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## **Unit Labor Costs and Manufacturing Sector Performance in Africa**

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# Unit Labor Costs and Manufacturing Sector Performance in Africa

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## *Abstract*

Several studies have highlighted that African manufacturing wages are higher than comparator countries at similar levels of development, which contributes to the continent's lower levels of manufacturing competitiveness. This paper derives unit labor costs – average wages relative to productivity – for two-digit manufacturing sectors across a wide range of developed and developing countries over the 1990-2015 period. We benchmark the unit labor costs to China and estimate the impact of relative unit labor costs on manufacturing sector value added, employment, investment and exports. We find that relative unit labor costs have a smaller effect on manufacturing performance in Africa relative to other developing regions. Further, we find that for Africa, the level and growth of labor productivity have a quantitatively stronger and more robust effect on manufacturing performance than the level and growth of real wages. The results have important implications for industrial policy in African countries.

*JEL codes: O14, L60, E24, J30*

*Keywords: labor costs; productivity; manufacturing; exports; investment; Africa; China*

## **1 Introduction**

For much of Africa, the level of industrialization has lagged behind other developing regions for decades. Today, manufacturing accounts for about 11 percent of Sub-Saharan Africa's (SSA) GDP, lower than the 1990 level of 16 percent (World Bank, 2020). Industrial employment in SSA accounts for just above 11 percent of total employment, not significantly higher than early 1990 levels (World Bank, 2020).<sup>1</sup> Furthermore, the value of African manufactured exports to the world

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<sup>1</sup> From 10.9% in 1991, industrial employment in SSA declined to a low of 9.8 percent of total employment in 2005.

remains low in comparison to other developing regions.<sup>2</sup> This study aims to assess whether and to what extent unit labor costs (ULCs) – average wages relative to labor productivity – constitute a constraint to Africa’s manufacturing industry growth. Specifically, we benchmark two-digit manufacturing industry ULCs for a wide range of countries in Africa and other regions to China – which has become one of the world’s foremost manufacturing producers over the last two decades – to assess how changes in relative unit labor costs (RULC) impact manufacturing industry outcomes. At the same time, we also take into account other important country-level factors of manufacturing sector performance, including resource dependence, the quality of infrastructure and institutions.

The manufacturing sector is considered an important engine of sustained growth and it tends to exhibit strong unconditional international convergence in labor productivity (Rodrik, 2013). In the case of Africa, the small share of the manufacturing sector in overall economic activity is a major impediment to improving aggregate productivity and achieving higher levels of income. McMillan et al. (2014) estimate that structural change in Africa between 1990 and 2005 contributed negatively to overall economic growth by as much as 1.3 per cent per annum on average, mostly due to the shift of labor from the primary sector to a tertiary sector that is dominated by informal enterprises with low productivity.<sup>3</sup> There is, however, heterogeneity across the continent, with some countries such as Ghana, Ethiopia and Malawi exhibiting positive structural change wherein the share of employment in agriculture declined and that of manufacturing increased (McMillan et al., 2014).

One of the challenges to industrialization in Africa over the last two decades has been international competition especially in the context of the rapid rise of China and other East Asian economies as global manufacturing powerhouses. China’s rapid ascent over the past two decades has been attributed to a number of structural and institutional factors, including an undervalued exchange

<sup>2</sup> According to UNCTAD statistics, Africa’s manufactured exports to the world in 2019 totaled USD 112.15 billion, compared to a value of USD 223.67 billion for South Asia, USD 529.34 billion for Latin America and the Caribbean and USD 5,295.55 billion from Eastern and South-Eastern Asia.

<sup>3</sup> The 2000-2005 period is shown to be more promising for Africa, where structural change became growth enhancing.

rate, wage repression and high productivity. In some African countries, RULCs have been estimated to be up to three times greater than China (Golub et al., 2018). In addition, greater trade liberalization in Africa has also meant higher levels of domestic competition from imported manufactured goods. In this context, relative unit labor costs are a useful indicator of manufacturing competitiveness, which not only focuses on relative wages but adjusts labor costs to account for productivity levels. Therefore, low wages alone are not seen to be a source of comparative advantage.

This study aims to investigate the extent to which the poor performance of the manufacturing sector may be due to low productivity and high labor costs which undermine global competitiveness, especially in the context of the unprecedented rapid growth of China as an exporter of manufactured products. The goal of this paper is twofold. First, it evaluates how RULCs vary within Africa and compare to other developing regions. Second, the paper investigates the relationship between RULCs and manufacturing industry performance globally and by region, accounting for other important country-level factors.

This paper uses a novel global manufacturing two-digit industry-level panel database constructed from various sources. The database covers the 1990-2015 period, for a sample of 113 developed and developing countries, including 20 African countries. It includes data related to manufacturing output, employment, exports and a range of country-level factors. The paper uses a fixed effects estimation approach to investigate how changes in RULCs and other important indirect costs of production affect manufacturing sector growth, employment, exports and investment.

The paper makes several contributions to the literature. First, it analyses manufacturing performance at the more detailed two-digit level, which is not commonly studied in the literature, particularly for a long time-horizon and covering a large sample of developing countries. Second, this is one of the first papers to benchmark ULCs to China for a global set of countries. Over the last decade, there has been considerable attention paid to the impact of China on developed countries' manufacturing sectors (Acemoglu et al., 2016; Balsvik et al., 2015; Dauth et al., 2014) and this paper sheds light on how the relative competitiveness of different regions has evolved over time. Third, this chapter goes beyond calculating and comparing RULCs or direct wage costs

as done in existing studies (Gelb et al., 2020; Golub et al., 2018), by estimating the impact of RULCs on various measures of manufacturing performance.

The rest of the paper is structured as follows. Section 2 discusses the existing literature on the constraints to African manufacturing performance and competitiveness. Section 3 presents the methodology and data, followed by descriptive analysis in Section 4. The econometric estimation results are presented and discussed in Section 5, and Section 6 concludes.

## **2 Literature Review: Constraints to Manufacturing Growth in Africa**

The literature on Africa's uneven economic performance and lackluster manufacturing growth is now expansive. While early research focused on the macroeconomic environment, as firm-level data became more readily available, the focus shifted to microeconomic dynamics. There is relatively little analysis of manufacturing industries, to which this paper contributes. This section first reviews the firm-level empirical evidence on the major constraints to manufacturing growth in Africa, followed by a discussion of industry-level evidence, focusing on the role of ULCs.

### **2.1 Firm-level evidence**

Greater access to firm-level survey data in Africa, such as the World Bank's 1990s Regional Program on Enterprise Development (RPED) survey, Investment Climate and World Business Environment surveys, and the more recent Enterprise Surveys, have spurred a large set of firm-level studies focusing on African manufacturing performance. Bigsten and Soderbom (2006) provide a comprehensive review of the first decade of research arising from these data, they identify several barriers to manufacturing performance in Africa that we elaborate on below.

First, an unstable or volatile macroeconomic environment creates price volatility, uncertainty in consumer demand patterns, and hampers investment (Gunning & Mengistae, 2001). The uncertainty is seen to negatively affect firm investment decisions and promotes more conservative approaches to inventory management and product mixes (Pattillo and Söderbom, 2001). Recent evidence from Ugandan panel data shows that the macroeconomic environment and demand stability are amongst the most important constraints to firm performance (Mawejje & Sebudde, 2019). Second, there is considerable evidence to suggest that firms in Africa are credit constrained,

especially small firms (Bigsten et al., 2003). Further evidence from firm-level data in Kenya shows that access to credit enables firms to address liquidity constraints and grow faster (Nkurunziza, 2010). Third, there is a particularly strong average wage-firm size relationship amongst African firms: the average wage rises rapidly with firm size (Fafchamps and Söderbom, 2006). This could point to there being a labor cost constraint to firm growth, which could be driven by a number of reasons, such as a need to pay efficiency wages to induce higher productivity or increased monitoring and managerial costs. Fourth, inadequate core infrastructure in Africa has been shown to be a major growth constraint by imposing additional indirect costs (Eifert et al., 2008). Firms often have to provide their own infrastructure, but where the cost is too large – for example, road networks – it serves to keep firms small and localized due to the inability to reach markets further away. Subsequent research supports this evidence that African firms face higher indirect costs than in other developing regions due to the poor quality and/or high cost of core infrastructure, information and communication technology, and public services, which negatively affects firm growth, productivity and export performance (Clarke, 2012; Eifert et al., 2008).

Some results from these studies are pertinent to the topic at hand. Fafchamps and Söderbom (2006) study wages, worker supervision and productivity in manufacturing using matched employee-employer data from ten African countries. They find that supervision rates in Africa seem to be higher than in other parts of the world, signaling labor management issues. In addition, the authors find that while worker effort (i.e., productivity) responds positively to supervision in SSA, the response is considerably larger with respect to wages, and that wages increase with firm size for both production workers and supervisors. Fafchamps and Söderbom (2006) propose that instead of pointing to issues of poor education – which is relatively higher amongst manufacturing workers in Africa – labor management might be difficult in the region due to problems with the enforcement of employment contracts due to weak legal institutions, as well as poor infrastructure and equipment such as electricity and input shortages and machine breakdown.

