

Structural Change: Pace, Patterns and Determinants

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Abstract

This paper provides a comprehensive assessment of structural change in the world economy. The analysis relies on a newly-constructed dataset comprising 169 countries and covering the period from 1991 to 2013. Shapley decompositions are employed to evaluate the pace and pattern of structural change across regions and sub-regions. Country-level estimates are then used to conduct an original empirical exercise on the determinants of structural change. The results suggest that labour reallocations (structural change) have played a critical role in enhancing economic performance since the early 2000s – even if they remain comparatively less important than within-sector productivity improvements. The widespread reallocation of labour from agriculture to the services sectors has been the key driver of structural change. Finally, we find robust evidence that the pace of structural change is significantly shaped by human and physical capital accumulation. The policy implication is that investments in education and economic infrastructure are crucial to accelerate structural change.

JEL Classification: J24, O40, O50

Keywords: Structural change, labour productivity

1. Introduction

The economic growth literature has largely relied on theoretical models underpinned by an aggregate production function – such as Solow’s neoclassical growth model – thus emphasising the role of economy-wide factor accumulation and productivity. These one-sector models have provided a theoretical foundation for countless empirical studies investigating the determinants of economic growth through econometric methods and growth accounting frameworks. In particular, the seminal work of Barro (1991) on cross-country growth regressions opened a vast and prolific field of empirical research.¹ However, several studies have shown that the empirical results tend to be sensitive to model specification, sample data, and estimation method – see, for example, Levine and Renelt (1992) and Pritchett and Summers (2014). This lack of robustness might be partly due to one-sector models not accounting for the large sector heterogeneity that is characteristic of developing economies. In fact, Eberhart and Teal (2013) demonstrate that the aggregation of heterogeneous sectors in cross-country growth regressions can have a considerable impact on inference.

These critiques have contributed to a renewed interest in dual economy models and the role of structural change in the growth process (McMillan and Heady, 2014). While one-sector growth models were originally conceived with developed economies in mind, it can be argued that structural (dual-sector) models provide a better representation of developing economies. Temple (2005), for instance, asserts that dual economy models should take centre stage in the analysis of economic growth in developing countries.² These models assume the co-existence of a relatively ‘advanced’ sector and a relatively ‘backward’ sector in the economy – e.g. modern versus traditional, industry versus agriculture, capitalist versus subsistence, or formal versus informal (Fields, 2007). Moreover, they acknowledge that productivity gaps across sectors can be an important source of economic growth (Lewis, 1954). These gaps can be seen as allocative inefficiencies and thus opportunities to catalyse growth. The reallocation of labour across sectors assumes particular importance. Changes in the structure of employment are not only important for boosting economic growth, they can also ensure that the benefits of growth are equitably distributed across society – since workers in the lagging sector are unlikely to experience significant increases in living standards.

The early literature on structural change dates back to the 1950s and 1960s. Kuznets (1957), Chenery (1960), and Chenery and Taylor (1968) uncover important stylised facts on the relationship between a country’s economic structure and its income level. This literature posits that structural change is a key characteristic and driver of economic and social development. In fact, the historical experience of developed and emerging economies confirms that sustained economic development requires structural change. The reallocation of factors of production across sectors with different productivity levels can induce economic gains, or losses, depending on the direction.³ Typically, growth-enhancing structural change is narrowly defined as a process whereby labour moves from low-productivity to higher-productivity sectors (McMillan et al., 2014). This reallocation of labour raises workers’ productivity, which contributes to accelerate aggregate productivity and output growth. These ‘between-sector’ effects are in contrast to ‘within-sector’ effects, which relate to labour productivity improvements within a specific sector – often achieved through enhanced skills, complementary capital, improved technology, better management practices, and resource

¹ Durlauf et al. (2005) provide a comprehensive review of this literature.

² Recent examples include Herrendorf et al. (2014), who develop a multi-sector extension of the one-sector growth model that is consistent with the stylized facts of structural change; Duarte and Restuccia (2010), who use a general equilibrium model to investigate the role of sectoral labour productivity in explaining structural change; and Temple and Wößmann (2016), who develop empirical growth models suitable for dual economies.

³ The magnitude of these gains/losses depend on the size of productivity gaps and the pace at which resources are transferred to other sectors.

reallocations.⁴ Broader definitions of structural change go beyond changes in economic structure – such as production and employment – as they also encompass changes in other aspects of society (Kuznets, 1966). For instance, structural change may entail a spatial reorganisation of the population (through rural-urban migration) and demographic change (arising from lower fertility rates). This paper uses a decomposition strategy that enables an empirical assessment that is compatible with a broader view of structural change – by assessing the contribution of demographic and employment changes to economic performance, in addition to the relative importance of between-sector and within-sector productivity effects.

The identification of key sectoral drivers can shed light on the patterns of structural change. Historically, successful countries transformed from agrarian societies into industrial societies, and only subsequently into services-based economies. Whether this ought to be the path for today's developing countries is the subject of a contentious debate. In developing countries, labour productivity in agriculture is considerably lower than in the non-agricultural sector (Gollin et al., 2014). This suggests that a reallocation of labour from agriculture to industry and/or services would considerably boost aggregate productivity and economic growth. Meanwhile, agricultural productivity is likely to rise, as labour-saving technologies are adopted and (surplus) labour moves out of the sector. Manufacturing is often seen as the critical sector for engendering structural change, due to increasing returns to scale, high tradability, and strong backward/forward linkages to agriculture and services. While the sector has certainly played an important role in the rise of today's developed countries, growing levels of automation might be reducing its potential to absorb large numbers of workers.⁵ Services, especially those associated with knowledge and innovation, may also be able to produce structural change and thus sustain economic growth – as the recent experience of India seems to suggest.⁶ Whether services can be a substitute to manufacturing, or merely a leading/lagging complement, is a key issue for policy making (Roncolato and Kucera, 2014). If they are a substitute, then countries may be able to 'leapfrog' manufacturing in the traditional development path. However, services can be a leading complement, if they increase demand for manufactured goods – e.g. an expanding IT sector requiring computer hardware and other physical infrastructure; or a lagging complement, if they depend on demand from the manufacturing sector – e.g. finance and insurance sectors relying on the performance of manufacturing firms. Historical experiences are seldom unequivocal, since even in China manufacturing was not the sole driver of economic performance, and neither has India neglected its manufacturing sector.

The recent emphasis on structural change has led to a rapidly expanding body of theoretical and empirical work. Datasets have been compiled to document regional patterns, with varying degrees of sectoral disaggregation and country coverage. However, the majority of studies have small country samples and there have been very few attempts to empirically assess the determinants of structural change in developing countries. This paper contributes to this emerging literature by constructing a comprehensive dataset and providing deeper insights into the recent dynamics of structural change. The sample includes 169 countries, which enhances the representativeness of regional estimates and enables a sub-regional perspective to evaluate the level of heterogeneity within regions. More importantly, the paper scrutinises the determinants of structural change in a novel way to offer insights on how to enhance it.

⁴ Even in the absence of labour productivity growth within sectors, shifting labour towards higher-productivity sectors will increase aggregate productivity growth. However, structural change can be growth-reducing if labour moves to lower-productivity sectors – e.g. urban informal activities.

⁵ Rodrik (2016) suggests that globalisation and labour-saving technological progress in manufacturing have contributed to premature deindustrialisation.

⁶ However, the services sector is highly heterogeneous, with modern (dynamic) activities often lumped with traditional (low-productivity) activities.

2. Methodology and data

2.1. Shapley decompositions

Most studies measuring the pace and pattern of structural change focus on the decomposition of aggregate labour productivity growth. This paper adopts a broader analytical framework with a view to providing further insights. In addition to assessing the contribution of within-sector and between-sector productivity effects to economic performance, the impact of employment rates and demographic change is also evaluated. Higher employment rates can boost economic activity, while lower dependency ratios can generate a sizeable demographic dividend. Hence, the starting point is output per capita (y):

$$y = w \cdot e \cdot a$$

where w is output per worker (i.e. labour productivity), e the employment rate, and a the relative size of the working-age population.⁷ Shapley decompositions are employed to calculate the proportion of output per capita growth that can be attributed to each of the three components, which are denoted by \bar{w} , \bar{e} , and \bar{a} :⁸

$$\frac{\Delta y}{y} = \bar{w} \frac{\Delta y}{y} + \bar{e} \frac{\Delta y}{y} + \bar{a} \frac{\Delta y}{y}$$

This decomposition has the advantage of being additive and that each component has the interpretation of a counterfactual scenario. At this point, output per worker can be decomposed into two components:

$$\Delta w = \sum_{i=1}^n \Delta w_i \left(\frac{s_{i,t=0} + s_{i,t=1}}{2} \right) + \sum_{i=1}^n \Delta s_i \left(\frac{w_{i,t=0} + w_{i,t=1}}{2} \right)$$

where w_i represents output per worker in sector i (Y_i/E_i), s_i is the sectoral employment share (E_i/E), and n is the total number of economic sectors. The first part measures within-sector productivity effects, while the second measures between-sector effects (i.e. employment reallocation). The latter is often taken as a measure of structural change.

This decomposition exercise relies on three main sources of data. Data on sectoral employment comes from the World Employment and Social Outlook (WESO) of the International Labour Organization (ILO). The dataset includes employment data for 174 countries, which is disaggregated by 14 economic sectors and covers the period from 1991 to 2013. Data on sectoral output comes from the National Accounts Main Aggregates database of the United Nations Statistics Division (UNSD), which provides a consistent dataset of national accounts aggregates for 212 countries and territories. This paper uses gross value added (GVA) by kind of economic activity in US dollars at constant market prices. Finally, data on total population and working-age population (i.e. 15-64 years-old) comes from the World Population Prospects (2012 Revision) database of the United Nations Population Division (UNPD), which provides demographic estimates and projections for 233 countries and territories.

⁷ This is derived from $\frac{Y}{N} = \frac{Y}{E} \cdot \frac{E}{A} \cdot \frac{A}{N}$, where Y is total output, N is total population, E is total employment, and A is the working-age population.

⁸ See World Bank (2012) for further details. The Shapley decomposition considers the marginal effect on a variable (in this case, output per capita growth) of sequentially eliminating each of the contributory factors, and then assigns to each factor the average of its marginal contributions in all possible elimination sequences (Sorrocks, 2013).

The consolidation of these three data sources led to a large annual dataset comprising 169 countries. The employment data was the main binding constraint for the country sample. In 2013, these 169 countries represented 98.7 percent of the world's population and 99.9 percent of global GVA. The countries were then grouped into four main world regions – Africa, Asia, Latin America & Caribbean (LAC), and Other (i.e. developed) – as well as 13 sub-regions (see Table 8 in Annex). Since structural change is a gradual process, the sample is split into two equal-sized time periods (1991-2002 and 2002-2013) in order to evaluate changes in the pace of structural change. The second period coincides with an improved growth record in many developing countries.

