African countries lag behind in the process of structural change and are probably placed at the beginning of the transition process. Hence the shape of the sectoral shares may not conform to the ones described in their paper. A third relevant element arising when studying the process of structural change is that sectoral labour productivities grow differently across countries. This is supposed to reflect differences in the levels of sectoral productivities: where productivity is near the frontier it should grow more slowly than in sectors where accumulation has still much room.[10] As McMillan, et al. (2014) point out, less developed economies are characterized by larger differences in sectoral productivities than developed countries. This characteristic is even more relevant where mining contributes for a large share of the overall GDP, which is the case for many natural resources-endowed Sub-Saharan African countries like Nigeria, Botswana and Zambia. Given its characteristic of being largely capital intensive, mining produces much more value added than agriculture, and it does so by employing an extremely smaller labour force share.

i. Structural characteristics of Sub-Saharan African countries. Do we have to focus on agriculture?

One of the most serious constraints on the study of Sub-Saharan Africa is that of data availability, which explains why studies on African economies have relied on dual economy models, failing to exploit larger sectoral studies allowing for the use of larger information. Besides, many studies suggest that Africa has not yet had undergone a process of structural transformation. Authors stress the importance of the agricultural sector, suggesting that no structural change and consequent economic growth can take place without intervening on agricultural productivity. In this respect, Tiffen (2003) suggests that Sub-Saharan Africa be at the beginning of the transition stage that she describes in her paper. As so, agriculture is still the most important sector in many African countries. She studies the agricultural sector of some representative districts in Kenya, Senegal, Niger and Nigeria. Despite being considered an underdeveloped sector, she illustrates how farmers are able to respond rationally to changing climatic, geographical, inputs and regulatory conditions. Besides, household diversification of income sources (rural -agricultural and non-agricultural - or urban) are exploited to protect income in hardships or to allow for investments during expansions. The author points out that, in order to foster the structural change process in Sub-Saharan Africa, it is crucial to study the relationships between agriculture and the non-agricultural sectors. In the transition from early developmental stages to later stages industry and services provide an increasing market for agricultural output. At the same time, as urbanisation and non-

[9] They say that poorer countries show higher shares of agricultural employment relative to richer countries.

[10] We're not considering here, the possibility that innovation enters the process and boosts productivity in certain sectors rather than others.

agricultural sectors increase, well off farmers become increasingly more interested in non-agricultural products. It is also noteworthy that non-agricultural sectors can allow for household income diversification that can be useful for income protection and, even more importantly in a development perspective, investment in agricultural inputs which allow for an increase in agricultural productivity. In her view, intervention by the state is not needed to foster premature industrial development, but to understand these crucial relationships between agricultural and non-agricultural sectors and to correctly place them in the sequence of the development process and allow them to perform properly (this is increasingly important, given that the state cannot do everything and that foreign aid is decreasing). The consideration of the importance of the agricultural sector and of how it relates with the other sectors in the structural change process is also crucial in the analysis by Bryceson (1996). Her description of the process of "deagrarianization" in Sub-Saharan Africa matches well with Tiffen's position. Bryceson (1996) explains that the process of urbanisation of African countries following independence was not supported by the existence of a developing industrial sector, hence the excess labour was absorbed by the government needs for urban infrastructural development and economic activities' nationalisation.[11] The urban expansion was not followed by an increased connection with the rural areas and the spreading of commercial activities. To secure food provisioning, in fact, it was more reliable to import food from the United States and the European Community, because African agriculture was largely prone to climatic cycles. This did not favour the extensive exploitation of the land: agricultural production was directed for subsistence rather than trade and the development of urban areas did not exert any pressure for food product provisioning by the rural areas. When policy suggestions of the IMF and the World Bank led to the reduction of government expenditure and to aid conditioning, many urban employees lost their job, many of them went back to the rural areas or to smaller service towns. Being better educated, they hardly accepted agricultural work out of non-subsistence needs, leading to the development of non-agricultural activities also in rural areas. Non-agricultural activities were also the result of the need for diversification and risk management that farmers felt urgent for reducing the impact on their subsistence and income of possible climatic shocks and resulting bad harvests. In the view of the author, deagrarianization as an African phenomenon can hardly be compared to the process that led Europe to industrialize between the 19th and the 20th centuries. The lack of a developing industrial sector and the peculiar characteristics of agriculture in Africa must be taken into account for giving insights on the specific African development process. This point is even more stressed by Diao, et al. (2010). They first review the classical dual economy model where the role of agriculture is mainly that of providing excess labour and food for the industrial sector. Given the large difference in productivity between the two sectors, growth requires the establishment of an industrial sector and a reduction in the share of national GDP due to agriculture. Though this view is generally accepted, it has nonetheless faced some criticisms after the Asian experience of a dynamic agricultural sector. The authors report that a growing number of economists believes that growth in African countries must start from agriculture. The agricultural sector accounts for a large share of the overall GDP of many African countries, and for an even larger labour share. People living in rural areas and working in the agricultural sector have low incomes, they hardly consume out of subsistence and hence they are not suitable to become market for the other economic sectors. Investments in the agricultural sector (rural infrastructures and agricultural technologies) are then needed to match the gains in agricultural productivity of other developing countries. The authors stress that agriculture can have different roles depending on the circumstances: broadly speaking, its role is massive in early stages of development when its share of national income is high and it employs a large part of the labour force, while it decreases in importance in more advanced stages of development. But this does not end the story of agricultural contribution to growth: agriculture can play a relevant role when agro-ecological conditions allow to and when a country has not a relative advantage in minerals or industrial goods exports. In dynamic and growing economies farmers can have higher opportunities for diversification of their income sources, rather than in slowly growing economies where opportunities for

[11] (Collier & Gunning, 1999) in turn explain this as a means by the government for establishing a friendly bureaucracy in the aim of granting services in favour of the ethnic group of the incumbent rather than of fostering efficient public services.

diversification and exit strategies are little. After having introduced these relevant characteristics connected to agriculture and growth in SSS, the paper focuses on a sample of six countries. Then the authors try to perform a "forecasting" analysis based on the hypothesis of a growing agricultural sector or a growing industrial sector, in order to establish if African countries should invest in an agriculture-led or industry-led growth. They first analyse the consequences of a growth trend consistent with the one actually performed (baseline scenario), then they move to one hypothesis of accelerated growth with agriculture as leading sector and another hypothesis of accelerated growth with industry as leading sector. The authors use data from WDI and UNIDO, and show that their models account for a higher elasticity of poverty to agricultural growth than to industrial growth. Hence they suggest that the agricultural sector is more relevant for African growth since it helps reduce poverty more than industrial growth. Broadly speaking, this happens because households where agriculture is the primary source of income (which account for a large share of the population in SSA countries) are the poorest, hence agricultural growth is more likely to reduce poverty than export-agricultural or non-agricultural growth. What matters is also the consumption basket of poor rural households: this is made for at least 50% of food staples, hence when agricultural productivity increases, thus lowering food prices, rural households receive special benefit. Export crops have particularly high quality, but they only are relevant for a small group of farmers with better urban and export market access. Hence staple crops are more suitable (at least initially) for fostering growth because they are more widespread than export crops. They can also allow for a higher level of poverty reduction because poor rural households do not produce export crops. The view of Diao, et al. (2010) is directly criticized by Collier & Dercon (2014). They suggest that the view of focusing on growth in the agricultural sector because it has the highest labour share and the lowest incomes in the African economies is too narrow. Small poor farmers (defined by the authors as "reluctant micro-entrepreneurs") do not guarantee to invest and allow agricultural productivity to boost. If agricultural productivity is to be improved, it is much more reasonable to focus on larger farmers, which, especially if oriented towards commercial agriculture, are better suitable for creating scale economies and for pushing to introduce technological innovation into the agricultural sector. Also the idea of creating income opportunities for the poor is short-sighted: if income opportunties are to be created it is not correct to reate them where tha labour share is greater. As classical structural change theory suggests, it is more appropriate to change the structure of the economy and thus to create opportunities in those sectors that promise to grant larger opportunities. Income effects on poor farmers might also reasonably be very low. The poverty reduction effects of agricultural growth can be large at the margin, allowing a large amount of people to raise their incomes just above the poverty line. But without productivity effects, the results of this kind of growth are probably destined to be more limited than large farms, commercially-oriented agricultural growth policies where large scale economies could boost productivity much more and generate more sustainable experiences.

As pointed out by the above reviewed literature, agriculture is still at the centre of the discussions on African growth opportunities. A huge portion of the discussion is oriented at investments needed to increase agricultural productivity, which stagnates relative to the other sectors, as it will be showed in Chapter 2. Landlockedness of many African countries suggests that agriculture be one of the principal opportunities for them to be involved in the economic activities of their coastal neighbours. Even commerically-oriented agriculture would depend on trade with better placed countries. But the growth dynamics of the most recent years have showed that overall African growth has been conditioned by commodity shocks, remarking the dramatic weight that natural resources have in the economic structure of the region.

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CHAPTER 2 - STRUCTURAL CHANGE IN SUB-SAHARAN AFRICA: BAYESIAN MODEL AVERAGING AS A PROPOSED SOLUTION TO MODEL-UNCERTAINTY

Abstract

In this chapter we analyse the contribution of structural change to the productivity growth of a sample of Sub-Saharan African countries. Their large agricultural sector suggests that there is scope for productivity-boosting structural change through labour force reallocation from low-productivity agriculture to more productive industrial or services sub-sectors. To assess if it has been the case we use data from the 10 Sector Database to first decompose labour productivity growth into three terms (within, structural change and covariance) and then disentangle their productivity-boosting or productivity-slowing effects. We find structural change to be the main contributor to productivity growth in the region and use a Bayesian Model Averaging methodology to address the problem of model uncertainty in the identification of the drivers of productivity-boosting (-slowing) structural change. This is relevant for the suggestion of optimal patterns for policy intervention in support of the process. We find only the employment share in agriculture to be robustly correlated to productivity-boosting structural change, while a number of variables often considered significant by the literature on development in Sub-Saharan Africa play no role in the process.

JEL classification – O11; O41; O47
Keywords – Sub-Saharan Africa, Economic development, Structural change, Productivity, Model uncertainty, Bayesian Model Averaging

2.1. Introduction

There is a relevant literature that documents the process of structural change as common to all developing economies. According to Lall (1995), as a first approximation structural change can be defined as a process of economic (market) liberalisation leading to a more efficient allocation of resources. The action of markets, if free from distortions, determines the prices of factor inputs according to their accumulation and returns (productivity). This drives the movement of labour from low-productivity agriculture to industry and the services. De Brauw et al. (2014) suggest that, even though each country has its own growth characteristics, this pattern of labour reallocation is a common feature for all growing countries. Duarte & Restuccia (2010) characterize structural change using the distribution of labour hours across sectors and describe it as a process where the share of labour hours observes a decreasing path in agriculture, an inverted U-shaped path in industry (this is typical of countries at an early stage of development) and an increasing path in services. Their panel includes already developed countries as well as countries where the agricultural sector is still large (although no African country is present). They find that the rough trends described above characterize all the countries in their sample, which indicates that the process of structural transformation is fairly similar in all economies. Tiffen (2003) explains the process from a dual-economy perspective. She notices that low-income countries employ in agriculture a proportion of workers which is higher than the proportion of agricultural output as a ratio of GDP. Average agricultural productivity is lower than average non-agricultural productivity, hence producing a certain level of output often requires a larger labour force in agriculture than in other sectors.[12] This describes the problem of efficiency that is at the origin of the process: structural change requires that the labour force move from agriculture to industry and the services, which are usually characterized by higher productivity levels. As Gollin et al. (2002) suggest, while the increase in agricultural productivity is extremely relevant in the transition from an agricultural to a non-agricultural economy, as the transition happens the productivity in the non-agricultural sector determines the successful growth performance of the country. Agriculture must be able to fulfil the needs for food and raw materials of the other (expanding) sectors despite a decreasing agricultural employment share. When industry and services are well established and diversified, firms in these sectors can no longer rely solely on the agricultural market (which also gets gradually smaller). Thus, further expansion requires either growing exports or specialisation, which allows the industrial and services subsectors to place their goods in the other subsectors.

As it is clear from the brief review above, the literature on the subject has usually analysed the process from a two- or three-sector approach, where agriculture is described as the traditional sector while industry and the services as the modern or non-agricultural one. The choice does not change the quality of the analysis, though, since the dimension of the agricultural sector is often enough of a feature to characterize the whole process. Data availability constraints have often limited the possibility of revived studies on structural change in Sub-Saharan Africa (McMillan & Headey, 2014). The lack of data (particularly on employment) is probably one of the main reasons why studies on African countries have relied on dual economy models. Furthermore, the region is often described as lagging behind in the structural change process, with a still large agricultural sector and limited industrial development. Many studies still place agriculture at the centre of the discussions on African growth opportunities, and suggest that no structural change and consequent economic growth can take place without increasing agricultural productivity that serves to raise the incomes of the poorest and to free up labour force for the other, more efficient, sectors. Diao et al. (2010) refer to the Asian experience of a dynamic agricultural sector to reinforce the view that investment in agriculture is the priority in Sub-Saharan Africa. The agricultural sector accounts for a large share of the overall GDP of many African countries, and for an even larger employment share. Rural households have low incomes and hardly consume more than what is needed for subsistence. Investments in the agricultural sector (rural infrastructures and agricultural technologies)

[12] See also McMillan & Headey (2014) on this point.

are more efficient because they raise the incomes of a larger share of the population and because they sustain the income of the poorest, thus potentially generating larger increases in agricultural and non-agricultural consumption. Collier & Dercon (2014), however, suggest that the view of focusing on growth in agriculture because it has the highest labour share and the lowest incomes in the African economies is too narrow. Small poor farmers (defined by the authors as "reluctant micro-entrepreneurs") do not guarantee to invest and allow agricultural productivity to boost. If agricultural productivity is to be improved, it is much more reasonable to focus on larger farmers, which, especially if oriented towards commercial agriculture, are better suitable for creating scale economies and for pushing to introduce technological innovation into the agricultural sector. The idea of creating income opportunities for the poor is short-sighted as well: if income opportunities are to be created it is not convenient to create them where the labour share is greater. As classical structural change theory suggests, it is more appropriate to change the structure of the economy and thus to create opportunities in the sectors that operate at higher productivity levels. Income effects on poor farmers might also reasonably be very low. The poverty reduction effects of agricultural growth can be large at the margin, allowing a large amount of people to raise their incomes just above the poverty line. But without productivity effects, the results of this kind of growth are probably destined to be more limited than large farms, commercially-oriented agricultural growth policies where large scale economies could boost productivity much more and generate more sustainable experiences. There are other reasons connected to the recent growth experience of Sub-Saharan Africa that suggest not to limit the focus on the agricultural sector. Overall African growth has been strictly dependent on commodities. A country like Nigeria, accounting for around 20% of the overall continental GDP, relies on mining for more than 40% of its own GDP, followed by agriculture with around 30%. Mining is less relevant for South Africa, instead (the country is responsible for around 35% of the GDP of the region), where manufacturing accounts for around 15% of its own GDP and the services for more than 60%. South Africa is in some respects an outlier, though, showing the most modern economic structure in the region, together with Mauritius. There are reasons to concentrate on the services as well. Since independence, the services have absorbed a significant part of the labour force. Collier & Gunning (1999) note that, despite their countries being characterized by relevant agricultural sectors, African governments were direct expression of the urban resident population, hence they did not show any interest in fostering agricultural or commercial activities. Governments became closer and closer to autocracy, expanding the public sector needed to guarantee control over private activity, defend their interests and the interests of the (minority) social groups that sustained them. They built public employment and payment structures following social connections rather than ability, thus lowering the quality of the public services offered (the result was poor transportation infrastructure, insufficient power supply, bad telecommunications and unreliable courts with consequent contract enforcement problems that increased risks for firms, while poor education and public health systems handicapped households). The situation has nowadays largely improved (policy enhancements have been favoured by the reforms suggested since the '80s by the IMF and the World Bank), and we register large movements of labour force towards the Services in the most recent years. Assessing if that movement is good for growth is one of the tasks of this chapter.

The first part of the chapter is focused on characterizing the structural change process in a sample of Sub-Saharan African countries from a three-sector perspective. We analyse data on sectoral employment and value added shares as well as on labour productivity to gain insights on sectoral sizes and on sectoral productivities in the region. We want to understand to what extent Sub-Saharan Africa follows the stylized facts highlighted by the literature on structural change and consequently where the region is placed in the structural change process. We find that low-productivity agriculture absorbs too large a share of total employment in Sub-Saharan Africa. This may undermine growth because labour is not employed in high-productivity (or in growing-productvity) sectors, although it also grants that there is large room for structural change to take place and to boost productivity in the region. Although labour reallocation from agriculture is of the most importance given the dimension of the sector, it is useful to look at a more complex network of sectoral labour movements in order to understand if labour reallocation has been good or bad for productivity growth. This is our first question: *what has been the contribution of structural change to overall labour productivity growth in Sub-Saharan African countries?* To answer, we decompose productivity growth into three terms (within, structural change and covariance): the structural change term combines information on sectoral labour reallocation and on sectoral productivity to asses if its effect has been productivity-boosting or productivity-slowing. An example may clarify this: agricultural employment in Nigeria has decreased until the early '80s and has increased again afterwards. Zambia's agricultural employment share seems to have stopped increasing only in the late years 2000. Combined to low agricultural productivity, these facts mean that employment has moved from high-productivity to low-productivity sectors, thus undermining overall productivity growth. However, labour reallocation within other high-productivity sub-sectors may have counterbalanced this negative effect. It is by looking at a sufficiently defragmented sectoral composition of the economy that we can define the cumulative contribution of structural change to overall labour productivity. We do so by exploiting a longer time period then recent works on structural change in Africa (our data range from independence to the most recent years) and this allows us to understand if the process has been relevant beyond its cyclical behaviour. After having shown the contribution of structural change on productivity growth, a second question becomes of interest: *what drives the effect of structural change on productivity growth?* Many are the factors that may characterize the structural change process in Sub-Saharan African countries, according to the literature (some of them have already been introduced in the above review, others will be detailed in Section 1.5). Model uncertainty is therefore a relevant issue in our context, and we try to address it by a Bayesian Model Averaging (BMA) estimation. Bayesian statistics is an optimal framework to account for uncertainty, because it allows to express prior beliefs about the parameters and the models and to update them through the information contained in the data. Parameter results are also averaged across a large set of models, each one weighted by its posterior probability. Studies suggest that averaging gives more reliable estimates of the parameters of interest than sticking to a model incorrectly considered as true. We also take into account the country heterogeneity present in our panel and inspect the endogeneity potentially characterizing the relationship between some of the regressors and our dependent variable. The problem of endogeneity is often underestimated by studies on structural change, but we show that, if not taken into account, it may heavily condition estimation results. Our results show that variables often judged important to explain structural change and growth in Sub-Saharan African countries turn out not to be robust to averaging over a large number of models. We also find that agricultural employment share is the most important productivity-boosting driver of structural change, thus reinforcing the fundamental development theory idea that movements of labour out of a large agricultural sector are associated to productivity growth because labour is reallocated per se to more productive sectors.

The remaining part of the chapter is structured as follows. Section 2.2 uses data on employment, value added and productivity in the three broad sectors of Agriculture, Industry and Services, to describe the development process of the Sub-Saharan African countries in the sample. Section 2.3 assesses structural change perspectives in light of the variability of sectoral productivities and proposes a decomposition of the full-economy labour productivity growth into three terms (within, structural change and covariance) to identify the contribution of each term to the productivity growth. Section 2.4 describes the Bayesian Model Averaging (BMA) approach we use to address the problem of model uncertainty and to assess which variables are more likely associated with productivity-boosting or productivity-slowing structural change and presents the main results of the estimation. Section 2.5 concludes. Appendix A1 provides sectoral summary statistics at the country and aggregate levels. Appendix A2 illustrates the choice of the prior distributions for the parameters and the models in the BMA estimation. Appendix A3 provides detailed information on the sources of the variables used as regressors in the BMA estimation as well as summary statistics for them.

2.2. Three-sector analysis

Before carrying out a more detailed investigation of the role and determinants of structural change in Africa, we start by providing a preliminary analysis of the dynamics of this process at the country level, focusing on the three macro-sectors of agriculture, industry and services. The objective here is to establish if and/or in what sense Africa is lagging behind in the process of structural change. To do this, we refer to three different features of structural change – that is, changes in sectoral employment and value-added shares, as well as productivity levels.[13]

DATA

We use data maintained by the Groningen Growth and Development Centre (GGDC), University of Groningen, to perform such an analysis for a sample of 11 African countries. The GGDC 10 Sector Database (Timmer et al., 2015) addresses one of the most important constraints on the study of African economies, i.e. the availability of reliable data, particularly on sectoral output and employment.[14] The World Development Indicators by the World Bank include time series for value added for the three broad sectors of agriculture, industry and services. Industry and the services can be split in various sub-sectors, but again data at this level would not contain information on employment. Other sources of data on economic sectors in Sub-Saharan Africa are available in the datasets by the African Development Bank, but they would not include data on sectoral employment. The United Nations Industrial Development Organization (UNIDO) provides data on the manufacturing sector, but this data is often not complete or entirely absent for many countries. Tiffen (2003) stresses this as a relevant constraint on the study of African economies based on mathematical or econometric approaches. McMillan & Headey (2014) underline that this is the main reason why revived studies on structural change have not covered Sub-Saharan Africa. Hence the GGDC 10 Sector Database allows for an important opportunity to account for Sub-Saharan Africa's structural change process and is the best dataset available for this purpose. Although the dataset contains only 11 countries, they account for more than 70% of the total Sub-Saharan African GDP, according to data on GDP constant 2005 USD by the World Bank (WDI).

The GGDP 10 Sector Database contains value added and employment level data for the ten sectors of the economy as defined by the International Standard Industrial Classification, Revision 3.1 (ISIC rev. 3.1). Table 2.1 identifies the ten sectors. Value added data are available in current and constant 2005 national prices. To allow for regional comparison at the Sub-Saharan African level we convert the constant data on value added in PPP, taking the US$ as reference currency. The data conversion is not made at the aggregate level. The Africa Sector database, derived by the 10 Sector database, is supplemented by data on relative prices at the sectoral level, so we are able to present data on real value added in a particularly precise fashion. This is important for international comparisons, since relative prices vary greatly across sectors, particularly because of the presence of tradable and non tradable goods. The data conversion is as follows:

$$y_{j,t} = \frac{y_{j,t}^N}{rp_{j}*xr} \tag{2.1}$$

[13] Duarte & Restuccia use sectoral hours worked rather than employment shares, which is a more precise measure of the structure of an economy, but they point out that the process is equally well described by employment shares.

[14] The dataset can be retrieved from the following link: http://www.rug.nl/research/ggdc/data/10-sector-database, while at the link http://www.rug.nl/research/ggdc/data/africa-sector-database it is possible to download the Africa Sector Database, limited to the African sample.

where $y_{j,t}$ represents the 2005 US$ PPP value added in sector *j* at time *t*, $y_{j,t}^{N}$ is the value added in sector *j* at time *t* in constant 2005 national currency, rp_j is the 2005 relative price in sector *j*, and xr is the exchange rate of the national currency relative to the US$.

PPP value added in the total economy is obtained by simply adding up the PPP sectoral value added series.

ISIC REV. 3.1 CODE	10SD SECTOR NAME	ISIC REV. 3.1 DESCRIPTION
ATB	Agriculture	Agriculture, Hunting and Forestry, Fishing
C	Mining	Mining and Quarrying
D	Manufacturing	Manufacturing
E	Utilities	Electricity, Gas and Water supply
F	Construction	Construction
G+H	Trade services	Wholesale and Retail trade; repair of motor vehicles, motorcycles and personal and household goods, Hotels and Restaurants
I	Transport services	Transport, Storage and Communications
J+K	Business services	Financial Intermediation, Renting and Business Activities (excluding owner occupied rents)
L,M,N	Government services	Public Administration and Defence, Education, Health and Social work
O,P	Personal services	Other Community, Social and Personal service activities, Activities of Private Households
TOT	Total Economy	Total Economy

Table 2.1
Description of the sectors included in the GGDC 10-Sector database

We derive data on sectoral average labour productivity by dividing the PPP value added in sector *j* at time *t* by the corresponding employment level.

Sector employment shares

Starting with the employment share, Figure 2.1 shows that, although agricultural labour shares are overall declining, only Mauritius and South Africa show a declining trend throughout the whole period observed. Botswana saw a declining agricultural share until 1990, while afterwards it did not change. The other countries in the sample have shown a stronger declining trend only after 1990 or in the most recent years, except for Nigeria, where the agricultural labour share declined until 1980 and went back up afterwards, and Zambia, where the labour share of the agricultural sector has never decreased. Despite this general declining trend only Mauritius and to some extent South Africa report relatively low agricultural labour shares (Table 2.2).[15] The other African countries in the sample, as of 2010, report an agricultural labour share of at least 38% (Botswana), and up to 75% (Ethiopia). Employment shares in the services sector have generally increased across the time period observed. This trend has been very weak in Ethiopia,

[15] Agricultural employment shares are usually under 5% in developed countries, while those of Mauritius and South Africa are in line with the ones of Latin American countries and of some Asian countries.

Malawi, Senegal and Tanzania. Zambia saw no change, while in Nigeria there seem to have been a symmetric path with respect to the agricultural labour share: we notice that the employment share in agriculture decreases until 1980 and starts increasing again afterwards, while in the services the reverse happens. Mauritius and South Africa have seen a steady increase in the services labour force. Mauritius relies much on tourism, while South Africa is much more developed than the average Sub-Saharan African country. Generally, we can easily see from Table 2.2 that the labour share in the services sector is higher where the agricultural labour force is lower. The most evident cases are those of Mauritius and South Africa on one side, Ethiopia, Tanzania and Zambia on the other. Finally, Figure 2.1 shows how the labour force in the industrial sector is generally lower than in the other two sectors. As pointed out by McMillan et al. (2014), there are some signs of an increasing trend but, as of 2010, the industrial sector does not give evident signs of a structural change process going on in Sub-Saharan Africa. If compared to the average 2010 value of the Asian and Latin American regions (23.43% and 21.55% respectively) the African average industrial employment share of 13.4% shows that Africa is lagging behind in the process. Notable exceptions are again Mauritius and South Africa, where we can see an inverted-U shaped trend as suggested by Duarte & Restuccia (2010). Nigeria, despite a very high value added share in industry (see Table 2.3) shows a very low industrial employment share. This is mainly due to the fact that a huge proportion of the industrial value added in the country is produced by the mining sector, which is highly capital intensive, thus needing a low proportion of labour input to achieve a high productivity level. This is a first indication of how important it is to work with sectoral data in order to get the proper policy indications for structural change. A three-sector approach completely misses the point here, if information on subsectors is not considered.

	Agriculture	*Industry*	*Services*
Botswana	38.17%	11.68%	50.30%
Ethiopia	75.15%	8.84%	16.02%
Ghana	41.57%	15.36%	43.09%
Kenya	48.30%	16.38%	35.30%
Malawi	65.18%	9.40%	25.40%
Mauritius	7.09%	30.27%	62.45%
Nigeria	60.66%	6.25%	33.09%
Senegal	51.45%	13.96%	34.64%
South Africa	15.03%	21.85%	63.12%
Tanzania	71.66%	5.86%	22.47%
Zambia	72.24%	7.46%	20.30%

Table 2.2
Three-sectors employment shares in 2010

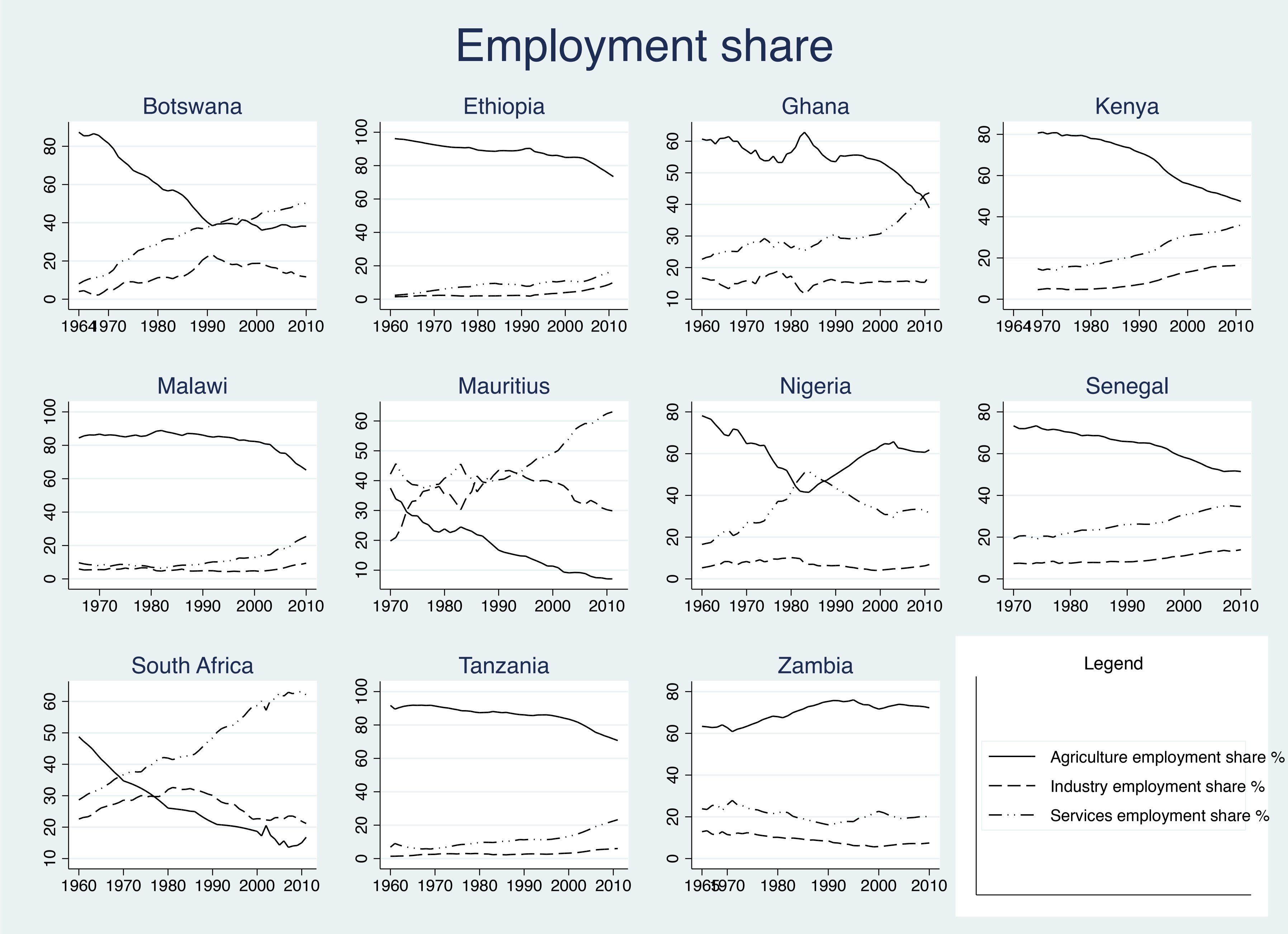

Figure 2.1
Three-sectors employment shares - 1960-2010

Sector value added shares

An analysis of value added shares shows how agriculture is by far the sector that produces the smallest proportion of overall GDP in all of the countries in the sample (the only exception, as of 2010, is that of Ethiopia). The countries where the agricultural share is higher are Ethiopia and Tanzania, where it accounts for around 20% of the overall value added. Notice, however, that in the former country it has had a steady declining trend across the overall time span observed, while in the latter it has decreased steadily only since the middle nineties. These two countries have produced this 20% of the overall value added at the cost of more than 70% of the labour share of the overall economy. The highest share in all of the countries in the sample is that of the services sector. Either this sector already accounted for a large share of the overall economy in the sixties, either it has grown over the other sectors, as it happened in Botswana, Ethiopia and Nigeria. Industry has only grown in Botswana, Nigeria and Zambia, but the trend has reverted since the early eighties in all of them. Only Tanzania seems to have been caught into an increasing industrial tendency in the most recent years. With the only exception of Ethiopia, the industrial value added is consistently higher than the agricultural value added. This result, moreover, is obtained at the cost of a much smaller labour share than in agriculture, with the notable exceptions of Mauritius and South Africa. As Table 2.4 shows, industrial productivity is far higher than in agriculture.

	Agriculture	*Industry*	*Services*
Botswana	1.90%	30.63%	67.48%
Ethiopia	19.40%	13.74%	66.86%
Ghana	7.13%	16.80%	76.08%
Kenya	11.52%	15.39%	73.09%
Malawi	12.17%	22.54%	65.29%
Mauritius	2.37%	29.35%	68.28%
Nigeria	17.19%	40.95%	41.86%
Senegal	11.45%	19.56%	69.00%
South Africa	2.50%	25.10%	72.40%
Tanzania	23.04%	27.89%	49.08%
Zambia	7.95%	26.61%	65.44%

Table 2.3
Three-sectors value added shares in 2010

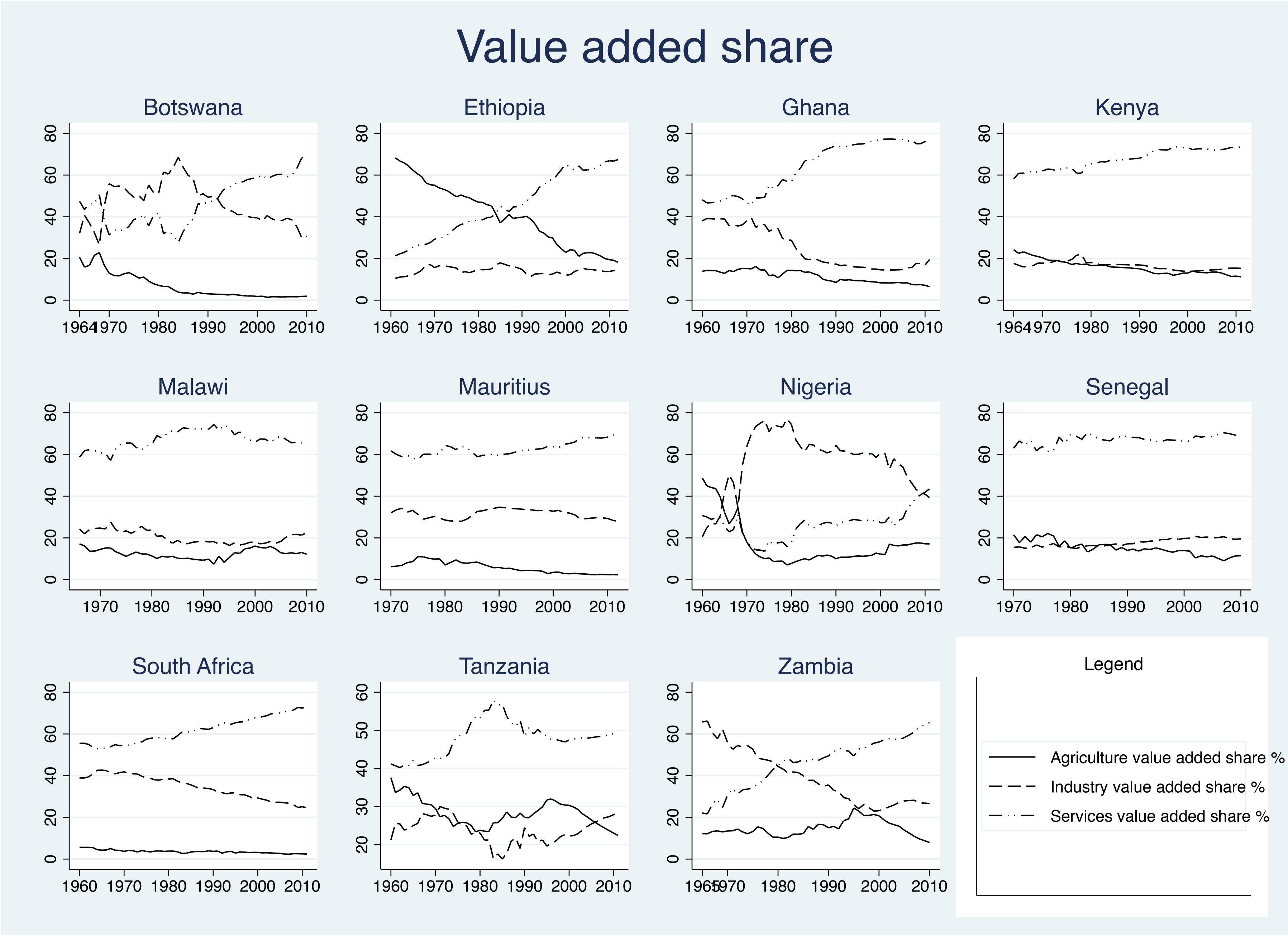

Figure 2.2
Three-sectors value added shares - 1960-2010

Sector labour-productivity levels

As the brief analysis on value added shares has pointed out, industrial value added is generally higher than in agriculture, and in addition the latter sector has a far greater employment share than industry in almost all of the countries observed (the only exceptions being Mauritius and South Africa). Figure 2.3 on productivity levels, clearly accounts for the performance of the agricultural and the industrial sectors. Agricultural productivity is practically flat in all of the countries but Mauritius and South Africa.[16] It appears, then, that agriculture cannot sustain a shift of the economy of these countries towards expanding non-agricultural sectors. By comparing the productivity levels, it is easily seen that industry and services have generally a greater productivity level than agriculture. Sometimes the ratio of the productivities is extremely large, as it is the case for the Industry/Agriculture ratio in Botswana (53) and Zambia (32), and for the Services/Agriculture ratio in Botswana (27). Productivity ratios can be used as a measure of the variation in the productivities. Least developed countries usually account for a larger variability in the sectorial productivities. This path seems to be followed here, where Mauritius and South Africa show the least variability in the sample. Industry and services are far more balanced, since in three cases (Malawi, Mauritius and South Africa) their productivity is practically equal, in four cases (Ethiopia, Ghana, Kenya and Senegal) the productivity in the services is higher, and in four cases (Botswana, Nigeria, Tanzania and Zambia) industrial productivity is higher. A rapid look at the sub-sectorial productivity levels in these countries shows that in Botswana, Nigeria and Zambia the distance of the industrial productivity from the one in the services is justified by the large part played by the mining sector, which produces extremely more than the other sectors by employing a very small labour share. For the cases of Botswana and Zambia, the contribution of the construction sector is also relevant for the industrial productivity level, while for Zambia the contribution of utilities also matters.

	Agriculture	*Industry*	*Services*	*Industry / Agriculture*	*Services / Agriculture*	*Services/ Industry*
Botswana	1217.81	64267.77	32871.29	52.8	27.0	0.5
Ethiopia	337.55	2032.34	5457.90	6.0	16.2	2.7
Ghana	976.28	6229.99	10055.93	6.4	10.3	1.6
Kenya	708.66	2789.14	6150.12	3.9	8.7	2.2
Malawi	260.95	3350.68	3591.95	12.8	13.8	1.1
Mauritius	6297.72	18278.18	20605.73	2.9	3.3	1.1
Nigeria	835.19	19312.63	3726.85	23.1	4.5	0.2
Senegal	790.42	4977.79	7076.40	6.3	9.0	1.4
South Africa	3607.84	24902.32	24866.63	6.9	6.9	1.0
Tanzania	554.91	8213.39	3769.61	14.8	6.8	0.5
Zambia	522.05	16935.40	7868.58	32.4	15.1	0.5

Table 2.4
Three-sectors productivity levels and ratios in 2010

[16] Ethiopia and Ghana seem to account for a slight increase in agricultural productivity in the most recent years, but it arguably is far too low to be able to fulfil the needs of expanding non-agricultural sectors.

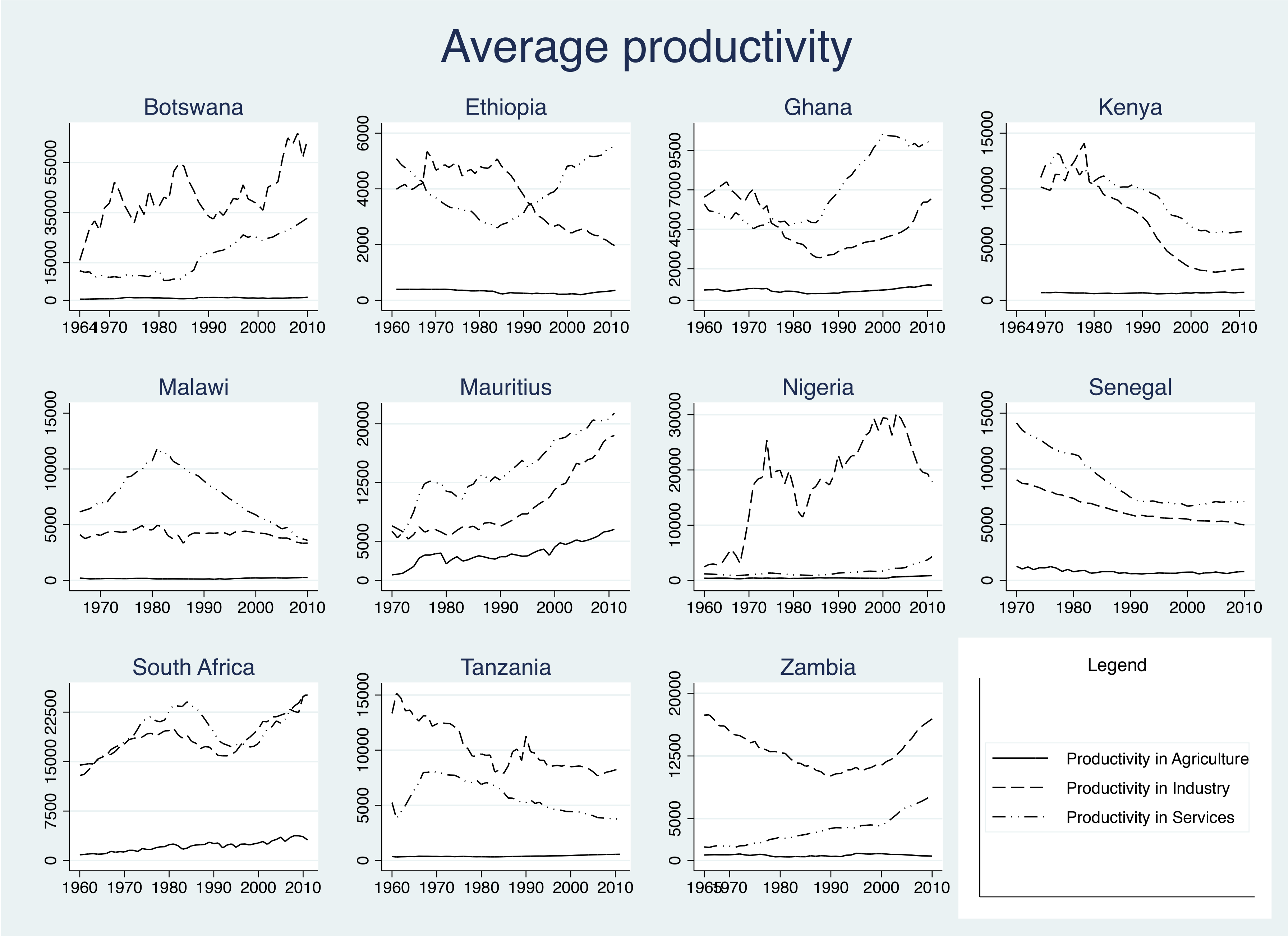

Figure 2.3
Three-sectors average labour productivity - 1960-2010

	2010 (GGDC)			2015 (WDI & ILOSTAT)		
	Agriculture	*Industry*	*Services*	*Agriculture*	*Industry*	*Services*
Employment share	58.64%	10.18%	31.18%	48.23%	12.24%	39.53%
Value added share	9.12%	26.57%	64.31%	16.2%	25.02%	58.78%
Productivity level	679.80	11400.01	9012.05	1975.72	12018.9	8744.42

Table 2.5

Three-sectors Sub-Saharan Africa aggregates in 2010 (GGDC) and 2015 (WDI & ILOSTAT)

In conclusion, the evidence gathered from this preliminary analysis suggests that productive resources are used poorly in Sub-Saharan Africa since the agricultural sector, the least productive one, absorbs the vast majority of the labour force. A snapshot of this is provided in Figure 2.4 and Table 2.5. Figure 2.4 reports the behaviour of the sectoral employment and value-added shares, as well as labour productivity from 1970 to 2010, in Africa.[17]

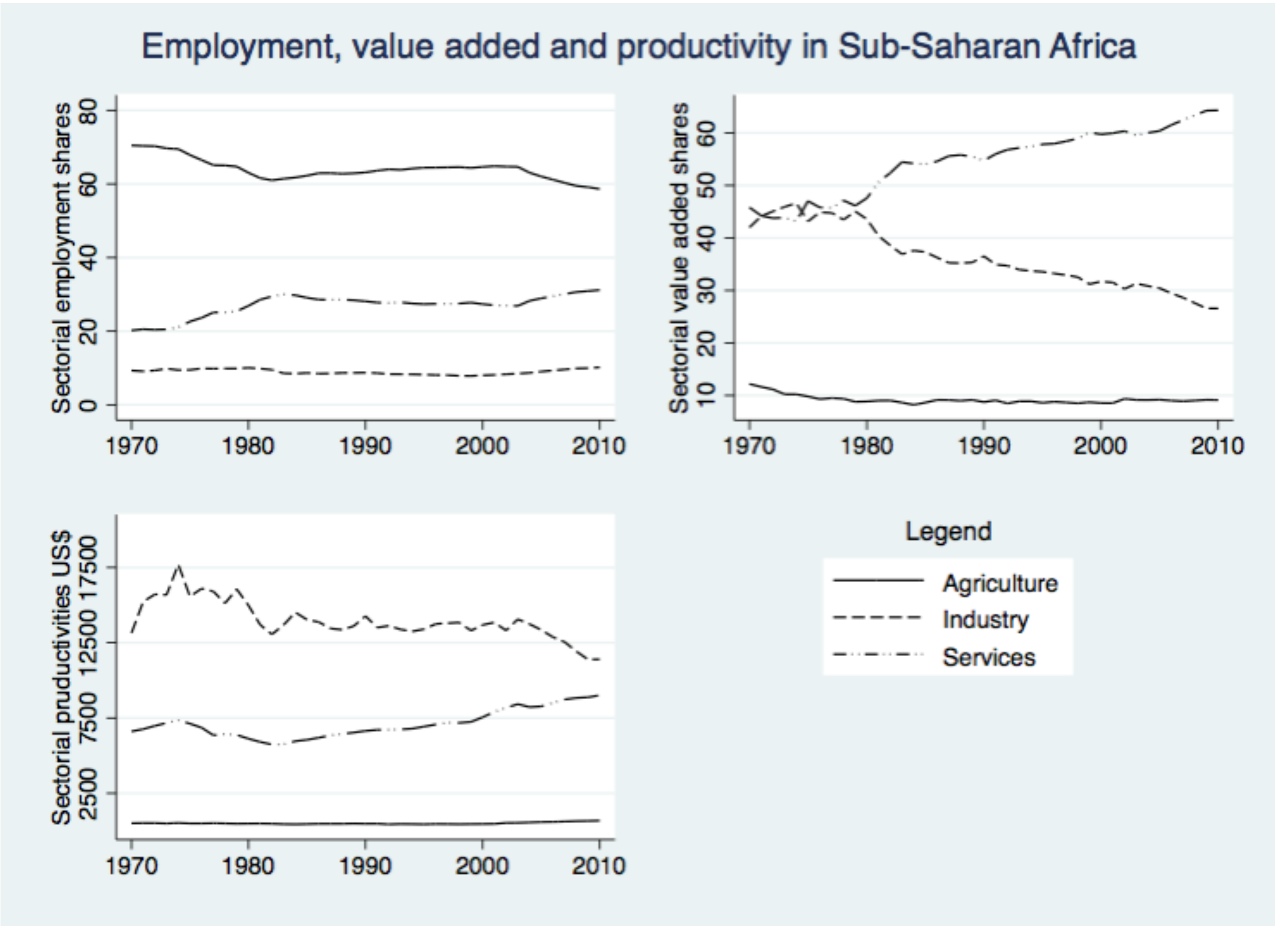

Figure 2.4

Aggregate SSA sectoral trends – 1970-2010

[17] The shorter time span depends on the fact that for some countries observations are available only from 1970, and this conditions the aggregate data. Also notice that both in Figure 2.4 and Table 2.5 the averages refer to ten of the eleven countries in our sample, the eleventh being Zambia which is excluded because data on employment in the Government services sector are not available for this country.

