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Labour Markets and Global Value Chains:

Moderating the labour market implications of trade integration in Sub-Saharan Africa

by

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Abstract: With the rise of international fractionalization of production, global value chain (GVC) integration has become an important pillar of economic growth strategies especially in low- and middle-income countries during the past decades. Differentiating between backward and forward GVC integration, economic growth and upgrading potentials are well-defined, but to be sustainable growth through GVC integration needs to incorporate decent job creation. By investigating the labour market implications of GVC integration and potential country-specific characteristics moderating these relationships, this paper aims to shed light on the ability of GVC integration to foster inclusive economic growth. Using fixed-effects panel regressions on a set of 17 Sub-Saharan African countries during the period 2000-2015, labour intensity embodied in GVC trade has been found to decrease. This is especially prevalent for backward integrated trade, where in some cases, higher levels of trade are associated with lower levels of total employment and labour compensation. When promoting GVC integration as a growth paradigm, this joblessness of export growth should alert policy makers and be taken as a reminder that the inclusiveness of growth is not an automatism. For the moderation of the GVC-labour nexus education and infrastructure have been found impactful. While transport infrastructure has been found to matter for all sectors, the moderating effect of ICT infrastructure on trade in services is surprisingly absent.

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AIDI	African Infrastructure Development Index
ETD	Economic Transformation Database
FD	Final Demand
FVAX	Foreign Value Added in Exports
GVC	Global Value Chain
HICs	High-Income Countries
ISIC	International Standard Industry Classification
ICT	Information and Communication Technology
IO	Input-Output
IX	Intermediate Exports
LM	Labour Market
LMICs	Low- and Middle-Income Countries
LMF	Labour Market Flexibility
SSA	Sub-Saharan Africa
VA	Value Added
WSS	Water and Sanitation

1. Introduction

Opening up for international trade has been a major development paradigm for countries at all stages of development since the beginning of international trade theory about two centuries ago, but the recent change in the character of international trade has brought forth new challenges for understanding the economic and social implications of trade integration. Instead of trading final goods and services, today large parts of imports and exports are intermediate goods and services, which are crossing borders many times before being consumed. This trade in global value chains (GVC) describes the internationalization of production and is often associated with large benefits for economic development, growth and job creation specially in low- and middle-income countries (LMICs) (Farole, 2016a). While expanding literature discusses the ability of GVC integration to foster economic growth and economic upgrading, less emphasis has been laid on the inclusiveness of this growth. Facing the increasing population of Sub-Saharan Africa (SSA), decent job creation is a principal concern for policy makers and hence will be the focus of this study.

From providing primary inputs like natural resources and simple manufacturing goods to the production of high-tech electronics, the character of GVC trade varies not only by sectors but also by an industry's position within the GVC. In this study, these differences in the nature of GVC integration will be accounted for by differentiating between backward and forward GVC integration. These two types of GVC integration are associated with different levels of production complexity, labour intensity and upgrading potential, and hence affect labour markets (LMs) differently. Analysing the relationships of backward and forward GVC integration with employment, labour compensation and average wages for 17 SSA countries during the period 2000-2015, this study shall give insight on the nexus of GVC trade and LMs. By investigating the structural differences in GVC activities and a number of country-specific characteristics that may moderate this nexus, the following research question shall be answered:

What are and what drive the labour market implications of global value chain integration in Sub-Saharan Africa between 2000 and 2015?

The aim of this paper is to draw a clearer picture on the nature and scale of employment, labour compensation and average wages embodied in GVC trade. Since the LM outcomes of GVC activities also depend on the type of firms a country attracts as well as a country's ability to absorb technology and knowledge spillovers, four potential country-specific moderating factors will be discussed: workforce capability, labour market flexibility, trade openness and infrastructure development.

Overall, I find that labour intensity decreases with higher levels of GVC trade. This is especially prevalent for backward integrated trade, where in some cases, growth in GVC trade is associated with a reduction of total employment and labour compensation. When promoting GVC integration as a growth paradigm, this potential joblessness of growth through GVC integration should alert. For the moderation of the GVC-labour nexus, education, labour market flexibility and infrastructure have been found impactful. While transport and ICT infrastructure matter for

inclusiveness, the moderating effect of ICT infrastructure on trade in services is surprisingly absent.

The rest of this paper is structured as follows: Chapter 2 first discusses the different types of GVC integration and how these interact with the LM indicators in LMICs. After introducing the four moderating factors of the GVC-labour nexus, a brief review of the existing literature on the role of GVC integration in SSA is provided. The theoretical and empirical considerations serve to derive the hypotheses for the empirical analyses in this paper. Chapter 3 describes the research design and the construction of the variables based on the multi-region input-output tables by Eora. The results of the analyses are presented in chapter 4. Discussing the limitations and future research suggestions, chapter 5 concludes.

2. Theory and Literature Review

International trade and, in recent years, the integration into GVCs is an important pillar of economic growth strategies in many countries including those of SSA. Understanding the dynamics behind GVC integration and LM outcomes, however, is essential for assessing whether economic growth from GVC integration is sustainable and inclusive. This chapter offers the necessary overview of previous theoretical and empirical research regarding the GVC integration - labour market outcome nexus (in short GVC-labour nexus). In chapter 2.1., I discuss the different types of GVC integration and their ability to foster economic and social upgrading in LMICs. The expected relationship of GVC integration and the three LM indicators will be outlined in chapter 2.2., in which I further distinguish between trade in different economic sectors. Besides these structural differences in GVC integration, the moderating power of different country-specific characteristics will be considered to understand why some countries experience stronger LM effects. These potential moderating factors include workforce capability, labour market flexibility, trade openness and infrastructure development. Lastly, the current state of GVC integration in SSA is discussed in chapter 2.4. Throughout this chapter, seven hypotheses are stated to guide through the empirical analysis.

2.1.   Global Value Chain Integration

Traditionally, international trade has been defined by the import and export of final goods and services. By opening up to international markets a country could use its comparative advantage in the production of certain tradable goods and services to specialize, develop technological competences and produce beyond its domestic demand. With the rise of the international fragmentation of production and hence the rise of GVCs beginning in the 1960s (Baldwin, 2014), the character of international trade has shifted towards intra-industry trade and specialization in task rather than final products. Today, trade in intermediate inputs is at least as important in value as trade in final products (Gereffi, 2014).

The rapid change in the character of trade comes with new opportunities and challenges for participating in global markets and economic upgrading especially for LMICs. Naturally, the international division of production stages has large structural impacts on all participating economies, but while the impact on economic growth and employment structures in high-income countries (HICs) have been broadly debated in academia (e.g. Inglehart & Norris, 2016; Kummritz, Taglioni & Winkler, 2017; Pan, 2020), the impact on LMICs is less clear.

Typically, LMICs participate in GVC by providing primary goods and simple manufacturing products which tend to be in the beginning of the value chain and are of low complexity (or low value-adding) (Hollweg, 2019). Higher levels of value creation such as complex manufacturing production or distributional services tend to be performed by HICs. While this distribution of tasks, is in line with classical theories of comparative advantage, the paradigm of growth through GVC participation for LMICs implies that countries join on low value-adding stages, but later move up the GVC to more complex production stages (Gereffi, Bamber & Fernandez-Stark, 2016). This process is referred to as economic and social upgrading, but it does not happen automatically since it highly depends on the nature of participation and a country's ability to capture spillover effects.

Previous research has identified three major channels through which GVC participation affects economic and social upgrading in LMICs (World Trade Organization, 2017): First, the slicing up of production processes allows for a country to enter the global market without needing to provide a full production chain. Instead countries can use their comparative advantage more effectively by specializing for example in labour-intensive production stages (Farole, 2016a). GVCs therefore not only allow for more precise specialization but also for easier and more rapid integration (Baldwin, 2014).

A second channel through which GVC integration fosters economic development is through the growing connectivity with more productive firms which opens up great opportunities for knowledge and technology spillovers. Firms participating in GVCs tend to be more productive and technologically advanced (Farole & Winkler, 2014), hence cooperation with these international firms may boost domestic productivity through spilling over knowledge to domestic firms. Though LMICs usually enter the global production process on a low value-adding stage, spillover effects can help boost the catching-up process and initiating the shift toward more complex production stages (Foster-McGregor, Kaulich & Stehrer, 2015).

The third aspect, especially important for inclusive growth, concerns the potential creation of decent employment opportunities through GVC integration. The inflow of international investment creates jobs in more productive, mostly non-agricultural sectors. Through domestic production linkages of GVC-participating firms and increasing productivity of domestic firms, local economic activity can foster new high-quality jobs.

If all three channels apply, GVC integration should lead to a specialization in tasks in which a country has a comparative advantage. In the case of LMICs, this usually means low- to middle-skilled, labour-intensive production. At the same time, GVC integration should foster productivity growth without a loss of employment. This requires a trade-off between labour productivity and employment growth with the different types of GVC integration likely to call on different channels.

As the research on GVCs is relatively young, various definitions and terms are being applied to describe the different types of GVC integration and a country's role in it (see e.g. Wang, Wei & Zhu, 2018). The most common distinction which is also followed in this study, is between forward and backward GVC integration, with each measure referring to the production stage's position within the GVC.

Forward GVC integration

Forward GVC integration describes a country's involvement in GVCs by looking at the purpose of the good in the receiving country. To classify as part of a *global* value chain a product needs to be exported at least twice before being consumed (Antras & Chor, 2018). The measure of forward integration incorporates this by differentiating between exports used for final consumption and those used as intermediate inputs for further production. If a country A's exports are used as inputs in the production of country B, the production stage of country A is considered "upstream" to the production stage of country B. A country's level of forward GVC integration is hence measured as the share of intermediate goods in total exports. In this paper's analysis the total value of trade in forward integration will be used, which equals the value of intermediate good exports (IX).

The measure of forward integration used here considers the usage of a country's exports only one step further in the GVC. While Antras and Chor (2018) point out the true level of "upstreamness" could be detected only if one follows the usage of exports through all stages of production, this is a highly complex procedure beyond the scope of this analysis. Looking at the exports' purpose for the first-stage importer, however, is a simplified approach to measure "upstreamness" which, to the best of my knowledge, is the predominant approach in existing studies.

As the measure implies, forward integration captures the GVC integration at earlier production stages and, especially in SSA, these are often associated with low value-adding tasks such as primary goods and basic manufacturing production (Foster-McGregor, Kaulich & Stehrer, 2015). Following this, forward integration is seen as easier to achieve for LMICs, but at the same time, forward integrated trade is associated with fewer opportunities for domestic linkages and economic upgrading. Leaving aside the magnitude of trade, forward integration can be expected more labour-intensive and hence closely correlated to employment and labour compensation growth. Nonetheless, due to lower labour productivity growth compared to backward integration, I expect wages to be relatively constant at different levels of forward integration.

Backward GVC integration

Backward GVC integration is defined as the foreign value added in a country's exports (FVAX), or in other words a country's imports included in exports. The intention behind this measure is that more complex production stages tend to be located further along the GVC and hence require more imported inputs. Using the example of car production, producing primary inputs such as screws is a rather simple task somewhat in the beginning of the GVC. Putting together the different parts of car, on the other hand, requires various inputs such as the motor and screws. In the case of global production, this later stage of the production requires more imports than the production of a primary input like screws. To differentiated between these low complexity stages (screws) and

relatively high complexity stages (putting together a car), backward integration aims to capture the latter.

Relatively abundant literature discusses the conditions and economic implications of backward GVC integration and though it is a fairly young research subject a consensus on the importance of backward integration for economic upgrading exists (e.g. Jiang & Milberg, 2012; Kummritz, Taglioni & Winkler, 2017; Pahl & Timmer, 2019). Concerning the LM effects, the higher complexity of production associated with backward integration is expected to imply lower labour intensity. Consequently, the correlation of backward integrated trade and employment is lower than for forward integrated trade. At the same time, backward integration is associated with an increase in skill intensity and hence labour compensation and potentially average wages should increase with a high volume of backward integration.

Following these theoretical characteristics of GVC integration the following hypothesis can be stated as:

> **Hypothesis 1**: *Backward GVC integration is associated with smaller labour market effects than forward GVC integration. The employment effect is expected to be larger (smaller) than the labour compensation effect in backward (forward) integrated trade.*

2.2. Impact of GVC integration on Labour Markets

GVC studies are closely linked to the matters of economic development which include not only economic growth but also job creation and the inclusiveness of LMs (Farole, 2016a). When studying the effects of GVC integration, researchers often distinguish between economic and social upgrading effects. While economic upgrading refers to productivity growth and structural change in value added (VA) and has been studies in depth during the last years, studies on social upgrading are relatively scare and often limited to country- or sector-specific studies.

Social upgrading is a relatively broad term for the improvement of working conditions, labour compensation and employment opportunities. While a large part of the literature focuses on matters of labour rights and standards (e.g. Barrientos & Visser, 2012; Rossi, 2013), the trends in larger LM indicators such as employment and average wages in relationship to GVC integration are less studied. Several case studies provided insight into the developments in certain sectors, but as Farole (2016a) points out "the evidence of the impact of GVC integration on jobs in developing countries remains largely anecdotal".

Taking simple comparative advantage theory as basis, increasing participation in trade should lead to an increase in labour-intensive production in LMICs and a shift towards capital-intensive production in HICs. Indeed, large political debates have been arising around the alleged decline of manufacturing employment in HICs (Inglehart & Norris, 2016). The expected rise of manufacturing employment in LMICs, on the other hand, is not as easy to generalize. During the past decades, manufacturing production has significantly increased in large emerging countries (Baldwin & Lopez-Gonzalez, 2015), but as Rodrik introduces with the term *Premature*

Deindustrialization, it seems that in Africa and Latin America VA and employment in manufacturing have not been significantly increasing over the past decades (Rodrik, 2016)[1]. Although the overall speed of structural change in SSA is relatively low, studying the impact of GVC integration might give important insight on why this is the case and under which conditions GVC integration may be able to contribute to a more rapid structural change.

Facing the high labour abundance in SSA, sustainable and inclusive economic growth can only be achieved if decent jobs are being created. For the consideration of which type of GVC integration is most beneficial for these countries, hence, the number of jobs created as well as the quality of these jobs is essential. As the debates on jobless growth and sustainability of specialization in services show (Alessandrini, 2009; McMillan & Rodrik, 2011), shifting labour out of low value-adding activities usually comes with a trade-off between productivity and employment growth. Simply put, specializing in more complex production stages improves labour productivity and hence the quality of jobs, but at the same time fewer workers are required for these tasks which results in less people profiting from economic activity. Following the Sustainable Development Goals (United Nations, 2015) the optimal effect of GVC integration on LMs should foster employment growth and labour compensation per worker simultaneously. Additional to these two main factors, several other LM outcomes such as gender- or skill-biased employment would need to be considered to provide a full picture of inclusiveness (e.g. Shepherd & Stone, 2012; Farole, Hollweg & Winkler, 2018; Hollweg, 2019). Due to limited space and lacking data, however, the following analysis will be solely focus on employment, labour compensation and average wages embodied in exports. The picture drawn from these indicators shall not be interpreted as complete, but rather as a starting point for a deeper understanding of the GVC-labour nexus.

Besides the differences in the impact of forward and backward integration on LMs, the potential effects on social and economic upgrading from GVC integration are likely to differ in scale and nature across economic sectors. Agricultural production is the largest sector in most SSA economies and is characterized by relatively low labour productivity and high labour intensity. Increasing trade and the specialization in so-called cash crops can improve the conditions of the agricultural workforce, but it is a widely accepted fact that rapid and long-term economic growth can only be achieved if a country moves out of the agricultural sector into more productive sector (see e.g. Rodrik, 2014; Mensah, Owusu, Solomon, Foster-McGregor, Neil & Szirmai, 2018; Diao, McMillan & Wangwe, 2018). Furthermore, agricultural production is usually located in the very beginning of value chains (forward GVC integration) and hence captures only a small potential for upgrading.

Following the classical theory of modern economic growth introduced by Nicholas Kaldor (1966), structural change should involve a shift of VA and employment from the traditional agricultural sector to manufacturing. Only at an advanced level of development, economies should shift towards services. Kaldor and the majority of structural change economists suggest that

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[1] Based on new empirical evidence from the Economic Transformation Database, Kruse, Mensah, Sen and Vries (2021) relativize Rodrik's findings of premature deindustrialization for Asia and Sub-Saharan Africa. They find that since the early 2000s trends in manufacturing employment and VA have reversed causing a so-called "manufacturing renaissance".

manufacturing is the ideal sector for a shift in economic activity because this sector is labour-intensive and can improve in labour productivity due to its reliance on technology. Large parts of the literature on technology and knowledge spillovers point out the great development prospect of the manufacturing sector (e.g. Herrendorf, Rogerson & Valentinyi, 2014; Rodrik, 2016; Diao, McMillan & Rodrik, 2017). Yet, as summarized succinctly by Baldwin and Forslid (2020), the uniqueness of manufacturing as the sector able to foster decent job creation might not be true anymore. While manufacturing has been associated with large demand for low-skilled workers in the past, many manufacturing products like electronics or transport equipment have become highly complex and less depended on low-skilled labour with the recent rise of automation and digitalization. While this is rather a tendency than a fact applying to all industries within manufacturing sector, it challenges the traditional view of manufacturing fostering decent employment.

In contrast to manufacturing, the service sector is traditionally viewed as "non-tradable, menial, low productivity and low-innovation" (McCredie & Bubner, 2010). Evidentially, the non-tradability of services does not hold for all services anymore, at least since the so-called service transformation in the 1970s and 1980s (Eichengreen & Gupta, 2013). Nevertheless, the implications of trade in services are still debated controversially. Generally, services are considered less suitable for economic upgrading as they incorporate fewer opportunities for domestic linkages and technology upgrading. At the same time, countries like India have achieved significant structural change through specializing in modern tradable services (Ghani & Kharas, 2010). Concerning the labour intensity of service sector trade, one needs to be aware of the heterogeneity within the sector. While the so-called traditional services like transport, trade and other services are typically labour-intensive, modern services like business and financial services are rather capital and skill-intensive. Following this, the LM implications of GVC integration in services are likely to vary depending on the role of each sub-sector, but considering the non-tradability of many low-skill intensive activities, it is more likely that increasing GVC trade will lead to an increase in labour productivity and a shift toward high-skilled rather than low-skilled employment.