The output data determined the level of sectoral disaggregation. The UNSD data is disaggregated into seven sectors of economic activity, which meant that the ILO 14-sector data had to be aggregated in order to ensure data consistency (Table 1).⁹ Both sources report data according to the third revision of the International Standard Industrial Classification of All Economic Activities (ISIC Rev.3.1). In this paper, agriculture includes fishing (section B), while mining & quarrying (section C) and electricity, gas & water supply (section E) are grouped together. Commerce includes wholesale & retail trade (section G) and hotels & restaurants (section H). 'Other services' comprises a range of fairly heterogeneous service activities, from the 'modern' financial intermediation sector (section J) to 'traditional' domestic work (section P). Section Q is not quantified in national accounts and is usually negligible in terms of employment.

Table 1: Data aggregation by ISIC section

ISIC Rev.3.1		Aggregation for this paper	
Sector	Section	Short name	Section(s)
Agriculture, hunting & forestry	A	Agriculture	A, B
Fishing	B	Mining & utilities	C, E
Mining and quarrying	C	Manufacturing	D
Manufacturing	D	Construction	F
Electricity, gas and water supply	E	Commerce	G, H
Construction	F	Transport	I
Wholesale and retail trade; repair of motor vehicles (...)	G	Other services	J-P
Hotels and restaurants	H		
Transport, storage and communications	I		
Financial intermediation	J		
Real estate, renting and business activities	K		
Public administration and defence; compulsory social security	L		
Education	M		
Health and social work	N		
Other community, social and personal service activities	O		
Activities of private households as employers (...)	P		
Extraterritorial organizations and bodies	Q		

Note: Usually, sections C-F are considered to be part of 'industry', while 'services' consists of sections G-P.

This decomposition exercise has three distinctive features that set it apart from the existing empirical literature. First, it offers a broader perspective on structural change by assessing the impact of demographic structure and employment rates on economic performance – in addition to within-sector and between-sector productivity effects. Second, the sample size is significantly larger than existing studies – even when compared to the 81 countries of Roncolato and Kucera (2014) – which enhances the representativeness of the findings. Finally, it provides an additional perspective by assessing trends at the sub-regional level.

⁹ Individual country studies usually enable greater sectoral disaggregation – see, for example, Martins (2017).

2.2. Econometric estimation

Regression analysis is used to investigate the determinants of structural change. The general specification of the econometric model is guided by a review of the existing theoretical and empirical literature. The potential determinants are grouped into the following key dimensions:

$$\text{structural change} = f(\text{initial conditions, macroeconomic stability, trade \& exchange rate, financial capital, human capital, physical capital, governance})$$

The model is estimated through a panel fixed-effects estimator. The general specification can be written as (Baltagi, 2008):

$$y_{it} = \alpha + \beta x_{it} + u_{it}$$

where y is the dependent variable, α is a scalar, β is a $K \times 1$ vector of slope parameters, i denotes the country, t denotes time, and x_{it} is the it^{th} observation on K explanatory variables. A one-way error component model is used for the disturbances (u_{it}):

$$u_{it} = \mu_i + v_{it}$$

where μ_i is the unobservable country-specific effect, and v_{it} is the remainder stochastic disturbance term. This fixed-effects model (FE) has constant slopes (β) but allows the intercepts to vary for each country ($\alpha + \mu_i$), thus accounting for time-invariant country characteristics such as geography, climate, and culture.¹⁰ The likelihood of omitted variable bias is therefore considerably reduced. However, the model requires the validity of standard assumptions for the disturbance term – i.e. $v_{it} \sim IID(0, \sigma_v^2)$ – meaning that residuals are normally distributed, uncorrelated, and homoscedastic. Cluster-robust standard errors are estimated to address potential cross-sectional heteroscedasticity and within-panel serial correlation. Moreover, robustness to outliers and potential multicollinearity is judiciously investigated through formal tests.

In terms of data, some of the estimates obtained through the decomposition exercise are used. The between-sector productivity effect (i.e. structural change) is of particular importance, since it is the dependent variable. Moreover, potentially relevant variables were compiled from different sources. The selection of variables was guided by several considerations, including their use in the related empirical literature, country coverage, and reliability as a proxy for the dimensions defined above. Dabla-Norris et al. (2013), for example, use several variables covering policy and institutional factors, as well as country ‘fundamentals’. However, it should be noted that their study evaluates differences in output structures, rather than structural change as defined by the employment reallocation effect.¹¹ McMillan et al. (2014) is probably the study that is closer to this exercise, although it uses a cross-sectional dataset (i.e. one time period) and only 38 countries. In this paper, most variables are averaged over time – with the exception of the initial conditions – since the structural change estimates correspond to two time periods (1991-2002 and 2002-2013). Nine countries were excluded from the original sample due to the lack of data for key variables.¹² Hence, the dataset is a balanced panel of 160 countries and two time periods.

The main variables used in the econometric exercise are listed below (Table 2). A country’s initial conditions may influence the pace of structural change. For instance, given the large productivity

¹⁰ The FE estimator is a ‘within-groups’ estimator since it depends on deviations from group [cross-section] means. In the special case where $T=2$, the fixed-effects estimator is numerically equivalent to the first-differences estimator.

¹¹ Mijiyawa (2017) follows a similar approach with a focus on Africa.

¹² Afghanistan, Cuba, East Timor, Iraq, Montenegro, Myanmar, Puerto Rico, West Bank & Gaza Strip, and Zimbabwe.

gaps observed between agriculture and the remaining economic sectors, countries with a high share of employment in agriculture have (at least in principle) greater scope to benefit from employment reallocations. As these gaps close through time, the scope for reallocation gains is reduced. Moreover, resource-rich countries may have limited incentives to diversify their economic structures, especially when high demand and prices for natural resources lead to fast economic growth – thus reinforcing their comparative advantage and specialisation.¹³ Macroeconomic stability is often seen as an essential precondition for sustained economic growth. In particular, growing fiscal deficits, large public debts, high inflation, and widening current account deficits may fuel economic uncertainty and instability, which is unlikely to be conducive to structural change. International trade and a competitive exchange rate may facilitate structural change if they lead to output and employment growth in high-productivity sectors. Lack of access to affordable finance is often seen as a key constraint facing firms. In this context, high real interest rates undermine credit expansion to the private sector, which may in turn restrict production and employment growth.

Table 2: Key variables

Dimension	Variable	Code	Sign	Source (Database)
Dependent variable	Between-sector productivity (% contribution)	btw	n/a	Decomposition
Initial conditions	Employment in agriculture (%)	ea0	+	ILO (WESO)
	Mining & utilities (% of GVA)	yce0	–	UNSD (NAMA)
Macroeconomic stability	Current account balance (% of GDP)	cab	+	IMF (WEO)
	General government gross debt (% of GDP)	debt	–	IMF (WEO)
	General government net lending/borrowing (% of GDP)	def	–	IMF (WEO)
	Inflation, consumer prices (% change)	inf	–	IMF (WEO)
Trade & exchange rate	Net barter terms of trade (index)	tot	+	World Bank (WDI)
	Trade (% of GDP)	open	+	World Bank (WDI)
	Real effective exchange rate (index)	reer	–	Bruegel (Darvas)
Financial capital	Domestic credit to private sector (% of GDP)	cred	+	World Bank (GFD)
	Real interest rate (%)	rir	–	World Bank (WDI)
Human capital	Gross enrolment ratio in secondary (%)	ger2	+	World Bank (WDI)
	Gross enrolment ratio in tertiary (%)	ger3	+	World Bank (WDI)
	Life expectancy at birth	lex	+	World Bank (WDI)
	Mean years of schooling	mys	+	UNDP (HDRO)
Physical capital	Assess to electricity (% of population)	elect	+	World Bank (WDI)
	Assess to improved sanitation facilities (% of population)	san	+	World Bank (WDI)
	Assess to improved water source (% of population)	wat	+	World Bank (WDI)
	Internet users (per 100 people)	net	+	World Bank (WDI)
	Generation capacity (MW per capita)	tgcn	+	World Bank (SE4ALL)
	Road density (km per sq. km)	roadl	+	World Bank (WDI)
Governance	Political regime (polity2)	pol2	+	CSP (Polity IV)
	Political rights & Civil liberties (average score)	prcl	–	Freedom House
	Voice & accountability	gov1	+	World Bank (WGI)
	Political stability & Absence from violence/terrorism	gov2	+	World Bank (WGI)
	Government effectiveness	gov3	+	World Bank (WGI)
	Regulatory quality	gov4	+	World Bank (WGI)
	Rule of law	gov5	+	World Bank (WGI)
	Control of corruption	gov6	+	World Bank (WGI)

Note: NAMA National Accounts Main Aggregates, WDI World Development Indicators, WEO World Economic Outlook, WESO World Employment and Social Outlook, WGI World Governance Indicators. Independent variables are computed as period averages, with the exception of initial conditions. The share of employment in agriculture (ea0) and the share of mining & utilities in GVA (yce0) were calculated from the original data. Total generation capacity (GW) and total road network (km) were used to compute generation capacity per capita (tgcn) and road density (roadl), respectively.

Since employment dynamics play a central role in inducing structural change, human capital is likely to be of vital importance. Not only workers require improved skills to move to higher-productivity jobs, but skills and knowledge are also key to promote entrepreneurship, creativity, and dynamism –

¹³ Despite high labour productivity levels, the mining sector cannot absorb large numbers of workers due to its capital-intensive nature.

thus affecting both labour supply and demand. A country's average years of schooling may provide information on the average skill level of the workforce. Depending on the country, the expansion of secondary education might be more (or less) important than tertiary education.¹⁴ Health outcomes can also be important, since good physical health and cognitive functions are key for workers to seize better job opportunities. Physical capital can also be critical to enhance structural change. For instance, the improvement and expansion of basic infrastructure – e.g. energy, water and sanitation, transport, and telecommunications – can significantly enhance a country's competitiveness. Finally, good governance and strong institutions can provide a more conducive environment for accelerating structural change. Time-invariant variables – especially those reflecting country characteristics such as geography, climate, and culture – are implicitly captured by the country-specific constant terms. Variables that are only available for much smaller country samples are not considered, since they may heighten concerns of selection bias. Moreover, variables related to investment or savings are not included because they often operate indirectly – first building up physical, financial, and human capital, and only then affecting structural change. These specific channels are monitored instead.

Most studies assessing the determinants of structural change use output shares as a proxy for structural change. This can be misleading, since changes in employment structures often lag behind and are fundamental to the economic transformation process. To our knowledge, the only study that uses estimates on the labour reallocation effect – as a proxy for structural change – is McMillan et al. (2014). However, their study uses a cross-sectional dataset, which can only explain differences across countries. This paper uses a panel dataset to explain accelerations (and decelerations) of structural change within countries.