There is other evidence to suggest that formal sector manufacturing wages in Africa are relatively high. A comparison of average manufacturing wages at the firm-level in the early 2000s has shown that average manufacturing wages in Africa are higher than in other countries with similar GDP per capita levels, with the notable exception of Ethiopia (Clarke, 2012; Gelb et al., 2020). ULCs for SSA are estimated to be similar to other developing regions but significantly higher than East

Asia (Clarke, 2012). Using independently collected data from garment firms in Kenya and Bangladesh, Fukunishi (2009) finds that the firms in the two countries operate with almost equal efficiency; however, the unit cost of Kenyan firms was 2.5 times greater, making them less price competitive due to higher wages. The author conjectures that higher wages in this context is partly driven by higher cost of living in Kenya, which is not sufficiently offset by higher productivity.

Evidence for Africa suggests that higher wages may only be weakly related to worker-level productivity. Fox and Oviedo (2008) investigate the wage setting mechanisms in manufacturing firms across 20 countries in SSA and find that returns to education are higher amongst older cohorts of workers, but this does not correlate strongly with higher productivity for these workers. Similarly, Van Biesebroeck (2011) suggests that there are higher wage returns to experience than to firm-specific skills (associated with higher productivity) in Kenya and Tanzania. This points to other important social or institutional norms around wage setting. Fafchamps et al. (2009) examine wage gaps and job sorting in manufacturing firms across 11 African countries and show that a large part of the education wage gap is explained by occupation and firm effects, thereby implying that the returns to skills are strongly influenced by the characteristics of the firm. It is larger, more productive firms that can make the best use of workers' skills and pay higher wages (M. Fafchamps et al., 2009). Furthermore, foreign-owned firms in Africa, particularly from advanced countries, and those that export are associated with higher wage premiums than domestic firms (Coniglio et al., 2015; Fox and Oviedo, 2008; te Velde and Morrissey, 2003).

More recently, in a comprehensive analysis of African formal manufacturing firm performance – measured by a range of variables such as total factor productivity, labor productivity, sales growth, export share and investment rate, Harrison et al. (2014) find that African firms perform on average worse on all measures relative to firms in comparator countries. However, when controlling for a set of key differences in firm characteristics, geography, infrastructure, institutional factors and the business environment, African manufacturing firms display a conditional advantage in productivity levels and growth. This implies that conditional on country specific factors, African firms have higher productivity and growth. The authors show that the key factors that affect African manufacturing firms are infrastructure, access to finance and party competition.



## 2.2 Industry-level evidence

While firm-level studies provide insight on microeconomic dynamics, they have some limitations. First, firm-level studies in the African context often rely on small sample surveys that over-sample large firms and are therefore not representative of the population of firms (Bigsten & Soderbom, 2006). In addition, the industrial composition of these data is typically limited and therefore do not represent the manufacturing or services sectors at larger. Therefore, we cannot immediately generalize these results at the aggregate sector level. Second, firm-level studies do not capture intra-industry dynamics such as spillover effects, competition and business stealing, and market expansion. Industry-level analysis, as is conducted in this study, enables us to capture these dynamics. Inter-industry linkages are best dealt with at the macro level.

Earlier work on industry-level competitiveness in Africa focused on total factor productivity (TFP) as a measure of competitiveness. Adenikinju et al. (2002) analyze detailed manufacturing industries in Cameroon, Côte d'Ivoire, Nigeria and Senegal during the 1970s-1990s and show that TFP declined across most industries, but particularly for the textile, leather and food industries. The authors' estimation results show that TFP is significantly and positively related to the export share of output and there exists a feedback from exports to TFP. The authors argue that these results support the need for productivity improvements and export promotion policies to improve overall competitiveness.

More recent work explores ULCs as a proxy for competitiveness, which does not only consider labor costs but also encompasses other structural factors that could impact labor productivity. Ceglowski and Golub (2012) calculate China's RULC for the aggregate manufacturing industry over 1998-2009 and find considerable cost advantage relative to a range of developed and developing countries, which is due to larger wage differentials rather than productivity differentials.<sup>4</sup> The authors estimate that China's ULC was at about 40 percent of the US' in 1998, 36 percent by 2003, and rose to 68 percent by 2009. Following from this work, Golub et al. (2018) show that in 2010 Mauritius, South Africa, Malawi, Senegal and Kenya had RULCs that were

<sup>4</sup> Ceglowski and Golub (2012) use the 2010 version of UNIDO INDSTAT2 data but the authors only make use of the aggregate manufacturing data.

between 1.2 and 3 times greater than China, while Ethiopia and Tanzania had lower or equivalent RULC to China. The authors found that even though productivity in much of SSA was higher than China, the SSA-China wage differential was larger, therefore resulting in China's higher levels of competitiveness.

Relatedly, a few country-specific studies focusing on RULCs as a measure of competitiveness in SSA find robust evidence that a decline in RULCs has a strong positive effect on manufacturing exports. For Senegal, Mbaye and Golub (2002) found a significant impact of RULC on the total real export value, but in particular, a considerably larger significant effect on manufacturing exports. Using industry-level data for South Africa over 1970s-1990s, Edwards and Golub (2004) found that South African ULCs were quite high relative to other newly industrializing countries at that time. In addition, their results showed that South African exports respond strongly to RULCs: a 1 percent rise in RULC reduces the export volume by about 4.7 percent, on average across manufacturing industries, in the long-run. When the effect is decomposed, relative wages appears to have a larger effect on exports than relative productivity.

This study aims to contribute to the literature on manufacturing sector performance with a focus on the role of unit labor costs. The next section describes the methodology and data used in the empirical analysis.

### 3 Methodology and Data

#### 3.1 Empirical model

ULCs are measured as the product of the labor requirement per unit of output and the average labor compensation (Ark et al., 2000; Golub et al., 2018). First, the unit labor requirement  $a$  in each manufacturing industry  $j$  is defined as follows:

$$a_j = L_j / Q_j \quad (1)$$

With  $L$  denoting the level of employment and  $Q$  is value added,  $a$  represents the inverse of labor productivity. Denoting the average total compensation per worker in each manufacturing sector  $j$  by  $w_j$ , the ULC can be expressed as:

$$ULC_j = a_j w_j \quad (2)$$

Therefore, ULCs can be understood as the average wage in each industry divided by its labor productivity ( $ULC_j = \frac{w_j}{1/a_j}$ ). To compare the competitiveness of a country's manufacturing sector to that of a comparator country requires a measure of relative unit labor costs RULCs:

$$RULC_{ij} = \frac{a_j w_j}{a_j^* w_j^*} \quad (3)$$

The asterisk (\*) refers to the foreign comparator country and all variables are in a common currency, the US dollar. Hence, a  $RULC > 1$  for any manufacturing industry  $j$  in country  $i$  signals a lower level of competitiveness than the corresponding manufacturing industry in the comparator country. In the case of this paper, the comparator country is China. Therefore, all countries' industries are benchmarked to Chinese industries. Competitiveness vis-à-vis a comparator country measured by RULCs can increase via three channels: 1) a reduction in relative wages; 2) an increase in relative productivity; and 3) a depreciation of the nominal exchange rate.

We follow the approach of the International Labour Organisation and prior studies in converting variables into a common currency. As described in Ark et al. (2000), when comparing across several countries, nominal labor compensation is converted from each local currency to US dollars using the market exchange rate, whereas value added is deflated using domestic price deflators and converted to US dollars using the PPP exchange rate to take into account price differences between countries. Therefore, fluctuations in the market exchange rate will rightly not affect productivity, but they affect cost differences in terms of labor compensation.

Two types of empirical exercise are undertaken in this paper. First, we calculate and examine the trends in relative unit labor costs within Africa and compare these to other developing regions. Second, we econometrically estimate the relationship between RULCs and performance outcomes – value added, employment, investment and exports – across manufacturing industries. We use a fixed effects estimation approach. We exploit within-country, with-industry variation over time, and identify the impact of changes in RULCs within each industry on the four growth outcomes over time.

Given the unbalanced nature of the panel, we use five-year averages to create a balanced panel by time period. We estimate the following equation, where the overbar represents 5-year averages:

$$\bar{Y}_{ijt} = \alpha_{ijt} + \beta_1 \overline{RULC}_{ijt} + \beta_2 \bar{Z}_{ijt} + \gamma_i + \eta_j + \delta_t + \varepsilon_{ijt} \quad (4)$$

The dependent variable,  $Y_{ijt}$  is, alternatively, one of the following outcome measures for country  $i$ , industry  $j$ , in time  $t$ : real value added, employment, real investment (measured as gross fixed capital formation), or real exports. There are 5 periods, each representing a period average. The coefficient of interest is  $\beta_1$ , which reveals the impact of a unit increase in relative unit labor costs on a measure of sector performance. Vector  $Z$  includes measures of country-level factors such as the quality of infrastructure and institutional variables. To improve causal interpretation, the model includes country, and industry-period interacted fixed effects to control for unobserved heterogeneity within countries and to account for industry-specific time trends over time. We also estimate the equation in five-year differences to assess how changes in RULC affect changes in the outcome variables.

We furthermore decompose RULC into the wage and productivity components to estimate the relative magnitude of the wage versus productivity effects using the following model:

$$\bar{Y}_{ijt} = \alpha_{ijt} + \beta_1 \overline{RW}_{ijt} + \beta_2 \overline{RP}_{ijt} + \beta_3 \bar{Z}_{ijt} + \gamma_i + \eta_j + \delta_t + \varepsilon_{ijt} \quad (5)$$

RW stands for relative wage and RP for relative productivity. All other variables are as defined above.