Juxtaposed, GVC integration in both manufacturing and services come with an increase in labour productivity, but relative effects of integration on employment and labour compensation are likely to differ. In light of this, the following two hypotheses on the impact of GVC integration in manufacturing and services on the LM indicators are formulated:

Hypothesis 2: An increase in GVC integration in manufacturing is correlated with larger effects on employment relative to labour compensation.

Hypothesis 3: An increase in GVC integration in services is correlated with larger effects on labour compensation relative to employment.

2.3. Moderating the Labour Market Implications

Integrating into GVCs and specializing in certain tasks is likely to change the role and kind of labour included in the production, but the LM effects are unevenly distributed not only among sectors but also on the micro level, among the industries and firms involved (e.g. Meyer & Sinani, 2009; Goger, Hull, Barrientos, Gereffi & Godfrey, 2014; Farole, 2016b). After having distinguished between the two types of integration and the different sectors, country-specific characteristics need to be considered in order to understand how policies may be able to shape the character of GVC trade. Discussing some of the many potential moderators, the factors discussed in this paper can be subsumed by two mechanisms through which the GVC-labour nexus is influenced: first, the type of GVC activities depends on the domestic conditions for production. Structural endowments, e.g. a lack of basic education or restricted trading conditions, may prevent more complex industries to enter the country (Meyer & Sinani, 2009). By shaping the domestic conditions, countries may be able to attract those firms and industries that are associated with the desired LM outcomes (Farole, Hollweg & Winkler, 2018). Second, domestic cooperation with GVC-participating firms and benefitting from potential knowledge and technology spillovers does not take place automatically. It depends on both the character of the firms providing the advanced technology and knowledge and the ability of the domestic workforce to make use of it (Meyer & Sinani, 2009).

A variety of conditions have been found to impact a country's specialization process and the ability to create productivity spillovers (see, e.g. Amiti & Konings, 2007; Meyer & Sinani, 2009; Taglioni & Winkler, 2016), but as the majority of research focuses on the impact of domestic conditions on economic upgrading, not all factors are equally relevant for LM effects. Kummritz et al. (2017) find that a spectrum of policies targeting a) investment and trade flows, b) the business climate and c) the quality of output and input factors moderate the probability of economic upgrading from GVC integration. They find that for backward GVC integration, the quality of infrastructure and the connectivity to global firms are vital while for forward GVC integration the initial level of domestic firm productivity is equally important.

Although the literature on moderating factors of LM outcomes, is relatively limited, a number of factors have been found to be important. Providing evidence on global trends in the GVC-labour nexus, Farole et al. (2018) find that human capital, labour market flexibility (LMF) and trade openness matter, but their impact significantly varies strongly across the types of GVC integration. Focusing on the GVC-labour nexus in LMICs, Hollweg (2019) points at similar factors impacting the GVC-labour nexus. Additional to LMF and trade policies, she stresses the importance of trade infrastructure for fostering employment in GVCs. Building on these considerations, four potential moderators of the GVC-labour nexus will be considered: workforce capability, LMF, trade openness and infrastructure development. Generally, the point of understanding the relationship of these country-specific moderating factors and the GVC-labour nexus is to identify potential bottlenecks and policies that may help to shape the implications of GVC participation. It should be kept in mind, however, that the direction of causality cannot be identified. In the case of skill composition, for example, higher levels of education may attract more international firms. At the

same time, the presence of these firms might improve overall skill levels through higher investments in trainings and skill development. Facing this endogeneity problem, identifying moderating factors, hence, can only provide insights on associations rather than causal relationships.

2.3.1. Workforce Capability

It is a relatively well-established fact that for both low- and high-income countries, GVC integration in correlated with higher average skill levels (e.g. Shingal, 2015; Ehab & Zaki, 2021). This is possible because the definition of "high-skilled" and "low-skilled" is not identical in all countries and hence jobs that require "low-skilled labour" in advanced economies can foster demand for relatively high-skilled labour in LMICs. While GVC integration increases the demand for more skilled workers (Farole, Hollweg & Winkler, 2018), firms participating in GVCs also tend to investment more in trainings and skill-development of their employees (World Bank, 2017). As mentioned above, the causality between skill composition and GVC integration may run in both directions, but its explanatory power as a moderating factor may still give insight on whether and how workforce capabilities are related to GVC activities.

Workforce capabilities are important for attracting foreign investment as well as benefiting from technology and knowledge spillovers. Studies in Ethiopia and Rwanda show that investing in workforce capability increases the probability of success for implementing upgrading strategies (Taglioni & Winkler, 2016). Looking at a sample of 72 LMICs, Farole and Winkler (2014) confirm that higher government spending on education has a positive effect on productivity levels. Meyer and Sinani (2009) analyse the relationship of education and foreign direct investment spillovers in more detail and find that indeed all levels of education - primary, secondary and tertiary education - matter for the ability to benefit from foreign investment.

Looking at the impact of education on the GVC-labour nexus specifically, Farole et al. (2018) find that years of schooling are positively moderating the labour demand embodied in forward integrated trade, but in the case of backward integration, more years of schooling negatively mediate the labour demand. Farole et al. identify these trends by using a set of countries covering all stages of development, but for less developed countries the effect of education might be quite different and considering the overall years of schooling might oversimplify the role of education on the GVC-labour nexus. As research on structural change and trade integration has shown, low levels of basic education are often a bottleneck for economic development and employment creation in non-agricultural sectors (McMahon & Boediono, 1992). Papageorgiou (2003) finds that especially in LMICS primary education is essential as an input factor for production. Good basic education can improve the "quality" of low-skilled workers and hence may boost a country's attractiveness for labour-intensive international firms.

Higher education is likely to matter especially for economic upgrading capabilities. While basic education can boost a LMICs comparative advantage in cost efficient provision of low-skilled labour, a solid basis of highly educated workers may allow not only to take over more complex

tasks in the value chain but also increases the ability to benefit domestically from multinational firms. One prominent example of the impact of investing in tertiary education is India. Since the rise of information and communication technology (ICT) in the 1980s, India has become strongly integrated in GVCs through providing services and specialized manufacturing products (Ghani, 2010). One of the most common explanations for India to be the country entering GVCs this way instead of, for example, China is the country's relatively large investments in tertiary education (Ghani, 2010). Considering this, higher education (secondary and tertiary education) are assumed to attract especially high-skill intensive activities and hence positively moderate especially labour compensation and average wages.

Having discussed the potential channels through which education may moderate the GVC-labour nexus, for the empirical analysis the following hypothesis can be formulated:

> **Hypothesis 4**: *An increase in GVC integration is correlated with larger labour market effects when accompanied by higher levels of primary, secondary and tertiary education.*

2.3.2. Labour Market Flexibility

Well-functioning LMs are important for GVC integration as the process of integration goes hand in hand with the reallocation of resources among sectors and firms. Aside from reducing negative externalities for parts of the workforce such as (temporary) unemployment or declining wages (Taglioni & Winkler, 2016), LM regulation can influence skill composition and wage payments.

The debate on whether LM regulation foster or hinder economic and social upgrading is ambiguous. On the one hand, LMs should be flexible enough to favour the needs of multinational firms. Especially in LMICs low labour costs are an important pulling factor for multinational firms and hence high flexibility may attract investment (Javorcik & Spatareanu, 2005). On the other hand, wage pressure and labour fluctuation may increase due to LMF (Hale & Long, 2011). While a certain level of labour turnover is needed for technology and knowledge to be spilling over to domestic firms, but too much fluctuation can hinder the accumulation of knowledge in the first place (Javorcik & Spatareanu, 2005).

While the ambiguity of the impact of LMF on economic upgrading is relatively well-defined, its role in moderating the GVC-labour nexus is less so. In their global study, Farole et al. (2018) find that LMF has a positive moderating effect on the level of backward GVC integration and the total labour compensation resulting from it. Kingdon, Sandefur and Teal (2006) analyse the interplay of LMF and wage development in SSA in the 1990s and find that higher LMF prevents a wage divergence between multinational and domestic firms. Following the argument that labour and low-skill intensive production might be attracted to the country when LMF is high, one could also suggest that average wages decrease as the share of low-skilled workers relative to high-skilled increased.

After all, the moderating power of LMF on the labour compensation effects of GVC integration are rather uncertain. The employment effects of GVC integration, on the other hand, can be

expected to be positively moderated by LMF if indeed labour-intensive production is attracted by higher flexibility. Following the academic consensus on the importance of LMF for structural transformation in SSA (e.g. Crivelli, Furceri & Toujas-Bernate, 2012; McMillan & Headey, 2014; Mensah, Owusu, Solomon, Foster-McGregor, Neil & Szirmai, 2018) and the importance of low labour costs for the attraction of low-skill intensive activities especially in LMICs the following hypothesis can be made:

Hypothesis 5: An increase in GVC integration is correlated with larger employment effects when accompanied by higher levels of labour market flexibility.

2.3.3. Trade Openness

Extensive literature exists on the importance of trade openness for economic growth. Research has shown that the technology and knowledge spillovers from foreign direct investment and GVC activities are larger for countries with open trade regimes (Meyer & Sinani, 2009; Du, Harrison & Jefferson, 2011; Havranek & Irsova, 2011). One channel through which this takes place is that openness to trade challenges domestic firms to compete in productivity. As Crespo and Fontoura (2007) point out, in open economies foreign investors are less constraint by the size and efficiency of the local market. Hence, export-oriented firms, which tend to be the most productive and technologically advanced, prefer open economies as GVC partners (Meyer & Sinani, 2009).

In contrast, a less affirmative perspective on the impact of trade openness also presented by Crespo and Fontoura (2007) suggests that foreign investments in more open economies tend to focus on international distribution and marketing rather than bringing new technologies to the host countries. If this aspect dominates, an open trade setting would imply that there are less incentives to create domestic linkages and spillovers. Their critique suggests that, even though the volume of trade may be higher, the character of GVC activities is less focused on the domestic markets when opening up for trade. While this certainly is a valid concern, facing the usually small domestic market potential the negative consequences might be less relevant in the context of SSA after all.

Generally, the impact of trade openness on employment, poverty reduction and wage development is still debated (e.g. Le Goff & Singh, 2013; Wamboye & Seguino, 2015; Kelbore, 2015) and especially at low levels of development opening up to trade can prevent the development of complex production rather than opening up new trade opportunities (Meschi & Vivarelli, 2007). Following this diversity of potential effects, GVC integration might be affected in different ways. For backward integration, opening up to trade might lead to economic upgrading and in turn lower labour intensity. At the same time, countries might be pressured to remain in stages of production fitting their comparative advantage best, which would mean to remain in labour-intensive production. As forward integrated trade is usually characterized by low value-adding production, opening up to trade might indeed come with larger export opportunities.

Having evaluated the different channels through which trade openness may moderate the GVC-labour nexus, previous academic research seems to be agreeing that trade openness positively

moderates the LM effects of GVC integration (Farole et al., 2018). Aware of possibility that the dynamics might be challenged in SSA, the expected role of trade openness in the GVC-labour nexus can therefore be summarized as:

Hypothesis 6: An increase in GVC integration is correlated with larger labour market effects when accompanied by higher levels of trade openness.

2.3.4. Infrastructure

Another factor likely to moderate not only the attractiveness of GVC participation in general but also the kind of firms entering a country is infrastructure. A lack of reliable infrastructure can reduce market potential, hinder technological catching up, leave behind rural areas. When considering the role of infrastructure in economic activity, a large variety of aspects - from transport over health to electricity infrastructure - could be considered. As the list goes on, a choice of limitation has to be made. Following the African Development Bank Group (2013), four aspects of infrastructure development are especially relevant for economic upgrading and sustainable economic growth. United in the African Infrastructure Development Index (AIDI) four kinds of infrastructure are included: transport, ICT, electricity and water and sanitation (WSS) infrastructure.

All four kinds of infrastructure matter especially for the spatial of domestic firms to participate in GVC trade. Transport infrastructure has been found to be an important bottleneck for the attraction of complex production processes especially in SSA (Christ & Ferrantino, 2011). For many value chains a delay in exports has large negative implication for investment attractiveness. Hummels, Minor, Reisman and Endean (2017) find that a one-day delay in exporting due to lack of road infrastructure is equivalent to a one percent increase in tariffs. For the moderation of the GVC-labour nexus, transport infrastructure can therefore be expected to foster both domestic participation and thus labour-intensive production and the attractiveness for more complex GVC tasks. A similar relationship can be expected for the role of electricity. Assuming that higher electricity infrastructure is both enabling and caused by capital-intensive production, labour intensity is expected to decrease for GVC-activities when accompanied by better electricity infrastructure.

ICT infrastructure is expected to me most important for complex manufacturing and services. Facing the rise of digitalization and automation, well-developed ICT infrastructure is likely to be essential for keeping up with the rapid technological change (Polikanov & Abramova, 2003). While ICT infrastructure is becoming more and more important for participating in GVC in the first place, employment and labour compensation are likely to stay behind when highly complex manufacturing and services are growing. When skill requirements are increasing, overall labour compensation and average wages are expected to grow with GVC trade. This is especially the case fir trade in services, as labour productivity differences within sub-sector are higher and higher ICT infrastructure can be expected to foster especially those activities with high-skill intensity and highly complex production.

Following this, I expect the overall development of infrastructure to matter for all LM implications of GVC integration. While electricity and transport infrastructure are likely to affect spatial inclusiveness and the ability of domestic firms to participate in GVCs, especially ICT infrastructure is also expected to shape the trade pattern towards more complex, less labour and low-skill intensive production. The expectations of infrastructure as a moderator of the GVC-labour nexus can therefore be summarized as:

> *Hypothesis 7: An increase in GVC integration is correlated with larger labour market effects when accompanied by higher infrastructure development. The effects on labour compensation are higher when accompanied by better ICT infrastructure.*

2.4. GVC Integration in Sub-Saharan Africa

The importance of LMICs in global trade is increasing, but facing the tremendous rise of emerging economies like China and India, the role of low developed countries in global production is often overlooked (Haraguchi, Cheng & Smeets, 2017). Globally, the role of SSA in overall and GVC trade is relatively small. The African Economic Outlook (2014) states that Africa's share in global trade in VA grew from 1.4% in 1995 to only 2.2% in 2011. From the African perspective, however, GVC trade plays a surprisingly important role in the overall economies. In fact, Foster-McGregor et al. (2015) find that the African continent is more integrated into GVCs than most other regions of the world.

The descriptive analysis of GVC activities in Africa by Foster-McGregor et al. takes a comprehensive look at the development of GVC integration on the whole African continent. They find that the share of domestic VA in IX, meaning forward GVC integration, has been relatively high already by the mid-1990s and continues to grow. Between 1995 and 2010, the ratio of domestic VA in IX has been increasing by over 43%. Not only in total numbers, but also relative to backward integration, forward integration has been growing in importance. On African average, in 1995 about two thirds of GVC trade had been forward integrated, whereas in 2010, the share has increased to about 75%.

Foster-McGregor et al. continue to stress that GVC participation through forward integration is less likely to create dynamic upgrading effects. Taking a closer look at the sectoral composition of GVC integration reveals that there is an additional sign for the low possibility of upgrading in Africa as a large share of IX are primary goods. For almost half of the countries under investigation the share of primary goods in IX was above 50%. A somewhat less pessimistic outlook can be drawn for countries like Rwanda, Malawi and Botswana where a large share of IX is categorized as industrial supplies. Although on the lower end of complexity in manufacturing production simple manufacturing tasks such as cork and wood products could still imply better economic and social upgrading potentials.

Concerning backward integration in Africa, Foster-McGregor (2015) find that the levels of integration are significantly lower than in other regions of the world. With on average 13% of

FVAX, Africa is less backward integrated than other developing regions (19%). However, looking at country-specific performances reveals that this picture overlooks the large heterogeneity in GVC integration across the continent. While for countries like Lesotho and Mauritius, the ratio FVAX to total exports is above 40%, in countries like Ghana and Cameroon the ratio is below 10%.

Interestingly, when comparing the share of forward and backward integration in overall GVC trade by country, significant differences in specialization can be found. While some countries like Nigeria and Angola participate in GVCs almost solely through forward integration (around 85%), backward integration accounts for about 75% of GVC participation in Lesotho and Mauritius. This significant heterogeneity across countries provides an interesting basis for analysing the structural differences across SSA.

For the effect of GVC integration on LM outcomes the majority of literature is based on micro-level evidence. Summarizing the findings from three case studies on horticulture, apparel and tourism in different African countries, Goger et al. (2014) find that high logistical costs, skill deficiencies and gender disparities remain to be the main bottlenecks for achieving economic and social upgrading. Analysing the job creation from GVC participation in manufacturing in Ethiopia, Kenya, Senegal and South Africa between 2000 and 2014, Pahl and Timmer (2019) find that GVC integration has generally increased labour demand, though due to technological change industries participating in GVCs have become less labour-intensive.

Assessing the GVC-labour nexus in the manufacturing sector for a set of 79 low- and middle-income countries a clear positive association between GVC integration and labour productivity is identified by Farole (2016b). Different to the findings for larger samples, for Southern Africa (Namibia, South Africa and Swaziland) he finds productivity spillovers to be larger for backward integration than for forward integration. Taking a closer look at South Africa alone, Farole finds that backward GVC integration had a significant effect on employment not only in the manufacturing sector but also through domestic linkages especially in the service sector. In line with Pahl and Timmer (2019), Farole (2016b) concludes that labour intensity in manufacturing has sharply declined. As for the cross-country analyses discussed above, in the case of manufacturing GVC participation in Southern Africa, transport infrastructure, low workforce capabilities and a lack of labour mobility have been identified as bottlenecks for deeper regional and global integration.

3. Data and Methodology

To explore the relationship of GVC integration and LMs in SSA, as well as the country-specific characteristics that may moderate this relationship, multiple moderated fixed-effect panel regressions are conducted. The analysis includes 17 SSA countries during a 15 years period (2000-2015). Chapter 3.1 discusses the data used for the analysis and explains the construction of the GVC and LM indicators based on global input-output (IO) tables. The research design and choice

of model are described in chapter 3.2, while the last sub-chapter provides a broad overview on the overall development of GVC integration and LMs in SSA.

3.1. Data

The empirical analysis of this paper is based on the relationship of two measures of GVC trade and three LM indicators. For the analysis, detailed information on the origin of production inputs and the usage of exports abroad are needed. While some years ago researchers had to estimate this information from import-export data, today so-called IO tables report the national and international streams of VA across sectors in enormous detail. In the following analysis, the backward and forward GVC integration as well as the employment and labour compensation embodied in exports are thus estimated based on global IO tables.

