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Industrial clusters and firm-level innovation in Africa

No.006 October 2023

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AKADEMIYA2063 Working Paper **No.006, October 2023**

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Acknowledgments

This study was carried out for the Program of Accompanying Research for Agricultural Innovation (PARI) as part of the cooperation between the Center for Development Research (ZEF) and AKADEMIYA2063. We are grateful to the German Federal Ministry for Economic Cooperation and Development (BMZ) for funding this work through PARI as part of the German Government's One World, No Hunger Initiative (SEWOH).

AKADEMIYA2063 is supported financially by the United States Agency for International Development (USAID), the Bill & Melinda Gates Foundation (BMGF), the German Federal Ministry for Economic Cooperation and Development (BMZ), the African Development Bank (AfDB), the UK's Foreign, Commonwealth & Development Office (FCDO), the Global Center on Adaptation (GCA), and the Food and Agriculture Organization of the United Nations (FAO). The views expressed in this publication do not necessarily reflect those of the funders.

Special thanks to our anonymous peer-reviewers, who provided helpful and valuable comments throughout the development of this paper.

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Suggested Citation

Sakyi, D., and G. Tadesse. 2023. *Industrial clusters and firm-level innovation in Africa.* AKADEMIYA2063 Working Paper Series, No. 006. Kigali: AKADEMIYA2063.
https://doi.org/10.54067/awps.006

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Abstract

This paper examines the extent and importance of industrial clustering for national economic growth by investigating the relationship between industrial clusters and firm-level innovation in Africa. The paper is guided by an endogenous clustering model that assumes clustering depends on the growth stage of industrial development, which also is critical for the innovativeness of an industrial firm. As an industry grows, firms start to concentrate in similar locations and create clusters, but the profitability of the industry as a whole also then declines, which causes firms to innovate. To empirically test these hypotheses, we utilized the most recent data from the World Bank Enterprise Surveys datasets for 25 African countries for the years 2013 to 2020. Simple descriptive statistics and a binary logistic regression are used to examine industrial growth stage patterns and the relationship between clustering and firm-level innovation. Our analysis of industrial growth stage patterns indicates that most industries in Africa are at the emerging stage with a rising trend in firm numbers. With respect to the relationship between innovation and industrial clusters, a generally low level of innovation is seen, and we find no significant association between spending on research and development and industrial clustering. As clustering is an important driver of product and process innovations in industrial firms globally, these results suggest an important role for policy in ensuring that industrial clusters in Africa are transformed into innovation hubs.

Keywords: industrial clusters, industrial growth stages, innovation, Africa

Industrial clusters and firm-level innovation in Africa

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1. INTRODUCTION

Calls for the industrialization of national economies have gained prominence in the last few decades. This is because of the critical role industrialization plays in motivating firms to innovate, which results in improved economic growth. Therefore, it is not surprising that the fourth goal of the African Development Agenda 2063 and the ninth Sustainable Development Goal focus on economic transformation by promoting industrialization and innovation as key drivers of economic prosperity. Within industries, clusters form an important basis through which firms can innovate to enhance their performance and overcome constraints to their growth and development (McCormick 1999; Fang 2019; Kim et al. 2023; Zhao et al. 2023). Cluster innovation performance remains an important driver of national competitiveness that is crucial for the continued economic survival of firms within a cluster. Knowledge spillovers within a cluster can significantly influence the innovative performance and competitiveness of the clustered firms (Claver-Cortés, et al. 2020; Kim et al. 2023). For this reason, Schmitz and Nadvi (1999) stress that industrial clustering-based development policy remains crucial for developing economies due to the gains industrial clusters offer for growth in employment, productivity, and sales and the enhanced potential firms within clusters have to innovate and become globally competitive.

Generally speaking, industrial clusters involve agglomerations of interconnected firms, suppliers, service providers, and associated institutions in the same or related industries, all of whom are linked by externalities of various types (Marshall 1920; Krugman 1991; Porter 2003; Fang 2019). Such agglomerations of industrial activity have long been recognized to positively affect the competitiveness of firms within them by increasing their productivity, stimulating the emergence of new firms, improving the commercial and social networks within which they operate, and driving firm-level innovation (Wolman and Hincapie 2015; Kim et al. 2023). Firms that are members of a cluster enjoy several benefits that enhance their drive to innovate. Among these benefits is better access to technical and commercial information than more isolated firms can obtain—an outcome mainly driven by their position within a wide network (Porter 1990; Bianchi and Bellini 1991; Geroski 1995; Bell 2005). Additionally, there is common knowledge available to firms within a cluster that, over time, establishes a higher level of absorptive capacity at the cluster level (Cohen and Levinthal 1990; Geroski 1995; Porter 1998; Claver-Cortés, et al. 2020). Schmitz and Nadvi (1999) stress the importance of the collaboration and cooperation that arises among firms within an industrial cluster and how this helps distinguish firms in the industry that thrive from those that stagnate and eventually die. Thus, although improvements in transportation and communication services might be seen as reducing the need for firms to agglomerate physically within an industry, proximity remains essential for rapid communication and cooperation among firms. Additionally, competition among firms characterized by geographical proximity ensures that the innovative activities of these firms benefit through easy access to intermediate resources, lower costs of inputs, and mutual learning and networking to gain the information needed to propel improvements in the industry.

The innovative performance of clustered firms in both developed and developing economies has been studied repeatedly. This research generally has found that clusters are important for the innovative performance of clustered firms and for their competitiveness (see Beaudry and Breschi 2003; Newman and Page 2017; Fang 2019; Claver-Cortés, et al. 2020; Kim et al. 2023; Zhao et al. 2023). In Africa, the private sector is dominated by micro, small, and medium firms. These contribute significantly to job creation and employment as well as to overall economic output. Significant numbers of industrial clusters can be found in many major cities in African countries. However, limited access to finance, low capital intensity, relatively basic infrastructure and institutions, and constraints on access to markets and innovations adversely affect the growth of these firms (Newman and

Page 2017; Ayele et al. 2018). Industrial clusters can play an important role in remedying these constraints (Yoshino 2011). For instance, Newman and Page (2017) argue for spatial industrial policies in Africa through the creation of Special Economic Zones to help enhance the competitiveness and innovative performance of these firms through improved diffusion of knowledge and technology within these clusters. The creation of such zones should enable the firms clustered within them to better innovate and compete within the industry domestically, regionally, and globally.

How clustered are African firms, and how important are industrial clusters for firm-level innovation in Africa? To answer these questions, we assessed the distribution of firms across industries in 25 African countries, estimated what level of growth the firms in these industries have achieved, and determined the level of industrial clustering by examining the geographic concentration of firms in each industry. Through these analyses, the paper provides empirical evidence on whether strengthening the link between industrial clusters and firm-level innovation may provide a possible route for industrial development in Africa.

The paper is organized as follows. The next section presents a review of the literature on industrial clusters and firm-level innovation. This is followed by a description of the indicators used to measure industrial clustering across the 25 African countries examined and our results on the level of clustering by industrial firms and its role in firm-level innovation. Finally, the paper summarizes the most important findings of the research and concludes with policy suggestions.

2. THEORIES AND EMPIRICS ON INDUSTRIAL CLUSTERING

2.1 Theories of industrial clustering

The pioneering economic analysis of industrial clusters is attributed to Marshall (1920) who described the origins of localized groupings of industries and the advantages that sustain their existence and growth. He attributed the origins of industrial clusters to the existence of physical conditions that were advantageous for a particular industry. For instance, metal industries were usually sited in areas where there were mines or ease of access to fuel, while iron industries tended to cluster in areas where coal was abundant. Additionally, industrial clusters may occur where the location or emergence of a relatively wealthy population attracts skilled workers to meet the demand for exceptionally high-quality goods.

Within this context, three key advantages of industrial clusters are noted. All are potential drivers of innovation within firms. First, there are knowledge and skill spillovers associated with such localization. "If one man starts a new idea, it is taken up by others and combined with suggestions of their own; and thus, it becomes the source of further new ideas" (Marshall 1920, p. 225). Within a cluster, there is therefore almost constant generation of, and improvement on, ideas that promote efficiency and improve the process of production. Second, industrial clusters make possible the development of subsidiary industries that supply at lower cost intermediate inputs needed by an industry. This promotes the efficiency of firms within the cluster and, therefore, strengthens the localization of the industry. Third, industrial clusters create a local pool of specialized labor, which benefits both employers and employees. A pooled specialized labor market makes it cheaper and easier for firms in the industry to hire highly skilled labor for their activities. "Men seeking employment naturally go to places where there are many employers who need such skill as theirs and where therefore it is likely to find a good market" (Marshall 1920, p. 225). These advantages tend to reinforce industrial clusters and the localization of industries.

Also useful in considering linkages between industrial clusters and firm-level innovation is the industrial concentration model of Krugman (1991), which relies on the interaction of economies of scale, transportation costs, and demand. If economies of scale are sufficiently large in industrial production, firms will choose a limited number of locations from which to serve the national market. In choosing these locations, they have an incentive to minimize transportation costs, and will therefore choose sites with sufficiently large local demand. Local demand is however likely to be large where the majority of firms are concentrated. He notes that this circularity is what sustains the clustering of firms once a cluster has been established.