From the first graph we see that the agricultural employment share has declined over time, but remains almost twice as large as the employment share in the services. The third graph shows instead that the agricultural productivity has slightly increased in the latest decade observed, but remains far lower than the productivities of the other two sectors. Table 2.5 reports the 2010 sectoral averages for the same three variables, in Africa (values are updated to 2015 by using data on sectoral value added in 2010 US$ from the WDI, and on sectoral employment from the ILOSTAT database). As can be seen, 59% of overall employment in Sub-Saharan Africa is in the agricultural sector (a mere 11 points decrease since 1970), while services account for around 31% (about 11 percentage points more than in 1970) and industry, the most productive sector, for a mere 10% (and just 1 percentage points more compared to 1970). With such large differences in terms of labour productivity and employment shares between the agricultural sector and the rest of the economy, structural change can still be a significant engine of growth for most African countries.

In the following sections we continue using data from the GGDC 10 Sector Database, the only one providing observations at a high sectoral level. However, the latest version of the dataset contains data up to 2010 for many of the countries, up to 2012 for a few of them. We use data on sectoral value added expressed in 2010 US$ from the WDI and data on sectoral employment from the ILOSTAT database, to have a quick glance at trends for our three variables up to 2015. In particular, sectoral labour productivities are obtained dividing the sectoral value added from the WDI by the sectoral employment level from the ILOSTAT. These data are reported in the right part of Table 2.5 and in Figure 2.5. Here the black lines represent the data from the GGDC 10 Sector database, while the grey lines report data from the WDI and ILOSTAT. The most striking thing from Figure 2.5 is the difference in the employment shares in agriculture and the services as they appear in the GGDC and ILOSTAT datasets. Data from the International Labour Organisation for 2010 report an employment share of 49.51% in agriculture (against 58.64% from the GGDC), of 11.76% in industry (against 10.18% from the GGDC) and of 38.73% in the services (against 31.18% from the GGDC). Despite these base differences, the employment share in agriculture is still higher than the ones for the services and industry and it seems to show a decreasing trend. As for the sectoral productivities, despite the differences in the data for employment, they are quite close to the ones computed from the GGDC (the largest gap is for agriculture). The highest productivity level is in industry, followed by the services and agriculture, exactly as reported by the GGDC 10 Sector database. Despite the base differences between the datasets, the data appear not to have changed very much between 2010 and 2015.

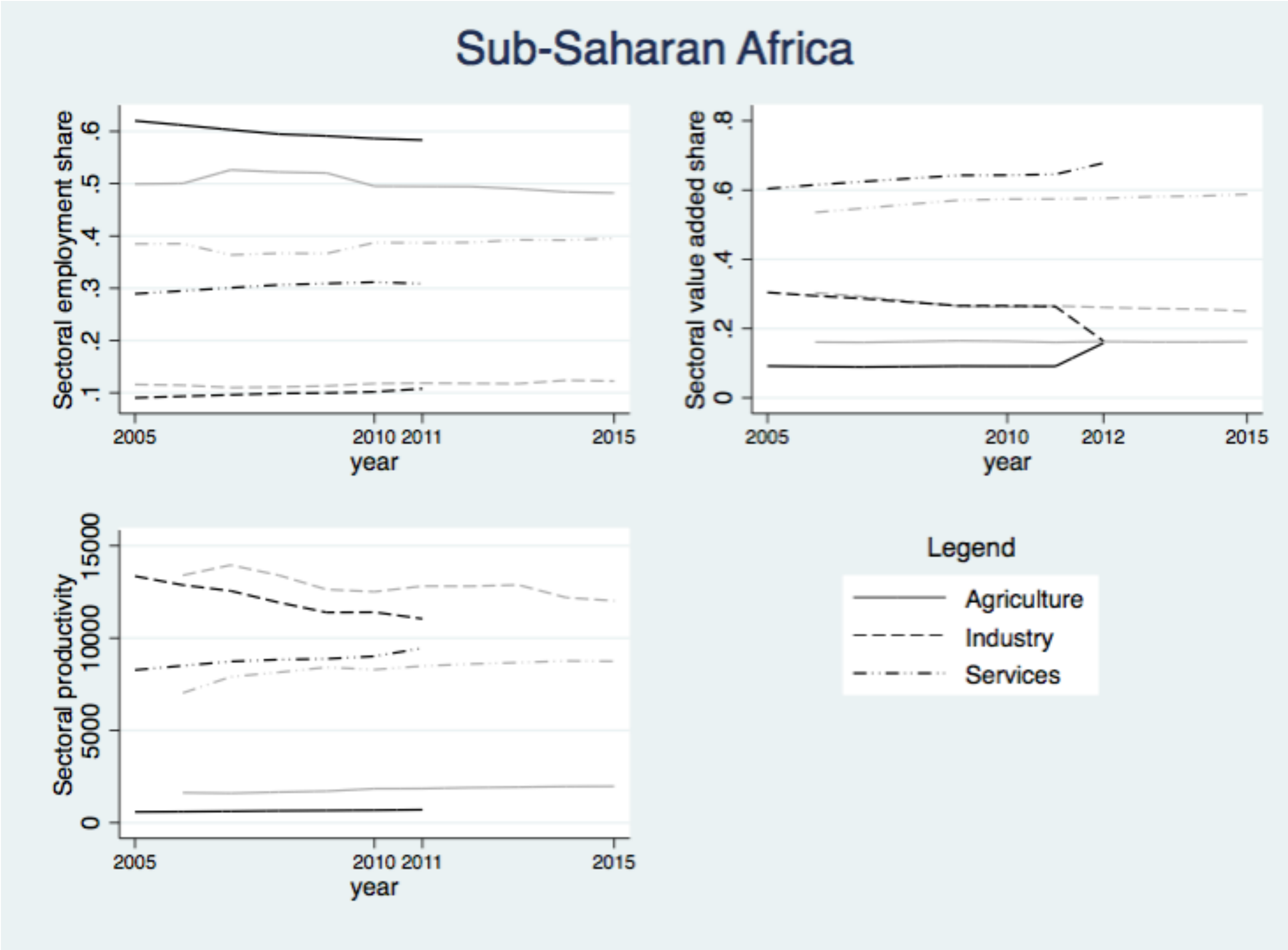

Figure 2.5
Aggregate SSA sectoral trends – comparison to data from the WDI and ILOSTAT 2005-2015 (grey lines)

2.3. Decomposition of the total productivity growth rate

If we were to adopt a strategy focused entirely on agriculture, we should accept the simple fact that the majority of people in Africa are employed in agriculture and that the income produced in agriculture is the lowest. An increase in agricultural productivity would determine higher incomes for poor rural households and farmers, and this would be followed by an increase in agricultural and non-agricultural consumption and investment. Agricultural productivity would keep increasing and growing incomes would sustain non-agricultural production. Although agricultural productivity is important a broader view on the various sectors is relevant because it allows to understand where it is better to reallocate labour force moving away from agriculture. Moreover, sub-sectors of the services are often very large in Sub-Saharan African countries, hence labour movements from this sectors to high- or low-productivity ones may have a remarkable impact on overall labour productivity.

Before proceeding in the decomposition of productivity growth, we analyse the relationship between the variability of sectoral productivities and structural change. Labour productivities grow differently across countries and this is supposed to reflect differences in the levels of sectoral productivities: where productivity is near the frontier it should grow more slowly than in sectors where accumulation has still much room.[18] As pointed out by McMillan et al. (2014), countries that lag behind the structural change process are characterized by a higher variability in sectoral productivity than developed countries. This characteristic is even more relevant where mining contributes for a large share of the overall GDP, which is the case for many natural resources-endowed Sub-Saharan African countries like Nigeria, Botswana and Zambia. Given its characteristic of being largely capital intensive, mining produces much more value added than agriculture, and it does so by employing an extremely small share of the labour force. While the broad analysis presented in Section 2.2 has already accounted for a significant degree of variability in labour productivity, a more specific sectoral analysis should grant more precise results.

As previously anticipated, the availability of the GGDC 10-Sector database makes it possible to study productivity and labour reallocation at a more detailed level than the classic three-sector analysis of structural change. Such an analysis can provide key insights for policies aimed at improving the efficiency of labour allocation, such as incentives for faster job-creation in the sectors where the productivity level is higher and/or increasing.

It is often noticed that more advanced countries are characterised by lower differences in sectoral productivities, while structural change in developing economies arises due to the exploitation of larger potential gains in productivity in the agricultural sector with respect to industry and services, where productivity levels are not so different from those in developed economies. Rising agricultural productivity generates labour reallocation towards industry and services because agricultural needs can be fulfilled with a smaller labour force. At the same time, industrial and services productivities are generally higher than agricultural productivity, hence labour reallocation allows for overall growth in the economy. Where the variability of inter-sectoral productivity is higher we expect that this depends on the presence of a large agricultural sector characterized by low productivity relative to the other two sectors. The presence of a large low-productivity sector brings down average overall productivity, and this is why where variability is larger the scope for structural change is also expected to be larger.

We can describe these two steps by means of two separate fixed effects regressions relating the variability in sectoral productivities to the employment share in agriculture, and the productivity in the total economy to the variability in sectoral productivities.

[18] We're not considering here, the possibility that innovation enters the process and boosts productivity in certain sectors rather than others.

We use the previously generated data on agricultural employment share and sectoral productivity for each country in the sample provided by the 10 Sector Database. We compute the natural logarithms of the employment share in agriculture, of the sectoral productivities and of the productivity in the total economy. We then compute the standard deviation of the natural logarithm of the sectoral productivities as a measure of variability. The data cover the period from 1960 to 2011, but the panel is not balanced. Table 2.6 provides summary statistics for the natural logarithm of the employment share in agriculture (*lagr_es*), the standard deviation of the natural logarithm of sectoral productivities (*lsd_prod*), and the natural logarithm of the productivity in the total economy (*lprod_tot*). The data are presented at the country level and for the sample as a whole. We also provide information about the first and last year observed for each country and the minimum first and maximum last year in the whole sample.

	observations	*mean*	*sd*	*min*	*max*
Botswana	47			1964	2010
lagr_es	47	-0.66	0.3	-1.02	-0.13
lsd_prod	47	1.34	0.0	1.19	1.52
lprod_tot	47	9.19	0.7	7.60	10.11
Ethiopia	51			1961	2011
lagr_es	51	-0.13	0.0	-0.31	-0.04
lsd_prod	51	1.53	0.1	1.30	1.69
lprod_tot	51	6.55	0.2	6.30	7.23
Ghana	52			1960	2011
lagr_es	52	-0.61	0.1	-0.94	-0.46
lsd_prod	52	1.52	0.0	1.40	1.63
lprod_tot	52	8.04	0.3	7.56	8.66
Kenya	43			1969	2011
lagr_es	43	-0.41	0.1	-0.74	-0.21
lsd_prod	43	1.27	0.0	1.22	1.40
lprod_tot	43	7.98	0.0	7.88	8.06
Malawi	45			1966	2010
lagr_es	45	-0.19	0.0	-0.43	-0.12
lsd_prod	45	1.48	0.0	1.32	1.58
lprod_tot	45	7.03	0.1	6.78	7.24
Mauritius	42			1970	2011
lagr_es	42	-1.82	0.4	-2.66	-0.99
lsd_prod	42	1.05	0.2	0.63	1.49
lprod_tot	42	9.19	0.4	8.33	9.88
Nigeria	52			1960	2011
lagr_es	52	-0.53	0.1	-0.88	-0.25
lsd_prod	52	2.13	0.2	1.39	2.53
lprod_tot	52	7.48	0.4	6.43	8.04
Senegal	41			1970	2010
lagr_es	41	-0.45	0.1	-0.66	-0.31
lsd_prod	41	1.52	0.1	1.26	1.75
lprod_tot	41	8.11	0.1	7.91	8.37
South Africa	52			1960	2011
lagr_es	52	-1.39	0.3	-2.00	-0.72
lsd_prod	52	0.93	0.0	0.80	1.07
lprod_tot	52	9.57	0.2	8.92	9.98
Tanzania	52			1960	2011
lagr_es	52	-0.16	0.0	-0.35	-0.09
lsd_prod	52	1.40	0.1	1.08	1.73
lprod_tot	52	7.10	0.1	6.73	7.48
Zambia	46			1965	2010
lagr_es	46	-0.36	0.0	-0.50	-0.27
lsd_prod	46	1.46	0.0	1.35	1.59

lprod_tot	46	7.76	0.1	7.48	8.08
Total	523			1960	2011
lagr_es	523	-0.60	0.5	-2.66	-0.04
lsd_prod	523	1.43	0.3	0.63	2.53
lprod_tot	523	7.98	1.0	6.30	10.11

Table 2.6
Summary statistics for the log of the employment share in agriculture, the standard deviation of the log sectoral productivities and the log of the average productivity in total economy

We first estimate equation (2.2):

$$S_{it} = \alpha_i + \beta x_{it} + u_{it} \tag{2.2}$$

Where S_{it} is the standard deviation of the natural logarithm of the sectoral productivities at the country level in a given time period, x_{it} represents the natural logarithm of the employment share in agriculture at the country level in a given time period, u_{it} are observations residuals, α_i are unobserved country specific characteristics and β is the regression coefficient of interest, i.e. the marginal impact of the natural logarithm of the agricultural employment share on the standard deviation of the log of sectoral productivities. As expected, the coefficient is positive (0.23) and highly significant, with a t statistic of 8.62. This result is illustrated in Figure 2.6, where we draw a scatterplot with the standard deviation of the natural logarithm of sectoral productivities in the vertical axis and the natural logarithm of the employment share in agriculture in the horizontal axis (the circles represent the coordinate points for the two variables in the relative axis), and we fit a line derived from regression (2.2). The graph shows that a larger employment share in agriculture is associated with larger variability in sectoral productivities.

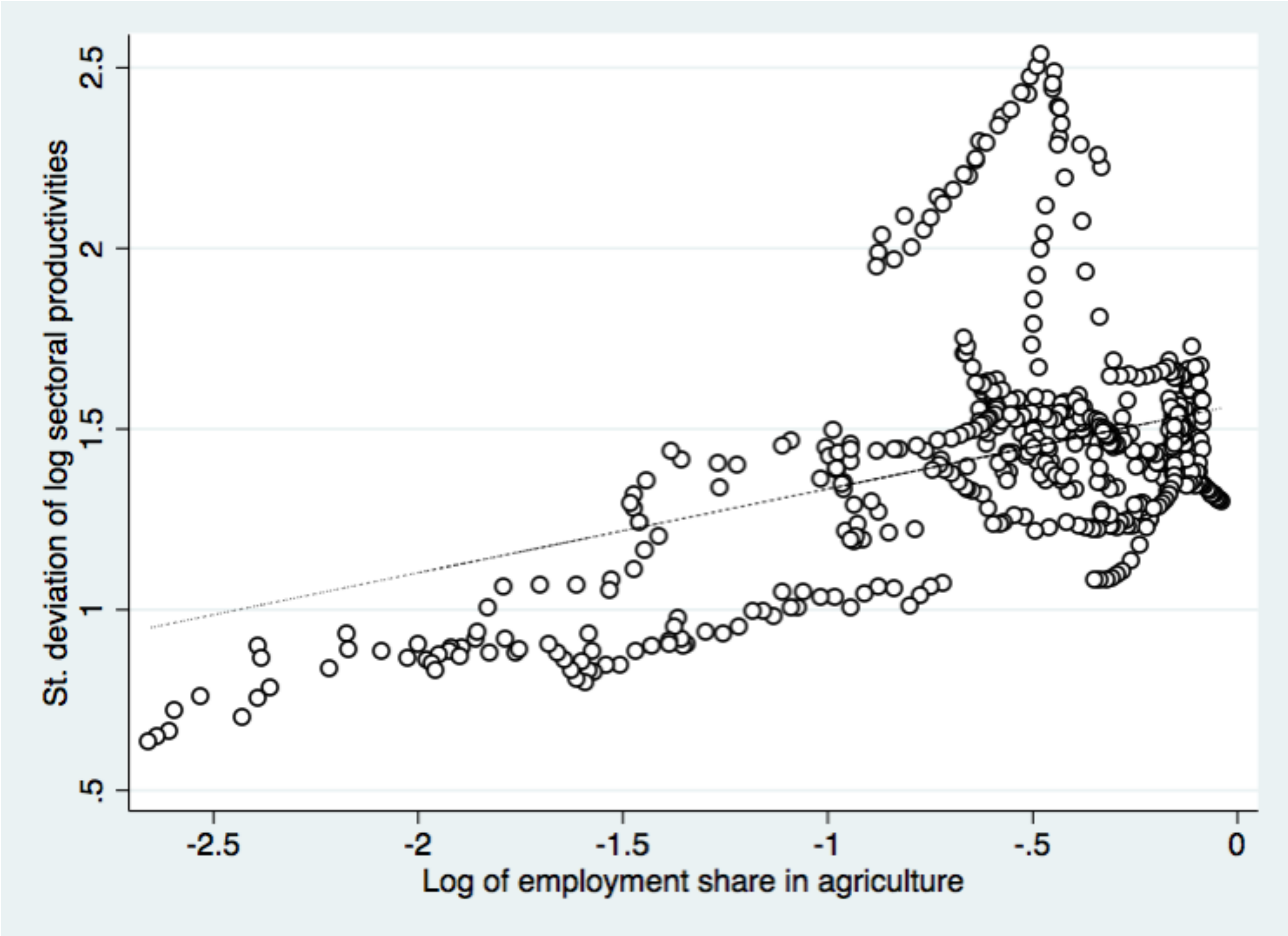

Figure 2.6
Fitted line for the relationship between the standard deviation of log sectoral productivities and the log of agricultural employment share

We then estimate equation (2.3):

$$Y_{it} = \delta_i + \gamma S_{it} + e_{it} \qquad (2.3)$$

Where Y_{it} represents the natural logarithm of the productivity in the total economy at the country level in a given time period, S_{it} is the standard deviation of the natural logarithm of the sectoral productivities at the country level in a given time period, e_{it} are observations residuals, δ_i are unobserved country specific characteristics and γ is the regression coefficient of interest, i.e. the marginal impact of the standard deviation of the log of sectoral productivities on the log of the productivity in the total economy. We obtain again the expected sign in the coefficient (-0.43) and a high t statistic (-4.30). The result is illustrated in Figure 2.7, where we draw a scatterplot with the natural logarithm of the productivity in the total economy in the vertical axis and the standard deviation of the natural logarithm of sectoral productivities in the horizontal axis (here again the circles represent the coordinate points for the two variables), and we fit a line from regression (2.3). We find that where the variability in sectoral productivities is larger the productivity in the total economy is lower.[19] The two relationships described

[19] We also tried to estimate the two specifications by using the coefficient of variation of log sectoral productivities as a measre of variability, but the results are qualitatively equivalent.

above seem perfectly in line with the view that there is still a significant potential for structural change in Sub-Saharan Africa.

Figure 2.7
Fitted line for the relationship between the log of average productivity in total economy and the standard deviation of log sectorial productivities

To investigate the pattern of structural change in the countries in our sample, we follow a standard approach in the literature recently adopted by McMillan et al. (2014), among others – that is, we decompose average productivity into different components, accounting for the effects of the change in sectoral productivity and structural change. Note, however, that McMillan et al. (2014) adopt a two-terms decomposition of the change in labour productivity: the first one is the within-component, which measures the productivity change in each economic sector from the beginning to the end of the period of interest (from *t-k* to *t*), keeping constant the employment share. The second term is the structural change term, captured by the product between the end-of-period sectoral productivity level and the change in employment from time *t-k* to time *t*. The decomposition just described can be expressed by the following formula:

$$\Delta Y_t = \sum_{j=1}^{J} \Delta y_{j,t} s_{j,t-k} + \sum_{j=1}^{J} \Delta s_{j,t} y_{j,t} \quad (2.4)$$

where Y represents the overall productivity level, y_j the productivity level in sector *j*, s_j the employment share in sector *j*, *t* is the final period observed, *t-k* is the initial period observed and Δ represents differences in the productivity level or employment share between *t* and *t-k*.

As de Vries et al. (2015) report, this is just one of the possible decomposition choices that can be made. We prefer an alternative decomposition that describes productivity as the result of the summation of three terms: the first one and the second one are conceptually identical to those in McMillan et al. (2014), except for the fact that the structural change term results from multiplying the initial sectoral productivity level (rather than the final one) times the change in employment share. The third component is a covariance term, defined as the summation of the interactions between the change in sectoral productivity and the change in employment share during the period of interest. This component captures the idea that, from a structural change perspective, it is relevant not only that labour moves towards sectors where productivity is higher, but that it moves towards sectors where productivity is growing (that is to say where productivity at time *t* is higher than productivity at time *t-k*), i.e. towards economic sectors where productivity shows the potential to be high in the future. The decomposition is formalised in (2.5), where notation is the same as before.

$$\Delta Y_t = \sum_{j=1}^{J} \Delta y_{j,t} s_{j,t-k} + \sum_{j=1}^{J} \Delta s_{j,t} y_{j,t-k} + \sum_{j=1}^{J} \Delta y_{j,t} \Delta s_{j,t} \qquad (2.5)$$

Let us notice that:

- The first term will be positive if overall within-sector productivity has increased;
- The second term will be positive if workers have moved towards sectors where the level of labour productivity is higher;
- The third term can be positive or negative, depending on the cumulative effect of labour force movements across sectors and sectoral productivity change. Specifically, if workers have overall moved towards sectors where productivity has increased (decreased), this will be captured by a positive (negative) sign of the third term of the decomposition.

The decomposition specified in (2.5) refers to changes in total labour productivity levels. It can be transformed into a decomposition of the growth rate of labour productivity dividing through by Y_{t-k}, the initial total productivity level.

In what follows, we produce and discuss graphical representations of this "productivity-growth decomposition" for each of the countries in our sample, as well as for the resulting Sub-Saharan African aggregate.[20] To smooth out business cycle disturbances in the decomposed growth rates, our analysis relies on 5-year Simple Moving Averages (SMA) of each term in the decomposition and the overall labour productivity growth rate.[21]

[20] As before, we drop Zambia from the sample because of missing data on employment level in the Government services subsector.
[21] Following much of the empirical panel-data literature, we have chosen to average data over a 5-year period as a convenient compromise between the need to purge the data from business cycle effects and that of not losing too many observations.

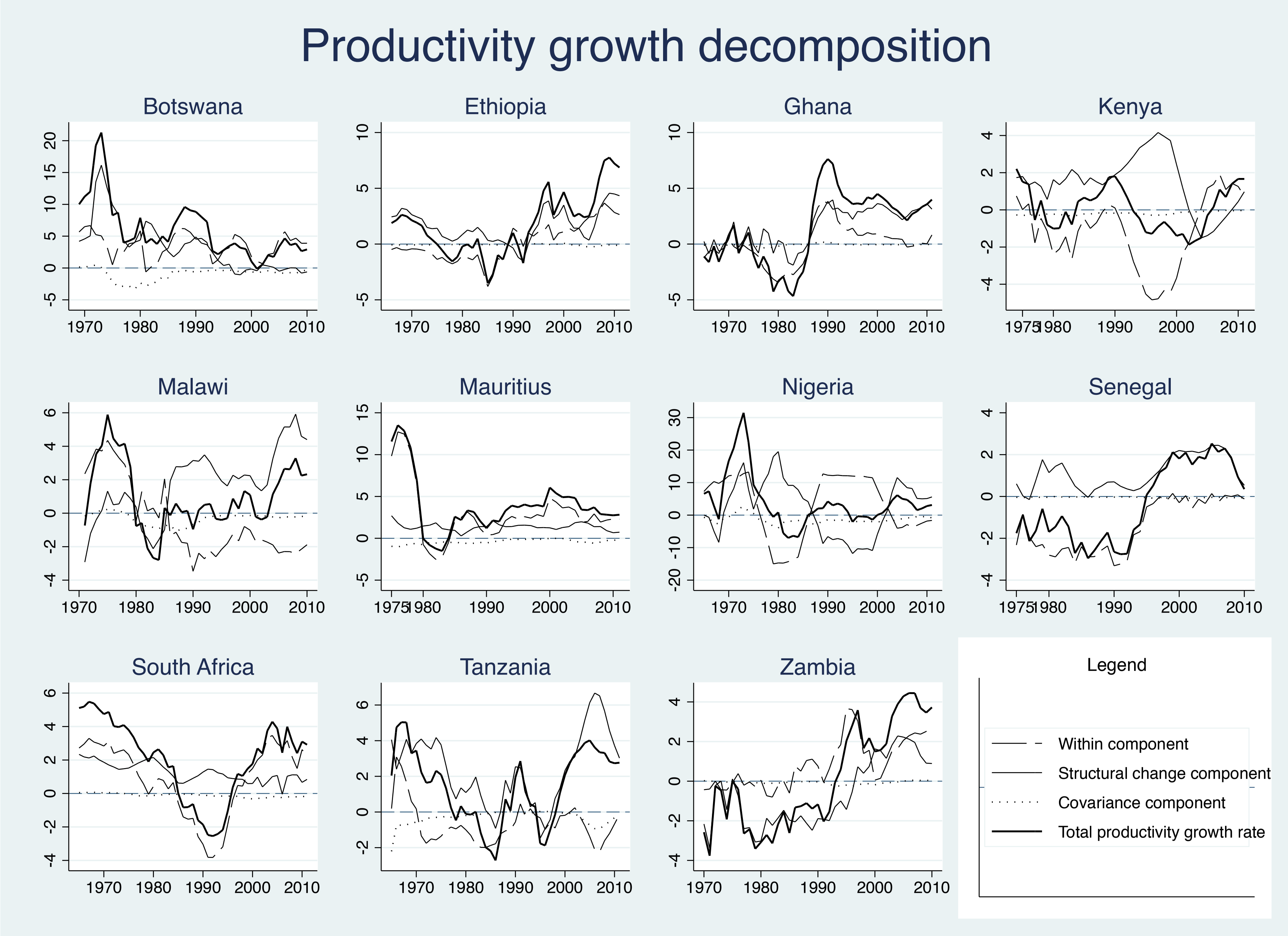

Figure 2.8
Full economy labour productivity growth rate decomposition - 5 years SMAs

Figure 2.8 presents the graphical representation of the full economy labour productivity growth rate (in bold lines) and of its breakdown into within (dashed lines), structural change (continuous lines) and covariance (dotted lines) components for each country in the sample. SMAs help denoting that, beyond a certain degree of heterogeneity, labour productivity growth seems showing a common behaviour of the overall productivity growth, with a decreasing trend until the early '80s and an upwards trend from the early '90s. The only countries not experiencing the preliminary decreasing trend are Senegal and Zambia, where productivity growth was negative in the '70s. This trending behaviour emerges clearly when looking at the Sub-Saharan African aggregate (Figure 2.9), whose graphical representation also suffers much less from the disturbances of the business cycle than the those of the individual countries.

country	*1961-1970*	*1971-1980*	*1981-1990*	*1991-2000*	*2001-2011*	*1961-2011*
Botswana	**13.04**	**8.08%**	**6.47%**	**1.91%**	**3.15%**	**5.96%**
Within	5.93%	3.18%	3.80%	2.30%	4.29%	3.72%
Structural	6.60%	7.14%	3.74%	0.12%	-	3.13%
Covariance	0.51%	-	-1.07%	-	-	-0.89%
Ethiopia	**1.97%**	**-0.11%**	**-1.25%**	**3.76%**	**4.93%**	**1.92%**
Within	-	-	-1.19%	1.09%	2.66%	0.25%
Structural	2.47%	1.14%	-0.01%	2.63%	2.46%	1.74%
Covariance	-	-	-0.05%	0.04%	-	-0.07%
Ghana	**-**	**-**	**2.57%**	**4.04%**	**2.94%**	**1.48%**
Within	-	-	0.94%	1.17%	0.23%	-0.02%
Structural	0.33%	0.11%	1.57%	2.92%	2.75%	1.56%
Covariance	-	-	0.06%	-	-	-0.06%
Kenya	**4.20%**	**0.25%**	**1.23%**	**-**	**0.78%**	**0.35%**
Within	5.22%	-	-0.18%	-	1.11%	-0.89%
Structural	-	1.71%	1.61%	3.00%	-	1.42%
Covariance	-	-	-0.20%	-	-	-0.18%
Malawi	**-**	**2.56%**	**-0.32%**	**0.35%**	**2.07%**	**0.83%**
Within	1.90%	1.92%	-0.71%	-	-	-0.40%
Structural	-	0.84%	1.08%	2.08%	4.43%	1.53%
Covariance	-	-	-0.69%	-	-	-0.31%
Mauritius	**na**	**5.76%**	**1.89%**	**4.89%**	**3.09%**	**3.89%**
Within	na	4.54%	1.23%	3.56%	2.16%	2.85%
Structural	na	2.08%	1.17%	1.40%	1.24%	1.47%
Covariance	na	-	-0.50%	-	-	-0.43%
Nigeria	**11.61**	**5.08%**	**0.19%**	**-1.01%**	**4.05%**	**3.99%**
Within	9.66%	-	2.55%	10.00	-	3.06%
Structural	2.56%	10.68	-0.78%	-	7.43%	2.31%
Covariance	-	-	-1.58%	-	-	-1.38%
Senegal	**na**	**-**	**-2.42%**	**0.94%**	**1.44%**	**-0.44%**
Within	na	-	-2.86%	-	0.01%	-1.45%
Structural	na	0.87%	0.46%	1.42%	1.48%	1.06%
Covariance	na	-	-0.03%	-	-	-0.05%
South	**4.93%**	**3.13%**	**-0.92%**	**0.36%**	**3.13%**	**2.14%**
Within	2.78%	1.37%	-1.80%	-	2.67%	1.00%
Structural	2.10%	1.83%	0.95%	0.77%	0.64%	1.25%
Covariance	0.05%	-	-0.07%	-	-	-0.11%
Tanzania	**2.75%**	**0.99%**	**-0.12%**	**0.15%**	**3.28%**	**1.45%**
Within	0.18%	-	-1.22%	-	-	-0.69%
Structural	3.95%	2.43%	1.16%	0.43%	4.73%	2.58%
Covariance	-	-	-0.06%	-	-	-0.44%
Zambia	**-**	**-**	**-1.89%**	**1.77%**	**4.01%**	**0.23%**
Within	-	-	0.08%	1.86%	2.43%	0.92%
Structural	-	-	-1.93%	0.10%	1.56%	-0.62%
Covariance	0.02%	-	-0.04%	-	0.02%	-0.06%
Africa	**na**	**1.80%**	**-0.11%**	**0.15%**	**2.37%**	**1.05%**

Within	na	0.44%	-0.37%	0.81%	0.57%	0.36%
Structural	na	1.49%	0.36%	-	1.85%	0.78%
Covariance	na	-	-0.10%	-	-	-0.10%

Table 2.7
Average ten-year and full period productivity growth and breakdown[22]

Our productivity growth decomposition is useful to understand which economic phenomenon contributes positively (productivity-boosting) or negatively (productivity-slowing) to the overall productivity growth. In Table 2.7 we report the average ten-year overall productivity growth (first row) and its breakdown into the three components for each country and for the African aggregate. The last column reports the same statistics for the whole period. Splitting the data period into decades is very convenient in highlighting the main contribution of each term in the decomposition to the overall productivity growth. We find that most countries are characterized by productivity-boosting structural change throughout the period, while the within term has slowed down productivity more often, sometimes even past 1990, when productivity growth started trending up. The most relevant exceptions to the positive performance of the structural change term are those of Nigeria between 1980 and 2000, and Zambia until the early '90s. This must be properly pointed out, however, since the Nigerian experience in the '90s is so strong that it determines the structural change term to be productivity-slowing at the aggregate level.[23] We also find that the covariance term has generally slowed down productivity growth, sometimes even sizeably (see for example the cases of Botswana, Malawi, Nigeria and Tanzania). Hence, although labour reallocation has generally moved towards sectors where productivity was higher, it has not been entirely efficient, since those same sectors where experiencing decreases in productivity.

When looking at the Sub-Saharan African aggregate we first notice the productivity-slowing effect of the structural change term during the '90s. This is due to the already cited negative effect of the structural change term on productivity in Nigeria. Table 2.7 shows however that structural change has been the main productivity-boosting term in the decomposition with an average magnitude of 0.78% throughout the period observed. The within term averaged 0.36%, while the covariance term has been negative throughout the period, although its magnitude is the lowest among the three terms (-0.10%). A closer look at Figure 2.9 sheds some more light on what we have observed: we find productivity-boosting labour reallocation until the middle '80s, a period in which, nonetheless, the productivity-slowing effect of the within term has determined the decreasing trend in the overall productivity growth. From the end of the '80s productivity growth has oscillated around approximately 1% and -1% due to the productivity-boosting effect of the within term and to the productivity-slowing effect of the structural change term. The already mentioned upward trend in productivity growth that has started in the early '90s was first driven by the within term, but, when sectoral productivities went down at the end of the years 2000, labour reallocation helped keeping productivity growth high. McMillan et al. (2014) find that structural change was productivity-slowing, on average, from 1990 to 2005. After splitting the time period into two parts they show that structural change was productivity-slowing from 1990 to 1999 and productivity-boosting from 2000 to 2005. The within term remains the main productivity-boosting source in their decomposition. Our productivity decomposition results are somewhat different. Specifically, in line with McMillan et al. (2014), the evidence we gather indicates that during the '90s labour reallocation has been mainly productivity-slowing at the aggregate level, but we also find that its effect has been generally productivity-boosting at the country level and that the aggregate negative sign owes a lot to the experience of one single country: Nigeria. Also, our results indicate that during the following decade structural change has been the main driver of productivity growth. A quick look at Table 2.7 clarifies this: in the years 2000 the structural change term has averaged 1.85%, while the within term 0.57% and the covariance term -0.05%. Clearly, our analysis

[22] The sum of the three terms may not add up exactly to the productivity growth because of rounding.
[23] Between 1991 and 1999 the structural change term in Nigeria has been constantly productivity-slowing with a minimum value of -15.61% and a maximum of -8.27%.

covers a longer time span, but we find that the structural change term unequivocally had a positive impact on productivity growth since the first half of the years 2000, and that its effect would have been similar in the previous decade were it not for the large magnitude of its productivity-slowing effect in Nigeria. The discrepancies with the results of McMillan et al. (2014) may be due to several reasons. It is worth noting that they only present decomposition results at the aggregate regional level, without accounting for potential heterogeneity at the country level the way we do. This is relevant, though, as our results suggest. As mentioned, we also use a different methodology to decompose labour productivity growth and we find that the covariance term, which measures dynamic labour reallocation, is often sizeable and, thus, should be accounted for (its effect has been productivity-slowing throughout the period observed). We also smooth out cyclical effects using 5-year SMA. This is relevant because it helps getting rid of noisy information that may undermine relevant tendencies. Moreover, we rely on the updated and improved data contained in the latest version of the GGDC 10-sector dataset, based on PPP indexes computed using conversion rates for 2005 USD rather than 2000 USD as McMillan et al. (2014) do.[24]

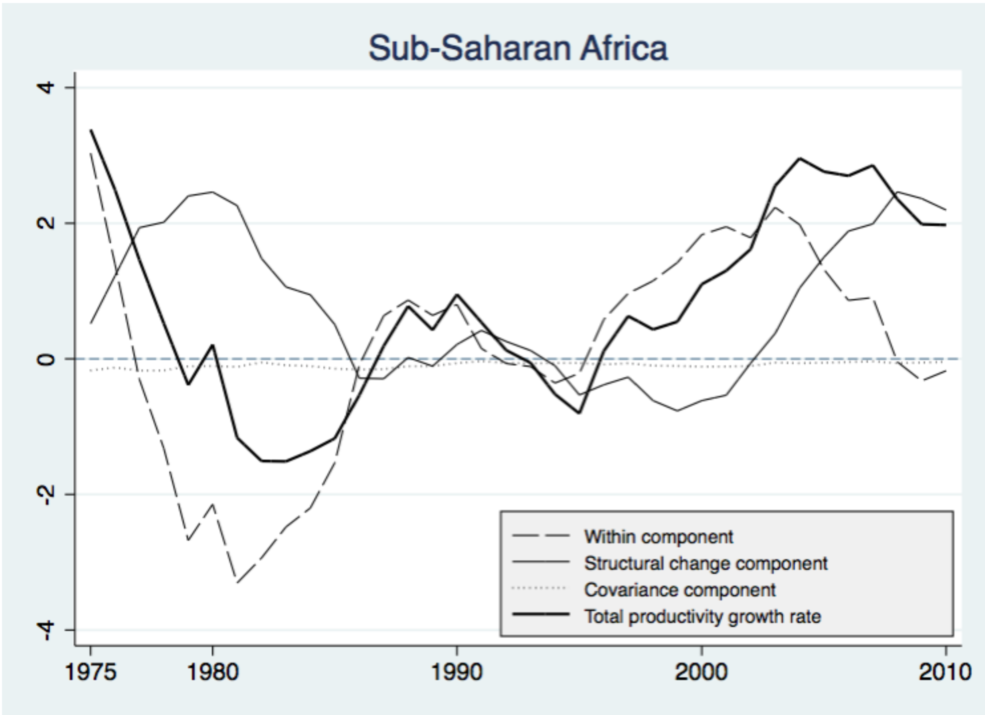

Figure 2.9
Full-economy labour productivity growth rate decomposition - 5 years SMAs for Sub-Saharan Africa

We can give useful insights on the forces determining these effects by looking at the Tables in Appendix A1, providing summary statistics for sectoral average productivities and employment shares at the country and at the aggregate levels. We find that the agricultural employment share has generally

[24] By comparing the 10-Sector database (updated as of January 2015) to the Africa sector database (last update in October 2013) we note several differences. Data on employment for Nigeria are extremely different: we note in particular that the series for agricultural labour is far lower in the most recent dataset (at least until 2004. Afterwards agricultural employment is higher in the 10-Sector database), as well as manufacturing. The services sectors, on the contrary, are characterized by larger employment in the 10-Sector database, and this difference is particularly relevant for trade services. Even data for value added show some differences: value added in agriculture and business services is lower in the 10-Sector database. These discrepancies are likely to produce significant changes in the results of the analysis of sectorial productivities and differences in sectorial labour shares. On the contrary, the figure for Zambia is somewhat reversed: differences in employment levels are minor, while agricultural and business services value added are far lower in the most recent dataset, while the contrary is true for mining, trade and transport services. We also report changes for Tanzania, where the series for value added in business services has been entirely updated, while all of the series for sectorial employment level have been updated starting from 2003. Negligible changes in employment levels characterize some of the other countries in the sample, while value added for business services has benefited from updates for the majority of the countries in the sample. We assume that the data included in the 10-Secotr database are improved and updated with respect to those available by McMillan et al. (2014), as well as they are with respect to the Africa sector database.

decreased and that the main increase has characterized the Services sub-sectors. This may be enough to account for the productivity-boosting effect of structural change, since productivity in the Services is higher than in Agriculture throughout the region. This is also the reason to expect productivity-boosting structural change in the future, although it is not clear if this will be efficient, i.e. if employment will move towards the sectors with the highest productivity levels. According to the data, in the decades examined employment has moved mainly towards the Trade services, a pattern that is common to all of the countries in the sample.[25] Even the other Services sub-sectors have benefited from labour inflows, but the degree of heterogeneity at the country level is much higher than for the Trade and/or the magnitude of the inflow is much lower. Of these sub-sectors Transport, Business and Personal services have been characterized by increases in productivity, while productivity in Trade and Government services has decreased. Unfortunately, these are the sectors where the employment share has been higher, a fact that may explain the productivity-slowing effect of the covariance term in the decomposition. We find instead much weaker inflows towards the industrial sub-sectors. Labour has moved towards the Construction sub-sector, where productivity is high but decreasing (another element that may explain the productivity-slowing effect of the covariance term). We find no movement or a decrease in the employment share in the Utilities and Mining sub-sectors, where productivity is higher. These sectors, together with the Business services, may be the main responsible for the performance of the within term in the decomposition. We find no sign of inflows towards the Manufacturing sub-sector, where productivity has increased. However, if we look at the '80s and '90s we find an increase in the employment share accompanied by a decreasing productivity level. The degree of heterogeneity in this sub-sector is significant: we find one main block of countries like Ethiopia, Kenya, Nigeria, Senegal, Tanzania and Zambia where employment has increased despite the decreasing productivity; Botswana and the two most modern countries of Mauritius and South-Africa where both productivity and employment share have increased; Ghana and Malawi where there is very little change in productivity and employment. This shows that the sector that historically has played the most relevant role in development shows but little signs of expansion. We believe that productivity in Manufacturing should be boosted in order to take advantage of the timid allocation of labour that is shown by our data. Economic policies fostering investment, human development, innovation, as well as trade openness are crucial to create the conditions for an emerging Manufacturing sector. Sub-Saharan Africa is usually thought to be lacking sound institutions and policies, but following the suggestions of the IMF and World Bank adjustments have been made in the past, and the political and institutional frameworks have certainly improved. These aspects will be investigated in the econometric model that will be used to discover the main determinants of structural change in the region.

[25] An occurrence which is also underlined by de Vries et al. (2015).

2.4. Bayesian Model Averaging & Selection for structural change

This section introduces a Bayesian Model Average (BMA) approach in order to select the variables that are most likely to determine the structural change path in Sub-Saharan Africa. Economic theory suggests a number of explanations for the phenomenon of interest, but a certain degree of model uncertainty is still present, as African economic performance still remains an unresolved puzzle, and perspectives for economic development are still uncertain, with some authors expressing pessimism, and others a cautionary optimism.

We contribute to this strand of the literature assessing African economic performance in terms of structural change perspectives, and apply a BMA approach to the study of the subject, which is entirely new to our knowledge. By applying a Bayesian Model Averaging approach, Masanjala & Papageorgiou (2003) show that determinants of economic growth in African countries are different from the rest of the world. And their view is reinforced in Masanjala & Papageorgiou (2008). We would like to assess if this difference can also be useful to explain the structural change pattern of Sub-Saharan Africa. Our application of the BMA methodology also takes into consideration the issues of individual heterogeneity and potential endogeneity, which are often neglected in studies relying on BMA. In this section we first introduce BMA, then we show the data used and explain the transformations applied to the data to deal with heterogeneity and endogeneity issues. Finally, we present the results.

ii. Classical statistical framework

The introduction of the BMA approach in social sciences owes a lot to Raftery (1995). Hoeting, et al. (1999) and Wasserman (2000) also offer very useful insights on the methodology. As noted by Raftery (1995), the application of the BMA approach to the analysis of social and economic problems follows directly from some of the basic principles of probability and statistics, i.e. conditional probability, Bayes' theorem and the law of total probability. In BMA we start with a prior belief about the distribution of the data, we then use Bayes' theorem and the concept of conditional probability to update our prior belief conditioning on the data observed. As it is well known, the Bayesian framework represents an optimal choice for treating uncertainty within a mathematically coherent approach. In our case, we address the problem of uncertainty relative to both the parameters of interest and the model selection problem. We anticipate that we stick with a linear model class and inspect the full model space to average the estimated parameters through each model's posterior probability.