A number of institutions provide national and international IO tables with a variety of time periods, country coverage and thematic focuses (e.g. WIOD, Exiobase, GTAP). Due to the substantial country coverage and the additional information on labour compensation as a primary input, in this analysis the Eora Global Supply Chain database (in the following Eora) (Lenzen, Moran, Kanemoto & Geschke, 2013) is used to calculate both GVC integration and LM indicators. The IO tables by Eora provide a time series from 1990 to 2017 with information on 26 sectors for 189 countries. Each table covers one year and includes information on a) domestic and international production inputs from one sector to another, b) each sector's domestic and foreign final demand and c) the primary inputs included in the production of each sector. VA data in the Eora database is reported in thousand US$ in current prices.

As motivated in chapter 2.1., trade through backward integration is measured as the FVAX. Trade through forward GVC integration is measured as intermediate goods and services in exports. Both measures reflect a part of the total exports and are hence correlated with overall exports. It should be noted here that the two measures are not exclusive to each other. The same exports can be classified as backward and forward integrated simultaneously. For measuring the employment and labour compensation embodied in exports, the primary input information on labour compensation provided by Eora and information on persons employed provided by the Economic Transformation Database (ETD) (Vries, Arfelt, Drees, Godemann, Hamilton, Jessen-Thiesen, Kaya, Kruse, Mensah & Woltjer, 2021) are employed. The variables reflect the total value / number of workers in all sectors embodied in the exports of one certain sector. When considering, for example, the relationship of trade in manufacturing and employment, the number of workers in the manufacturing sector *and* in all other domestic sectors involved in the production of manufacturing exports are measured. A detailed description of how the four measures have been calculated based on the global IO tables and the ETD can be found in Appendix A.

Though the underlying Eora database provides information on large set of SSA countries and sectors, the sample in this analysis is limited to 17 SSA countries and nine sectors. This is because ETD provides information on persons employed for 12 sectors and 17 countries of SSA. To combine this data with the Eora database, sectoral information had to be aggregated and as the

ETD uses the newest revision of the International Standard Industrial Classification (ISIC Rev. 4) some sectors that are reported separately in the ETD are reported as one in the Eora. After combining the datasets, the analysis now includes nine sectors which can be further aggregated into three broad sectors: primary (agriculture and mining), manufacturing and services. A detailed report on the sectoral (dis-)aggregations can be found below in table 1. A list of countries included in the analysis and detailed information on the data availability by country can be found in the Appendix table A1. Aside from the measures discussed so far, a third LM indicator will be included in the analysis. This additional measure provides information on the average wages paid to each worker and is calculated as labour compensation divided by employment. This way one cannot only detect whether the value of compensation has changed but also whether the payment to each worker has.

For the country-specific characteristics moderating the GVC-labour nexus, data on education levels, LMF, trade openness and infrastructure development is included. As discussed in chapter 2.3.1 a relatively detailed look at the moderating role of education shall be taken by including three different levels of education. The school enrolment ratios for primary, secondary and tertiary education provided by the UNESCO Institute for Statistics (2021) are being employed. The data includes information on the number of students enrolled in the respective level of education expressed as the percentage of the official school-age population. All three indicators are available for the full time period (2000-2015), though especially for secondary education data is incomplete for many countries. As enrolment ratios can be expected to change relatively gradually over time, interpolation has been applied for gaps of a maximum of two years. An overview of data availability is provided in table 2.

For the measures of LMF and trade openness the following analysis relies on data from the "Economic Freedom of the World" index by the Fraser Institute (Gwartney, Lawson, Hall & Murphy, 2020). Trade openness or "Freedom to trade internationally" is one of the main indicators of the index and measures aspects like tariffs, regulatory trade barriers, black market exchange rates and the controls of movement of capital and people. On a scale from 0 to 10, a higher value reflects higher trade openness. The measure of LMF is itself a sub-indicator of the indicator "regulations" in the "Economic Freedom of the World" index. Among others the measure includes information on the level of hiring and firing regulations, minimum wages and centralized collective bargaining. Again, on a scale from 0 to 10 a higher value indicates higher LMF. Both indicators are available for the full sample period, though data is incomplete for some countries before 2005. Unfortunately, for Burkina Faso no data is available for these two indicators.

The last group of moderators included in this analysis concerns infrastructure development. Generally, a variety of aspects can be considered when measuring infrastructure, but as discussed in chapter 2.3.4., this analysis focuses on those aspects of infrastructure considered critical for enabling productivity and development (African Development Bank Group, 2021). The African Infrastructure Development Index (AIDI) includes a variety of measures concerning transport, electricity, ICT and WSS infrastructure. In the following analysis, the moderating power of both the full infrastructure index and the individual sub-indices will be tested. The transport infrastructure index includes information on the quantity of paved roads per inhabitants and the

quantity of road networks per km2 of exploitable land. The ICT infrastructure index considers several measures of telephone and internet availability. The electricity infrastructure index relies on the total of private and public electricity generation. Due to multicollinearity (see chapter 3.3.), the index for WSS infrastructure is not included. All infrastructure measures take values between 0 and 100, with a higher value indicating better infrastructure.

Table 1: Sectoral Division

Three sector aggregation	Nine sector aggregation	Eora Global Supply Chain Database	Economic Transformation Database (ETD)
Primary Sector	Agriculture and Fishing	Agriculture and Fishing	Agriculture, Foresting and Fishing
	Mining and Quarrying	Mining and Quarrying	Mining and Quarrying
Manufacturing	Manufacturing	Food and Beverages; Textiles and Wearing Apparel; Woods and Paper; Petroleum, Chemicals and Non-metallic Mineral Products; Metal products; Electrical and Machinery; Transport equipment; Other Manufacturing	Manufacturing
	Construction	Construction	Construction
Services	Utilities	Electricity, Gas and Water; Recycling	Utilities
	Trade Services	Maintenance; Wholesale trade; Retail trade; Hotels and Restaurants	Trade services
	Transport Services	Transport Services	Transport services
	Business and Financial Services	Post and Telecommunication; Financial Intermediation and Business Activities	Business services; Financial services; Real Estate
	Other Services	Public Administration; Education, Health and Other Services; Private services; Others	Government services; Other services

Notes: Originally Eora IO tables report information on 26 sectors while ETD reports on 12 sectors. Data has been aggregated and combined into nine sectors.

Table 2: Descriptive Statistics

Variables	Obs.	Mean	Std. Dev.	Min	Max	Skew.	Kurt.
Exports (thousand US$, current prices)	2329	10.776	1.681	6.97	16.833	.482	3.299
Backward GVC integration (thousand US$, current prices)	2488	10.378	2.068	3.857	23.041	1.039	5.358
Forward GVC integration (thousand US$, current prices)	2720	10.704	1.813	6.858	17.679	.763	3.862
Employment (thousand)	2564	2.024	2.949	-3.953	11.398	.459	2.76
Labour Compensation (thousand US$)	2564	9.199	2.22	3.356	18.299	.467	3.395
Average Wage (US$ per person employed)	2564	7.175	2.832	-4.299	17.252	-.395	4.226
Primary Enrolment* (%)	2700	104.562	20.241	45.017	149.271	-.219	3.472
Secondary Enrolment* (%)	2080	44.998	25.756	6.197	109.444	.707	2.408
Tertiary Enrolment* (%)	2180	28.002	22.337	.269	83.761	.675	2.284
Labour Market Flexibility* (0-10)	2421	6.653	1.404	2.767	9.238	-1.023	3.843
Trade Openness* (0-10)	2410	6.435	.955	2.76	8.542	.155	3.164
African Infrastructure Development Index* (0-100)	2210	19.817	15.261	.369	78.972	1.878	6.331
Transport Infrastructure Index* (0-100)	2210	10.768	9.146	1.255	37.649	1.448	4.413
ICT Infrastructure Index* (0-100)	2210	3.15	6.965	0	47.998	3.742	19.118
Electricity Infrastructure Index* (0-100)	2210	10.463	18.317	0.119	82.376	2.875	10.545

Notes: * = country-wise only. Gross enrolment ratios may exceed 100% due to the inclusion of over- and under-aged students. Country-wise data availability is displayed in Appendix A table A1.

3.2. Methodology

The aim of this study is to explore the relationship of LMs and trade in GVC. The empirical analysis of the GVC-labour nexus and the country-specific characteristics moderating this relationship is based on a standard fixed-effects model. Using export volumes and employment, labour compensation and average wages in exports, the analysis will provide information on whether and to what extent employment and labour compensation follow the same trend as GVC integrated trade. Following Farole et al. (2018), all regression models include three types of fixed effects. Country-sector fixed effects control for unobserved and time-invariant heterogeneity between the individual sectors in each country. Sector-time fixed effects are included to control for unobserved heterogeneity over time regarding specific sectors and country-time fixed effects control for unobserved heterogeneity over time regarding specific countries. To avoid potential problems of heteroscedasticity the results of all regression model will be based on cluster-robust standard errors[2].

Before getting to the relationship of GVCs and LMs, a pre-step of the analysis is needed to get a picture of the overall impact of trade on LMs in SSA. For the overall economy, higher VA is usually positively correlated with more employment and labour compensation. This is because additional VA, meaning additional production or service provision, will create at least some additional demand for labour. At the same time, higher levels of production may come with a change of the labour-intensity of production. While for the overall economy, a decrease of total

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[2] Regressions including multiple sectors are clustered by country-sector identifiers. Regression referring to specific sectors are clustered by countries using bootstrap estimation.

labour demand at higher production is rather unlikely, in the case of economic activity in trade, the overall labour productivity can change enormously and hence higher volumes of trade could be correlated with a decrease in total employment and labour compensation. Testing these relationships and the development of average wages at different export levels, not specified to GVC activities yet, the following equation shall be tested:

$$\ln LMI_{sct} = \alpha + \gamma \ln EXP_{sct} + \alpha_{cs} + \alpha_{ct} + \alpha_{st} + \varepsilon_{ct}. \tag{1}$$

LMI_{sct} stands for one of the labour market indicators in sector s of country c at year t. EXP_{sct} denotes the overall exports of the respective sector. Three types of fixed effects are included: country-sector fixed effects α_{cs}; country-year fixed effects α_{ct} and sector-year fixed effects α_{st}. All LMI and GVC indicators are measured in natural logarithms. A positive correlation coefficient γ would indicate that employment or labour compensation embodied in exports increase with rising exports. A coefficient below one, would indicate that production is less labour-intensive. For average wages as the LMI, a positive correlation coefficient γ means that wages are higher with higher values of trade and hence would indicate that industries pay either higher wages for the same skill level or shift towards more skilled workers.

The first stage of the main analysis is to test the relationship of the different types of GVC trade with the three LM indicators. Looking at different LM indicators and the two types of GVC integration the first stage of analysis can be specified as

$$\ln LMI_{sct} = \alpha + \gamma \ln GVC_{sct} + \alpha_{cs} + \alpha_{ct} + \alpha_{st} + \varepsilon_{ct} \tag{2}$$

with LMI_{sct} denoting the respective LM indicator for sector s in country c at time t and GVC_{ct} denoting the respective type of GVC integration. Again, α_{cs}, α_{ct} and α_{st} denote the fixed effects as described above. Considering employment and labour compensation, a positive correlation with the respective measure of GVC integration would indicate that labour demand increases with larger value of GVC trade. A negative correlation coefficient would indicate that at higher trade volumes, labour intensity is significantly lower and hence less overall employment (labour compensation) is needed to produce exports. In the case of wages, a positive coefficient would indicate that employees receive on average higher wages when GVC trade is high.

With a first general image of the GVC-labour nexus in SSA, a more differentiated analysis of the relationship of GVC integration and the LMs with respect to different sectors can be taken. For this purpose, the economy is split into three broad sectors (primary, manufacturing and services). Using sectoral dummies, the analysis can be specified as

$$\ln LMI_{cst} = \alpha + \gamma \ln GVC_{cst} + \delta \ln GVC_{cst} * sector_{ct} + \mu_c + \eta_t + \theta_s + \varepsilon_{cst}. \tag{3}$$

The effect of the respective GVC integration on the sector of interested ($sector_{ct}$) is given by the sum of γ and δ. Additional to this level of disaggregation, an even closer look into the service sector can be taken by disaggregating it into its five underlying sectors. For the analysis of GVC integration and its impact on LMs, it should be noted here that endogeneity arises between the measures as they are simultaneously determined by equilibrium relationships in the Eora data. If changes in the trade volume are endogenous to changes in LM outcomes, causality can run in both directions. For example, a larger volume in trade through GVCs affects a higher labour demand in

the export sector. At the same time, a greater labour supply may foster specialization in a certain sector and in turn cause the expansion of trade. While this analysis, hence, cannot postulate any causality running from one to another, the focus of this analysis is a better understanding of the overall relationship and potential policy that may shape these relationships.

The second part of the initial research question stated in the introduction refers to the drivers or moderators of the GVC-labour nexus and shall be answered by investigating the role of the four groups of country-specific characteristics. Each of the potential moderator will be included as interacting with the GVC integration measure and can be described as

$$\ln LMI_{cst} = \alpha + \gamma \ln GVC_{cst} + \beta\, moderating_{ct} + \delta \ln GVC_{cst} * moderating_{ct} + \alpha_{cs} \quad (4)$$

$$+\alpha_{ct} + \alpha_{st} + \varepsilon_{cst},$$

with $moderating_{ct}$ denoting the country and time specific performance in the respective variable. Each specific factor can be considered a moderator of the GVC-labour nexus if the coefficient estimates of the interaction term (δ) is significantly different from zero. As for the relationship of GVC integration and LMs in general, causality in the potential correlation of the country-specific characteristics and the GVC-labour nexus is unclear. Using moderated regression models, the interaction terms estimate in how far the marginal effect of one explanatory variable (GVC integration) depends on a second explanatory variable, the moderator of that effect.

3.3. Descriptive Analysis

The role of GVCs has become more and more important for economic growth and development both in low- and high-income countries, but the development of GVC integration in Africa has been quite heterogeneous. Therefore, a detailed look into the GVC development in the 17 SSA countries is provided. In their descriptive analysis of GVC integration in Africa, Foster-McGregor et al. (2015) find that for the overall continent, GVC integration has not significantly changed between 1995 and 2010. Especially for backward integration, they conclude that countries are struggling to increase levels of participation. As discussed in chapter 2.4. the role of SSA in GVC is relatively small from a global perspective, whereas GVC participation is of great importance from the country perspective. On average for the 17 SSA countries, trade in GVCs accounts for more than half of overall trade, regardless of whether trading in the GVC is measured by forward or backward integration.

The role of backward integration or foreign VA in exports in total exports is quite heterogeneous across the 17 sampled countries. Considering the share of FVAX, not the overall value, Foster-McGregor et al.'s findings of no significant increase in backward integration, can generally be confirmed. Indeed, on country average the share of FVAX has decreased from 69.3% in 2000 to 56.4% in 2015. Though overall the levels are significantly higher than those found by Foster-McGregor et al., a spotlight analysis of comparing the years 2000 and 2015 shows similar trends. In 2000, the level of backward integration has been relatively high with levels between 44.7% and 96.7% (figure 1). In 2015, this gap has somewhat decreased, but a significant heterogeneity

between countries remains (figure 2). Only in five countries (Uganda, Senegal, Namibia, Lesotho and Botswana) the share of FVAX has increased. This lack of improvement in GVC integration confirms the observation that countries have been struggling to participate more. Taking into account the unstable development of GVC integration, the empirical analysis examines differences in integration levels rather than growth rates.

Figure 1: Share of Foreign Value Added in Export by country in 2000

Notes: Due to data inconstancy shares for Kenya and South Africa are based on limited sectors. Source: author's illustration based on Eora Global Supply Chain database.
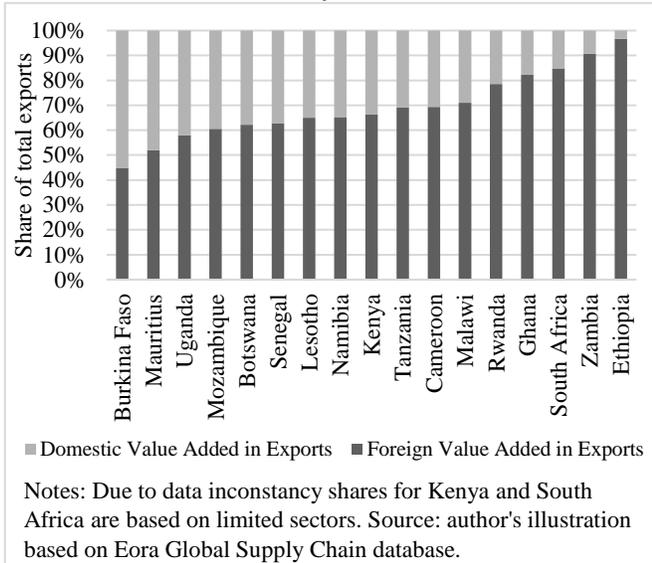
Figure 2: Share of Foreign Value Added in Export by country in 2015

Notes: Due to data inconstancy shares for Kenya and South Africa are based on limited sectors. Source: author's illustration based on Eora Global Supply Chain database.
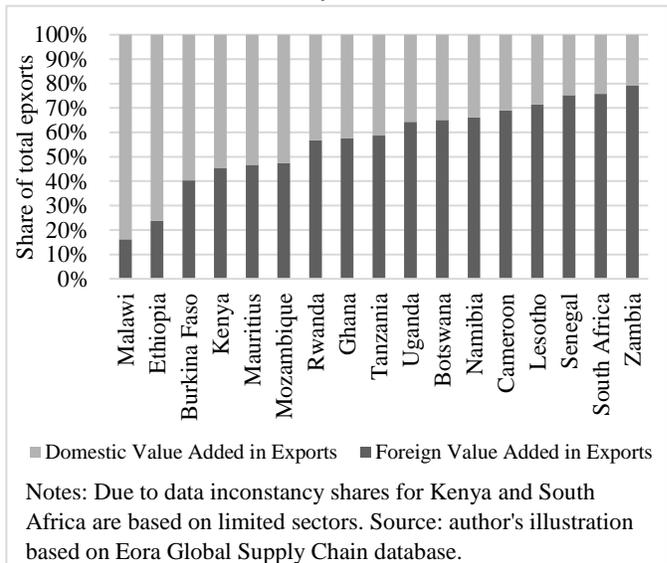
For forward integration, similar levels and distribution can be found, but high backward integration does not always correlate with forward integration. For example, in 2000 Burkina Faso was the least backward integrated country of the sample with a share of 44.5% (figure 1) but performed slightly above average in forward integration with a share of 73.4% (figure 3). Though Foster-McGregor et al. (2015) measure forward GVC integration slightly different, the overall levels of forward integration found for the 17 countries in this sample are relatively similar to their findings. Even though on a smaller magnitude than backward integration, the average share of trade through forward integration (IX) relative to total exports has decreased between 2000 and 2015 (figures 3 & 4). Again, significant heterogeneity across countries is evident. While some countries have experienced relatively large increases in forward integration (Ethiopia 17.6%, Lesotho 9.1%), there are also countries facing significant decreases over time (Botswana -18.7%, Mauritius -8.5%). Contrary to Foster-McGregor et al.'s findings for whole Africa, this sample does not show an overall positive trend for the level of forward integration. On average, the share of IX has decreased from 73.4% in 2000 to 69.5% in 2015.