¹⁴ Most countries have attained high enrolment ratios in primary school – which provides foundational skills – although quality remains a key challenge. Nonetheless, the quality of education is significantly more difficult to measure in a comparable way across countries.

3. Economic structure and labour productivity

The structure of output and employment varies considerably across regions (Figure 1). For instance, manufacturing contributes to 26 percent of total GVA in Asia, but only 11 percent in Africa. Other services account for 52 percent of total GVA in developed countries, but less than 30 percent in Africa and Asia. The disparities are even starker with regard to employment. Agriculture employs more than half of Africa's workers, but accounts for less than 5 percent of total employment in developed countries. As noted in the early literature on structural change, stark differences in economic structure are partly responsible for the large income gaps observed across regions.

Figure 1: Structure of output and employment

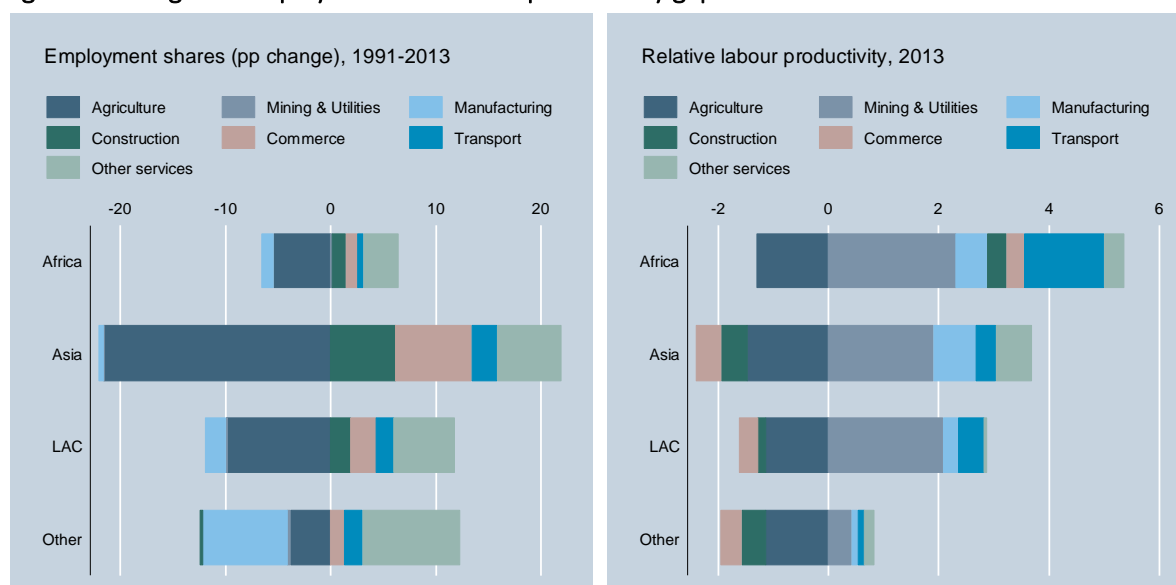


The concept of structural change is intrinsically linked to labour productivity. This paper uses GVA per worker as a measure of labour productivity. Agriculture has the lowest labour productivity in all regions, while mining & utilities has the highest – by wide margins (see Table 9 in Annex). On average, the largest labour productivity gaps across sectors are observed in Africa – followed by Asia – and are relatively small in Latin America & Caribbean and developed countries. In fact, labour productivity gaps appear to be related to income levels, with larger gaps found in poorer regions. As an example, mining & utilities is 37 times more productive than agriculture in Africa, but only 5 times in developed countries. Even when excluding mining & utilities, these gaps remain large. Countries can considerably enhance their economic performance by exploiting these large labour productivity gaps – especially in Africa and Asia. However, the employment-generation potential of some high-productivity sectors is rather limited – such as mining & utilities – owing to their high capital-intensity.

The share of employment in agriculture has declined in all regions. Between 1991 and 2013, it decreased by 21, 10, and 5 percentage points in Asia, Latin America & Caribbean, and Africa – respectively. Most of these declines were observed in the period 2002-2013. Ideally, agricultural labour should move to sectors that have above-average (and growing) levels of labour productivity (Figure 2). Between 1991 and 2013, Africa observed an employment shift towards other services, a sector that lags behind mining & utilities, transport, and manufacturing in terms of labour productivity. In Asia, employment shifted towards construction, commerce, and other services. However, both construction and commerce had productivity levels below the economy-wide average, which has somewhat limited the impact of this labour reallocation. In Latin America & Caribbean, labour mainly reallocated to other services, but the productivity of the sector is only

marginally above that of the aggregate level. Developed countries shed a considerable amount of manufacturing jobs – in fact, all regions experienced a decline in the manufacturing share. Nonetheless, since productivity gaps are small in developed countries, the potential scope for structural change is more limited than in developing countries.

Figure 2: Changes in employment and labour productivity gaps



Note: Relative labour productivity is calculated as the natural logarithm of the ratio of sectoral productivity to aggregate productivity. Large productivity gaps are represented by wider bar areas. If the width of a bar measures 1 unit, then the sector's productivity is 10 times higher than the average (if positive) or a tenth of the average (if negative).

Economic structure also varies substantially within regions, especially in Africa. Agriculture has the lowest labour productivity in all 13 sub-regions, while mining & utilities has the highest productivity levels in 11 sub-regions. The share of employment in agriculture declined in all sub-regions, especially during the 2002-2013 period. Overall, recent trends appear to be positive, but the sectors where employment is expanding the most have lower-than-average labour productivity levels. This may suggest a trade-off. The highest-productivity sectors tend to be capital intensive and thus less able to absorb large numbers of workers. Hence, the key for accelerating structural change might be in increasing the dynamism of manufacturing, commerce, and other services.

4. Empirical results

4.1. Pace and pattern of structural change

Africa's economic performance has improved remarkably since 2002 (Table 3). Annual GVA per capita growth accelerated from 0.3 percent in 1991-2002 to 2.4 percent in 2002-2013, which mainly reflected improvements in labour productivity.¹⁵ In fact, both within-sector and between-sector components provided strong contributions since 2002. The between-sector effect accounted for over one-third of output per capita growth in 2002-2013. The reallocation of labour from agriculture to the services sectors was the key driver of structural change (see Table 10 in Annex).¹⁶ Employment also emerged as a positive influence in the latter period, mainly due to an increase in the employment rate. The contribution of the demographic structure declined, owing to a slower increase in the share of the working-age population. Overall, commerce, transport and other services accounted for two-thirds of output per capita growth in 1991-2013.

GVA per capita growth was outstandingly high in Asia, accelerating from 4.3 percent in 1991-2002 to 5.9 percent in 2002-2013. Within-sector productivity improvements were the main driver of this strong performance, accounting for nearly three-quarters of output per capita growth in 1991-2013. Manufacturing was by far the most important sector within this component. The contribution of structural change has also been substantial and growing, mainly owing to the reallocation of labour from agriculture to other services. Employment has dampened growth – as the employment rate declined in both periods – but demographic changes supplemented output per capita growth with over 0.5 percentage points.

Table 3: Decomposition of GVA per capita growth (1991-2013)

Region	Period	Contribution from (percentage points):				GVA per capita growth (%)
		Within-sector productivity	Between-sector productivity	Changes in employment	Changes in demography	
Africa	1991-2013	0.52	0.44	0.13	0.28	1.36
	1991-2002	-0.05	0.04	-0.02	0.36	0.33
	2002-2013	1.10	0.84	0.28	0.19	2.41
Asia	1991-2013	3.74	1.10	-0.34	0.59	5.09
	1991-2002	3.39	0.58	-0.27	0.57	4.27
	2002-2013	4.12	1.63	-0.36	0.54	5.92
LAC	1991-2013	0.30	0.35	0.48	0.49	1.61
	1991-2002	-0.10	0.19	0.30	0.54	0.94
	2002-2013	0.73	0.47	0.65	0.43	2.29
Other	1991-2013	1.05	0.26	0.11	-0.01	1.40
	1991-2002	1.36	0.33	0.00	0.10	1.80
	2002-2013	0.68	0.23	0.21	-0.11	1.01

In Latin America & Caribbean, GVA per capita growth also accelerated in the latter period, with labour productivity accounting for most of this improvement. Once again, the between-sector component was mainly accounted by (relative) employment shifts from agriculture to services. The contribution of the employment component also increased – due to a stronger increase in the employment rate – while the demographic structure continued to provide a sizeable (though

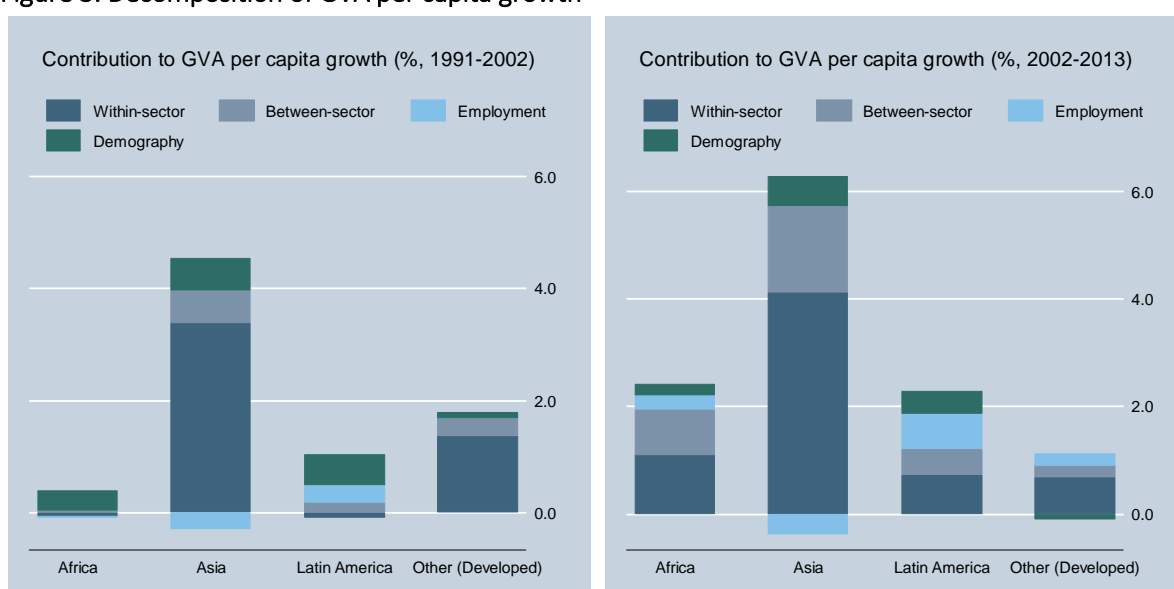
¹⁵ The contribution of labour productivity growth to GVA per capita growth corresponds to the sum of the within-sector and between-sector components.