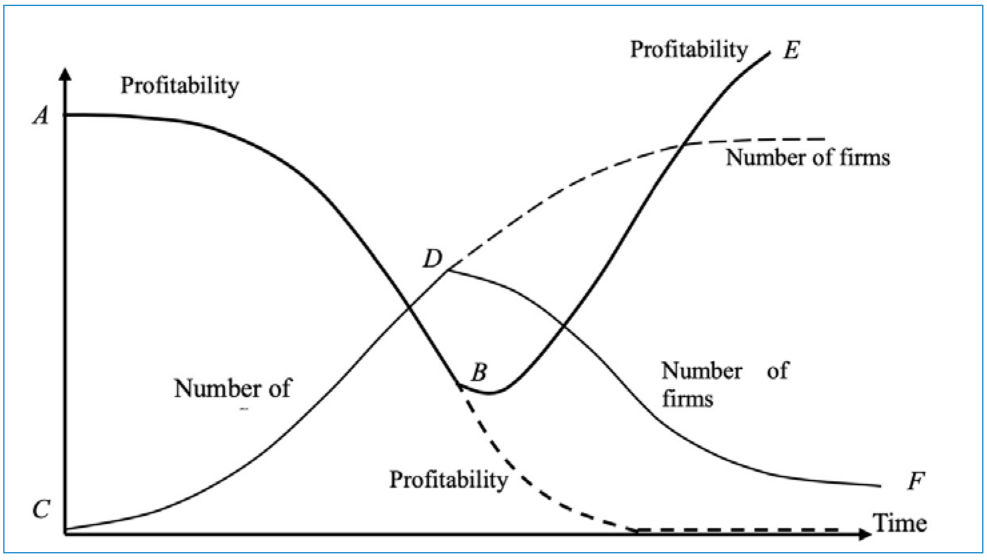
The pooling of labor, the creation of subsidiary industries that supply specialized inputs, and the emergence of technological and other knowledge spillovers are the main reasons for industrial clusters and firm-level innovation (Krugman 1991). A pooled labor market is advantageous to firms because good times, where a firm may have excess demand for labor, may coincide with bad times for another firm, in which case the firm experiencing good times can afford to hire more without necessarily increasing wages. From the

worker's perspective, however, a bad time for their firm of employment may coincide with good times for other firms, thus allowing the worker to remain employed in the industry at the new firm experiencing good times without having to change their location. This mechanism keeps unemployment within the cluster at a relatively low level. Similarly, the pooling of suppliers of specialized inputs in the presence of increasing returns enables a large concentration of firms to have more efficient suppliers. Additionally, it is more efficient for producers—due to lower transport costs—to be located close to a pool of specialized inputs. All these forces play significant roles in promoting industrial clusters and firm-level innovation.

The competitive diamond model of Porter (1990) is another useful tool for understanding industrial clusters and how such clusters propel firm-level innovation. While classical economic thought attributes the competitive advantage of firms or nations to natural endowments or input costs, their competitiveness depends crucially on their ability to innovate. The innovation, in this case of industrial firms, may take the form of new products, methods of production, ways of marketing, or approaches to conducting training. Factor conditions, demand conditions, related and supporting industries, and firm strategy, structure, and rivalry are all important attributes of a firm's competitiveness and drive for innovation. To achieve competitiveness and increase its innovative drive, high-quality specialized inputs, including human capital, physical infrastructure, and scientific and technological infrastructure, must be available and easily accessible. In addition, the existence of a domestic customer base that is sophisticated and demanding puts pressure on firms to innovate and become more competitive. The presence of local suppliers and related industries which are themselves internationally competitive becomes an advantage for firms seeking to innovate. Close working relationships with these local supporting industries allow firms to influence and facilitate the technical efforts of their suppliers to increase the pace of innovation. Lastly, the strategies, structure, and rivalries of locally clustered firms tend to put pressure on all to be more innovative in their products and processes. In sum, Porter (1990) asserts that the formation of clusters attracts specialized employees, promotes the creation of subsidiary industries of specialized suppliers, and creates a competitive environment within which firms are motivated to do better than they would have done in isolation. These outcomes help drive competitiveness and firm-level innovation within a cluster.

This paper adopts the endogenous industrial clustering model of Sonobe and Otsuka (2011), which builds on the earlier work. According to this model, the profits obtained by an industrial firm and the physical concentration of firms within an industry are inversely related over time (Figure 1). At the initial stage of industrial development, a few firms start to operate at a high level of profitability. However, as the number of firms increases, profitability declines to the extent that many firms become unprofitable, which leads to industrial collapse, unless firms start to innovate. Simply, as the number of firms in the industry increase, competition also increases, and profitability declines. Declining profitability will force firms either to exit or to innovate to obtain the profits necessary to remain in business.

Figure 1. Development patterns of industrial clusters



Source: Sonobe and Otsuka (2011)

In Figure 1, the broken "Profitability" line starting from "B" shows the case where there is no innovation, which ultimately leads to industrial collapse as shown by the dashed "Number of firms" line running from "D". However, if firms innovate, the "Profitability" line starts to rise as shown by the solid line from "B" to "E". With innovation, the number of firms will decline for some time as unprofitable firms that are unable to innovate exit. But the number of firms then stabilizes, as shown by the dark "Number of firms" line from "D" to "F", as innovative firms remain in the industry, primarily within clusters. This means that the extent of the innovativeness of firms within an industry is associated with patterns of industrial clustering.

Based on this relationship between the number of firms in an industry and their profitability over time, as shown in Figure 1, three industrial growth stages can be defined: initiation, emerging, and maturation. The initiation stage is characterized by a few scattered firms in the industry with a relatively low firm entry rate. At the emerging stage, the rate of entry of new firms increases significantly. The maturation stage is characterized by a reduction in the firm entry rate. Thus, industrial clustering depends on the industrial growth stage. The impetus for firms to cluster becomes high in the emerging stage as the challenges for a firm to remain profitable become evident. Clustering is maintained in the maturation stage as the profitable firms seek to retain for their continuing profitability the advantages that clustering provides. Given this pattern of clustering over the evolution of an industry, it also means that firms are likely to be more innovative during the emerging and maturation stages than at the initiation stage.

2.2 Empirics on the role of clustering for firm-level innovation

Leaving aside theoretical reasoning, several empirical studies have highlighted the role of industrial clusters as an important driver of the innovative activities of firms and of economic development. Jaffe et al. (1993) use patent citations to measure the extent to which knowledge spillovers are localized geographically in the United States. Relying on probit estimations, they found strong, statistically significant indications that knowledge spillovers tend to be localized, confirming the extent to which innovative activities are related to firms within an industry being clustered.

Audretsch and Feldman (1996a) use data from the Innovation Database of the Small Business Administration of the United States government to study research and development (R&D) spillovers and the geography of innovation and production. Employing ordinary least squares and three-stage least squares estimation techniques, their results indicate that clustering of innovative activity is higher in industries where knowledge spillovers are dominant, compared with industries where knowledge spillovers are relatively less important. The researchers extend their analysis by examining the extent to which innovative activities of clustered industries are related to stages in the industry life cycle (Audretsch and Feldman 1996b). Employing a three-stage least squares estimation technique, they find that the tendency for innovative activity to cluster in an industry is influenced strongly by the life cycle stage of an industry. A high amount of innovative activity by small firms relative to larger ones is indicative of the industry being in the initiation stage of its life cycle, while the dominance of large firms reflects an industry in the maturation stage.

Baptista and Swann (1998) examine whether industrial clustered firms are more likely to innovate than firms outside clustered industries. The study uses a record of 248 manufacturing firms in the United Kingdom for the period 1975 to 1982. Results from ordinary least squares and count data model-based estimations techniques show that firms located in clusters and those with strong performance in their industry are more likely to innovate, confirming the empirical link between industrial clusters and firm-level innovation.

Beaudry and Breschi (2003) examine whether firms located in industrial clusters are more innovative than firms located outside the clusters. The study uses firm-level patent data for Italy and the United Kingdom for the period 1990 to 1998. They find that clusters of similar firms alone do not explain innovative performance. Rather, the presence of strong firms within related industries within a cluster is more crucial for the innovative activities of firms in the industry. This is particularly the case for Italian firms, where a strong presence of firms in other related industries within the cluster spurs innovative performance.

Bell (2005) examines the impact of industrial clusters and networks on firm performance and their influence on the innovative behavior of firms located inside and outside industrial clusters of Canadian mutual fund companies. Additionally, the differential effects of institutional and managerial ties on firm-level innovation were studied. Relying on the ordinary least squares estimation techniques, the study finds that industrial clusters enhance firm-level innovation. The researchers suggest that

the positive effect of industrial clusters on firm-level innovation reflects the existence and ready access to geographically proximate supporting industries. However, industrial networks' effect on innovation depends on whether there is centrality in institutional or managerial ties. While centrality in managerial ties enhances firm-level innovation, institutional ties do not.