Suppose we want to explain the structural change process in Sub-Saharan African countries by adopting a linear model $\mathcal{M}_1$ of the form:

$$\boldsymbol{y}_{\mathcal{M}_1} = \boldsymbol{X}_{\mathcal{M}_1}\boldsymbol{\beta}_{\mathcal{M}_1} + \boldsymbol{u}_{\mathcal{M}_1} \qquad (2.6)$$

In (2.6) $\mathrm{y}_{\mathcal{M}_1}$ is a $\mathrm{n} \times 1$ vector of n observations on the dependent variable (the structural change term in the decomposition of overall productivity growth in Sub-Saharan African countries), $\mathrm{X}_{\mathcal{M}_1}$ is a $\mathrm{n} \times \mathrm{k}$ matrix of n observations on k independent explanatory variables, $\beta_{\mathcal{M}_1}$ is a $\mathrm{k} \times 1$ vector of unknown regression parameters, including the constant term, and $\mathrm{u}_{\mathcal{M}_1}$ is a $\mathrm{n} \times 1$ vector of errors, which we assume $\mathrm{iid} \sim \mathrm{N}(0, \sigma^2)$. Based on theoretical and empirical reasons, we include a given set of regressors $\mathrm{x}_{\mathrm{i}\mathcal{M}_1}$ in the matrix $\mathrm{X}_{\mathcal{M}_1}$. In a classical linear regression context we are interested in estimating each parameter in $\beta_{\mathcal{M}_1}$, assessing its statistical significance by means of a t-statistic and relative p-value, and assessing how well the model fits the data. We treat the model as if it were the true model and draw conclusions from it, as well as derive recommendations based on it. The process summarily described above ignores the uncertainty that characterises the choice of our true model. It may well be that there exists another model $\mathcal{M}_2$ of the form:

$$\boldsymbol{y}_{\mathcal{M}_2} = \boldsymbol{X}_{\mathcal{M}_2}\boldsymbol{\beta}_{\mathcal{M}_2} + \boldsymbol{u}_{\mathcal{M}_2} \tag{2.7}$$

where we include a new set of regressors in $X_{\mathcal{M}_2}$, such that $x_{i\mathcal{M}_1} \neq x_{i\mathcal{M}_2}$. After careful inspection, we are able to assess that the model in (2.7) fits the data reasonably well, and that it is a serious competitor of (2.6) for the role of true model. Raftery (1995) shows that this situation is often common in empirical research based on assessing the statistical significance of the parameters of interest by means of p-values. BMA helps set up a different framework where uncertainty in the model selection process is directly assessed, where we are returned with information on the posterior probabilities of the inclusion of each parameter of interest, and where the parameters of interest are estimated by weighting them by their model's posterior probability. Raftery (1995) also suggests that weighting provides more precise results than sticking to estimates from one specific model.

iii. Bayesian statistical framework

Suppose we want to use a Bayesian approach for $\mathcal{M}_1$. $\boldsymbol{\beta}_{\mathcal{M}_1}$ and $\boldsymbol{\sigma}^2_{\mathcal{M}_1}$ (the variance of the errors for the model) are the unknown parameters we are interested in, and we denote them by $\boldsymbol{\theta}_{\mathcal{M}_1}$. We denote our prior belief about the unknown parameters by using the notation $f(\boldsymbol{\theta}_{\mathcal{M}_1})$.[26] Observing the data allows us to specify the likelihood, the probability to observe the actual data given that $\boldsymbol{\theta}_{\mathcal{M}_1}$ is the true parameter vector. We denote this by $f(D|\boldsymbol{\theta}_{\mathcal{M}_1})$, where D stands for the observed data. Bayes' theorem allows us to reverse the direction of conditionality by the formula in (2.8). We then use (2.8) to update our prior beliefs about the true parameter vector:

$$f(\boldsymbol{\theta}_{\mathcal{M}_1}|D) = \frac{f(D|\boldsymbol{\theta}_{\mathcal{M}_1})f(\boldsymbol{\theta}_{\mathcal{M}_1})}{f(D)} \tag{2.8}$$

Here $f(D) = \int f(D|\theta_{\mathcal{M}_1})f(\theta_{\mathcal{M}_1})d\theta_{\mathcal{M}_1}$, i.e. since $\theta_{\mathcal{M}_1}$ is a vector of continuous random variables, we integrate over all of its possible values to compute the total probability for $\theta_{\mathcal{M}_1}$. The denominator in (2.8) is often defined the normalising constant (it is necessary to allow probabilities to add up to one), but since it is not dependent on $\theta_{\mathcal{M}_1}$ we can omit it and accept (2.8) up to a constant of proportionality. Hence (2.8) transforms into:

$$f(\boldsymbol{\theta}_{\mathcal{M}_1}|D) \propto f(\boldsymbol{\theta}_{\mathcal{M}_1}|D)f(\boldsymbol{\theta}_{\mathcal{M}_1}) \tag{2.9}$$

By (2.9) we state that the posterior distribution of $\theta_{\mathcal{M}_1}$ is proportional to the likelihood times the prior distribution.

Up to this point we have only considered uncertainty about the parameters of interest conditioning on the selected model, but the Bayesian approach allows us to incorporate model uncertainty in our estimation strategy. In fact, exactly as we did for $\theta_{\mathcal{M}_1}$, we can compute the posterior distribution for each of the competing models in the model space $\boldsymbol{\mathcal{M}}$. A full Bayesian approach (which is the one we adopt

[26] $f(\cdot)$ denotes the Probability Density Function (PDF).

here) would consider the full model space allowed by the number of regressors. Suppose we have collected data about k independent variables. The model space $\mathcal{M}$ is composed of 2^k models. This considers every possible combination of the regressors included in X. $\mathcal{M}_i \in \mathcal{M}$ is the i^{th} model in the model space, and we need to compute its posterior probability. The elements we need for this computation are analogous to those of the previous step: the prior density for $\mathcal{M}_i$ i.e. $f(\mathcal{M}_i)$ and the likelihood function for the data given that $\mathcal{M}_i$ is the true model, i.e. $f(D|\mathcal{M}_i)$. We apply Bayes' theorem to obtain (2.10):

$$f(\mathcal{M}_i|D) = \frac{f(D|\mathcal{M}_i)f(\mathcal{M}_i)}{\sum_{i=1}^{2^k} f(D|\mathcal{M}_i)f(\mathcal{M}_i)} \tag{2.10}$$

Here $f(D|\mathcal{M}_i) = \int f(D|\theta_{\mathcal{M}_i}, \mathcal{M}_i)f(\theta_{\mathcal{M}_i}, |\mathcal{M}_i)d\theta_{\mathcal{M}_i}$ is the integrated likelihood for model $\mathcal{M}_i$. After computing the posterior probabilities we can compare the competing models to assess if the data support $\mathcal{M}_i$ over $\mathcal{M}_j$ (for $i \neq j$). This is commonly done by the posterior odds of $\mathcal{M}_i$ against $\mathcal{M}_j$, where the posterior odds is the ratio of each model's posterior probability.

$$\frac{f(\mathcal{M}_i|D)}{f(\mathcal{M}_j|D)} = \frac{f(D|\mathcal{M}_i)f(\mathcal{M}_i)}{f(D|\mathcal{M}_j)f(\mathcal{M}_j)} = \frac{f(D|\mathcal{M}_i)}{f(D|\mathcal{M}_j)}\frac{f(\mathcal{M}_i)}{f(\mathcal{M}_j)} \tag{2.11}$$

The first term on the right-hand side of equation (2.11) is the ratio of the integrated likelihoods of the competing models, i.e. the Bayes factor for $\mathcal{M}_i$ against $\mathcal{M}_j$. The second term is the ratio of the prior probabilities of the competing models, i.e. their prior odds. When there is no prior preference for one of the models in $\mathcal{M}$ we have $f(\mathcal{M}_i) = f(\mathcal{M}_j)$, hence the prior odds will be equal to 1 and Bayes factor is sufficient to decree which is the most supported model based on the observed data. When many candidate models exist, given $\mathcal{M}$, (Raftery, 1995) suggests to compare models to a baseline model, usually the null model ($\mathcal{M}_0$) or a saturated model ($\mathcal{M}_s$).

iv. Model averaging

Rather than in comparing models, we are interested in averaging over the parameters of interest based on each model's posterior probability. Generally speaking, model averaging implies that one first estimates the parameters conditioned on each model in $\mathcal{M}$, and then computes the weighted average of these estimates. Thus:

$$\hat{\beta} = \sum_{i=1}^{I} \lambda_i \beta_i \tag{2.12}$$

The key element in (2.12) is λ_i, i.e. the weights attributed to each model in the summation. BMA allows to adopt a coherent non-arbitrary approach for the selection of the model weights. In fact the λ_i in a BMA framework are the models' posterior probabilities, hence they reflect our prior beliefs about $\mathcal{M}_i$ and how much the data support $\mathcal{M}_i$.

v. Variables

As anticipated, the dependent variable in our estimation is the structural change term obtained from the decomposition of aggregate labour productivity growth for the eleven African countries in our panel.

The selection of our set of independent variables is based on standard growth and development theory. In particular, we take into account the role played by the presence of a large and inefficient agricultural sector, a typical feature of Sub-Saharan African countries. Development theory postulates that labour reallocation needs growing agricultural productivity. When the agricultural sector is large and agricultural production aims at subsistence, there is no incentive in increasing marginal productivity in the agricultural sector. As suggested by Tiffen (2003), the non-agricultural sector is extremely small and the needs for food and raw materials of the entire economy can be fulfilled by allocating nearly all the labour force within the traditional sector. The expansion of the more modern sectors through labour reallocation would hinder the satisfaction of the needs for primary products if it weren't accompanied by increasing agricultural productivity (or by imports of agricultural goods), given the decrease in the agricultural employment share. By this simple reasoning, we expect that a large agricultural sector increases the scope for structural change, and that increasing agricultural productivity is necessary to free up labour resources to be reallocated to the non-agricultural sectors. Gollin et al. (2002) also show that agricultural land availability is another useful condition for the establishment of a structural change process. Following McMillan et al. (2014) we also assess the impact of a measure of currency flexibility, i.e. the real effective exchange rate. Currency overvaluation has been a common feature in Sub-Saharan African countries and it may undermine industries that rely on tradable goods and commerce-led agriculture, whose productivity level is generally higher than subsistence agriculture. McMillan et al. (2014) stress the fact that Africa has a comparative advantage in primary sectors such as mining, which turn out to produce at very high productivity levels but hardly attract labour force relative to other sectors. This is why a comparative advantage in primary products is expected to reduce the scope for productivity-boosting structural change.[27] Besides, although public policies have improved a lot since the '80s, African resource-endowed countries have been often characterized by an extractive approach linked to corruptive practices, leading to the enrichment and empowerment of the incumbencies and their ethnic groups rather than to fostering private and public investments or welfare improvements. This may be another channel through which comparative advantage may have undermined structural change.[28] We don't have a long enough series for the raw materials share in exports, we use the share of value added in the mining sector as a rough measure of comparative advantage, instead. In addition, we include: the share of urban population, to capture the effect of urban dynamics on structural change. As a rough characterization, an increasing urban population should indicate that sectors where productivity is higher are emerging; a proxy of openness and a measure of the efficiency of economic policies, given by the debt to GDP ratio; a human capital measure and a proxy for infrastructural endowment (i.e. the 'telephone' variable); indicators of institutional quality, such as measures for the form of government, the respect for civil liberties and the prevalence of corruption, are also introduced.

Table 2.8 lists the variables included in the BMA analysis. Appendix A3 provides country-level summary statistics for each variable.

[27] Diao et al. (2010) also stress that comparative advantage in primary sectors undermines raising productivity in Agriculture.

[28] This channel, which is connected to the idea of the "curse of natural resources", is possibly a weaker one, though, because it may affect productivity rather than labour reallocation.

	name	description	source
dependent variable	struct_gr	Structural change term in the decomposition of the average total productivity growth rate	GGDC
regressors	pop_gr	Total population growth rate	WDI
	urban	Urban population share	WDI
	urban_gr	Urban population growth rate	WDI
	eq_dist	Distance from the equator [0,1]	Authors' calculation based on data on latitudes included in Nunn and Puga, 2012
	land_pa	Agricultural land per agricultural employment (square metres)	Authors' calculation based on data about agricultural land (WDI) and agricultural employment (GGDC)
	agr_emp	Agricultural employment share	Authors' calculation based on data about agricultural and overall employment (GGDC)
	agr_prod_s	Relative agricultural productivity	Authors' calculation based on data about agricultural value added and agricultural employment (GGDC)
	gdp_pc_gr	GDP per capita growth rate	Authors' calculation based on overall value added (GGDC) and total population (WDI)
	min_va	Value added in Mining as a fraction of overall value added	Authors' calculation based on data about value added (GGDC)
	reer	Real effective exchange rate	Bruegel
	gdp_def	Inflation - GDP deflator	WDI
	fin_depth	Financial depth, measured by Private credit by deposit money banks as a fraction of GDP	GFDD
	ext_debt	External debt to GDP ratio	WDI
	debt_gdp	Debt to GDP ratio	HPDD
	ec_glob_ind	Economic globalisation index	KOF
	shec_se	Level of the shadow/informal economy as a fraction of official GDP	QOG - EO
	educ	Human capital	PWT
	inf_mort	Percentage of child deaths over overall pregnancies	Authors' calculation based on WDI
	telephone	Fixed-line and mobile subscriptions per 100 people	WDI
	chga_hinst	Form of Government	QOG - CHGA
	vdem_corr	Political corruption index	VDEM
	vdem_civlib	Civil liberties index	VDEM

Table 2.8
Variables definitions and sources

vi. FOD variables transformation

Since we want to apply BMA in a linear regression context, we have to deal with individual heterogeneity. In a country-level panel context, it is reasonable to think that variables in levels carry over country characteristics that may vary greatly from country to country. We don't want to lose this information, because it would bias our final results. However, dealing with individual heterogeneity in a BMA context is not straightforward, and this is why applied works based on BMA typically rely on cross-country analyses. In a classical panel context, individual heterogeneity would be accounted for via a fixed-effects estimation. In a BMA linear regression context, instead, we need to treat variables in a way that allows us to pool observations together as if we were in a cross-sectional context. One way to do this would be to rely on first differencing variables at the country level. Suppose we want to apply first differencing on $\mathcal{M}_1$ (for ease of notation we drop the $\mathcal{M}_1$ index in the following equations):

$$\boldsymbol{y}_{it} = \boldsymbol{\alpha}_i + \boldsymbol{X}_{it}\boldsymbol{\beta} + \boldsymbol{u}_{it}$$

where the it index clarifies that we're in a panel context and the α_i represent the unobserved time invariant individual effects. By first differencing we obtain:

$$\begin{gathered}\boldsymbol{\Delta y}_{it} = \boldsymbol{y}_{it} - \boldsymbol{y}_{it-1} = \\ \boldsymbol{\alpha}_i + \boldsymbol{X}_{it}\boldsymbol{\beta} + \boldsymbol{u}_{it} - \boldsymbol{\alpha}_i - \boldsymbol{X}_{it-1}\boldsymbol{\beta} - \boldsymbol{u}_{it-1} = \\ \boldsymbol{\Delta X}_{it}\boldsymbol{\beta} + \boldsymbol{\Delta u}_{it}\end{gathered} \tag{2.13}$$

There is a potential side effect in using first differences to deal with individual heterogeneity. In (2.6) and (2.7) we have assumed the $u_{\mathcal{M}_i}$ to be $\text{iid} \sim \text{N}(0, \sigma^2)$ and $\text{Cov}(u_{it}, u_{it-1}) = 0$. In a panel context where the time dimension is relevant first differencing induces serial correlation in the errors even if the assumption holds for the model in levels, i.e. $\text{Cov}(u_{it}, u_{it-1}) \neq 0$. This may lead to biased estimates. León-González & Montolio (2015) and León-González & Vinayagathasan (2015) suggest dealing with individual heterogeneity by applying the Forward Orthogonal Deviation (FOD) transformation of the predetermined variables introduced by Arellano & Bover (1995). This transformation consists in subtracting to each of the $T_i - 1$ observations in the sample the mean of all future observations. The related formula is:

$$x_{it}^* = \sqrt{\frac{T_i-t}{T_i-t+1}}\left[\left(x_{it} - \frac{1}{T_i-t}x_{it+1} + \cdots + x_{iT_i}\right)\right] \tag{2.14}$$

In (2.14) i represents the individuals, while t represents the time dimension.

The linear model we want to estimate is then no longer the same as in (2.6) and (2.7). We rewrite it as in (2.15):

$$\boldsymbol{y}_{it}^* = \boldsymbol{X}_{it}^*\boldsymbol{\beta}^* + \boldsymbol{X}_{it}\boldsymbol{\beta} + \boldsymbol{u}_{it}^* \tag{2.15}$$

where X_{it}^* is a matrix of p transformed regressors, while X_{it} is a matrix of q untransformed regressors, and $p + q = k$. The reason to include X_{it} stands in the fact that we want to include individual time invariant and categorical variables in the estimation (distance from the equator and regime institutions in our case), and the FOD transformation would delete the first ones and affect the meaningfulness of the others.

vii. Endogeneity

Arellano & Bover (1995) also show that lags of the predetermined variables are valid instruments for the transformed variables. This is particularly useful in our context, in order to deal with another problem which may affect our estimation strategy. That is, some of the explanatory variables in $\mathbf{X}_{it}^{*}$ are potentially endogenous, and this needs to be taken account of to avoid biased results. Hence, before proceeding with the BMA analysis, this paragraph gives careful consideration to the possible endogeneity issues related to the variables in Table 2.8.

The dependent variable is the structural change term in the overall productivity growth of the Sub-Saharan countries in the sample. As regressors we include demographic variables (total population growth rate, urban population share, urban population growth rate), geographic variables (distance from the equator), economic variables (real effective exchange rate, employment share in agriculture, mining as a fraction of GDP, GDP per capita growth rate, external debt stocks, debt to GDP ratio, inflation, financial depth, level of the informal economy, index for economic globalization), variables for infrastructural depth (fixed and mobile telephone lines) and human capital (index for average years of schooling and returns to education and infant mortality rate) and policy variables (regime institutions, level of corruption, civil liberties). Theory defines structural change as the allocation of labour from less productive to more productive sectors, and notably from agriculture to manufacturing and services. We also know that structural change is a powerful driver for growth and that growth is associated with a slowing down of the population growth rate. However, in developing countries, growth can be associated with high population growth rates, and only after decades of strong growth may the population growth slow down, i.e. when people's preferences turn towards the substitution of the quality to the quantity of children. Thus, we will not consider population growth to be endogenous here, since the population growth rate in Africa has not been halted nor slowed down by the economic growth that the region has recently experienced (Chen & Ravallion, 2010). Both urban population share and urban population growth rate can be severely affected by structural change, hence we consider them to be endogenous and in need of being instrumented before being used to explain structural change. For the infant mortality rate we apply the same reasoning as for population growth. There has been an improvement in the living conditions of African countries, but to what extent do they depend on structural change? It seems safe to assume structural change not to be so relevant in the bettering of African people's living conditions. Employment share in agriculture is clearly determined by structural change, hence it must be instrumented before any regression trying to assess how much it determines structural change. Land per agricultural labour depends on labour reallocation, hence it can be assumed to be endogenous. The same is true for the agricultural productivity share. There is certainly some scope for structural change to determine to some extent education. When they move from agriculture to manufacturing and the services, workers must be endowed with different skills than those needed for agriculture. And this is particularly true for the services, where cultural skills are needed, while professional skills are needed for manufacturing. Although it does not seem that in Africa this process has been so strong it seems safer to control for endogeneity. Measures for economic globalisation can surely have a relevant impact on structural change. It also seems reasonable that structural change can affect trade, since production can be oriented towards tradable goods, but this also applies to agriculture and mining. Mining as a fraction of GDP needs not being affected by structural change and can be simply used to measure some kind of advantage or disadvantage of resource endowed countries in the structural change process (McMillan et al. (2014) suggest a disadvantage). GDP per capita growth rate can be clearly affected by structural change, hence it is safer to use it after instrumentation. As for the other economic variables, real effective exchange rate, external debt stocks, debt to GDP ratio, inflation, financial depth, level of the informal economy can be safely assumed to be exogenous. Distance from the equator is clearly an exogenous variable, and we assume the policy variables as exogenous as well.

Following León-González & Montolio (2015) and León-González & Vinayagathasan (2015), we deal with endogeneity via instrumental variable estimation, instrumenting the transformed regressors by their untransformed lags, similarly to the standard panel context. We favour parsimony for the choice of the lags, hence we use the first three lags of the untransformed variables as instruments. This also responds to the need to preserve the sample size. Arbitrarily increasing the number of lags would result in loss of observations. Although our time dimension spans at least from the start of the seventies until 2010, the panel is not balanced and some of the regressors lack a relevant amount of observations. This, in a linear regression, affects the entire sample size.

To see how we deal with endogeneity, notice that $\boldsymbol{X}_{it}^{*}$ in (2.15) includes both exogenous and endogenous ($\boldsymbol{Z}_{it}^{*}$) regressors. We address the endogeneity problem by estimating the following equation for each z_{it}^{*}:

$$\boldsymbol{Z}_{it}^{*} = \boldsymbol{Z}_{it-k}\boldsymbol{\gamma} + \boldsymbol{v}_{it}^{*} \qquad k = 1, \dots, 3 \tag{2.16}$$

Where $\boldsymbol{Z}^{*}$ represents the transformed endogenous regressors, and $\boldsymbol{Z}$ the untransformed endogenous regressors. $\boldsymbol{Z}_{it-k}$ affects $\boldsymbol{y}_{it}^{*}$ only through its effect on $\boldsymbol{Z}_{it}^{*}$: $Cov(z_{it-k}, u_{it}^{*}) = 0$.

Dealing with endogeneity issues is not a standard practice in applied works relying on BMA and we have no knowledge of other works accounting for endogeneity in a BMA framework that studies structural change.

To sum up, we will proceed as follows:

1) FOD transformation of the predetermined time varying variables;
2) IV regression of the transformed endogenous variables, where we use up to the third lag of the corresponding predetermined variables as instruments;
3) BMA regression.

viii. Results

The model space is $\mathcal{M} = 2^{\mathrm{k}}$. Since we rely on a set of 22 regressors in our estimation $\mathcal{M} = 2^{22} = 4194304$. The most intuitive way of interpreting the results of the BMA estimates is to look at the posterior inclusion probabilities (pip), i.e. the posterior probability that a regressor is robust and, thus, should be included in the model. Following Raftery (1995), we apply the following scheme to decide for the inclusion of a variable in the model:

50% ≤ pip < 75% - weak evidence
75% ≤ pip < 95% - positive evidence
95% ≤ pip < 99% - strong evidence
pip ≥ 99% - very strong evidence

We start by reporting the results obtained by first assuming that all regressors in the BMA analysis are exogenous. As can be seen in Table 2.9, there is evidence of robust correlation with structural change only for three variables: GDP per capita growth rate, civil liberties and debt to GDP ratio. They have different posterior inclusion probabilities, and according to Raftery (1995) the evidence ranges from weak (debt to GDP ratio) to positive (civil liberties) and very strong (GDP per capita growth rate). The GDP per capita growth rate and the index of civil liberties share a positive sign, but their magnitudes are quite different.

According to our results a 1 percentage point increase in the GDP per capita growth rate should foster approximately 0.3 percentage points productivity-boosting structural change, while an increase in the civil liberties index (which ranges from 0 to 1) of 0.01 should determine a much smaller productivity-boosting effect of structural change of around 0.07 percentage points. The negative impact of the debt to GDP ratio is even smaller, and a 1-point increase is associated with a productivity-slowing structural change of 0.02 percentage points.

Number of observations = 296
k = 22

struct_gr_FDM	*Coef.*	*Std. Err.*	*t*	*pip*	*[1-Std. Err. Bands]*	
_cons	0.0087	0.0069	1.25	1.00	0.0017	0.0156
pop_gr_FDM	0.2142	0.3979	0.54	0.28	-0.1837	0.6121
urban_FDM	-0.0016	0.0150	-0.11	0.06	-0.0166	0.0134
urban_gr_FDM	0.0371	0.1113	0.33	0.15	-0.0742	0.1484
eq_dist	-0.0009	0.0083	-0.11	0.05	-0.0092	0.0074
land_pa_FDM	0.0000	0.0000	0.28	0.11	0.0000	0.0000
agr_emp_FDM	0.0181	0.0398	0.45	0.22	-0.0217	0.0579
agr_prod_s_FDM	0.0034	0.0220	0.15	0.07	-0.0186	0.0254
gdp_pc_gr_FDM	**0.2875**	**0.0516**	**5.57**	**1.00**	**0.2359**	**0.3390**
min_va_FDM	-0.0345	0.0658	-0.52	0.27	-0.1002	0.0313
reer_FDM	0.0000	0.0000	-0.04	0.05	0.0000	0.0000
gdp_def_FDM	-0.0010	0.0048	-0.21	0.08	-0.0058	0.0038
fin_depth_FDM	0.0040	0.0176	0.23	0.09	-0.0136	0.0216
ext_debt_FDM	-0.0055	0.0095	-0.59	0.3	-0.0150	0.0039
debt_gdp_FDM	**-0.0178**	**0.0125**	**-1.43**	**0.73**	**-0.0303**	**-0.0053**
ec_glob_ind_FDM	0.0000	0.0001	0.1	0.05	-0.0001	0.0001
shec_se_FDM	0.0348	0.0740	0.47	0.23	-0.0392	0.1089
educ_FDM	0.0003	0.0049	0.06	0.06	-0.0047	0.0052
inf_mort_FDM	-0.1368	0.2967	-0.46	0.23	-0.4335	0.1599
telephone_FDM	0.0000	0.0001	0.14	0.06	-0.0001	0.0001
chga_hinst	-0.0004	0.0015	-0.25	0.1	-0.0019	0.0011
vdem_corr_FDM	0.0020	0.0112	0.18	0.07	-0.0091	0.0132
vdem_civlib_FDM	**0.0666**	**0.0334**	**2**	**0.86**	**0.0332**	**0.0999**

Table 2.9
BMA estimates in which all regressors are treated as exogenous[29]

However, treating the growth rate of GDP per capita as an exogenous regressor is a dubious choice, since structural change is itself a source of GDP growth via its effect on productivity growth. As mentioned above, there are reasons to believe that other variables may be, at least to some extent, endogenous as well. Based on this, we perform a new BMA analysis where the GDP per capita growth

[29] The suffix "_FDM" indicates that the variable has been transformed by applying (9).

rate and the other variables listed in Table 2.10 are treated as endogenous, and thus are instrumented following the procedure proposed by León-González & Montolio (2015) and León-González & Vinayagathasan (2015).

name	*description*
urban_gr	Urban population growth rate
land_pa	Agricultural land per agricultural employment
agr_emp	Agricultural employment share
agr_prod_s	Relative agricultural productivity
gdp_pc_gr	GDP per capita growth rate
ec_glob_ind	Economic globalisation index
educ	Human capital

Table 2.10
List of endogenous regressors

The new estimates are reported in Table 2.11, while Table 2.12 compares BMA robust regressors in the model where we assume full exogeneity and in the one where we explore endogeneity. We begin by noticing that none of the regressors previously selected as robust in Table 2.9 has now a large enough posterior inclusion probability to be considered as a robust determinant of structural change according to the Raftery (1995) selection criteria. Specifically, the pip values are 6% for the GDP per capita growth rate, 15% for the civil liberties index and 36% for the debt to GDP ratio. Thus, taking account of potential endogeneity issues has a significant impact on the outcome of the BMA analysis. In contrast, we find that four different variables are now selected as robust and should, thus, be included in the model: the agricultural employment share, the infant mortality rate, the economic globalisation index and the external debt to GDP ratio. In terms of our proposed pip threshold we find weak evidence for the inclusion of the economic globalisation index (69%) and the external debt to GDP ratio (60%), strong evidence for the infant mortality rate (91%) and very strong evidence for the agricultural employment share. With a posterior inclusion probability of 100%, we can conclude that the dimension of the agricultural sector is a key characteristic in the structural change process of Sub-Saharan African countries, one that should definitely be included in any model assessing the development perspectives of the region.

Number of observations = 296
k = 22

struct_gr_FDM	*Coef.*	*Std. Err.*	*t*	*pip*	*[1-Std. Err. Bands]*	
_cons	-0.0338	0.0166	-2.04	1.00	-0.0504	-0.0173
pop_gr_FDM	0.0171	0.1120	0.15	0.06	-0.0949	0.1290
urban_FDM	0.0008	0.0114	0.07	0.05	-0.0106	0.0123
urban_gr_ex	-0.0006	0.0840	-0.01	0.05	-0.0846	0.0834
eq_dist	0.0097	0.0279	0.35	0.15	-0.0182	0.0377
land_pa_ex	0.0000	0.0000	-0.01	0.07	0.0000	0.0000

agr_emp_ex	**0.6520**	**0.1132**	**5.76**	**1.00**	**0.5388**	**0.7652**
agr_prod_s_ex	0.0074	0.0644	0.11	0.06	-0.0570	0.0717
gdp_pc_gr_ex	0.0044	0.0357	0.12	0.05	-0.0313	0.0401
min_va_FDM	-0.0027	0.0183	-0.15	0.06	-0.0210	0.0156
reer_FDM	0.0000	0.0000	0.13	0.06	0.0000	0.0000
gdp_def_FDM	0.0000	0.0027	0.01	0.05	-0.0027	0.0027
fin_depth_FDM	-0.0011	0.0101	-0.11	0.06	-0.0112	0.0090
ext_debt_FDM	**-0.0111**	**0.0101**	**-1.10**	**0.60**	**-0.0212**	**-0.0010**
debt_gdp_FDM	-0.0081	0.0109	-0.74	0.41	-0.0189	0.0028
ec_glob_ind_ex	**-0.0032**	**0.0026**	**-1.25**	**0.69**	**-0.0058**	**-0.0006**
shec_se_FDM	0.0040	0.0252	0.16	0.07	-0.0212	0.0293
educ_ex	0.0015	0.0118	0.13	0.06	-0.0102	0.0133
inf_mort_FDM	**-0.9101**	**0.3968**	**-2.29**	**0.91**	**-1.3069**	**-0.5133**
telephone_FDM	-0.0001	0.0003	-0.46	0.23	-0.0004	0.0001
chga_hinst	-0.0012	0.0023	-0.50	0.25	-0.0035	0.0012
vdem_corr_FDM	0.0041	0.0153	0.27	0.11	-0.0111	0.0194
vdem_civlib_FDM	0.0070	0.0184	0.38	0.17	-0.0114	0.0255

Table 2.11
BMA estimates in which selected regressors are treated as endogenous[30]

Exogenous specification			*Endogenous specification*		
robust regressor	***coefficient***	***pip***	***robust regressor***	***coefficient***	***pip***
gdp_pc_gr	0.2875	1.00	agr_emp*	0.652	1.00
debt_gdp	-0.0178	0.73	ext_debt	-0.0111	0.60
vdem_civlib	0.0666	0.86	ec_glob_ind*	-0.0032	0.69
			inf_mort	-0.9101	0.91

* These regressors are treated as endogenous within the model/specification

Table 2.12
Comparison list of robust regressors in the two BMA specifications

The positive sign of the agricultural employment share confirms what we have already suggested in Section 2.3: a large agricultural sector is by itself a source of productivity-boosting structural change in Sub-Saharan Africa. This sector is characterised by the lowest labour productivity level, hence the larger the share of labour force employed in agriculture the bigger the potential for labour outflows from this into other sectors to increase the aggregate labour productivity level in the economy. Its net productivity-boosting effect on structural change is also remarkable: according to our model, a 1 percentage point larger agricultural employment share determines an average productivity-boosting structural change term of approximately 0.7 percentage points. All the other robust regressors have a negative coefficient. The most robust is the infant mortality rate. The model suggests that a 1 percentage point fall in the infant

[30] Endogenous regressors are those with the suffix "_ex".

mortality rate implicates an average increase in structural change term of 0.9 percentage points, a substantial productivity-boosting effect. While it is true that infant mortality is higher in countries where the traditional agricultural sector is still large, the variable is robust to controlling for the agricultural employment share, hence it exerts a net effect on structural change. We know that malnutrition is one of the causes of infant mortality either directly or via the worsening of the effects of infant diseases. Famines and/or low agricultural productivity may be signalled by this variable. Workers may be forced to leave higher-productivity sectors to assist their offspring or to join agriculture to provide for their own subsistence or for the subsistence of their families. As for the economic globalization index, the model predicts that gaining 1 point in terms of economic openness is associated with an average productivity-slowing effect of the structural change term of 0.3 percentage points. This is a relevant result if we think that the economic globalization index ranges from 0 (closed economy) to 100 (open economy). Moving up of ten points in this range would determine a 3-percentage-point negative effect. Tiffen (2003) indicates commerce as one of the main potential drivers for structural change, since it may introduce more efficient technologies and production methodologies that may foster productivity. Commerce is not the only element in the economic globalization index, but it is certainly the most relevant, and in any case even the other main components of the index (Foreign Direct Investment and capital flows) would definitely foster investment and productivity. This channel seems to work in reverse for Sub-Saharan Africa, which may indicate either that knowledge coming from abroad is not disseminated in African societies or it is confined to sectors where labour reallocation is low (mining). We also note that the majority of the countries in our sample performs very badly in terms of economic openness.[31] In the 2017 ranking proposed by the Swiss Federal Institute of Technology Mauritius is among the most open economies in the world (9th position), but we have to move to the 60th position to find another country from our sample (South Africa).[32] Then follow Zambia (72th) and Botswana (76th), while the other seven countries are past the 100th position. We believe this has to be taken into account when interpreting these results. A possible strategy is to investigate for the presence of a threshold past which economic openness enters the model with the expected sign. The last regressor is the weakest even in terms of its net effect. The model predicts that a 1% larger external debt to GDP ratio is associated with an average productivity-slowing structural change term of 0.01 percentage points. This may be due to the outflow of labour from high-productivity sectors where investment is undermined by debt repayment.

Our results are quite different from previous studies on Africa's structural change and growth performance. McMillan et al. (2014) perform a classical linear regression where the agricultural employment share, the raw materials share in exports, an index of the currency undervaluation and the employment rigidity index are used as main regressors. They find that agricultural employment share is significantly associated to productivity-boosting structural change only conditionally on the absence of a comparative advantage in primary products and that comparative advantage reduces the scope for productivity-boosting structural change. They also find that a currency undervaluation helps productivity-boosting structural change, while rigidity in the labour market constraints it. While a large enough time period was not available for the employment rigidity index, we have used the value added share in Mining as a proxy for comparative advantage and the real effective exchange rate as a measure of currency flexibility. We highlight that our methodology does not provide any evidence for the role of these two variables on structural change. We also find that the agricultural employment share is very robustly correlated to productivity-boosting structural change, not conditionally, and our results are robust to averaging across a very large number of models. This indicates that the problem of model uncertainty is remarkable in the context of structural change and that it should be accounted for in order to avoid the risk of incorrect inferences. BMA analysis appears as the most suitable approach in this respect, because it explicitly incorporates model uncertainty and addresses it by updating prior beliefs by means of the information available within the data. It is also interesting to notice that agricultural land

[31] The economic globalisation index ranges from 0 (close economy) to 100 (open economy).
[32] The ranking can be retrieved at: http://globalization.kof.ethz.ch/media/filer_public/2017/04/19/rankings_2017.pdf).

per employment is irrelevant in our estimation. Gollin et al. (2002) suggest that both the quantity and the quality of land per person are relevant for agricultural productivity. We find no evidence that agricultural land per employment affects structural change, nor does relative agricultural productivity. These may be seen as indication that a structural transformation is yet to come for Sub-Saharan Africa. Structural change is a far slower process than economic growth via capital accumulation, and Africa may well be on its path for structural change, but it has not reached a sufficient agricultural productivity level. The same indication comes from the urban population share or the urban population growth rate. Sub-Saharan African countries' towns do not seem to grow because more productive occupations are available. This is in line with the analysis by Bryceson (1996), who suggests that Sub-Saharan African deagrarianization (indeed the data show that urban population growth is always higher than rural population growth, except than in Mauritius) has different characteristics than the process observed in the nineteenth century European industrialising countries and is not associated with labour shifts to more productive sectors. This may signal rising unemployment or that the excess labour is mainly absorbed by the informal sector. Other economic variables included in the estimation prove not to be important to explain structural change. It is the case of inflation, level of the informal economy, financial depth and fixed and mobile telephone lines used as a proxy for infrastructural endowment. Even variables capturing the institutional and social characteristics of the countries in the sample have proven to be irrelevant after being passed through the lens of the BMA methodology, while we did not use a variable for colonial origins because there is almost zero variability in this respect, since almost all of the countries in our sample have been English colonies.

2.5. Conclusions

In this chapter we have studied the contribution of structural change to overall productivity growth in a sample of Sub-Saharan African countries. We have tried to analyse as large a time span as possible and inspected the time trends for labour force reallocation and productivity from a three-sector perspective. This has been extremely useful, since it has pointed out the still large dimension of the agricultural sector and the remarkable variability in inter-sectoral productivities. Moreover, were we to exclude the most economically developed countries in the sample (notably Mauritius and South Africa), we would find that where the agricultural sector is smaller, the services follow rather than manufacturing. Data about productivity also show that agricultural productivity is flat relative to that of the other sectors, while a permanent increase in agricultural productivity is recognised as a crucial factor in the early stages of economic development. Recent data from the GGDC have provided researchers with the possibility to inspect ten economic sectors, and this in turn has made it possible to perform a precise decomposition of the productivity growth rate into three components. Although we have documented the time trends for each of the three components by country and at the aggregate level, our principal focus has been the examination of the structural change process. We have found that the process has had a productivity-boosting effect throughout the period observed and that this has been determined mainly by the movement of labour away from agriculture. Other factors have had a productivity-slowing effect through structural change, instead. It is the case of the infant mortality rate, which may signal a process where workers abandon work in order to directly take care of malnourished or ill children or move to lower-productivity sectors that may be better-suited to directly address nutrition issues for their families or their communities. Somewhat surprisingly, economic openness exerts a productivity-slowing effect. Although the degree of openness of the countries in our sample is low, this result may support the idea that in earlier stages of development it is better to protect weaker economic sectors from foreign competition (this is the choice of recently developed Asian economies). A higher degree of openness may be allowed when competition may stimulate innovation and productivity in economic sectors producing tradable goods, rather than menacing the survival of firms and rising unemployment. The role of innovation and competition through trade is particularly relevant for the manufacturing sector. Unfortunately, this sector is small in the majority of the countries in our sample, and there are but small signs of expansion. This appears to be a major constraint in the structural change process of the region. Finally, a large external debt is a typical characteristic of Sub-Saharan African countries. Our results show that debt may constraint the opportunities of development, probably because it may undermine investment and increases in labour productivity, thus forcing labour force to move away from high-productivity sectors.

The BMA methodology we have used has allowed us to deal with the presence of uncertainty in the specification of a satisfactory model to explain the structural change performance of Sub-Saharan African countries. The availability of panel data has allowed us to also control for endogeneity in the relationship between structural change and some of the regressors. This is relevant because the typical set up of the studies on structural change does not deal with potential endogeneity issues. At the same time, we report that many useful variables that could naturally enter a model for structural change are not available in a balanced panel format for Sub-Saharan Africa (the most relevant case is that of the index of employment flexibility). Moreover, BMA is computationally very demanding, and the set of regressors cannot be arbitrarily increased. Extending the number of regressors would require the implementation of methodologies to restrict the application of BMA to a subset of the full model space. The most used approaches are Occam's window and Markov Chain Monte Carlo model composition (MC^3). We believe, however, that exploring such techniques to include meaningful regressors in our model would help providing further useful insights about the determinants of the structural change process in Sub-Saharan Africa, and we look forward to incorporating these methodologies in our further research.

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Appendix A1 – Summary statistics for average productivity and employment share

Botswana

sector	1964-1970	1971-1980	1981-1990	1991-2000	2001-2010
Agriculture	546.2	972.3	848.8	1043.7	949.1
Mining	21014.3	26284.3	110944.7	125867.1	183383.2
Manufacturing	3069.7	26435.4	22790.5	17143.8	17885.1
Utilities	8658.1	12075.9	11725.2	24030.4	47194.4
Construction	46525.8	61093.0	25070.5	25826.4	55149.0
Trade Services	31079.7	35038.9	13736.3	17401.6	16452.8
Transport Services	2535.5	5104.9	9206.7	18816.7	21813.4
Business Services	10632.2	24831.5	34562.3	65754.4	76041.5
Government Services	12111.0	9859.9	13231.0	17845.7	21402.2
Personal Services	2625.7	1876.4	4298.1	17681.0	39789.5
Total Economy	2645.5	6292.0	10816.8	17159.4	21532.4

Table A1
Sectoral ten-year average productivity level in Botswana[33]

sector	1964-1970	1971-1980	1981-1990	1991-2000	2001-2010
Agriculture	85.19%	67.98%	51.04%	39.55%	37.71%
Mining	0.91%	3.09%	3.49%	2.97%	2.15%
Manufacturing	1.03%	1.62%	3.23%	5.58%	6.30%
Utilities	0.13%	0.49%	1.12%	1.05%	0.64%
Construction	1.79%	3.41%	6.75%	9.69%	5.69%
Trade Services	1.38%	2.52%	5.31%	9.24%	15.35%
Transport Services	1.21%	1.09%	1.60%	2.41%	2.74%
Business Services	0.93%	1.43%	2.55%	4.50%	5.65%
Government Services	3.90%	9.56%	14.02%	17.88%	18.92%
Personal Services	3.54%	8.81%	10.89%	7.14%	4.84%
Total Economy	100.00%	100.00%	100.00%	100.00%	100.00%

Table A2
Sectoral ten-year average employment share in Botswana

[33] Average productivity is measured in 2005 million US dollars weighted by sectoral PPPs.