### 3.2 Data

The main source of data is the UNIDO INDSTAT2 dataset covering the 1963-2017 period and most of the world. The dataset contains annual data on number of employees, wages and salaries, value added (VA) and gross fixed capital formation (GFCF) for 23 manufacturing industries at the two-digit ISIC level. The data are derived from annual census data of manufacturing activity within each country. The wage compensation data include direct wages and salaries, bonuses, housing allowances, payments in kind, but not employer contributions to worker benefits. The dataset is not complete; there are many missing cells over time, particularly for low-income countries, making it difficult to conduct annual time-series analysis over a long period. We chose to limit the regression sample to the post-1990 time period to maximize the number of countries with the required data points. The unit of analysis is the two-digit manufacturing industry.

The monetary values are provided both in local currency units and in US dollars, converted at the average market exchange rate for each year. The deflator used to convert value added into real values is constructed from the World Bank's World Development Indicators (WDI) values for nominal and real manufacturing value added for each country. This is available for most countries in the sample, with the exception of China. For China, we deflate manufacturing value added using the producer price index for industrial activities provided by OECD statistics. For both deflators, 2011 is the base year. The real value added for each manufacturing sector is then converted to US dollars using the WDI's PPP conversion rate.

The export data is obtained from Comtrade and matched to the UNIDO data using concordance tables provided by the United Nation Statistics Division and Eurostat. We match the 4-digit SITC product codes to the 23 ISIC industry codes. For each country, we use real exports to the world in US dollars as the measure of exports.

A number of country-level controls are obtained from the World Bank's World Development Indicators. To account for the structure of the economy, we use the share of land area that is used for agriculture (a proxy for primary sector dependence) and the percentage of ores and metals in exports (a proxy for natural resource dependence). We control for indicators of infrastructure using the proportion of the population with access to electricity and the air freight capacity. Financial sector development is proxied by domestic credit provided by the financial sector as a percentage of GDP, which includes credit to various sectors excluding the central government. The availability and level of skills in the labor force is measured by the tertiary enrollment rate, while institutional quality is measured by two of the World Governance Indicators, government effectiveness and regulatory quality. Variable definitions are provided in Table A1 in the Appendix.

After inclusion of the control variables into the dataset, the sample is further reduced due to missing values on some variables. The final sample used for regression analysis contains a total of 85 countries, of which 15 are African countries. We present descriptive analysis of unit labor costs for a broader range of African countries, however, due to the lack of data for other variables, some of these countries are dropped in the final regressions. The full list of countries used in the

regression analysis is presented in Table A2 in the Appendix. The regression sample statistics are provided in Table A3.

## **4 Descriptive Analysis**

As presented in Table 1, on average, manufacturing ULCs in Africa have declined from 1.65 times China's ULCs in the 1990s to almost parity in the post-2010 period. However, whilst the previous decades showed declining trends in the annual average growth rate of RULCs, post 2010, RULCs in Africa have been rising.<sup>5</sup> The data also shows that Africa's productivity differential with China was smaller than the wage differential in the 2000s but this is reversed in the post-2010 period, which is reflected in the lower RULC. Over the 1990-2015 period, South Asia remains the most competitive region, as measured by ULCs, followed by Latin America and the Caribbean (LAC) and then Africa. In the post 2010 period, however, improvements in African competitiveness has resulted in lower ULCs than the LAC region.

There is heterogeneity in ULCs across the continent. Figure 1 presents the trends in RULCs for 20 African countries, for which there are at least five years of consecutive data. Some East African countries stand out for having higher levels of competitiveness than China: Ethiopia, Kenya, and Tanzania. This is also true for Uganda and Burundi, although we have fewer datapoints to consider. Several countries, namely Cameroon, Mauritius, Morocco, Namibia, South Africa and Tunisia show lower levels of competitiveness at the aggregate manufacturing level, relative to China. With the exception of Cameroon, these countries have relatively higher average income levels (middle-income countries) and so the higher RULCs reflect that productivity is not high enough to compensate for the higher wage levels.

In the most recent period (2010-2015), the data presented in Table 2 shows that of the African countries for which we have data, five countries have ULCs that exceed China's and a further two, Malawi and Tunisia, have ULCs that are about parity with China. Therefore, half of the countries in Africa for which we have data are shown to have higher levels of competitiveness than China.

<sup>5</sup> It remains to be seen whether the observed increase in RULC in the post-2010 will be sustained, in which case the past gains in competitiveness would be eroded.

In the latest period, South Africa and Mauritius have the highest RULCs at 2.5 times and almost 2 times that of China. At the other end of the range, Botswana, Algeria and Tanzania have the lowest RULCs at 0.08, 0.24 and 0.35.

There is also considerable industry-level heterogeneity in RULCs across Africa, presented in Table 3. Over the 1990-2015 period, the industries that are most competitive relative to China on ULCs are resource-based manufacturing industries – leather products and footwear, wood products, non-metallic mineral products and food and beverages – with RULCs ranging from 1 to 1.7. The least competitiveness industry is office, accounting and computing machinery with ULCs that 19 times China’s, followed by tobacco products at 18 times, although the tobacco products industry displays RULCs of between 3-6 in the post-2000 period. While the higher technology industries such as office, accounting and computing machinery as well as radio, TV and communication equipment currently exhibit lower levels of competitiveness vis-à-vis China, these are also two of the industries with the greatest rates of improvement over the 25-year period. Therefore, within the overall manufacturing sector, there are signs of improvements in competitiveness in higher value added industries.

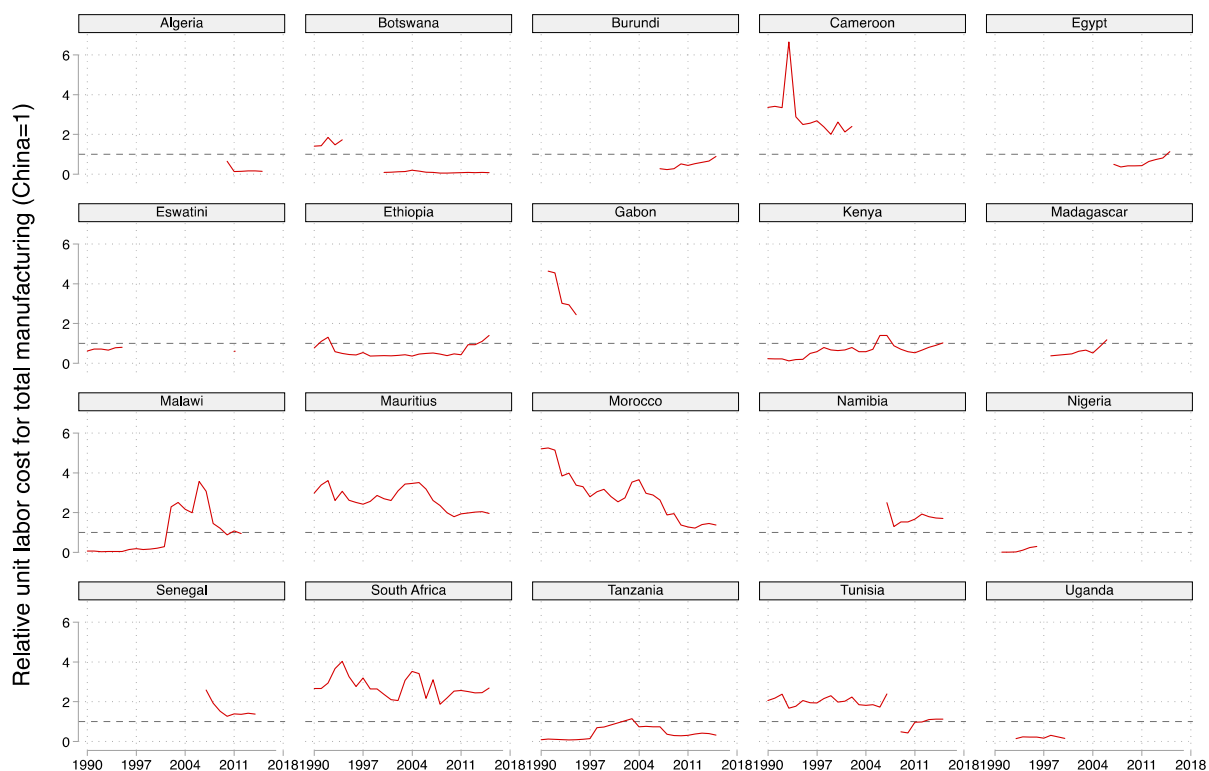
Table 1: RULC, relative wages and productivity vis-a-vis China by region for total manufacturing sector

Region	1990-1999		2000-2009		2010-2015		1990-2015	
	average	annual % change	average	annual % change	average	annual % change	average	annual % change
<b>RULC</b>								
Africa	1.65	-1.61	1.51	-3.12	1.03	5.18	1.45	-1.45
Middle East	2.60	545.77	2.83	-5.26	1.78	8.65	2.50	90.86
East Asia & Pacific	4.03	-4.07	3.06	-4.54	2.10	4.90	3.21	-2.22
South Asia	0.47	-3.36	0.51	-1.08	0.62	12.03	0.52	1.65
Latin America & Caribbean	1.45	-1.31	1.21	-1.31	1.45	10.55	1.36	0.90
Europe & Central Asia	11.94	-7.09	5.94	-3.50	3.11	-1.32	7.59	-3.56
North America	6.75	3.58	5.69	8.94	4.72	-9.21	5.55	-2.92
<b>Relative wages (US\$)</b>								
Africa	8.26	-7.27	1.91	-7.77	1.01	-2.32	4.15	-6.63
Middle East	20.76	-6.81	5.65	-8.53	2.33	-2.55	10.69	-6.65
East Asia & Pacific	22.80	-6.26	6.18	-8.03	2.65	-4.16	11.76	-6.58
South Asia	2.29	-6.77	0.84	-7.51	0.37	-2.93	1.29	-6.45