Yoshino (2011) studied industrial clusters of five sub-Saharan African economies—Cameroon, Ghana, Kenya, Mauritius, and Rwanda. Quantitative and qualitative data were collected from firms sampled inside and outside clusters in the same industry. Employing the Blinder-Oaxaca decomposition method and probit estimation techniques, the study found that firms within industrial clusters performed significantly better in terms of productivity, sales, and market access than similar firms located outside the industrial cluster. This performance differential was attributed primarily to the higher capital intensity of firms located within clusters.

Fang (2018) uses employment, establishment, and patent data from Maryland for the years 2001 to 2012 to differentiate and quantify firm learning—firms improving in clusters—and firm selection—less innovative firms being forced out of clusters. Using nonparametric and quantile regression estimation techniques, Fang found that learning and innovative activities are greater among firms in clustered industries than among firms in non-clustered industries, an outcome that supports the cluster innovation relationship. In later research, Fang (2019) examines firm innovation among industrial clusters in the state of Maryland using establishment and patent application data from 2004 to 2013. Employing continuous quantile regression estimations, the study found that out of the twenty clusters studied, eleven exhibited significant innovation. Additionally, he found heterogeneity across different industries in the extent to which clustered firms drive innovation and attributed this mainly to knowledge spillovers. He also examines the relationship between innovation and industrial clusters of small versus large firms and finds that small in-cluster firms innovate more.

Finally, Kim et al. (2023) examined the factors that enhance the innovation performance of clustered firms by focusing on the role of organizational diversity and knowledge spillovers. This study found that the degree of diversity of organizations in a cluster can positively affect the innovation performance of clustered firms. This is the case as various levels of skill and technology from existing firms create opportunities and serve as valuable knowledge for other firms to innovate.

3. DATA AND METHODS

3.1 Data

The data for this paper is extracted from the World Bank's set of Enterprise Surveys (WBES). The WBES collects data on the non-agricultural formal private economy of countries around the world. In each country, the survey is administered to a representative sample of firms. The population or universe of the study is defined to include all firms in the manufacturing, services, transportation, and construction sectors. Firms in financial services, public utilities, health care, and government services are not considered by the survey. The primary sampling unit of the WBES is the establishment.

The WBES collects an array of qualitative and quantitative data on the performance of the firm and the business environment of the country in which the firm is based through interviews with firm managers and other relevant stakeholders. The survey questions consider infrastructure, trade, finance, regulations, taxes and business licensing, corruption, crime and informality, innovation, labor, and perceptions about obstacles to doing business.

A stratified sampling methodology is employed for the survey. Three levels of stratification are used: sector of activity (industry), firm size, and region. To limit the survey to firms only in the formal sector, the sample frame only includes firms with at least 5 employees. Firms with between 5 and 19 employees are categorized as small, while those with employees between 20 and 99 and those with at least 100 employees are classified as medium and large, respectively. The regions for the survey design in each country are usually the main urban centers, as these are the locations where most non-agricultural activities are concentrated.

WBES data is available for 50 African countries for the years 2005 to 2020. However, due to a lack of adequate data on innovations for a significant number of countries, for the analysis here only the most recent survey from 25 countries was used to analyze the relationship between industrial clusters and firm-level innovation—Benin, Burundi, Cameroon, Côte d'Ivoire, DR Congo, Eswatini, Ethiopia, Ghana, Kenya, Malawi, Mali, Mauritania, Mozambique, Namibia, Niger, Nigeria, Rwanda,

Senegal, Sierra Leone, South Africa, Tanzania, Togo, Uganda, Zambia, and Zimbabwe. Table 1 summarizes the number of firms in each country and the year of the survey from which data was drawn for use in the analysis here.

Table 1. Summary of firms in the sample by country

Country	Number of firms	Percent	*Year of survey*
Benin	83	0.8	*2016*
Burundi	123	1.2	*2014*
Cameroon	261	2.6	*2016*
Côte d'Ivoire	250	2.5	*2016*
DR Congo	392	4.0	*2013*
Eswatini	101	1.0	*2016*
Ethiopia	767	7.8	*2015*
Ghana	622	6.3	*2013*
Kenya	791	8.0	*2018*
Malawi	323	3.3	*2014*
Mali	132	1.3	*2016*
Mauritania	73	0.7	*2014*
Mozambique	188	1.9	*2018*
Namibia	333	3.3	*2014*
Niger	82	0.8	*2017*
Nigeria	1,596	16.2	*2014*
Rwanda	151	1.5	*2019*
Senegal	367	3.7	*2014*
Sierra Leone	105	1.1	*2017*
South Africa	958	9.7	*2020*
Tanzania	589	6.0	*2013*
Togo	110	1.1	*2016*
Uganda	569	5.8	*2013*
Zambia	328	3.3	*2019*
Zimbabwe	549	5.6	*2016*
Total	9,843	100.0	

Source: Authors' estimation based on WBES (2020)

3.1.1 Defining industrial clusters

We define industrial clustering using two approaches. The first is based on the endogenous clustering approach in which the level of clustering depends on the growth stage of the industry. The growth stage is identified using trends in the rate of entry of firms into the industry. By graphing the cumulative number of firms against the ages of the firms in the industry, we can observe for the industry its firm entry growth rate over time. If the firm entry rate grows smoothly, the industry is characterized as in the initiation stage. If an industry shows a high firm entry rate in recent years, the industry is identified as being in the emerging stage. If the firms' entry rate stabilizes after rapid growth, the industry is characterized as in the maturation stage.

The second approach defines industrial clustering based on the concentration of firms in a given geographic location. In this case, firms in an industry in each country are first grouped into location-industry groups by region. Seven industries are identified—food processing, non-food manufacturing, construction, trade (retail and wholesale), transport and communication, hospitality (hotel, restaurants), and other services. Each location-industry group that contained less than five firms was then dropped from the sample.

This was done to ensure that there was a sufficient number of firms within each group, since each was to reflect the existence of a natural industrial cluster within a particular region. Location-industry groups that had between 5 and 20 firms were considered to be in the initiation stage. Those with more than 20 but at most 50 firms were considered to be in the emerging stage. Lastly, location-industry groups containing more than 50 firms were classified in the maturation stage.

3.1.2 Firm-level innovation

The WBES captures the extent of innovation within a firm by asking a set of questions. The first inquires whether the firm introduced any new or significantly improved product in the last three years, i.e., product innovation. Firms were also asked whether they introduced any new or significantly improved method for manufacturing products or offering services in the last three years, i.e., process innovation. Lastly, firms are asked whether there has been any formal spending on research and development (R&D) activities in the past three years. WBES uses a three-year recall period to cater for any bias that may result from accidental innovations that are not the result of formal research and development activity by the firm (van Uden, et al. 2017). In the analysis here, we use the responses to these questions to measure innovation by each firm on three dimensions: product innovation, process innovation, and R&D spending. Firms that answered yes to each of these questions were assigned a value of 1 for the dimension, while those that answered no were assigned 0.

3.2 Model specification

We estimated the effect of industrial clusters defined by the industry's growth stage on the probability of innovation by firms in the industry. Since the dependent variables, i.e., product innovation, process innovation, or R&D spending, are binary, we rely on a binary logistic regression to estimate the impact of the industry's growth stage, i.e., initiation, emerging, or maturation stage, on the likelihood of engaging in the different forms of innovative activity. We estimate the following model:

$$prob(Innov_i = 1|.) = \theta(\beta_0 + \beta_1 Stage_i + \beta_2 Legal_i + \beta_3 Age_i + \beta_4 Size_i + \beta_5 Train_i + \beta_6 Educ_i + \beta_7 Exp_i + \beta_8 Foreign_i + \beta_9 GVC_i + \gamma_c + \sigma_s + \tau_t)$$

where $\theta(.)$ is the cumulative distribution function of the logistic distribution, γ, σ, and τ represent country-specific, industry-specific, and year dummies, respectively. $prob(Innov_i)$ indicates the probability of firm i engaging in product innovation, process innovation, or R&D spending. $Stage$ represents the industrial growth stage of the industry of which the firm is a part, while, $Legal$, Age, $Size$, $Train$, $Educ$, Exp, $Foreign$, and GVC are covariates.

- *Legal* represents the legal status of the firm. Dummies were created for each category, with a firm assigned a value of 1 if it operated under a particular legal status, and 0 otherwise. Public limited company status served as the reference category.
- *Age:* The age of the firm is measured by the difference between the year of the survey and the year the firm began operations.
- *Size*: The size of the firm is measured by the number of permanent employees of the firm. Small firms have at least 5 but less than 20 permanent employees, medium firms are those with 20 up to 99 employees, while large firms are those with at least 100 employees.
- *Train*: Formal training denotes whether the firm offered formal training programs to its full-time employees in the last fiscal year, with the firm assigned a value of 1 if it offered such training, and 0 otherwise.
- *Educ* captures the percentage of a firm's employees that completed secondary school to provide a measure of the human capital available to the firm.
- *Exp:* Manager's experience captures the number of years the top manager of the firm has in the industry in which the firm operates.
- *Foreign*: Foreign captures firms that are foreign-owned. This variable is coded 1 if at least 10% of a firm is owned by foreign individuals or entities, and 0 otherwise.
- *GVC*: Global value chain participation measures the extent of a firm's participation in global value chains. The variable is coded 1 if a firm meets any of one of the following three criteria: a foreign firm that sources at least 10% of its inputs from domestic suppliers; a domestic firm that imports at least 10% of its material inputs; or a domestic firm for which at least 10% of sales was exported. Firms that did not meet any of these criteria were coded as zero.