Figure 3: Share of Intermediate Goods in Exports by country in 2000

Notes: Due to data inconstancy shares for Kenya and South Africa are based on limited sectors. Source: author's illustration based on Eora Global Supply Chain database.

Figure 4: Share of Intermediate Goods in Exports by country in 2015

Notes: Due to data inconstancy shares for Kenya and South Africa are based on limited sectors. Source: author's illustration based on Eora Global Supply Chain database.

Splitting the economies into the three broad sectors (primary, manufacturing and services) allows to take a differentiated look on these sectors' roles in GVC integration. Starting with their role in backward integration, figures 5 and 6 show the share of each sector in trade through backward integration for 2000 and 2015. On behalf of comparability, the two graphs include only countries with information on all nine sub-sectors. In both years, significant differences in the sectoral composition across the ten countries become evident. Overall, the role of the pr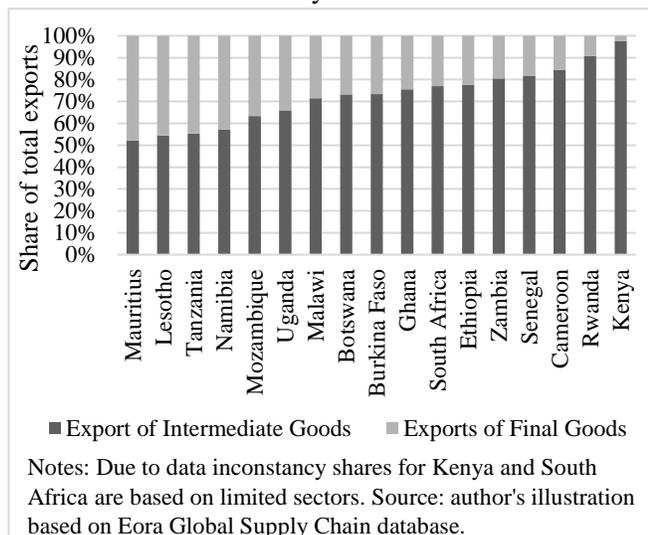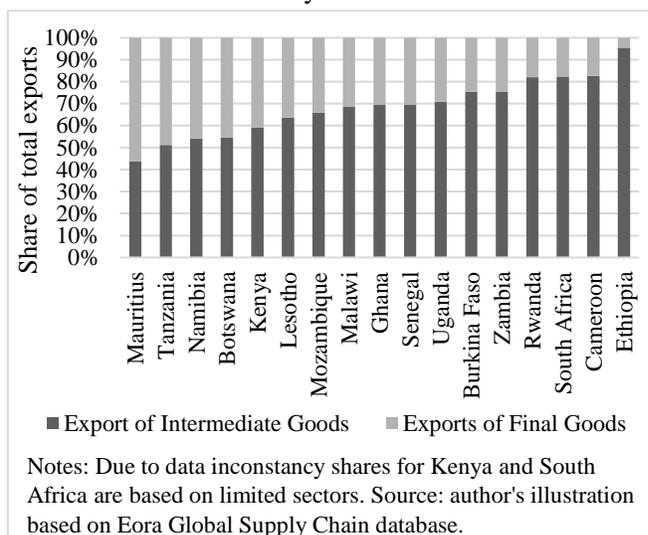imary sector, including agriculture and mining, has decreased from 27% to 23.1%. In Cameroon the primary sector accounts for over 50% of FVAX, while in other countries like Lesotho and Botswana the primary sector accounts for less than 10%. Noteworthy, the share of the primary sector in trade through backward integration for Mauritius is extremely low with only 2.5% in 2000 and 1.4% in 2015. This does not necessarily mean that Mauritius is trading this little in primary goods relative to other sectors. As we are looking at the FVAX, the low share could also indicate that Mauritius is focusing on primary production independent from imports.

A similar development can be observed for manufacturing where the average share has decreased from 48.8% to 44.9%. Interestingly, the heterogeneity of the importance of manufacturing has decreased, which is mostly driven by relatively sharp increases in Rwanda (+13.9%) and Tanzania (8.1%). For services, the role in backward integration has improved over time. Though still on lower levels than manufacturing, the share of services in FVAX has increased by almost eight percentage points between 2000 and 2015. In nine out of the ten countries the share has increased; only in Ghana services follow a different trend. While it should be kept in mind that these shares only reflect the relative importance of sector and not the total volume of exports, the different developments of manufacturing and services provide interesting implications for the debate on *Premature Deindustrialization* and support the observation that structural change towards services is more successfully than towards manufacturing in many SSA countries. Unfortunately, due to lack of data, it is not possible to grasp a more detailed view on the industry developments within manufacturing, but for services a more detailed analysis is possible. A disaggregation of the service

sector into the five subsectors shows that trade services, transport services and business and financial services (hereafter business services) account for the largest part of about 80% of the contribution of services to trade through backward integration (figure B1). Interestingly, while trade and transport services are not typically associated with high tradability, the role of business services within the service sector is relatively small and has even decreased over the time.

Figure 6: Sectoral Composition of Backward GVC integration by country in 2000

Notes: For comparability only countries information on all subsectors are included. Source: author's illustration based on Eora Global Supply Chain database.
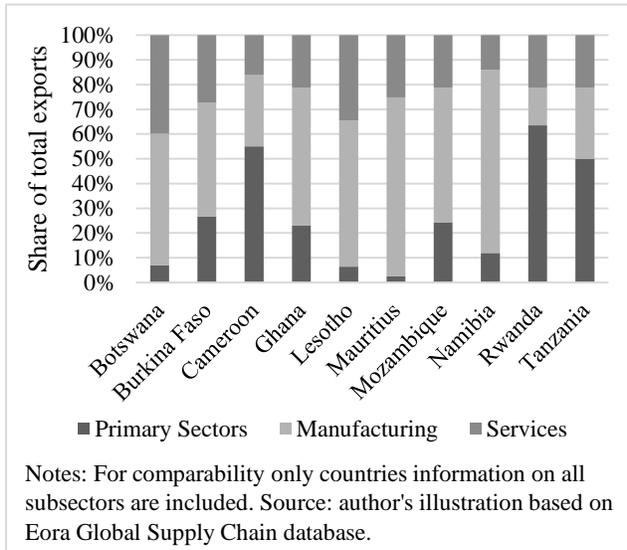
Figure 5: Sectoral Composition of Backward GVC integration by country in 2015

Notes: For comparability only countries information on all subsectors are included. Source: author's illustration based on Eora Global Supply Chain database.
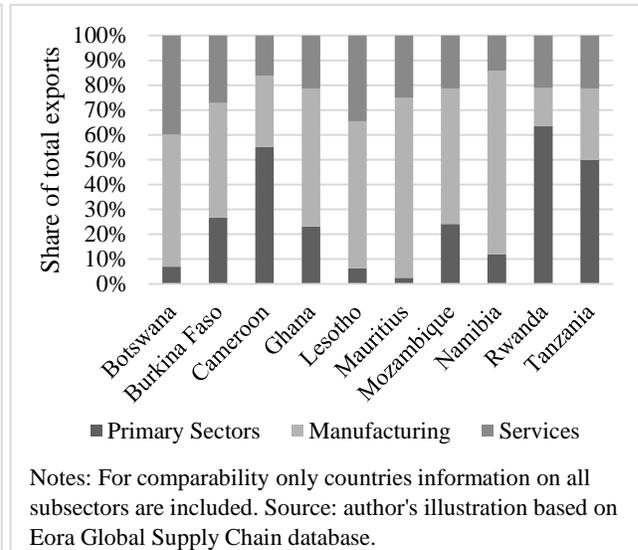
Similar sectoral compositions can be found when looking at sectors in trade through forward integration. Generally, a close correlation of backward and forward integration is expected as both measures are based on the same economic and export structures, but at the same time one would have expected larger differences in the contribution of certain sectors. As discussed in chapter 2.1., forward integration is typically associated with less complex, mostly primary production, while backward integration is associated with more complex sectors like manufacturing and services.

Similar to the case of backward integration, a large heterogeneity in the contribution of sectors across countries can be found for forward integrated trade (figures 7 & 8). In 2000, the primary sector in Rwanda and Cameroon accounted for 58.4% and 48.1% of IX. In Mauritius and Botswana, the share of primary production in IX was comparably low with less than 7% in 2000. The same holds true for the role of the manufacturing sector which ranges from 15.7% in Rwanda to 59.5% in Namibia in 2000. Overall, the role of the manufacturing sector has decreased in most countries as only for Rwanda and Tanzania manufacturing has become more important over time. With an average share of 32.8% in 2000 and 37.4% in 2015, the role of services in forward integration has initially been lower than manufacturing but outperforms manufacturing in 2015. In nine out of ten countries, services became more important; as for the case of backward integration Ghana is the only exception.

Figure 8: Sectoral Composition of Forward GVC integration by country in 2000

Notes: For comparability only countries information on all subsectors are inlcuded. Source: author's illustration based on Eora Global Supply Chain database.
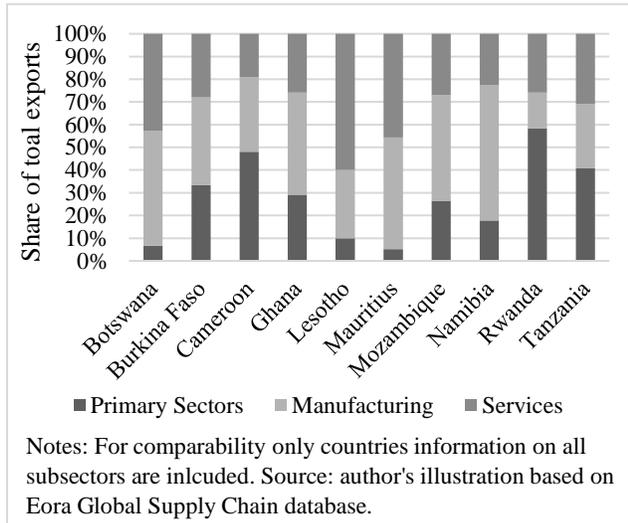
Figure 7: Sectoral Composition of Forward GVC integration by country in 2015

Notes: For comparability only countries information on all subsectors are inlcuded. Source: author's illustration based on Eora Global Supply Chain database.
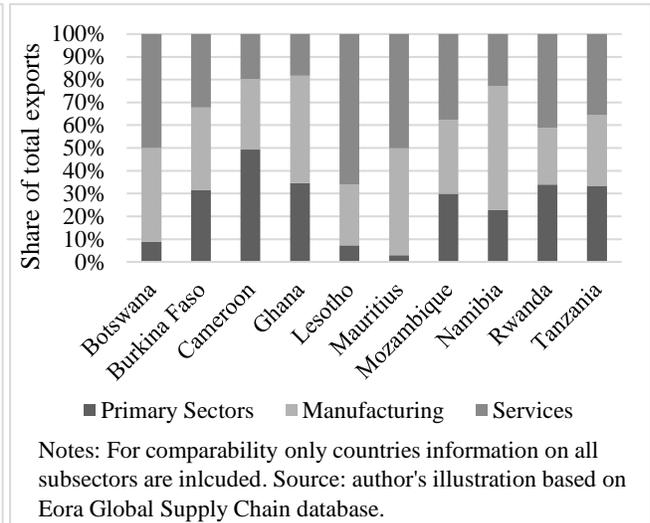
To get an idea of which services are driving the strong performance of services in forward integration the sectoral contribution can be broken down to the five subsectors (figure B2). As for the sectoral composition of backward integration, trade services, transport services and business services are making up for the majority of service sector contribution. Similarly, to the development of backward integration, the role of business services has declined while the role of transport has increased between 2000 and 2015. Interestingly, for forward integration trade services have also gained importance.

Considering the similarity in sectoral contribution to the two measures of GVC integration, the traditional classification seems not to fit here. The contribution of primary goods is almost identical for the two integration measures in 2000 and only slightly higher in forward integration in 2015. Only in the case of manufacturing contribution, the shares fit the expectations as they are higher for backward than for forward integration. This interesting deviation from traditional and global associations can be interpreted in two ways: first, it might indicate that the role of SSA in GVCs is not driven by the sectoral characteristics usually applied in structural change theory. The great role of agriculture in backward integration in Rwanda, for example, might indicate a higher complexity of the agricultural production and the large shares of services in forward integration could suggest that services do not need to located at the end of a GVC but might actually be part of less complex stages of a GVC. A second explanation for the deviation could be rooted in the nature of measuring backward and forward integration. As discussed in 2.1. the measured only consider the first stage of origin and use of VA in exports. Distinguishing the kinds of integration in more detail, hence may change the sectoral compositions.

Having outlined the magnitude and sectoral composition of GVC integration, the role of the different sector in employment and labour compensation embodied in exports is quite different. The overall employment patterns across sectors are relatively stable, hence figure 11 and 12 report the shares for 2015 only. Sectoral composition in employment and labour compensation in 2000 can be found in the appendix (figure B1 and B2). As figure 12 shows, the overwhelming majority of employment is embodied in primary exports. Only in Mauritius, the manufacturing sector accounts for a significantly large share (57%) which is due to its extraordinarily small share of primary sector in exports. A diametrically opposite composition can be found for labour compensation (figure 12), where manufacturing and services account for at least 77%. The large differences between these two compositions visualize both the different levels of labour productivity and averages wages.

Figure 11: Employment embodied in Exports by Sectors in 2015

Notes: For comparability only countries information on all subsectors are included. Source: author's illustration based on Eora Global Supply Chain database and Economic Transformation Database.
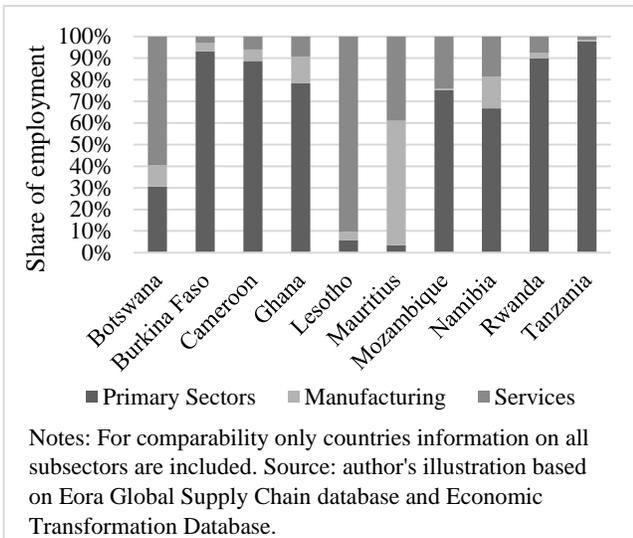
Figure 12: Labour Compensation embodied in Exports by Sectors in 2015

Notes: For comparability only countries information on all subsectors are included. Source: author's illustration based on Eora Global Supply Chain database.
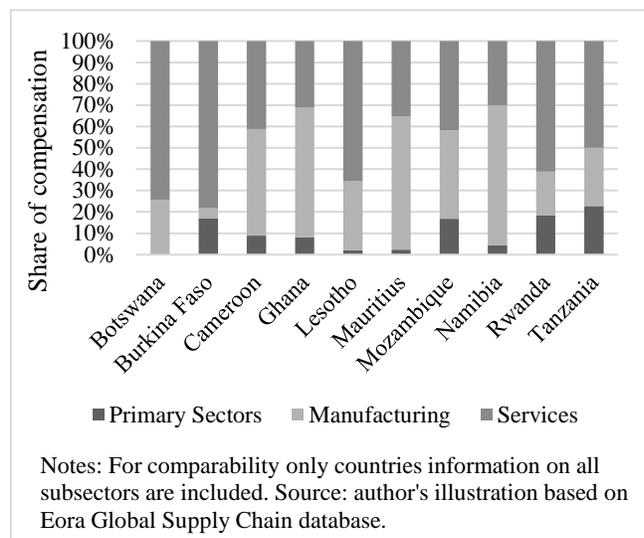
A major part of the following analysis is to test potential moderators of the GVC-labour nexus in SSA. A number of these moderators like education and infrastructure are investigated using several measures of the same moderator group. To be aware of potential collinearity problems between these variables and the moderators in general, a pairwise correlation matrix of all explanatory variables is given in table 3. Overall, correlations of the potential moderating variables are relatively low, except for secondary education, which is closely correlated mostly to measures of infrastructure. Following the most widely used approach, variables with pairwise correlation above 0.7 will not be included in a regression simultaneously. As the groups of moderators are tested individually, this is the case only for the fourth infrastructure index, WSS Infrastructure. Since the literature discussed in chapter 2.3.4. emphasizes the importance of transport infrastructure, the WSS infrastructure index measure will not be included in the following analysis.