¹⁶ A sector will have a positive contribution to the between-sector component if: (i) its labour productivity is above the aggregate average and its employment share increases; or (ii) its labour productivity is below the aggregate average and its employment share declines. This explains the large positive values for both agriculture and the services sectors.

declining) contribution. On the whole, the services sectors were the key drivers of economic performance.

In developed countries, however, GVA per capita growth decelerated considerably in 2002-2013, partly owing to the global financial crisis. A declining within-sector contribution accounted for most of this disappointing performance, although the negative impact of the demographic structure component was also noticeable – mainly on account of population ageing and the relative shrinking of the working-age population. The only positive sign came from the employment component. Nonetheless, large between-sector effects are not expected owing to relatively small productivity gaps across sectors (see Figure 6 in Annex). Like in Asia, manufacturing provided a strong boost to within-sector productivity, but had a large negative impact on the employment component – as the sector recorded a strong decline in employment. Other services accounted for most of GVA per capita growth in 1991-2013, mainly owing to changes in the employment rate.

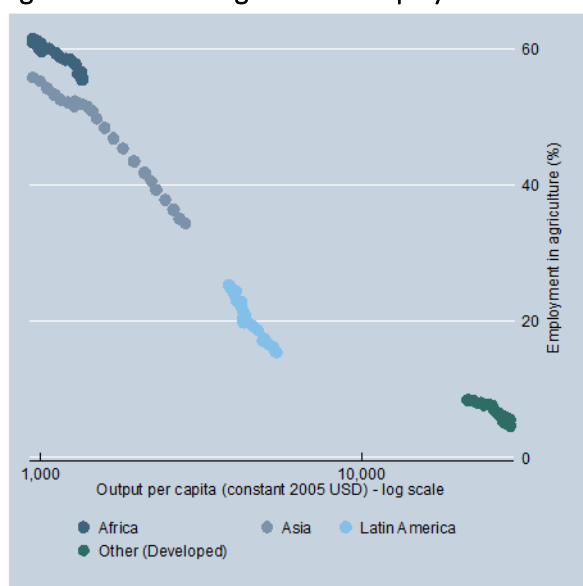
Figure 3: Decomposition of GVA per capita growth



Overall, the within-sector and between-sector productivity trends seem promising in developing countries, while employment and demography played a relatively minor role in boosting output per capita growth – with the exception of Latin America & Caribbean (Figure 3). Since agriculture is the least productive sector in all regions (and sub-regions), employment shifts from agriculture to the remaining sectors contributed decisively to enhance structural change. In fact, there is a clear negative relationship between agricultural employment and average incomes – both within and across regions (Figure 4). It also seems that the faster labour moves out of agriculture, the larger is the increase in output per capita – suggesting that faster economic development depends on the rate at which production resources are reallocated to more efficient uses.¹⁷

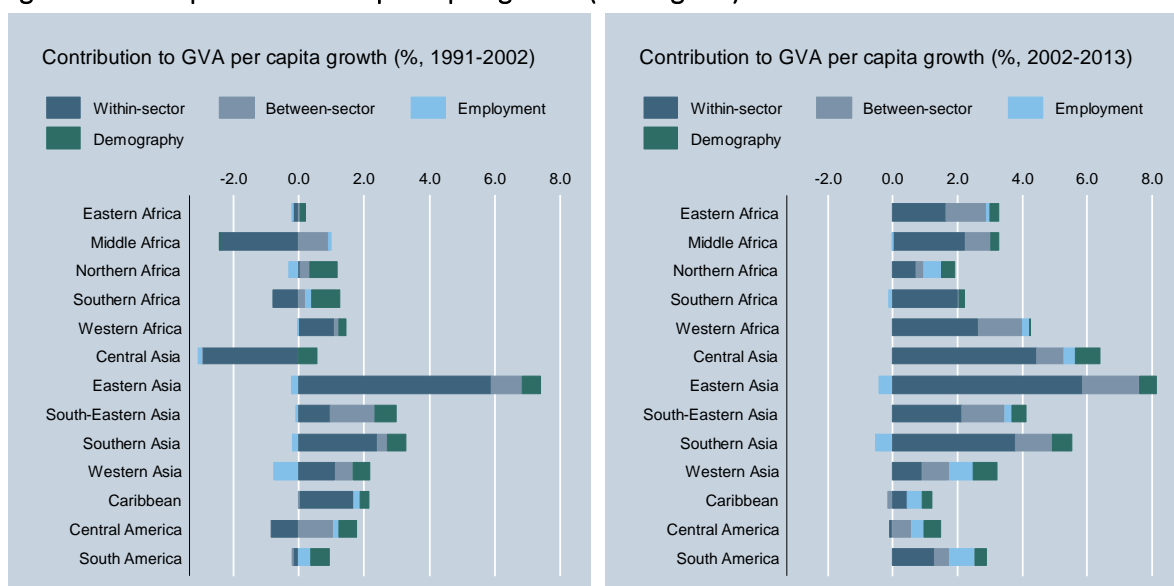
¹⁷ Nonetheless, large productivity gaps between agriculture and non-agriculture also enable large reallocation effects. In Africa, the share of agriculture in total employment only declined by about 5 percentage points between 1991 and 2013 (compared to 22 percent in Asia), but still delivered 0.8 percentage points growth (compared to 1.6 in Asia). Hence, similar changes in employment structures will lead to greater gains in countries with larger productivity gaps.

Figure 4: Trends in agricultural employment and output per capita, 1991-2013



With the exception of the Caribbean, all sub-regions have recently experienced improvements in economic performance (Figure 5). In these 12 sub-regions, both GVA per capita growth and labour productivity growth were faster in 2002-2013 than in the previous period. The top three performing sub-regions were in Asia. Overall, within-sector productivity improvements played a major role in accelerating output per capita growth in most sub-regions. In 2002-2013, within-sector effects were larger than between-sector effects in all sub-regions, except Central America. However, structural change was also a key contributor to the improved economic performance in several sub-regions, especially in Eastern and Western Africa, and Central, Eastern, and Southern Asia. Demographic trends were particularly important in Asian sub-regions, while employment rates were relatively more important in Latin America & Caribbean.¹⁸

Figure 5: Decomposition of GVA per capita growth (sub-regions)



¹⁸ Further details on sub-regional trends can be found in Martins (2015).

In order to facilitate comparisons with the results of other studies, within-sector and between-sector effects are reported both as compound annual growth rates and shares (see Table 11 in Annex).¹⁹ In the first case, the contributions add up to the annual compound growth rate of output per worker, while in the second they add up to 100 percent. There are some discrepancies in terms of the contribution of structural change to output per worker growth. For instance, our results point to positive within-sector and between-sector productivity changes for all regions, which is not always the case in the literature. McMillan et al. (2014) find growth-reducing structural change in Africa and Latin America & Caribbean during the 1990-2005 period, McMillan and Harttgen (2014) suggest the same for Latin America & Caribbean in 2000-2005, as well as Timmer et al. (2014) regarding Latin America & Caribbean in 1990-2010. Despite this, our results for Africa are very similar to those reported by McMillan and Harttgen (2014).²⁰ The estimates for Asia suggest a stronger contribution from structural change than that reported in other studies. The findings from UNCTAD (2014) and Roncolato and Kucera (2014) are not directly comparable due to different regional aggregates. Nevertheless, UNCTAD (2014) suggest that structural change accounted for about 33 percent of GVA per worker growth in developing countries, which is comparable to what is obtained when aggregating Africa, Asia and Latin America & Caribbean into a single region.²¹ There are also some differences in terms of the relative contribution of each sector. Our results suggest that services were the key driver of economic performance, while manufacturing had a limited impact. However, Roncolato and Kucera (2014) argue that, on the whole, industry has been as important as services. A range of factors might explain some of these discrepancies, such as differences in country samples, time frames, level of sectoral aggregation, data sources, and empirical methodologies.

4.2. Determinants of structural change

The initial sample for the econometric exercise comprised 160 countries. However, two countries stood out as potential outliers (Figure 7 in Annex). Equatorial Guinea (GNQ) had an extremely large structural change component in 1991-2002 (11.9) – due to a sharp increase in the share of mining & utilities in total GVA and a severe decline in the employment share in agriculture. These trends generate an extreme outlier that undermines inference. Oman (OMN) had the second best performance in 1991-2002 (3.1) but the worst score in 2002-2013 (-1.6). These values were also found to significantly affect model behaviour. The exclusion of these two countries leads to a final sample of 158 countries.

Given the relatively small sample size ($N=158$ and $T=2$), the robustness of the results should be carefully examined. Therefore, basic descriptive statistics are scrutinised for each variable, while bivariate fixed-effects regressions are run to identify unusual observations that may unduly affect the results. In this context, it is important to distinguish between the following statistical concepts: outlier, leverage, and influence. An outlier is an observation with a very large residual and is typically associated with an unusual value on the dependent variable. This was precisely the case of Equatorial Guinea and Oman, mentioned above. Leverage relates to an unusual value on an independent variable. A single high-leverage observation may considerably affect the estimated coefficients and standard errors of a regression – to such an extent that excluding it from the sample changes statistical inference. The hat-value (h) is computed to identify such observations. Finally, influence can be thought of as a combination of the previous two – outlierness and leverage. The Cook's distance (D) is calculated to uncover influential observations.

¹⁹ The shares enable a comparison of the relative contribution of structural change, especially when the values for output per worker growth are dissimilar.

²⁰ McMillan and Harttgen (2014) also report results for an expanded African sample (19 countries), but disaggregated into four sectors only. The findings are broadly similar to the main results.

²¹ Such a decomposition yields an output per worker growth rate of 3.4 percent per year for 1991-2013, of which 72 percent is due to within-sector improvements and the remaining 28 percent is due to structural change.

Several variables appear to have a statistically significant impact on structural change (Table 4).²² The initial share of employment in agriculture (ea0), the real interest rate (rir) and access to water (wat) are statistically significant at the 1 percent level, while terms of trade (tot), tertiary education (ger3), life expectancy (lex), years of schooling (mys), and political regime (pol2) are statistically significant at the 5 percent level. However, there is a high-leverage observation in the real interest rate (rir) equation – corresponding to D. R. Congo (COD). When this observation is dropped from the sample, the independent variable is no longer statistically significant. Several other observations are identified as having high-leverage, such as Libya (LBY) and Uzbekistan (UZB) for the real exchange rate (reer), and the D. R. Congo (COD) for inflation (inf). The Cook’s distance statistic suggests that D. R. Congo (COD) exerts significant influence on inflation (inf), while Venezuela does the same for political regime (pol2). These tests are also performed in the fully-specified model.