4. EMPIRICAL RESULTS

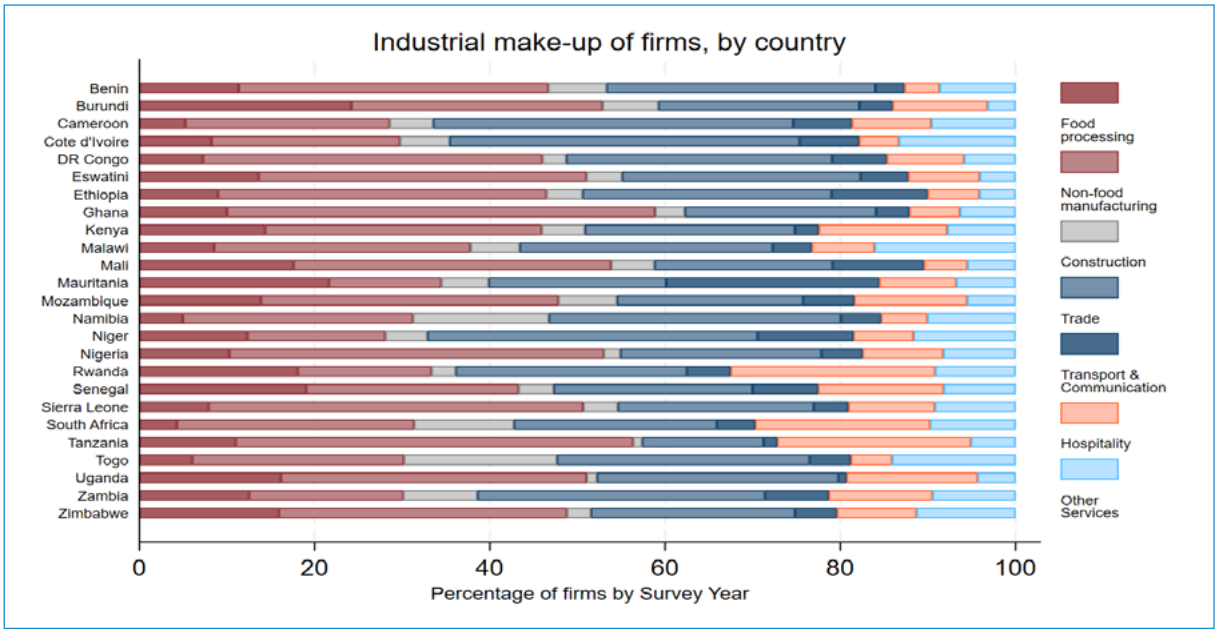
4.1 Firm entry rate in an industry

Graphs of the cumulative share of firms that began at and before a particular year for each industry in each of the 25 African countries considered in the study are presented in Annex Figure 1. Generally, it is observed that the number of firms in each industry continues to rise over time in most countries. The rise in the number of firms may be an indication of improvements in the ease of doing business in these countries over time. Countries such as Côte d'Ivoire, DR Congo, Ghana, Ethiopia, Malawi, Mali, Mozambique, Namibia, Nigeria, South Africa, and Senegal show a particularly steep rise in the number of firms across industries particularly from the year 2000 onwards. The rapid rise of firms' entry corresponds to the emerging stage of industrial growth. The charts in Annex Figure 1, therefore, show that most industries in Africa are at an emerging stage. This stage of industrial growth should offer considerable room for innovation, which is a key component of continued industrial growth. However, it also offers challenges of declining average profits for firms within the industry—many firms entering the industry may result in industrial collapse if firms are unable to diversify products and reduce production costs to maintain profits (Sonobe and Otsuka 2011).

4.2 Geographic concentration of firms

As noted, based on geographic location, firms are grouped into seven industrial categories. We describe the geographic concentration of firms within these industries across countries. As is evident in Figure 2, firms in non-food manufacturing and trade (wholesale and retail) tend to dominate across the 25 African countries considered. This is followed by the other services industry—particularly in Kenya, Zambia, and Zimbabwe—and the food processing industry—notably in Burundi, Mauritania, Senegal, and Zimbabwe. Firms in the construction, transport and communication, and hospitality industries generally form the smallest percentage of firms in most countries. However, Rwanda, South Africa, and Tanzania showed an exceptionally high concentration of firms in the hospitality industry, second only to non-food manufacturing and trade (wholesale and retail), while Mauritania showed a high concentration of firms in the transport and communication industry.

Figure 2. Industrial make-up of firms, by country, percentage share



Source: Authors' estimation based on WBES (2020)

With regard to the number of firms across industries and locations, across all countries in the sample, industrial activity was generally highest in the non-food manufacturing sector, followed by trade (wholesale and retail) (Annex Table 1). Also, for most countries, all industries are found to be concentrated in the major cities or regions of the countries, particularly in the capital cities.

Based on the geographical concentration of firms as explained above, we identified the industrial growth stages of the sample firms in each industry cluster location. We observe that the emerging stage has the largest share of firms in the sample. This is followed by the maturation stage. Industry clusters in the initiation stage are the least common.

4.3 Firm-level innovation

Table 2 summarizes information on the different forms of innovative activities that firms reported engaging in across the countries in the sample. Generally, product innovation is the most common innovative activity among firms, followed by process innovation. Among the sample countries considered, Namibia, Uganda, Malawi, Tanzania, Mauritania, Nigeria, Ghana, and Burundi are the countries with at least 50 percent of firms indicating introducing some new product or service in the previous three years. Similarly, Namibia, Uganda, Mauritania, Nigeria, Tanzania, and Ghana remain the best performers for process innovation, with at least half of the sample of firms in each reporting that a new method of production had been introduced in the previous three years. In contrast, in South Africa less than 10 percent of firms engaged in either product or process innovation. Spending on research and development is generally low among firms in these African countries, except for Namibian firms. In all other sample countries, less than 30 percent of firms reported that they had formally engaged in any spending on R&D in the previous three years. On average, 42.6, 34.3, and 18.4 percent of firms in the sampled countries have been involved in product innovation, process innovation, and R&D spending, respectively, over the previous three years.

Table 2. Innovation activities over previous three years by firms across countries

Country	% of firms engaged in product innovation	% of firms engaged in process innovation	% of firms spending on research and development
Benin	32.5	16.9	14.5
Burundi	51.2	43.9	23.6
Cameroon	42.5	14.9	8.8
Côte d'Ivoire	37.2	16.4	9.2
DR Congo	44.1	35.7	26.5
Eswatini	20.8	7.9	18.8
Ethiopia	37.8	20.5	8.6
Ghana	51.4	51.4	21.9
Kenya	47.2	26.9	20.6
Malawi	53.3	48.3	17.6
Mali	34.8	34.8	15.9
Mauritania	64.4	61.6	30.1
Mozambique	38.3	17.0	10.1
Namibia	68.5	65.5	44.7
Niger	31.7	15.9	14.6
Nigeria	53.3	56.1	17.7
Rwanda	8.6	6.0	7.3
Senegal	49.3	41.1	4.6
Sierra Leone	31.4	17.1	14.3
South Africa	3.3	1.3	24.2
Tanzania	56.7	53.0	17.1
Togo	38.2	15.5	20.9
Uganda	67.1	60.6	27.8
Zambia	36.3	12.8	11.6
Zimbabwe	26.2	14.2	13.8
Total	**42.6**	**34.3**	**18.4**

Source: Authors

4.4 Regression results

Table 3 reports the summary statistics on the potential covariates used in our binomial logistic regression analyses. As noted, the emerging stage has the largest share of firms, followed by the maturation stage, with the initiation stage having the lowest number of firms. The most common legal status among firms is sole proprietorship, followed by limited liability and limited partnership. The average age of firms in the sample is about 18 years. Just over half of the firms in the sample are categorized as small, followed by medium, with large firms making up about one-sixth of firms in the sample. Just over a quarter of firms reported that they had organized some formal training for permanent full-time workers over the previous three years. While three-fifths of workers in the sample firms have completed secondary school, some firms reported that none of their full-time workers had done so, while others that all of their full-time employees had completed secondary school. The average years of experience for top managers in the sample is about 15 years. Firms in the non-food manufacturing industry are the most common, followed by trade, food processing, other services, hospitality, transport and communication, and construction. With respect to foreign ownership and global value chain participation, about one-eight of all firms were at least 10 percent owned by foreign individuals or entities while three-fifths of the survey firms participated in global value chains.