Latin America & Caribbean	14.30	-5.91	3.41	-8.93	1.43	-3.38	7.35	-6.71
Europe & Central Asia	36.61	-6.76	11.20	-7.25	4.05	-7.11	19.32	-6.73
North America	67.70	-14.75	21.90	-7.66	8.32	-6.90	36.38	-6.33
<b>Relative productivity (PPP US\$)</b>								
Africa	15.50	-8.31	1.46	-7.55	2.35	19.44	7.07	-3.54
Middle East	45.94	-10.61	3.43	-7.57	2.07	-4.27	19.47	-4.11
East Asia & Pacific	7.23	-5.29	1.97	-6.67	1.22	-4.75	3.82	-3.65
South Asia	7.27	-6.43	1.79	-7.98	0.62	-8.81	3.63	-3.99
Latin America & Caribbean	578.02	-11.03	3.97	-9.51	1.27	-6.06	224.14	-4.16
Europe & Central Asia	130.37	-11.02	1.86	-6.61	1.19	-5.80	51.13	-4.16
North America	8.13	-16.43	3.25	-5.84	2.23	-2.38	3.70	-4.39

Notes: Average wage is calculated as the total wage cost divided by the number of employees. Average productivity is calculated as the value added per worker. Source: Author's calculations using UNIDO (2019) and WDI (2020).

Figure 1: RULC vis-a-vis china for total manufacturing, Africa, 1990-2015



Notes: The dashed line (=1) represents equivalence to China's ULC. Source: Author's calculations using UNIDO (2019) and WDI (2020).



Table 2: RULC vis-a-vis China for African countries for the whole manufacturing sector

Country	1990-1999		2000-2009		2010-2015		1990-2015	
	average	avg annual % change	average	avg annual % change	average	avg annual % change	average	avg annual % change
Algeria					0.24	-15.49		
Botswana	1.58	-11.11	0.11	-3.37	0.08	1.40	0.45	-3.94
Burundi			0.26	0.483	0.61	13.94	0.49	27.78
Cameroon	3.18	-4.48	2.38	-11.11			2.99	-2.37
Egypt			0.43	-8.18	0.70	34.17	0.61	16.02
Eswatini	0.72	-11.11					0.71	-0.08
Ethiopia	0.64	-5.78	0.43	0.08	0.88	38.94	0.62	3.32
Gabon	3.52	-11.79						
Kenya	0.38	20.41	0.84	1.32	0.75	14.99	0.64	13.91
Madagascar	0.38		0.71	30.25			0.67	26.64
Malawi	0.10	14.51	1.88	53.48	0.97	3.78	0.99	57.58
Mauritius	2.87	-0.45	2.90	-2.89	1.96	1.96	2.67	-3.80
Morocco	3.91	-4.34	2.76	-3.38	1.35	-0.02	2.88	-8.18
Namibia	1.09		1.78	-19.50	1.73	2.34	1.68	2.70
Senegal			2.02	-20.57	1.37	2.18	1.61	-6.65
South Africa	3.05	-0.09	2.59	-0.83	2.53	1.18	2.75	0.03
Tanzania	0.26	76.86	0.69	-12.38	0.35	2.33	0.43	10.34
Tunisia	2.05	1.30	1.82	-8.41	0.95	32.25	1.70	-1.89
Uganda	0.22	8.69						

Source: Author's calculations using UNIDO (2019) and WDI (2020).

Table 3: RULC vis-a-vis China: African average by manufacturing industry

Country	1990-1999		2000-2009		2010-2015		1990-2015	
	average	annual % change	average	annual % change	average	annual % change	average	annual % change
Food and beverages	1.77	6.65	1.88	-4.35	1.19	3.55	1.68	0.10
Tobacco products	38.69	-4.52	5.99	-4.52	2.90	0.49	17.86	-3.12
Textiles	1.69	-1.71	1.87	-3.32	2.59	17.19	1.97	1.33
Wearing apparel, fur	11.92	13.69	3.90	-9.71	2.87	3.02	6.75	-2.30
Leather products and footwear			1.15	-2.37	1.00	2.50	1.08	-1.88
Wood products	1.75	2.24	1.50	-2.84	1.59	-1.71	1.62	0.03
Paper and paper products	1.55	-6.18	1.87	28.98	2.68	12.29	1.93	1.94
Printing and publishing	2.38	-3.80	1.84	-4.06	1.27	-4.23	1.91	-2.66
Coke, petroleum products, nuclear fuel	2.48	3.30	4.63	-10.58	2.55	56.56	3.33	9.26
Chemicals and chemical products	1.60	-2.36	2.22	-3.41	1.44	6.13	1.80	-1.02
Rubber and plastics products	2.84	-6.64	1.86	-5.29	1.05	4.88	2.05	-3.18

Non-metallic mineral products	1.67	-0.37	1.30	-3.99	1.02	8.55	1.37	-0.64
Basic metals	2.07	-0.87	1.61	1.95	2.27	9.49	1.94	1.79
Fabricated metal products	3.12	-6.45	2.16	3.45	2.23	-2.45	2.54	-1.80
Machinery and equipment	2.13	-4.22	1.54	11.92	1.39	0.35	1.73	0.72
Office, accounting and computing machinery			32.15	-11.07	5.62	-18.49	18.88	-8.25
Electrical machinery and apparatus	4.39	5.17	3.59	-8.23	2.07	17.33	3.55	-0.78
Radio, television and communication equipment			3.70	-7.09	1.78	3.58	3.12	-7.79
Medical, precision and optical instruments	1.89	-0.17	2.37	3.77	2.53	-7.05	2.18	1.58
Motor vehicles, trailers	4.68	0.98	2.97	-5.30	1.20	0.33	3.22	-2.52
Other transport equipment			1.66	-7.50	1.75	28.48	1.70	-0.43
Furniture	3.18	-8.73	1.02	-0.63	0.64	-3.15	1.76	-3.63
Recycling			3.98	-6.48			3.68	-9.28

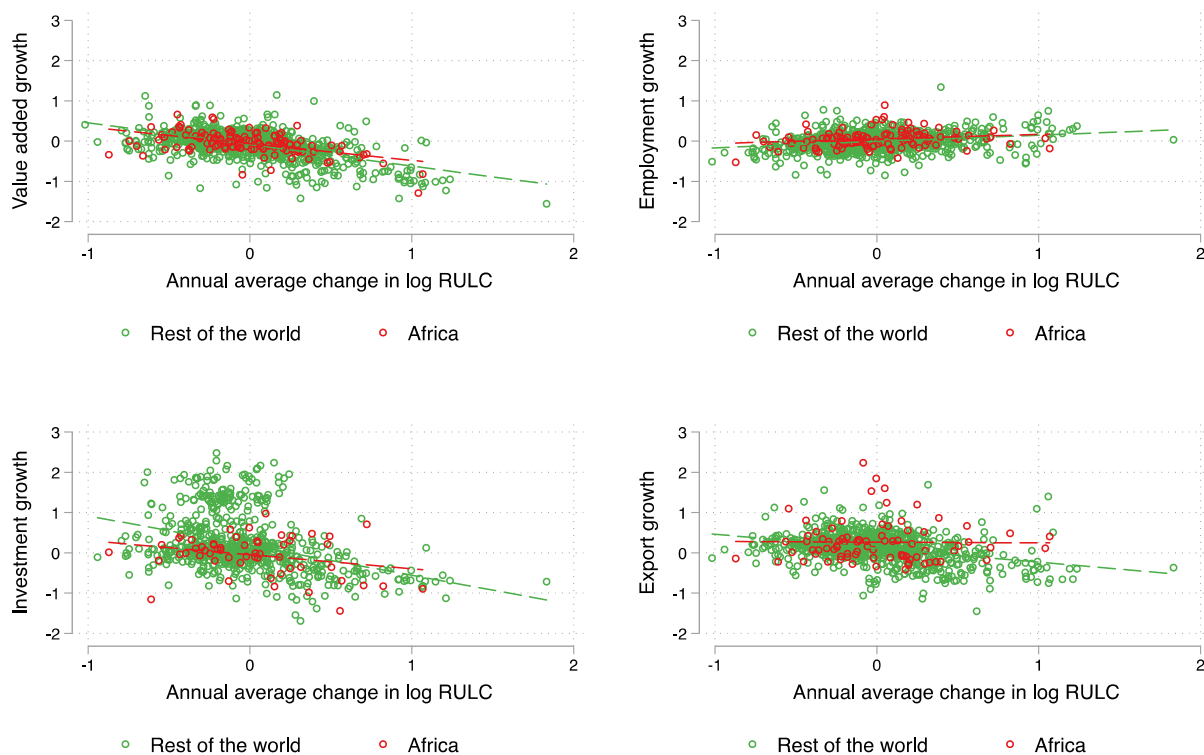
Notes: The following industries only have data for 2003-2015: Leather; office accounting and computing machinery; radio, television and communication equipment; other transport equipment. The data for the recycling industry is only available over 2003-2010. Source: Author's calculations using UNIDO (2019) and WDI (2020).