Table 4: Bivariate fixed-effects regressions

Variable (short name)	Code	Coef.	SD	R-sq.	Leverage (h > 0.6)	Influence (D > 0.1)
Employment in agriculture	ea0	0.05	(0.01)***	0.11	..	..
Mining & utilities	yce0	-0.01	(0.01)	0.01	KWT	..
Current account balance	cab	-0.00	(0.01)	0.00	..	..
Government debt	debt	-0.00	(0.00)*	0.03	LBR	..
Fiscal deficit	def	0.01	(0.02)	0.00	KWT	..
Inflation	inf	0.00	(0.00)	0.00	COD	COD
Terms of trade	tot	0.01	(0.00)**	0.07	..	..
Trade openness	open	0.00	(0.00)	0.00	..	..
Real exchange rate	reer	0.00	(0.00)	0.01	LBY, UZB	..
Credit to private sector	cred	0.00	(0.00)	0.01	..	..
Real interest rate	rir	-0.02	(0.01)***	0.04	COD	..
Secondary education	ger2	0.01	(0.01)	0.02	..	..
Tertiary education	ger3	0.01	(0.00)**	0.02	..	..
Life expectancy	lex	0.04	(0.02)**	0.04	..	..
Years of schooling	mys	0.13	(0.06)**	0.03	..	..
Access to electricity	elect	0.02	(0.01)*	0.02	..	..
Access to sanitation	san	0.01	(0.01)	0.01	..	..
Access to water	wat	0.03	(0.01)***	0.05	..	..
Internet users	net	0.00	(0.00)*	0.01	..	..
Generation capacity	tgcn	-0.07	(0.07)	0.00	ISL, QAT	..
Road density	roadl	0.01	(0.01)	0.00	MLT	..
Political regime	pol2	0.05	(0.02)**	0.03	..	VEN
Political rights	prcl	-0.11	(0.12)	0.01	..	..
Voice & accountability	gov1	0.13	(0.30)	0.00	..	..
Political stability	gov2	0.05	(0.18)	0.00	..	..
Government effectiveness	gov3	0.08	(0.31)	0.00	..	..
Regulatory quality	gov4	-0.36	(0.34)	0.01	..	..
Rule of law	gov5	0.00	(0.33)	0.00	..	..
Control of corruption	gov6	0.21	(0.26)	0.00	..	..

Notes: The dependent variable is the between-sector effect (btw). The asterisks represent statistical significance at the 1 percent (***), 5 percent (**) and 10 (*) percent levels. The country ISO codes can be found in the Annex.

Bivariate regressions can also provide useful information on the (unconditional) determinants of structural change, especially given the small sample – in statistical terms – and likely collinearity between independent variables. The initial share of employment in agriculture (ea0) is probably the strongest candidate for inclusion. Its coefficient is statistically significant at the 1 percent level, the associated R-squared is the highest, and it has been included in McMillan et al. (2014). The positive sign suggests that the higher the initial labour share in agriculture, the greater scope there is to engender structural change. This is unsurprising, since agriculture has the lowest sectoral labour productivity across most countries, and thus any move out of the sector is likely to induce positive

²² In this paper, the ‘significance’ of a variable is always meant as ‘statistical significance’ – at the 1, 5, or 10 percent levels.

structural change. In addition, several variables within the human capital and physical capital dimensions appear to be strong contenders for inclusion, especially since they do not seem to contain high-leverage or influential observations. The positive signs on the education variables suggest that improved skills and knowledge enable workers to move to more productive jobs (or even create these jobs through enhanced entrepreneurial skills), while the coefficient on life expectancy suggests that a healthier workforce may also contribute to structural change. With regard to physical capital, the positive signs suggest that infrastructure development can accelerate structural change.

Since some explanatory variables are strongly correlated with other variables within the same dimension, principal component analysis is used to isolate the common elements of these variables (Table 5).²³ In all cases, the eigenvalue of the first component is very large, while the eigenvalue of the second component is considerably below 1. Moreover, the first components explain most of the variation in the variables – above 80 percent in all cases – while the eigenvector of the first component shows similar values across variables. These results provide strong support for the use of common components as proxies for their respective dimensions. Some variables were discarded from the physical capital component due to the lack of commonality with the remaining variables – internet users (net), generation capacity per capita (tgcn), and road density (roadl). It was not possible to obtain a good component for the remaining dimensions.²⁴

Table 5: Principal component analysis

Human capital (pc_hk)	c_1	c_2	c_3	c_4		
Eigenvalue	3.36	0.28	0.24	0.11		
Proportion	0.84	0.07	0.06	0.03		
Secondary education (ger2)	0.52	-	-	-		
Tertiary education (ger3)	0.49	-	-	-		
Life expectancy (lex)	0.49	-	-	-		
Years of schooling (mys)	0.50	-	-	-		
Physical capital (pc_pk)	c_1	c_2	c_3			
Eigenvalue	2.71	0.19	0.10			
Proportion	0.90	0.06	0.03			
Access to electricity (elect)	0.58	-	-			
Access to sanitation (san)	0.58	-	-			
Access to water (wat)	0.57	-	-			
Governance (pc_gov)	c_1	c_2	c_3	c_4	c_5	c_6
Eigenvalue	5.26	0.32	0.24	0.11	0.04	0.03
Proportion	0.88	0.05	0.04	0.02	0.01	0.01
Voice & accountability (gov1)	0.39	-	-	-	-	-
Political stability (gov2)	0.37	-	-	-	-	-
Government effectiveness (gov3)	0.42	-	-	-	-	-
Regulatory quality (gov4)	0.41	-	-	-	-	-
Rule of law (gov5)	0.43	-	-	-	-	-
Control of corruption (gov6)	0.42	-	-	-	-	-

Notes: The Kaiser-Meyer-Olkin measure of sampling adequacy (proportion of common variance) is above 0.7 for all variables.

The first econometric specification (i) includes the initial share of employment in agriculture (ea0) and physical capital (pc_hk), since access to water (wat) also appeared to be a strong candidate for inclusion (Table 6). The second specification (ii) adds human capital (pc_pk) to the first specification. The results show that all three variables are strongly significant (at 1 percent), and that they jointly explain nearly one-third (0.31) of the (within-group) variance of structural change. The declining magnitude of the coefficient on physical capital is due to some correlation between the physical

²³ Ghosh and Phillips (1998), for example, use the first principal component of primary enrolment rate, secondary enrolment rate, and life expectancy as a proxy for human capital.

²⁴ It is advisable to have at least three variables loading on each retained component.

capital and the human capital components. In fact, a principal components analysis of the seven variables supports a single component (pc_hpk), which is equally significant when inserted in the regression. Nonetheless, it is useful to know which variables are particularly relevant in the context of structural change. Hence, the third specification (iii) replaces human capital (pc_hk) by years of schooling (mys), while the fourth specification (iv) uses tertiary education (ger3). The variables are strongly significant, while the change in coefficient magnitude can be explained by the different measurement units.²⁵ Secondary education (ger2) is just about significant at 10 percent (not shown in table), probably because it is not highly relevant across all countries – see region-specific regressions.²⁶ Sequentially replacing physical capital (pc_pk) by access to water (wat), access to sanitation (san), and access to electricity (elect) leads to lower statistical significance at 5 or 10 percent – see (v). This might be because the individual variables capture specific aspects from a household perspective, while the common component of the three variables is a better proxy for a country's (broader) infrastructure development. Adding other variables, such as inflation (inf), trade openness (open), real exchange rate (reer), terms of trade (tot), credit to private sector (cred), and governance variables, does not change the results.²⁷ Since the dependent variable is a constructed measured – and thus subject to some 'noise' – R-squares around 0.3 can be considered relatively good.

Table 6: Determinants of structural change (full sample)

	FE (i)	FE (ii)	FE (iii)	FE (iv)	FE (v)	FE (vi)	RR (vii)	QR (viii)
Employment in agr. (ea0)	0.09 (0.01)***	0.10 (0.01)***	0.10 (0.01)***	0.10 (0.01)***	0.10 (0.01)***	0.07 (0.01)***	0.11 (0.01)***	0.11 (0.01)***
Physical capital (pc_pk)	0.86 (0.16)***	0.46 (0.17)***	0.60 (0.16)***	0.75 (0.15)***		0.46 (0.13)***	0.46 (0.17)***	0.38 (0.14)***
Human capital (pc_hk)		0.42 (0.10)***			0.46 (0.10)***	0.19 (0.08)**	0.29 (0.10)***	0.30 (0.05)***
Years of schooling (mys)			0.25 (0.07)***					
Tertiary education (ger3)				0.02 (0.00)***				
Access to water (wat)					0.02 (0.01)**			
Constant	-2.58 (0.45)***	-3.18 (0.46)***	-4.83 (0.73)***	-3.51 (0.49)***	-4.78 (0.95)***	-1.84 (0.50)***	-5.21 (0.84)***	-5.22 (1.11)***
Obs.	316	316	316	316	316	172	316	316
Countries	158	158	158	158	158	86	158	158
Prob > F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
Hausman	0.00	0.00	0.00	0.00	0.00	0.00	-	-
R-sq.	0.24	0.31	0.30	0.30	0.31	0.29	0.48	0.48

Notes: For the fixed-effects regressions (FE), cluster-robust standard errors are in parenthesis and the R-squared corresponds to the 'within' model.

In order to assess the robustness of these results, the main specification (ii) was tested on selected sub-samples. For instance, countries that had at least one value for the structural change component (btw) outside the 0-2 range were dropped. This led to the exclusion of 72 countries: eight countries had values between 2 and 3, while the remaining had negative values. Despite this dramatic sample reduction, the conclusions remain valid even if the coefficient on human capital is smaller and only statistically significant at the 5 percent level – see (vi). Additional estimators were

²⁵ The magnitude of the coefficients depends on the unit of measurement. For instance, years of schooling ranges from 1 to 13, while tertiary education ranges from 0 to 96. Moreover, the common components have small values.

²⁶ Life expectancy (lex) is only statistically significant at 10 percent – when replacing human capital (pc_hk).