Table 3: Pairwise Correlation Matrix of Independent Variables

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) **Exports**	1.000											
(2) **Backward GVC integration**	0.957	1.000										
(3) **Forward GVC integration**	0.989	0.945	1.000									
(4) **Primary Enrolment**	0.022	0.024	0.013	1.000								
(5) **Secondary Enrolment**	0.407	0.491	0.495	0.205	1.000							
(6) **Tertiary Enrolment**	-0.325	-0.368	-0.352	0.007	-0.291	1.000						
(7) **Labour Market Flexibility**	0.055	-0.036	-0.007	0.467	0.240	0.057	1.000					
(8) **Trade Openness**	0.145	0.117	0.111	-0.025	0.632	-0.054	0.210	1.000				
(9) **African Infra. Dev. Index**	0.280	0.411	0.408	0.048	**0.870**	-0.167	0.113	0.529	1.000			
(10) **Transport Infra. Index**	0.023	0.013	0.014	0.086	0.657	0.030	0.355	0.597	**0.724**	1.000		
(11) **ICT Infra. Index**	0.249	0.255	0.312	-0.036	0.519	-0.048	0.036	0.291	0.677	0.289	1.000	
(12) **Electricity Infra. Index**	0.418	0.584	0.547	-0.036	**0.743**	-0.272	-0.127	0.268	**0.821**	0.364	0.457	1.000
(13) **WSS Infra. Index**	0.183	0.281	0.259	0.159	**0.791**	-0.151	0.275	0.538	**0.819**	**0.747**	0.425	0.509

Notes: WSS = Water and Sanitation, pairwise correlation threshold for two explanatory variables being included simultaneously: 0.7.

4. Empirical Analysis

In this chapter, the main empirical findings of the analysis of GVC integration and LMs are presented. The first subchapter provides results on the first part of the initial research question: what are the LM implications of GVC integration? By discussing the overall and sectoral relationships of GVC integration and LM indicators, the analysis refers to first three hypotheses described in chapter 2.1 and 2.2. The second part of the research question is addressed in chapter 4.2. Here, the empirical findings for the moderators of the GVC-labour nexus are discussed. Following chapter 2.3. and the respective hypotheses, the results for the four groups moderating factors are reported. The last subchapter summarizes and discusses the implications of the results.

4.1. GVC integration and Labour Market implications

To explore the relationship of trade in GVCs and LMs, two measures of GVC integration and three LM indicators are being employed. Before diving into the results of these relationships, however, an overview of the overall relationship of trade and LMs is required. Following equation 1, table 4 reports the results for the relationship of overall exports with the three LM indicators. In the case of employment and labour compensation (column 1 & 2), the coefficient estimates are positive and significant indicating that total employment (labour compensation) embodied in the production of exports, indeed, is higher with larger export volume. Controlling for structural and time-sensitive differences among sectors and countries, the results suggest that a 10% increase in exports corresponds to a 7.01% (7.23%) increase in total employment (labour compensation). These findings imply that labour productivity increases with the trade volume as the coefficient

estimates are below one, but employment (labour compensation) effects are not set off by this change in production structure. For the relationship of the export volume with average wages (column 3), the results show no significant relationship. Interestingly, though labour compensation increases somewhat faster than employment, the insignificant results for the coefficient estimate of average wages suggests that the perception of trade creating skill-biased employment opportunities cannot be confirmed.

Table 4: Labour Market indicators and Exports

	(1) Employment	(2) Labour Compensation	(3) Average Wages
Exports	0.701***	0.723***	0.0221
	(0.0939)	(0.0703)	(0.0590)
Constant	-6.052***	0.0882	6.140***
	(0.972)	(0.725)	(0.615)
Country-Sector FEs	yes	yes	yes
Country-Year FEs	yes	yes	yes
Sector-Year FEs	yes	yes	yes
Observations	2,329	2,329	2,329
R-squared	0.764	0.912	0.808
Number of country-sectors	160	160	160

Notes: All variables in natural logarithm. FEs = Fixed Effects. Robust standard errors in parentheses: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Now, considering the relationship of the three LM indicators with GVC integration, table 5 provides insights on the two types of trade integration. For backward GVC integration (columns 1 to 3), the results suggest that a 10% increase in trade through backward integration, or a 10% increase in FVAX, corresponds to a 1.58% (1.39%) increase in employment (labour compensation). This means that though net job creation is positive for trade through backward integration, these exports are significantly less labour-intensive compared to overall exports. While this is in line with expectations, it is rather surprising that the LM effect of backward integration is larger for employment than for labour compensation. Initially, domestic production embodied in backward integration was expected to rely on higher demand for skilled workers and hence expected to show a higher correlation coefficient for labour compensation than for employment. The results for the third LM indicators, average wages (column 3), confirm that this is not the case as the coefficient estimate is not significant. The first part of hypothesis 1, which suggests larger labour compensation effects relative to employment effects of trade through backward integration can therefore not be confirmed.

For forward GVC integration (columns 4 to 6), the effect on employment and labour compensation is significantly larger and relatively similar to the trends of overall exports. A 10% increase in forward GVC integration, or a 10% increase in IX, is associated with a 7% (7.23%) increase in employment (labour compensation). For average wages, the estimated correlation coefficient is positive but insignificant. While the overall differences in the magnitude of effects between backward and forward integration are in line with the expectations, the results for labour

compensation (column 5) and, though statistically insignificant, for average wages (column 6) suggest that compensation effects of forward integration are larger than the employment effects. Following from this and the findings for backward integration, both statements made in hypothesis 1 can be rejected.

Table 5: Labour Market indicators and GVC integration

| | (1) | (2) | (3) | (4) | (5) | (6) |
| | | Labour | Average | | Labour | Average |
	Employment	Compensation	Wage	Employment	Compensation	Wage
Backward GVC integration	0.158*	0.139*	-0.0184			
	(0.0836)	(0.0711)	(0.0382)			
Forward GVC integration				0.700***	0.713***	0.0128
				(0.0726)	(0.0628)	(0.0503)
Constant	0.521	8.186***	7.664***	-5.379***	1.726**	7.105***
	(0.878)	(0.752)	(0.410)	(0.801)	(0.708)	(0.531)
Country-Sector FEs	yes	yes	yes	yes	yes	yes
Country-Year FEs	yes	yes	yes	yes	yes	yes
Sector-Year FEs	yes	yes	yes	yes	yes	yes
Observations	2,332	2,332	2,332	2,564	2,564	2,564
R-squared	0.719	0.876	0.808	0.765	0.890	0.836
Number of country-sectors	160	160	160	167	167	167

Notes: Backward GVC integration measured as foreign value added in exports. Forward GVC integration measured as intermediate good exports. All variables are in natural logarithm. FEs = Fixed Effects. Robust standard errors in parentheses: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Using the three broad sectors (primary, manufacturing and services) as dummy variables, a moderated regression model is being applied to detect differences in the GVC-labour nexus across sectors. The results for both backward and forward integration are reported in table 6 and provide some interesting insights. Starting with the effects of backward integration, the coefficient estimates of the baseline effects reported in the first and second row of table 6 are higher than in table 5. As the interaction terms for the primary sector and manufacturing are insignificant, their results are equal to the baseline effects. For the primary and manufacturing sectors, therefore, a 10% increase in the volume of trade through backward integration is associated with a 3.63% (2.57%) increase in employment (labour compensation). Contrary to the regression results for the overall economies, the coefficient estimate for average wages (column 3) is now significant and negative.

For the service sector, the interaction terms for employment and wages are significant which suggests that the implications of backward integration are different from the other two sectors. While the main effect coefficient estimate is positive for employment, the interaction term almost fully offsets this relationship. Statistically, a 10% increase in trade through backward integration in services is associated with a 0.46% increase in employment only. While this implies that trade in services creates almost no additional jobs, the effect of backward integration on wages is also different from other sectors. With a positive and significant interaction term, the overall negative wage effect of backward integration is not only smaller for services but turns positive. For the

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service sector, hence, higher volumes of backward integrated trade are associated with higher average wages and a smaller increase in overall employment relative to other sectors.

Turning to the regression results for forward GVC integration, fewer differences across the sectors can be found. Only for average wages in the primary sector the interaction term is significant. The positive coefficient estimate for forward integration in the primary sector reduces the overall negative correlation with average wages. Thinking back to the example of internationalizing the agricultural production in chapter 2.2., this relationship seems intuitive. Higher forward integration in agriculture is usually associated with a shift towards cash crops. Unlike simple agricultural products like fruits or wheat, cash crops are more complex and usually continued to be processed abroad. While less complex and hence less value-adding agricultural products like fruits are exported for final demand, an increase in forward integration in agriculture is likely to be linked to an increase in higher value-adding products like coffee and tea.

Summarizing these results, the analysis shows that GVC integration of the manufacturing sector is positively correlated with employment and labour compensation of exports for both backward and forward integration. In line with the expectations formulated in hypothesis 2 in chapter 2.2., the effect on employment is larger than the effect on labour compensation, with average wages embodied in the production of manufacturing exports decreasing with higher levels of trade integration. Though labour productivity in manufacturing production is increasing with the volume of GVC trade (coefficient estimates are below one), specialization in manufacturing is still associated with increasing labour demand. Though other aspects may play a role as well, the decreasing average wages suggest that the employment composition of manufacturing workers tends be more low-skill intensive.

For the LM implications of trade in services, the employment growth associated with backward integration is significantly slower than for other sectors. At the same time, labour compensation and average wages increase with higher levels of integration. For backward integration, the results therefore suggest that service exports are significantly less labour-intensive and tend to increase demand for high-skilled worker. These findings are not the same for service trade through forward integration. Here, employment effects are identified to be larger than employment effects and no significant impact on average wages can be found. At this stage of analysis, hypothesis 3, which suggested a larger labour compensation effect for GVC trade in the service sector, can therefore only be confirmed for trade through backward integration. In the next step of the analysis, I will test whether these results are uniform across the different kinds of services.

As discussed in the previous chapter, the role of services in GVC trade in SSA has been increasing between 2000 and 2015. A closer look into the service sub-sectors may provide insight on the dynamics within this development. Table 7 reports the relationship between backward and forward integration and the LM indicators in interaction with the five sub-sectors of the service sector: business, trade, transport, utilities and other services. With the exception of business services, the GVC-labour relationships are significantly different from the total economy effects. The labour compensation effect in backward integration, for example, is positive in all sectors except the transport sector. While for the utilities the effect is larger than the baseline effect, the interaction terms for trade, transport and other services reduce the labour compensation effect. Though many

different nuances across sectors can be found based on these results, only the most important will be discussed here.

Table 6: Labour market indicators and GVC integration by Sectors

	(1) Employment	(2) Labour Compensation	(3) Average Wage	(4) Employment	(5) Labour Compensation	(6) Average Wage
Backward GVC integration	0.363***	0.257*	-0.106*			
	(0.132)	(0.140)	(0.0548)			
Forward GVC integration				0.740***	0.685***	-0.0555
				(0.0849)	(0.0724)	(0.0492)
Interaction with…						
Primary Sector	-0.0147	0.0722	0.0869	-0.0682	0.168	**0.236****
	(0.217)	(0.169)	(0.130)	(0.144)	(0.106)	(0.115)
Manufacturing	-0.415	-0.440	-0.0243	0.140	0.157	0.0165
	(0.312)	(0.290)	(0.103)	(0.183)	(0.173)	(0.135)
Services	**-0.317****	-0.200	**0.117***	-0.0528	-0.0229	0.0299
	(0.132)	(0.135)	(0.0642)	(0.102)	(0.0787)	(0.0720)
Constant	0.480	7.850***	7.370***	-5.256***	2.121***	7.377***
	(0.818)	(0.755)	(0.361)	(0.859)	(0.742)	(0.675)
Country-Sector FEs	yes	yes	yes	yes	yes	yes
Country-Year FEs	yes	yes	yes	yes	yes	yes
Sector-Year FEs	yes	yes	yes	yes	yes	yes
Observations	2,332	2,332	2,332	2,564	2,564	2,564
R-squared	0.727	0.880	0.809	0.766	0.890	0.839
Number of country-sectors	160	160	160	167	167	167

Notes: For subsectors included in the three broad sectors please refer to table 1. All variables are in natural logarithm. For readability main effects for dummy variables are suppressed. FEs = Fixed Effects. Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

In the previous step of the analysis, the effect of backward integration on employment has been smaller for the service sector compared to other sectors, but a more detailed analysis in table 7 shows that this effect is driven by transport and other services. Especially for transport services, the deviation from the overall effect of backward integration is prevalent. Results from the interaction terms suggest that employment and labour compensation effects are smaller for trade in the transport sector. Since the estimated effect of backward integration in transport on the LM indicators equals the sum of coefficient estimates for the overall effect (row 1) and the interaction term (row 5), the sector-specific relationship can be described as following: A 10% increase in the volume of trade through backward integration is correlated to a 3.44% (2.1%) decrease in total employment (labour compensation). This means that at higher levels of trade volume, labour productivity is that much higher that less employment is needed for more exports. On smaller magnitude the development of labour compensation in transport exports follows the same trend which suggests that not only the number of persons employed decreases but also the compensation paid to all workers. Overall, the positive correlation with average wages suggests that at least parts of the increase in labour productivity is passed on to the workers by paying higher wages on average. Though no information on the skill-composition of the workforce is available, one may

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suggest that this increase of average wages goes hand in hand with an increase of relative demand for skilled workers.

Table 7: Labour market indicators and GVC integration by Services

	(1) Employment	(2) Labour Compensation	(3) Average Wage	(4) Employment	(5) Labour Compensation	(6) Average Wage
Backward GVC integration	0.352***	0.271***	-0.0817			
	(0.112)	(0.103)	(0.0553)			
Forward GVC integration				0.730***	0.762***	0.0317
				(0.0824)	(0.0645)	(0.0655)
Interaction with…						
Business and Financial Services	-0.134	-0.205	-0.0716	0.0153	-0.0953	-0.111
	(0.218)	(0.200)	(0.0984)	(0.144)	(0.105)	(0.0991)
Trade	-0.228	**-0.256****	-0.0284	-0.214	**-0.217****	-0.00327
	(0.186)	(0.127)	(0.121)	(0.155)	(0.0895)	(0.133)
Transport	**-0.696****	**-0.481****	**0.215****	0.0879	0.00830	-0.0796
	(0.172)	(0.178)	(0.0858)	(0.140)	(0.135)	(0.154)
Utilities	0.186	**0.410****	0.223	**0.214***	0.0391	-0.175
	(0.190)	(0.122)	(0.194)	(0.123)	(0.162)	(0.236)
Other Services	**-0.331****	**-0.209****	**0.122***	**-0.174***	-0.151	0.0228
	(0.118)	(0.104)	(0.0699)	(0.0940)	(0.0947)	(0.0697)
Constant	0.0601	7.884***	7.824***	-6.254***	1.234*	7.488***
	(0.845)	(0.777)	(0.453)	(0.848)	(0.660)	(0.647)
Country-Sector FEs	yes	yes	yes	yes	yes	yes
Country-Year FEs	yes	yes	yes	yes	yes	yes
Sector-Year FEs	yes	yes	yes	yes	yes	yes
Observations	2,332	2,332	2,332	2,564	2,564	2,564
R-squared	0.736	0.885	0.812	0.769	0.891	0.837
Number of country-sectors	160	160	160	167	167	167

Notes: For subsectors included in the three broad sectors please refer to table 1. All variables are in natural logarithm. For readability main effects for dummy variables are suppressed. FEs = Fixed Effects. Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

4.2. Moderating Factors

Knowing about the differences in the LM implications of GVC integration, the results for country-specific characteristics potentially moderating these relationships are presented in this chapter. In the following, four groups of moderating factors are investigated by using a moderated fixed-effects regression model. All regression results in this chapter are based on equation 4 (see chapter 3.2.) and the four groups of moderators are investigated individually. The core interest of the regression results lays in the magnitude and direction of the interaction of GVC integration and the respective moderators. All interaction terms consist of two continuous variables, the GVC integration measure and the respective moderating variable. Additional to the results for the interaction term, all regression results report the baseline or main effect of GVC integration, while for matter of readability the results for the main effect of the respective moderating variables are not reported.

4.2.1. Workforce Capabilities

The first set of moderators relates to the workforce capabilities in terms of education which is expected to matter for both the attraction of labour-intensive production and for economic upgrading. As discussed in chapter 2.3.1., education levels will be considered in terms of the three levels of school enrolment ratios: primary, secondary and tertiary school enrolments. All three measures are considered in term of percentage of the official school-age population and can be included as moderators simultaneously (see pair-wise correlation matrix in chapter 3.3.).

Tables 8 provides the results including all economic sectors. Starting with primary school enrolment ratios, the coefficient estimate for the interaction term with backward GVC integration are significant for the employment and average wages, while the baseline effect is insignificant. These results suggest that at higher levels of primary education backward integrated trade is more likely to be positively correlated with employment. At the same time, at higher levels of primary education higher backward integration is negatively correlated with average wages. For forward integration, primary education similarly moderates the effect on employment and labour compensation, but though employment is increasing somewhat faster than labour compensation no significant effect on the average wages can be found. Overall, the findings are in line with the expectations. As motivated in chapter 2.3.1., higher primary school enrolment ratios indicate that the "quality" of low-skilled workers increases and hence the country becomes more attractive for labour-intensive production. While positively affects overall employment, it seems that the share of low-skilled workers increases and in turn labour compensation and average wages grow slower than employment.

Secondary education levels appear to be positively mediating the effect of backward integration on average wages, while the effect of forward integration on employment and labour compensation is positive at higher levels of secondary education. In other words, if accompanied by higher secondary education backward integrated trade tends to improve average wages without a significant effect on overall employment. Forward integrated trade accompanied by higher levels of secondary education can be associated with a shift away from labour-intensive production. While both cases suggest a shift toward higher skilled labour, only in the case of forward integration employment is negatively correlated to GVC trade. For tertiary education, the interaction terms show significant coefficient estimates for labour compensation for both backward and forward integration. In both cases, GVC trade is likely to be positively correlated with labour compensation at higher levels of tertiary education. Though the correlation with average wages is not significant, the results suggest a slight improvement in the overall compensation of workers.

Referring back to hypothesis 4 stated in chapter 2.3.1., the three education levels moderate the GVC-labour nexus in different ways. While primary education positively mediates the employment embodied in GVC trade, tertiary education positively affects the labour compensation embodied. For secondary education, the results suggest a shift towards higher skilled workers, but especially for forward integrated trade LM effects tend to be negative with higher levels of

secondary education. Overall, the results for primary and tertiary education are in line with the expectation of higher level of education positively mediating the GVC-labour nexus.