Ethiopia

sector	1961-1970	1971-1980	1981-1990	1991-2000	2001-2011
Agriculture	394.6	365.5	280.2	237.2	276.3
Mining	10692.0	4338.2	1129.2	881.4	756.0
Manufacturing	999.9	1218.2	1332.8	1005.3	722.7
Utilities	22906.1	20581.4	19185.9	20364.6	21921.6
Construction	24154.9	24694.6	22436.3	13165.8	7218.6
Trade Services	3580.0	2519.1	1871.0	1705.0	1575.1
Transport Services	4354.7	4292.3	4573.4	6322.9	9076.0
Business Services	10068.1	27984.5	43666.3	47695.0	37522.5
Government Services	6104.0	4593.7	4197.8	7460.3	14366.1
Personal Services	2576.0	1570.9	1144.6	1608.4	2424.0
Total Economy	609.8	658.8	597.9	671.6	1031.9

Table A3
Sectoral ten-year average productivity level in Ethiopia

sector	1961-1970	1971-1980	1981-1990	1991-2000	2001-2011
Agriculture	94.51%	90.87%	88.91%	87.33%	80.77%
Mining	0.01%	0.02%	0.07%	0.22%	0.35%
Manufacturing	1.58%	1.74%	1.69%	2.34%	4.66%
Utilities	0.03%	0.05%	0.07%	0.08%	0.10%
Construction	0.24%	0.27%	0.26%	0.34%	1.33%
Trade Services	1.51%	3.12%	3.73%	4.08%	7.23%
Transport Services	0.23%	0.39%	0.43%	0.37%	0.45%
Business Services	0.13%	0.10%	0.09%	0.12%	0.30%
Government Services	1.01%	1.75%	2.37%	2.48%	2.40%
Personal Services	0.75%	1.69%	2.38%	2.65%	2.41%
Total Economy	100.00%	100.00%	100.00%	100.00%	100.00%

Table A4
Sectoral ten-year average employment share in Ethiopia

Ghana

sector	1960-1970	1971-1980	1981-1990	1991-2000	2001-2011
Agriculture	657.2	634.4	447.4	584.1	831.9
Mining	8174.2	8071.0	5070.1	3395.8	4631.4
Manufacturing	2904.9	2232.3	1296.3	1763.5	2083.6
Utilities	3987.2	8000.8	11310.4	16359.6	21700.6
Construction	21367.5	19777.6	15278.4	11023.3	14545.3
Trade Services	1777.1	1266.8	828.6	1139.5	1286.5
Transport Services	6390.6	6201.5	6809.7	8764.0	10638.1
Business Services	150651.9	143679.6	113831.1	134033.7	112843.4
Government Services	7265.0	6059.1	7557.1	10149.5	12170.2
Personal Services	3388.0	3675.6	4628.1	6196.3	6541.7
Total Economy	2775.6	2567.3	2253.7	3501.7	4962.9

Table A5
Sectoral ten-year average productivity level in Ghana

sector	1960-1970	1971-1980	1981-1990	1991-2000	2001-2011
Agriculture	59.90%	54.98%	57.73%	54.96%	46.67%
Mining	1.41%	0.78%	0.61%	1.38%	1.42%
Manufacturing	10.62%	13.65%	12.13%	11.32%	11.10%
Utilities	0.41%	0.45%	0.37%	0.38%	0.37%
Construction	2.87%	2.36%	1.38%	2.24%	2.84%
Trade Services	14.40%	14.54%	15.50%	16.56%	21.43%
Transport Services	2.59%	2.63%	2.33%	2.75%	3.24%
Business Services	0.31%	0.33%	0.56%	1.06%	1.89%
Government Services	5.40%	6.74%	6.12%	5.24%	5.80%
Personal Services	2.09%	3.55%	3.28%	4.10%	5.24%
Total Economy	100.00%	100.00%	100.00%	100.00%	100.00%

Table A6
Sectoral ten-year average employment share in Ghana

Kenya

sector	1969-1970	1971-1980	1981-1990	1991-2000	2001-2011
Agriculture	689.3	664.0	634.2	620.6	697.2
Mining	8996.6	5763.3	10111.4	5173.7	1876.0
Manufacturing	3297.1	5047.3	5467.5	3016.6	1638.4
Utilities	25122.4	27479.0	18340.7	16066.3	20072.4
Construction	38318.2	36207.2	19363.4	9224.7	6474.0
Trade Services	3786.7	4391.8	3335.7	2105.1	1527.5
Transport Services	7924.1	7068.3	9186.8	5110.0	4675.9
Business Services	32845.3	40758.9	45680.0	42763.1	48244.7
Government Services	20966.7	21937.0	21272.7	17042.2	14215.7
Personal Services	10181.1	7420.9	3396.9	3226.5	2440.6
Total Economy	2703.3	2945.2	2987.3	2999.0	2817.7

Table A7
Sectoral ten-year average productivity level in Kenya

sector	1969-1970	1971-1980	1981-1990	1991-2000	2001-2011
Agriculture	80.82%	79.58%	74.83%	62.83%	51.35%
Mining	0.11%	0.22%	0.12%	0.27%	0.49%
Manufacturing	3.70%	3.56%	4.37%	7.96%	12.24%
Utilities	0.13%	0.17%	0.28%	0.30%	0.21%
Construction	0.82%	0.91%	1.12%	1.87%	2.52%
Trade Services	5.25%	4.70%	6.76%	10.56%	14.74%
Transport Services	1.45%	1.86%	1.53%	2.67%	3.46%
Business Services	0.88%	0.80%	0.88%	1.42%	1.29%
Government Services	3.42%	4.10%	5.05%	6.05%	6.02%
Personal Services	3.42%	4.10%	5.05%	6.08%	7.68%
Total Economy	100.00%	100.00%	100.00%	100.00%	100.00%

Table A8
Sectoral ten-year average employment share in Kenya

Malawi

sector	1966-1970	1971-1980	1981-1990	1991-2000	2001-2010
Agriculture	162.4	169.9	131.0	161.3	229.9
Mining	2903.8	5202.8	3390.2	8099.4	16956.8
Manufacturing	1813.2	1898.3	1976.3	2259.3	1947.0
Utilities	1631.8	2704.3	2576.4	4494.7	4570.6
Construction	7236.7	8623.3	9409.5	7590.5	5358.5
Trade Services	4679.3	5382.0	4750.6	2243.3	1324.9
Transport Services	2389.9	3367.9	4008.8	4057.2	3027.7
Business Services	33432.6	55550.4	46934.7	41061.6	46711.0
Government Services	7326.2	9505.1	11789.2	6610.9	3476.1
Personal Services	7260.3	10572.9	11259.7	14131.7	9942.9
Total Economy	924.3	1142.0	1116.0	1133.6	1254.0

Table A9
Sectoral ten-year average productivity level in Malawi

sector	1966-1970	1971-1980	1981-1990	1991-2000	2001-2010
Agriculture	85.83%	85.85%	87.22%	84.07%	74.57%
Mining	0.14%	0.13%	0.17%	0.08%	0.08%
Manufacturing	2.93%	3.50%	3.18%	2.75%	3.34%
Utilities	0.23%	0.20%	0.24%	0.18%	0.22%
Construction	2.22%	2.27%	1.44%	1.61%	3.08%
Trade Services	1.82%	2.76%	2.58%	4.82%	9.12%
Transport Services	1.18%	1.09%	0.76%	0.73%	1.43%
Business Services	0.15%	0.27%	0.40%	0.63%	0.70%
Government Services	3.52%	2.53%	2.91%	4.15%	5.87%
Personal Services	1.99%	1.39%	1.11%	0.98%	1.60%
Total Economy	100.00%	100.00%	100.00%	100.00%	100.00%

Table A10
Sectoral ten-year average employment share in Malawi

Mauritius

sector	1970	1971-1980	1981-1990	1991-2000	2001-2011
Agriculture	715.5	2320.4	2844.4	3457.2	5409.9
Mining	125073.5	201440.8	115064.0	52264.2	38410.9
Manufacturing	5478.2	5186.1	5465.1	7086.1	11828.0
Utilities	10030.5	10138.7	19777.3	50841.5	77759.1
Construction	6967.4	6113.8	7412.2	10330.3	17086.0
Trade Services	10170.2	10736.0	12204.7	12549.6	13304.8
Transport Services	5740.5	7018.1	10366.7	13846.7	23438.9
Business Services	22837.3	20948.6	16992.8	30126.6	30181.7
Government Services	9554.0	21034.1	22427.1	20215.3	24548.2
Personal Services	804.2	1461.4	2271.4	6451.5	12256.7
Total Economy	4302.1	6552.2	8140.6	11149.2	16975.9

Table A11
Sectoral ten-year average productivity level in Mauritius

sector	1966-1970	1971-1980	1981-1990	1991-2000	2001-2011
Agriculture	37.30%	27.34%	21.53%	13.84%	8.52%
Mining	0.07%	0.06%	0.12%	0.30%	0.19%
Manufacturing	10.61%	18.32%	26.67%	29.93%	22.38%
Utilities	1.64%	1.89%	1.51%	0.87%	0.98%
Construction	7.80%	12.44%	9.26%	10.06%	9.98%
Trade Services	7.70%	9.58%	10.34%	15.05%	20.25%
Transport Services	5.81%	6.76%	5.83%	6.36%	7.73%
Business Services	1.12%	1.61%	2.64%	3.55%	7.14%
Government Services	12.08%	9.51%	10.81%	13.08%	16.16%
Personal Services	15.85%	12.48%	11.31%	6.97%	6.66%
Total Economy	100.00%	100.00%	100.00%	100.00%	100.00%

Table A12
Sectoral ten-year average employment share in Mauritius

Nigeria

sector	1960-1970	1971-1980	1981-1990	1991-2000	2001-2011
Agriculture	374.3	396.2	426.6	403.1	701.5
Mining	245472.2	694871.1	197914.1	990176.6	759408.3
Manufacturing	335.9	725.1	1612.2	1772.0	2161.1
Utilities	718.9	542.5	602.0	871.0	1660.8
Construction	4686.8	6622.0	4880.6	8806.3	9456.9
Trade Services	1053.1	1148.7	840.1	1002.2	2413.6
Transport Services	611.0	739.4	378.3	515.5	1493.9
Business Services	8186.6	21028.7	21904.1	31100.8	16159.8
Government Services	911.8	1041.1	1213.8	1653.3	2344.2
Personal Services	915.0	570.4	390.1	851.3	1792.9
Total Economy	826.3	2358.6	1853.4	2044.4	2632.7

Table A13
Sectoral ten-year average productivity level in Nigeria

sector	1960-1970	1971-1980	1981-1990	1991-2000	2001-2011
Agriculture	71.95%	58.07%	45.06%	57.84%	62.51%
Mining	0.15%	0.27%	0.56%	0.14%	0.16%
Manufacturing	5.75%	6.68%	4.52%	3.70%	3.78%
Utilities	0.12%	0.38%	0.56%	0.37%	0.28%
Construction	1.06%	1.77%	1.64%	0.82%	1.15%
Trade Services	13.69%	17.08%	26.08%	23.15%	16.99%
Transport Services	1.73%	2.12%	3.79%	2.67%	2.76%
Business Services	0.23%	0.35%	0.60%	0.65%	1.72%
Government Services	2.31%	5.05%	6.98%	5.06%	4.30%
Personal Services	3.01%	8.22%	10.23%	5.60%	6.35%
Total Economy	100.00%	100.00%	100.00%	100.00%	100.00%

Table A14
Sectoral ten-year average employment share in Nigeria

Senegal

sector	1970	1971-1980	1981-1990	1991-2000	2001-2010
Agriculture	1264.4	1035.8	737.3	648.6	698.7
Mining	19899.9	22061.8	26543.8	23281.7	13552.7
Manufacturing	7799.8	6927.0	5562.5	4448.4	3538.2
Utilities	22069.1	16163.2	8937.2	15775.6	90448.8
Construction	8873.4	8502.5	7863.8	7509.5	7461.2
Trade Services	9697.6	7177.3	4052.3	2712.3	2297.2
Transport Services	16857.1	13933.4	9761.6	8810.2	10916.8
Business Services	126401.9	174659.9	216982.6	172548.1	151027.7
Government Services	26235.0	22825.1	17632.0	15116.7	14810.7
Personal Services	2991.9	2635.8	2084.6	1954.8	2264.0
Total Economy	4316.9	3878.1	3216.0	2867.3	3393.7

Table A15
Sectoral ten-year average productivity level in Senegal

sector	1970	1971-1980	1981-1990	1991-2000	2001-2010
Agriculture	73.28%	71.70%	67.75%	62.86%	53.45%
Mining	0.21%	0.17%	0.09%	0.10%	0.16%
Manufacturing	5.64%	5.80%	5.69%	6.97%	9.17%
Utilities	0.34%	0.43%	0.63%	0.41%	0.10%
Construction	1.26%	1.28%	1.60%	2.10%	3.54%
Trade Services	7.28%	8.40%	11.73%	15.78%	20.29%
Transport Services	1.81%	1.89%	1.94%	1.88%	2.94%
Business Services	0.19%	0.19%	0.23%	0.30%	0.46%
Government Services	5.02%	5.21%	5.29%	4.81%	5.04%
Personal Services	4.97%	4.92%	5.05%	4.80%	4.85%
Total Economy	100.00%	100.00%	100.00%	100.00%	100.00%

Table A16
Sectoral ten-year average employment share in Senegal

South Africa

sector	1960-1970	1971-1980	1981-1990	1991-2000	2001-2011
Agriculture	1096.6	1810.1	2305.7	2391.4	3233.4
Mining	18534.9	18380.1	14776.1	16713.0	32454.0
Manufacturing	14166.3	19612.8	20579.1	19800.6	23667.1
Utilities	25861.1	32197.6	36757.8	42963.5	70767.6
Construction	11093.7	17038.5	13125.3	9312.2	12144.9
Trade Services	9558.0	13300.8	13432.6	9553.6	11412.4
Transport Services	13240.5	18376.2	19383.1	18282.7	30770.6
Business Services	35474.2	57172.0	57268.4	36553.5	50456.1
Government Services	41346.4	41227.7	37942.3	26943.5	21983.5
Personal Services	6410.3	7524.7	9316.6	9271.3	12381.6
Total Economy	9630.3	14462.1	16148.1	14474.5	19205.0

Table A17
Sectoral ten-year average productivity level in South Africa

sector	1960-1970	1971-1980	1981-1990	1991-2000	2001-2011
Agriculture	41.79%	30.69%	24.33%	19.95%	15.89%
Mining	8.90%	8.37%	8.68%	5.95%	2.58%
Manufacturing	11.42%	14.63%	15.86%	13.23%	13.05%
Utilities	0.52%	0.79%	1.03%	0.98%	0.61%
Construction	4.74%	5.99%	6.08%	5.71%	6.38%
Trade Services	12.13%	14.59%	15.84%	18.94%	20.77%
Transport Services	3.68%	4.55%	4.90%	5.23%	5.05%
Business Services	2.11%	2.82%	4.01%	6.80%	9.95%
Government Services	5.29%	7.58%	9.59%	12.38%	15.03%
Personal Services	9.42%	9.99%	9.68%	10.83%	10.69%
Total Economy	100.00%	100.00%	100.00%	100.00%	100.00%

Table A18
Sectoral ten-year average employment share in South Africa

Tanzania

sector	1960-1970	1971-1980	1981-1990	1991-2000	2001-2011
Agriculture	357.1	353.5	350.4	415.4	520.1
Mining	21483.7	3469.1	990.4	2306.0	4081.2
Manufacturing	5260.6	6452.0	5358.9	4812.9	4159.7
Utilities	6503.4	10942.3	16592.5	10458.0	5943.1
Construction	53243.0	26384.3	27993.5	23111.7	21514.8
Trade Services	10672.4	4804.8	2625.7	2253.1	2181.2
Transport Services	7104.0	8410.3	7049.0	6918.5	5532.0
Business Services	44920.6	43732.3	43252.1	51885.6	29196.6
Government Services	5810.4	11414.9	9523.5	7458.9	5295.3
Personal Services	1007.8	2061.6	2265.0	2017.6	1933.4
Total Economy	993.5	1230.3	1159.6	1179.6	1540.6

Table A19
Sectoral ten-year average productivity level in Tanzania

sector	1960-1970	1971-1980	1981-1990	1991-2000	2001-2011
Agriculture	91.35%	89.05%	87.17%	85.29%	76.36%
Mining	0.10%	0.41%	0.56%	0.52%	0.85%
Manufacturing	1.40%	1.70%	1.34%	1.51%	2.59%
Utilities	0.09%	0.09%	0.09%	0.16%	0.34%
Construction	0.35%	0.73%	0.49%	0.67%	1.11%
Trade Services	1.35%	3.41%	4.64%	5.98%	8.41%
Transport Services	0.69%	0.84%	0.76%	0.75%	1.42%
Business Services	0.12%	0.19%	0.25%	0.21%	0.50%
Government Services	2.84%	2.26%	3.26%	3.21%	6.48%
Personal Services	1.70%	1.33%	1.45%	1.70%	1.94%
Total Economy	100.00%	100.00%	100.00%	100.00%	100.00%

Table A20
Sectoral ten-year average employment share in Tanzania

Zambia

sector	1965-1970	1971-1980	1981-1990	1991-2000	2001-2010
Agriculture	675.2	628.8	488.9	711.3	640.5
Mining	13266.6	10617.9	8029.3	6094.5	9284.4
Manufacturing	9727.4	7454.2	6467.9	7361.7	8249.9
Utilities	6065.6	21323.7	32542.6	30754.7	38968.5
Construction	24614.8	24577.9	21930.6	18815.9	27306.1
Trade Services	5799.8	5889.9	9140.6	9352.3	7089.4
Transport Services	3059.3	2889.4	3145.8	4117.8	10006.3
Business Services	3671.1	7021.2	8875.8	20302.6	35211.5
Government Services	na	na	na	na	na
Personal Services	323.2	422.2	459.7	413.3	1031.2
Total Economy	2872.5	2479.5	1987.2	2011.4	2726.1

Table A21
Sectoral ten-year average productivity level in Zambia

sector	1965-1970	1971-1980	1981-1990	1991-2000	2001-2010
Agriculture	63.15%	64.89%	71.85%	74.40%	73.05%
Mining	4.49%	3.84%	3.07%	1.82%	1.82%
Manufacturing	2.51%	3.77%	3.93%	2.97%	3.15%
Utilities	0.55%	0.68%	0.52%	0.44%	0.32%
Construction	4.71%	3.03%	1.64%	1.28%	1.57%
Trade Services	3.90%	4.48%	3.80%	4.65%	8.92%
Transport Services	2.94%	2.70%	2.49%	1.89%	1.71%
Business Services	1.19%	1.42%	1.51%	1.20%	1.07%
Government Services	na	na	na	na	na
Personal Services	16.57%	15.19%	11.19%	11.34%	8.38%
Total Economy	100.00%	100.00%	100.00%	100.00%	100.00%

Table A22
Sectoral ten-year average employment share in Zambia

Sub-Saharan Africa

sector	1970	1971-1980	1981-1990	1991-2000	2001-2010
Agriculture	504.5	501.4	467.5	451.7	589.6
Mining	44915.7	64072.8	38798.5	52139.0	73849.7
Manufacturing	5902.3	6852.1	8394.2	7389.5	6674.0
Utilities	15419.2	13237.0	14174.8	18965.3	24444.9
Construction	14711.6	14215.0	11314.1	10395.7	10853.9
Trade Services	3620.0	3647.3	2788.2	2676.5	3433.6
Transport Services	7695.7	7622.9	6326.0	7489.6	10119.3
Business Services	41762.3	49183.8	49703.1	42863.7	44295.4
Government Services	12566.8	13041.9	12009.5	12389.5	11772.8
Personal Services	3203.9	2811.2	2634.5	3931.0	4654.5
Total Economy	2916.4	3419.0	3281.6	3330.1	4005.2

Table A23
Sectoral ten-year average productivity level in Sub-Saharan Africa

sector	1970	1971-1980	1981-1990	1991-2000	2001-2010
Agriculture	70.47%	67.20%	62.27%	64.26%	61.80%
Mining	1.32%	1.24%	1.32%	0.97%	0.63%
Manufacturing	6.20%	6.21%	5.39%	5.27%	6.19%
Utilities	0.21%	0.32%	0.41%	0.34%	0.27%
Construction	1.59%	1.89%	1.70%	1.58%	2.07%
Trade Services	9.79%	10.72%	14.01%	13.98%	13.93%
Transport Services	1.58%	1.91%	2.40%	2.16%	2.36%
Business Services	0.56%	0.61%	0.85%	1.30%	1.93%
Government Services	3.87%	4.37%	5.48%	5.26%	5.60%
Personal Services	4.42%	5.52%	6.17%	4.87%	5.21%
Total Economy	100.00%	100.00%	100.00%	100.00%	100.00%

Table A24
Sectoral ten-year average employment share in Sub-Saharan Africa

Appendix A2 – Prior distributions details

As it is well known, one of the most controversial aspects about the application of BMA is in the choice of the prior distributions for $\theta_{\mathcal{M}_i}$ and for $\mathcal{M}_i$. A convenient way to represent the issue is to associate it to the distinction between the subjective and the objective Bayesian approach, like in Wasserman (2000). The subjective approach entails the availability of prior information about the distribution of $\theta_{\mathcal{M}_i}$ and $\mathcal{M}_i$. This information can be very useful and might be further strengthened by the data if correct. However, most applied works rely on the objective approach to Bayesianism, where noninformative flat priors reflect the absence of a prior preference for one or more models in $\mathcal{M}$, or at least allow to reduce the sensitivity of the results to the prior distribution. Although this choice may not be entirely coherent with a Bayesian approach, it seems nonetheless a satisfactorily enough conservative compromise, since it does not inflate posterior probabilities when the evidence from the data is weak. Here we follow Magnus et al. (2010) in the prior definition for the parameters. They impose an improper prior distribution to σ^2:

$$f(\sigma^2|\mathcal{M}_i) \propto \sigma^{-2}$$

They chose the following proper prior for $\boldsymbol{\beta}$:

$$\boldsymbol{\beta}\ |\sigma^2, \mathcal{M}_i \sim N(0, \sigma^2 V_{0i})$$

We also follow Magnus et al. (2010) and the standard empirical BMA literature in treating equally each model in $\mathcal{M}$. Each model's prior probability is then:

$$\mathrm{f}(\mathcal{M}_\mathrm{i}) = 2^{-k}$$

Appendix A3 – Extended sources and summary statistics for variables used in BMA

Extended source and papers	***Link to dataset***
Bruegel = Zsolt, 2012	http://bruegel.org/publications/datasets/real-effective-exchange-rates-for-178-countries-a-new-database/
GFDD = Global Financial Development Database, World Bank 2016	http://databank.worldbank.org/data/home.aspx
GGDC = Groningen Growth and Development Centre, Timmer et al. 2015	http://www.rug.nl/ggdc/productivity/10-sector/
HPDD = Historical Public Debt Database, IMF 2016	http://data.imf.org
KOF = Swiss Federal Institute of Technology	http://globalization.kof.ethz.ch
PWT = Penn World Tables, v. 9.0, Feenstra et al. 2015	http://www.rug.nl/ggdc/productivity/pwt/
QOG = Quality of Government dataset - EO = Elgin and Oztunali, 2012	http://qog.pol.gu.se/data
QOG = Quality of Government dataset - CHGA = Cheibub et al., 2010	http://qog.pol.gu.se/data
WDI = World Development Indicators, World Bank 2017	http://databank.worldbank.org/data/home.aspx
VDEM = Varieties of democracy dataset, v. 6.2, Coppedge et al. 2016	https://www.v-dem.net/en/data/data-version-6-2/

Table A25
Extended sources for the variables in the BMA estimation and links to datasets

Panel 1

		struct_gr	*pop_gr*	*land_pa*	*eq_dist*	*urban*	*urban_gr*	*agr_emp*
Botswana	*initial*	0.1674	0.0239	1709.2009	0.2465	0.0306	0.0364	0.8748
	final	-0.0111	0.0202	1015.8382	/	0.5624	0.0244	0.3809
	mean	0.0313	0.0277	1414.9185	/	0.2956	0.0908	0.5445
	sd	0.0742	0.0078	216.7438	/	0.2053	0.0589	0.1765
Ethiopia	*initial*	0.0235	0.0235	64.5502	0.0958	0.0643	0.0580	0.9619
	final	0.0368	0.0265	12.1499	/	0.1732	0.0513	0.7515
	mean	0.0172	0.0279	34.4548	/	0.1162	0.0485	0.8862
	sd	0.0249	0.0054	18.5781	/	0.0310	0.0073	0.0473
Ghana	*initial*	0.0165	0.0322	74.2203	0.0885	0.2325	0.0564	0.6067
	final	0.0424	0.0255	36.6872	/	0.5071	0.0395	0.4156
	mean	0.0157	0.0263	46.6377	/	0.3540	0.0424	0.5510
	sd	0.0294	0.0042	13.6957	/	0.0798	0.0078	0.0486
Kenya	*initial*	-0.0073	0.0316	82.3377	0.0059	0.0736	0.0600	0.8063
	final	0.0091	0.0269	36.9925	/	0.2357	0.0441	0.4831
	mean	0.0141	0.0326	52.8624	/	0.1554	0.0570	0.6789
	sd	0.0200	0.0049	13.2725	/	0.0472	0.0164	0.1148
Malawi	*initial*	-0.0961	0.0225	26.7687	0.1468	0.0439	0.0456	0.8439
	final	0.0507	0.0308	14.6906	/	0.1554	0.0383	0.6518
	mean	0.0153	0.0286	16.9698	/	0.1023	0.0550	0.8325
	sd	0.0381	0.0119	4.8307	/	0.0379	0.0188	0.0556
Mauritius	*initial*	0.0540	0.0325	15.6642	0.2237	0.3318	0.0468	0.3730
	final	0.0080	0.0024	24.3628	/	0.4058	-0.0027	0.0716
	mean	0.0149	0.0129	18.2883	/	0.4147	0.0171	0.1879
	sd	0.0141	0.0067	2.7634	/	0.0277	0.0173	0.0858
Nigeria	*initial*	0.0040	0.0206	40.3390	0.1065	0.1541	0.0354	0.7818
	final	0.0740	0.0272	22.1609	/	0.4348	0.0487	0.6066
	mean	0.0222	0.0255	35.9519	/	0.2673	0.0470	0.5935
	sd	0.1413	0.0024	6.9362	/	0.0862	0.0074	0.0972
Senegal	*initial*	0.0361	0.0277	120.8159	0.1596	0.2300	0.0565	0.7328
	final	0.0079	0.0298	42.5667	/	0.4223	0.0360	0.5145
	mean	0.0106	0.0285	64.3923	/	0.3555	0.0411	0.6417
	sd	0.0152	0.0021	23.8595	/	0.0565	0.0104	0.0721
South Africa	*initial*	0.0276	0.0318	306.8828	0.3223	0.4662	0.0357	0.4876
	final	-0.0153	0.0150	441.0652	/	0.6222	0.0237	0.1503
	mean	0.0130	0.0217	391.7397	/	0.5188	0.0276	0.2681
	sd	0.0115	0.0043	43.4793	/	0.0486	0.0045	0.0972
Tanzania	*initial*	0.1351	0.0297	63.1170	0.0696	0.0525	0.0587	0.9174
	final	0.0316	0.0323	26.9199	/	0.2811	0.0576	0.7166
	mean	0.0258	0.0307	40.9352	/	0.1596	0.0661	0.8606
	sd	0.0341	0.0022	11.2663	/	0.0699	0.0223	0.0532

Zambia	*initial*	0.0327	0.0306	268.2099	0.1495	0.1814	0.0764	0.6331
	final	0.0156	0.0303	86.9823	/	0.3872	0.0418	0.7225
	mean	-0.0062	0.0308	153.4220	/	0.3430	0.0469	0.7002
	sd	0.0332	0.0036	56.7137	/	0.0622	0.0263	0.0475

Panel 2

		agr_prod	*agr_prod_s*	*reer*	*gdp_pc_gr*	*min_va*	*gdp_def*	*fin_depth*
Botswana	*initial*	472.2881	0.2356	114.5980	0.2213	0.1022	0.0193	0.1132
	final	1219.8289	0.0498	105.5531	0.0657	0.1065	0.0892	0.2412
	mean	892.8313	0.1046	102.9550	0.0618	0.2001	0.0882	0.1444
	sd	212.9978	0.0639	8.1993	0.0936	0.1092	0.0570	0.0486
Ethiopia	*initial*	395.0854	0.7098	186.9186	0.0165	0.0008	0.0427	0.0085
	final	337.5473	0.2582	98.6018	0.0774	0.0026	0.0144	0.1719
	mean	309.0769	0.4600	158.9246	0.0202	0.0019	0.0738	0.0857
	sd	67.2263	0.1414	54.1731	0.0441	0.0008	0.1015	0.0592
Ghana	*initial*	655.6548	0.2281	203.0092	-0.0276	0.0402	0.0347	0.0456
	final	976.3652	0.1714	87.9847	0.0720	0.0118	0.1660	0.1378
	mean	629.0269	0.2047	291.5697	0.0170	0.0210	0.2800	0.0681
	sd	137.6306	0.0384	386.0432	0.0535	0.0118	0.2315	0.0370
Kenya	*initial*	687.3096	0.2596	103.5190	0.0140	0.0038	0.0866	0.1222
	final	708.6380	0.2386	105.9394	0.0231	0.0032	0.0209	0.3055
	mean	655.2384	0.2250	89.8333	0.0088	0.0036	0.0887	0.1994
	sd	39.7377	0.0197	11.5644	0.0254	0.0005	0.0830	0.0492
Malawi	*initial*	204.5459	0.2027	207.2776	-0.1120	0.0037	-0.0047	0.0560
	final	260.9647	0.1867	106.3815	0.0565	0.0194	0.1213	0.1134
	mean	171.8326	0.1511	171.5465	0.0092	0.0064	0.1636	0.0858
	sd	41.9500	0.0312	41.6207	0.0459	0.0036	0.1971	0.0405
Mauritius	*initial*	715.4774	0.1663	142.7667	0.0378	0.0211	0.0858	0.2377
	final	6238.3577	0.3307	111.9464	0.0394	0.0025	0.0113	0.8246
	mean	3411.1154	0.3244	115.6069	0.0541	0.0133	0.0813	0.3592
	sd	1351.3787	0.0564	11.1042	0.0509	0.0058	0.0474	0.1918
Nigeria	*initial*	396.4493	0.6239	142.4063	0.0316	0.1145	0.0626	0.0457
	final	835.1881	0.2835	114.4675	0.0509	0.3266	1.0382	0.1664
	mean	455.5020	0.2726	174.7143	0.0380	0.4931	0.1942	0.1135
	sd	131.2036	0.1273	104.0411	0.1511	0.1479	0.2512	0.0603
Senegal	*initial*	1264.4443	0.2929	142.4063	-0.0186	0.0097	0.0247	0.1915
	final	790.5336	0.2225	114.4675	0.0111	0.0067	0.0181	0.2434
	mean	791.9232	0.2333	174.7143	0.0042	0.0078	0.0460	0.2222
	sd	194.5430	0.0315	104.0411	0.0305	0.0015	0.0592	0.0644
South Africa	*initial*	862.8665	0.1153	183.0583	0.0103	0.1819	0.0126	0.4857
	final	3608.2459	0.1664	114.5415	0.0136	0.0359	0.0635	0.7176

	mean	2149.1063	0.1430	138.8988	0.0152	0.0951	0.0993	0.5390
	sd	783.3050	0.0268	31.9980	0.0245	0.0472	0.0533	0.1034
Tanzania	*initial*	357.2946	0.4094	154.2511	-0.0228	0.0272	0.2060	0.0831
	final	554.9278	0.3214	107.0517	0.0371	0.0219	0.0925	0.1460
	mean	397.6938	0.3298	190.9804	0.0139	0.0133	0.1709	0.0623
	sd	66.9876	0.0351	94.0054	0.0345	0.0078	0.0868	0.0389
Zambia	*initial*	656.8672	0.2162	69.7195	0.0179	0.2553	-0.0366	0.0645
	final	521.9807	0.1613	105.5604	0.0541	0.1030	0.1395	0.0994
	mean	624.9248	0.2680	66.7320	-0.0018	0.1158	0.2783	0.0692
	sd	123.0800	0.0613	18.2208	0.0431	0.0580	0.3685	0.0205

Panel 3

		debt_gdp	*ext_debt*	*ec_glob_ind*	*shec_se*	*educ*	*life_exp*	*inf_mort*
Botswana	*initial*	0.4578	0.1724	64.9229	0.6002	1.1906	50.5477	0.1035
	final	0.1995	0.1467	66.9879	0.3185	2.7159	63.4023	0.0383
	mean	0.2218	0.1949	66.1269	0.4365	1.8067	56.6281	0.0583
	sd	0.1196	0.1247	4.2099	0.0838	0.5614	4.6916	0.0196
Ethiopia	*initial*	0.0766	0.2517	28.8103	0.4912	1.0159	38.4057	0.1252
	final	0.4053	0.2459	26.2998	0.3426	1.2815	61.2961	0.0483
	mean	0.6528	0.6881	29.6287	0.3901	1.0925	47.1495	0.0904
	sd	0.4188	0.3742	1.9204	0.0336	0.0874	5.8490	0.0407
Ghana	*initial*	0.1177	0.2635	20.9204	0.4038	1.0997	45.8315	0.1112
	final	0.4626	0.2880	51.6255	0.3742	2.2592	60.6100	0.0478
	mean	0.3738	0.5889	29.7532	0.3757	1.6910	53.7491	0.0828
	sd	0.2562	0.3436	11.7552	0.0185	0.3900	4.3093	0.0210
Kenya	*initial*	0.1537	0.3021	26.4991	0.3522	1.1969	46.3624	0.1060
	final	0.4440	0.2220	40.6564	0.2895	2.1659	58.7186	0.0407
	mean	0.3692	0.5316	31.0527	0.3166	1.6156	54.3776	0.0690
	sd	0.1986	0.2444	5.6415	0.0178	0.3059	3.7962	0.0156
Malawi	*initial*	0.4093	0.4772	41.8903	0.5513	1.3245	37.7736	0.1765
	final	0.5766	0.1490	43.7015	0.3969	1.6919	56.8362	0.0544
	mean	0.8395	0.8187	41.5518	0.3999	1.4237	43.8904	0.1131
	sd	0.4054	0.4237	3.1417	0.0545	0.1250	4.0427	0.0489
Mauritius	*initial*	0.1792	0.0911	43.5384	0.3118	1.3782	58.7452	0.0635
	final	0.5204	0.2780	87.2186	0.2185	2.4765	72.9673	0.0131
	mean	0.4621	0.2929	53.6786	0.2719	1.9014	67.4615	0.0326
	sd	0.1361	0.1346	11.3706	0.0342	0.3560	4.0357	0.0184
Nigeria	*initial*	0.2045	0.0693	18.0957	0.6839	1.1517	37.1830	0.1635
	final	0.0960	0.0443	50.7649	0.4964	1.7589	51.3295	0.0754
	mean	0.5870	0.6149	35.5435	0.5439	1.2992	44.7441	0.1057
	sd	0.5338	0.5930	14.5669	0.0707	0.1840	3.5416	0.0376

Senegal	*initial*	0.1801	0.1438	27.6262	0.5378	1.0526	38.2060	0.1121
	final	0.3552	0.3054	46.5571	0.4085	1.4536	64.0144	0.0446
	mean	0.5211	0.5423	33.6270	0.5238	1.1799	50.7652	0.0804
	sd	0.2433	0.2740	5.8223	0.0455	0.1291	8.7643	0.0220
South Africa	*initial*	0.5292	0.1578	58.0450	0.3304	1.7387	49.0363	0.0835
	final	0.3468	0.2951	65.3736	0.2487	2.5044	54.3908	0.0368
	mean	0.3820	0.2149	59.1055	0.2730	1.9569	55.6863	0.0387
	sd	0.0752	0.0441	5.3903	0.0258	0.2024	4.0960	0.0258
Tanzania	*initial*	0.1675	1.2213	27.0497	0.7841	1.3049	43.6539	0.1261
	final	0.2734	0.2862	40.0313	0.5252	1.5962	61.6256	0.0407
	mean	0.7684	0.8967	30.8253	0.6417	1.3759	49.9556	0.0925
	sd	0.3134	0.4978	5.0828	0.0605	0.1006	4.0688	0.0231
Zambia	*initial*	0.5727	0.4670	45.7714	0.4584	1.2778	45.1098	0.1097
	final	0.1889	0.2319	61.2015	0.4208	2.2221	56.3839	0.0502
	mean	1.2813	1.3717	50.0858	0.4366	1.7470	47.7579	0.0902
	sd	0.7606	0.8872	5.9222	0.0514	0.3163	3.6661	0.0147

Panel 4

		telephone	*vdem_corr*	*vdem_civlib*	*chga_hinst*
Botswana	*initial*	0.5718	0.0925	0.4076	3
	final	122.1211	0.2193	0.8419	4
	mean	18.3654	0.1970	0.7855	3.0238
	sd	30.4999	0.0415	0.1209	0.1543
Ethiopia	*initial*	0.1389	0.7316	0.2208	5
	final	8.8656	0.6543	0.4239	3
	mean	0.9055	0.6623	0.5563	3.9184
	sd	1.7762	0.0548	0.1488	0.8123
Ghana	*initial*	0.3180	0.3415	0.6847	3
	final	72.8474	0.5492	0.9331	2
	mean	8.2500	0.6323	0.7023	2.8980
	sd	18.4373	0.0934	0.1728	1.1769
Kenya	*initial*	0.3930	0.1753	0.1593	3
	final	62.8582	0.7797	0.7018	2
	mean	7.3482	0.7685	0.3976	2.7556
	sd	15.4531	0.1655	0.1467	0.4346
Malawi	*initial*	0.1644	0.1342	0.1493	3
	final	22.1362	0.6463	0.7378	2
	mean	2.3814	0.3092	0.2894	2.6591
	sd	5.0643	0.2132	0.2645	0.4795
Mauritius	*initial*	1.7303	0.3179	0.7977	0

	final	126.2476	0.4311	0.8492	0
	mean	31.0408	0.4581	0.8402	0
	sd	39.1554	0.0655	0.0356	0
Nigeria	*initial*	0.2157	0.8185	0.5750	0
	final	55.4168	0.8779	0.6882	2
	mean	7.7515	0.8225	0.5627	3
	sd	15.6750	0.0302	0.0853	1.3683
Senegal	*initial*	0.2945	0.5642	0.6532	3
	final	67.0349	0.6150	0.8568	1
	mean	8.4642	0.5947	0.7628	2.6250
	sd	16.7685	0.0128	0.0722	0.7889
South Africa	*initial*	4.6749	0.4278	0.1897	3
	final	108.7867	0.3898	0.8797	3
	mean	28.5287	0.4241	0.4070	3
	sd	33.7871	0.0279	0.3259	0
Tanzania	*initial*	0.1693	0.4493	0.3887	3
	final	46.3506	0.5324	0.7136	4
	mean	5.0027	0.3294	0.6760	3.0889
	sd	11.3545	0.1624	0.0639	0.2878
Zambia	*initial*	0.5699	0.0717	0.3170	3
	final	39.9885	0.4291	0.7397	3
	mean	4.9017	0.3234	0.5351	3
	sd	9.8553	0.1627	0.1760	0

Table A26

Summary statistics for the untransformed variables in the BMA estimation – Panels 1-4

CHAPTER 3 - PANEL DATA EVIDENCE OF THE RELATIONSHIP BETWEEN STRUCTURAL CHANGE AND INEQUALITY, WITH A SPECIAL ATTENTION TO SUB-SAHARAN AFRICA

Abstract

In this chapter we derive the structural change term in the decomposition of productivity growth for a larger sample of countries, including Latin American, Asian, European countries and the United States. We introduce some commonly used measures of inequality and describe features of the relationship between development and inequality as firstly suggested by the Kuznets curve hypothesis. The data suggest that inequality in the distribution of income in the heterogeneous sample at hand does not reflect the inverted-U shape described by Kuznets, and this is coherent with the presence of already developed countries and still underdeveloped ones. There is evidence that the Sub-Saharan African countries in the sample be placed in the increasing portion of the curve, but there is lack of signs that may predict an evolution like the one depicted by Kuznets, especially considering that inequality in Sub-Saharan Africa is already large. Finally, we apply panel data models to try to assess if the structural change process can affect inequality, by controlling for some relevant factors identified by the literature. This is relevant for Africa, because the scope for structural transformation is large and effects on inequality can be substantial. Our results suggest that structural change affects negatively inequality, hence labour reallocation works as a natural redistributive channel.

JEL classification – O11; O15

Keywords – Sub-Saharan Africa, Structural change, Economic development, Income inequality, Income distribution

3.1. Introduction

With the analysis carried out in this chapter we investigate the relationship between structural change and inequality in the distribution of income, with a special focus on the experience of Sub-Saharan African countries. An important distinction here deserves to be specified, since when thinking to Africa the first thing that comes to mind is poverty. Indeed, inequality is connected to poverty although it has a far larger scope. Inequality (at least the one in which we are interested in this chapter, vertical inequality) has to do with the distribution of income, while studies on poverty are interested in the subsistence of people, usually relating this to a specific threshold of income, i.e. the poverty line: those who live below this threshold are poor, the others are not. Studies on inequality do not limit their interest to those living below the poverty line and which are characterized by owning a small percentage of the national income, but they focus on the entire distribution of income and in particular to measuring to what extent it is unequal. The matter of inequality is relevant independently of the economic development of a society, since it pertains to the opportunities allowed to households and individuals. When inequality is large there is a smaller population share characterized by a larger set of possibilities in terms of quality of life, education and health. In extreme cases, where average income is low and a large population share lives close to the poverty line, in poor rural households or in densely populated slums, the question of inequality involves the problem of poverty and subsistence. Increases in inequality let people fall below the poverty line and increase the chances to suffer from hunger and reduced life expectancy. This is the case of African countries where the agricultural employment share is large or where urban development has not come together with industrialisation and increased employment opportunities, leaving a large part of the urban population in miserable living conditions. UNRISD (2010) also stresses that where economic growth is concentrated in agricultural low-productive activities and highly productive but static primary sectors, this has led to unequal labour markets, and this is again the case for Sub-Saharan African countries. The report looks at employment as a channel for the redistribution of income generated from growth. This happens with structural transformation which, moving employment to higher productivity sectors fosters growth and automatically redistributes income to workers moving to these more dynamic sectors. Moreover, sectoral productivity differentials are large in developing countries, as suggested by McMillan, et al. (2014) and this in turn reflects to household income differentials (Galbraith, et al., 2014). The relationship betweeen structural change and inequality is then straightforward and we want to investigate it with the help of the data provided by the GGDC 10-Sector database, that have introduced more precise information for structural transformation in countries with weak statistical capacities. The opportunity to link consistent structural change information to inequality motivates our research.

The link between structural change and inequality was perhaps first established by the empirical works by Kuznets and and the introduction of its inverted-U shape hypothesis for the relationship between development and inequality (Kuznets, 1955). According to this hypothesis, inequality should first rise up with development and then move down after a certain point. This is related to the structural transformations happening with development. New sectors of the economy substitute traditional ones, sectoral accumulation of resources grows faster in these new sectors, and capital moves towards them. Innovation pushes this process further and those investing in the new sectors gain profits and continue accumulating capital, increasing the gap with the other sectors. The basic idea illustrated by Kuznets is that inequality rises when structural transformations increases the dimension of non-agricultural sectors in spite of agriculture. When the agricultural employment share is higher, due to its low productivity level, we expect a smaller

degree of inequality, while this should rise when non-agricultural sectors take place and substitute for agriculture.
(Ahluwalia, 1976) builds upon the Kuznets idea noticing how the movement of the labour force from traditional, low productivity sectors to modern more productive sectors increases inequality because of the difference of mean income between sectors. When the labour force is increasingly absorbed by the modern sectors the share of low incomes decreases and the difference in inter-sectoral mean incomes decreases as well (thus the inverted-U shape of the relationship). Education and improvements in labour organization in the more advanced stages of development reduce income differentials in the modern sectors, thus also operating a reduction in income inequality when the modern sectors absorb the vast majority of the labour force.
These analyses are still of interest because of the still high share of agricultural employment in Sub-Saharan African countries. As shown in the previous chapter, there have been signs of structural transformation in the SSA countries in our sample, but either these signs have been weak or they have gone in the direction of expanding services sectors, rather than industry. Sub-Saharan Africa is still lacking a process of industrialisation, the countries in the region seem to be following a different path than that of developed countries and recently developed ones. Exposure to the globalization has on one side subjected industries to the competition of technologically more advanced industries, on the other one it has helped African countries having a comparative advantage in the mining sector to exploit the commodity boom and monetize their advantage in natural resources. But these countries seem not to be undergoing a classical industrialisation process, since the region lags behind in the development of technology and there are but small signs of industrialisation in the sense of labour reallocation from the agricultural sector.
Some studies (Dollar & Kraay, 2002) have shown that economic growth has positive returns to all the sectors of society because it increases the average threshold for all social classes, but it does not affect, per se, income distribution. Other factors must be investigated to identify the reasons for the patterns of inequality within countries. Aizenman, et al. (2012) and UNRISD (2010) sustain that institutional and political factors are crucial in the governance of the structural change process and of its impact on inequality. Strategic state intervention through redistribution, establishment of public services (education and healthcare) and social protection plans are all direct or indirect means of assessing the problem of inequality and providing those placed at the bottom of the distribution of income with the means needed for social and economic inclusion. These aspects also relate to the evolution of democracies and the empowerment of civil and political rights, allowing all parts of the society to play an active role in the social and economic choices of the governments.
A study on inequality in Sub-Saharan African countries has to overcome the problem of data availability in order to derive useful conclusions. Inequality is generally measured by means of the Gini coefficient, but the number of Gini observations for the Sub-Saharan African countries in our sample is fairly poor, and it forces us to rely on different measures of inequality. As reported below, we rely on the two measures of inequality (i.e. the estimated household income inequality (EHII) and the industrial pay inequality (IID)) of the University of Texas Inequality Project (UTIP).
These will constitute the dependent variables in our regression analysis, but we mainly want to focus on the role of the structural change process as a driver or a counteraction to inequality. To do so, we need to build a measure of structural change and we rely on the usual productivity growth decomposition shown in the previous chapter.

The remaining part of the chapter is structured as follows. Section 3.2 uses data on employment and value added to derive a measure of average labour productivity. Here we also use the usual decomposition of the full-economy labour productivity growth into three terms (within, structural change and covariance). The structural change term is the most relevant regressor in our estimation of the causes of inequality in the distribution of income. Section 3.3 presents the data on inequality in the countries in our sample. Section 3.4 discusses the relationship between inequality and development with a special focus on Sub-Saharan Africa with the help of the available data. Section 1.5 presents the methodology and the results of the estimation of inequality on structural change and a set of explanatory control variables. Section 3.5 concludes. Appendix A1 illustrates the sources of data for the value added shares of the trade and accommodation sectors, used as weights for the computation of a unique sector of trade services and accommodation (G+H). Appendix A2 includes tables with summary statistics comparing development and inequality. Appendix A3 provides extended sources for the variables used in the regressions.

3.2. Decomposition of the total productivity growth rate

To analyse the relationship between structural change and vertical inequality in Sub-Saharan African countries, we first derive data on structural change by using the most accurate data available on sectoral employment and value added.

DATA

Our primary data source is the 10-Sector Database (Timmer et al., 2015) of the Groningen Growth and Development Centre (GGDC), University of Groningen. The main advantage of this dataset is that it contains data on sectoral output and employment at a ten-industry level for 11 Sub-Saharan African countries, while other popular datasets only contain data at a three-sectoral level and usually completely miss data on employment.[34] Table 3.1 identifies the ten sectors. The dataset also contains data for Asian, Latin American and European countries, the United States and two North-African countries (Egypt and Morocco). Table 3.3 illustrates all of them.

ISIC Rev. 3.1 code	***10SD sector name***	***ISIC Rev. 3.1 description***
AtB	Agriculture	Agriculture, Hunting and Forestry, Fishing
C	Mining	Mining and Quarrying
D	Manufacturing	Manufacturing
E	Utilities	Electricity, Gas and Water supply
F	Construction	Construction
G+H	Trade services	Wholesale and Retail trade; repair of motor vehicles, motorcycles and personal and household goods, Hotels and Restaurants
I	Transport services	Transport, Storage and Communications
J+K	Business services	Financial Intermediation, Renting and Business Activities (excluding owner occupied rents)
L,M,N	Government services	Public Administration and Defence, Education, Health and Social work
O,P	Personal services	Other Community, Social and Personal service activities, Activities of Private Households
TOT	Total Economy	Total Economy

Table 3.1
Description of the sectors included in the GGDC 10-Sector database

Value added data are available in current and constant 2005 national prices. To allow for international comparison we convert the constant value added data in PPP, taking the US$ as

[34] The GGDC 10 Sector Database contains value added and employment level data for the ten sectors of the economy as defined by the International Standard Industrial Classification, Revision 3.1 (ISIC rev. 3.1).

reference currency. This is important for international comparisons, since relative prices vary greatly across sectors, particularly because of the presence of tradable and non tradable goods. The data conversion is not made at the aggregate level. The Africa Sector database (de Vries, et al., 2015), derived by the 10-Sector database, is supplemented by data on 2005 sectoral output relative prices and 2005 national currency/US$ exchange rates at the general economy level, so we are able to present data on real value added for the 11 African countries in our sample in a particularly precise fashion. To derive real value added for the non-African countries included in the 10-Sector Database (also 10-SD, in what follows), we need sectoral 2005 relative prices and exchange rates too. Inklaar & Timmer (2014) provide a dataset with 2005 sectoral output relative prices for 42 countries, some of which are included in the 10-SD. We also retrieve national currency/2005 US$ exchange rates at the general economy level from the OECD.[35] One problem we have is that the 10 sectors for which Inklaar & Timmer (2014) provide relative prices do not coincide with those for which the 10-Sector Database provide output and employment data. Table 3.2 shows the differences between the sectoral disaggregations of the two datasets. Wholesale and retail trade and Hotels and restaurants are split in Inklaar and Timmer (2014) while they constitute one sector in the 10-SD. To stay consistent with the available sectoral value added and employment data, we compute a unique sectoral relative price by using the contributions (shares) of trade and accommodation to the country total economy value added as weights (in Appendix A1 we provide details about sources of sectoral shares for the countries in our sample). Government services, and Personal services are merged instead, while they are included separately in the 10-SD, so we simply need to sum up the two sectoral value added and employment levels as included in the 10-Sector database. This leaves us with a 9-industry sectoral disaggregation for the non-African countries in our sample, but this should not compromise the precision of our structural change data when compared to the African countries in our final dataset.

As it is shown in Table 3.3, we end up with a sample of 28 countries, of which 11 belong to Sub-Saharan Africa (Botswana, Ethiopia, Ghana, Kenya, Malawi, Mauritius, Nigeria, Senegal, South Africa, Tnzania and Zambia), 4 to Latin America (Argentina, Brazil, Chile and Mexico), 5 to Asia (China, India, Indonesia, Japan and South Korea), 7 to Europe (Denmark, France, Italy, the Netherlands, Spain, Sweden and the United Kingdom) and finally the United States.

ISIC code Rev. 3.1	***10SD-Sector Database***	***Inklaar & Timmer***	***ISIC Rev. 3.1 description***
AtB	Agriculture	Agriculture, forestry & fishing	Agriculture, Hunting and Forestry, Fishing
	Mining	Mining & quarrying	Mining and Quarrying
D	Manufacturing	Manufacturing	Manufacturing
E	Utilities	Utilities	Electricity, Gas and Water supply
F	Construction	Construction	Construction

[35] OECD (2017), Exchange rates (indicator). doi: 10.1787/037ed317-en. Accessed on 22 August 2017 from https://data.oecd.org/conversion/exchange-rates.htm.

G+H	Trade services	Wholesale & retail trade Hotels & restaurants	Wholesale and Retail trade; repair of motor vehicles, motorcycles and personal and household goods, Hotels and Restaurants
I	Transport services	Transport & communication	Transport, Storage and Communications
J+K	Business services	Financial & business services	Financial Intermediation, Renting and Business Activities (excluding owner occupied rents)
L,M,N	Government services	Community, social & personal services	Public Administration and Defence, Education, Health and Social work
O,P	Personal services		Other Community, Social and Personal service activities, Activities of Private Households
	Total Economy	Total Economy	Total Economy

Table 3.2
Differences in sectoral disaggregation between the GGDC 10-Sector database and Timmer & de Vries (2015)

We derive PPPs by the following formula:

$$y_{j,t} = \frac{y_{j,t}^{N}}{rp_{j} * xr} \qquad (3.1)$$

where $y_{j,t}$ represents the 2005 US$ PPP value added in sector *j* at time *t*, $y_{j,t}^{N}$ is the value added in sector *j* at time *t* in constant 2005 national currency, rp_j is the 2005 relative price in sector *j*, and xr is the exchange rate of the national currency relative to the US$.