²⁷ Terms of trade (tot) and political regime (pol2) – without the outlier of Venezuela – are not far from the 10 percent acceptance level. Some variables appear to be significant, but that is due to the presence of influential observations – such as D. R. Congo (inf and rir), Libya (reer), and Hong Kong (open). Once removed, the coefficients are no longer statistically significant. Using logarithms or adding squared values (to account for possible non-linearity) does not improve the results.

also used to test the robustness of the fixed-effects estimator. For instance, robust regressions (RR) assign different weights to each observation (through iterations) based on their absolute residuals. The results corroborate the key findings, although the coefficient on human capital declines somewhat – see (vii). As before, using tertiary education (ger3) and access to water (wat) also yields coefficients statistically significant at 1 percent – with similar magnitudes. Quantile regressions (QR) express the quantiles of the conditional distribution of the dependent variables as linear functions of the independent (conditioning) variables. The results presented here correspond to the median.²⁸ Once again, the results corroborate the robustness of the main findings – see (viii). Finally, several test diagnostics are performed – such as the hat-value (h), Cook’s distance (D), and residual analysis – which suggest that the model is well specified.²⁹

Turning to the region-specific regressions, only the most robust specifications are reported (Table 7). Since sample sizes are significantly smaller, inference needs to proceed carefully. The first point to make is that the initial finding regarding the share of employment in agriculture (ea0) is robust to all sub-samples – the variable remains strongly significant (at 1 percent) and the coefficient is broadly similar across all regions. In Africa, the initial share of mining & utilities in total GVA is strongly significant, suggesting that the abundance of mineral resources in some African countries acts as a deterrent to structural change. This could be due to disincentives to invest in other sectors. Physical capital is also significant at 1 percent. However, including human capital variables in the specification produces clear signs of collinearity, since human capital and physical capital are highly correlated in the Africa sub-sample. In the second specification, physical capital is replaced by secondary education (ger2), which is significant at 5 percent. Replacing it with years of schooling (mys) also leads to a positive coefficient at 5 percent, although the R-squared drops somewhat. On the other hand, replacing it with human capital (pc_hk) provides a slightly stronger specification, with the coefficient significant at 1 percent. In the third specification, the principal component that combines the 7 variables relating to both human and physical capital (pc_hpk) is used to confirm the importance of both dimensions.

²⁸ Hence, the median of the dependent variable is estimated – conditional on the independent variables – rather than the conditional mean performed by ordinary least squares. The median, unlike the mean, is not affected by large outliers.

²⁹ Including Equatorial Guinea and Oman in the sample (160 countries) leads to somewhat larger coefficients on the three main variables (all statistically significant at 1 percent), although they are both identified as outliers ($D > 0.1$).

Table 7: Determinants of structural change (regions)

	FE Africa (i)	FE Africa (ii)	FE Africa (iii)	FE Asia (i)	FE Asia (ii)	FE LAC (i)	FE Other (i)
Employment in agr. (ea0)	0.10 (0.03)***	0.10 (0.03)***	0.10 (0.03)***	0.09 (0.02)***	0.09 (0.02)***	0.09 (0.02)***	0.12 (0.01)***
Mining & utilities in total GVA (yce0)	-0.07 (0.02)***	-0.07 (0.02)***	-0.07 (0.02)***				
Physical capital (pc_pk)	0.78 (0.25)***			0.55 (0.25)**			
Secondary education (ger2)		0.03 (0.01)**					
Human & physical capital (pc_hp)			0.51 (0.18)***		0.57 (0.15)***		
Tertiary education (ger3)				0.02 (0.01)**		0.05 (0.02)**	0.01 (0.00)***
Real exchange rate (reer)						0.01 (0.00)**	0.01 (0.00)*
Political regime (pol2)							0.03 (0.01)**
Constant	-3.39 (1.50)**	-5.42 (2.08)**	-3.31 (1.54)**	-3.24 (0.89)***	-2.88 (0.80)***	-4.39 (1.40)***	-2.68 (0.55)***
Obs.	94	94	94	84	84	52	86
Countries	47	47	47	42	42	26	43
Prob > F	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hausman	0.00	0.00	0.00	0.00	0.00	0.00	0.00
R-sq.	0.34	0.33	0.34	0.28	0.29	0.44	0.68

Notes: Robust standard errors are in parenthesis.

In Asia, physical capital (pc_pk) and tertiary education (ger3) are statistically significant at 5 percent. The finding that tertiary education matters more in Asia, while secondary education matters more in Africa, probably reflects the different education levels and skill needs across the two regions. Once again, human and physical capital are highly correlated. The joint component is predictably strong. In Latin America & Caribbean, tertiary education is significant at 5 percent, while the only other variable that seems relevant is the real exchange rate (reer). The positive sign suggests that real exchange rate appreciations may actually promote structural change.³⁰ Despite the highly parsimonious specification, the R-squared is considerably higher than in Africa and Asia. Finally, tertiary education (ger3) is strongly significant in developed countries, while the political regime (pol2) and the exchange rate (reer) are significant at the 5 and 10 percent level, respectively. The significant coefficient on political regime may suggest that governance matters more at higher levels of development, while real exchange rate appreciations seem to favour higher-productivity sectors in developed countries. Overall, these explanatory variables explain almost 70 percent of the within-country variability in the data. Physical capital does not appear to be relevant in more developed countries, possibly suggesting that the existing variables are not capturing the type of infrastructure development that is required to accelerate structural change in these countries.³¹

Dabla-Norris et al. (2013) investigate the determinants of sectoral output shares in agriculture, manufacturing, and services – rather than structural change as measured by the employment reallocation effect. However, the authors also conclude that human and physical capital are important for structural change – in addition to a set of initial conditions (e.g. natural resource dominance). The empirical results in McMillan et al. (2014) suggest that a higher share of agriculture in employment, a lower share of raw materials in total exports, an undervalued exchange rate, and greater labour market flexibility all contribute to growth-enhancing structural change. However, it is

³⁰ Dabla-Norris et al. (2013) find that real exchange rate appreciations are positively associated with manufacturing and services output shares for above-median countries – i.e. countries with already high output shares in those sectors.

³¹ Average levels of access to electricity, water and sanitation are already very high.

important recall that their study used cross-sectional regressions, which means that their results explain differences across countries, rather than accelerations (or decelerations) of structural change within countries. When including the share of raw materials in total exports – which slightly reduces the country sample – its coefficient is not statistically significant. The rigidity of employment index is only available for the period 2003-2009, thus not useful for this exercise. The undervaluation index was constructed by the authors and is not publicly available. Nonetheless, the real exchange rate (reer) should capture a similar effect – in fact, it is used in Dabla-Norris et al. (2013).

5. Conclusion

There is a renewed interest in the study of structural change, mainly owing to concerns that recent growth patterns have not been inclusive nor sustainable. In fact, structural change has re-emerged as a key policy priority for many developing countries. There is little doubt that transforming economic structures is a necessary precondition for economic and social development. Historically, many countries were able to rapidly raise living standards by reallocating resources from traditional activities – such as subsistence agriculture – towards higher-productivity sectors – such as manufacturing and modern services. Not only does structural change stimulate economic growth, it can also lead to a more inclusive and sustained growth path. However, there is little research on how to accelerate its pace, especially for developing countries.

This paper uncovered evidence of growth-enhancing structural change in 12 out of the 13 sub-regions investigated. All sub-regions recorded a reduction in the share of employment in agriculture between 2002 and 2013, while services observed the largest relative increases in employment. Since agriculture has the lowest level of labour productivity, the reallocation of workers from agriculture to other sectors led to positive structural change, which helped boost aggregate productivity and thus economic growth. Although within-sector productivity improvements were the key driver of economic performance, the contribution of structural change has also been considerable and often growing in importance. Changes in the demographic structure had a positive impact on output per capita growth in developing regions, while the impact of employment rates varied considerably. With regard to sectoral dynamics, services were the main driver of economic performance and the key catalyst for structural change. Agriculture and manufacturing had a limited impact, but raising agricultural productivity remains crucial for eradicating poverty, while manufacturing can play a more important role if employment and labour productivity are simultaneously increased.

McMillan et al. (2017) posit that neoclassical and dual economy models offer complementary perspectives on economic growth. They argue that neoclassical models explain the growth process within modern sectors – mainly through broad-based physical and human capital accumulation, as well as the enhancement of institutional capabilities.³² Dual-economy models, on the other hand, are said to explain relationships and flows across sectors – through policies that ensure that resources flow to modern higher-productivity activities (typically from agriculture to industry). While our results do not directly contradict their hypothesis, they do suggest that physical and human capital play an important part in promoting structural change – namely, in the reallocation of employment across sectors.³³ Whether these are less important than targeted measures, it is difficult to assess. In fact, it could be argued that even general policy measures are likely to induce differentiated effects across sectors (e.g. real exchange rate, education, infrastructure). Moreover, sector-specific policies are not easily captured, and even if they were, the sectors being targeted often vary from country to country. Hence, this paper should not be seen as evidence that targeted policies do not matter. It is plausible that the unexplained variation in structural change within countries could be accounted by (unobserved) sector-specific interventions. McMillan et al. (2017) also claim that it is possible to have rapid structural change without significant improvements in the ‘fundamentals’ – defined as infrastructure, education, and institutions. While our results do suggest that initial conditions (unconditionally) influence structural change, they do not explain much of the variance. Physical and human capital do seem to play a vital role in boosting structural change.

In sum, there is still much scope for accelerating structural change. Labour productivity gaps and employment shares in agriculture remain high in several parts of the world. While the period since

³² The neoclassical growth model emphasises accumulation of physical and human capital (i.e. factors of production) and changes in total factor productivity (i.e. technical progress).

³³ In fact, Ando and Nassar (2017) show that education can improve the efficiency of sectoral labour allocation.

2002 has been unquestionably positive for developing countries, it is vital to improve the pace of structural change in order to fully seize its benefits. The key message of this paper is that investments in education and economic infrastructure are critical to accelerate structural change. Hence, the policy recommendations arising from both neoclassical and dual economy models may not be as different as one may expect.