Finally, in Figure 2 we plot the unconditional relationship between changes in the four main outcome variables and changes in RULCs over the sample period. Our main analysis aims to investigate the role of RULCs as a determinant of manufacturing sector outcomes, namely, value added, employment, investment and exports. We expect a priori that improvements (reductions) in RULCs are positively associated with manufacturing value added, investment and exports. The results for employment are inconclusive. At any given level of output, employment is negatively associated with productivity improvements, therefore we cannot a priori determine the relationship between employment and RULCs.

The data shows that growth in real value added, investment and exports are negative associated with changes in RULCs, with investment exhibiting the strongest relationship of the three variables. Changes in RULCs are positively related to employment growth, although the slope coefficient is relatively small. Manufacturing industries in Africa (red points) seem to exhibit similar patterns to industries in other regions regarding value added and growth. For investment, however, African manufacturing industries that have experienced improvements in competitiveness do not appear to experience the same growth in investment as compared to industries in other regions with similar improvements in competitiveness. The opposite is true for exports, where many African industries lie above the global average. In the next section, we aim

to test these relationships using a fixed effects estimation approach and controlling for other country-level factors that could affect these relationships.

Figure 2: Changes in manufacturing outcomes and RULCs (1990 - 2015)



Notes: Each point represents a two-digit manufacturing industry across all countries in our sample. All variables are in log form. Source: Author's calculations using UNIDO (2019) and WDI (2020).

## 5 Regression Results and Discussion

### 5.1 Baseline specification

Table 4 presents the regression results for the baseline specification in levels, where each panel from A to E represents separate regressions by region. We present the results for each outcome indicator with and without control variables. Each regression includes country fixed effects as well

as the interaction of period and industry effects. In panel A<sup>6</sup>, for the full sample of countries, we find that higher RULCs are negatively associated with the size of the manufacturing industry measured by (log) value added. In contrast, manufacturing industries with higher RULCs are associated with greater levels of employment. By construction, both value added and employment are used to calculate RULCs. In this case, the result could reflect that lower productivity (value added per worker) – seen in higher RULCs – could be associated with both lower value added and higher employment, since more workers are needed to produce a given level of output. The results in columns 5-8 show that RULCs vary negatively with investment and exports, with a quantitatively stronger association between RULCs and investment.

The results for manufacturing value added are qualitatively similar in all regions and they are consistent with those for the full sample. Quantitatively, the negative effects of RULCs on manufacturing value added are smaller in African countries, and highest in the Middle East and South Asia. For the two regions, manufacturing value added declines more than proportionately following an increase in RULCs, by up to 1.2 times for the Middle East and 1.1 times for South Asia. For Africa and Latin America, a 10 percent increase in RULCs is associated with 6 percent and 7 percent decline in manufacturing value added, respectively.

The results for employment are similar in the full sample and in the Africa sample. The coefficient on RULCs is positive and significant in both cases. In contrast, the coefficient is negative and significant in the case of Middle East countries. The results show no impact of RULCs on employment in the case of South Asia and Latin America. Overall the results in the full sample seem to be driven by the Africa sample.

High RULCs are associated with lower investment in the full sample and at the regional level except in the case of the Middle East. In the case of African countries, a 10 percent increase in RULC is associated with 3 percent reduction in the levels of investment. Exports are also negatively associated with RULCs, but the result is not robust to inclusion of control variables in the cases of Africa and Latin America.

<sup>6</sup> The full regression results for the full sample of countries are presented in Tables A3 and A4 in the Appendix.

Table 5 presents the baseline specification estimated in five-year changes. The results provide the effect of changes in RULCs on growth rates of the various indicators of manufacturing performance. For the full sample, the results are consistent with those reported in Table 4. An increase RULCs are associated with reductions in output growth, investment growth and export growth, and an increase in employment. For Africa, we find that industry-level increases in RULCs have a significantly negative effect on value added growth. A 10 percent increase in RULC growth is associated with a 5 percent decline in value added growth. Increases in RULCs have only a small positive effect on employment growth. Changes in RULCs have a negative effect on investment growth in Africa, but this effect becomes insignificant when other country level factors are accounted for. Finally, a ten percent increase in RULCs reduces export growth by 1.3 percent, a smaller response than seen in South Asia (5 percent). An increase in the growth of RULCs has no impact on export growth in the case of the Middle East and Latin America and the Caribbean.

Table 4: RULC and manufacturing performance, whole sample and by region

	(1) VA	(2) VA	(3) Employment	(4) Employment	(5) Investment	(6) Investment	(7) Exports	(8) Exports
<b>A. Full sample:</b>								
RULC	-0.725*** (0.035)	-0.756*** (0.037)	0.106*** (0.033)	0.096*** (0.034)	-0.540*** (0.063)	-0.525*** (0.064)	-0.323*** (0.038)	-0.339*** (0.039)
Obs.	5,174	5,174	5,101	5,101	4,011	4,011	5,118	5,118
R <sub>2</sub>	.814	.818	.808	.81	.706	.711	.803	.805
<b>B. Africa:</b>								
RULC	-0.626*** (0.060)	-0.574*** (0.067)	0.186*** (0.058)	0.238*** (0.068)	-0.532*** (0.103)	-0.316** (0.122)	-0.139* (0.078)	-0.104 (0.090)
Obs.	704	704	661	661	412	412	684	684
R <sub>2</sub>	.764	.778	.749	.756	.670	.72	.690	.703
<b>C. Middle East:</b>								
RULC	-1.173*** (0.173)	-1.169*** (0.182)	-0.282* (0.145)	-0.290* (0.154)	-0.451 (0.346)	-0.497 (0.381)	-0.617*** (0.171)	-0.633*** (0.184)
Obs.	392	392	371	371	274	274	392	392
R <sub>2</sub>	.787	.805	.778	.789	.774	.793	.736	.741
<b>D. South Asia:</b>								
RULC	-1.169*** (0.238)	-1.124*** (0.287)	0.092 (0.216)	0.266 (0.258)	-0.222 (0.353)	-0.757** (0.360)	-0.964** (0.389)	-1.085** (0.457)
Obs.	230	230	230	230	225	225	176	176
R <sub>2</sub>	.902	.905	.903	.908	.828	.866	.920	.921

<b>E. LAC:</b>								
RULC	-0.794*** (0.067)	-0.756*** (0.074)	0.001 (0.070)	0.080 (0.072)	-1.104*** (0.246)	-0.095 (0.215)	-0.432*** (0.126)	-0.163 (0.132)
Obs.	777	777	777	777	475	475	777	777
R <sub>2</sub>	.900	.902	.885	.890	.713	.843	.751	.774
Industry x Period FE	X	X	X	X	X	X	X	X
Country FE	X	X	X	X	X	X	X	X
Controls		X		X		X		X

Notes: Robust standard errors are reported. Disaggregated results for East Asia and Pacific, Europe and Central Asia and North America are not shown, but countries in these regions are included in the full sample. The focus is on regions that are most closely comparable to Africa.

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 5: Five-year changes in RULC and manufacturing performance, whole sample and by region

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$\Delta VA$	$\Delta VA$	$\Delta \text{Employment}$	$\Delta \text{Employment}$	$\Delta \text{Investment}$	$\Delta \text{Investment}$	$\Delta \text{Exports}$	$\Delta \text{Exports}$
<b>A. Full sample:</b>								
$\Delta RULC$	-0.668*** (0.045)	-0.659*** (0.046)	0.064** (0.030)	0.067** (0.032)	-0.334*** (0.078)	-0.277*** (0.078)	-0.198*** (0.031)	-0.154*** (0.029)
Obs.	3,587	3,587	3,527	3,527	2,649	2,649	3,494	3,494
R <sub>2</sub>	.514	.532	.340	.346	.312	.333	.316	.344
<b>B. Africa:</b>								
$\Delta RULC$	-0.579*** (0.067)	-0.488*** (0.071)	0.136 (0.084)	0.193* (0.100)	-0.339*** (0.114)	-0.036 (0.135)	-0.155** (0.064)	-0.126* (0.067)
Obs.	469	469	427	427	264	264	448	448
R <sub>2</sub>	.631	.667	.289	.361	.387	.494	.419	.465
<b>C. Middle East:</b>								
$\Delta RULC$	-0.637*** (0.118)	-0.631*** (0.139)	0.105 (0.083)	0.093 (0.088)	0.278 (0.583)	0.764 (0.667)	-0.224 (0.169)	-0.132 (0.200)
Obs.	245	245	236	236	173	173	245	245
R <sub>2</sub>	.649	.656	.586	.619	.58	.62	.405	.427
<b>D. South Asia:</b>								
$\Delta RULC$	-0.530** (0.228)	-0.582*** (0.194)	0.485** (0.192)	0.464*** (0.170)	2.475*** (0.668)	0.762* (0.405)	-0.537* (0.293)	-0.537* (0.293)
Obs.	142	142	142	142	134	134	40	40
R <sub>2</sub>	.635	.687	.537	.634	.541	.887	.633	.633
<b>E. LAC:</b>								
$\Delta RULC$	-0.618*** (0.065)	-0.647*** (0.103)	-0.007 (0.084)	0.015 (0.128)	-1.543*** (0.264)	-0.339 (0.209)	-0.090 (0.079)	-0.012 (0.102)
Obs.	548	548	548	548	283	283	548	548
R <sub>2</sub>	.500	.550	.316	.365	.609	.879	.391	.446
Industry x Period FE	X	X	X	X	X	X	X	X
Country FE	X	X	X	X	X	X	X	X
Controls		X		X		X		X

Notes: Robust standard errors are reported. Disaggregated results for East Asia and Pacific, Europe and Central Asia and North America are not shown, but these regions are included in the full sample. The focus is on regions that are most closely comparable to Africa.