PPP value added in the total economy is obtained by simply adding up the PPP sectoral value added series.

We derive data on sectoral average labour productivity by dividing the PPP value added in sector j at time t by the corresponding employment level.

Country	ISO code	Region	10-Sector Database			Inklaar & Timmer	Africa Sector Database	Final dataset
			VA2005	VA	EMP	Relative prices		
Argentina	ARG	Latin America	√	√	√	√		√
Australia	AUS	Oceania				√		
Austria	AUT	Europe				√		
Belgium	BEL	Europe				√		
Bulgaria	BGR	Europe				√		
Bolivia	BOL	Latin America	√	√	√			
Brazil	BRA	Latin America	√	√	√	√		√
Botswana	BWA	Sub-Saharan Africa	√	√	√		√	√
Canada	CAN	North America				√		
Chile	CHL	Latin America	√	√	√	√		√
China	CHN	Asia	√	√	√	√		√
Colombia	COL	Latin America	√	√	√			
Costa Rica	CRI	Latin America	√	√	√			
Cyprus	CYP	Europe				√		
Czech Republic	CZE	Europe				√		
Germany	DEU	Europe				√		
West Germany	DEW	Europe		√	√			
Denmark	DNK	Europe	√	√	√	√		√
Egypt	EGY	Middle East & N. Africa	√	√	√			
Spain	ESP	Europe	√	√	√	√		√
Estonia	EST	Europe				√		
Ethiopia	ETH	Sub-Saharan Africa	√	√	√		√	√
Finland	FIN	Europe				√		
France	FRA	Europe	√	√	√	√		√
United Kingdom	GBR	Europe	√	√	√	√		√
Ghana	GHA	Sub-Saharan Africa	√	√	√		√	√
Greece	GRC	Europe				√		
Hong Kong	HKG	Asia	√	√	√			
Hungary	HUN	Europe				√		
Indonesia	IDN	Asia	√	√	√	√		√
India	IND	Asia	√	√	√	√		√
Ireland	IRL	Europe				√		
Italy	ITA	Europe	√	√	√	√		√
Japan	JPN	Asia	√	√	√	√		√

Kenya	KEN	Sub-Saharan Africa	√	√	√		√	√
Korea (Rep. of)	KOR	Asia	√	√	√	√		√
Lituania	LTU	Europe				√		
Luxembourg	LUX	Europe				√		
Latvia	LVA	Europe				√		
Mexico	MEX	Latin America	√	√	√	√		√
Malta	MLT	Europe				√		
Morocco	MOR	Middle East & N. Africa	√	√	√			
Mauritius	MUS	Sub-Saharan Africa	√	√	√		√	√
Malawi	MWI	Sub-Saharan Africa	√	√	√		√	√
Malaysia	MYS	Asia	√	√	√			
Nigeria	NGA	Sub-Saharan Africa	√	√	√		√	√
Netherlands	NLD	Europe	√	√	√	√		√
Peru	PER	Latin America	√	√	√			
Philippines	PHL	Asia	√	√	√			
Polonia	POL	Europe				√		
Portugal	PRT	Europe				√		
Romania	ROU	Europe				√		
Russia	RUS	Europe				√		
Senegal	SEN	Sub-Saharan Africa	√	√	√		√	√
Singapore	SGP	Asia	√	√	√			
Slovakia	SVK	Europe				√		
Slovenia	SVN	Europe				√		
Sweden	SWE	Europe	√	√	√	√		√
Thailand	THA	Asia	√	√	√			
Turkey	TUR	Europe				√		
Taiwan	TWN	Asia	√	√	√			
Tanzania	TZA	Sub-Saharan Africa	√	√	√		√	√
United States	USA	North America	√	√	√	√		√
Venezuela	VEN	Latin America	√	√	√			
South Africa	ZAF	Sub-Saharan Africa	√	√	√	√	√	√
Zambia	ZMB	Sub-Saharan Africa	√	√	√		√	√
Total			41	42	42	42	11	28

Table 3.3
Countries included in final dataset

To investigate the pattern of structural change in the countries in our sample, we follow a standard approach in the literature recently adopted by McMillan et al. (2014), among others – that is, we decompose average productivity into different components, accounting for the effects of the change in sectoral productivity and structural change. Note, however, that McMillan et al. (2014) adopt a two-terms decomposition of the change in labour productivity: the first one is the within-component, which measures the productivity change in each economic sector from the beginning to the end of the period of interest (from *t-k* to *t*), keeping constant the employment share. The second term is the structural change term, captured by the product between the end-of-period sectoral productivity level and the change in employment from time *t-k* to time *t*. The decomposition just described can be expressed by the following formula:

$$\Delta Y_t = \sum_{j=1}^{J} \Delta y_{j,t} s_{j,t-k} + \sum_{j=1}^{J} \Delta s_{j,t} y_{j,t} \quad (3.2)$$

where Y represents the overall productivity level, y_j the productivity level in sector *j*, s_j the employment share in sector *j*, *t* is the final period observed, *t-k* is the initial period observed and Δ represents differences in the productivity level or employment share between *t* and *t-k*.

As de Vries et al. (2015) report, this is just one of the possible decomposition choices that can be made. We prefer an alternative decomposition that describes productivity as the result of the summation of three terms: the first one and the second one are conceptually identical to those in McMillan et al. (2014), except for the fact that the structural change term is obtained by multiplying the initial sectoral productivity level (rather than the final one) times the change in employment share. The third component is a covariance term, defined as the summation of the interactions between the change in sectoral productivity and the change in employment share during the period of interest. This component captures the idea that, from a structural change perspective, it is relevant not only that labour moves towards sectors where productivity is higher, but that it moves towards sectors where productivity is growing (that is to say where productivity at time *t* is higher than productivity at time *t-k*), i.e. towards economic sectors where productivity shows the potential to be high in the future. The decomposition is formalised in (3.3), where notation is the same as before.

$$\Delta Y_t = \sum_{j=1}^{J} \Delta y_{j,t} s_{j,t-k} + \sum_{j=1}^{J} \Delta s_{j,t} y_{j,t-k} + \sum_{j=1}^{J} \Delta y_{j,t} \Delta s_{j,t} \quad (3.3)$$

Let us notice that:

- The first term will be positive if overall within-sector productivity has increased;
- The second term will be positive if workers have moved towards sectors where the level of labour productivity is higher;
- The third term can be positive or negative, depending on the cumulative effect of labour force movements across sectors and sectoral productivity change. Specifically, if workers

have overall moved towards sectors where productivity has increased (decreased), this will be captured by a positive (negative) sign of the third term of the decomposition.

The decomposition specified in (3.3) refers to changes in total labour productivity levels. It can be transformed into a decomposition of the growth rate of labour productivity dividing through by Y_{t-k}, the initial total productivity level.

In what follows, we produce and discuss graphical representations of this "productivity-growth decomposition" for some of the countries in our sample, in order to derive suggestions for the structural change process at the international level. To smooth out business cycle disturbances in the decomposed growth rates, our analysis relies on 5-year Simple Moving Averages (SMA) of each term in the decomposition and the overall labour productivity growth rate.[36] In Figures 3.1-3.3, productivity growth is represented in bold solid lines, the structural change term in solid lines, the within term in dashed lines and the covariance term in dotted lines. Tables 3.4-3.6 present ten-year averages for productivity growth (in bold) and for each term in the decomposition. The last column presents the whole period-averages.

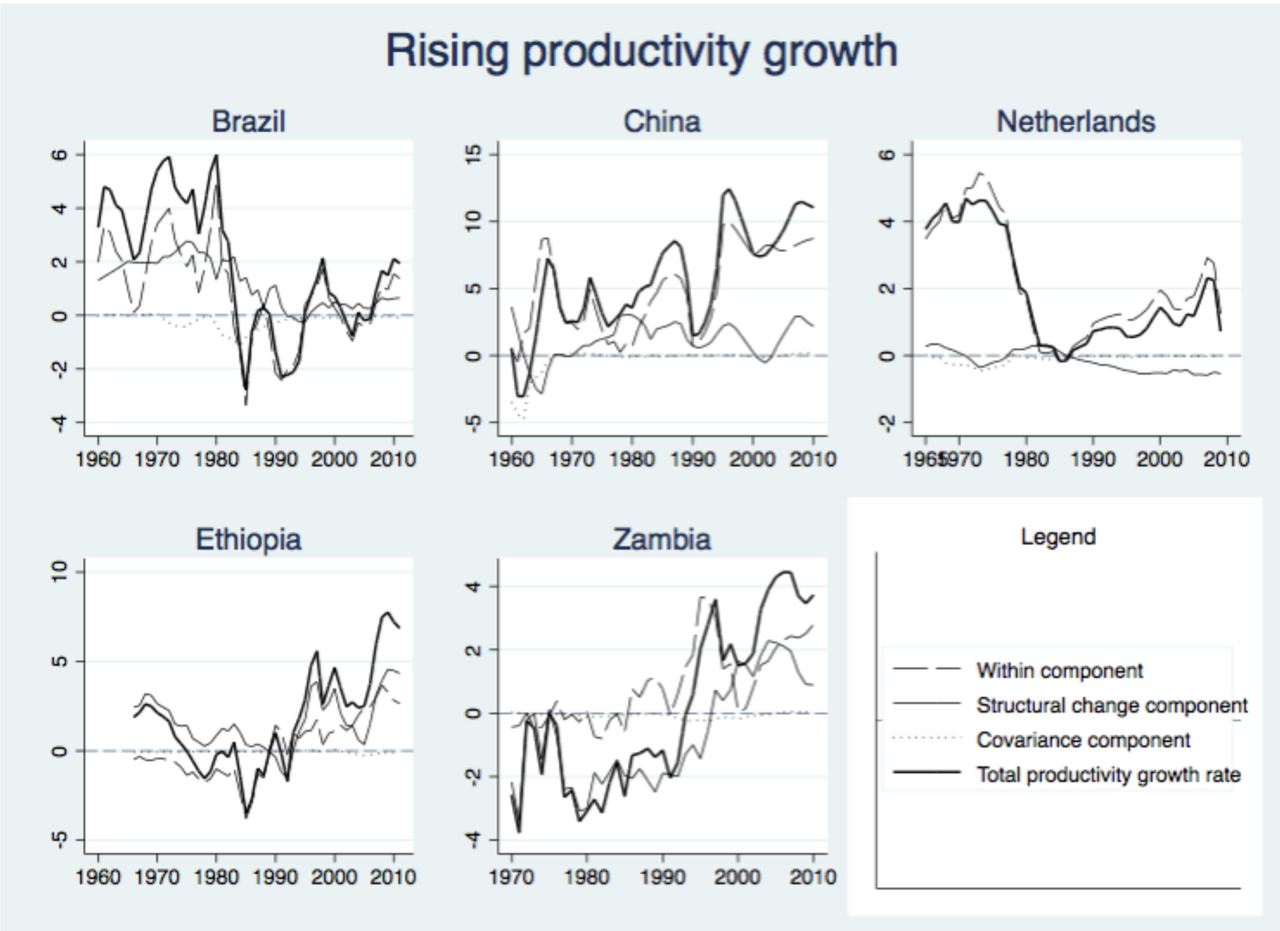

Figure 3.1
Full-economy labour productivity growth rate decomposition - 5 years SMAs for countries with rising trends

[36] Following much of the empirical panel-data literature, we have chosen to average data over a 5-year period as a convenient compromise between the need to purge the data from business cycle effects and that of not losing too many observations.

country	*1960-1970*	*1971-1980*	*1981-1990*	*1991-2000*	*2001-2011*	*1960-2011*
Brazil	**4.46%**	**5.09%**	**-2.07%**	**0.40%**	**0.92%**	**1.80%**
Within	2.53%	3.42%	-2.76%	0.34%	0.53%	0.84%
Structural	1.90%	2.06%	1.26%	0.13%	0.46%	1.16%
Covariance	0.03%	-0.40%	-0.58%	-0.07%	-0.07%	-0.21%
China	**2.80%**	**3.36%**	**4.58%**	**9.77%**	**10.19%**	**6.07%**
Within	4.53%	1.28%	3.17%	8.59%	8.27%	5.15%
Structural	-1.06%	2.13%	1.42%	1.22%	1.85%	1.07%
Covariance	-0.66%	-0.05%	-0.01%	-0.03%	0.07%	-0.15%
Netherlands	**3.88%**	**3.09%**	**0.28%**	**1.00%**	**0.88%**	**1.85%**
Within	3.84%	3.31%	0.37%	1.51%	1.39%	2.10%
Structural	0.18%	0.00%	-0.05%	-0.49%	-0.49%	-0.16%
Covariance	-0.14%	-0.22%	-0.05%	-0.03%	-0.01%	-0.09%
Ethiopia	**1.97%**	**-0.11%**	**-1.25%**	**3.76%**	**4.93%**	**1.92%**
Within	-0.43%	-1.19%	-1.19%	1.09%	2.66%	0.25%
Structural	2.47%	1.14%	-0.01%	2.63%	2.46%	1.74%
Covariance	-0.07%	-0.06%	-0.05%	0.04%	-0.19%	-0.07%
Zambia	**-2.57%**	**-1.54%**	**-1.89%**	**1.77%**	**4.01%**	**0.23%**
Within	-0.43%	-0.02%	0.08%	1.86%	2.43%	0.92%
Structural	-2.16%	-1.45%	-1.93%	0.10%	1.56%	-0.62%
Covariance	0.02%	-0.07%	-0.04%	-0.19%	0.02%	-0.06%

Table 3.4
Average ten-year and full period productivity growth and breakdown – Countries with rising productivity growth[37]

There is some heterogeneity in the productivity growth behaviour from country to country. Broadly, relative to the overall period observed or to the most recent trend, we can distinguish countries that have experienced rising productivity growth, countries where the productivity growth has declined over time and countries where productivity growth has been heavily subject to cycles. Figures 3.1-3.3 and Tables 3.4-3.6 group together countries belonging to one of these three broad trends. We include one Latin American country, one Asian country, one European/Western country and two Sub-Saharan African countries per figure, so to derive an idea of the trends even at the regional level.

[37] The sum of the three terms may not add up exactly to the productivity growth because of rounding.

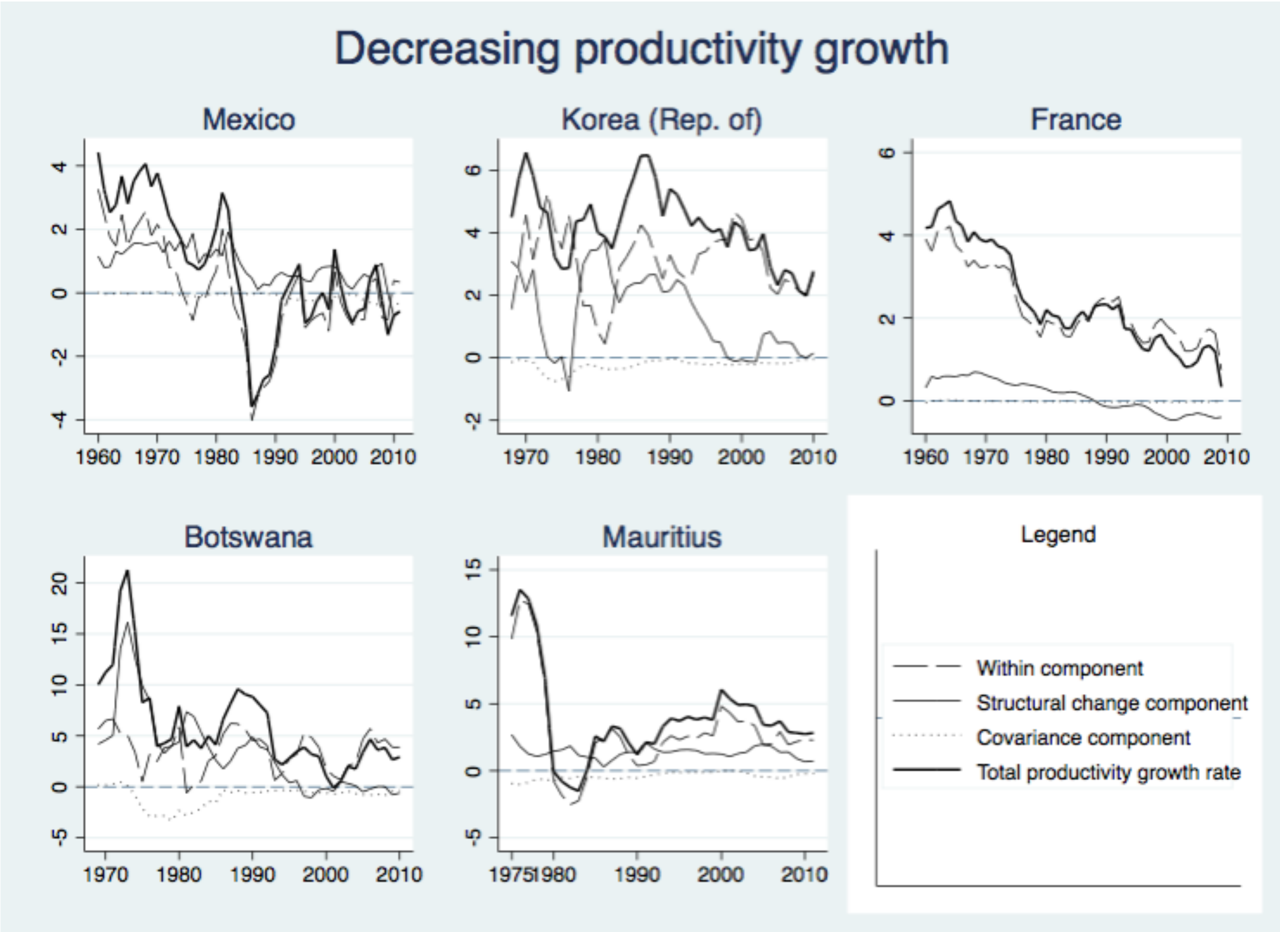

Figure 3.2
Full-economy labour productivity growth rate decomposition - 5 years SMAs for countries with decreasing trends

country	*1960-1970*	*1971-1980*	*1981-1990*	*1991-2000*	*2001-2011*	*1960-2011*
Mexico	**3.51%**	**1.51%**	**-1.41%**	**0.21%**	**-0.41%**	**0.71%**
Within	2.11%	0.18%	-1.95%	-0.21%	-0.05%	0.06%
Structural	1.39%	1.39%	0.58%	0.61%	-0.07%	0.78%
Covariance	0.00%	-0.07%	-0.05%	-0.19%	-0.29%	-0.12%
Korea (Rep. of)	**5.37%**	**3.42%**	**5.57%**	**4.16%**	**2.54%**	**4.14%**
Within	2.87%	2.17%	3.46%	3.91%	2.35%	2.96%
Structural	2.65%	1.75%	2.26%	0.46%	0.31%	1.41%
Covariance	-0.15%	-0.49%	-0.14%	-0.21%	-0.12%	-0.23%
France	**4.26%**	**2.52%**	**2.17%**	**1.40%**	**0.63%**	**2.27%**
Within	3.64%	2.20%	2.17%	1.69%	1.00%	2.19%
Structural	0.62%	0.33%	0.03%	-0.26%	-0.35%	0.09%
Covariance	0.00%	-0.02%	-0.03%	-0.03%	-0.02%	-0.02%
Botswana	**13.04%**	**8.08%**	**6.47%**	**1.91%**	**3.15%**	**5.96%**
Within	5.93%	3.18%	3.80%	2.30%	4.29%	3.72%
Structural	6.60%	7.14%	3.74%	0.12%	-0.56%	3.13%
Covariance	0.51%	-2.24%	-1.07%	-0.50%	-0.57%	-0.89%
Mauritius	**na**	**5.76%**	**1.89%**	**4.89%**	**3.09%**	**3.89%**

Within	na	4.54%	1.23%	3.56%	2.16%	2.85%
Structural	na	2.08%	1.17%	1.40%	1.24%	1.47%
Covariance	na	-0.86%	-0.50%	-0.07%	-0.31%	-0.43%

Table 3.5
Average ten-year and full period productivity growth and breakdown – Countries with decreasing productivity growth[38]

The figures and the tables let some clear features emerge: structural change is the most important productivity-boosting element in Sub-Saharan African countries. While this term is positive also in the experiences of Latin American and Asian countries, in the former ones it is less strong than in SSA and in the latter ones the within term is far more relevant in explaining productivity growth. In Western countries as well, productivity growth is driven almost entirely by the within term, and the structural change term is very low or slightly productivity-slowing.

Does this have an impact on the distribution of income? Displacement of the labour force out of the agricultural sector is certain to have a positive impact on the incomes of those who seek for jobs in the other sectors of the economy. But still, the agricultural share is too high in the region to let us call for a structural transformation of the economy. Besides, agricultural employment does not flow in the industrial sector, but mainly towards the services. Industry has been the sector that has driven the structural change process in past development experiences, and it has done so by applying technological change and boosting its marginal productivity. Rising industrial urban sectors have employed rising shares of the labour force, first in miserable conditions, then, thanks to the action of trade unions and to the spreading out of civil rights and redistributive policies, in far better ones. It is worth noting, in fact, that the reduction of inequality in the distribution of income is not necessarily an automatic process, but one that involves a change in the social and political priorities.

[38] The sum of the three terms may not add up exactly to the productivity growth because of rounding.

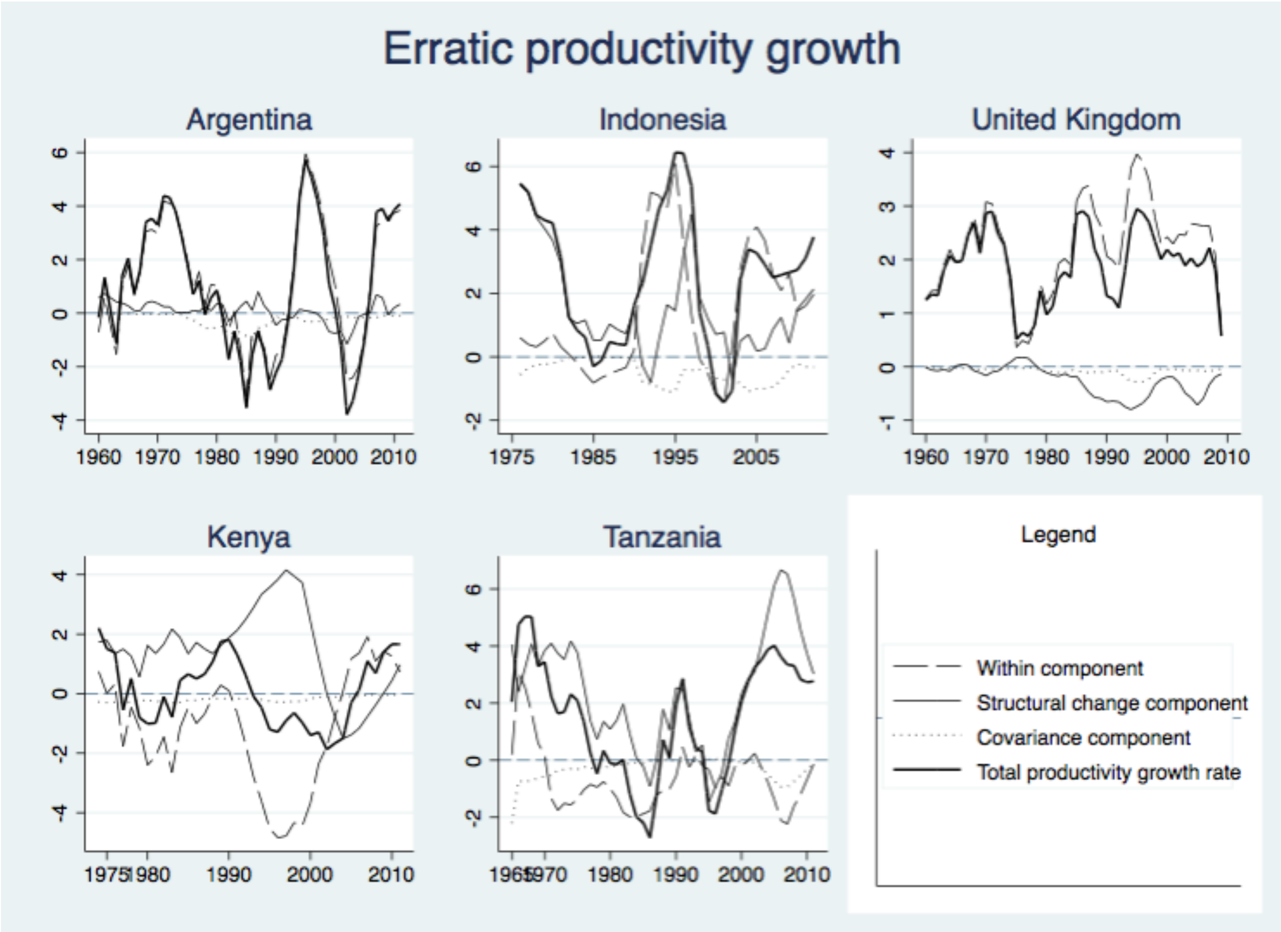

Figure 3.3
Full-economy labour productivity growth rate decomposition - 5 years SMAs for countries with erratic trends

country	*1960-1970*	*1971-1980*	*1981-1990*	*1991-2000*	*2001-2011*	*1960-2011*
Argentina	**2.70%**	**1.35%**	**-2.88%**	**2.96%**	**1.87%**	**1.24%**
Within	2.37%	1.51%	-2.34%	3.50%	1.86%	1.41%
Structural	0.36%	0.18%	0.00%	-0.33%	0.15%	0.08%
Covariance	-0.03%	-0.34%	-0.53%	-0.22%	-0.13%	-0.24%
Indonesia	**na**	**4.73%**	**0.65%**	**2.64%**	**3.05%**	**2.78%**
Within	na	0.64%	-0.31%	2.45%	2.56%	1.41%
Structural	na	4.46%	0.99%	1.08%	1.13%	1.84%
Covariance	na	-0.37%	-0.03%	-0.88%	-0.63%	-0.48%
United Kingdom	**2.38%**	**0.74%**	**2.08%**	**2.57%**	**1.16%**	**1.81%**
Within	2.52%	0.77%	2.58%	3.20%	1.62%	2.16%
Structural	-0.11%	0.03%	-0.42%	-0.47%	-0.41%	-0.27%
Covariance	-0.03%	-0.05%	-0.08%	-0.16%	-0.05%	-0.08%
Kenya	**4.20%**	**0.25%**	**1.23%**	**-1.30%**	**0.78%**	**0.35%**
Within	5.22%	-1.19%	-0.18%	-4.10%	1.11%	-0.89%
Structural	-0.73%	1.71%	1.61%	3.00%	-0.27%	1.42%
Covariance	-0.29%	-0.26%	-0.20%	-0.20%	-0.06%	-0.18%

Tanzania	**2.75%**	**0.99%**	**-0.12%**	**0.15%**	**3.28%**	**1.45%**
Within	0.18%	-1.18%	-1.22%	-0.26%	-0.96%	-0.69%
Structural	3.95%	2.43%	1.16%	0.43%	4.73%	2.58%
Covariance	-1.39%	-0.26%	-0.06%	-0.02%	-0.49%	-0.44%

Table 3.6
Average ten-year and full period productivity growth and breakdown – Countries with erratic productivity growth[39]

[39] The sum of the three terms may not add up exactly to the productivity growth because of rounding.

3.3. Alternative measures of inequality

The most common measure of inequality found in the literature is the Gini coefficient, an index based on the Lorenz curve. The Lorenz curve presents in the horizontal axis the cumulative percentage of the population of a country and in the vertical axis the corresponding cumulative income share. In case of perfect equality in the distribution of income, the cumulative percentage of the population and the comulative income share coincide, and this is represented by the 45° line of the cartesian plane starting from the origin, the line of equal distribution. The Lorenz curve is a convex curve lying below the line of equal distribution, indicating that the lowest population shares owe less than the corresponding income share, and that the highest population shares owe more than their corresponding income share. The more extreme the Lorenz curve, i.e. the higher its distance from the 45° line, the higher the inequality in income distribution, because an increasingly lower income share would be associated to the lowest population shares and viceversa an increasingly larger income share would be associated to the highest populastion shares. The Gini coefficient is computed by dividing the area between the line of equal distribution and the Lorenz curve by the total area below the 45° line. It can be interpreted as a percentage: the closer the ratio to 1 (or 100%) the higher the level of inequality within the country. A high level of inequality is often identified with a Gini of 0.40 (40%).

We use data on inequality from the *All the Ginis* dataset, compiled by Branko L. Milanovic and maintained by the World Bank. The problem with the Gini coefficient is that there are often very few observations available for the Sub-Saharan African countries in our sample. Table 3.7 shows the total number of observations, the minimum and maximum values, mean and standard deviation for the Gini and the other measures of inequality we introduce later on. Sub-Saharan African countries have often less than, or just above 10 total observations for a time span of more than 60 years. Furthermore, observations are also not uniformally distributed across periods. We generally have lack (where not entire absence) of data for the '60s and the '70s and a few observations in the '80s. The largest number of observations is concentrated in the '90s and the years 2000, but there is no exact cross-country correspondence. All of these issues would represent a serious limit to the actual information on inequality we could use, hence we have also relied on alternative measures of inequality, the ones proposed by the University of Texas Inequality Project (UTIP).

		Observations	*Min value*	*Average*	*Max value*	*St. Dev.*
Argentina	*Gini*	33	34.5	45.788	53.3	4.642
	ehii	17	41.932	45.665	49.231	1.961
	iid	17	0.031	0.052	0.082	0.014
Botswana	*Gini*	5	54.2	59.84	63	3.317
	ehii	21	40.661	48.064	53.013	2.676
	iid	27	0.012	0.063	0.157	0.034
Brazil	*Gini*	40	49	57.295	63.7	3.35
	ehii	17	46.245	48.474	49.366	0.714
	iid	17	0.059	0.097	0.12	0.017
Chile	*Gini*	29	45	53.452	57.3	2.873
	ehii	44	40.341	46.395	50.322	2.525
	iid	44	0.015	0.056	0.118	0.023
China	*Gini*	34	26.6	36.703	55.8	7.186
	ehii	16	31.443	35.558	41.767	3.533
	iid	16	0.001	0.011	0.031	0.012
Denmark	*Gini*	28	22.9	31.1	41.3	5.948
	ehii	42	29.751	31.312	33.724	0.872
	iid	42	0.005	0.006	0.01	0.001

Ethiopia	*Gini*	9	27.9	34.9	50.1	7.006
	ehii	19	42.96	46.554	49.218	1.516
	iid	44	0.014	0.045	0.088	0.019
France	*Gini*	21	24	34.071	49	6.914
	ehii	30	32.801	35.552	37.705	1.638
	iid	30	0.012	0.015	0.018	0.002
Ghana	*Gini*	11	32.7	37.409	42.8	3.94
	ehii	26	46.084	48.795	50.47	1.057
	iid	28	0.033	0.055	0.075	0.01
India	*Gini*	45	29.2	33.998	51.1	4.222
	ehii	45	46.992	50.029	52.355	1.451
	iid	45	0.041	0.077	0.11	0.019
Indonesia	*Gini*	26	29.2	34.658	45	3.927
	ehii	36	45.752	49.465	51.956	1.927
	iid	36	0.042	0.076	0.115	0.018
Italy	*Gini*	33	29.7	34.555	40.8	3.245
	ehii	40	34.884	37.037	40.074	1.221
	iid	40	0.009	0.018	0.032	0.006
Japan	*Gini*	32	23.4	32.925	37.6	4.035
	ehii	45	33.65	37.218	43.155	3.137
	iid	45	0.022	0.038	0.073	0.019
Kenya	*Gini*	6	29.9	46.333	57.3	10.302
	ehii	36	45.331	49.474	52.941	1.721
	iid	40	0.028	0.065	0.116	0.02
Korea (Rep. of)	*Gini*	16	28.8	34.969	45.5	3.751
	ehii	44	36.558	39.757	44.096	2.53
	iid	44	0.016	0.024	0.038	0.005
Malawi	*Gini*	8	38.6	45.3	62	8.35
	ehii	35	42.857	50.603	56.201	3.621
	iid	35	0.014	0.09	0.198	0.058
Mauritius	*Gini*	4	35.8	39.45	45.7	4.471
	ehii	40	35.499	40.937	48.134	4.285
	iid	40	0.01	0.06	0.104	0.026
Mexico	*Gini*	24	47.1	51.996	58	2.683
	ehii	31	41.705	43.603	46.612	1.738
	iid	31	0.017	0.025	0.044	0.009
Netherlands	*Gini*	30	27.6	29.88	42	2.647
	ehii	42	31.184	34.257	37.56	1.739
	iid	43	0.006	0.009	0.013	0.002
Nigeria	*Gini*	12	35.2	42.3	51.1	5.227
	ehii	28	39.69	45.781	50.063	2.598
	iid	28	0.007	0.031	0.064	0.015
Senegal	*Gini*	7	33.8	45.857	56	8.166
	ehii	29	37.405	45.697	50.981	3.963
	iid	29	0.004	0.035	0.077	0.022
South Africa	*Gini*	11	57.3	63.191	69.8	3.996
	ehii	41	41.849	44.316	48.135	1.54
	iid	41	0.042	0.056	0.085	0.009
Spain	*Gini*	28	23.4	32.132	36.4	3.659
	ehii	45	36.897	39.498	41.009	1.149
	iid	45	0.017	0.028	0.045	0.008
Sweden	*Gini*	27	22.8	28.026	39	3.663
	ehii	38	27.42	28.688	30.535	0.875
	iid	38	0.003	0.004	0.007	0.001
Tanzania	*Gini*	11	33.8	40.755	59	8.342
	ehii	34	45.062	50.064	54.508	2.534

	iid	34	0.025	0.072	0.143	0.031
United Kingdom	*Gini*	54	27.2	32.878	37.8	3.743
	ehii	41	28.015	33.127	37.812	3.284
	iid	41	0.011	0.014	0.019	0.002
United States	*Gini*	66	38.6	43.158	48.2	2.759
	ehii	42	33.872	36.898	40.08	1.726
	iid	42	0.018	0.024	0.028	0.003
Zambia	*Gini*	11	41.6	50.973	61.5	5.892
	ehii	18	45.177	47.564	50.532	1.729
	iid	18	0.028	0.048	0.082	0.015
Total	*Gini*	661	22.8	39.564	69.8	9.983
	ehii	942	27.42	41.858	56.201	6.938
	iid	980	0.001	0.042	0.198	0.032

Table 3.7
Inequality summary statistics at the country level – 1950 - 2015

Despite its limiting constraints in data availability, the Gini coefficient is a very intuitive and widespread measure of inequality, hence it is useful to report bar-graph representations of the levels of inequality in the countries in our sample.

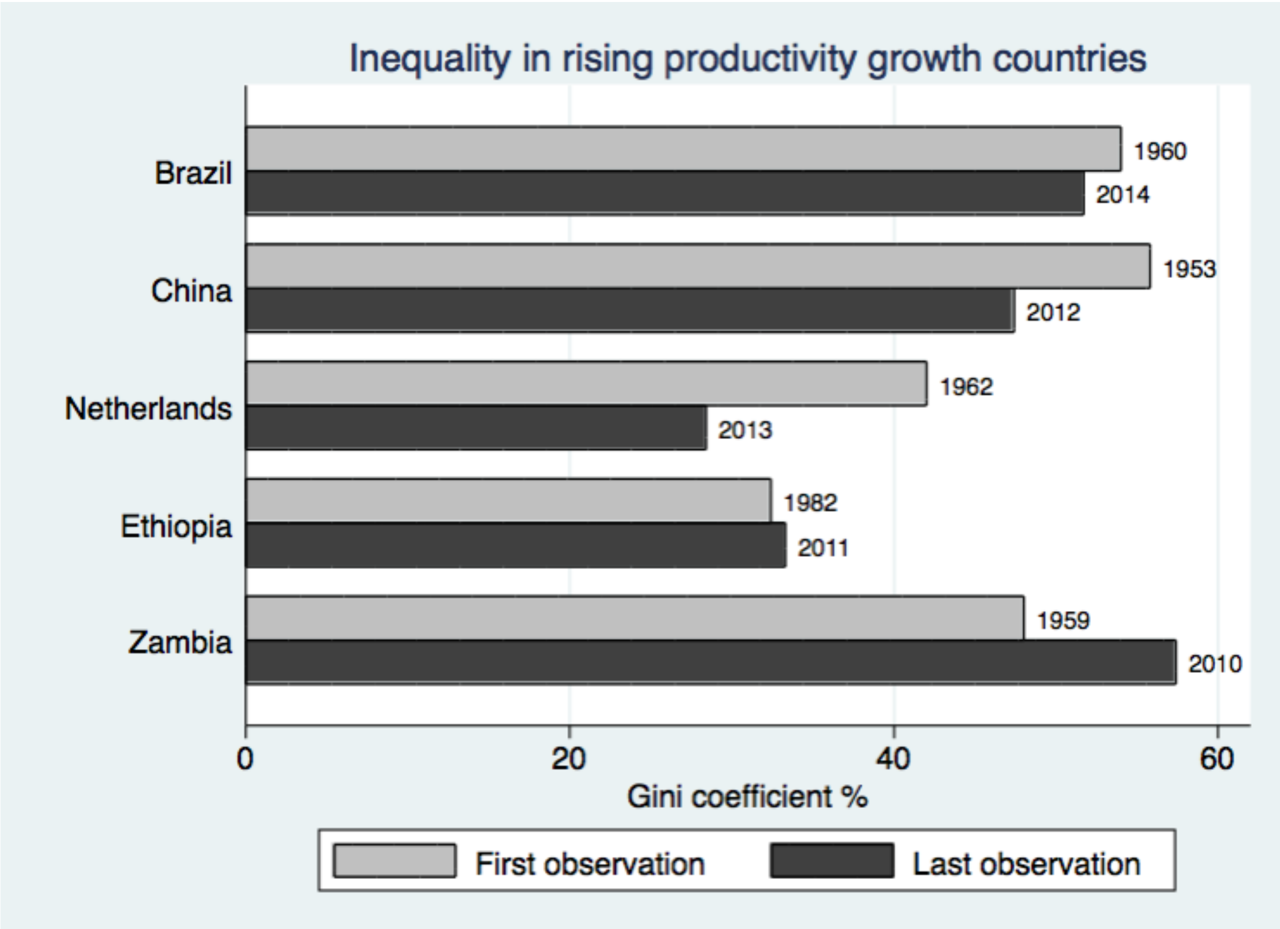

Figure 3.4

Initial and final observations available for the Gini coefficient in countries where productivity growth has been increasing

We use the categorization in increasing, decreasing and erratic productivity growth countries for purposes of simplicity in the exposition and visualisation. The graphs are reported in Figures 3.4-3.6. Given the cross-country inconsistence in data availability, it is impossible to present the data for all countries at the same time, hence we choose to show the first and the last available observations for each country. Observed years are indicated at the right of the bars.

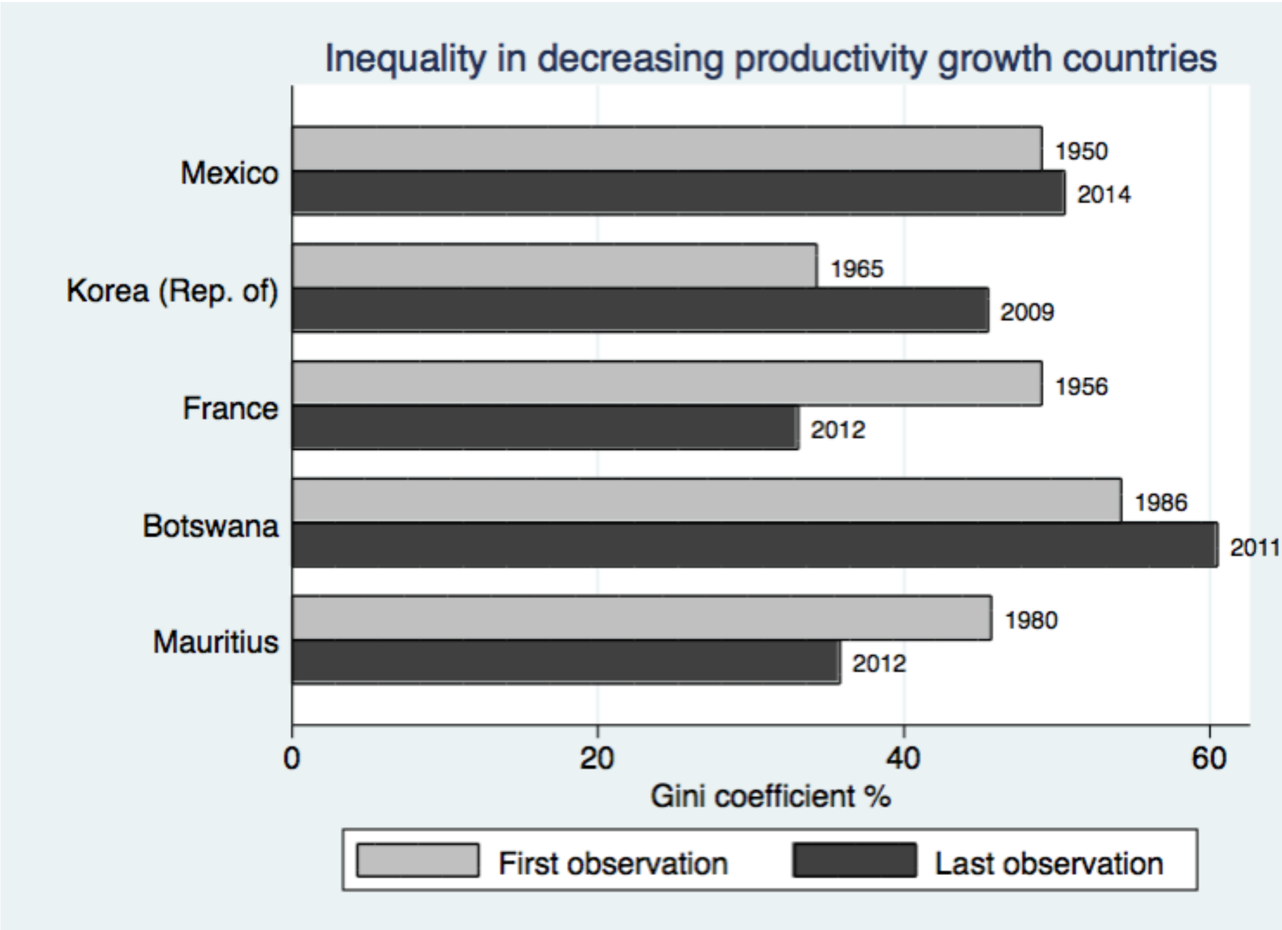

Figure 3.5

Initial and final observations available for the Gini coefficient in countries where productivity growth has been decreasing

By looking at these Figures one thing emerges: the degree of heterogeneity in the levels of inequality is quite large among underdeveloped and developing countries, while developed ones are much tighter and close to a low inequality range. Even trends in inequality are heterogeneous, since we observe countries (even developed ones) where inequality is larger in recent years than in the past, and other ones where inequyality has reduced. These data, however, do not allow us to draw an accurate picture of the evolution of inequality during the whole time span observed, particularly for Sub-Saharan African countries with very few observations.