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Annex

Table 8: Country sample

Africa	Code	Asia	Code	LAC	Code	Other (Developed)	Code
Eastern Africa		Central Asia		Caribbean		Albania	ALB
Burundi	BDI	Kazakhstan	KAZ	Bahamas	BHS	Australia	AUS
Comoros	COM	Kyrgyzstan	KGZ	Barbados	BRB	Austria	AUT
Eritrea	ERI	Tajikistan	TJK	Cuba	CUB	Belarus	BLR
Ethiopia	ETH	Turkmenistan	TKM	Dominican Rep.	DOM	Belgium	BEL
Kenya	KEN	Uzbekistan	UZB	Haiti	HTI	Bosnia & Herzegovina	BIH
Madagascar	MDG	Eastern Asia		Jamaica	JAM	Bulgaria	BGR
Malawi	MWI	China	CHN	Puerto Rico	PRI	Canada	CAN
Mauritius	MUS	Hong Kong, China	HKG	Trinidad & Tobago	TTO	Croatia	HRV
Mozambique	MOZ	Korea, Republic of	KOR	Central America		Czech Republic	CZE
Rwanda	RWA	Mongolia	MNG	Belize	BLZ	Denmark	DNK
Tanzania, United Rep.	TZA	South-Eastern Asia		Costa Rica	CRI	Estonia	EST
Uganda	UGA	Brunei Darussalam	BRN	El Salvador	SLV	Finland	FIN
Zambia	ZMB	Cambodia	KHM	Guatemala	GTM	France	FRA
Zimbabwe	ZWE	East Timor	TLS	Honduras	HND	Germany	DEU
Middle Africa		Indonesia	IDN	Mexico	MEX	Greece	GRC
Angola	AGO	Lao P.D.R.	LAO	Nicaragua	NIC	Hungary	HUN
Cameroon	CMR	Malaysia	MYS	Panama	PAN	Iceland	ISL
Central African Rep.	CAF	Myanmar	MMR	South America		Ireland	IRL
Chad	TCO	Philippines	PHL	Argentina	ARG	Italy	ITA
Congo	COG	Singapore	SGP	Bolivia	BOL	Japan	JPN
Congo, Dem. Rep.	COD	Thailand	THA	Brazil	BRA	Latvia	LVA
Equatorial Guinea	GNQ	Viet Nam	VNM	Chile	CHL	Lithuania	LTU
Gabon	GAB	Fiji	FJI	Colombia	COL	Luxembourg	LUX
Northern Africa		Papua New Guinea	PNG	Ecuador	ECU	Malta	MLT
Algeria	DZA	Solomon Islands	SLB	Guyana	GUY	Montenegro	MNE
Egypt	EGY	Southern Asia		Paraguay	PRY	Netherlands	NLD
Libya	LBY	Afghanistan	AFG	Peru	PER	New Zealand	NZL
Morocco	MAR	Bangladesh	BGD	Suriname	SUR	Norway	NOR
Sudan (former)	SDN	Bhutan	BTN	Uruguay	URY	Poland	POL
Tunisia	TUN	India	IND	Venezuela	VEN	Portugal	PRT
Southern Africa		Iran, Islamic Rep.	IRN			Republic of Moldova	MDA
Botswana	BWA	Maldives	MDV			Romania	ROU
Lesotho	LSO	Nepal	NPL			Russian Federation	RUS
Namibia	NAM	Pakistan	PAK			Serbia	SRB
South Africa	ZAF	Sri Lanka	LKA			Slovakia	SVK
Swaziland	SWZ	Western Asia				Slovenia	SVN
Western Africa		Armenia	ARM			Spain	ESP
Benin	BEN	Azerbaijan	AZE			Sweden	SWE
Burkina Faso	BFA	Cyprus	CYP			Switzerland	CHE
Cape Verde	CPV	Georgia	GEO			FYR of Macedonia	MKD
Côte d'Ivoire	CIV	Iraq	IRQ			Ukraine	UKR
Gambia	GMB	Israel	ISR			United Kingdom	GBR
Ghana	GHA	Jordan	JOR			United States	USA
Guinea	GIN	Kuwait	KWT				
Guinea-Bissau	GNB	Lebanon	LBN				
Liberia	LBR	Oman	OMN				
Mali	MLI	Qatar	QAT				
Mauritania	MRT	Saudi Arabia	SAU				
Niger	NER	Turkey	TUR				
Nigeria	NGA	United Arab Emirates	ARE				
Senegal	SEN	West Bank & Gaza Strip	PSE				
Sierra Leone	SLE	Yemen	YEM				
Togo	TGO						

Notes: Due to the lack of disaggregated data, Sudan refers to 'former Sudan' and is included in Northern Africa. Eastern Asia includes Hong Kong, China (not a UN member country); South-Eastern Asia includes Fiji, Papua New Guinea and Solomon Islands (all from Melanesia); Western Asia includes West Bank & Gaza Strip (not a UN member country). The Caribbean includes Puerto Rico (not a UN member country). Following common practice, 'developed' includes Europe, as well as Canada and United States (both from Northern America), Australia and New Zealand (both from Oceania) and Japan (from Eastern Asia).

Table 9: Output, employment and labour productivity by sector

Region / Sector	GVA (% total GVA)			Employment (% total employment)			GVA per worker (constant 2005 USD)		
	1991	2002	2013	1991	2002	2013	1991	2002	2013
Africa	100.0	100.0	100.0	100.0	100.0	100.0	3,108	3,103	3,834
Agriculture	14.4	15.6	15.2	60.7	60.0	55.4	739	809	1,052
Mining & Utilities	21.9	18.8	13.3	1.2	1.1	1.3	58,687	51,510	38,832
Manufacturing	13.1	12.2	10.9	7.4	6.8	6.2	5,530	5,573	6,796
Construction	3.6	3.9	5.5	2.5	2.7	3.9	4,581	4,473	5,463
Commerce	13.2	13.0	15.6	10.3	10.7	11.4	3,959	3,780	5,273
Transport	6.8	8.5	12.2	2.2	2.2	2.9	9,625	11,921	16,399
Other services	26.9	27.8	27.3	15.7	16.4	19.1	5,309	5,247	5,474
Asia	100.0	100.0	100.0	100.0	100.0	100.0	2,208	3,385	6,259
Agriculture	15.2	11.2	7.9	55.7	49.6	34.2	604	768	1,448
Mining & Utilities	13.1	11.3	9.5	1.5	1.2	1.4	19,670	32,496	42,285
Manufacturing	17.4	22.7	26.0	12.5	12.0	12.1	3,071	6,390	13,449
Construction	6.4	5.4	6.3	3.8	5.3	10.0	3,721	3,440	3,941
Commerce	12.8	12.7	13.7	14.6	17.3	21.9	1,937	2,498	3,936
Transport	6.4	7.5	7.9	3.0	3.9	5.5	4,634	6,458	9,073
Other services	28.6	29.1	28.6	8.8	10.7	14.9	7,150	9,224	12,010
LAC	100.0	100.0	100.0	100.0	100.0	100.0	10,518	10,626	12,116
Agriculture	5.4	5.5	5.0	25.2	20.1	15.4	2,264	2,895	3,933
Mining & Utilities	10.8	11.2	9.6	1.2	1.0	1.2	91,902	121,970	97,981
Manufacturing	18.6	18.4	16.6	14.6	13.7	12.6	13,375	14,248	15,884
Construction	6.9	6.2	6.5	5.6	6.3	7.5	12,966	10,440	10,433
Commerce	16.8	16.1	17.5	22.0	23.4	24.5	8,032	7,324	8,669
Transport	6.6	8.0	9.5	4.3	5.2	6.0	16,089	16,372	19,164
Other services	34.8	34.7	35.4	27.0	30.4	32.8	13,592	12,149	13,063
Other	100.0	100.0	100.0	100.0	100.0	100.0	47,749	57,431	63,495
Agriculture	1.8	1.6	1.5	8.4	6.8	4.6	10,392	13,115	20,392
Mining & Utilities	5.0	4.4	4.1	3.0	2.5	2.7	79,329	100,536	97,528
Manufacturing	15.7	15.1	15.2	21.7	17.3	13.6	34,530	50,251	70,872
Construction	7.1	5.8	4.5	7.2	7.1	7.0	47,006	47,038	41,251
Commerce	12.4	13.9	13.7	18.7	19.4	20.1	31,523	41,199	43,214
Transport	7.2	8.2	9.1	6.3	6.5	8.0	54,648	72,565	71,761
Other services	50.9	51.0	52.0	34.7	40.4	44.0	69,952	72,483	74,985

Source: Calculated from UNSD and ILO.