Table 3. Summary statistics of variables

Variable	Mean	Standard Deviation	Minimum	Maximum
Industrial cluster stage, 0/1				
Initiation stage	0.300	0.458	0	1
Emerging stage	0.389	0.487	0	1
Maturation stage	0.311	0.463	0	1
Legal status, 0/1				
Public limited company	0.052	0.222	0	1
Limited liability company	0.187	0.390	0	1
Sole proprietorship	0.518	0.500	0	1
Limited partnership	0.134	0.341	0	1
Partnership	0.098	0.297	0	1
Other	0.011	0.102	0	1
Age, years firm in operation	18.6	15.69	0	220
Firm size, 0/1				
Small	0.526	0.499	0	1
Medium	0.307	0.461	0	1
Large	0.168	0.374	0	1
Formal training, 0/1	0.281	0.449	0	1
Employees' education, % complete secondary school	60.9	36.45	0	100
Manager's experience, years	15.8	10.20	1	72
Industry, 0/1				
Food processing	0.108	0.311	0	1
Non-food manufacturing	0.368	0.482	0	1
Construction	0.038	0.191	0	1
Trade (Retail & Wholesale)	0.252	0.434	0	1
Transport & Communication	0.040	0.196	0	1
Hospitality (hotels, restaurants)	0.085	0.279	0	1
Other services	0.109	0.312	0	1
Foreign, 0/1	0.137	0.344	0	1
Global value chain participation, 0/1	0.609	0.488	0	1

Source: Authors

The results from the logit model are presented in Table 4. The estimates reported are the marginal effects at the mean of each explanatory variable. This allows us to show more exactly the magnitude of the effect of each regressor on the different dependent variables on the innovative behavior of firms considered. Column (1) reports how each of the explanatory variables affects the likelihood of a firm engaging in product innovation, while columns (2) and (3) show these effects for process innovation and R&D spending, respectively.

Table 4. Logit marginal effects for firm innovation and growth stages

	(1) Product innovation	(2) Process innovation	(3) R&D spending
Industrial cluster stage (ref=Initiation stage)			
Emerging stage	0.027*	0.022*	0.015
	(0.015)	(0.013)	(0.010)
Maturation stage	0.059***	0.054***	0.006
	(0.017)	(0.016)	(0.011)
Legal status (ref=Public limited company)			
Limited liability company	0.064**	0.036	0.019
	(0.030)	(0.027)	(0.023)
Sole proprietorship	-0.025	-0.015	-0.077***
	(0.026)	(0.024)	(0.021)
Limited partnership	0.033	0.026	-0.024
	(0.029)	(0.027)	(0.022)
Partnership	0.056*	0.033	-0.022
	(0.031)	(0.029)	(0.024)
Other	0.133**	0.221***	-0.012
	(0.059)	(0.061)	(0.054)
Age of firm	0.000	-0.001	0.000
	(0.000)	(0.000)	(0.000)
Firm size (ref=Small)			
Medium	0.010	0.022*	0.003
	(0.013)	(0.011)	(0.008)
Large	0.027	0.038**	0.068***
	(0.017)	(0.016)	(0.012)
Foreign	0.029*	0.015	0.003
	(0.017)	(0.015)	(0.011)
Formal training	0.198***	0.189***	0.145***
	(0.012)	(0.011)	(0.007)
Employees' education	0.001***	0.000**	0.000***
	(0.000)	(0.000)	(0.000)
Manager's experience	0.001	0.000	-0.001**
	(0.001)	(0.001)	(0.000)
Global value chain participation	0.050***	0.027**	0.026***
	(0.012)	(0.011)	(0.008)

Source: Authors' estimation based on WBES (2020): Standard errors in parentheses, * p<0.10, ** p<0.05, *** p<0.01
Sample size: 9,843. Country, industry, and year dummy variables are included in all models.

The results reveal that firms in the maturation stage are 5.9 and 5.4 percentage points more likely to engage in product innovation and process innovation, respectively, than those in the initiation stage. Similarly, firms in the emerging stage are 2.7 and 2.2 percentage points more likely to engage in product innovation and process innovation, respectively, than those in the initiation stage. These findings are consistent with the knowledge spillover hypotheses of Marshall (1920) and Krugman (1991), the industrial growth stages model of Sonobe and Otsuka (2011), and the empirical studies on the role of industrial clustering for innovation of Bell (2005), Fang (2019), Claver-Cortés, et al. 2020, Kim et al. 2023, and Zhao et al. 2023 in which clustered industries were found to innovate more than less clustered ones.

However, the results show no statistically significant relationship between the industrial growth stage of a firm and its likelihood of engaging in R&D spending. Several reasons may explain this. The knowledge spillover advantage that firms in clusters experience is more likely to occur in an environment where there is an appreciable amount of knowledge accumulation in the first place. Beaudry and Breschi (2003) note that clustering may be a source of negative externalities for a firm if there are no innovative firms within the cluster. Our summary statistics on innovation (Table 2) show that African firms generally have a low level of intention to innovate, as signaled by low R&D spending. Egbetokun et al. (2016) note that Africa largely lags behind other economic regions in terms of economic infrastructure, institutions, and educational systems that are necessary to build innovative capability. For this reason, firms operating in such an environment—even if clustered—are likely to be less innovative. These characteristics of the economic context in which the firms are operating could be responsible for the insignificant association seen between R&D spending by a firm and the industrial cluster stage of the firm. In the context of Africa, the economic and social environment may significantly limit the impact of industrial clusters on fostering R&D spending by firms in such clusters (McCormick 1999). Strengthening any factors that encourage and incentivize the production and dissemination of knowledge among firms across an industry may be an important focus for policy reforms.

Considering the results for the other determinants of innovation, formal training is found to have a statistically significant impact on all three firm innovation practices. This finding is consistent with those reported by van Uden, et al. (2017), and Hussen and Çokgezen (2020) who similarly found that formal on-the-job training has a significant positive influence on firm innovation. Although the effect is small, workers' education similarly has a statistically significant impact on the likelihood of product innovation, process innovation, and R&D spending. This finding confirms that of Hussen and Çokgezen (2020), who found that firms' internal human capital development initiatives and employees' education significantly increase the likelihood of both product and process innovation.

Similar to the findings of van Uden, et al. (2017), medium-sized firms were found to be more likely than small firms to engage in process innovation, but not any more likely to engage in product innovation and R&D spending. While large firms similarly are more likely than small firms to engage in process innovation, they also are more likely than small firms to spend on R&D. However, large firms are no more likely than small firms to innovate their product lines.

Firms that participate in the global value chain are found to be more likely to engage in all three forms of innovative behavior. This result confirms the findings of De Marchi, et al. (2018)but their ability to become innovation leaders is less certain. The GVC approach stresses that the inter-firm linkages afforded by being part of a chain are crucial for transferring knowledge. However, their impact on the innovation performance of the developing country firms involved in these GVCs remains controversial and requires more research. The present study provides a systematic review of the literature on developing country GVCs to investigate the learning channels used by local firms, both within (firm level, collective level who stress the importance of firms from developing countries participating in global value chains to improve their ability to innovate.

Unlike other studies, including Coad, et al. (2016) and Shefer and Frenkel (2005), our analysis found that the age of the firm does not play a significantly important role in the innovation behavior of a firm, whether product innovation, process innovation, or R&D spending. Similarly, no statistically significant relationship exists between the likelihood of product or process innovation by a firm and the manager's experience. However, a statistically significant negative relationship exists between R&D spending and the firm manager's experience—firms in our sample with more experienced managers were less likely to report any spending in the previous three years on research and development.

5. CONCLUSIONS AND POLICY RECOMMENDATIONS

Industrialization remains an important part of the development agenda of African economies due to the ability of industrial production to boost economic output, create jobs, and enhance the productivity of other sectors of the economy. In both developed and developing countries, industrial activity tends to be concentrated in particular geographical regions. This clustering of industries has been noted to be associated with a higher degree of competitiveness and innovation among firms within the industrial cluster. Firms in Africa are found commonly to be located in proximity to other firms in the same industry. It is therefore expected that these clustered firms will engage in a higher level of innovative behavior.

This study investigates how clustered are African firms and how important industrial clusters are for firm-level innovation in Africa. To achieve these objectives, we utilized the most recent survey data from the World Bank's Enterprise Survey for 25 countries in sub-Saharan Africa from the period 2013 to 2020. Tables, graphs, and binary logistic regression were used for the empirical analyses. Our findings show that industrial clustering is an important driver of process and product innovation of African firms but not for spending on R&D.

While a generally low level of innovation in the region may play a role in explaining the outcome of limited spending on R&D, the role of policy in transforming clusters into innovation hubs should not be underestimated. As noted by McCormick and Oyelaran-Oyeyinka (2007), clusters are not by themselves innovation systems. To transform clusters into innovation systems and ensure African countries reap the full economic benefits from doing so will require sustained policy support from governments and other stakeholders. Porter (1998) highlights the importance of universities in promoting a culture of innovation in regions where industrial clusters are located. Similarly, Turkina, et al. (2019) stress that clustered firms that have connections with universities and other research institutions can maintain their innovative performance for a longer period. With technical and financial support from the government and other stakeholders, such research institutions, particularly those located within regions in which industrial clusters are found, can collaborate with firms in industrial clusters to further enhance their development of new products, new methods of production, and even new methods of organizing industrial activities that will help to make the clustered firms more productive. At the same time, the internal policies which firms adopt to guide their investments and growth can also contribute to promoting their innovative activities.