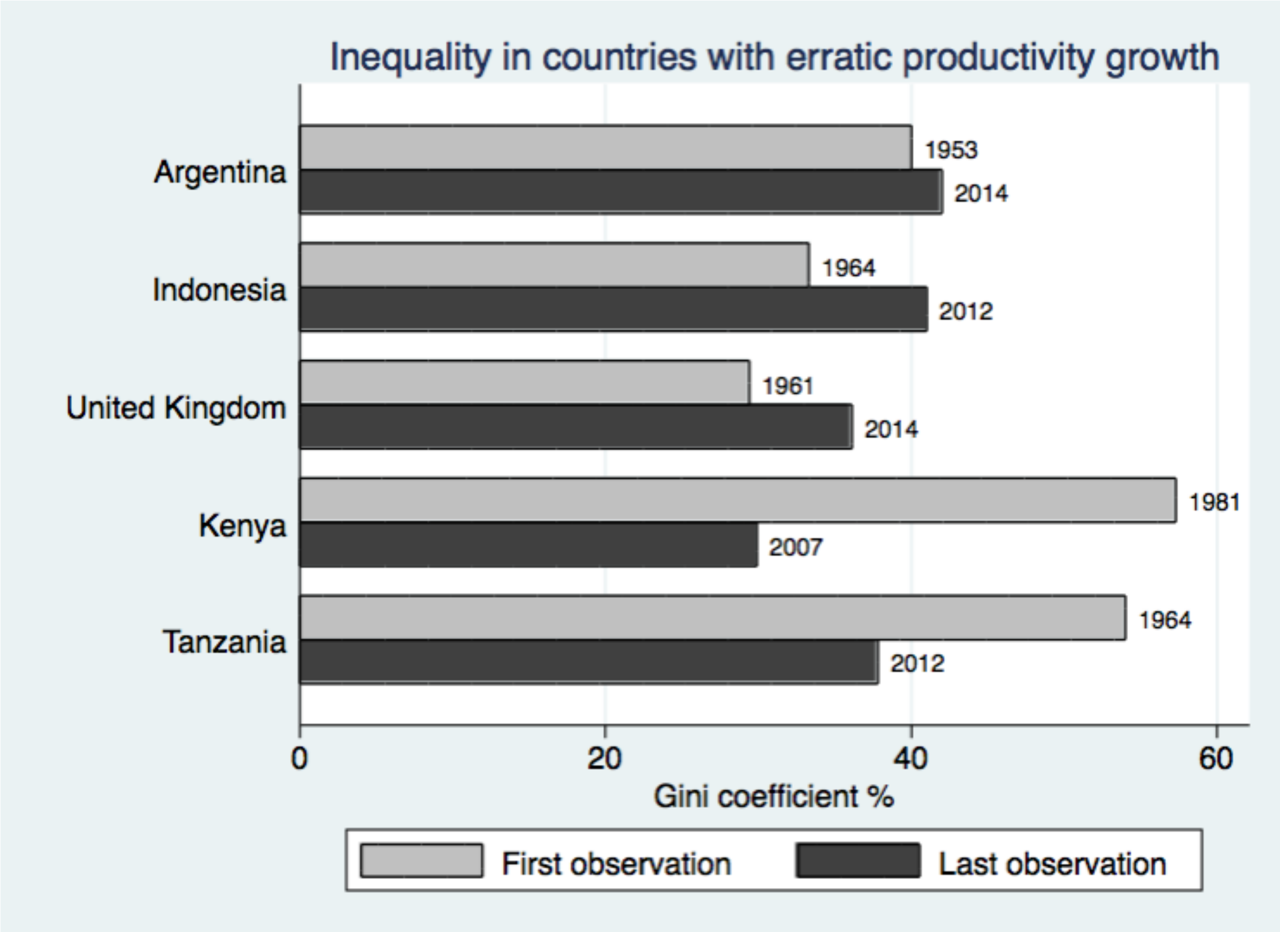

Figure 3.6

Initial and final observations available for the Gini coefficient in countries where productivity growth has been erratic

This problem may also undermine an accurate regression analysis, since the Sub-Saharan African sub-panel is our main focus in the analysis and it accounts for more than one third of our overall panel. The University of Texas inequality project (UTIP, http://utip.lbj.utexas.edu) is helpful in providing two distinct measures of inequality, being it for income (the Estimated household income inequality) or for industrial pay (the Industrial pay inequality). The Estimated household income inequality (abbreviated in EHII) is a measure of income inequality obtained by regressing the Gini coefficients presented by Deininger & Squire (1996) on a set of controls, among which the UTIP-UNIDO measure for industrial pay inequality. It is expressed in the classical GINI form, and then it is easy to be understood. Its main advantage resides in allowing for a larger set of observations for the Sub-Saharan African panel. Table 3.7 shows the main summary statistics for the EHII, to facilitate comparisons with the Gini coefficient provided by Milanonic and the other UTIP measure, the Industrial pay inequality. The table shows that on average the EHII and the Gini are comparable, although there are differences between the two measures for a subset of Sub-Saharan African countries and for some Latin American and Asian ones. The IID is instead based on the between group component of the Theil's T statistic, a measure of dispersion.[40] Conceição, et al. (2000) provide

[40] Theil's T statistic applied to income inequality generally provides a measure of the discrepancy between the population share and its income share.

a useful introduction to the Theil index, but here it is sufficient to note that the measure we use accounts for the differences in the pay structure between categories of the industrial sector as defined by the United Nations International Standard Industrial Classification of All Economic Activities (ISIC), and it uses data from the United Nations Industrial Development Organisation (UNIDO). The applied formula is the following:

$$\sum_{j=1}^{J} s_j \frac{y_j}{Y} * ln(\frac{y_j}{Y}) \qquad (3.4)$$

where s_j denotes the employment share of industrial category j, y_j the average pay in industrial category j, and Y the average pay in the whole industrial sector. Thus the average pay in industrial category j is weighted by its employment share and the natural logarithm component allows the term to be 0 when the average pay in industrial category j is equal to the average pay in the whole industrial sector, hence the sector does not contribute to the measure of inequality. If the average pay in all industrial categories is equal to the average pay in the whole sector, then there is no inequality and the summation yields 0.

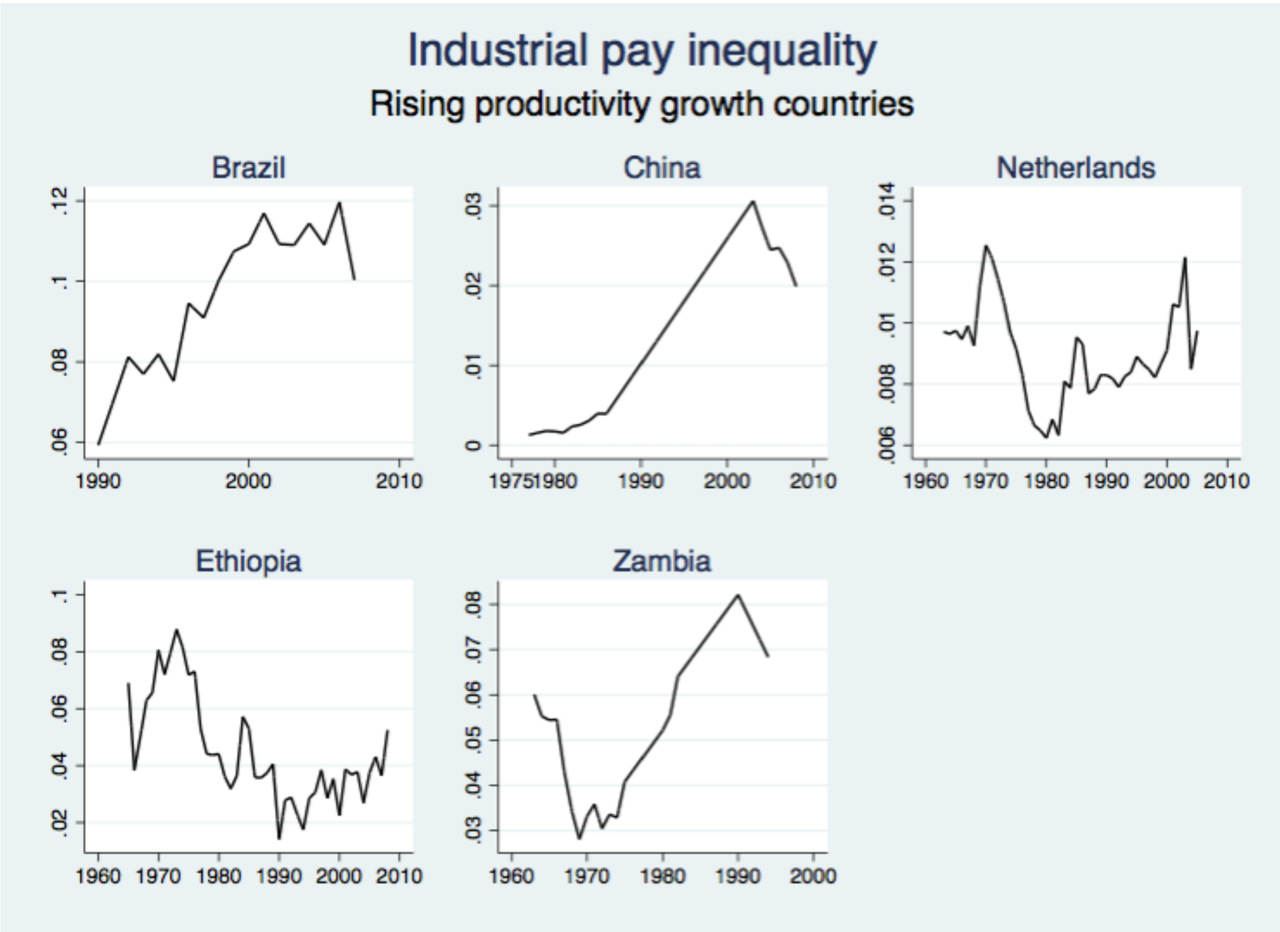

Figure 3.7
Graphical representation of inequality (Industrial pay inequality) trends – countries with rising productivity growth

Figures 3.7-3.9 provide graphical representations of the time series of industrial pay inequality by using the usual grouping adopted before. From a structural change perspective, it is interesting to look at these data, which should account for intra-industrial productivity differentials. Sub-Saharan African countries are in fact among the most unequal countries, and this reflects the poorly developed industrial sector. As Chapter 2 has shown, labour reallocation has been limited towards the industrial sector, which remains small and where productivity is often smaller than in the services. This suggests that the sector is not mature and characterized by firms performing much better than others.

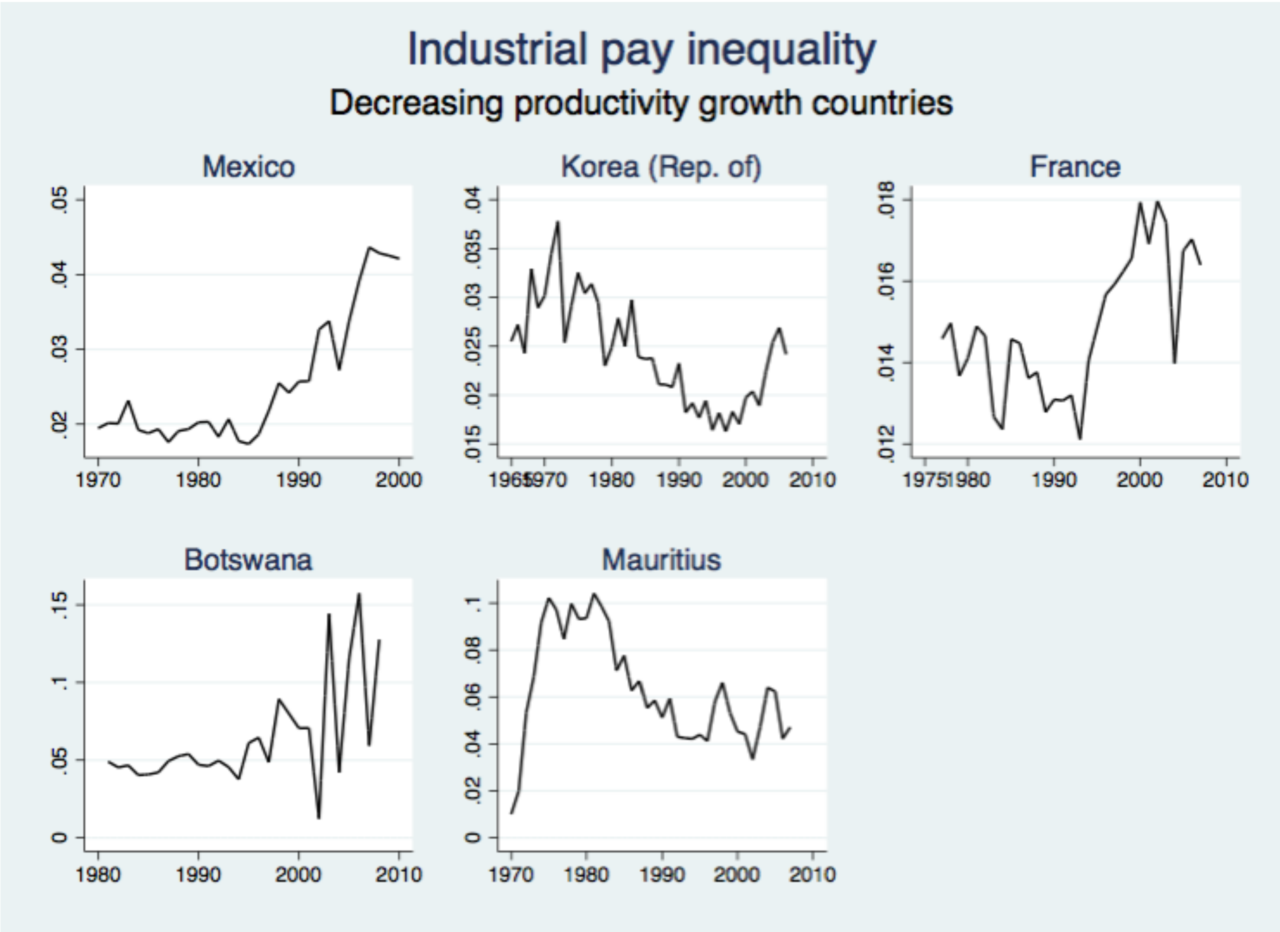

Figure 3.8
Graphical representation of inequality (Industrial pay inequality) trends – countries with decreasing productivity growth

It is interesting to study if and how the structural change process has affected this measure of inequality. We know that structural change has been close to zero in already industrialised countries, strong in developing Asia, moderate in Latin America and important in Sub-Saharan Africa. The problem is that there are signs that the process has only partly involved industry in Sub-Saharan Africa. So perhaps structural change has actually affected Industrial pay inequality in Latin America and Asia, but it is not clear if this effect will come out in a regression analysis on a heterogeneous panel like the one we're working with. Based on the results further hypotheses can be proposed.

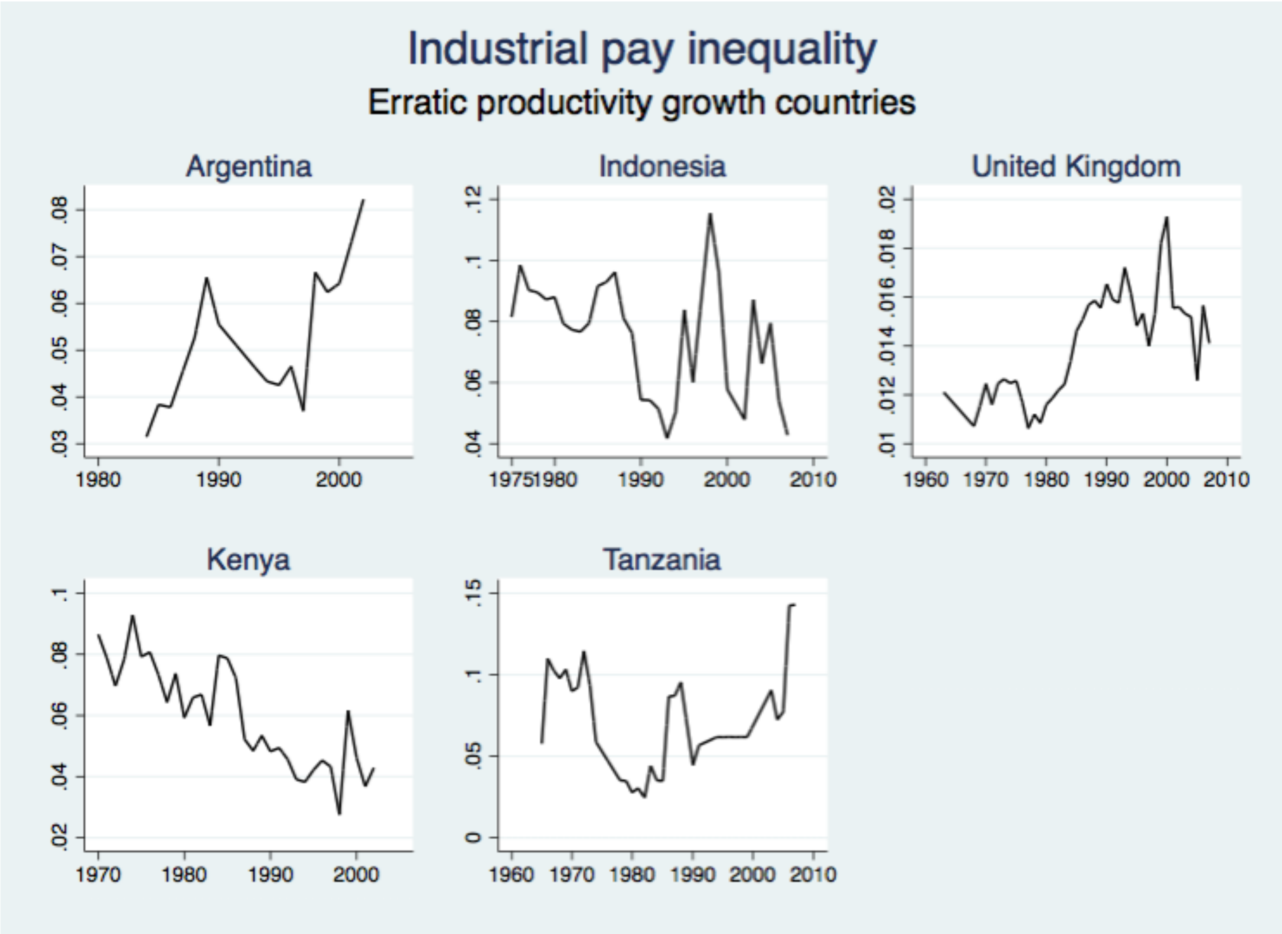

Figure 3.9
Graphical representation of inequality (Industrial pay inequality) trends – countries with erratic productivity growth

3.4. Characteristics of the relationship between structural change and inequality

The Kuznets curve idea suggests a non linear relationship between development and inequality. The observations used to derive the inverted-U shaped hypothesis are however relative to the end of the 19th century and the first half of the 20th for a small sample of developed countries. This relationship has not always been consistent with following studies, and, moreover, there is no guarantee that the underlying factors explaining the relationship are universal or time invariant. Our study on Sub-Saharan African structural change process has already clarified that the process of development in the region, if any is in progress, is not pointing in the direction of an increasing manufacturing sector, as experienced by industrialised countries and developing Asia. We mainly register labour reallocation from agriculture to the services, and this is happening at a relatively low pace (in Chapter 2 we showed that the agricultural employment share of the Sub-Saharan African aggregate sample declined from 70.5% in 1970 to 58.6% in 2010). This does not mean that Sub-Saharan Africa is not developing, but it is often doing so at a low pace and the country trends are very heterogeneous, reflecting the various economic structures that we may find in the region.

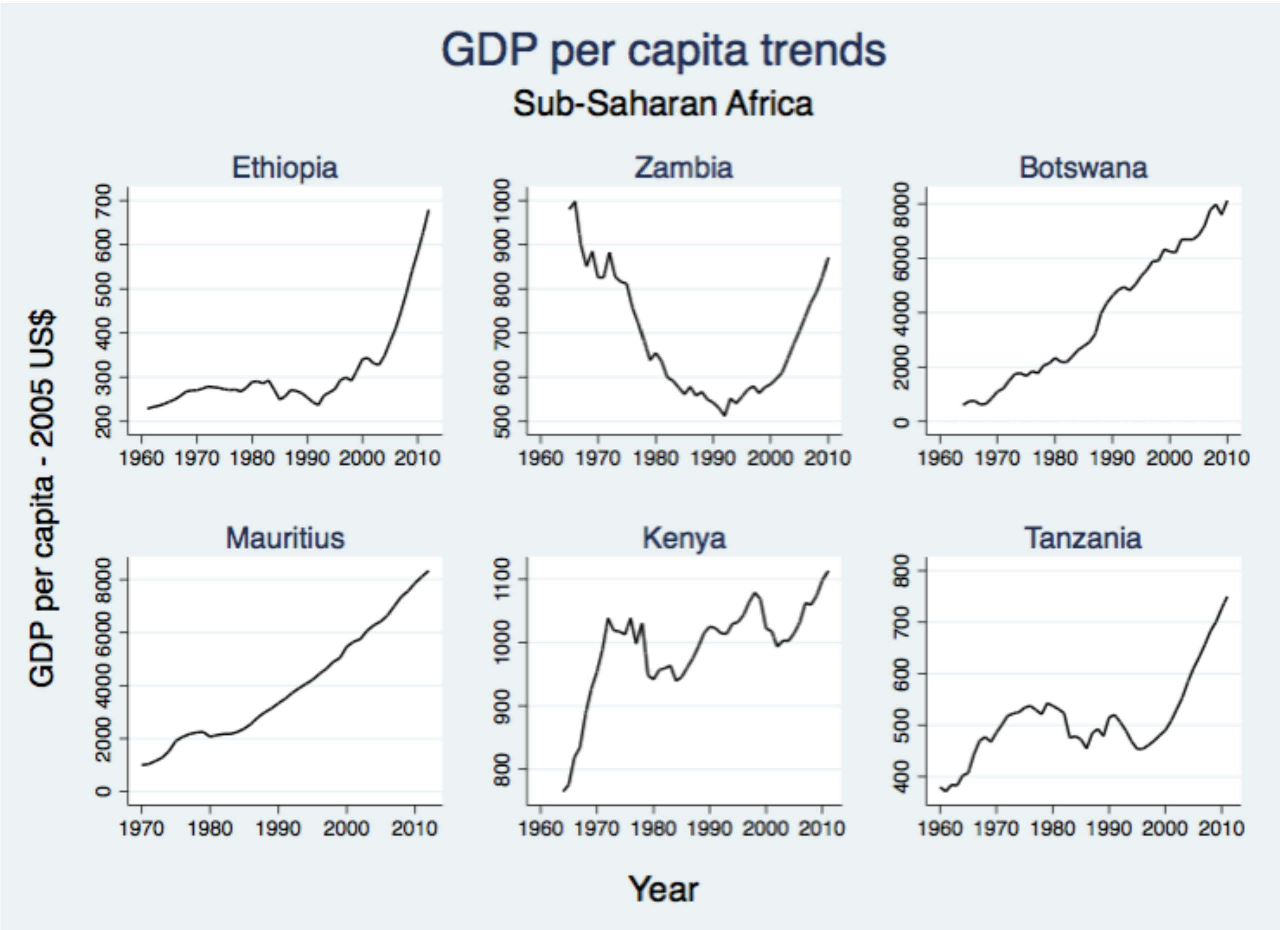

Figure 3.10
Trends in GDP per capita in a sample of Sub-Saharan African countries

Figure 3.10 shows that there is a basic link between the economic structure of a country and its level of development. The countries that have a GDP per capita level below or slightly above 1100 US$ (Ethiopia, Zambia, Kenya and Tanzania) have a prevailing agricultural sector (as shown in Table 2.2 of Chapter 2).[41] This feature is related to the relationship illustrated in Figures 2.6 and 2.7 of Chapter 2, where we show that a larger agricultural sector is associated with larger variability in intersectoral productivities, which in turn comes along with lower productivity in the total economy.

	Observations	*Min value*	*Average*	*Max value*	*St. Dev.*
Argentina	52	5570.16	7551.19	11852.81	1295.32
Botswana	47	600.17	3857	8123.71	2409.7
Brazil	52	2262.13	5153.28	7340.92	1468.53
Chile	52	3690.69	6597.73	12918.58	2771.23
China	51	268.26	1940.5	8535.07	2141.71
Denmark	50	10886.17	20573.13	29862.33	5327.57
Ethiopia	52	228.7	313.24	679.04	101.15
France	50	8119.89	15819.01	22742.64	4372.25
Ghana	52	810.34	1306.63	2592.13	429.68
India	53	741.12	1511.09	3667.47	809.21
Indonesia	53	856.09	2219.03	4562.23	1076.87
Italy	50	6982.69	15985.32	22665.84	4947
Japan	52	5419.46	20164.27	30257.92	7829.79
Kenya	48	764.74	991.42	1113.36	75.18
Korea (Rep. of)	52	1821.74	9634.94	23514.03	6941.5
Malawi	45	333.8	446.74	546.99	47.26
Mauritius	43	998.29	3989.39	8332.95	2178.85
Mexico	52	4740.67	8523.1	11185.28	1949.68
Netherlands	50	10549.08	20793.16	32865.8	6195.56
Nigeria	52	233.99	672.32	1029.68	226.54
Senegal	41	913.93	1024.8	1194.25	75.61
South Africa	52	2976.97	4514.99	6343.85	788.3
Spain	50	5865.13	14691.99	23071.74	4911.87
Sweden	50	9613.5	17359.65	31151.68	5823.72
Tanzania	52	370.99	510.99	750.07	83.18
United Kingdom	50	12676.88	18990.98	28836.7	4849.08
United States	51	19718.44	32662.47	47276.07	8279.6
Zambia	46	512.25	687.16	998	135.62
Total	*1400*	*228.7*	*8603.05*	*47276.07*	*9354.17*

Table 3.8
GDP per capita (2005 US$): summary statistics at the country level – 1950 - 2016

[41] The same phaenomenon pertains to Nigeria where, despite its natural resource-advantage, agriculture is by far the largest economic sector.

An implication of the inverted-U shaped hypothesis is that developing countries should be experiencing increasing inequality, while it should decrease in already developed ones. The former ones are placed in the increasing portion of the curve, while the latter ones in the decreasing portion. This can be illustrated in a cross-sectional approach, where we draw a scatterplot with the measure of inequality in the vertical axis and GDP per capita in the horizontal axis. Since there is not always exact correspondence in time between GDP per capita and the three measures of inequality (the Gini coefficient for Sub-Saharan African countries, in particular, has many missing observations), we choose the last and the first observations available for the Gini coefficient, the estimated household income inequality and industrial pay inequality and match them to the last (and first) observations available of GDP per capita (Table A2 in Appendix 2 reports the value and the matching year for these observations). This is justified by the idea that income distribution changes more slowly than development, hence the phaenomenon of interest should still be described in a quite accurate manner. We perform this in our cross section, made by the 28 countries.

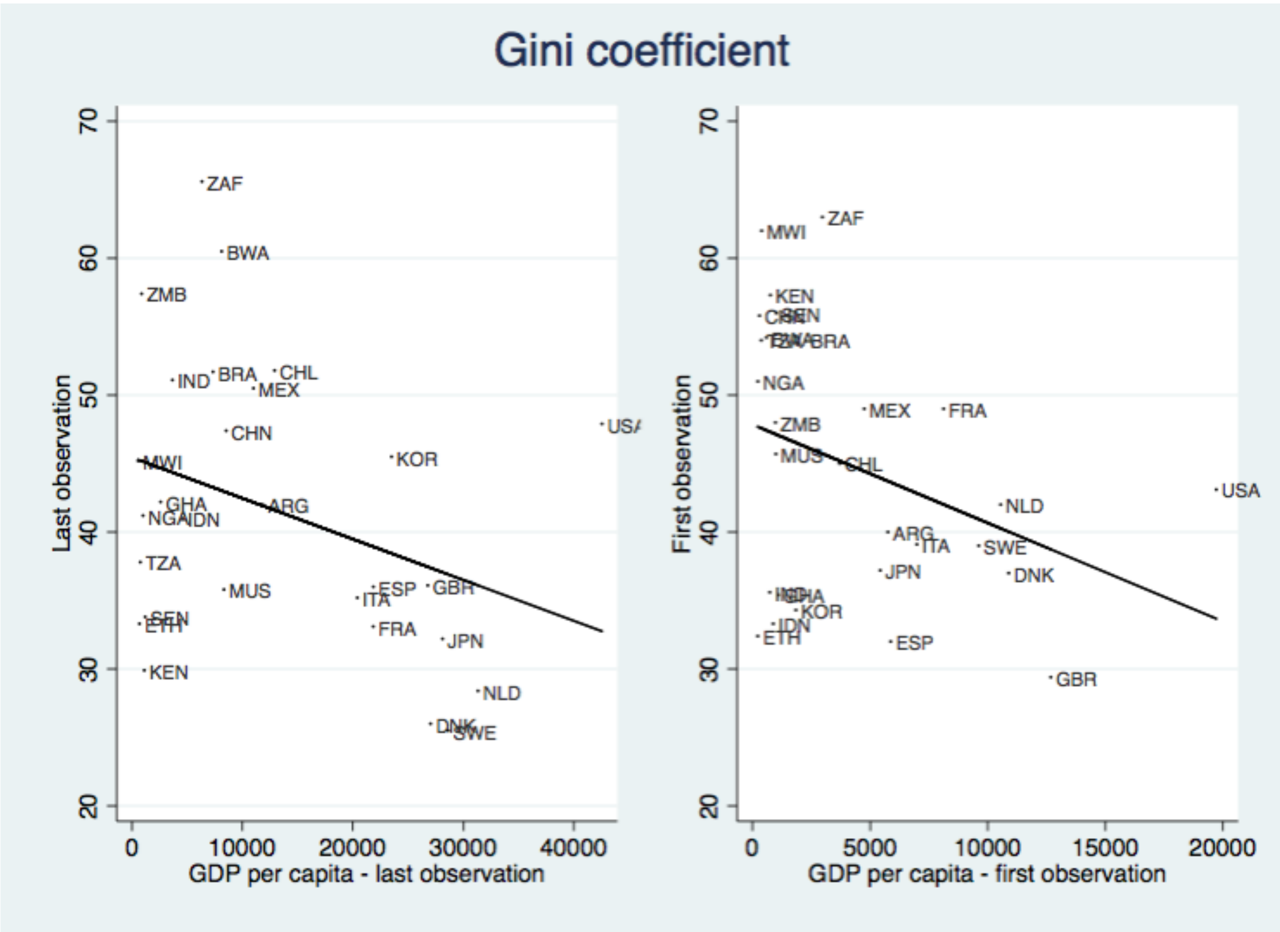

Figure 3.11
Fitted lines for the cross-sectional regressions of inequality (Gini coefficient) on development – (end of period vs start of period)

Figures 3.11 to 3.13 graph the scatterplots for each of the three measures of inequality and draw a fitted line which shows the negative relationship existing between development and inequality. If the Kuznets hypothesis holds, we expect developing countries to be found in the increasing portion of the inverted-U shaped curve, or in the highest section of the decreasing portion, while developed countries are at the bottom of the decreasing portion.

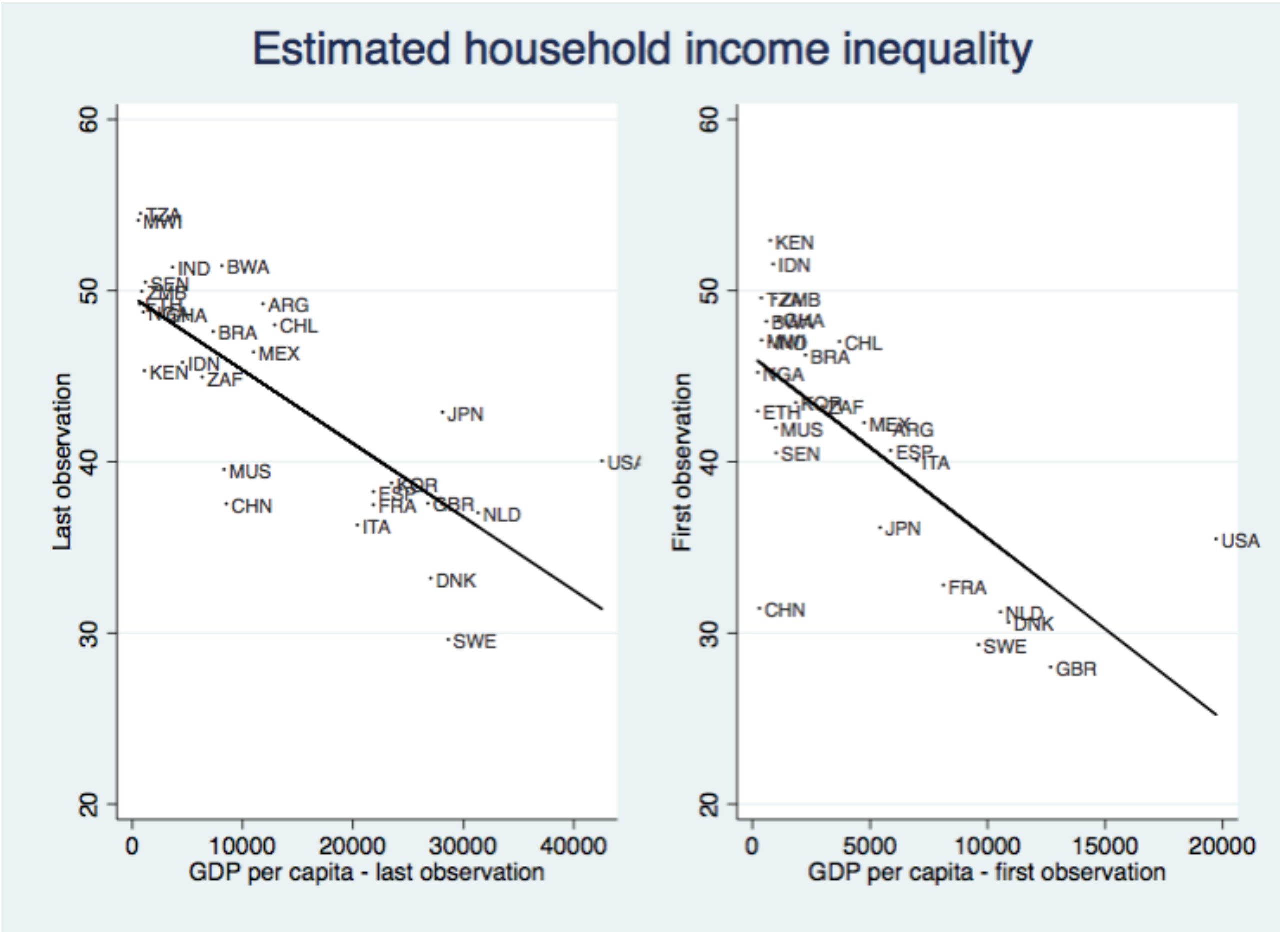

Figure 3.12
Fitted lines for the cross-sectional regressions of inequality (Estimated household income inequality) on development – (end of period vs start of period)

		Inequality - last observation			*Inequality - first observation*		
		gini	ehii	iid	gini	ehii	iid
GDP per capita	last observation	-0.0003 (0.075)	-0.00043 (0.000)	-0.0000021 (0.001)			
	first observation				-0.00072 (0.062)	-0.0011 (0.000)	-0.000003 (0.016)
	constant	45.45 (0.000)	49.65 (0.000)	0.08 (0.000)	47.85 (0.000)	46.15 (0.000)	0.05 (0.000)
	p-values in parenthesis						

Table 3.9

Table of coefficients from the six regressions

Table 3.9 reports the coefficients from the six cross-sectional regressions together with the relative p-values. The relationship is negative and significant for each of the three measures of inequality, and it weakens in time. In absolute values, the magnitude of the coefficients of the cross-section with the initial observations is larger than that of the cross-section with the last observations. There seem to be some sort of convergence towards lower levels of inequality.

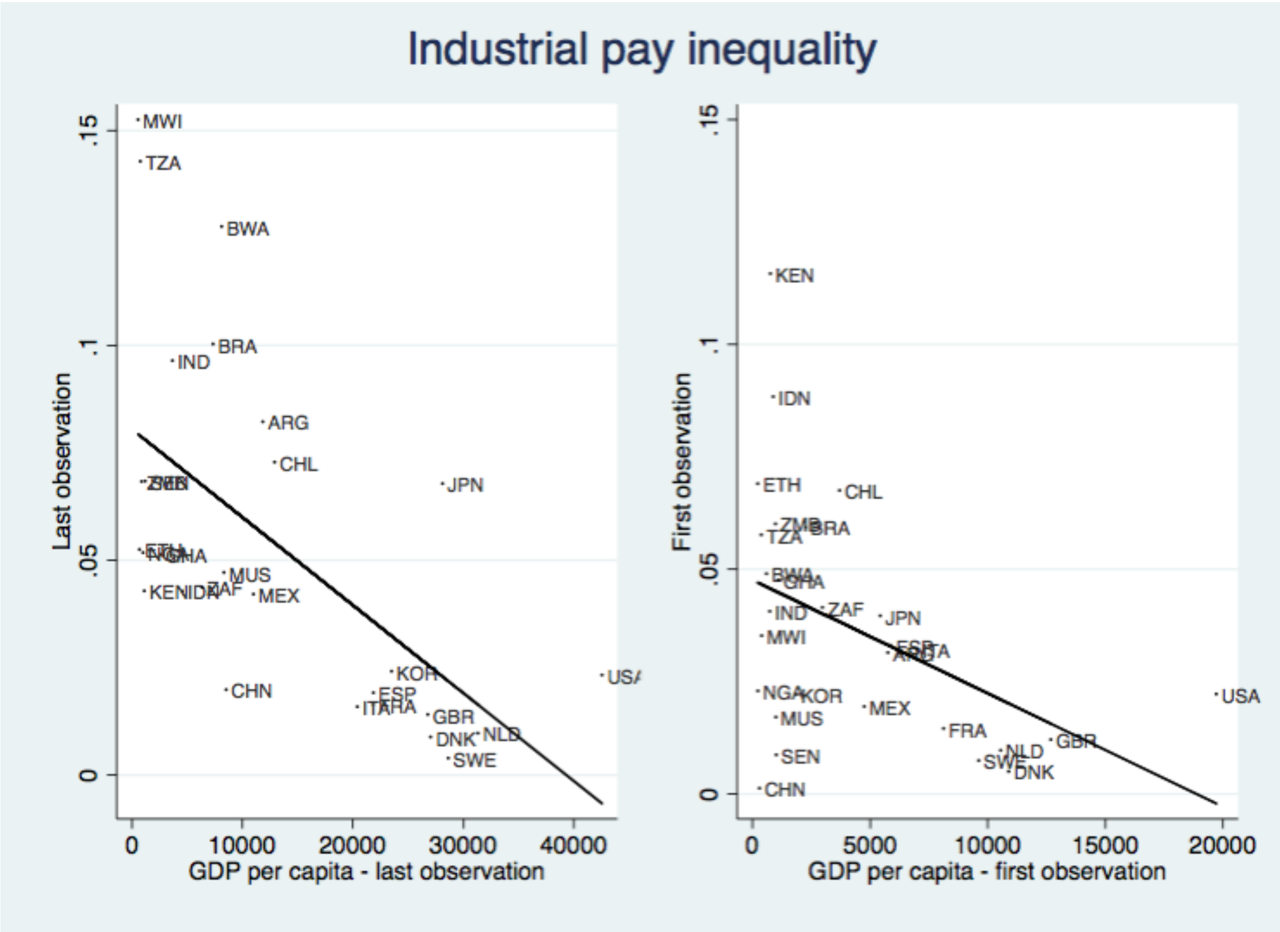

Figure 3.13
Fitted lines for the cross-sectional regressions of inequality (Industrial pay inequality) on development – (end of period vs start of period)

Another line of reasoning is coherent with the hypothesis that underdeveloped Sub-Saharan African countries be placed in the left, rising portion of the inverted-U shaped Kuznets curve: the presence of a large agricultural sector in the region. Displacement from agriculture driven by productivity differentials should result in rising incomes in the non-agricultural sector and larger inequality in the overall economy. It is worth recalling here that the relationship stilized in the Kuznets curve hypothesis heavily depended on the expansion of the manufacturing sector, where investment and technological progress would favour the most dynamic firms. Besides, in the first phase of industrialisation trade-unionism would still not be sufficiently developed to foster the improvement of the living conditions of the working class and the promotion of redistributive policies. Chapter 2 has shown that this phaenomenon is lacking in Sub-Saharan Africa: there is but a timidly expanding manufacturing sector, and labour reallocation mostly aims for the services. Despite this, it is to note that positive population growth and rapid urban development, in a condition of stagnant agricultural productivity, might well affect the distribution of income in the presence of large productivity differentials, as it is the case for Sub-Saharan African countries.[42] However, these countries are also characterized by the settlement of large parts of the growing urban population in densely populated slums and by relevant informal sectors, where productivity is not comparable to official industrial and services sectors. The first phaenomenon would reinforce inequality, while the latter would bring it down. It is to note here that the presence of large slums and informality is probably caught by the two measures of inequality based directly on income distribution, i.e. the Gini coefficient and the Estimated household income inequality. As regards the Industrial pay inequality measure, it is derived by wage differentials in ISIC sectoral disaggregations, hence it can only capture formal sectors, while it completely miss the informal activities that are so large in Sub-Saharan African countries. This is of course useful in a study concerned mainly on sectoral dynamics, like this one, but less informative when a study is concerned on a measure of inequality in the whole society.

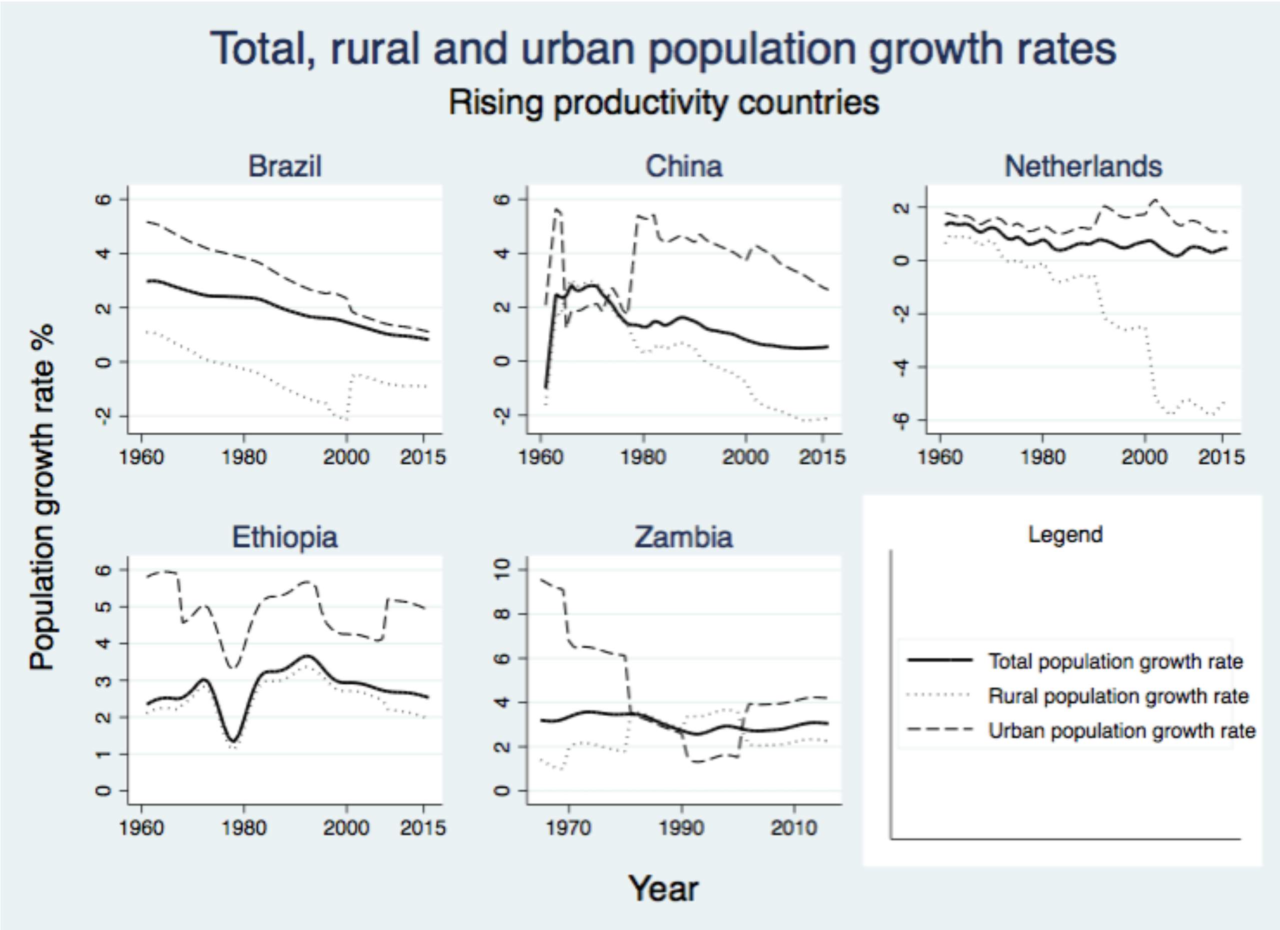

Figure 3.14
Trends in population growth in rising productivity countries

Figures 3.14 to 3.16 illustrate that population growth is stable and positive in Sub-Saharan African countries, and that it distributes mainly in urban areas (rural areas as well have positive growth rates, but urban population growth is a more relevant phaenomenon).

[42] Table 2.4 in Chapter 2 compares average sectoral productivities, and shows that both the services and industry have a far larger productivity than agriculture and the services have generally a larger productivity than industry.

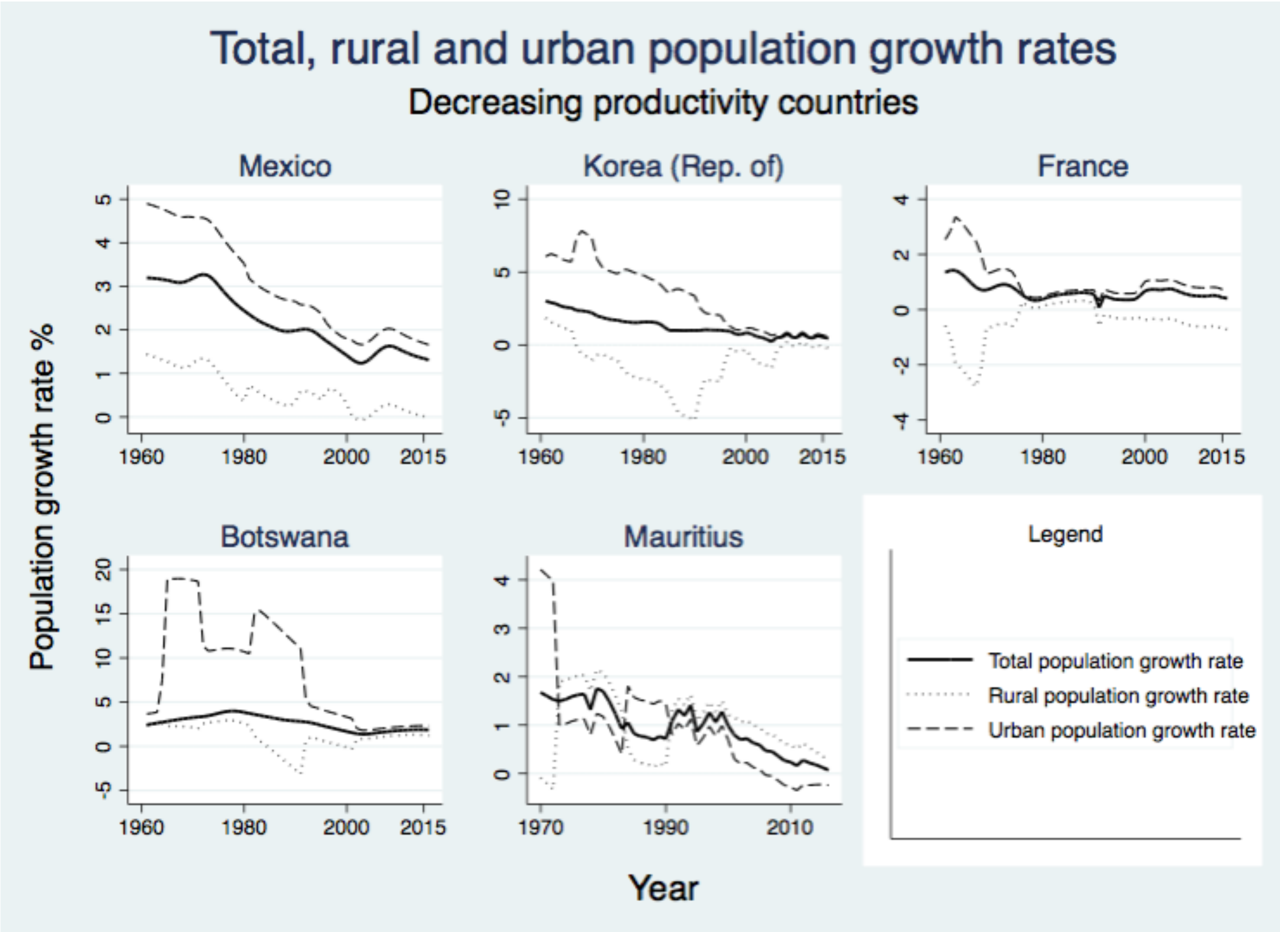

Figure 3.15
Trends in population growth in decreasing productivity countries

In non-Sub-Saharan African countries population growth is declining over time or stabilized around zero and it converges to urban population growth, while rural population growth is mostly negative.