Figure 6: Labour productivity gaps, 2013

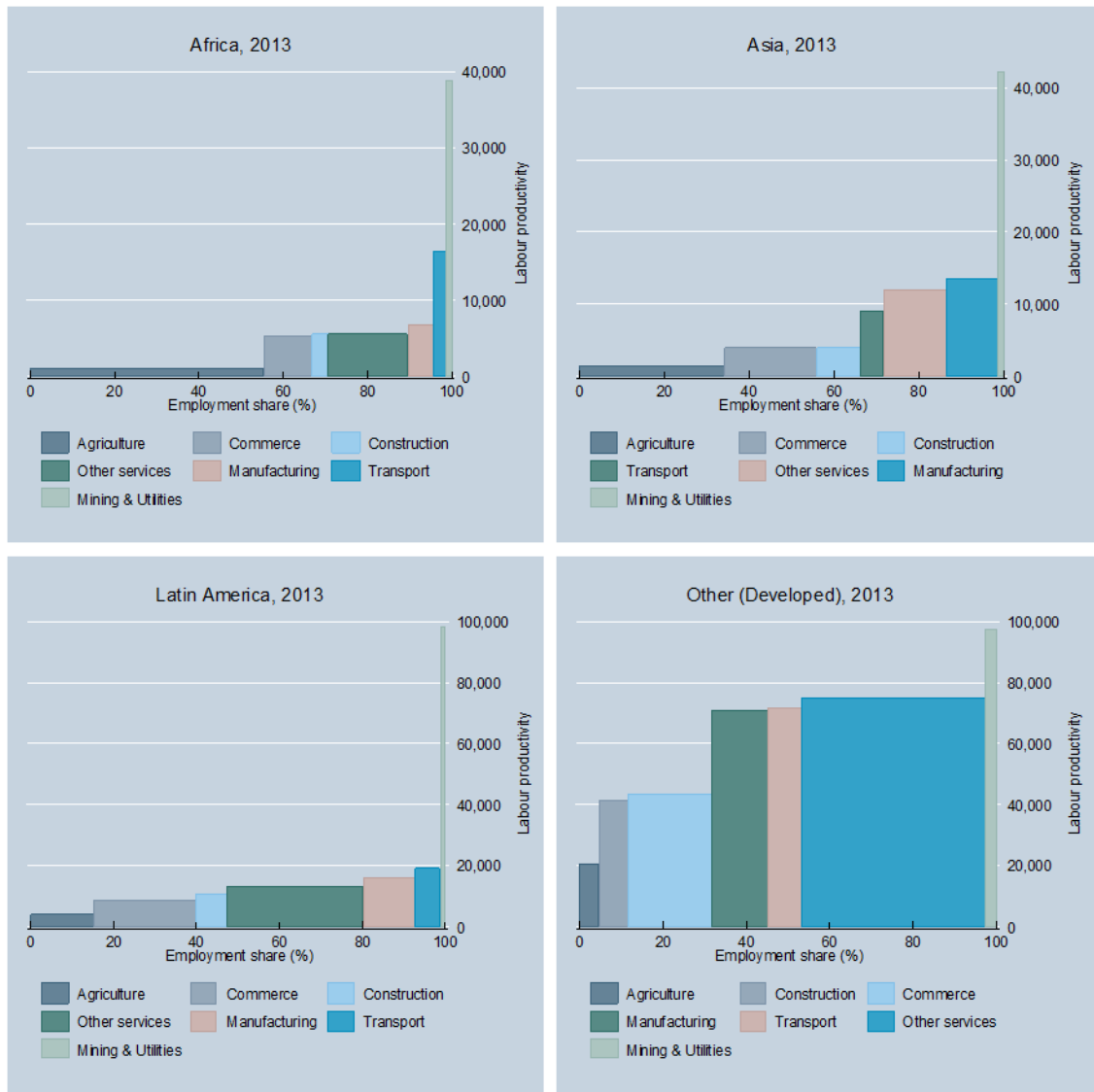


Table 10: Decomposition of GVA per capita growth, 1991-2013

Region / Sector	Contribution from (%):				Total contribution (%)
	Within-sector productivity	Between-sector productivity	Changes in employment	Changes in demography	
Africa	38.0	32.4	9.4	20.3	100.0
Agriculture	17.6	13.4	-12.6		18.4
Mining & Utilities	-23.8	6.7	0.6		-16.5
Manufacturing	8.3	-3.1	-3.4		1.8
Construction	2.7	2.1	5.0		9.8
Commerce	13.8	1.1	4.4		19.4
Transport	16.6	6.0	2.4		25.0
Other services	2.8	6.2	12.9		21.9
Asia	73.4	21.7	-6.7	11.6	100.0
Agriculture	8.9	16.2	-24.6		0.5
Mining & Utilities	7.6	-0.5	-0.2		7.0
Manufacturing	30.0	-0.4	-1.3		28.4
Construction	0.4	-0.6	5.8		5.5
Commerce	8.6	-2.2	6.1		12.4
Transport	4.4	1.5	2.1		8.1
Other services	13.6	7.7	5.3		26.5
LAC	18.5	21.6	29.6	30.3	100.0
Agriculture	8.5	20.3	-22.0		6.8
Mining & Utilities	1.9	-1.0	0.2		1.1
Manufacturing	8.6	-1.7	-1.7		5.3
Construction	-4.2	0.2	7.5		3.5
Commerce	3.7	-1.8	13.8		15.7
Transport	4.0	2.7	6.3		12.9
Other services	-4.0	3.0	25.4		24.4
Other	74.6	18.3	7.6	-0.5	100.0
Agriculture	3.8	8.9	-11.9		0.9
Mining & Utilities	3.1	-0.7	-0.9		1.5
Manufacturing	37.8	1.4	-25.1		14.1
Construction	-2.4	0.1	-0.1		-2.4
Commerce	13.4	-1.5	5.9		17.8
Transport	7.2	0.8	6.2		14.2
Other services	11.7	9.2	33.5		54.4

Note: Changes in employment refer to changes in the ratio of sectoral employment to the working-age population (Ei/A) – since it is not possible to disaggregate the working-age population by sector. For the same reason, changes in the demographic structure cannot be related to sectors.

Table 11: Comparison with other studies

Study	Period	Region (# countries)	Compound annual growth rate (%)			Share of contribution from (%):	
			Output per worker growth	Contribution from: Within sectors	Between sectors	Within sectors	Between sectors
This paper	1991-2013	Africa (49)	1.0	0.5	0.4	54	46
		Asia (48)	4.8	3.7	1.1	77	23
		LAC (28)	0.7	0.3	0.4	46	54
		Other (44)	1.3	1.1	0.3	80	20
This paper	2002-2013	Africa (49)	1.9	1.1	0.8	57	43
		Asia (48)	5.8	4.1	1.6	72	28
		LAC (28)	1.2	0.7	0.5	61	39
		Other (44)	0.9	0.7	0.2	75	25
McMillan et al. (2014)	1990-2005	Africa (9)	0.9	2.1	-1.3	248	-148
		Asia (10)	3.9	3.3	0.6	86	15
		LAC (9)	1.4	2.2	-0.9	166	-65
		High income (9)	1.5	1.5	-0.1	105	-6
McMillan & Harttgen (2014)	2000-2005	Africa (9)	2.1	1.2	0.9	57	43
		Asia (10)	3.9	3.5	0.4	89	11
		LAC (9)	1.0	1.9	-0.9	186	-86
		High income (9)	1.2	1.4	-0.2	116	-16
Timmer et al. (2014)	1990-2010	Africa (11)	1.9	1.7	0.1	94	6
		Asia (11)	3.6	3.1	0.6	85	15
		LAC (9)	0.9	1.1	-0.1	113	-13
UNCTAD (2014)	1991-2012	LDCs (38)	2.3	1.5	0.7	65	33
		ODCs (..)	3.7	2.4	1.2	66	33
		Developed (..)	1.4	1.2	0.1	90	9
Roncolato & Kucera (2014)	1999-2008	SSA (2)	2.6	1.9	0.5	73	19
		Asia (14)	5.3	3.3	2.0	62	38
		MENA (3)	1.2	1.8	-0.6	150	-50
		LAC (19)	0.8	0.6	0.2	75	25
		CSE Europe & CIS (18)	5.1	4.9	0.3	96	6
		Developed (25)	1.3	1.4	-0.1	108	-8

Notes: CIS Commonwealth of Independent States, CSE Central & Southeast, LAC Latin America & Caribbean, LDC Least Developed Countries, MENA Middle East & North Africa, ODC Other Developing Countries, SSA sub-Saharan Africa. The shares in the last two columns do not always add up to 100 – especially for SSA in Roncolato and Kucera (2014) – due to rounding of reported results. Timmer et al. (2014) disaggregate between-sector effects into static and dynamic reallocation effects, but only the combined effect is reported here – to facilitate comparisons. UNCTAD also estimates the contribution of changes in relative prices across sectors – though these are small.

Figure 7: Structural change component by country

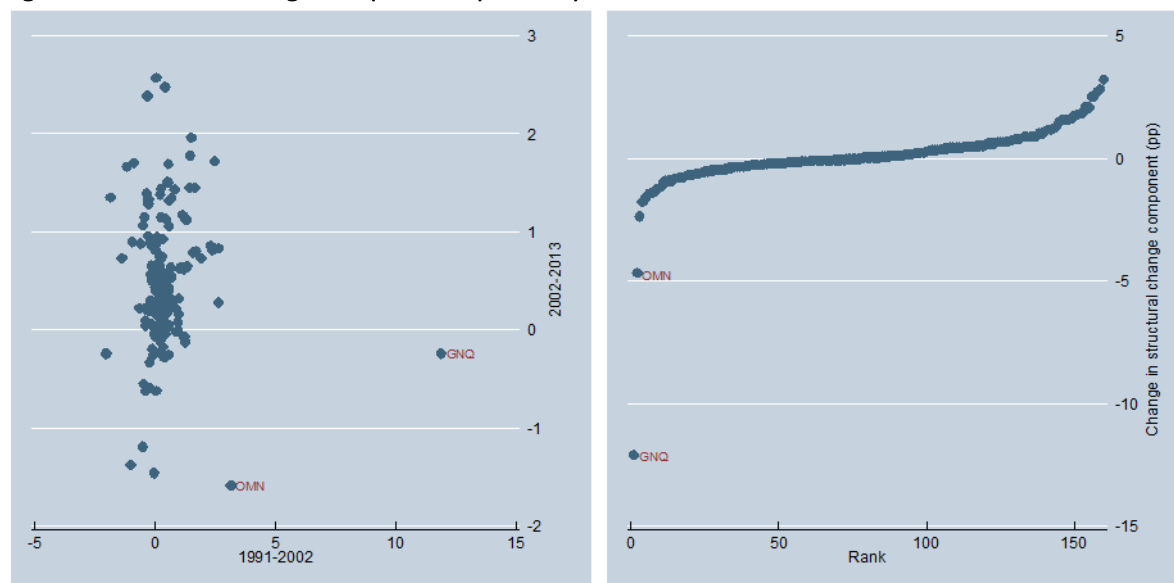


Table 12: Descriptive statistics of the key variables

Variable (short name)	Code	1991-2002				2002-2013			
		Mean	SD	Min	Max	Mean	SD	Min	Max
Structural change	btw	0.3	0.7	-2.0	2.6	0.5	0.6	-1.5	2.6
Employment in agriculture	ea0	35.5	26.3	0.3	90.7	33.0	26.5	0.3	91.1
Mining & utilities	yce0	10.7	14.4	0.4	72.7	10.6	14.0	0.4	68.0
Current account balance	cab	-3.1	6.3	-22.5	33.1	-1.9	8.9	-18.8	39.3
Government debt	debt	68.5	59.1	0.0	612.8	53.0	40.2	0.9	369.6
Fiscal deficit	def	-2.9	3.6	-19.6	10.9	-1.3	4.8	-17.6	28.9
Inflation	inf	69.4	266.9	0.5	2,887.3	6.2	4.8	-0.1	31.0
Terms of trade	tot	100.7	11.4	67.2	171.4	112.4	29.1	69.7	191.5
Trade openness	open	78.2	44.8	18.6	333.0	90.1	51.6	25.9	392.7
Real exchange rate	reer	103.8	38.8	52.4	405.8	101.7	6.7	80.7	133.1
Credit to private sector	cred	38.3	37.1	0.8	204.7	53.3	49.3	1.7	250.9
Real interest rate	rir	8.1	11.7	-46.6	58.8	5.8	6.1	-8.4	36.7
Secondary education	ger2	64.8	33.3	5.4	148.2	75.1	28.9	11.9	137.2
Tertiary education	ger3	20.7	18.2	0.2	74.4	31.8	25.7	0.5	96.3
Life expectancy	lex	65.7	10.3	37.2	80.2	69.0	9.6	45.8	82.5
Years of schooling	mys	6.5	3.0	0.7	12.5	7.5	3.1	1.3	12.8
Assess to electricity	elect	71.2	34.7	0.3	100.0	75.8	32.7	4.1	100.0
Assess to sanitation	san	65.0	32.5	5.4	100.0	69.7	30.6	8.7	100.0
Assess to water	wat	80.8	19.8	22.4	100.0	85.7	16.3	38.1	100.0
Internet users	net	4.3	6.3	0.0	26.3	27.4	24.8	0.5	89.9
Generation capacity	tgc_n	0.8	1.0	0.0	6.6	1.0	1.3	0.0	7.3
Road density	road_n	7.6	9.6	0.0	64.2	8.1	9.9	0.3	65.4
Political regime	pol2	3.2	6.2	-10.0	10.0	4.3	6.0	-10.0	10.0
Political rights	prcl	3.6	1.8	1.0	7.4	3.3	1.9	1.0	7.2
Voice & accountability	g1	-0.1	0.9	-1.8	1.7	-0.1	1.0	-2.1	1.6
Political stability	g2	-0.1	1.0	-2.6	1.5	-0.1	0.9	-2.3	1.5
Government effectiveness	g3	0.0	1.0	-1.8	2.1	0.0	1.0	-1.6	2.2
Regulatory quality	g4	0.0	0.9	-2.0	2.1	0.0	0.9	-2.0	1.9
Rule of law	g5	-0.1	1.0	-2.1	1.9	-0.1	1.0	-1.6	1.9
Control of corruption	g6	0.0	1.0	-1.7	2.4	0.0	1.0	-1.4	2.5

Note: Each period includes 158 countries.