Table 8: Moderating effect of Workforce Capabilities

	(1)	(2)	(3)	(4)	(5)	(6)
	Employment	Labour Compensation	Average Wage	Employment	Labour Compensation	Average Wage
Backward GVC integration	-0.255	-0.0583	0.197			
	(0.207)	(0.171)	(0.137)			
Forward GVC integration				0.401	0.329	-0.0714
				(0.331)	(0.276)	(0.247)
Interaction with…						
Primary School Enrolment Ratio	**0.00477****	-2.10e-05	**-0.00479*****	**0.00483***	**0.00431****	-0.000522
	(0.00208)	(0.00166)	(0.00146)	(0.00268)	(0.00203)	(0.00223)
Secondary School Enrolment Ratio	-0.00395	0.00107	**0.00502*****	**-0.00580****	**-0.00370***	0.00211
	(0.00240)	(0.00199)	(0.00167)	(0.00258)	(0.00192)	(0.00205)
Tertiary School Enrolment Ratio	0.00316	**0.00466****	0.00150	0.00356	**0.00492****	0.00135
	(0.00316)	(0.00215)	(0.00212)	(0.00323)	(0.00246)	(0.00267)
Constant	7.105***	6.916***	-0.119	-0.606	3.835	7.554***
	(1.884)	(1.566)	(1.485)	(3.373)	(3.000)	(0.802)
Country-Sector FEs	yes	yes	yes	yes	yes	yes
Country-Year FEs	yes	yes	yes	yes	yes	yes
Sector-Year FEs	yes	yes	yes	yes	yes	yes
Observations	1,373	1,373	1,373	1,531	1,531	1,531
R-squared	0.739	0.903	0.815	0.784	0.893	0.819
Number of country-sectors	143	143	143	147	147	147

Notes: GVC and LM indicators are in natural logarithm. For readability main effects for moderating variables are suppressed. FEs = Fixed Effects. Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Considering the GVC-labour nexus on sectoral level, the moderating power of education has been tested for both disaggregation in three broad sectors and the service sub-sectors. Some interesting deviation in the moderation can be found between the three broad sectors. While the positive moderation of the employment effect by primary education persists only for forward integrated trade in the primary sector (Appendix C table C1) and backward integrated trade in manufacturing (table C2), the negative moderation of the employment effects by secondary education can be found in all sectors and are especially strong in the primary sector. Tertiary education continues to matter especially for the positive effects of GVC integration on wages in manufacturing and services (table C3), but for primary production the effect is quite different. Here, the employment and labour compensation effects of GVC integration are positively moderated by tertiary education. While average wages are negatively affected by higher tertiary education, the positive effects on employment and labour compensation might suggest that high-level expertise boosts the shift from low value-adding agricultural production to more complex and GVC-integrated cash crops.

4.2.2. Labour Market Flexibility

The moderating role of LMF on the GVC-labour nexus has been discussed to be potentially driven by two opposite effects. On the one hand, LMF may improve a countries attractiveness for labour-intensive production and hence should positively moderate the employment embodied in GVC trade. On the other hand, high LMF may decrease the ability to benefit from advanced technology and knowledge domestically, which would hinder labour compensation and wage effects.

The empirical results presented in table 9 suggest that there is no moderating power of LMF on the LM effects of forward integration. This remains to be the case even when looking at the three broad indicators and the service sub-sectors. When it comes to the role of LMF in backward integrated trade, the employment and labour compensation effects are positively moderated. This suggests that for countries with higher LMF, employment and labour compensation are more likely to be positively correlated with backward integrated GVC trade. Interestingly and contrary to expectations, the effect on labour compensation is larger than the employment effect.

Table 9: Moderating effect of Labour Market Flexibility

	(1)	(2)	(3)	(4)	(5)	(6)
	Employment	Labour Compensation	Average Wage	Employment	Labour Compensation	Average Wage
Backward GVC integration	-0.216	-0.249	-0.0327			
	(0.218)	(0.173)	(0.123)			
Forward GVC integration				0.752***	0.851***	0.0984
				(0.176)	(0.165)	(0.0972)
Interaction with…						
Labour Market Flexibility	**0.0485***	**0.0539****	0.00538	0.00100	-0.00294	-0.00395
	(0.0269)	(0.0209)	(0.0158)	(0.0247)	(0.0196)	(0.0151)
Constant	4.073*	11.21***	7.136***	-3.425	2.024	5.449***
	(2.438)	(1.918)	(1.383)	(2.256)	(1.862)	(1.258)
Country-Sector FEs	yes	yes	yes	yes	yes	yes
Country-Year FEs	yes	yes	yes	yes	yes	yes
Sector-Year FEs	yes	yes	yes	yes	yes	yes
Observations	2,048	2,048	2,048	2,265	2,265	2,265
R-squared	0.722	0.850	0.785	0.765	0.860	0.810
Number of country-sector	148	148	148	157	157	157

Notes: GVC and LM indicators are in natural logarithm. For readability main effects for moderating variables are suppressed. FEs = Fixed Effects. Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Considering sectors, forward integration remains unaffected and neither is backward integrated trade in manufacturing (table C4). While the average wage effects of backward integrated trade in primary sector is negatively moderated by LMF (table C5), LMF positively moderates the employment effects of integration in the two service sub-sectors, business and trade services (tables C6 and C7).

Referring back to the hypothesis stated in chapter 2.3.2., an increase in GVC integration is actually correlated with larger employment effects when accompanied by higher levels of LMF, but only for backward integrated trade of business and trade services. The overall moderation suggests that employment is positively correlated to backward integration, but so is labour compensation. For the primary sector, no effect on employment or labour compensation can be found, but here it seems that wage pressure increases with higher flexibility and hence average wages are negatively moderated.

4.2.3. Trade Openness

The role of trade openness in GVC integration is generally assumed positive as only open countries can attract foreign investments. For the LM implications of this GVC integration, however, the impact of trade openness is difficult to predict (see chapter 2.3.3). Higher trade openness can affect the GVC-labour nexus either by opening new trade and productivity gain opportunities for domestic firms or by pressuring LMICs into specializing in low value-adding production stage. Thus, one would either expect a larger moderating effect on average wages or employment. Table 10 suggests that at least in the case of trade through forward integration neither of them is the case.

For forward GVC integration (column 4 to 6), none of the three interactions shows a significant moderating effect of trade openness. For backward integration, only one GVC-labour relationship appears to be significantly moderated: the effect on average wages. The main effect coefficient estimate suggest that backward integration and average wages are negatively correlated, but interacting this relationship with the level of trade openness reduces the effect. In other words, backward integrated trade accompanied by high trade openness is less likely to be associated by a negative effect on average wages.

Again, considering the potential differences in the role of trade openness on sectoral level no significant moderation of the GVC-labour nexus can be found for the primary and service sectors. For manufacturing trade (table C8), the results indicate that the positive labour compensation effect of backward integration is likely to be smaller when accompanied by higher trade openness. Similar moderation can be found for the average wage effect of forward integrated trade in trade services (table C9) and the employment and labour compensation effects of backward integrated trade in transport services (table C10).

While overall trade openness seems to be less relevant as a moderator of the GVC-labour nexus, trade openness leads to smaller LM effects for certain sectors. Hypothesis 6 which suggested a positive moderation of trade openness on the LM effects of GVC integration, can therefore be rejected.

Table 10: Moderating effect of Trade Openness

	(1)	(2)	(3)	(4)	(5)	(6)
	Employment	Labour Compensation	Average Wage	Employment	Labour Compensation	Average Wage
Backward GVC integration	0.122	-0.101	-0.224*			
	(0.205)	(0.155)	(0.115)			
Forward GVC integration				0.796***	0.691***	-0.106
				(0.204)	(0.158)	(0.136)
Interaction with…						
Trade Openness	-0.00215	0.0315	**0.0336****	-0.0109	0.0156	0.0266
	(0.0269)	(0.0193)	(0.0154)	(0.0283)	(0.0171)	(0.0193)
Constant	-3.710*	4.651***	8.361***	-2.390	8.311***	10.70***
	(2.045)	(1.564)	(1.215)	(2.843)	(2.139)	(1.651)
Country-Sector FEs	yes	yes	yes	yes	yes	yes
Country-Year FEs	yes	yes	yes	yes	yes	yes
Sector-Year FEs	yes	yes	yes	yes	yes	yes
Observations	2,037	2,037	2,037	2,254	2,254	2,254
R-squared	0.720	0.847	0.785	0.765	0.859	0.808
Number of country-sector	148	148	148	157	157	157

Notes: GVC and LM indicators are in natural logarithm. For readability main effects for moderating variables are suppressed. FEs = Fixed Effects. Robust standard errors in parentheses: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

4.2.4. Infrastructure

The fourth and last group of moderators considered in this analysis concerns infrastructure development. As many different aspects of infrastructure may impact the LM, first the comprehensive African Infrastructure Development Index (AIDI) will be employed. Additional to the overall index, three of its sub-indices will also be considered additionally.

Of all moderating variables under investigation in this analysis, infrastructure seems to be the most influential. Starting with role of AIDI on the LM implications of backward integration, the first three columns of table 11 show that in combination with higher infrastructure development the effects of backward integration on employment and average wages tend to be reduced. The positive correlation of GVC integration and employment levels is negatively moderated by infrastructure, while the negative correlation with average wages is positively moderated. In other words, while GVC integrated trade accompanied by high infrastructure development tends to decrease labour-intensity, average wages are increasing which suggests an increase in skill composition.

As discussed in chapter 2.3.4., infrastructure development is likely to matter in two ways: first, it matters for the attractiveness of rural areas to participate in GVCs. Second, infrastructure development matters for modern and technology-intensive production. The results discussed above suggest that at least the latter is indeed taking place. While these results are pessimistic for the inclusiveness of growth in terms of employment opportunities, one needs to keep in mind that

they also indicate the importance of infrastructure for economic upgrading. Instead of a shift toward high-skilled labour the increase in average wages could be interpreted as an improvement of wages paid to workers of all skill levels. Unfortunately, in this analysis a differentiation between LM outcomes for high- and low-skilled workers is not possible due to lack of quality data. An in-depth analysis differentiating between skill levels, however, would certainly give further insights on the true winners and losers behind these developments.

Table 11: Moderating effect of African Infrastructure Development Index

	(1)	(2)	(3)	(4)	(5)	(6)
	Employment	**Labour Compensation**	**Average Wage**	**Employment**	**Labour Compensation**	**Average Wage**
Backward GVC integration	0.290**	0.177*	-0.113**			
	(0.118)	(0.0957)	(0.0565)			
Forward GVC integration				0.926***	0.774***	-0.152*
				(0.110)	(0.0767)	(0.0918)
Interaction with…						
African Infrastructure Development Index	**-0.00679****	-0.00147	**0.00532****	**-0.0104****	**-0.00444***	**0.00599****
	(0.00300)	(0.00316)	(0.00178)	(0.00258)	(0.00239)	(0.00202)
Constant	-0.940	7.080***	8.020***	-8.675***	-0.646	7.148***
	(1.365)	(1.246)	(0.720)	(1.192)	(0.887)	(0.715)
Country-Sector FEs	yes	yes	yes	yes	yes	yes
Country-Year FEs	yes	yes	yes	yes	yes	yes
Sector-Year FEs	yes	yes	yes	yes	yes	yes
Observations	1,883	1,883	1,883	2,078	2,078	2,078
R-squared	0.708	0.853	0.730	0.783	0.900	0.770
Number of country-sector	153	153	153	165	165	165

Notes: GVC and LM indicators are in natural logarithm. For readability main effects for moderating variables are suppressed. FEs = Fixed Effects. Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

A more detailed look into the sub-indices embodied in the AIDI reveals which parts of a country's infrastructure are important for the GVC-labour nexus. Table 12 provides information on the regression results for three sub-indices (transport, ICT and electricity infrastructure).

Table 12: Moderating effect of Infrastructure Sub-Indices

	(1) Employment	(2) Labour Compensation	(3) Average Wage	(4) Employment	(5) Labour Compensation	(6) Average Wage
Backward GVC integration	0.187*	0.0945	-0.0926			
	(0.112)	(0.0932)	(0.0562)			
Forward GVC integration				0.856***	0.728***	-0.128
				(0.105)	(0.0789)	(0.0937)
Interaction with…						
Transport Infrastructure	**0.0101****	**0.0158*****	**0.00571***	-0.00477	0.00240	**0.00717***
	(0.00491)	(0.00398)	(0.00340)	(0.00462)	(0.00358)	(0.00421)
ICT Infrastructure	0.000976	**0.00494*****	**0.00396*****	**-0.00564*****	-0.00208	**0.00356*****
	(0.00196)	(0.00155)	(0.00148)	(0.00212)	(0.00184)	(0.00130)
Electricity Infrastructure	**-0.0198*****	**-0.0200*****	-0.000281	**-0.00525****	-0.00447	0.000774
	(0.00444)	(0.00464)	(0.00321)	(0.00260)	(0.00274)	(0.00130)
Constant	-0.649	6.749***	7.398***	-7.411***	1.022	8.432***
	(1.220)	(0.983)	(0.694)	(1.156)	(0.849)	(1.005)
Country-Sector FEs	yes	yes	yes	yes	yes	yes
Country-Year FEs	yes	yes	yes	yes	yes	yes
Sector-Year FEs	yes	yes	yes	yes	yes	yes
Observations	1,883	1,883	1,883	2,078	2,078	2,078
R-squared	0.721	0.868	0.730	0.781	0.901	0.768
Number of country-sector	153	153	153	165	165	165

Notes: GVC and LM indicators are in natural logarithm. For readability main effects for moderating variables are suppressed. FEs = Fixed Effects. Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Starting with the moderation of transport infrastructure, backward integrated trade is associated with an increase in employment which is larger when accompanied by higher transport infrastructure. For labour compensation and average wages, positive effects is more likely when accompanied by high transport infrastructure. For forward integration, the positive effects on employment and labour compensation are not affected by transport infrastructure, but the interaction term for average wage suggests that for forward integrated trade average wages are positively affected when transport infrastructure is high. Overall, these results suggest that trade infrastructure indeed improves the inclusiveness at least for backward integration.

Better electricity infrastructure, on the other hand, negatively moderates the employment and labour compensation effects of backward integration and the employment effect of forward integration. As suggested in chapter 2.3.4., GVC integration accompanied by higher electricity infrastructure indeed tends to be more capital-intensive rather than attracting labour-intensive activities. For ICT infrastructure, a positive moderation can be found for the wage effect of both measures of GVC integration. While the employment effect of backward integrated trade is not affected by the level of ICT infrastructure, in the case of forward integration, the positive employment effect is smaller at higher levels of ICT infrastructure. These findings are in line with

the expectations motivated in chapter 2.3.4, as higher ICT infrastructure is often associated with modern, more complex and technology-intensive exports.

Both for the overall AIDI and the sub-indices, interesting differences across sectors can be found. Considering the combined index, the regression results (tables C11 to C13) show that infrastructure matters for the GVC-labour nexus of the primary sector and services, but not for the manufacturing sector. This remains to be the case when considering the sub-indices (tables 13, C14 & C15), but a surprising observation can be made for the role of ICT infrastructure in services. As discussed in chapter 2.3.4., based on the nature of goods (and services), one would expect a well-developed ICT infrastructure to matter especially for high complex production, for example, in the service sector. Contrary to expectation, ICT infrastructure plays only a small role as a moderator in services compared transport and electricity infrastructure. Indeed, ICT infrastructure matters only for transport services (table C16) and other services (table C17).

Table 13: Moderating effect of Infrastructure Sub-Indices – Services

	(1) Employment	(2) Labour Compensation	(3) Average Wage	(4) Employment	(5) Labour Compensation	(6) Average Wage
Backward GVC integration	-0.0440	-0.129	-0.0851			
	(0.113)	(0.103)	(0.0525)			
Forward GVC integration				0.868***	0.798***	-0.0708
				(0.166)	(0.112)	(0.153)
Interaction with…						
Transport Infrastructure	**0.0112***	**0.0225***	**0.0114***	-0.00976	0.00513	**0.0149****
	(0.00591)	(0.00438)	(0.00368)	(0.00731)	(0.00445)	(0.00656)
ICT Infrastructure	0.00341	**0.00693****	0.00352	-0.000262	0.00272	0.00298
	(0.00338)	(0.00293)	(0.00272)	(0.00281)	(0.00197)	(0.00271)
Electricity Infrastructure	-0.0108	**-0.0131***	-0.00229	**-0.0101****	**-0.0133****	**-0.00319***
	(0.00810)	(0.00749)	(0.00352)	(0.00181)	(0.00114)	(0.00170)
Constant	2.159*	11.43***	9.268***	-6.995***	1.405	8.401***
	(1.164)	(1.086)	(0.525)	(1.682)	(1.140)	(1.532)
Country-Sector FEs	yes	yes	yes	yes	yes	yes
Country-Year Fixed Effects	yes	yes	yes	yes	yes	yes
Sector-Year Fixed Effects	yes	yes	yes	yes	yes	yes
Observations	926	926	926	1,039	1,039	1,039
R-squared	0.783	0.892	0.728	0.837	0.931	0.763
Number of country-sectors	76	76	76	83	83	83

Notes: GVC and LM indicators are in natural logarithm. For readability main effects for moderating variables are suppressed. FEs = Fixed Effects. Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

4.3. Discussion

The descriptive analysis has shown that the levels of GVC integration are highly heterogeneous for both forward and backward integration across the 17 SSA countries. Aside from cross-country differences, within the 15 years period, the shares of foreign VA and intermediate goods in exports have changed quite substantially within countries. Contrary to initial expectations the sectoral

composition of GVC trade does not differ significantly between trade through forward and backward integration. However, the two types of GVC integration do not appear simultaneously and hence differences in the LM implications and the country-specific moderators can be detected. Based on this diversity of experiences, SSA is an interesting and somewhat unusual case for studying the LM implications of trade in GVCs.

Overall, the economic growth prospects from trade in GVCs in SSA are relatively good as labour productivity seems to increase substantially with the levels of integration. At the same time, the prospects for the inclusiveness of this trade are rather small. In line with expectations, the magnitude of employment and labour compensation embodied in exports is larger for forward than for backward integration. Contrary to expectations, however, the employment effect of backward integration exceeds the labour compensation effect, which suggests that workers embodied in backward integrated trade are either less skilled or subject to higher wage pressure. In the case of forward integrated trade, the opposite takes place. Since in both cases no significant effect on average wages is found, the results suggest that the usual perception of GVC integration being more high-skill intensive or well-paid cannot be confirmed.

The finding of integration not being accompanied by a significant shift towards high-paid employment is most profound for trade in manufacturing. Both forward and backward integrated trade in manufacturing have larger effects on employment than on labour compensation. Despite substantial labour productivity growth in manufacturing production, the expansion of GVC trade in manufacturing is associated with increasing employment. Although other aspects may play a role as well, the decreasing average wages embodied in manufacturing export production suggest that the employment composition tends be more low-skill intensive and hence promote the inclusion of low-skilled workers.