Our findings further reveal that, while medium and large firms tend to be more innovative than small firms, even small firms that have formal on-the-job training for employees tend to be more innovative than those that do not. Since clusters usually employ similar kinds of labor, clustered firms can pool resources to train their employees. Such industrial cluster-level training may take the form of workshops or seminars that expose workers from several firms to new products and methods that are relevant to the industry. We also found that firms that participated in the global value chain were more likely to engage in firm-level innovation. Interested stakeholders can further advance innovation in clusters within industries by facilitating the access of firms within those clusters to international suppliers and markets.

Overall, industrial stakeholders must be strategic as to what actions they might take to drive innovative activities among clusters within the industry, as doing so will be important to enabling firms in the industry to grow and to continue to contribute to both national economic output and employment. Putting in place measures that will foster a vibrant culture of innovation within clusters of firms within an industry will ensure that the clusters not only expand in size, but also that they become more competitive in regional and international markets.

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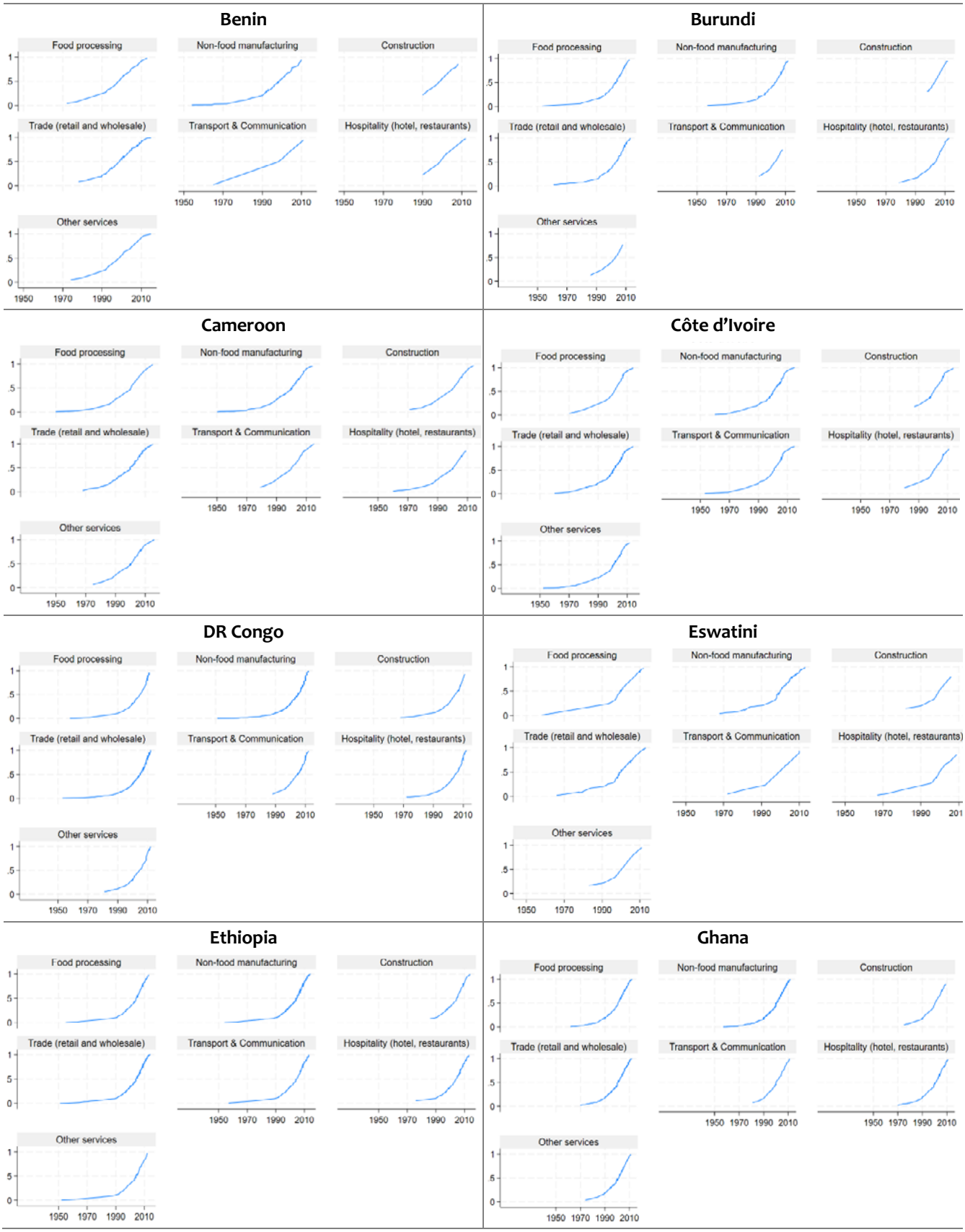
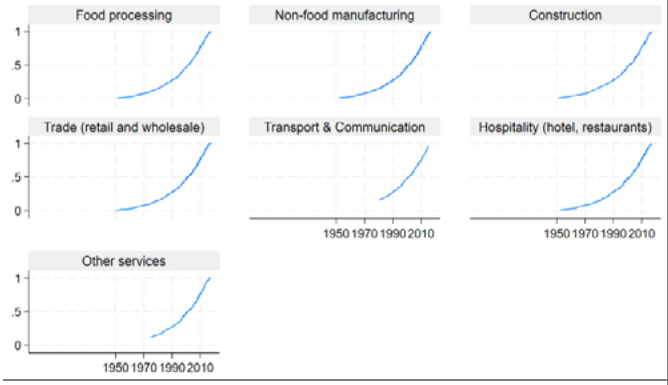
ANNEXES

Annex Figure 1. Firm entry into industry over time in each sample country, cumulative share of current firms in industry by year



Source: Authors' estimation based on WBES (2020)

Kenya



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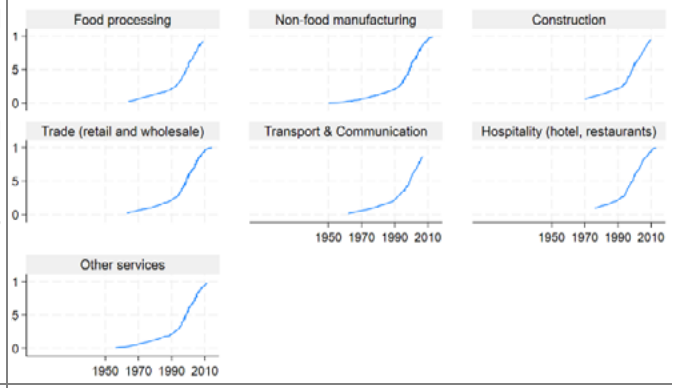

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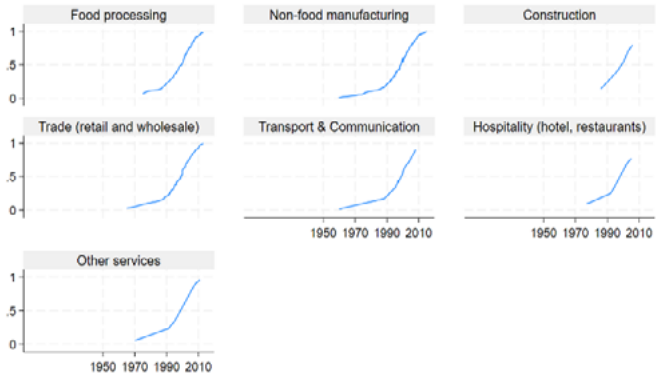
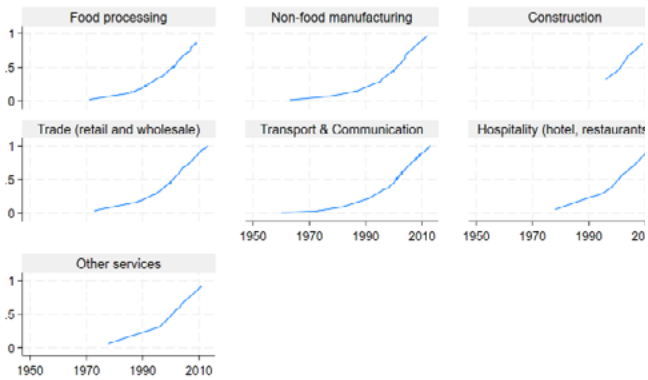
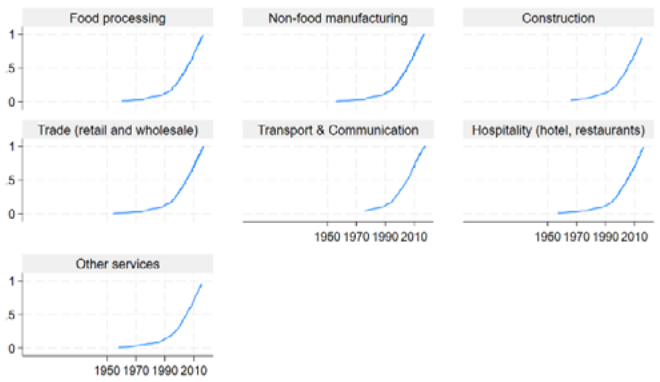