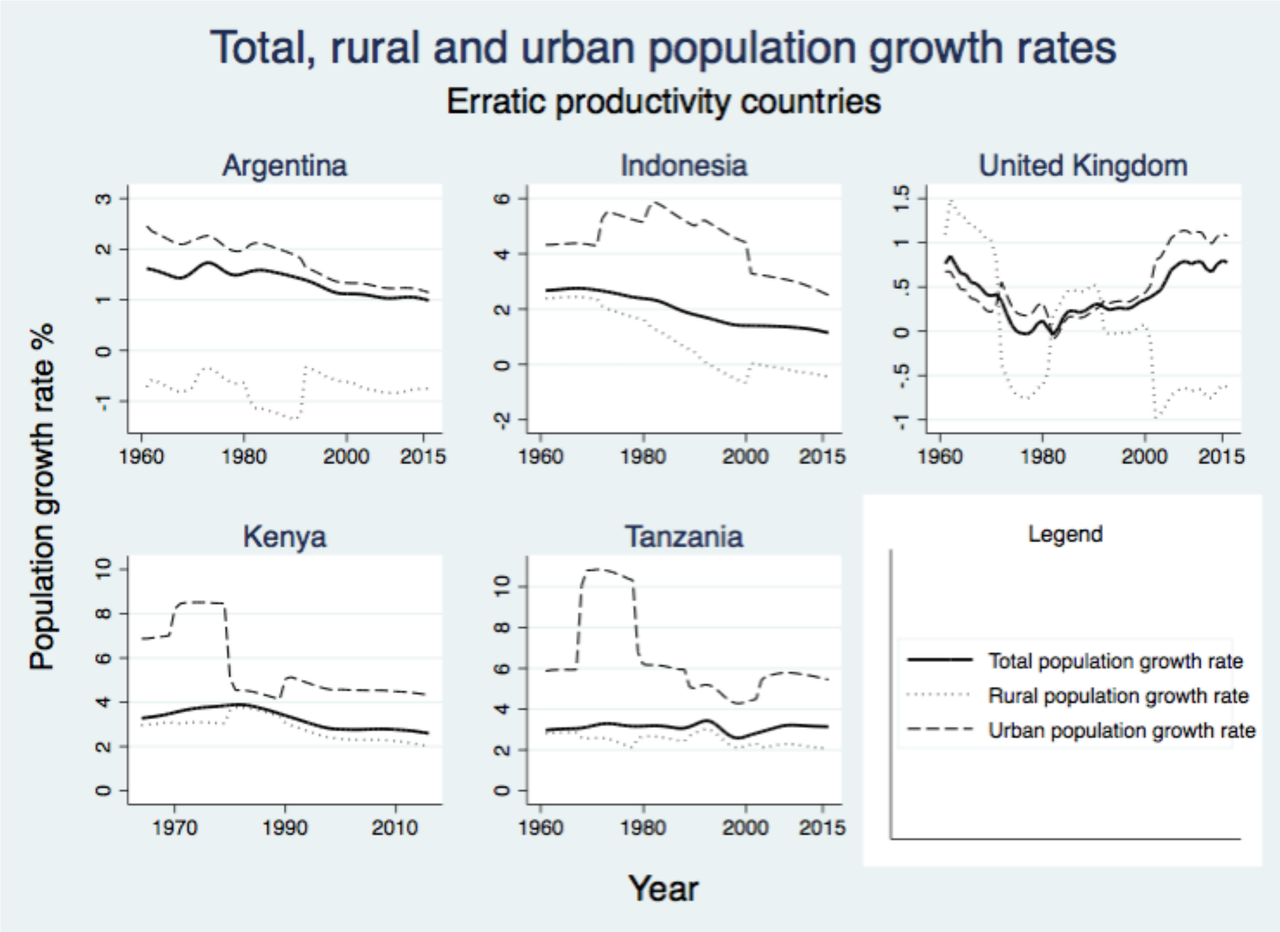

Figure 3.16
Trends in population growth in erratic productivity countries

In what follows we regress inequality (estimated household income inequality and industrial pay inequality) on the urban population growth rate with a panel fixed effects methodology augmented by the inclusion of an interaction dummy for Sub-Saharan African countries. This allows us to isolate the association between urban population growth and inequality in Sub-Saharan African countries from the overall panel. Equation (3.5) formalizes the model:

$$i_{it} = \alpha_i + \beta_1 x_{it} + \beta_2 x_{it} * d + u_{it} \tag{3.5}$$

Where i_{it} is the chosen measure of inequality at the country level in a given time period, x_{it} represents the urban population growth rate at the country level in a given time period, d is a dummy variable taking the value of 1 for Sub-Saharan African countries and 0 otherwise, u_{it} are observations residuals, α_i are unobserved country specific characteristics, $\beta_1 + \beta_2$ is the regression coefficient of interest, i.e. the marginal impact of urban population growth on inequality in the restricted (Sub-Saharan African) panel.

	ehii	*iid*
urban_pop_gr	0.3179	-0.0004
	(0.006)	(0.713)
urban_inter	-0.3873	-0.0016
	(0.004)	(0.144)
constant	41.5759	0.0454
	(0)	(0)

p-values in parenthesis

Table 3.10
Regression results from equation (3.5) for Estimated household income inequality (EHII) and Industrial pay inequality (IID)

Table 3.10 reports the results of the estimation, while in Figure 3.17 we draw a scatterplot with the measure of inequality in the vertical axis and the urban population growth rate in the horizontal axis (the circles represent the coordinate points for the two variables in the relative axis). We also draw a fitted line where the slope is the sum of the two estimated coefficients ($\beta_1 + \beta_2$).

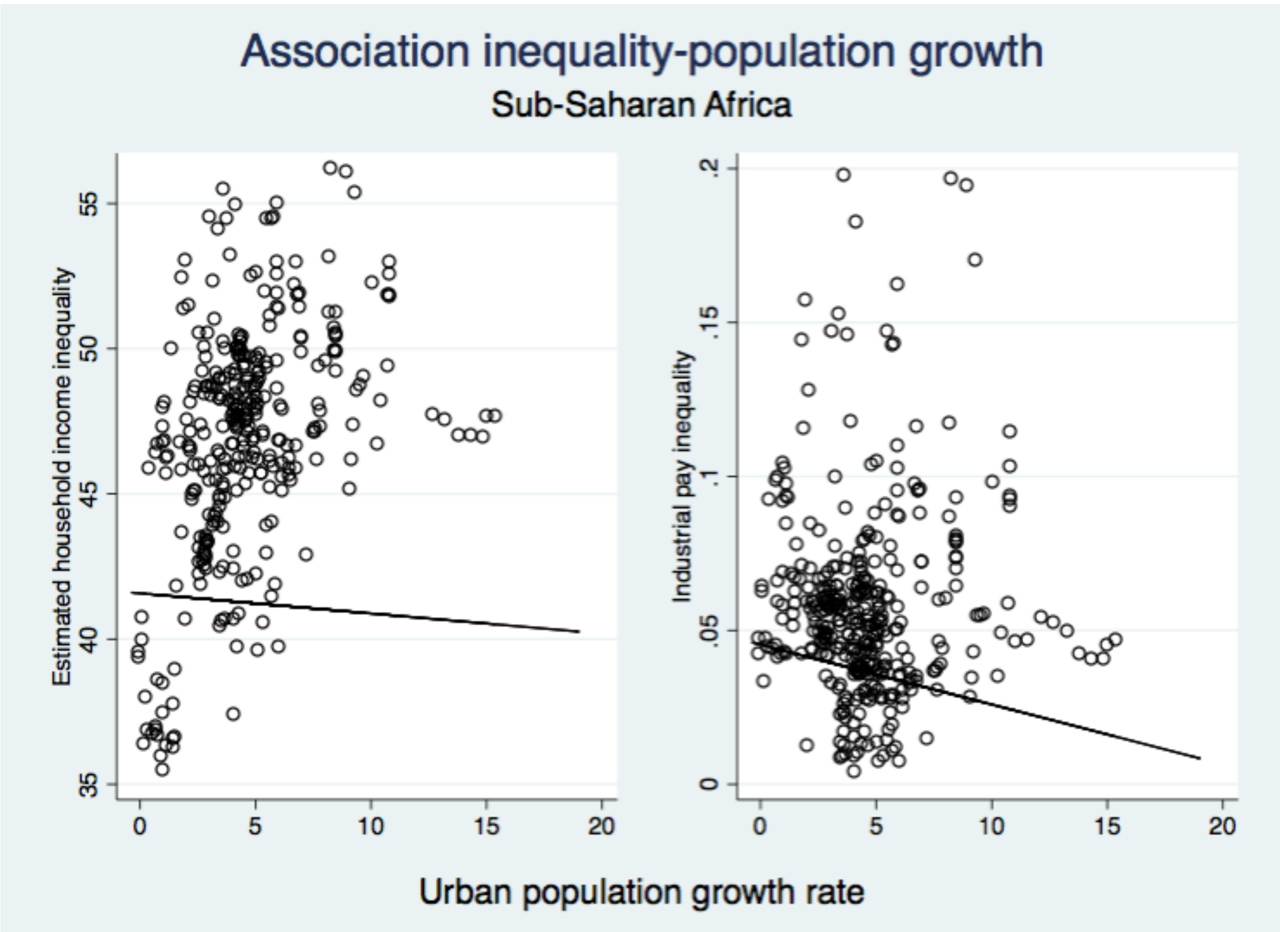

Figure 3.17
Association between inequality and urban population growth in Sub-Saharan Africa

From the scatterplots it is hard to derive a coherent idea of the relationship between urban population growth and inequality. It seems positive for the Estimated household income inequality measure (although variation is large), while it is much more confusing for the industrial pay inequality measure. However, when we take into account unobserved country characteristics and isolate the African panel, we find that in Sub-Saharan African countries the association is negative, perhaps indicating the prevalence of the cited forces (slums and informality) on productivity differentials. The fact that coefficients are not significant in the case of the iid variable may signal that the same forces are less relevant in a formal inter-sectoral context.

3.5. Methodology

This section describes the methodology used for the estimation of the effect of structural change on inequality. Our estimations follow the original idea of an inverted-U relationship between inequality and development, but progressively introduce controls. We begin by a pooled OLS regression, then we perform a fixed effects regression and finally a Diff-GMM estimation that allows us to control for potential endogeneity in some of the controls. The estimated model is a dynamic one, where we exploit lags of the dependent variable and of meaningful regressors.

Preliminarly, the data undergo a transformation procedure. The limited N dimension relative to a large T dimension in our context has its limitations. If j denotes instruments and k regressors, in a GMM context the model is exactly identified when $j = k$, i.e. when the moment conditions are equal to the number of explanatory variables. Adding more moment conditions allows $j > k$, which improves the efficiency of the estimator but poses the problem of the validity of the instrument set. It is empirically hard, infact, to satisfy:

$$\forall \quad z_j \quad E(z_j \varepsilon) = 0$$

where z_j are instruments i.e., that all instruments are orthogonal to the errors. Moreover, adding instruments downward biases the standard errors, affecting the validity of the inference and of the Hansen tests for overidentifying restrictions. We address the problem by taking 5-year averages of the observations. Then we run all our regressions on the transformed variables.

Table 3.11 shows the regressands and the regressors of our specification. They enter our regressions in 5-year averages. We exploit the first lag (corresponding to a period of 10 years together with the simultaneous term) of the regressands, and it is indicated by the prefix "L." in the regression tables.

	name	*description*	*source*
dependent variable	gini	Gini coefficient	All the Ginis
	ehii	Estimated household income inequality	UTIP
	iid	Industrial pay inequality	UTIP
regressors	struct_gr	Structural change term in the decomposition of the average total productivity growth rate	GGDC
	gdp_pc	GDP per capita	Authors' calculation based on overall value added (GGDC) and total population (WDI)
	gdp_pc_2	Square of GDP per capita	Authors' calculation

human_cap	Human capital (average years + returns to education)	PWT 9.0
paved_roads	Paved roads as a percentage of the overall length of a country's roads	CANA
royalties	Payment per use of intangible assets and produced originals, per GDP.	CANA
pol_lib	Political liberties	V-DEM

Table 3.11
Variables definitions and sources

i. Pooled OLS

In this section we describe the results obtained by a pooled OLS regression of the data, i.e. we estimate the relationship between inequality and development by adding covariates that may explain the variation and help assess the underlying factors that relate development to inequality. Our main interest is in the effect of labour reallocation to inequality, a framework that is particularly suitable when we introduce industrial pay inequality as dependent variable.

The equation of interest here is:

$$\boldsymbol{i} = \boldsymbol{X\beta} + \boldsymbol{u} \tag{3.6}$$

Where $\boldsymbol{i}$ is a $\mathrm{n} \times 1$ vector of n observations on the chosen dependent variable (inequality in income distribution as expressed by the Gini coefficient, the estimated household income inequality or the industrial pay inequality), $\mathbf{X}$ is a $\mathrm{n} \times \mathrm{k}$ matrix of n observations on k independent explanatory variables, $\boldsymbol{\beta}$ is a $\mathrm{k} \times 1$ vector of unknown regression parameters, including the constant term, and $\mathbf{u}$ is a $\mathrm{n} \times 1$ vector of errors, which we assume $\mathrm{iid} \sim \mathrm{N}(0, \sigma^2)$.

Pooled OLS - Gini coefficient

	(1)	(2)	(3)	(4)	(5)	(6)
L.gini5	0.886***	0.896***	0.891***	0.817***	0.804***	0.811***
	(0.033)	(0.031)	(0.031)	(0.048)	(0.049)	(0.049)
gdp_pc5	-0.063	-0.112	-0.279**	-0.179	-0.187	-0.089
	(0.087)	(0.085)	(0.129)	(0.162)	(0.162)	(0.165)
gdp_pc5_2	0.002	0.002	0.004*	0.002	0.002	0.000
	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
struct_gr5		-0.496***	-0.523***	-0.526***	-0.561***	-0.569***
		(0.167)	(0.167)	(0.174)	(0.176)	(0.173)
human_cap5			1.751*	1.834	2.444*	2.707**
			(1.020)	(1.203)	(1.302)	(1.286)
paved_roads5				-0.035*	-0.038*	-0.040**
				(0.019)	(0.019)	(0.019)

royalties5					-3.134	-3.787
					(2.583)	(2.557)
pol_lib5						-3.575**
						(1.533)
_cons	4.470***	4.722***	2.132	6.299*	6.226*	7.569**
	(1.535)	(1.485)	(2.111)	(3.282)	(3.277)	(3.275)
Observations	185	182	182	143	143	143

*Notes: Standard errors in parenthesis. ***, **, * denote 1%, 5% and 10% confidence levels, respectively*

Table 3.12
Pooled OLS regression – Dependent variable: Gini coefficient

	Pooled OLS - Estimated household income inequality					
	(1)	(2)	(3)	(4)	(5)	(6)
L.ehii5	0.930***	0.929***	0.929***	0.857***	0.861***	0.859***
	(0.028)	(0.028)	(0.028)	(0.033)	(0.034)	(0.034)
gdp_pc5	-0.092**	-0.101**	-0.083	0.009	0.012	0.007
	(0.045)	(0.046)	(0.066)	(0.070)	(0.070)	(0.073)
gdp_pc5_2	0.002**	0.002**	0.002*	0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
struct_gr5		-0.070	-0.071	-0.124**	-0.119*	-0.119*
		(0.059)	(0.059)	(0.061)	(0.061)	(0.061)
human_cap5			-0.165	-0.320	-0.162	-0.172
			(0.430)	(0.448)	(0.470)	(0.473)
paved_roads5				-0.028***	-0.028***	-0.029***
				(0.006)	(0.006)	(0.006)
royalties5					-0.898	-0.861
					(0.801)	(0.819)
pol_lib5						0.133
						(0.561)
_cons	3.738***	3.889***	4.107***	8.637***	8.294***	8.330***
	(1.382)	(1.386)	(1.501)	(1.852)	(1.876)	(1.888)
Observations	199	199	199	161	161	161

*Notes: Standard errors in parenthesis. ***, **, * denote 1%, 5% and 10% confidence levels, respectively*

Table 3.13
Pooled OLS regression – Dependent variable: Estimated household income inequality

	Pooled OLS - Industrial pay inequality					
	(1)	(2)	(3)	(4)	(5)	(6)
L.iid5	0.87449***	0.87455***	0.86515***	0.87370***	0.87150***	0.86502***
	(0.04561)	(0.04572)	(0.04694)	(0.05266)	(0.05228)	(0.05384)
gdp_pc5	-0.00069**	-0.00067*	-0.00111*	-0.00026	-0.00028	-0.00038
	(0.00033)	(0.00034)	(0.00060)	(0.00073)	(0.00072)	(0.00075)
gdp_pc5_2	0.00001	0.00001	0.00002	0.00000	-0.00000	0.00000
	(0.00001)	(0.00001)	(0.00001)	(0.00001)	(0.00001)	(0.00001)
struct_gr5		0.00016	0.00020	-0.00010	-0.00003	-0.00003
		(0.00056)	(0.00057)	(0.00062)	(0.00062)	(0.00062)
human_cap5			0.00364	0.00370	0.00648	0.00624
			(0.00408)	(0.00460)	(0.00480)	(0.00483)
paved_roads5				-0.00014**	-0.00015***	-0.00016***
				(0.00006)	(0.00006)	(0.00006)
royalties5					-0.01514*	-0.01446*

					(0.00817)	(0.00830)
pol_lib5						0.00293
						(0.00559)
_cons	0.01157***	0.01131***	0.00665	0.00929	0.00691	0.00632
	(0.00338)	(0.00351)	(0.00630)	(0.00760)	(0.00765)	(0.00775)
Observations	205	205	205	165	165	165

*Notes: Standard errors in parenthesis. ***, **, * denote 1%, 5% and 10% confidence levels, respectively*

Table 3.14

Pooled OLS regression – Dependent variable: Industrial pay inequality

This specification does not take into account neither the individual, nor the time dimensions and treats observations as if they were random extractions. This is not the optimal framework where to estimate parameters for the relationship of interest, since there are individual country specific unobservable characteristics (for example, developed countries have lower levels of inequality than underdeveloped ones) and the way in which variables change over time is relevant (GDP per capita and education, for example, are not stationary processes).

However, representing the observations by pooling them together is useful because it allows some graphic comparisons with the Kuznets' inverted-U shaped hypothesis: when we draw a scatterplot with the measure of inequality in the vertical axis and development (GDP per capita) in the horizontal axis and we fit the points obtained from a pooled regression that uses GDP per capita and its square as regressors (Figure 3.18), we get a U-shaped curve that, especially in the cases of the Estimated household income inequality and of the Industrial pay inequality, seem to fit the observations quite well.[43]

[43] Hollow circles represent actual observations, while full circles represent fitted data from the pooled regression of inequality (any measure) on GDP per capita and the square of GDP per capita.

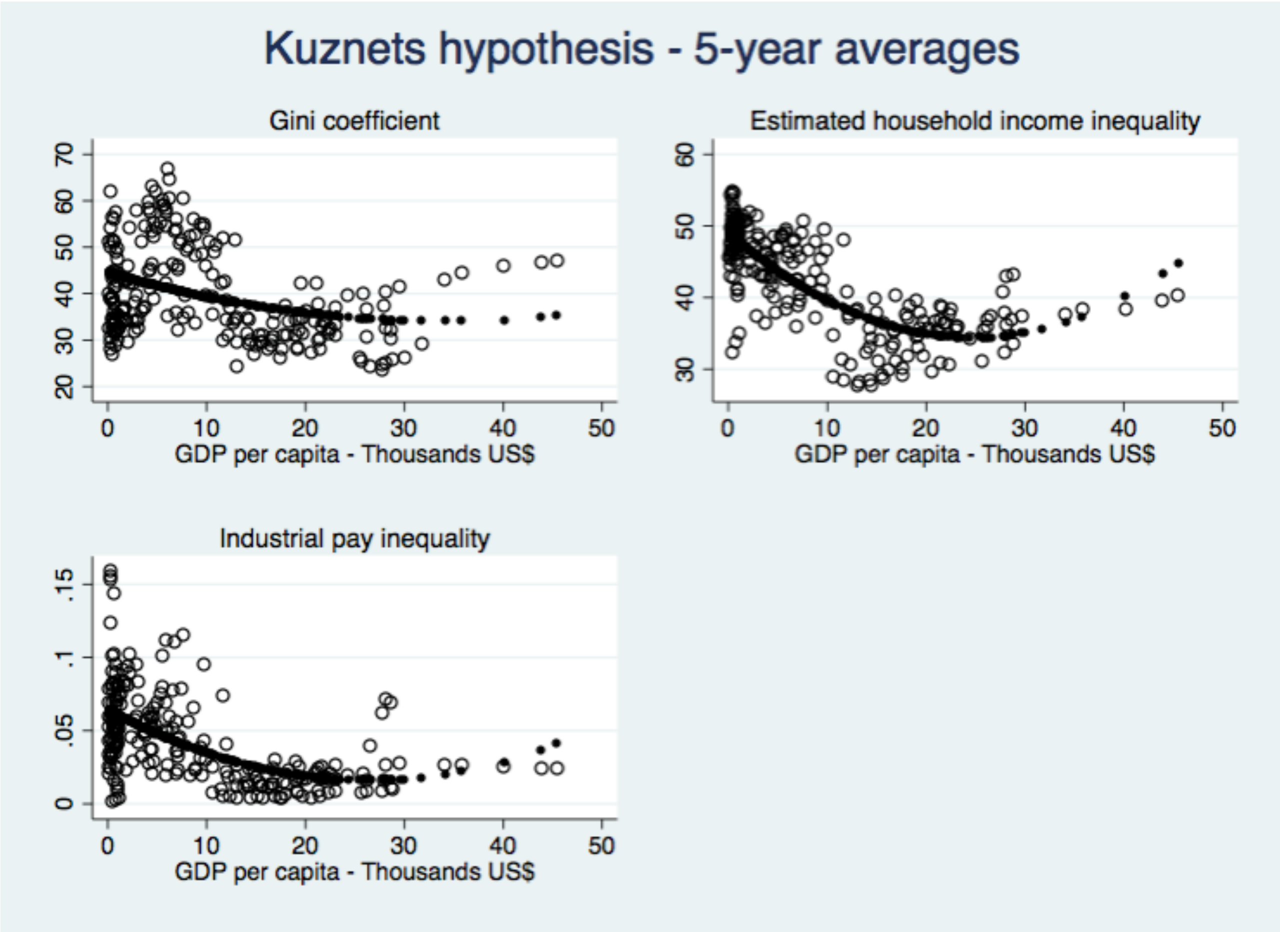

Figure 3.18
Kuznets hypothesis in pooled observations - 5-year averages

No matter which measure of inequality we choose, the coefficients for the two regressors are significant. The sign for GDP per capita is negative, while the one for the square of GDP per capita is positive. Hence we derive an equation of the form:

$$i = b_0 - b_1 * gdp\_pc + b_2 * gdp\_pc\hat{}2$$

For the Kuznets hypothesis to hold we should have a negative sign for the quadratic term, instead.

Moreover, including controls in the regression (in the case of the Gini coefficient it is sufficient to include the lagged dependent variable) affects the significance of the coefficients used as signals for the Kuznets relationship. When we use the Gini coefficient as measure of inequality, the "Kuznets regressors" are significant only in the third specification. When we use the Estimated household income inequality measure (EHII), they are significant in the first two specifications, while in the case of the Industrial pay inequality (IID) only GDP per capita is significant in the first three specifications. It is worth noting that the Kuznets hypothesis does not hold in all the regressions performed, the curve is U-shaped (and not always significant).

The structural change term is always significant when we choose the Gini coefficient (predicting around a half percentage point reduction in inequality per 1 point increase in the structural change term), it is significant only in the last three specifications for the EHII measure (and much smaller in absolute value than in the case of the Gini), it is never significant for the IID measure. The sign of the estimated coefficient is robustly negative (only in the second and third IID specifications it enters positively) and quite robust, especially in the case of the Gini.

In the case of the two UTIP measures of inequality we find that human capital is never significant, while it is significantly positive in three out of four Gini specifications. Much more significant are the results for the proxy of infrastructures (paved roads over total roads): the variable enters the relationship always significantly, and the coefficients are negative and robust to the choice of the specification. Technology, instead, is only significant in the case of the IID measure, where it enters negatively, while political liberties are significantly negative only in the case of the Gini.

There is a significantly potential bias in these results, which depends not only on the assumptions on individual characteristics and time, but also on endogeneity. The literature has often shown that inequality can have consequences on development (we might think for instance about the literature on agriculture in Sub-Saharan Africa, assessing that the large dimension of the rural sector and low incomes associated to it are ties to the potential economic growth of the region (Diao, et al., 2010)). Even human capital can be endogenous in our model, since inequality in the distribution of income can be a source of low human development for the quantiles of the population with lower incomes, and this might affect the overall measure of human capital. Endogeneity issues will be addressed in the third methodology used for our estimations, while in the next we only address the individual country-specific characteristics that may hamper our previous results.

ii. Fixed-effects

Our second approach relies on a fixed-effects specification, where we estimate the relationship between the variables of interest after having removed unobserved country specific effects via a within estimator.

The equation takes the form:

$$\boldsymbol{i_{it}} = \boldsymbol{\alpha_i} + \boldsymbol{X_{it}}\boldsymbol{\beta} + \boldsymbol{u_{it}} \tag{3.7}$$

Where i_{it} is a $(\mathrm{n} * T_i) \times 1$ vector of $\mathrm{n} * T_i$ observations on the chosen dependent variable, $\mathrm{X_{it}}$ is a $(\mathrm{n} * T_i) \times \mathrm{k}$ matrix of $\mathrm{n} * T_i$ observations on k independent explanatory variables (including lags for some of them), β is a $\mathrm{k} \times 1$ vector of unknown regression parameters, and $\mathrm{u_{it}}$ is a $\mathrm{n} * T_i \times 1$ vector of errors, which we assume $\mathrm{iid} \sim \mathrm{N}(0, \sigma^2)$.[44]

[44] Note here that we introduce the dimension T_i (which is multiplied by n to obtain the total number of observations). It denotes the fact that our panel is unbalanced.

Fixed effects - Gini coefficient						
	(1)	(2)	(3)	(4)	(5)	(6)
L.gini5	0.517***	0.528***	0.511***	0.417***	0.414***	0.430***
	(0.086)	(0.088)	(0.088)	(0.089)	(0.091)	(0.090)
gdp_pc5	-0.009	-0.128	-0.482	-0.314	-0.382	-0.381
	(0.228)	(0.214)	(0.354)	(0.404)	(0.434)	(0.414)
gdp_pc5_2	0.001	0.003	0.008	0.004	0.005	0.004
	(0.004)	(0.004)	(0.005)	(0.006)	(0.006)	(0.006)
struct_gr5		-0.282*	-0.306*	-0.349**	-0.332**	-0.333**
		(0.158)	(0.172)	(0.127)	(0.130)	(0.122)
human_cap5			2.922	2.589	2.274	4.058
			(2.937)	(3.305)	(3.472)	(3.831)
paved_roads5				0.005	0.006	0.018
				(0.041)	(0.042)	(0.033)
royalties5					3.467	3.641
					(7.398)	(7.397)
pol_lib5						-2.967
						(2.217)
_cons	18.457***	19.059***	15.739**	18.618***	19.420***	16.265**
	(4.186)	(4.366)	(5.665)	(5.796)	(6.097)	(6.878)
Observations	185	182	182	143	143	143

*Notes: Country clustered robust standard errors in parenthesis. ***, **, * denote 1%, 5% and 10% confidence levels, respectively*

Table 3.15

Fixed effects regression – Dependent variable: Gini coefficient

Fixed effects - Estimated household income inequality						
	(1)	(2)	(3)	(4)	(5)	(6)
L.ehii5	0.703***	0.703***	0.701***	0.619***	0.618***	0.624***
	(0.039)	(0.041)	(0.043)	(0.051)	(0.051)	(0.049)
gdp_pc5	-0.001	-0.000	-0.032	-0.030	-0.044	-0.054
	(0.074)	(0.076)	(0.128)	(0.141)	(0.146)	(0.142)
gdp_pc5_2	0.002	0.002	0.002	0.002	0.002	0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
struct_gr5		0.003	0.003	-0.027	-0.027	-0.025
		(0.112)	(0.111)	(0.083)	(0.084)	(0.084)
human_cap5			0.272	0.667	0.653	1.084
			(1.075)	(1.259)	(1.274)	(1.310)
paved_roads5				0.000	0.002	0.009
				(0.023)	(0.022)	(0.025)
royalties5					0.520	0.800
					(1.062)	(1.245)
pol_lib5						-0.805
						(0.869)
_cons	12.359***	12.364***	12.074***	14.723***	14.759***	13.816***
	(1.828)	(1.864)	(2.061)	(2.905)	(2.926)	(2.860)
Observations	199	199	199	161	161	161

*Notes: Country clustered robust standard errors in parenthesis. ***, **, * denote 1%, 5% and 10% confidence levels, respectively*

Table 3.16

Fixed effects regression – Dependent variable: Estimated household income inequality

Fixed effects - Industrial pay inequality

	(1)	(2)	(3)	(4)	(5)	(6)
L.iid5	0.64989***	0.63982***	0.63393***	0.53714***	0.53411***	0.54222***
	(0.06737)	(0.06421)	(0.06592)	(0.07677)	(0.07736)	(0.07649)
gdp_pc5	0.00012	0.00024	-0.00027	-0.00061	-0.00078	-0.00090
	(0.00067)	(0.00070)	(0.00102)	(0.00136)	(0.00137)	(0.00126)
gdp_pc5_2	0.00000	0.00000	0.00001	0.00001	0.00001	0.00001
	(0.00001)	(0.00001)	(0.00001)	(0.00002)	(0.00002)	(0.00002)
struct_gr5		0.00091	0.00092	0.00051	0.00051	0.00054
		(0.00143)	(0.00142)	(0.00118)	(0.00118)	(0.00118)
human_cap5			0.00451	0.00954	0.00958	0.01377
			(0.00993)	(0.01453)	(0.01460)	(0.01500)
paved_roads5				0.00027	0.00029	0.00033
				(0.00036)	(0.00035)	(0.00037)
royalties5					0.00544	0.00722
					(0.01340)	(0.01340)
pol_lib5						-0.00695
						(0.00761)
_cons	0.01496**	0.01370**	0.00766	-0.01042	-0.01115	-0.01705
	(0.00570)	(0.00594)	(0.01625)	(0.03753)	(0.03707)	(0.03848)
Observations	205	205	205	165	165	165

*Notes: Country clustered robust standard errors in parenthesis. ***, **, * denote 1%, 5% and 10% confidence levels, respectively*

Table 3.17
Fixed effects regression – Dependent variable: Industrial pay inequality

In this model the Kuznets hypothesis is never present, neither in terms of coefficients (mostly negative in GDP per capita, positive in its square) nor in terms of significance, independently of the chosen regressand. Structural change is always significant in the case of the Gini coefficient, where it is negative and robust to the specification chosen. The model predicts it decreases inequality by around 1/3 of a percentage point. It is never significant in the case of the UTIP measures of inequality: in the case of the EHII it has a negative sign in three out of five specifications, in the case of the IID it is always positive. This model yields larger positive coefficients for human capital than before, but they are never significant. Neither of the other controls enters significantly the relationship.

iii. Arellano-Bond Diff-GMM

Our third approach relies on a GMM estimator where the variables are differenced to eliminate fixed effects and we use lags of the level variables to instrument their differenced counterparts in order to take into account potential endogeneity issues.
The equation now takes the form:

$$\Delta \boldsymbol{i}_{it} = \Delta \boldsymbol{i}_{it-1}\boldsymbol{\gamma} + \Delta \boldsymbol{X}_{it}\boldsymbol{\beta} + \Delta \boldsymbol{u}_{it} \quad (3.8)$$

Where $\boldsymbol{i_{it}}$ is a $(\mathrm{n} * T_i)\times 1$ vector of $\mathrm{n} * T_i$ observations on the dependent variable, $\boldsymbol{i}$ is a $[\mathrm{n} * (T_i - 1)] \times 1$ observations on the first lag of the dependent variable, $\boldsymbol{\gamma}$ is a 1×1 vector of unknown regression parameters, $\mathbf{X_{it}}$ is a $(\mathrm{n} * T_i) \times \mathrm{k}$ matrix of $\mathrm{n} * T_i$ observations on k independent explanatory variables, $\boldsymbol{\beta}$ is a $\mathrm{k} \times 1$ vector of unknown regression parameters, and $\mathbf{u_{it}}$ is a $(\mathrm{n} * T_i) \times 1$ vector of errors, which we assume $\mathrm{iid} \sim \mathrm{N}(0, \sigma^2)$. Δ denotes first differencing.

In this specification variables are differenced to remove fixed-effects. We assume infrastructures (paved roads) and technology (royalties) as exogenous, all other covariates as endogenous. We instrument the lagged dependent variable, structural change and human capital with their second lag levels; GDP per capita, its square and political liberties with their first lag level.

Diff-GMM - Gini coefficient

	b/se	b/se	b/se	b/se	b/se	b/se
L.gini5	0.472**	0.373***	0.661***	0.744***	0.705***	0.670***
	(0.191)	(0.132)	(0.099)	(0.214)	(0.214)	(0.222)
gdp_pc5	-0.218	-0.482**	-0.233	-0.802	-1.144	-1.108
	(0.200)	(0.215)	(0.731)	(0.772)	(0.878)	(0.910)
gdp_pc5_2	0.005*	0.010***	0.004	0.012	0.017	0.016
	(0.003)	(0.003)	(0.011)	(0.010)	(0.012)	(0.011)
struct_gr5		-0.447**	-0.475*	-0.571*	-0.622**	-0.506*
		(0.224)	(0.266)	(0.294)	(0.284)	(0.294)
human_cap5			1.589	5.055	5.710	8.490
			(4.618)	(5.808)	(5.745)	(11.919)
paved_roads5				-0.042	-0.055	-0.046
				(0.090)	(0.087)	(0.082)
royalties5					4.619	-4.740
					(9.923)	(14.102)
pol_lib5						-0.226
						(8.127)
Observations	153	151	151	115	115	115
Instruments	33	42	51	31	32	38

*Notes: Windmeijer corrected country clustered robust standard errors in parenthesis. ***, **, * denote 1%, 5% and 10% confidence levels, respectively*

Table 3.18
Diff-GMM regression – Dependent variable: Gini coefficient

Diff-GMM - Estimated household income inequality

	b/se	b/se	b/se	b/se	b/se	b/se
L.ehii5	0.377*	0.386***	0.371***	0.268	0.259	0.194
	(0.227)	(0.115)	(0.118)	(0.205)	(0.197)	(0.268)
gdp_pc5	0.182	0.199	0.094	-0.155	-0.174	-0.211
	(0.224)	(0.218)	(0.322)	(0.241)	(0.241)	(0.334)
gdp_pc5_2	0.001	0.000	0.002	0.005	0.005	0.006
	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)	(0.005)
struct_gr5		0.186*	0.155*	0.137**	0.136***	0.144
		(0.101)	(0.088)	(0.057)	(0.052)	(0.097)
human_cap5			0.590	2.799	2.782	3.398
			(2.056)	(1.971)	(1.833)	(2.358)

paved_roads5				-0.016	-0.014	-0.001
				(0.024)	(0.024)	(0.033)
royalties5					0.833	-0.345
					(1.775)	(3.260)
pol_lib5						-0.264
						(2.017)
Observations	169	169	169	131	131	131
Instruments	24	32	40	31	32	38

*Notes: Windmeijer corrected country clustered robust standard errors in parenthesis. ***, **, * denote 1%, 5% and 10% confidence levels, respectively*

Table 3.19
Diff-GMM regression – Dependent variable: Estimated household income inequality

Diff-GMM - Industrial pay inequality

	b/se	b/se	b/se	b/se	b/se	b/se
L.iid5	0.41096	0.36723	0.50375***	0.36148*	0.35008*	0.26409
	(0.30894)	(0.25887)	(0.13665)	(0.18857)	(0.18596)	(0.24145)
gdp_pc5	0.00131	0.00128	-0.00001	-0.00056	-0.00061	-0.00062
	(0.00132)	(0.00111)	(0.00183)	(0.00197)	(0.00226)	(0.00325)
gdp_pc5_2	-0.00002	-0.00002	-0.00000	0.00000	0.00000	-0.00000
	(0.00002)	(0.00002)	(0.00002)	(0.00003)	(0.00003)	(0.00003)
struct_gr5		0.00081	0.00162	0.00080	0.00040	0.00071
		(0.00149)	(0.00135)	(0.00120)	(0.00091)	(0.00113)
human_cap5			0.01135	0.01961	0.01673	0.02518
			(0.01678)	(0.02015)	(0.02552)	(0.03793)
paved_roads5				0.00024	0.00019	0.00060
				(0.00049)	(0.00060)	(0.00079)
royalties5					0.01606	0.01633
					(0.01922)	(0.01518)
pol_lib5						-0.01291
						(0.01588)
Observations	175	175	175	135	135	135
Instruments	24	32	40	31	32	38

*Notes: Windmeijer corrected country clustered robust standard errors in parenthesis. ***, **, * denote 1%, 5% and 10% confidence levels, respectively*

Table 3.20
Diff-GMM regression – Dependent variable: Industrial pay inequality

Results from the Diff-GMM estimation for the Gini coefficient are coherent with those of the fixed effects regression. We find significant "Kuznets regressors" in the second specification, while the square of GDP per capita is significant in the first one. Coefficients contrast the Kuznets hypothesis and show a U-shaped pattern. The structural change term is always significant, negative and robust, and it is larger (in absolute terms) than in the fixed effects specifications, very close to the pooled ones. The other regressors are instead never significant. The structural change term is also significant in four out of five EHII specifications, but it is robustly positive. No other regressor is significant in the case of the EHII measure of inequality, apart from its lag (in the first three cases). In the case of the IID measure no regressor is significant (apart from its lag in some cases).

Although we have shrinked the T dimension in order to avoid instruments proliferation in the Diff-GMM specification, our reference model generates a number of instruments usually greater than the cross-section. We try to address the problem by performing a new set of estimations where we treat development as exogenous. We report the results in the following tables.

Diff-GMM - Gini coefficient

	b/se	b/se	b/se	b/se	b/se	b/se
L.gini5	-0.091	0.181	0.580***	0.756**	0.644**	0.439*
	(0.520)	(0.205)	(0.202)	(0.328)	(0.311)	(0.254)
gdp_pc5	-0.455	-0.568**	-0.587	-0.823	-0.931	-0.881
	(0.402)	(0.259)	(0.551)	(0.973)	(0.868)	(0.792)
gdp_pc5_2	0.005	0.009*	0.011	0.011	0.012	0.011
	(0.007)	(0.005)	(0.008)	(0.013)	(0.011)	(0.010)
struct_gr5		-0.182	-0.636***	-0.694***	-0.672**	-0.663**
		(0.221)	(0.230)	(0.257)	(0.271)	(0.263)
human_cap5			3.126	6.788	5.393	6.808
			(4.512)	(8.363)	(7.800)	(9.260)
paved_roads5				-0.017	-0.040	-0.064
				(0.077)	(0.070)	(0.070)
royalties5					8.019	8.234
					(5.815)	(8.219)
pol_lib5						-2.948
						(5.017)
Observations	153	151	151	115	115	115
Instruments	13	24	34	21	22	28

*Notes: Windmeijer corrected country clustered robust standard errors in parenthesis. ***, **, * denote 1%, 5% and 10% confidence levels, respectively*

Table 3.21

Diff-GMM regression – Dependent variable: Gini coefficient, development treated as exogenous

Diff-GMM - Estimated household income inequality

	b/se	b/se	b/se	b/se	b/se	b/se
L.ehii5	0.718***	0.646***	0.586***	0.842***	0.809***	0.513
	(0.178)	(0.120)	(0.210)	(0.232)	(0.233)	(0.364)
gdp_pc5	-0.077	0.022	-0.172	-0.143	-0.196	-0.363
	(0.122)	(0.128)	(0.244)	(0.271)	(0.305)	(0.415)
gdp_pc5_2	0.003	0.002	0.006	0.003	0.004	0.007
	(0.002)	(0.003)	(0.005)	(0.005)	(0.006)	(0.009)
struct_gr5		0.151	0.103	0.007	0.012	0.073
		(0.140)	(0.085)	(0.058)	(0.055)	(0.088)
human_cap5			1.525	1.187	1.332	3.949
			(2.021)	(2.248)	(2.163)	(2.981)
paved_roads5				-0.013	-0.006	0.025
				(0.031)	(0.032)	(0.028)
royalties5					1.108	1.363
					(1.793)	(1.176)
pol_lib5						-2.219*
						(1.288)
Observations	169	169	169	131	131	131
Instruments	10	18	26	21	22	28

*Notes: Windmeijer corrected country clustered robust standard errors in parenthesis. ***, **, * denote 1%, 5% and 10% confidence levels, respectively*

Table 3.22
Diff-GMM regression – Dependent variable: Estimated household income inequality, development treated as exogenous

	Diff-GMM - Industrial pay inequality					
	b/se	b/se	b/se	b/se	b/se	b/se
L.iid5	0.44729	0.41740	0.49939*	0.29957	0.27392	0.28028
	(0.46226)	(0.26600)	(0.25839)	(0.33781)	(0.34806)	(0.31078)
gdp_pc5	0.00041	0.00020	-0.00058	-0.00166	-0.00198	-0.00291
	(0.00063)	(0.00061)	(0.00129)	(0.00212)	(0.00226)	(0.00300)
gdp_pc5_2	-0.00000	-0.00000	0.00001	0.00001	0.00002	0.00003
	(0.00001)	(0.00001)	(0.00003)	(0.00004)	(0.00004)	(0.00005)
struct_gr5		0.00080	0.00128	0.00090	0.00077	0.00056
		(0.00067)	(0.00090)	(0.00165)	(0.00148)	(0.00099)
human_cap5			0.01313	0.02672	0.02600	0.03676
			(0.01159)	(0.01769)	(0.01973)	(0.03312)
paved_roads5				0.00002	0.00006	0.00077
				(0.00071)	(0.00056)	(0.00081)
royalties5					0.01298	0.01949
					(0.01471)	(0.01927)
pol_lib5						-0.01889
						(0.01440)
Observations	175	175	175	135	135	135
Instruments	10	18	26	21	22	28

*Notes: Windmeijer corrected country clustered robust standard errors in parenthesis. ***, **, * denote 1%, 5% and 10% confidence levels, respectively*

Table 3.23
Diff-GMM regression – Dependent variable: Industrial pay inequality, development treated as exogenous

Results when treating development as an exogenous process relative to inequality don't change too much from the previous Diff-GMM specification in terms of significance and signs of the coefficients. When the Gini coefficient is chosen as dependent variable we find the same results as before in terms of signs and significance of the coefficients (except for structural change which is not significant in the second specification). The magnitude of the coefficients for structural change is instead larger (in absolute terms) than before, but robust in all cases where it is significant. When we turn to the UTIP measures of inequality, we find that neither the "Kuznets regressors" and structural change nor the other controls are significant.

3.6. Advanced and emerging countries

In this section we also explore the possibility that heterogeneity in the composition of our sample of countries may affect the results of our estimations, in particular significance levels. We then repeat our regressions by considering emerging and advanced economies separately. We rely on the classification of advanced and emerging economies as provided by the IMF in the World Development Report of April 2017. According to the cited WEO, of the countries in our sample, Sub-Saharan African countries, Latin American countries, China, India and Indonesia are emerging economies, while the European countries, the USA, Japan and the Republic of Korea are advanced economies. We provide the results for the pooled, fixed effects and Diff-GMM regressions for the two saparate panels.