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

## 5.2 Decomposition specifications

To further explore the relationship between manufacturing performance and RULCs, we decompose RULCs into relative earnings and relative productivity. The results of the regressions in levels are presented in Table 6, which is analogous to Table 4, while those in 5-year changes are reported in Table 7, which is analogous to Table 5. A priori, on the one hand, we would expect that for any given level of productivity, higher wages would be negatively associated with levels of value added, employment, investment and exports as higher wages impose additional costs on producers. On the other hand, higher productivity would be associated with higher levels of value added, investment and exports, but lower levels of employment for any given level of output.

The results in Table 6 show a strong positive relationship between labor productivity and manufacturing value added in the full sample that also holds across developing regions. An increase in labor productivity is accompanied by an increase in manufacturing value added, and the effect is robust to controlling for industry, time and country-level factors. In the case of African countries, on average, a 10 percent improvement in labor productivity is associated with a 7 percent increase in manufacturing value added. The results also show a positive and significant, though smaller effect of labor productivity on gross fixed capital formation and exports. In the Africa sample, a 10 percent increase in labor productivity is accompanied by a 4 percent increase in investment and a 2 percent increase in manufacturing exports.

The results from the regressions in levels confirm the expectation that higher levels of labor productivity are associated with lower employment in the manufacturing sector. For any given level of output and wage rates, a 10 percent improvement in labor productivity is associated with a 3 percent reduction in employment. Improved competitiveness within any manufacturing sector, without a sufficient demand compensation channel to increase output, would entail a transfer of jobs to other sectors of the economy. For Africa, this might be limited given the positive export response to improved productivity.

According to the results in Table 6, there is no significant relationship between the level of real wages and indicators of manufacturing sector performance in Africa. The coefficients on real wages are insignificant, except in the case of investment; but even there, the significance disappears when industry and country-level factors are controlled for. In the other developing regions, we find a strong positive relationship between real wages and investment in the manufacturing sector. This result may reflect the fact that wages are high in the middle-income countries in these regions, which also happen to have high investment levels in selected manufacturing sectors. The result should not be interpreted as a causal relationship between real wages and gross fixed capital formation.

The results of regressions in growth rates presented in Table 7 are consistent with those in levels presented in Table 6 with regard to the impact of labor productivity on manufacturing performance. They show a strong positive and large effect of an increase in the growth rate of labor productivity on manufacturing value added growth for the full sample and in all the regions. They also show a positive effect of increases in labor productivity growth on exports growth for the whole sample and in the developing regions except the Middle East. Increases in productivity growth are also accompanied by increases in investment growth in the full sample; but in the case of Africa, the effects are not robust to controlling for country and industry-level specific factors. There is no significant effect of labor productivity growth on investment in the other developing regions.

The regressions in changes uncover a negative relationship between growth in real wages and growth in manufacturing value added, employment and exports in the full sample and in African countries. It is noteworthy that a simultaneous proportional increase in the growth rate of real wages and labor productivity is associated with a net increase in the growth of manufacturing value added. In the Africa sample a simultaneous increase in the growth rate of labor productivity and real wages by 10 percent would be associated with a 3.6 percent increase in the growth rate of manufacturing value added. In contrast, the results suggest that gains in export growth from an acceleration in labor productivity that is matched proportionately by an increase in real wage growth would result a deceleration of export growth. As in the regression in levels, the results in changes also do not show any significant relationship between real wage and in investment in the manufacturing sector.



Overall, the regression results obtained from a decomposition of RULCs into real wages and labor productivity conclusively show that there is a positive and robust relationship between labor productivity and manufacturing sector value added, investment and export, both in levels and in growth rates. They also show a negative relationship between labor productivity and employment in the manufacturing sector. Real wage growth is found to be associated with a deceleration in the pace of manufacturing sector value added growth in Africa, but not in the other regions. Acceleration in real wage growth is also associated with a deceleration in export growth in Africa and in South Asia, and these negative effects are not offset by simultaneous equal increase in labor productivity growth.

Table 6: Manufacturing sector performance, relative earnings and relative productivity: regressions in levels

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	VA	VA	Employment	Employment	Investment	Investment	Exports	Exports
<b>A. Full sample:</b>								
Relative earnings	-0.009 (0.057)	-0.029 (0.062)	0.013 (0.057)	-0.001 (0.062)	0.103 (0.109)	0.257** (0.122)	-0.016 (0.063)	-0.011 (0.068)
Relative productivity	0.863*** (0.034)	0.872*** (0.035)	-0.121*** (0.034)	-0.115*** (0.035)	0.645*** (0.065)	0.601*** (0.066)	0.408*** (0.039)	0.406*** (0.040)
Obs.	5095	5077	5095	5077	3991	3991	5039	5021
R <sub>2</sub>	.840	.842	.809	.811	.717	.725	.809	.811
<b>B. Africa:</b>								
Relative earnings	-0.153 (0.101)	-0.124 (0.119)	-0.135 (0.101)	-0.106 (0.119)	-0.583*** (0.159)	-0.304 (0.196)	0.077 (0.134)	0.117 (0.157)
Relative productivity	0.751*** (0.059)	0.693*** (0.069)	-0.240*** (0.058)	-0.290*** (0.069)	0.647*** (0.108)	0.416*** (0.137)	0.284*** (0.085)	0.228** (0.101)
Obs.	658	658	658	658	401	401	638	638
R <sub>2</sub>	.801	.808	.763	.769	.681	.724	.702	.714
<b>C. Middle East:</b>								
Relative earnings	-0.283 (0.259)	-0.315 (0.281)	-0.281 (0.261)	-0.339 (0.283)	1.980*** (0.406)	1.949*** (0.506)	-0.073 (0.309)	-0.133 (0.341)
Relative productivity	1.270*** (0.152)	1.242*** (0.173)	0.293* (0.149)	0.289* (0.167)	0.467* (0.262)	0.427 (0.308)	0.763*** (0.163)	0.781*** (0.181)
Obs.	371	371	371	371	274	274	371	371
R <sub>2</sub>	.840	.850	.778	.789	.835	.843	.763	.766

**D. South****Asia:**

Relative earnings	0.429 (0.385)	0.846* (0.448)	0.505 (0.380)	0.899** (0.443)	1.863*** (0.548)	1.197* (0.635)	-0.432 (0.566)	-0.468 (0.724)
Relative productivity	0.835*** (0.233)	0.581** (0.282)	-0.207 (0.234)	-0.451 (0.282)	-0.177 (0.356)	0.238 (0.383)	0.882** (0.388)	0.904* (0.471)
Obs.	230	230	230	230	225	225	176	176
R <sub>2</sub>	.918	.924	.904	.909	.848	.880	.922	.922

**E. LAC:**

Relative earnings	-0.386*** (0.118)	-0.315*** (0.117)	-0.338*** (0.115)	-0.289** (0.117)	1.339*** (0.350)	1.229*** (0.295)	0.015 (0.188)	0.402* (0.211)
Relative productivity	0.914*** (0.063)	0.850*** (0.067)	-0.082 (0.063)	-0.142** (0.068)	1.470*** (0.225)	0.474*** (0.170)	0.626*** (0.136)	0.439*** (0.139)
Obs.	777	759	777	759	475	475	777	759
R <sub>2</sub>	.908	.914	.891	.898	.771	.90	.762	.787
Industry x Period FE	X	X	X	X	X	X	X	X
Country FE	X	X	X	X	X	X	X	X
Controls		X		X		X		X

Robust standard errors are reported. Disaggregated results for East Asia and Pacific, Europe and Central Asia and North America are not shown, but these regions are included in the full sample. The focus is on regions that are most closely comparable to Africa. For the regressions with controls, we add the average period exchange rate to the full set of controls. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 7: Manufacturing sector performance, relative earnings and relative productivity: regressions in changes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$\Delta VA$	$\Delta VA$	$\Delta \text{Employment}$	$\Delta \text{Employment}$	$\Delta \text{Investment}$	$\Delta \text{Investment}$	$\Delta \text{Exports}$	$\Delta \text{Exports}$
<b>A. Full sample:</b>								
$\Delta \text{Relative earnings}$	-0.204*** (0.043)	-0.239*** (0.047)	-0.122*** (0.041)	-0.131*** (0.046)	-0.191 (0.128)	-0.010 (0.134)	-0.122** (0.048)	-0.090* (0.050)
$\Delta \text{Relative productivity}$	0.883*** (0.032)	0.885*** (0.036)	-0.102*** (0.032)	-0.105*** (0.034)	0.486*** (0.095)	0.492*** (0.101)	0.283*** (0.042)	0.207*** (0.038)
Obs.	3,524	3,524	3,524	3,524	2,625	2,625	3,431	3,431
R <sub>2</sub>	.696	.700	.360	.367	.322	.347	.328	.351
<b>B. Africa:</b>								
$\Delta \text{Relative earnings}$	-0.415*** (0.076)	-0.337*** (0.099)	-0.352*** (0.069)	-0.249*** (0.092)	-0.468* (0.270)	0.174 (0.369)	-0.353*** (0.136)	-0.292** (0.142)
$\Delta \text{Relative productivity}$	0.761*** (0.088)	0.700*** (0.101)	-0.202*** (0.073)	-0.209*** (0.078)	0.478*** (0.155)	0.008 (0.185)	0.240*** (0.082)	0.185** (0.084)
Obs.	427	427	427	427	249	249	406	406