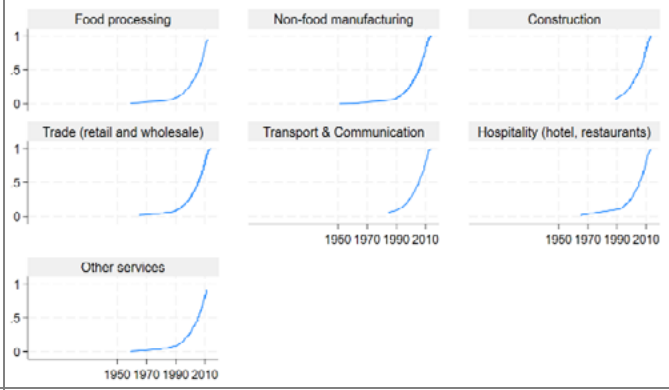
Mauritania



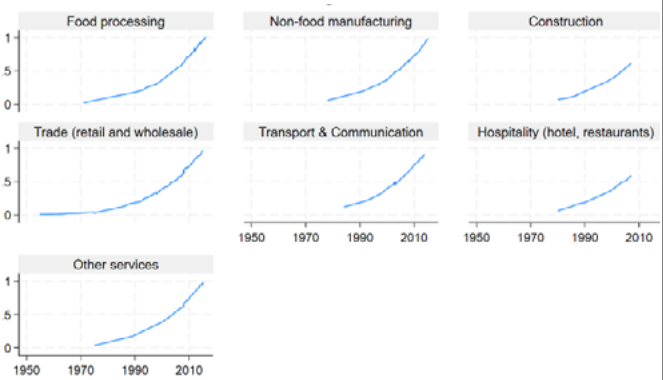
Mozambique



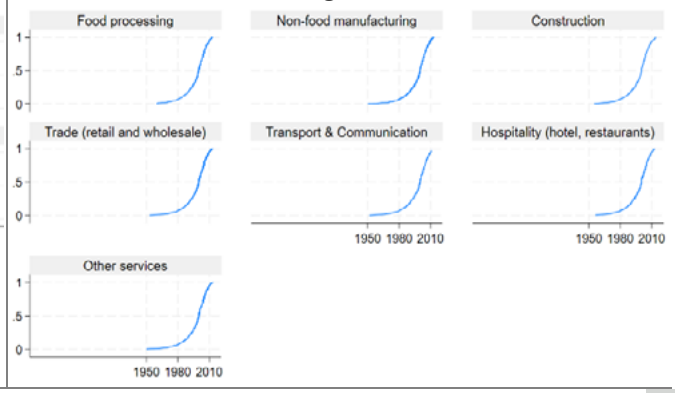
Namibia

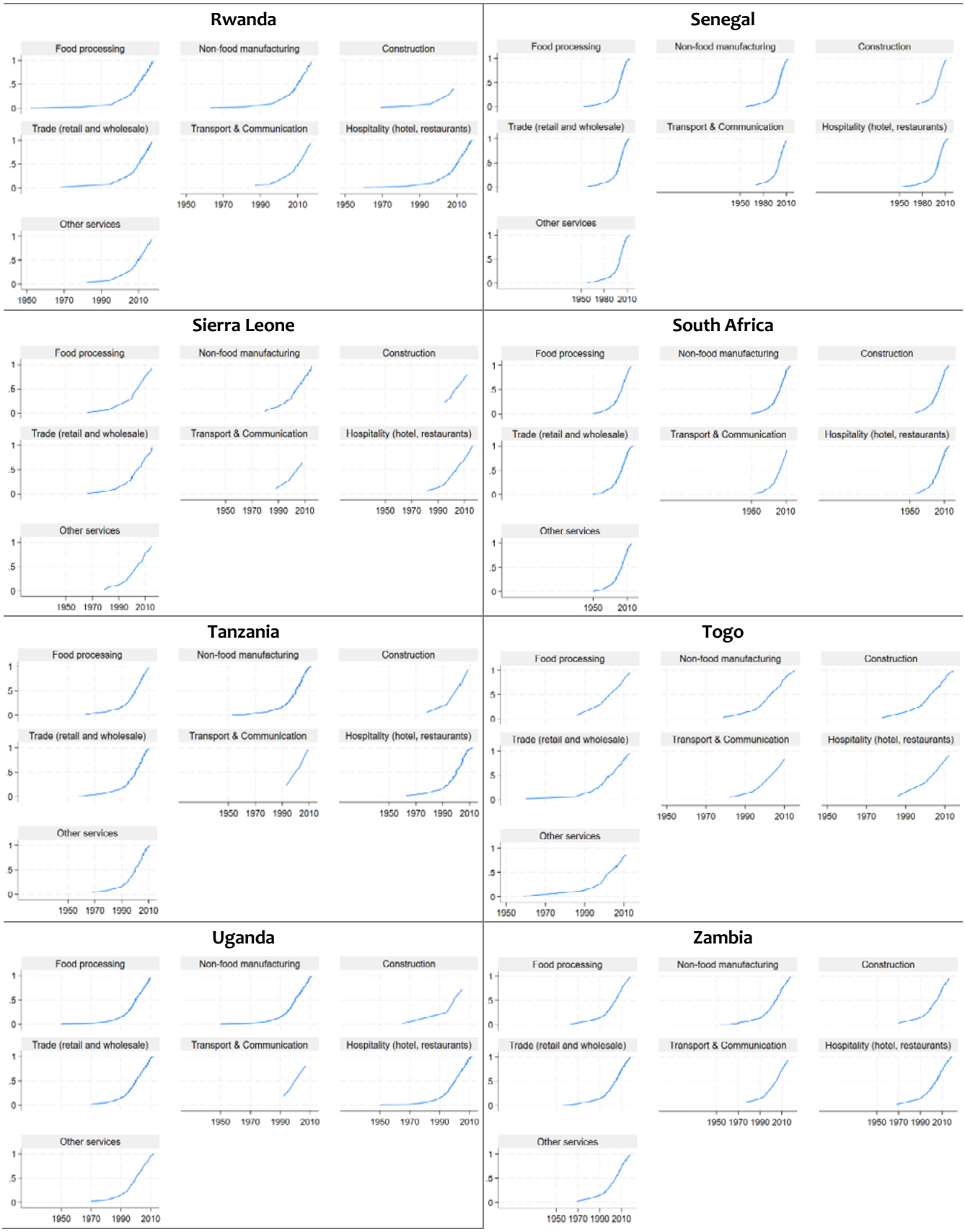


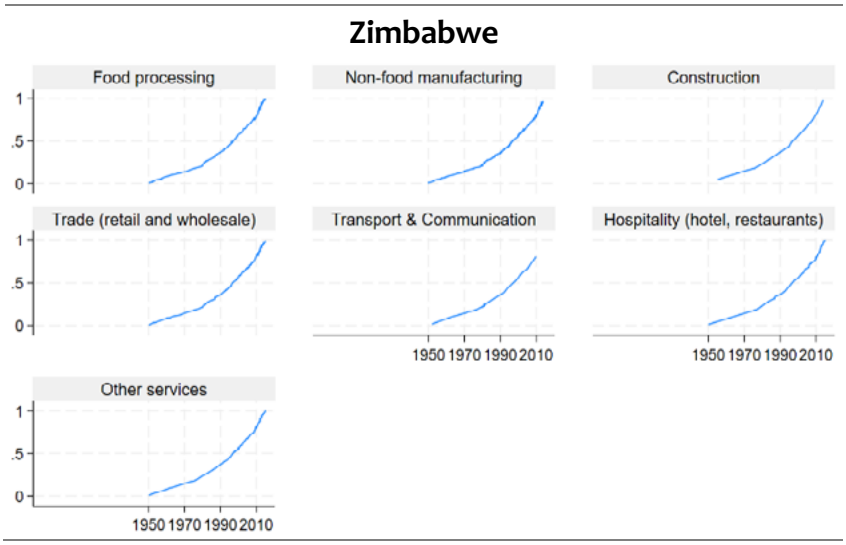
Niger



Nigeria




Rwanda
Food processing
Non-food manufacturing
Construction
Trade (retail and wholesale)
Transport & Communication
Hospitality (hotel, restaurants)
Other services
Senegal
Food processing
Non-food manufacturing
Construction
Trade (retail and wholesale)
Transport & Communication
Hospitality (hotel, restaurants)
Other services
Sierra Leone
Food processing
Non-food manufacturing
Construction
Trade (retail and wholesale)
Transport & Communication
Hospitality (hotel, restaurants)
Other services
South Africa
Food processing
Non-food manufacturing
Construction
Trade (retail and wholesale)
Transport & Communication
Hospitality (hotel, restaurants)
Other services
Tanzania
Food processing
Non-food manufacturing
Construction
Trade (retail and wholesale)
Transport & Communication
Hospitality (hotel, restaurants)
Other services
Togo
Food processing
Non-food manufacturing
Construction
Trade (retail and wholesale)
Transport & Communication
Hospitality (hotel, restaurants)
Other services
Uganda
Food processing
Non-food manufacturing
Construction
Trade (retail and wholesale)
Transport & Communication
Hospitality (hotel, restaurants)
Other services
Zambia
Food processing
Non-food manufacturing
Construction
Trade (retail and wholesale)
Transport & Communication
Hospitality (hotel, restaurants)
Other services