Emerging economies

Pooled regressions

Pooled OLS - Gini coefficient

	b/se	b/se	b/se	b/se	b/se	b/se
L.gini5	0.697***	0.727***	0.728***	0.636***	0.621***	0.635***
	(0.052)	(0.050)	(0.050)	(0.078)	(0.077)	(0.079)
gdp_pc5	2.371***	2.039***	1.974***	2.166***	2.213***	2.085***
	(0.463)	(0.442)	(0.478)	(0.646)	(0.637)	(0.657)
gdp_pc5_2	-0.168***	-0.146***	-0.145***	-0.164***	-0.169***	-0.159***
	(0.040)	(0.038)	(0.038)	(0.055)	(0.054)	(0.055)
struct_gr5		-0.431**	-0.438**	-0.462**	-0.548***	-0.554***
		(0.174)	(0.176)	(0.193)	(0.196)	(0.197)
human_cap5			0.488	0.561	1.797	2.182
			(1.309)	(1.652)	(1.776)	(1.840)
paved_roads5				-0.057*	-0.059*	-0.061**
				(0.031)	(0.030)	(0.030)
royalties5					-8.900*	-9.476*
					(5.123)	(5.182)
pol_lib5						-1.589
						(1.915)
_cons	8.373***	8.099***	7.334**	13.082***	12.529***	12.600***
	(2.041)	(1.958)	(2.840)	(4.639)	(4.582)	(4.593)
Observations	99	96	96	74	74	74

*Notes: Standard errors in parenthesis. ***, **, * denote 1%, 5% and 10% confidence levels, respectively*

Table 3.24
Pooled regression – Dependent variable: Gini coefficient (emerging economies)

Pooled OLS - Estimated household income inequality

	b/se	b/se	b/se	b/se	b/se	b/se
L.ehii5	0.853***	0.852***	0.854***	0.799***	0.808***	0.805***
	(0.046)	(0.046)	(0.047)	(0.052)	(0.052)	(0.055)
gdp_pc5	-0.402*	-0.413*	-0.382	-0.182	-0.149	-0.162
	(0.211)	(0.212)	(0.288)	(0.294)	(0.292)	(0.302)
gdp_pc5_2	0.038*	0.039*	0.037	0.012	0.007	0.008
	(0.022)	(0.022)	(0.024)	(0.024)	(0.024)	(0.025)
struct_gr5		-0.054	-0.055	-0.100	-0.085	-0.086
		(0.069)	(0.070)	(0.073)	(0.073)	(0.073)
human_cap5			-0.121	0.110	0.460	0.468
			(0.767)	(0.808)	(0.824)	(0.830)
paved_roads5				-0.032***	-0.035***	-0.036***
				(0.009)	(0.009)	(0.010)
royalties5					-2.310*	-2.257
					(1.329)	(1.365)
pol_lib5						0.136
						(0.710)
_cons	7.736***	7.869***	7.954***	11.111***	10.448***	10.546***
	(2.273)	(2.284)	(2.356)	(2.640)	(2.638)	(2.701)
Observations	116	116	116	95	95	95

*Notes: Standard errors in parenthesis. ***, **, * denote 1%, 5% and 10% confidence levels, respectively*

Table 3.25
Pooled regression – Dependent variable: Estimated household income inequality (emerging economies)

Pooled OLS - Industrial pay inequality

	b/se	b/se	b/se	b/se	b/se	b/se
L.iid5	0.82121***	0.82124***	0.80607***	0.83445***	0.84033***	0.83359***
	(0.06430)	(0.06455)	(0.06725)	(0.07505)	(0.07405)	(0.07651)
gdp_pc5	-0.00019	-0.00016	-0.00176	0.00023	0.00043	0.00024
	(0.00208)	(0.00209)	(0.00287)	(0.00321)	(0.00317)	(0.00323)
gdp_pc5_2	0.00002	0.00002	0.00010	-0.00009	-0.00014	-0.00013
	(0.00023)	(0.00023)	(0.00025)	(0.00027)	(0.00027)	(0.00027)
struct_gr5		0.00021	0.00029	-0.00002	0.00016	0.00014
		(0.00072)	(0.00073)	(0.00082)	(0.00081)	(0.00082)
human_cap5			0.00641	0.00642	0.01134	0.01123
			(0.00784)	(0.00881)	(0.00906)	(0.00911)
paved_roads5				-0.00013	-0.00018*	-0.00019*
				(0.00009)	(0.00009)	(0.00010)
royalties5					-0.02854*	-0.02765*
					(0.01490)	(0.01516)
pol_lib5						0.00285
						(0.00756)
_cons	0.01391***	0.01358***	0.00648	0.00684	0.00313	0.00256

	(0.00489)	(0.00504)	(0.01004)	(0.01178)	(0.01177)	(0.01192)
Observations	122	122	122	99	99	99

*Notes: Standard errors in parenthesis. ***, **, * denote 1%, 5% and 10% confidence levels, respectively*

Table 3.26
Pooled regression – Dependent variable: Industrial pay inequality (emerging economies)

We find the results of the pooled regressions for the emerging economies compatible with the full-sample regressions of the previous section. The most relevant diverging result is the one obtained when setting the Gini coefficient as regressand. Here we find evidence of an inverted-U shaped relationship between development and inequality, given a positive and significant sign for GDP per capita and a negative and significant sign for the square of GDP per capita.

Fixed effects regressions

Fixed effects - Gini coefficient

	b/se	b/se	b/se	b/se	b/se	b/se
L.gini5	0.277**	0.323***	0.316***	0.264*	0.247*	0.216
	(0.104)	(0.093)	(0.096)	(0.132)	(0.132)	(0.131)
gdp_pc5	4.030***	3.452***	3.841***	3.279***	3.092**	3.299**
	(0.688)	(0.672)	(0.845)	(0.952)	(1.157)	(1.324)
gdp_pc5_2	-0.262***	-0.230***	-0.243***	-0.217***	-0.226***	-0.239***
	(0.043)	(0.043)	(0.042)	(0.055)	(0.068)	(0.079)
struct_gr5		-0.268**	-0.256*	-0.355***	-0.299**	-0.308**
		(0.123)	(0.124)	(0.112)	(0.128)	(0.134)
human_cap5			-1.417	-0.749	-1.502	-3.286
			(3.011)	(3.377)	(4.051)	(5.024)
paved_roads5				-0.105	-0.086	-0.137
				(0.132)	(0.152)	(0.166)
royalties5					12.691	12.849
					(13.070)	(13.082)
pol_lib5						2.443
						(2.776)
_cons	22.944***	22.585***	24.487***	30.832***	31.745***	36.296***
	(3.199)	(3.234)	(5.367)	(9.727)	(9.172)	(10.345)
Observations	99	96	96	74	74	74

*Notes: Country clustered robust standard errors in parenthesis. ***, **, * denote 1%, 5% and 10% confidence levels, respectively*

Table 3.27
Fixed effects regression – Dependent variable: Gini coefficient (emerging economies)

Fixed effects - Estimated household income inequality

	b/se	b/se	b/se	b/se	b/se	b/se
L.ehii5	0.638***	0.636***	0.619***	0.576***	0.576***	0.588***
	(0.053)	(0.054)	(0.063)	(0.052)	(0.052)	(0.053)
gdp_pc5	-0.831	-0.829	-1.283**	-0.665	-0.664	-0.802*

	(0.487)	(0.490)	(0.542)	(0.456)	(0.455)	(0.459)
gdp_pc5_2	0.070*	0.070	0.089**	0.040	0.041	0.050
	(0.040)	(0.040)	(0.040)	(0.032)	(0.033)	(0.033)
struct_gr5		0.018	0.021	-0.008	-0.007	-0.003
		(0.123)	(0.115)	(0.086)	(0.087)	(0.086)
human_cap5			1.640	1.490	1.492	2.101
			(1.216)	(1.516)	(1.534)	(1.600)
paved_roads5				-0.023	-0.024	-0.016
				(0.036)	(0.036)	(0.042)
royalties5					-0.069	0.315
					(1.873)	(2.112)
pol_lib5						-0.887
						(0.861)
_cons	18.537***	18.605***	17.525***	19.583***	19.587***	18.404***
	(2.943)	(2.958)	(3.045)	(2.855)	(2.877)	(3.315)
Observations	116	116	116	95	95	95

*Notes: Country clustered robust standard errors in parenthesis. ***, **, * denote 1%, 5% and 10% confidence levels, respectively*

Table 3.28
Fixed effects regression – Dependent variable: Estimated household income inequality (emerging economies)

Fixed effects - Industrial pay inequality

	b/se	b/se	b/se	b/se	b/se	b/se
L.iid5	0.62848***	0.61745***	0.60079***	0.49342***	0.48742***	0.49754***
	(0.07877)	(0.07218)	(0.07763)	(0.07952)	(0.08048)	(0.07959)
gdp_pc5	-0.00546	-0.00533	-0.00963	-0.00803	-0.00830	-0.01030
	(0.00485)	(0.00487)	(0.00556)	(0.00684)	(0.00687)	(0.00690)
gdp_pc5_2	0.00048	0.00048	0.00067*	0.00046	0.00045	0.00059
	(0.00034)	(0.00034)	(0.00035)	(0.00044)	(0.00045)	(0.00046)
struct_gr5		0.00094	0.00099	0.00059	0.00056	0.00065
		(0.00150)	(0.00144)	(0.00117)	(0.00118)	(0.00116)
human_cap5			0.01585	0.02014	0.02029	0.02881
			(0.01230)	(0.01715)	(0.01721)	(0.01693)
paved_roads5				0.00027	0.00033	0.00037
				(0.00062)	(0.00061)	(0.00063)
royalties5					0.01135	0.01463
					(0.02208)	(0.02157)
pol_lib5						-0.01064
						(0.00852)
_cons	0.03249***	0.03157***	0.01412	0.00348	0.00094	-0.00689
	(0.01044)	(0.01039)	(0.01741)	(0.03677)	(0.03641)	(0.03570)
Observations	122	122	122	99	99	99

*Notes: Country clustered robust standard errors in parenthesis. ***, **, * denote 1%, 5% and 10% confidence levels, respectively*

Table 3.29
Fixed effects regression – Dependent variable: Industrial pay inequality (emerging economies)

Even the fixed-effects specifications return results that are similar to those of the previous section. Here again, however, there are significant traces in all the specifications of the Gini coefficient of the presence of a Kuznets relationship between development and inequality.

Diff-GMM regressions

Diff-GMM - Gini coefficient

	b/se	b/se	b/se	b/se	b/se	b/se
L.gini5	0.333*	0.382**	0.328	0.338	0.230	0.192
	(0.180)	(0.195)	(0.252)	(0.351)	(0.317)	(0.340)
gdp_pc5	2.643*	1.617	1.870	1.124	3.891	1.218
	(1.373)	(1.605)	(2.063)	(3.339)	(6.129)	(4.377)
gdp_pc5_2	-0.191**	-0.148	-0.196**	-0.152	-0.238	-0.114
	(0.081)	(0.091)	(0.099)	(0.172)	(0.255)	(0.238)
struct_gr5		-0.450**	-0.459**	-0.491*	-0.339	-0.399
		(0.187)	(0.215)	(0.263)	(0.347)	(0.323)
human_cap5			3.148	4.027	-4.837	-0.545
			(5.173)	(8.357)	(16.545)	(18.091)
paved_roads5				-0.187	-0.187	-0.315
				(0.264)	(0.341)	(0.273)
royalties5					12.833	10.853
					(21.723)	(20.497)
pol_lib5						1.064
						(9.965)
Observations	77	75	75	56	56	56
Instruments	31	38	46	31	32	37

*Notes: Windmeijer corrected country clustered robust standard errors in parenthesis. ***, **, * denote 1%, 5% and 10% confidence levels, respectively*

Table 3.30
Diff-GMM regression – Dependent variable: Gini coefficient (emerging economies)

Diff-GMM - Estimated household income inequality

	b/se	b/se	b/se	b/se	b/se	b/se
L.ehii5	0.493**	0.639***	0.340	0.133	0.147	-0.150
	(0.225)	(0.065)	(0.362)	(0.579)	(0.482)	(0.626)
gdp_pc5	-0.812	-0.737	-2.297	-2.699	-2.717	-3.506
	(0.874)	(0.985)	(1.890)	(3.143)	(3.348)	(3.170)
gdp_pc5_2	0.077	0.073	0.151	0.175	0.172	0.226
	(0.075)	(0.078)	(0.109)	(0.200)	(0.199)	(0.180)
struct_gr5		0.147	0.107	0.202	0.193	0.245*
		(0.131)	(0.175)	(0.150)	(0.143)	(0.135)
human_cap5			3.376	4.698	4.613	7.514
			(2.989)	(4.869)	(5.051)	(6.046)
paved_roads5				0.009	0.017	0.019
				(0.058)	(0.092)	(0.052)

royalties5					0.411	1.814
					(5.188)	(3.266)
pol_lib5						-1.036
						(2.575)
Observations	96	96	96	75	75	75
Instruments	24	32	40	31	32	38

*Notes: Windmeijer corrected country clustered robust standard errors in parenthesis. ***, **, * denote 1%, 5% and 10% confidence levels, respectively*

Table 3.31
Diff-GMM regression – Dependent variable: Estimated household income inequality (emerging economies)

Diff-GMM - Industrial pay inequality

	b/se	b/se	b/se	b/se	b/se	b/se
L.iid5	0.47273	0.37514	0.41325**	-0.08344	-0.08715	-0.08995
	(0.29727)	(0.26756)	(0.17989)	(0.30718)	(0.40532)	(0.27811)
gdp_pc5	0.00100	0.00072	-0.01346	-0.04078	-0.04140	-0.02276*
	(0.01088)	(0.00963)	(0.01635)	(0.02870)	(0.02900)	(0.01248)
gdp_pc5_2	0.00014	0.00028	0.00077	0.00223	0.00227	0.00132
	(0.00076)	(0.00080)	(0.00089)	(0.00154)	(0.00150)	(0.00084)
struct_gr5		0.00113	0.00093	0.00164*	0.00143*	0.00102*
		(0.00135)	(0.00093)	(0.00087)	(0.00075)	(0.00053)
human_cap5			0.03512	0.08596	0.08219	0.07830**
			(0.03722)	(0.05852)	(0.06085)	(0.03372)
paved_roads5				0.00101	0.00124	0.00165**
				(0.00105)	(0.00120)	(0.00082)
royalties5					0.02730	0.03921
					(0.06555)	(0.03768)
pol_lib5						-0.03041**
						(0.01508)
Observations	102	102	102	79	79	79
Instruments	24	32	40	31	32	38

*Notes: Windmeijer corrected country clustered robust standard errors in parenthesis. ***, **, * denote 1%, 5% and 10% confidence levels, respectively*

Table 3.32
Diff-GMM regression – Dependent variable: Industrial pay inequality (emerging economies)

The Diff-GMM specifications as well testimony of the presence of the Kuznets relationship when the Gini coefficient is chosen as regressand. Here, however, significance is weaker and episodic. We find weak significance for the structural change term with a positive sign. In the final (full) GMM specification also our proxies for human capital, infrastructural endowment and political liberties are significant. Only the latest variable has a negative impact on inequality (that is: political liberties are negatively associated with income inequality).

Advanced economies

Pooled regressions

Pooled OLS - Gini coefficient

	b/se	b/se	b/se	b/se	b/se	b/se
L.gini5	0.772***	0.770***	0.780***	0.756***	0.744***	0.742***
	(0.063)	(0.064)	(0.068)	(0.091)	(0.096)	(0.097)
gdp_pc5	-0.176	-0.153	-0.209	-0.185	-0.209	-0.229
	(0.159)	(0.195)	(0.226)	(0.322)	(0.330)	(0.346)
gdp_pc5_2	0.006*	0.005	0.006	0.006	0.006	0.006
	(0.003)	(0.004)	(0.004)	(0.006)	(0.006)	(0.006)
struct_gr5		0.138	0.052	0.765	0.735	0.918
		(0.682)	(0.707)	(0.998)	(1.008)	(1.349)
human_cap5			0.755	1.605	1.870	1.877
			(1.528)	(1.611)	(1.764)	(1.778)
paved_roads5				0.023	0.023	0.024
				(0.030)	(0.030)	(0.031)
royalties5					-0.922	-0.785
					(2.410)	(2.519)
pol_lib5						1.272
						(6.166)
_cons	8.008**	7.772**	6.146	2.114	2.311	1.261
	(3.214)	(3.438)	(4.773)	(7.339)	(7.408)	(9.038)
Observations	86	86	86	69	69	69

*Notes: Standard errors in parenthesis. ***, **, * denote 1%, 5% and 10% confidence levels, respectively*

Table 3.33
Pooled regression – Dependent variable: Gini coefficient (advanced economies)

Pooled OLS - Estimated household income inequality

	b/se	b/se	b/se	b/se	b/se	b/se
L.ehii5	0.937***	0.946***	0.968***	0.957***	0.967***	0.977***
	(0.029)	(0.030)	(0.032)	(0.042)	(0.045)	(0.047)
gdp_pc5	0.111**	0.054	-0.008	0.008	-0.010	-0.042
	(0.052)	(0.064)	(0.073)	(0.110)	(0.114)	(0.122)
gdp_pc5_2	-0.001	-0.000	0.000	-0.001	-0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
struct_gr5		-0.334	-0.429*	-0.609	-0.672*	-0.473
		(0.223)	(0.228)	(0.382)	(0.397)	(0.485)
human_cap5			0.848*	0.954	1.190*	1.288*
			(0.506)	(0.592)	(0.703)	(0.718)
paved_roads5				-0.012	-0.012	-0.010
				(0.013)	(0.013)	(0.014)
royalties5					-0.519	-0.408
					(0.822)	(0.840)
pol_lib5						1.583

						(2.193)
_cons	0.910	1.363	-0.850	0.284	-0.320	-2.225
	(1.351)	(1.375)	(1.895)	(2.890)	(3.059)	(4.049)
Observations	83	83	83	66	66	66

*Notes: Standard errors in parenthesis. ***, **, * denote 1%, 5% and 10% confidence levels, respectively*

Table 3.34
Pooled regression – Dependent variable: Estimated household income inequality (advanced economies)

Pooled OLS - Industrial pay inequality

	b/se	b/se	b/se	b/se	b/se	b/se
L.iid5	1.01409***	1.01062***	1.02015***	1.00568***	1.00685***	1.00096***
	(0.04312)	(0.04569)	(0.04688)	(0.05074)	(0.05105)	(0.05309)
gdp_pc5	0.00034	0.00038	0.00020	0.00106**	0.00102*	0.00110**
	(0.00023)	(0.00030)	(0.00035)	(0.00050)	(0.00051)	(0.00054)
gdp_pc5_2	-0.00000	-0.00001	-0.00000	-0.00002**	-0.00002**	-0.00002**
	(0.00000)	(0.00001)	(0.00001)	(0.00001)	(0.00001)	(0.00001)
struct_gr5		0.00026	0.00004	0.00102	0.00091	0.00032
		(0.00109)	(0.00112)	(0.00169)	(0.00171)	(0.00217)
human_cap5			0.00211	0.00282	0.00354	0.00341
			(0.00228)	(0.00250)	(0.00278)	(0.00282)
paved_roads5				-0.00004	-0.00004	-0.00005
				(0.00006)	(0.00006)	(0.00006)
royalties5					-0.00208	-0.00255
					(0.00347)	(0.00365)
pol_lib5						-0.00440
						(0.00988)
_cons	-0.00447	-0.00502	-0.00857	-0.01718	-0.01798	-0.01369
	(0.00282)	(0.00364)	(0.00529)	(0.01083)	(0.01097)	(0.01467)
Observations	83	83	83	66	66	66

*Notes: Standard errors in parenthesis. ***, **, * denote 1%, 5% and 10% confidence levels, respectively*

Table 3.35
Pooled regression – Dependent variable: Industrial pay inequality (advanced economies)

When considering advanced economies we find hardly any result when the Gini coefficient is chosen as regressand in the pooled specification. In the case of the EHII we find a weakly negative relationship between structural change and inequality and a weakly postive one between human capital and inequality, while in the case of the IID we only find traces of a Kuznets relationship in the latest three specifications.

Fixed effects regressions

Fixed effects - Gini coefficient

	b/se	b/se	b/se	b/se	b/se	b/se
L.gini5	0.582***	0.588***	0.564***	0.433**	0.432**	0.435**
	(0.109)	(0.110)	(0.109)	(0.136)	(0.136)	(0.137)
gdp_pc5	-0.166	-0.202	-0.849*	-0.723	-0.731	-0.686
	(0.155)	(0.189)	(0.397)	(1.012)	(0.996)	(1.024)
gdp_pc5_2	0.004*	0.005	0.012**	0.009	0.010	0.008
	(0.002)	(0.003)	(0.004)	(0.012)	(0.012)	(0.012)
struct_gr5		-0.312	-0.379	1.289	1.242	0.860
		(0.566)	(0.455)	(1.170)	(1.027)	(1.262)
human_cap5			6.668	9.649	9.862	9.843
			(3.748)	(8.141)	(7.747)	(7.945)
paved_roads5				0.030	0.028	0.031
				(0.059)	(0.056)	(0.059)
royalties5					-0.775	-0.680
					(5.538)	(5.594)
pol_lib5						-2.743
						(5.020)
_cons	14.823**	15.203**	6.228	-2.599	-2.760	-0.925
	(5.057)	(5.256)	(6.960)	(9.198)	(9.274)	(10.832)
Observations	86	86	86	69	69	69

*Notes: Country clustered robust standard errors in parenthesis. ***, **, * denote 1%, 5% and 10% confidence levels, respectively*

Table 3.36
Fixed effects regression – Dependent variable: Gini coefficient (advanced economies)

Fixed effects - Estimated household income inequality

	b/se	b/se	b/se	b/se	b/se	b/se
L.ehii5	0.831***	0.846***	0.845***	0.730***	0.726***	0.701***
	(0.049)	(0.050)	(0.050)	(0.048)	(0.058)	(0.050)
gdp_pc5	0.070	0.020	0.048	-0.137	-0.139	-0.126
	(0.062)	(0.093)	(0.273)	(0.250)	(0.249)	(0.267)
gdp_pc5_2	0.000	0.001	0.000	0.002	0.002	0.001
	(0.001)	(0.001)	(0.003)	(0.003)	(0.003)	(0.003)
struct_gr5		-0.408	-0.404	-0.330	-0.301	-0.424
		(0.277)	(0.273)	(0.295)	(0.342)	(0.434)
human_cap5			-0.296	2.311	2.258	2.426
			(2.502)	(2.245)	(2.250)	(2.445)
paved_roads5				0.030	0.031	0.036
				(0.028)	(0.028)	(0.029)
royalties5					0.398	0.538
					(1.446)	(1.208)
pol_lib5						-1.349
						(2.681)
_cons	4.790*	5.110**	5.592	2.417	2.573	3.716
	(2.195)	(2.257)	(3.822)	(3.702)	(3.853)	(4.476)

Observations	83	83	83	66	66	66

*Notes: Country clustered robust standard errors in parenthesis. ***, **, * denote 1%, 5% and 10% confidence levels, respectively*

Table 3.37
Fixed effects regression – Dependent variable: Estimated household income inequality (advanced economies)

Fixed effects - Industrial pay inequality

	b/se	b/se	b/se	b/se	b/se	b/se
L.iid5	0.87962***	0.88313***	0.86653***	0.78096***	0.78533***	0.73909***
	(0.08506)	(0.07516)	(0.07740)	(0.10624)	(0.11669)	(0.12530)
gdp_pc5	0.00036	0.00032	0.00210	0.00190	0.00191	0.00203
	(0.00050)	(0.00067)	(0.00143)	(0.00151)	(0.00153)	(0.00154)
gdp_pc5_2	-0.00000	-0.00000	-0.00002	-0.00003	-0.00003	-0.00003*
	(0.00001)	(0.00001)	(0.00002)	(0.00002)	(0.00002)	(0.00002)
struct_gr5		-0.00034	-0.00008	0.00164	0.00150	-0.00006
		(0.00142)	(0.00104)	(0.00169)	(0.00154)	(0.00130)
human_cap5			-0.01867	-0.00798	-0.00760	-0.00628
			(0.01252)	(0.01375)	(0.01284)	(0.01253)
paved_roads5				0.00019	0.00018	0.00024
				(0.00016)	(0.00016)	(0.00018)
royalties5					-0.00246	-0.00132
					(0.00658)	(0.00641)
pol_lib5						-0.01354**
						(0.00505)
_cons	-0.00323	-0.00260	0.02550	-0.01582	-0.01598	-0.01240
	(0.00748)	(0.00995)	(0.01579)	(0.02159)	(0.02101)	(0.02105)
Observations	83	83	83	66	66	66

*Notes: Country clustered robust standard errors in parenthesis. ***, **, * denote 1%, 5% and 10% confidence levels, respectively*

Table 3.38
Fixed effects regression – Dependent variable: Industrial pay inequality (advanced economies)

In the fixed-effects specifications we find no relevant result. the most interesting one is a negative association between political liberties and inequality in the final specification of the IID regressand.

Diff-GMM regressions

Diff-GMM - Gini coefficient

	b/se	b/se	b/se	b/se	b/se	b/se
L.gini5	0.199	0.209	0.254	0.303	-0.871	-1.498
	(0.178)	(0.193)	(0.307)	(0.339)	(0.748)	(2.398)
gdp_pc5	-0.966	-1.031	-0.773	1.648	0.096	-0.514

	(0.698)	(0.782)	(1.999)	(1.601)	(1.258)	(2.928)
gdp_pc5_2	0.019	0.020	0.016	-0.017	0.006	0.007
	(0.013)	(0.015)	(0.030)	(0.020)	(0.016)	(0.015)
struct_gr5		-0.310	0.113	2.814	2.232	0.776
		(1.126)	(1.572)	(2.604)	(2.513)	(6.060)
human_cap5			-1.076	-14.010	-3.815	7.486
			(10.257)	(13.819)	(12.705)	(55.848)
paved_roads5				0.208	0.896**	0.930***
				(0.289)	(0.383)	(0.187)
royalties5					-28.196	-24.933
					(21.945)	(22.078)
pol_lib5						-26.799
						(113.616)
Observations	76	76	76	59	59	59
Instruments	28	36	44	31	32	38

*Notes: Windmeijer corrected country clustered robust standard errors in parenthesis. ***, **, * denote 1%, 5% and 10% confidence levels, respectively*

Table 3.39
Diff-GMM regression – Dependent variable: Gini coefficient (advanced economies)

Diff-GMM - Estimated household income inequality

	b/se	b/se	b/se	b/se	b/se	b/se
L.ehii5	0.817***	0.622	0.190	0.558	0.532	0.124
	(0.301)	(0.485)	(0.602)	(0.567)	(0.562)	(0.850)
gdp_pc5	0.079	-0.029	-0.963	-0.333	-0.282	0.651
	(0.273)	(0.226)	(0.988)	(0.536)	(0.589)	(1.590)
gdp_pc5_2	0.000	0.003	0.014	0.004	0.004	-0.010
	(0.005)	(0.005)	(0.013)	(.)	(.)	(0.020)
struct_gr5		-0.529	-1.224	-1.218	-1.183	0.584
		(0.865)	(1.152)	(2.603)	(2.442)	(3.324)
human_cap5			8.906	1.967	1.133	5.270
			(8.965)	(.)	(6.899)	(4.963)
paved_roads5				0.317	0.317	0.309**
				(.)	(0.223)	(0.135)
royalties5					0.786	-3.234
					(5.978)	(.)
pol_lib5						-12.270
						(.)
Observations	73	73	73	56	56	56
Instruments	24	32	40	31	32	38

*Notes: Windmeijer corrected country clustered robust standard errors in parenthesis. ***, **, * denote 1%, 5% and 10% confidence levels, respectively*

Table 3.40
Diff-GMM regression – Dependent variable: Estimated household income inequality (advanced economies)

Diff-GMM - Industrial pay inequality

	b/se	b/se	b/se	b/se	b/se	b/se
L.iid5	0.68245***	0.60054***	0.64499***	0.21805	0.40151***	0.62941**
	(0.25238)	(0.22123)	(0.24870)	(0.80111)	(0.11711)	(0.28627)
gdp_pc5	0.00034	0.00024	0.00020	0.00033	-0.00011	-0.00153
	(0.00063)	(0.00073)	(0.00106)	(0.00129)	(0.00197)	(0.00259)
gdp_pc5_2	-0.00000	0.00000	-0.00000	-0.00001	-0.00000	0.00002
	(0.00002)	(0.00002)	(0.00001)	(0.00001)	(0.00002)	(0.00004)
struct_gr5		-0.00029	-0.00055	-0.00090	0.00023	-0.00215
		(0.00133)	(0.00111)	(0.00185)	(0.00377)	(0.00149)
human_cap5			0.00192	0.00667	0.00351	-0.00257
			(0.01237)	(0.01441)	(0.01730)	(0.01454)
paved_roads5				0.00007	0.00021	0.00020
				(0.00017)	(0.00025)	(0.00024)
royalties5					0.02145**	0.04570
					(0.00868)	(0.05208)
pol_lib5						0.03137
						(0.04485)
Observations	73	73	73	56	56	56
Instruments	24	32	40	31	32	38

*Notes: Windmeijer corrected country clustered robust standard errors in parenthesis. ***, **, * denote 1%, 5% and 10% confidence levels, respectively*

Table 3.41
Diff-GMM regression – Dependent variable: Industrial pay inequality (advanced economies)

Even the Diff-GMM specification does not return any relevant result, apart from a few cases of positive association between infrastructures and inequality when the Gini coefficient and the EHII are chosen as regressands. Finally, one specification of the IID regressand returns a positive association between technological endowment and inequality.

Splitting our panel in order to take into account the different composition of the sample of countries for which we have data has not provided new or very relevant insights. The most interesting one is perhaps the strong presence of a Kuznets relationship in the pooled and fixed-effects regressions of the Gini coefficient on our explanatories in the case of the emerging economies. Generally, the results of the emerging economies are more consistent with those obtained in the full sample regressions. In particular, structural change is almost never significant when advanced economies are considered and we seldon find significant traces of a Kuznets relationship, and this is consistent with the idea that advanced countries have achieved levels of development that have placed them from decades in a different phase of the relationship of interest.

3.7. Conclusions

In this chapter we have studied the relationship between the structural change component in the decomposition of average labour productivity growth and various measures of inequality available in the literature. We have also checked, by looking at the data and by estimating the parameters of interest, the presence of an inverted-U shaped curve in the relationship between development and inequality. This pattern should be relevant in the case of countries that have undergone the classical process of development characterized by the changing in the structure of the economy from agriculture to industry. This process has not yet happened in Sub-Saharan Africa, and there are signs that it may not happen in the future. African countries are undergoing a structural transformation in favour of the services sector, and little reallocation is headed towards the manufactures, while other important sectors for the continent growth process, namely mining, absorbe very little of the workforce flowing out of agriculture. Agriculture in itself is still the biggest sector of the economy in most countries in the region. It is hard to find signs of a process like the one described by Kuznets in this continent, if we think that inequality is already high in the less developed African countries and that intersectoral productivities are very relevant (as showed in Chapter 2) and shape the distribution of income in favour of the urban population, while the majority of people live in rural areas. Besides, the sample composition in our study also include advanced countries and newly industrialised Asian ones. In the first ones the services become increasingly relevant over industry. The new services sectors are heavily dependent on technological progress, which also increasingly shapes the industrial production processes nowadays. If the relationship between inequality and development were influenced by the technological development of a society, by favouring frms and workforce able to take advantage of it, we might report increasing inequality in this subsample of countries. Maybe Latin American countries are those more proximately placed in a position of rising inequality due to structural transformation, but they are a little subsample here. All these reasons may signal a differently-shaped relationship between development and inequality than the one suggested by Kuznets. And in fact our estimations suggest that, after a period of decreasing inequality, we are facing a new phase of rising inequality, although there is weak sign of this in our dynamic panel data regressions. As for structural change, in the majority of the cases our regressions suggest that the process of structural transformation is helping level-out income distribution. The process is more relevant in underdeveloped and newly developed countries, while it is extremely small in already developed ones. Hence it is shaping a more equal economic structure, although with different characteristics than in the past, considered the poor industrial development of the majority of the developing countries in our sample. Pushing towards structural transformation is imperative for states that want to build more equal societies. It is interesting noting that our measure for human capital gives extremely small signs of affecting inequality: it enters the relationship significantly only in a couple of pooled specifications. Perhaps it would be useful to study the ways in which education interacts with the different quantiles in income distribution, but this poses the problem of consistent time series data that are difficult to obtain especially for African countries. Infrastructures and technology seem to be weak controls in the relationship of interest wether it be an actual characteristic or a poor choice of their proxies. We would've expected a stronger influence of political liberties on inequality. It is reasonable to assume that in a more equal legal and political context it is easier to contrast the issue of inequality in income distribution, giving weaker social classes more instruments to affect political and economic choices. It will be useful to try proxying the phaenomenon of interest by means of different variables, even considering that the one we've actually chosen is affected by little variation in the data when we look at some countries in the most recent years, although the problem is mitigated by taking 5-year averages.

The poor results obtained in the regressions of the IID measure point out that structural change is weakly linked to industrial pay dispersion. Structural change in Sub-Saharan African countries has only weakly affected the industrial sector, while developed countries hardly experience a relevant structural change process. Perhaps the information included in the Latin American and Asian sub-sample is not enough to provide the evidence we look for.

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Appendix A1 – Sources for trade and Accommodation sectoral value added shares

The contribution of Wholesale and retail trade (letter G in the International Standard Industry Classification, ISIC, rev. 3.1) and Hotels and restaurants (letter H in the ISIC rev. 3.1) to the overall economy value added has been retrieved from heterogeneous sources. Table A1 presents these sources in some detail, providing web-links and dates when the data have been accessed.

Country	**Source**	**Link to dataset**	**Date accessed**
Argentina	ARKLEMS Project	https://arklemsenglish.wordpress.com/gdp/	2017-08-21
Brazil	OECD (2017), Value added by activity (indicator). doi: 10.1787/a8b2bd2b-en	https://data.oecd.org/natincome/value-added-by-activity.htm#indicator-chart	2017-08-17
Chile	OECD (2017), Value added by activity (indicator). doi: 10.1787/a8b2bd2b-en	https://data.oecd.org/natincome/value-added-by-activity.htm#indicator-chart	2017-08-17
China	National data - National Bureau of Statistics of China (NBS)	http://data.stats.gov.cn/english/easyquery.htm?cn=C01	2017-08-22
Denmark	OECD (2017), Value added by activity (indicator). doi: 10.1787/a8b2bd2b-en	https://data.oecd.org/natincome/value-added-by-activity.htm#indicator-chart	2017-08-17
France	EU KLEMS Project	http://www.euklems.net/index.html	2017-07-29
India	Reserve Bank of India - India KLEMS Database	http://rbidocs.rbi.org.in/rdocs/content/docs/KLEMS09122016.xls	2017-08-22
Indonesia	BPS - Statistics Indonesia	https://bps.go.id/Subjek/view/id/11#subjekViewTab3|accordion-daftar-subjek1 (No 8)	2017-08-22
Italy	EU KLEMS Project	http://www.euklems.net/index.html	2017-07-29
Japan	OECD (2017), Value added by activity (indicator). doi: 10.1787/a8b2bd2b-en	https://data.oecd.org/natincome/value-added-by-activity.htm#indicator-chart	2017-08-17
Korea (Rep. of)	OECD (2017), Value added by activity (indicator). doi: 10.1787/a8b2bd2b-en	https://data.oecd.org/natincome/value-added-by-activity.htm#indicator-chart	2017-08-17
Mexico	OECD (2017), Value added by activity (indicator). doi: 10.1787/a8b2bd2b-en	https://data.oecd.org/natincome/value-added-by-activity.htm#indicator-chart	2017-08-17
Netherlands	EU KLEMS Project	http://www.euklems.net/index.html	2017-07-29

Spain	EU KLEMS Project	http://www.euklems.net/index.html	2017-07-29
Sweden	EU KLEMS Project	http://www.euklems.net/index.html	2017-07-29
United Kingdom	EU KLEMS Project	http://www.euklems.net/index.html	2017-07-29
United States	OECD (2017), Value added by activity (indicator). doi: 10.1787/a8b2bd2b-en	https://data.oecd.org/natincome/value-added-by-activity.htm#indicator-chart	2017-08-17

Note: sectoral shares are computed from 2005 value added expressed in current national currencies, except for Argentina (expressed in 1993 national currency) and Chile (2013 value added, instead of 2005)

Table A1

Sorces of the data on sectoral value added share for Trade (G) and Accommodation (H)

Appendix A2 – Table with initial and final observations available for measures of inequality and development

Table A2 presents the values and the matching years for the initial and the final observations available in our sample for the three measures of inequality and GDP per capita, for each country. In the last row we present a rough measure of the discrepancy between GDP per capita and each measure of inequality. We compute the distance between the year in which development is observed and the year in which the measure of inequality is observed and consider its absolute value. Then we sum up these values and divide the sum by the number of observations. We do this for initial and final observations separately. As the numbers show, the discrepancy of the Gini coefficient is lower than the other two measures as regards the final conditions, while the estimated household income inequality and the industrial pay inequality are less distant from GDP per capita in the case of the initial conditions.

		GDP per capita $		*Gini coefficient*		*Household income inequality*		*Industrial pay inequality*	
country	*observation*	*year*	*value*	*year*	*value*	*year*	*value*	*year*	*value*
Argentina	final	2011	11852.81	2014	42.00	2002	49.23	2002	0.082
	initial	1960	5748.45	1953	40.00	1984	41.93	1984	0.031
Botswana	final	2010	8123.71	2011	60.50	2008	51.45	2008	0.128
	initial	1964	600.17	1986	54.20	1981	48.21	1981	0.049
Brazil	final	2011	7340.92	2014	51.70	2007	47.61	2007	0.100
	initial	1960	2262.13	1960	54.00	1990	46.24	1990	0.059
Chile	final	2011	12918.58	2014	51.80	2006	48.00	2006	0.073
	initial	1960	3690.69	1968	45.00	1963	47.03	1963	0.068
China	final	2010	8535.07	2012	47.40	2008	37.55	2008	0.020
	initial	1960	303.47	1953	55.80	1977	31.44	1977	0.001
Denmark	final	2009	27050.02	2010	26.00	2007	33.20	2007	0.009
	initial	1960	10886.17	1963	37.00	1963	30.63	1963	0.005
Ethiopia	final	2012	679.04	2011	33.30	2008	49.22	2008	0.053
	initial	1961	228.70	1982	32.40	1990	42.96	1965	0.069
France	final	2009	21858.19	2012	33.10	2007	37.49	2007	0.016
	initial	1960	8119.89	1956	49.00	1977	32.80	1977	0.015
Ghana	final	2011	2592.13	2012	42.20	1993	48.67	1995	0.051
	initial	1960	1107.04	1987	35.40	1963	48.33	1963	0.048
India	final	2012	3667.47	2011	51.10	2007	51.38	2007	0.096
	initial	1960	741.12	1951	35.60	1963	47.02	1963	0.041
Indonesia	final	2012	4562.23	2012	41.00	2007	45.82	2007	0.043
	initial	1960	886.97	1964	33.30	1970	51.56	1970	0.088
Italy	final	2009	20415.01	2010	35.20	2007	36.31	2007	0.016
	initial	1960	6982.69	1967	39.10	1967	40.07	1967	0.032
Japan	final	2011	28136.54	2011	32.20	2007	42.90	2007	0.068
	initial	1960	5419.46	1962	37.20	1963	36.16	1963	0.040
Kenya	final	2011	1113.36	2007	29.90	1998	45.33	2002	0.043
	initial	1964	764.74	1981	57.30	1963	52.94	1963	0.116

Korea (Rep. of)	final	2011	23514.03	2009	45.50	2006	38.76	2006	0.024
	initial	1960	1853.17	1965	34.30	1963	43.46	1963	0.022
Malawi	final	2010	546.99	2011	45.20	2001	54.11	2001	0.153
	initial	1966	392.51	1993	62.00	1964	47.11	1964	0.035
Mauritius	final	2012	8332.95	2012	35.80	2007	39.56	2007	0.047
	initial	1970	998.29	1980	45.70	1968	42.00	1968	0.017
Mexico	final	2011	11008.52	2014	50.50	2000	46.41	2000	0.042
	initial	1960	4740.67	1950	49.00	1970	42.29	1970	0.019
Netherlands	final	2009	31328.96	2013	28.40	2005	37.02	2005	0.010
	initial	1960	10549.08	1962	42.00	1963	31.23	1963	0.010
Nigeria	final	2011	1000.61	2010	41.20	1996	48.75	1996	0.052
	initial	1960	234.24	1959	51.00	1963	45.22	1963	0.023
Senegal	final	2010	1194.25	2011	33.80	2002	50.50	2002	0.068
	initial	1970	1015.12	1960	56.00	1974	40.52	1974	0.009
South Africa	final	2011	6343.85	2012	65.60	2008	44.96	2008	0.044
	initial	1960	2976.97	1990	63.00	1963	43.25	1963	0.042
Spain	final	2009	21868.40	2013	36.00	2007	38.26	2007	0.019
	initial	1960	5865.13	1965	32.00	1963	40.67	1963	0.033
Sweden	final	2009	28651.82	2008	25.50	2000	29.62	2000	0.004
	initial	1960	9613.50	1963	39.00	1963	29.32	1963	0.007
Tanzania	final	2011	750.07	2012	37.80	2007	54.51	2007	0.143
	initial	1960	379.67	1964	54.00	1965	49.58	1965	0.058
United Kingdom	final	2009	26800.99	2014	36.10	2007	37.58	2007	0.014
	initial	1960	12676.88	1961	29.40	1963	28.01	1963	0.012
United States	final	2010	42568.81	2015	47.90	2007	40.06	2007	0.023
	initial	1960	19718.44	1950	43.10	1963	35.50	1963	0.022
Zambia	final	2010	871.55	2010	57.40	1994	49.96	1994	0.068
	initial	1965	980.00	1959	48.00	1963	49.56	1963	0.060
Average distance develop-ineq[45]	final			1.89		6.18		5.96	
	initial			9.36		7.71		6.82	

Table A2
Comparison of the initial and final values of GDP per capita and different measures of inequality

[45] The three figures indicate the average absolute difference in years between the three measures of inequality and GDP per capita.

Appendix A3 – Extended sources for variables used in regressions

Extended source and papers	***Link to dataset***
All the Ginis = Milanovic	https://wfs.gc.cuny.edu/njohnson/www/BrankoData/allginis_2016.dta
CANA = Castellacci & Natera, 2011	http://english.nupi.no/Activities/Projects/CANA (not available as of 10/01/2017)
GGDC = Groningen Growth and Development Centre (Timmer et al. 2015)	http://www.rug.nl/ggdc/productivity/10-sector/
PWT 9.0 = Feenstra, et al., 2015	http://www.rug.nl/ggdc/productivity/pwt/
UTIP = Galbraith, et al., 2014	http://utip.lbj.utexas.edu/data.html
VDEM = Varieties of democracy dataset, v. 7.1, (Coppedge et al. 2017 & Pemstein, et al., 2015)	https://www.v-dem.net/en/data/data-version-7-1/
WDI = World Development Indicators, World Bank 2017	http://databank.worldbank.org/data/home.aspx

Table A3
Extended sources for the variables in regressions and links to datasets

Concluding remarks

This thesis has investigated the structural change patterns of Sub-Saharan African countries to understand their implications for the development of the region and for the issue of inequality. We have reviewed part of the literature on economic growth and development with a particular attention to the region of our interest. We have focused on the distinction between deep and proximate determinants of economic growth, which in our view has the merit of isolating some of the most prominent aspects that have undermined the development prospects of Sub-Saharan Africa. The post-colonial dynamics have affected the establishment of sound institutions and of sound economic policies. This has generated the accumulation of lags in addressing and trying to work around geographical and social constraints to economic development that are still effective nowadays.

In Chapter 2 we have analysed in detail the structural change pattern of the Sub-Saharan African countries in our sample. We have found some unaddressed tendencies, that were not recognized or underlined in previous studies. We have registered that structural change in Sub-Saharan African countries has mostly been productivity-boosting since labour displacement from agriculture has generally diverted towards sectors with higher productivity. This does not mean that the structural change process has been optimal though, since labour has mainly moved towards the services (trade, in particular) rather than industry. We have also underlined how some important Sub-Saharan African countries like Nigeria are characterized by the presence of a large mining sector where productivity is high, but little labour absorption capacity, since it is extremely capital intensive. All these characteristics suggest either that Sub-Saharan Africa lags behind in the structural change process or that its structural change process will be different from those usually followed by developed or developing countries. The main novelty of the chapter lies in the use of Bayesian Model Averaging as a tool to address the problem of model uncertainty in the identification of the determinants of structural change, specifically in the sense of productivity-boosting or productivity-slowing structural change. By considering individual heterogeneity and endogeneity in some of the regressors, we have found that the most robust regressor determining productivity-boosting structural change is the agricultural employment share. Since the agricultural employment share is large in the Sub-Saharan African countries considered, the opportunity for structural change is still intact. However, African countries have to struggle to obtain the advantages of the industrial development. There isn't in the literature a model for the explanation of structural change agreed upon by authors. Moreover, to the best of our knowledge, there is only one work in the literature that has tried to explain structural change by a classical linear regression strategy, i.e. McMillan et al. (2014). We have introduced their work in the second chapter of this thesis. Here we simply remark that addressing the problem of model uncertainty in a context where there is no common model agreed upon by the literature is useful in exploring a large set of possibilities starting from a set of variables that is likely to affect the structural change process in one way or another. Moreover, averaging allows to obtain more precise results than sticking to a model, however likely it might be, and neglecting other variables that are also capable of explaining the phaenomenon of interest. Another positive aspect in our regression strategy is that it inspects a remarkable time series and tries to clean the data from individual heterogeneity and relevant endogeneity issues. McMillan et al. (2014) only find the agricultural employment share conditionally significant, while in our specification this variable is extremely robust. In fact, with a posterior inclusion probability of 100%, it is a feature that all Sub-Saharan African governments have to take into account when studying policies that aim at the structural transformation of their countries. This is recognised by the literature on development, since there are numerous studies (some of the most relevant have been introduced in Chapters 1 and 2) that focus on agriculture and on the growth prospects of the region starting from a predominant agricultural economic structure. What our specification also suggests is that external debt, economic openness and infant mortality rate are associated with productivity-slowing structural change. The problem of external debt has been widely discussed in the literature and in social and political discussions about African development. Many efforts have been made in the past to reduce the external debt of Sub-Saharan African countries, a crucial aspect to free out resources that have been destined to debt repayment in the past. A quick look at the time series of the related variable shows that all of the countries in the sample have smaller external debt nowadays than in the past and this is due to international agreements and improved economic policies by African governments. As for economic openness there is a point in suggesting to reduce it in order to allow national economies to improve and be better prepared for international competition, especially in the industrial sector. The development of Asian countries is explicative of this pattern. What remains to understand is if African countries have the capabilities to drive such a process. As for the infant mortality rate, it is hard to understand if this variable denotes an empirical finding (labour displacement towards smaller productivity sectors, like we have tried to understand in Chapter 2) or if it simply reflects social, educational or healthcare disadvantages of the countries in the region. This must be further investigated.

In Chapter 3 we have focused on the issue of inequality and on the pattern of its relationship with the structural change term in the decomposition of productivity growth. We have been able to widen the sample of countries by including other Asian and Latin American developing countries and other Asian and Western developed countries. we have argued that structural transformation driven by productivity may be considered as a natural redistributive mechanism. Moving away from low-productivity agriculture, workers can earn higher incomes and level-out income inequality. This is why structural change may be crucial for inclusive development, allowing larger and larger parts of the populations of developing countries to be lifted away for poverty. In developing countries, the link between inequality and poverty is stronger and it characterizes the issue inequality by giving it different implications from advanced economies. We have tried to study the relationship between structural change and inequality by using a dynamic panel data specification compared to pooled and fixed-effects specifications. Although our regressands have not returned robust results (we have described the peculiar characteristics of each of them in Chapter 3 alongside their advantages and drawbacks), there are signals that structural change does effectively level out inequality, especially when we use the Gini coefficient as dependent variable. African countries should push towards a structural transformation of their economies because this provides their populations with stronger means to fight poverty and deprivation. We have also tried to split our sample into developing and advanced economies and have again found that, when considering the Gini coefficient, structural change negatively affects inequality. There are instead signs of a positive relationship when considering the EHII and the IID measures of inequality, but these are generally weaker. Splitting our sample has also been useful in identifying the Kuznets relationship between development and inequality. In all specifications for emerging economies, when considering the Gini coefficient, we find evidence that the first phases of development increase inequality, which start decreasing after a peak. This does not hold for advanced economies, indicating that they have undergone this process decades ago and now find themselves in a different phase.