R <sub>2</sub>	.741	.774	.449	.510	.421	.565	.451	.500
<b>C. Middle East:</b>								
ΔRelative earnings	0.405 (0.277)	0.550* (0.298)	0.303 (0.247)	0.408 (0.275)	0.681 (1.181)	1.974 (1.258)	-0.131 (0.373)	0.076 (0.433)
Δ Relative productivity	0.852*** (0.126)	0.803*** (0.137)	-0.072 (0.093)	-0.120 (0.098)	-0.252 (0.524)	-0.715 (0.584)	0.133 (0.172)	0.021 (0.187)
Obs.	236	236	236	236	173	173	236	236
R <sub>2</sub>	.757	.771	.593	.632	.584	.638	.382	.412
<b>D. South Asia:</b>								
ΔRelative earnings	0.464 (0.521)	0.482 (0.494)	0.553 (0.476)	0.608 (0.466)	3.822** (1.494)	1.384 (0.861)	-1.622** (0.665)	-1.622** (0.665)
Δ Relative productivity	0.480** (0.205)	0.626*** (0.179)	-0.538*** (0.189)	-0.456** (0.174)	-2.235*** (0.615)	-0.503 (0.364)	0.809** (0.370)	0.809** (0.370)
Obs.	142	142	142	142	134	134	40	40
R <sub>2</sub>	.680	.759	.550	.6335551	.538	.887	.740	.740
<b>E. LAC:</b>								
ΔRelative earnings	-0.483*** (0.111)	-0.515*** (0.188)	-0.368*** (0.106)	-0.480*** (0.178)	-1.028*** (0.274)	0.344 (0.383)	0.191* (0.102)	0.282** (0.131)
Δ Relative productivity	0.695*** (0.078)	0.673*** (0.100)	-0.184*** (0.063)	-0.192** (0.079)	1.732*** (0.301)	0.281 (0.181)	0.305*** (0.094)	0.226** (0.102)
Obs.	548	548	548	548	283	283	548	548
R <sub>2</sub>	.542	.580	.416	.475	.616	.880	.423	.474
Industry x Period FE	X	X	X	X	X	X	X	X
Country FE	X	X	X	X	X	X	X	X
Controls		X		X		X		X

Robust standard errors are reported. Disaggregated results for East Asia and Pacific, Europe and Central Asia and North America are not shown, but these regions are included in the full sample. The focus is on regions that are most closely comparable to Africa. For the regressions with controls, we add the average period exchange rate to the full set of controls. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

### 5.3 Heterogenous effects by type of industries

An important factor that could explain the observed pattern of the results for Africa is the structure of the manufacturing sector. We explore how the effects of changes in RULCs vary by industry by classifying the 23 manufacturing industries into four technology groups using the Lall (2000) classification system: resource-based, low-tech, medium-tech, and high-tech industries. The regression results are presented in Table 8. In the full sample as in the Africa sub-sample, an

acceleration in the growth of RULCs is accompanied by a deceleration in the growth of manufacturing value added. It is noteworthy that in both the full sample and in African countries, the impact is lowest in the resource-based industries and highest in medium-tech industries.

The results also show that an increase in RULC growth is associated with a decline in the growth of investment and exports in the full sample. The effects are most pronounced in the low-tech and medium-tech industries, while they are insignificant in the high-tech industries. In the case of Africa, a strong negative effect of RULC growth on investment growth is observed only among medium-tech industries. There are no discernable significant effects of RULC growth on employment growth either in the full sample or in African countries. Overall, the regression results by industry group are intuitive in light of the emergence of China as a dominant global player in the low-tech and medium-tech manufacturing industries.

Table 8: Heterogenous effects of changes in RULCs on manufacturing outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$\Delta VA$	$\Delta VA$	$\Delta \text{Employment}$	$\Delta \text{Employment}$	$\Delta \text{Investment}$	$\Delta \text{Investment}$	$\Delta \text{Exports}$	$\Delta \text{Exports}$
<b>Full sample</b>								
<b>A. Resource-based</b>								
$\Delta RULC$	-0.607*** (0.096)	-0.601*** (0.097)	0.049 (0.039)	0.057 (0.040)	-0.259* (0.135)	-0.219 (0.133)	-0.156*** (0.048)	-0.091** (0.043)
Obs.	876	876	856	856	649	649	851	851
R <sub>2</sub>	0.488	0.502	0.262	0.290	0.330	0.351	0.328	0.386
<b>B. Low-tech</b>								
$\Delta RULC$	-0.666*** (0.057)	-0.650*** (0.059)	0.129 (0.081)	0.135 (0.086)	-0.474** (0.201)	-0.413** (0.198)	-0.230*** (0.059)	-0.177*** (0.059)
Obs.	1252	1252	1236	1236	916	916	1220	1220
R <sub>2</sub>	0.575	0.608	0.365	0.375	0.301	0.327	0.354	0.385
<b>C. Medium-tech</b>								
$\Delta RULC$	-0.731*** (0.059)	-0.720*** (0.058)	0.052 (0.048)	0.056 (0.050)	-0.264** (0.116)	-0.202* (0.113)	-0.192*** (0.049)	-0.168*** (0.042)
Obs.	1073	1073	1058	1058	801	801	1045	1045
R <sub>2</sub>	0.539	0.561	0.281	0.286	0.320	0.345	0.386	0.414
<b>D. High-tech</b>								
$\Delta RULC$	-0.617*** (0.100)	-0.578*** (0.101)	-0.016 (0.084)	-0.002 (0.092)	-0.424 (0.286)	-0.349 (0.322)	-0.274* (0.140)	-0.189 (0.141)
Obs.	379	379	370	370	277	277	371	371
R <sub>2</sub>	0.661	0.683	0.612	0.619	0.469	0.482	0.504	0.546
<b>Africa</b>								
<b>E. Resource-based</b>								

$\Delta$ RULC	-0.371*** (0.079)	-0.319*** (0.071)	0.109 (0.091)	0.118 (0.111)	-0.078 (0.108)	0.003 (0.137)	-0.101 (0.072)	-0.098 (0.067)
Obs.	128	128	112	112	79	79	121	121
R <sub>2</sub>	0.433	0.531	0.172	0.323	0.276	0.373	0.362	0.432
<b><i>F. Low-tech</i></b>								
$\Delta$ RULC	-0.422*** (0.102)	-0.315*** (0.101)	0.263 (0.164)	0.321* (0.165)	-0.341 (0.219)	-0.053 (0.232)	-0.097 (0.094)	-0.036 (0.107)
Obs.	175	175	163	163	97	97	169	169
R <sub>2</sub>	0.563	0.641	0.329	0.402	0.287	0.407	0.273	0.335
<b><i>G. Medium-tech</i></b>								
$\Delta$ RULC	-0.726*** (0.098)	-0.649*** (0.106)	0.013 (0.048)	0.055 (0.067)	-0.444** (0.177)	-0.378* (0.204)	-0.102 (0.103)	-0.210* (0.117)
Obs.	129	129	117	117	78	78	124	124
R <sub>2</sub>	0.661	0.706	0.324	0.432	0.263	0.514	0.452	0.544
<b><i>H. High-tech</i></b>								
$\Delta$ RULC	-0.616*** (0.157)	-0.578* (0.265)	-0.106 (0.135)	-0.115 (0.166)	-	-	-0.609** (0.247)	-0.351 (0.217)
Obs.	33	33	30	30	-	-	31	31
R <sub>2</sub>	0.740	0.796	0.266	0.777	-	-	0.833	0.919
Industry & period FE	X	X	X	X			X	X
Country FE	X	X	X	X			X	X
Controls		X		X				X

Notes: Robust standard errors are reported. For Africa, there are seven countries with high-tech industry data in each regression. The exception is for the investment regressions, in which only Morocco and Tanzania had the required data for the dependent and control variables, leaving only 13 observations. Therefore, the regression is excluded.

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

## 6 Conclusion

This paper has sought to benchmark manufacturing industry competitiveness – as measured by unit labor costs – for a range of countries to China over the 1990-2015. In addition, the paper investigated how changes in relative unit labor costs affect the performance of manufacturing industry as measured by value added, employment, investment and exports. We conducted an analysis for a broad range of developed and developing countries with a focus on Africa, which has historically lagged behind other developing regions in terms of industrial development. Using regression analysis, we explored the effect of the composite measure of RULC, as well as by decomposing it into real wage and labor productivity. We ran the regressions both in levels and five-year changes on the full sample and by region to assess how African countries compare with countries in other developing regions.

The main regression results obtained using the composite measure of RULCs show a strong and robust negative relationship between relative unit labor costs and manufacturing value added. An

increase in RULCs is associated with a reduction in value added, and an acceleration of RULC growth is accompanied by a deceleration of growth in manufacturing value added. This result holds for the full sample, Africa and the other developing regions. It also holds when evaluating the effects across industry groups classified by the level of technological sophistication. For the Africa sample, the results suggest that a 10 percent increase in the level of RULCs is associated with a 5.7 decline in the level of manufacturing value added. In terms of growth rates, a 10 percent acceleration of the growth of RULCs would be accompanied by a 4.9 percent deceleration of manufacturing value added. We noted, however, that both in levels and growth rates, the estimated effects of RULCs on manufacturing value added are relatively smaller in African countries compared to other developing regions.