Contrary to expectation, GVC integration in services is not associated with a significant increase in average wages. While for most service sub-sectors integration is associated with increases in employment and labour compensation, backward integrated trade in transport services and other services show a different dynamic. Here, higher levels of trade are associated with lower levels of employment and labour compensation which suggests that workers are losing out from GVC integration. In other words, economic growth through GVC integration in these sectors is jobless. Although wages improve for those workers remaining, specialization in these sectors does not foster inclusive growth and hence seems not to be suitable for sustainable and long-term economic development in SSA.

Turning to the second part of the analysis, the four groups of moderating variables provide interesting insights on which country-specific characteristics shape or are being shaped by the GVC-labour nexus. Looking at the levels of primary, secondary and tertiary school enrolment shows that all of them matter, but in different ways. While the impact of secondary education depends on the nature of integration, primary and tertiary education are found to positively moderate the LM implications of GVC integration. Although of relatively small magnitude, GVC trade is associated with employment growth if accompanied by higher levels of primary education. As the effects of labour compensation and average wages are smaller than the employment effects, GVC trade accompanied by higher primary education tends to attract low-skill intensive

production and hence supports the inclusiveness of growth through GVC integration. Tertiary education, on the other hand, positively moderates the impact of GVC integration on labour compensation, hence promotes a shift towards more skilled workers. Interestingly, the effect of tertiary education is different for the primary sector, where both employment and labour compensation effects are positively moderated. As suggested in chapter 2.3.1., these findings indicate that tertiary education is indeed an enabler for shifting to higher value-adding primary production.

LMF has been shown to be relevant primarily for backward integrated trade. Here, higher LMF positively moderates the employment and labour compensation effects of GVC integration. It seems that the role of LMF in attracting low-skill intensive production is more important than increasing wage. Interestingly, a different role of LMF has been found for the primary sector. Here, the only significant moderation has been identified for average wages in backward integration, which suggests that wage pressure dominates the effect of LMF.

The third potential moderator of the GVC-labour nexus is trade openness. Overall, trade openness has been found to play a rather small role in the moderation of the GVC-labour nexus in SSA. One exception from this is its moderation of the average wage effects of backward integrated trade in manufacturing, trade and transport services. In all three cases, negative wage effects tend to be smaller if accompanied by high trade openness.

Lastly, infrastructure development has been found to affect the GVC-labour nexus in many ways. While transport infrastructure positively moderates the impact of backward integrated trade on the three LM indicators, well-developed electricity infrastructure can be associated with more capital-intensive production as both employment and labour compensation effects are negatively moderated. In both cases, labour compensation increases faster than employment, but while transport infrastructure positively moderates the LM effects, GVC trade accompanied with high electricity infrastructure tends to be less inclusive overall. ICT infrastructure has been found quite relevant for the average wage effects of GVC integration. If accompanied by higher ICT infrastructure, wages are more likely to increase with the level of GVC integration. Contrary to expectations, however, ICT infrastructure plays only a small role in moderating the LM effects in service exports. Indeed, only for GVC trade in transport and other services, ICT infrastructure matters.

5. Conclusion

The rise of GVCs has broad forth new opportunities for participating in international markets and benefiting from comparative advantages especially for LMICs. As an important pillar of their economic growth strategies, one needs to ask whether growth through GVC integration is accompanied by decent job creation. Facing the low-skilled labour abundance and the pending structural change, the inclusiveness of growth is especially relevant for SSA countries. In this paper, I therefore investigate the LM implications of GVC integration in 17 SSA countries during

the period 2000-2015. Using fixed-effects panel regressions, the relationships of backward and forward GVC integration with employment, labour compensation and average wages have been tested.

In general, I find that GVC integration is accompanied by a shift toward less labour-intensive production. Especially for backward integration, both employment and labour compensation levels are rising relatively slowly with GVC trade. While this is good news for initially highly labour-intensive sectors like agriculture, the trade-off between productivity and job creation seems to lean towards productivity, leaving little room for inclusiveness. Overall, GVC trade in manufacturing has been more inclusive than trade in services. Indeed, in some cases, such as backward integration in transport and other services, growth through GVC integration has even been found jobless. Higher level of GVC trade in these sectors is correlated with lower employment and labour compensation. Policy makers should be aware that specializing in these sectors will leave the workforce behind.

In this study, four groups of country-specific characteristics have been analysed to understand what drives the GVC-labour nexus. While I find that primary education matters for the inclusiveness of GVC trade for both forward and backward integration, tertiary education seems to be relevant especially for the primary sector's ability to shift toward higher value-adding production. LMF has been found to positively moderate the employment and labour compensation effects of trade through backward integration, which suggests that trade accompanied by higher LMF is more labour-intensive. While trade openness turned out to have relatively little influence on the LM implications of GVC integration, infrastructure development is a significant mediator of the GVC-labour nexus especially in the primary and service sectors. Contrary to expectations, ICT infrastructure has been found to be less relevant for the GVC-labour nexus in service exports than transport and electricity infrastructure.

While plausible in many cases, the correlation between the four groups of country-specific characteristics and the GVC-labour nexus does not allow to identify the direction of causality. Instead, the moderating factors discussed in this paper provide information on what is relevant for certain types of GVC integration and their LM implications. For future research, refocusing on country-specific analyses and an in-depth study of the interplay of the different moderators through e.g. a principle component decomposition may help to identify the direction of causality.

All in all, investigating the GVC-labour nexus shows that policy makers should not only worry about the economic growth and upgrading capabilities of GVC integration, but also about its inclusiveness. Especially for backward GVC integration, economic upgrading opportunities may be large, but the benefits for the labour force are small and in some cases like transport services, growth might even negative. The LM implications of GVC integration should be a principal concern of policy makers especially in SSA where decent job creation is most urgent. The provided insights into the moderating effects of country-specific policies may help optimising the productivity and inclusiveness trade-off inherent in GVC integration, but after all policy makers should be cautious promoting GVC integration as an inclusive growth strategy specially when focusing on trade in services.

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Appendix

Appendix A: Variable construction

To illustrate the structure of the global IO tables and for an easier understanding of how the variables are being constructed, figure A1 provides a simplified example of a global IO table. Starting with the transaction matrix, the light green box (T) provides information on the VA that is provided by one sector (row) for the output production of another sector (column). Taking for example cell (3,4), provides information on the VA from sector 3 (in country A) that is embodied in the output of sector 4 (in country A). As the green square in the upper-left corner indicates, for the first rows and columns (in this example 6x6), the matrix gives information on how much input from one sector is included in another sector's output with both sectors belonging to the same country (country A). These values reflect the domestic value added in output. All cells in the same first six columns (dark green square below) provide information on the imports of country A from abroad for the production of outputs. The dark green square on the right of the "domestic inputs" provides information on the value added provided by country A for production of output abroad, hence the exports of country A used for production in the respective country.

Figure A 1: Eora Global Input-Output Table - Structure
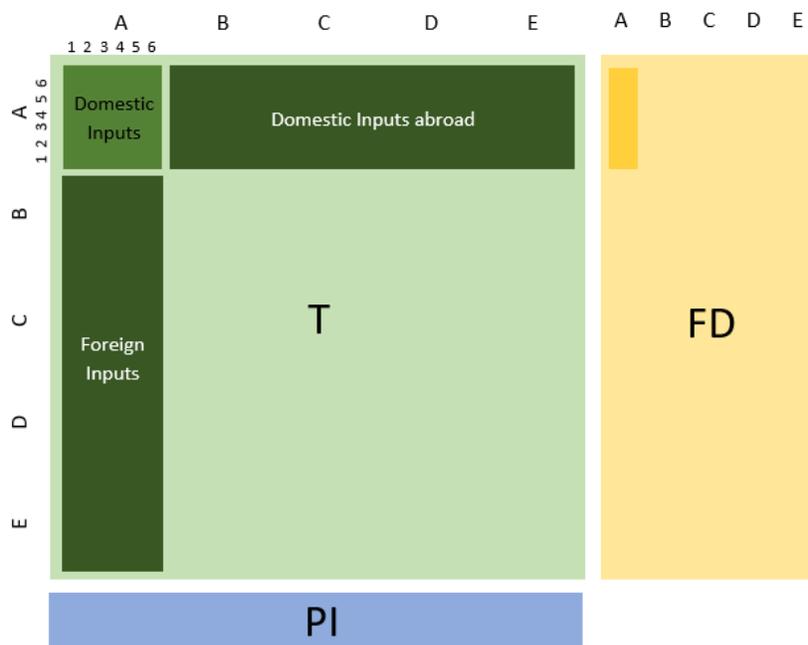
T = Transactions between sectors (domestic and international)
FD = Final Demand (domestic and international)
PI = Primary Inputs
A to E = Countries; 1 to 6 = Sectors

Source: Own illustration

The final demand matrix (FD) on the right of figure A1 (yellow), provides information on each country's VA that is being consumed for example by household or government consumption. Here, domestic final demand (output which is consumed rather than exported) and foreign final demand (export which is being consumed abroad) are included. Finally, the matrix in the bottom of figure A1 in blue (PI), gives information on the primary inputs embodied in the production of each sector. This includes for example information on the wages that are have been paid in order to produce the output of the respective sector

In the case of Eora, each global IO table consists of information about 26 sectors for 189 countries plus one vector with information on trade with the rest of the world. For illustration, this translates into a T-matrix with 4915 rows and 4915 columns. As discussed in chapter 2.1. backward GVC integration is measured as the foreign value added in exports ($fvax$) and follows the methodology first developed by Hummels, Ishii and Yi (2001). Measuring backward integration is conducted by a two-step approach. First, following Koopman, Wang and Wei (2012) foreign VA in exports is equal to the gross exports (exp) minus domestic VA in exports ($dvax$), which can be written as

$$fvax = exp - dvax_t. \tag{1}$$

The measure of domestic VA in exports is measured as

$$dvax_t = p'_t * \left(I - A_{dom,t}\right)^{-1} * e_t, \tag{2}$$

where e is the (column) vector of gross exports per sector and p_t is the (row) vector of primary input coefficients. The matrix $A_{dom,t}$ denotes the domestic input coefficient matrix, meaning the amount of inputs from domestic sector i needed to produce one unit of output in sector j. I is the identity matrix and $\left(I - A_{dom,t}\right)^{-1}$ is the well-known Leontief inverse. Multiplying the Leontief inverse with the vector e_t provides information how much input from each domestic sector is needed to produce the country's exports. Finally, to find the domestic VA in exports, one needs to multiply sectoral output by the transposed (column) vector p'_t.

Measuring the forward GVC integration of a sector in a certain country is somewhat less complex. As discussed in the previous chapter, forward integration is measured as the exports that are being used as intermediate inputs rather than being consumed. This means we are interested in distinguishing between the VA for *production* abroad and the VA used for *final demand* abroad. In the global IO tables, the foreign inputs for production of each country are reported in the T-Matrix (which is not the case in national IO tables) and hence the VA in the so-called intermediate exports (ix) can be measured as each sector's row-sum of the T-Matrix excluding domestic sectors. This means that forward integration or the value of IX can be measured as

$$ix_t = \sum_j T_{foreign,t}, \tag{3}$$

with $T_{foreign,t}$ denoting those parts of the T-matrix that include the sector's inputs to foreign production. By taking the column (j) sums, ix_t is a (column) vector reporting each sectors VA for production abroad.

The labour market indicators (*LMI*) are also calculated based on Eora IO tables. In this analysis, three LM indicators will be included: labour compensation, employment and average wages embodied in exports. In equation 2 the sum of all primary inputs per sector has been used to measure the total domestic VA in exports. To measure only the labour compensation or employment embodied in exports, the primary input vector needs be adjusted. While labour compensation is included as a primary input in the Eora database, information on the persons employed is extracted from the Economic Transformation Database (ETD) (Vries et al., 2021). Two of the three LM indicators, labour compensation and employment in exports, are hence calculated by

$$LMI_t = p'_{it} * \left(I - A_{dom,t}\right)^{-1} * e_t, \tag{4}$$

with i denoting the primary input of interested. The LM indictor for employment in exports is measured in thousand persons employed, while labour compensation is measured in thousand US $ in current prices

Table A 1: Data Availability by Country

Part A	GVC integration		Labour Market Implications		
Country	Backward	Forward	Employment	Labour Compensation	Wages
Botswana	2000-2015	2000-2015	2000-2015	2000-2015	2000-2015
Burkina Faso	2000-2015	2000-2015	2000-2015	2000-2015	2000-2015
Cameroon	2000-2015	2000-2015	2000-2015	2000-2015	2000-2015
Ethiopia	2000-2007	2000-2015	2000-2015	2000-2015	2000-2015
Ghana	2000-2015	2000-2015	2000-2015	2000-2015	2000-2015
Kenya	**2002-2015**	2000-2015	2000-2015	2000-2015	2000-2015
Lesotho	2000-2015	2000-2015	2000-2015	2000-2015	2000-2015
Malawi	**2002-2015**	2000-2015	**2000- 2007, 2009-2015**	**2000- 2007, 2009-2015**	**2000- 2007, 2009-2015**
Mauritius	2000-2015	2000-2015	2000-2015	2000-2015	2000-2015
Mozambique	2000-2015	2000-2015	2000-2015	2000-2015	2000-2015
Namibia	2000-2015	2000-2015	2000-2015	2000-2015	2000-2015
Rwanda	2000-2015	2000-2015	2000-2015	2000-2015	2000-2015
Senegal	2000-2015	2000-2015	2000-2015	2000-2015	2000-2015
South Africa	2000-2015	2000-2015	**2000, 2008, 2013-2015**	**2000, 2008, 2013-2015**	**2008, 2013-2015**
Tanzania	2000-2015	2000-2015	2000-2015	2000-2015	2000-2015
Uganda	2000-2015	2000-2015	2000-2015	2000-2015	2000-2015
Zambia	2000-2015	2000-2015	2000-2015	2000-2015	2000-2015

Notes: Years reflect data availability for all or at least the majority of sectors.

Part B	Moderating Variables					
Country	Primary Education	Secondary Education	Tertiary Education	Labour Market Flexibility	Trade Openness	AIDI*
Botswana	2000-2015	**2000-2008**	2000-2015	2000-2015	2000-2015	2003-2015
Burkina Faso	2000-2015	2000-2015	2000-2015	**-**	**-**	2003-2015
Cameroon	2000-2015	2000-2015	2000-2015	2000-2015	2000-2015	2003-2015
Ethiopia	2000-2015	2000-2015	**2000-2014**	**2005-2015**	**2005-2015**	2003-2015
Ghana	2000-2015	2000-2015	**2003-2005, 2010, 2011**	2000-2015	2000-2015	2003-2015
Kenya	2000-2015	**2000-2009**	2000-2015	**2001-2015**	**2001-2015**	2003-2015
Lesotho	2000-2015	2000-2015	2000-2015	**2005-2015**	**2005-2015**	2003-2015
Malawi	2000-2015	2000-2015	2000-2015	2000-2015	2000-2015	2003-2015
Mauritius	2000-2015	2000-2015	2000-2015	2000-2015	2000-2015	2003-2015
Mozambique	2000-2015	2000-2015	**-**	2000-2015	2000-2015	2003-2015
Namibia	**2000-2013**	**2000-2007**	**2005, 2006**	2000-2015	2000-2015	2003-2015
Rwanda	2000-2015	2000-2015	2000-2015	**2001-2015**	**2001-2015**	2003-2015
Senegal	2000-2015	2000-2015	**2000-2011**	2000-2015	2000-2015	2003-2015
South Africa	2000-2015	2000-2015	**2000-2003, 2007-2011**	2000-2015	2000-2015	2003-2015
Tanzania	2000-2015	**2010, 2014, 2015**	**2000-2011**	2000-2015	2000-2015	2003-2015
Uganda	2000-2015	**2004, 2007**	2000-2015	2000-2015	2000-2015	2003-2015
Zambia	2000-2015	**-**	2000-2015	2000-2015	2000-2015	2003-2015

Notes: *AIDI = African Infrastructure Development Index, data availability identical to sub-indices

Appendix B: Descriptive Analysis

Figure B 1: Disaggregation of Services in Backward GVC integration (2000 and 2015)
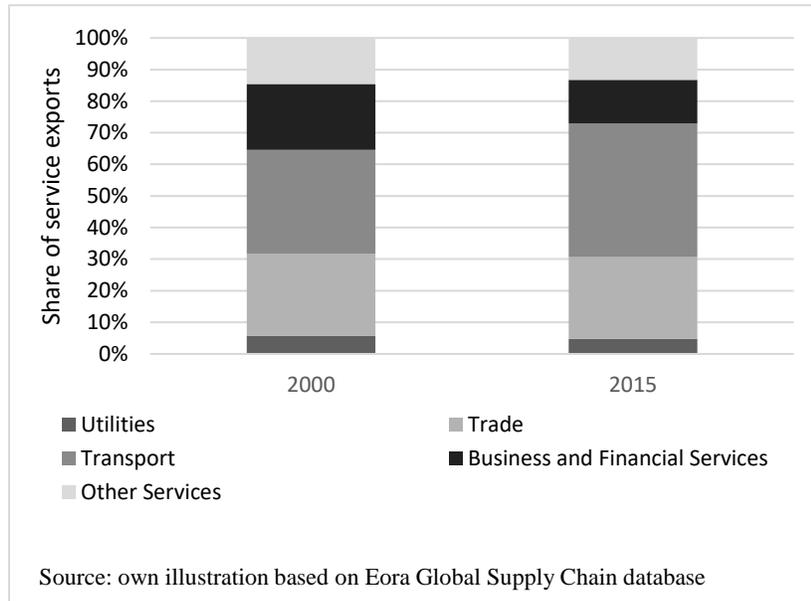

Source: own illustration based on Eora Global Supply Chain database

Figure B 2: Disaggregation of Services in Forward GVC integration (2000 and 2015)