Zimbabwe
Food processing
Non-food manufacturing
Construction
Trade (retail and wholesale)
Transport & Communication
Hospitality (hotel, restaurants)
Other services
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1950 1970 1990 2010

Annex Table 1. Concentration of firms across regions by industry and country, regional percentage share

Region	Food processing	Non-food manufacturing	Construction	Trade	Transportation and communication	Hospitality	Other services	*Year*
Benin								
Cotonou	11.5	42.3	5.1	32.1	-	-	9.0	2016
Porto Novo	-	-	-	100.0	-	-	-	2016
Burundi								
Bujumbura	24.4	42.4	7.1	13.1	6.1	-	7.1	2014
Gitegi	-	-	-	100.0	-	-	-	2014
Ngozi	-	-	-	50.0	-	50.0	-	2014
Cameroon								
Center	5.9	23.5	-	50.0	-	10.8	9.8	2016
Littoral	-	28.4	7.8	36.3	11.8	7.8	7.8	2016
West	10.5	21.1	1.8	43.9	1.8	12.3	8.8	2016
Côte d'Ivoire								
Abidjan	4.3	23.8	7.6	36.2	8.1	3.2	16.8	2016
Rest of country	9.2	12.3	-	63.1	-	7.7	7.7	2016
DR Congo								
Central	8.5	29.8	-	31.9	-	23.4	6.4	2013
East	10.2	58.2	-	31.6	-	-	-	2013
South	-	37.5	-	62.5	-	-	-	2013
West	5.8	40.1	1.9	28.0	7.7	9.2	7.3	2013
Eswatini								
Swaziland	13.9	39.6	5.0	20.8	7.9	6.9	5.9	2016
Ethiopia								
Addis Ababa	5.6	36.5	6.4	29.9	14.5	2.7	4.4	2015
Amhara	11.9	28.4	-	46.3	13.4	-	-	2015
Dire Dawa	47.6	23.8	-	-	-	-	28.6	2015
Oromia	8.9	37.4	-	32.5	12.2	8.9	-	2015
SNNPR	26.7	31.1	-	17.8	-	24.4	-	2015
Tigray	7.8	50.5	4.9	23.3	4.9	8.7	-	2015
Ghana								
Accra	9.8	48.9	4.1	25.9	-	5.1	6.3	2013
North	11.3	54.0	-	22.6	-	5.7	6.5	2013
Takoradi	10.7	42.9	-	17.9	-	16.1	12.5	2013
Tema	8.8	53.6	-	18.4	15.2	-	4.0	2013
Kenya								
Central	37.6	26.3	-	15.0	-	-	21.1	2018
Coast	8.0	25.0	-	19.0	-	-	48.0	2018
Eastern	9.1	32.7	-	14.6	-	-	43.6	2018
Nairobi	4.4	59.6	-	18.2	-	-	17.8	2018
Nyanza	10.6	15.2	-	28.8	-	-	45.5	2018
Rift Valley	15.6	27.5	-	22.2	-	-	34.7	2018
Malawi								
Blantyre	6.5	35.9	4.9	31.0	2.7	4.4	14.7	2014
Lilongwe	8.2	24.6	10.0	29.1	4.6	5.5	18.2	2014
Mzimba	-	100.0	-	-	-	-	-	2014

Region	Food processing	Non-food manufacturing	Construction	Trade	Transportation and communication	Hospitality	Other services	*Year*
Zomba	15.4	-	-	42.3	-	19.2	23.1	2014
Mali								
Bamako	13.3	31.6	9.2	22.5	13.3	5.1	5.1	2016
Mopti, Segou, Sikasso	29.4	50.0	-	20.6	-	-	-	2016
Mauritania								
Nouadhibou	52.4	-	-	-	47.6	-	-	2014
Nouackchott	23.1	13.5	11.5	26.9	25.0	-	-	2014
Mozambique								
Maputo	13.1	36.4	7.1	23.2	6.1	8.1	6.1	2018
Nampula	23.7	50.0	13.2	13.2	-	-	-	2018
Sofala	14.3	48.6	-	20.0	17.1	-	-	2018
Tete	-	50.0	50.0	-	-	-	-	2018
Zambezia	-	-	-	-	-	6.0	-	2018
Namibia								
Oshakati	-	15.7	36.1	31.5	-	6.5	10.2	2014
Walvis Bay	9.1	25.0	5.7	30.7	10.2	9.1	10.2	2014
Windhoek	2.2	42.3	8.0	27.0	3.7	4.4	12.4	2014
Niger								
Maradi	-	-	-	100.0	-	-	-	2017
Niamey	11.1	16.7	8.3	36.1	9.7	8.3	9.7	2017
Nigeria								
Abia	-	53.3	-	31.1	-	15.6	-	2014
Abuja	7.5	46.8	-	25.5	-	10.6	9.6	2014
Anambra	11.9	32.2	-	30.5	-	25.4	-	2014
Cross River	26.5	25.5	-	25.5	-	10.8	11.8	2014
Enugu	10.7	42.7	-	22.7	10.7	6.7	6.7	2014
Gombe	6.2	46.4	-	18.6	-	13.4	15.5	2014
Jigawa	12.0	40.0	-	24.0	10.0	7.0	7.0	2014
Kaduna	8.1	44.8	-	25.3	5.8	11.5	4.6	2014
Kano	23.7	31.2	-	31.2	3.2	4.3	6.5	2014
Katsina	6.3	36.7	-	21.5	11.4	11.4	12.7	2014
Kebbi	9.9	44.0	-	28.6	-	8.8	8.8	2014
Kwara	8.4	57.9	-	8.4	6.3	12.6	6.3	2014
Lagos	9.2	50.0	-	18.4	7.7	3.6	11.2	2014
Nasarawa	5.8	55.8	-	16.4	-	10.6	11.5	2014
Niger	8.6	60.2	-	14.0	-	10.8	6.5	2014
Ogun	20.0	52.0	-	16.0	-	0.0	12.0	2014
Oyo	7.8	37.5	-	23.4	-	23.4	7.8	2014
Sokoto	13.6	48.5	7.6	18.2	-	12.1	-	2014
Zamfara	-	80.7	-	19.4	-	-	-	2014
Rwanda								
Kigali	-	34.6	7.7	20.5	-	10.3	26.9	2019
Southern	-	45.2	-	28.6	-	26.2	-	2019
Western	-	32.3	-	35.5	-	32.3	-	2019

Region	Food processing	Non-food manufacturing	Construction	Trade	Transportation and communication	Hospitality	Other services	*Year*
Senegal								
Dakar	16.5	25.0	3.1	20.1	12.1	13.0	10.3	2014
Kaolack	35.3	21.6	-	43.1	-	-	-	2014
St. Louis	-	25.0	-	30.0	-	45.0	-	2014
Thies	8.3	22.2	12.5	38.9	-	18.1	-	2014
Sierra Leone								
Bo	-	100.0	-	-	-	-	-	2017
Kenema	-	100.0	-	-	-	-	-	2017
Western Urban	8.2	35.3	5.9	25.9	7.1	10.6	7.1	2017
South Africa								
Cape Town	8.8	19.7	7.5	20.1	5.9	28.5	9.6	2020
Durban	3.4	28.3	5.9	27.8	5.4	21.0	8.3	2020
Johannesburg	2.3	32.6	16.9	21.3	4.9	10.0	12.1	2020
Port Elizabeth	4.0	21.8	15.3	23.4	-	22.6	12.9	2020
Tanzania								
Arusha	16.2	50.5	-	12.1	-	21.2	-	2013
Dar es Salaam	9.0	37.7	1.9	17.2	3.4	23.1	7.8	2013
Mbeya	7.5	62.7	-	11.9	-	13.4	4.5	2013
Mwanza	13.2	58.8	-	11.8	-	16.2	-	2013
Zanzibar	11.5	63.2	-	11.5	-	13.8	-	2013
Togo								
Lome	5.3	29.8	16.0	22.3	7.5	-	19.2	2016
Plateaux	-	-	-	100.0	-	-	-	2016
Uganda								
Jinja	24.7	39.7	-	16.4	9.6	9.6	-	2013
Kampala	11.2	37.9	1.8	32.1	12.3	4.7	-	2013
Lira	28.6	28.6	-	42.9	-	-	-	2013
Mbale	21.5	38.5	-	26.2	13.9	-	-	2013
Mbarara	17.7	38.2	-	20.6	23.5	-	-	2013
Wakiso	22.4	31.0	-	32.8	13.8	-	-	2013
Zambia								
Kitwe	14.3	31.8	-	27.0	-	-	27.0	2019
Livingston	-	-	-	30.8	-	-	69.2	2019
Lusaka	21.6	21.1	-	29.7	-	-	27.6	2019
Ndola	9.3	25.9	-	27.8	-	-	37.0	2019
Zimbabwe								
Bulawayo	17.1	46.2	-	19.6	-	-	17.1	2016
Harare	22.1	40.3	-	15.5	-	-	22.1	2016
Manicaland	30.4	30.4	-	20.3	-	-	19.0	2016
Midlands	10.5	24.4	-	32.6	-	-	32.6	2016

Source: Authors' estimation based on WBES (2020)

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