We also found that high or rising RULCs exert a negative impact in investment and exports in the manufacturing sector. However, in the case of Africa countries, the effects are quantitatively smaller than those on manufacturing value added. In the Africa sample, a 10 percent increase in the growth of RULC is associated with a 0.3 percent decrease in investment growth and a 1.3 percent decrease in export growth.

The decomposition analysis revealed that the level and growth of labor productivity have a quantitatively stronger and more robust effect on manufacturing performance than the level and growth of real wages. High labor productivity is associated with high manufacturing value added, investment and exports. In contrast, in the full sample as in the Africa region, we find no significant relationship between the level of real wages and manufacturing sector performance indicators. However, we do find a significant negative relationship between changes in real wages and changes in value added, employment, and exports in the full sample and in the case of African countries. It is noteworthy that in both cases, the net effect of a simultaneous increase in the growth of labor productivity and real wages on manufacturing value added is positive. In the case of the Africa sample, a simultaneous 10 percent increase in the growth of real wages and labor productivity results in a net increase in the growth of manufacturing value added by 3.6 percent.

The results in this study have important implications for industrial policy in African countries. They suggest that while unit labor costs matter for competitiveness of the manufacturing sector, the most potent factor of manufacturing performance is labor productivity. Specifically,

improvements in labor productivity generate positive effects on growth in manufacturing that dominate the negative effects of proportional increases in real wages. This implies that improving labor productivity should be at the center of policies aimed at increasing competitiveness as a means of promoting manufacturing-based industrialization in. The industrialization agenda should focus on policies that increase labor productivity directly and indirectly, notably through human capital investment, enhanced availability and quality of production and trade infrastructure, innovation and transfer of technology, and improvements in overall business environment. Overall, the evidence in this study suggests that measures to specifically enhance labor productivity are likely to provide greater benefits than an industrial policy approach founded on wage competition.

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## 8 Appendix A

Table A1: Variable definitions

Variable name	Definition
Data from UNIDO database	
RULC	Unit labor costs (ULCs) are defined as the ratio of average wages relative to average productivity at the 2-digit sector level, within each country. RULCs are the ratio of ULCs relative to the same sector in China, in log form.
Real wages	Log of wage compensation in 2011 US\$ (includes direct wages and salaries, bonuses, housing allowances, and payments in kind).
Real value added	Log of value added in 2011 PPP US\$.
Employment	Log of the number of employees in each sector.
Real investment	Log of gross fixed capital accumulation in each sector, in 2011 US\$.
Data from Comtrade	
Real exports	Log of exports from each sector in 2011 US\$.
Data from World Development Indicators	
Agricultural land	Log of the share of land area that is arable, under permanent crops, and under permanent pastures.
Ore and metal exports	Log of the percentage of ores and metals exports in total merchandise exports.
Domestic credit provided by financial sector	Domestic credit provided by the financial sector includes all credit to various sectors on a gross basis, with the exception of credit to the central government. Percentage of GDP, log form.
Tertiary enrollment rate	Log ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown.
Access to electricity	Log of the number of people with access to electricity as a percentage of the population.
Air freight capacity	Log of air transport freight, measured in million ton-km.
Data from World Governance Indicators	
Government effectiveness	Score from -2.5-2.5. The score captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies (WGI, 2020).
Regulatory quality	Score from -2.5-2.5. The score captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development (WGI, 2020).

Table A2: List of countries in the regression sample

<b>Africa</b>	<b>Middle East</b>	<b>East Asia and Pacific</b>	<b>South Asia</b>	<b>Latin America and Caribbean</b>	<b>Europe and Central Asia</b>	<b>North America</b>
Algeria	Bahrain	Australia	India	Argentina	Albania	Canada
Botswana	Israel	Fiji	Nepal	Brazil	Austria	USA
Cameroon	Jordan	Indonesia	Pakistan	Chile	Azerbaijan	
Ethiopia	Kuwait	Malaysia	Sri Lanka	Colombia	Belarus	
Kenya	Oman	Mongolia		Costa Rica	Belgium	
Madagascar	Qatar	New Zealand		Ecuador	Bulgaria	
Malawi	Saudi Arabia	Philippines		El Salvador	Croatia	
Mauritius		Singapore		Honduras	Cyprus	
Morocco		Thailand		Mexico	Denmark	
Namibia				Panama	Estonia	
Senegal				Peru	Finland	
South Africa				Uruguay	France	
Tunisia					Georgia	
Uganda					Germany	
Tanzania					Greece	
					Hungary	
					Iceland	
					Ireland	
					Italy	
					Kazakhstan	
					Latvia	
					Lithuania	
					Luxembourg	
					Netherlands	
					North Macedonia	
					Norway	
					Poland	
					Portugal	
					Romania	
					Russian Federation	
					Slovenia	
					Spain	
					Sweden	
					Switzerland	
					Ukraine	
					United Kingdom	

Notes: Since RULCs are benchmarked against China, we do not include China in the regressions as there is no variation in RULCs (it is always equivalent to 1).

Table A3: Sample statistics

<b>Variable</b>	<b>Obs</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min</b>	<b>Max</b>
RULC (log)	5,174	0.789	1.207	-5.055	6.095
Value added (log)	5,174	20.416	2.311	10.553	26.614
Employment (log)	5,101	9.445	2.105	0	14.471
Real investment (log)	4,011	17.928	2.671	4.045	25.208
Real exports (log)	5,118	19.894	2.698	7.125	26.141
Agricultural land (log)	5,174	3.561	0.716	-0.067	4.448
Ore and metal exports (log)	5,174	1.190	1.267	-2.463	4.106
Domestic credit provided by financial sector (log)	5,174	4.164	0.716	1.338	5.659
Tertiary enrollment rate (log)	5,174	3.491	0.985	-0.985	4.842
Access to electricity (log)	5,174	4.424	0.506	1.066	4.605
Air freight capacity (log)	5,174	4.834	2.674	-2.996	10.563
Government effectiveness	5,174	0.529	0.874	-1.067	2.233
Regulatory quality	5,174	0.546	0.799	-1.404	2.1520

Table A4: Regression results for RULCs and manufacturing performance: Africa

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	VA	VA	Employment	Employment	GFCF	GFCF	Exports	Exports
RULC	-0.626*** (0.060)	-0.574*** (0.067)	0.186*** (0.058)	0.238*** (0.068)	-0.532*** (0.103)	-0.316** (0.122)	-0.139* (0.078)	-0.104 (0.090)
Agricultural land		-4.904*** (1.762)		-1.103 (1.779)		-9.366*** (3.201)		-1.127 (2.839)
Ore and mineral exports		-0.092 (0.070)		-0.178*** (0.068)		-0.448** (0.189)		-0.211** (0.102)
Domestic credit provision		0.665*** (0.219)		0.507** (0.204)		0.511 (0.444)		0.349 (0.310)
Tertiary enrollment		1.277*** (0.226)		0.287 (0.231)		0.482 (0.421)		1.137*** (0.301)
Access to electricity		0.691** (0.320)		0.305 (0.303)		1.194 (1.072)		-0.057 (0.428)
Air freight capacity		-0.047 (0.059)		0.117 (0.081)		0.430 (0.618)		0.049 (0.107)
Government effectiveness		-0.843* (0.440)		0.078 (0.436)		1.298 (1.637)		0.181 (0.768)
Regulatory quality		0.260 (0.548)		-0.627 (0.541)		0.286 (1.780)		0.420 (0.767)
Industry x Period FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	704	704	661	661	412	412	684	684
R <sup>2</sup>	0.764	0.778	0.749	0.756	0.670	0.720	0.690	0.703

Notes: Robust standard errors are reported; \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table A5: Regression results for five-year changes in RULCs and manufacturing performance:  
Africa

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$\Delta$ VA	$\Delta$ VA	$\Delta$ Employment	$\Delta$ Employment	$\Delta$ Investment	$\Delta$ Investment	$\Delta$ Exports	$\Delta$ Exports
$\Delta$ RULC	-0.579*** (0.067)	-0.488*** (0.071)	0.136 (0.084)	0.193* (0.100)	-0.339*** (0.114)	-0.036 (0.135)	-0.155** (0.064)	-0.126* (0.067)
Agricultural land		1.930 (2.101)		-0.387 (2.070)		89.593*** (20.852)		-1.049 (2.823)
Ore and mineral exports		0.257*** (0.086)		-0.009 (0.083)		4.668*** (0.921)		0.199 (0.122)
Domestic credit provision		-0.445** (0.196)		-0.125 (0.194)		7.879*** (1.511)		-0.296 (0.251)
Tertiary enrollment		-0.215 (0.396)		0.398 (0.381)		-19.356*** (4.861)		-0.667 (0.586)
Access to electricity		0.065 (0.042)		-0.210** (0.100)		1.983** (0.841)		-0.020 (0.070)
Air freight capacity		-0.445 (0.367)		0.478 (0.358)		-12.468*** (3.099)		-0.492 (0.444)
Government effectiveness		0.656 (0.441)		-0.485 (0.417)		15.950*** (5.522)		-1.020 (0.663)
Regulatory quality		-1.103** (0.536)		-0.342 (0.518)		-7.013** (3.017)		0.022 (0.701)
Industry x Period FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	469	469	427	427	264	264	448	448
R <sub>2</sub>	0.631	0.667	0.289	0.361	0.387	0.494	0.419	0.465

Notes: Robust standard errors are reported. Control variables are entered as five-year lags, to control for start of period country-level differences. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$