Source: own illustration based on Eora Global Supply Chain database
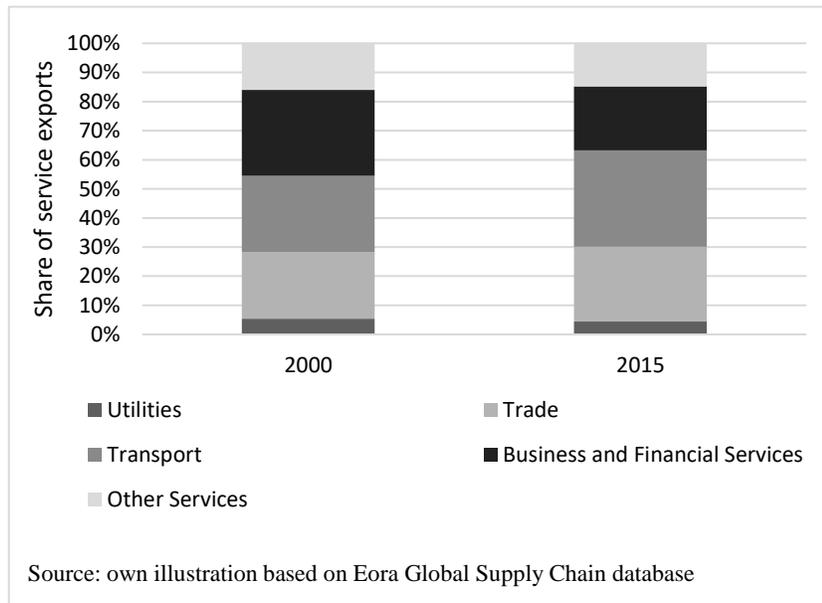
Figure B 3: Employment embodied in Exports by sector in 2000

Source: own illustration based on Eora Global Supply Chain database and the Economic Transformation Database
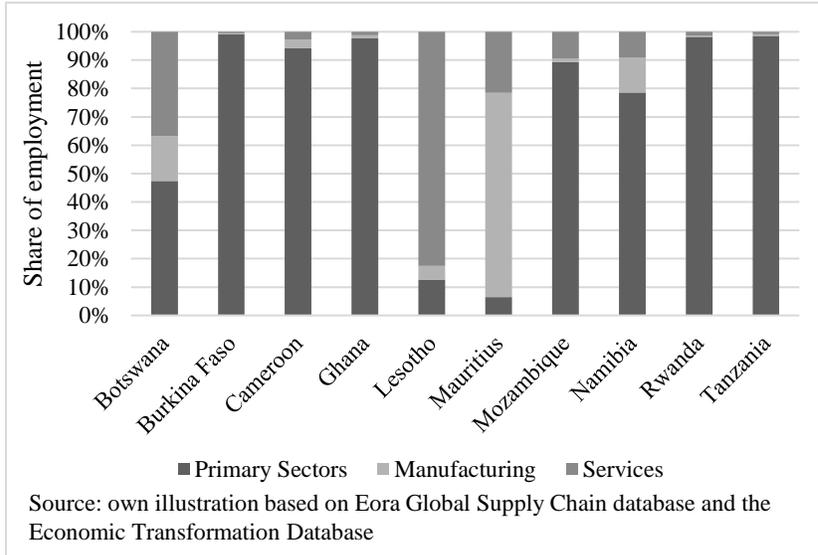
Figure B 4: Labour Compensation embodied in Exports by sector in 2000

Source: own illustration based on Eora Global Supply Chain database
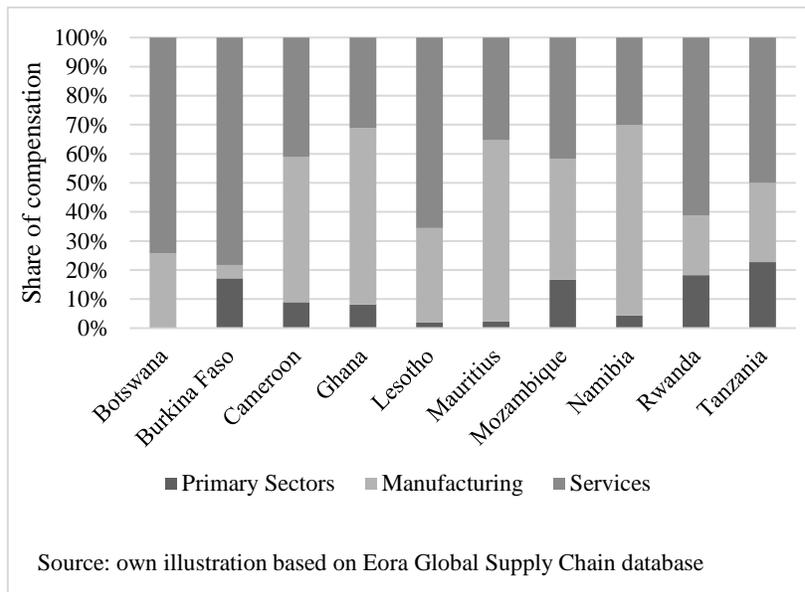
Appendix C: Moderating Factors

Table C 1: Moderating effect of Workforce Capabilities - Primary Sector

	(1) Employment	(2) Labour Compensation	(3) Average Wage	(4) Employment	(5) Labour Compensation	(6) Average Wage
Backward GVC integration	-0.863*	0.114	0.977***			
	(0.495)	(0.284)	(0.272)			
Forward GVC integration				-0.861	-0.125	0.736*
				(0.593)	(0.359)	(0.400)
Interaction with…						
Primary School Enrolment Ratio	0.00935	0.00105	**-0.00830***	**0.0128**	**0.00825***	-0.00457
	(0.00683)	(0.00599)	(0.00244)	(0.00589)	(0.00447)	(0.00443)
Secondary School Enrolment Ratio	**-0.0208***	-0.00583	**0.0150***	**-0.0264****	**-0.0138****	0.0126
	(0.0113)	(0.00846)	(0.00539)	(0.0109)	(0.00642)	(0.00881)
Tertiary School Enrolment Ratio	**0.0239****	**0.00994****	**-0.0140****	**0.0198****	**0.0105****	-0.00930
	(0.00696)	(0.00276)	(0.00613)	(0.00504)	(0.00261)	(0.00572)
Constant	11.47**	3.744	-7.726***	9.520	6.725**	-2.967
	(4.790)	(2.971)	(2.635)	(11.44)	(3.189)	(4.161)
Country-Sector FEs	yes	yes	yes	yes	yes	yes
Country-Year FEs	yes	yes	yes	yes	yes	yes
Sector-Year FEs	yes	yes	yes	yes	yes	yes
Observations	312	312	312	327	327	327
R-squared	0.759	0.956	0.919	0.723	0.927	0.910
Number of country-sectors	29	29	29	30	30	30

Notes: GVC and LM indicators are in natural logarithm. For readability main effects for moderating variables are suppressed. Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table C 2: Moderating effect of Workforce Capabilities - Manufacturing

	(1) Employment	(2) Labour Compensation	(3) Average Wage	(4) Employment	(5) Labour Compensation	(6) Average Wage
Backward GVC integration	0.231	-0.468	-0.699			
	(0.438)	(0.927)	(0.698)			
Forward GVC integration				0.492	0.918	0.426
				(0.875)	(0.778)	(0.545)
Interaction with…						
Primary School Enrolment Ratio	0.00385	0.0200	**0.0162***	0.0131	0.00847	-0.00461
	(0.00418)	(0.0115)	(0.00859)	(0.00772)	(0.00717)	(0.00401)
Secondary School Enrolment Ratio	**-0.00978***	**-0.00688***	0.00289	**-0.0121***	-0.00221	**0.00989**
	(0.00270)	(0.00386)	(0.00347)	(0.00367)	(0.00392)	(0.00360)
Tertiary School Enrolment Ratio	**-0.0110**	0.00349	**0.0145**	0.0133	**0.0240***	**0.0107***
	(0.00495)	(0.00678)	(0.00606)	(0.0136)	(0.0134)	(0.00559)
Constant	-0.0667	13.75	13.81**	-1.921	-0.741	1.180
	(6.265)	(8.680)	(5.758)	(8.213)	(7.604)	(7.592)
Country-Sector FEs	yes	yes	yes	yes	yes	yes
Country-Year FEs	yes	yes	yes	yes	yes	yes
Sector-Year FEs	yes	yes	yes	yes	yes	yes
Observations	122	122	122	137	137	137
R-squared	0.640	0.711	0.467	0.414	0.602	0.431
Number of countries	14	14	14	15	15	15

Notes: GVC and LM indicators are in natural logarithm. For readability main effects for moderating variables are suppressed. Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table C 3: Moderating effect of Workforce Capabilities - Services

	(1) Employment	(2) Labour Compensation	(3) Average Wage	(4) Employment	(5) Labour Compensation	(6) Average Wage
Backward GVC integration	-0.403	-0.327	0.0760			
	(0.289)	(0.292)	(0.170)			
Forward GVC integration				0.410	0.214	-0.196
				(0.673)	(0.595)	(0.518)
Interaction with…						
Primary School Enrolment Ratio	**0.00643**	0.00240	**-0.00403***	0.00578	**0.00740**	0.00162
	(0.00316)	(0.00308)	(0.00232)	(0.00548)	(0.00336)	(0.00545)
Secondary School Enrolment Ratio	-0.00264	-5.16e-05	0.00259	**-0.0100***	**-0.0113***	-0.00126
	(0.00379)	(0.00281)	(0.00334)	(0.00506)	(0.00369)	(0.00341)
Tertiary School Enrolment Ratio	-0.00199	0.00340	**0.00539**	0.00172	0.00866	**0.00694***
	(0.00288)	(0.00311)	(0.00221)	(0.00553)	(0.00526)	(0.00368)
Constant	7.898***	8.664***	0.767	5.613	6.361	8.096*
	(2.961)	(3.028)	(1.901)	(4.238)	(4.777)	(4.620)
Country-Sector FEs	yes	yes	yes	yes	yes	yes
Country-Year FEs	yes	yes	yes	yes	yes	yes
Sector-Year FEs	yes	yes	yes	yes	yes	yes
Observations	678	678	678	768	768	768
R-squared	0.810	0.917	0.824	0.845	0.920	0.836
Number of country-sectors	71	71	71	73	73	73

Notes: GVC and LM indicators are in natural logarithm. For readability main effects for moderating variables are suppressed. Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table C 4: Moderating effect of Labour Market Flexibility – Manufacturing

	(1)	(2)	(3)	(4)	(5)	(6)
	Employment	Labour Compensation	Average Wage	Employment	Labour Compensation	Average Wage
Backward GVC integration	0.0387	0.137	0.0987			
	(0.451)	(0.471)	(0.209)			
Forward GVC integration				0.611**	1.207***	0.596
				(0.237)	(0.264)	(0.389)
Interaction with…						
Labour Market Flexibility	-0.0256	-0.142	-0.116	-0.0935	-0.148	-0.0545
	(0.0910)	(0.0870)	(0.146)	(0.113)	(0.101)	(0.117)
Constant	1.466	-148.3	-2.172	-12.09	-16.02	-3.932
	(8.242)	(101.7)	(12.62)	(9.922)	(9.665)	(12.09)
Country-Sector FEs	yes	yes	yes	yes	yes	yes
Country-Year FEs	yes	yes	yes	yes	yes	yes
Sector-Year FEs	yes	yes	yes	yes	yes	yes
Observations	191	191	191	207	207	207
R-squared	0.241	0.533	0.298	0.229	0.530	0.364
Number of countries	15	15	15	16	16	16

Notes: GVC and LM indicators are in natural logarithm. For readability main effects for moderating variables are suppressed. Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table C 5: Moderating effect of Labour Market Flexibility - Primary Sector

	(1)	(2)	(3)	(4)	(5)	(6)
	Employment	Labour Compensation	Average Wage	Employment	Labour Compensation	Average Wage
Backward GVC integration	-0.404	0.399	0.803*			
	(0.888)	(0.519)	(0.462)			
Forward GVC integration				1.460***	1.715***	0.254
				(0.491)	(0.390)	(0.228)
Interaction with…						
Labour Market Flexibility	0.127	0.0213	**-0.106***	0.0288	0.00922	-0.0196
	(0.105)	(0.0644)	(0.0536)	(0.0691)	(0.0469)	(0.0365)
Constant	7.855	3.696	-4.159	18.08**	18.47***	0.388
	(10.05)	(5.904)	(5.225)	(6.878)	(4.369)	(3.951)
Country-Sector FEs	yes	yes	yes	yes	yes	yes
Country-Year FEs	yes	yes	yes	yes	yes	yes
Sector-Year FEs	yes	yes	yes	yes	yes	yes
Observations	447	447	447	484	484	484
R-squared	0.703	0.935	0.916	0.692	0.925	0.923
Number of country-sector	30	30	30	32	32	32

Notes: GVC and LM indicators are in natural logarithm. For readability main effects for moderating variables are suppressed. FEs = Fixed Effects. Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table C 6: Moderating effect of Labour Market Flexibility - Business Services

	(1)	(2)	(3)	(4)	(5)	(6)
	Employment	Labour Compensation	Average Wage	Employment	Labour Compensation	Average Wage
Backward GVC integration	-0.271	-0.406	-0.134			
	(0.291)	(0.537)	(0.405)			
Forward GVC integration				0.0709	0.347	0.276
				(0.546)	(0.768)	(0.646)
Interaction with…						
Labour Market Flexibility	**0.0977***	0.0928	-0.00495	0.0559	0.0672	0.0113
	(0.0525)	(0.0775)	(0.0609)	(0.0669)	(0.105)	(0.0877)
Constant	2.144	-133.2	10.88**	-0.791	5.752	6.543
	(2.937)	(87.78)	(3.825)	(5.783)	(8.328)	(6.817)
Country-Sector FEs	yes	yes	yes	yes	yes	yes
Country-Year FEs	yes	yes	yes	yes	yes	yes
Sector-Year FEs	yes	yes	yes	yes	yes	yes
Observations	203	203	203	227	227	227
R-squared	0.590	0.596	0.137	0.476	0.553	0.176
Number of countries	16	16	16	16	16	16

Notes: GVC and LM indicators are in natural logarithm. For readability main effects for moderating variables are suppressed. Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table C 7: Moderating effect of Labour Market Flexibility - Trade Services

	(1)	(2)	(3)	(4)	(5)	(6)
	Employment	Labour Compensation	Average Wage	Employment	Labour Compensation	Average Wage
Backward GVC integration	-1.006*	-0.327	0.679			
	(0.567)	(0.606)	(0.437)			
Forward GVC integration				-0.677	0.395	1.072
				(0.765)	(0.804)	(0.651)
Interaction with…						
Labour Market Flexibility	**0.159***	0.0424	-0.117	0.140	0.0512	-0.0893
	(0.0840)	(0.0763)	(0.0719)	(0.103)	(0.110)	(0.0958)
Constant	13.15**	-231.1***	-0.0280	10.40	6.026	-4.378
	(5.930)	(75.33)	(4.399)	(8.454)	(8.996)	(6.697)
Country-Sector FEs	yes	yes	yes	yes	yes	yes
Country-Year FEs	yes	yes	yes	yes	yes	yes
Sector-Year FEs	yes	yes	yes	yes	yes	yes
Observations	200	200	200	220	220	220
R-squared	0.496	0.642	0.415	0.401	0.604	0.384
Number of countries	15	15	15	16	16	16

Notes: GVC and LM indicators are in natural logarithm. For readability main effects for moderating variables are suppressed. Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table C 8: Moderating effect of Trade Openness - Manufacturing

	(1)	(2)	(3)	(4)	(5)	(6)
	Employment	**Labour Compensation**	**Average Wage**	**Employment**	**Labour Compensation**	**Average Wage**
Backward GVC integration	-0.347	0.268	-0.0599			
	(0.996)	(0.659)	(0.109)			
Forward GVC integration				1.116*	1.754***	0.638
				(0.532)	(0.594)	(0.690)
Interaction with …						
Trade Openness	-0.115	**-0.134***	-0.0187	-0.0965	-0.105	-0.00857
	(0.0738)	(0.0745)	(0.0809)	(0.0853)	(0.0783)	(0.0782)
Constant	-4.560	-137.1	4.964	-9.761	-10.33	-0.565
	(6.204)	(101.1)	(7.221)	(6.279)	(7.158)	(8.015)
Country-Sector FEs	yes	yes	yes	yes	yes	yes
Country-Year FEs	yes	yes	yes	yes	yes	yes
Sector-Year FEs	yes	yes	yes	yes	yes	yes
Observations	190	190	190	206	206	206
R-squared	0.297	0.553	0.285	0.247	0.539	0.361
Number of countries	15	15	15	16	16	16

Notes: GVC and LM indicators are in natural logarithm. For readability main effects for moderating variables are suppressed. Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table C 9: Moderating effect of Trade Openness - Trade Services

	(1)	(2)	(3)	(4)	(5)	(6)
	Employment	**Labour Compensation**	**Average Wage**	**Employment**	**Labour Compensation**	**Average Wage**
Backward GVC integration	-0.347	0.268	-0.0599			
	(0.996)	(0.659)	(0.109)			
Forward GVC integration				-0.175	1.466***	1.641**
				(0.757)	(0.463)	(0.729)
Interaction with …						
Trade Openness	0.0515	-0.0484	0.00297	0.0815	-0.123	**-0.204***
	(0.147)	(0.112)	(0.00519)	(0.123)	(0.0961)	(0.114)
Constant	6.798	-228.4***	7.202***	5.193	-5.313	-10.51
	(10.41)	(73.22)	(1.036)	(8.004)	(4.835)	(7.703)
Country-Sector FEs	yes	yes	yes	yes	yes	yes
Country-Year FEs	yes	yes	yes	yes	yes	yes
Sector-Year FEs	yes	yes	yes	yes	yes	yes
Observations	199	199	199	219	219	219
R-squared	0.450	0.637	0.276	0.382	0.608	0.462
Number of countries	15	15	15	16	16	16

Notes: GVC and LM indicators are in natural logarithm. For readability main effects for moderating variables are suppressed. Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table C 10: Moderating effect of Trade Openness - Transport Services

	(1)	(2)	(3)	(4)	(5)	(6)
	Employment	**Labour Compensation**	**Average Wage**	**Employment**	**Labour Compensation**	**Average Wage**
Backward GVC integration	0.365	0.599	0.135			
	(0.534)	(0.348)	(0.138)			
Forward GVC integration				0.488	1.222***	0.734
				(0.472)	(0.269)	(0.553)
Interaction with …						
Trade Openness	**-0.141***	**-0.153****	0.00361	-0.0497	-0.0241	0.0256
	(0.0773)	(0.0531)	(0.00714)	(0.0663)	(0.0316)	(0.0625)
Constant	-2.075	-243.3***	5.836***	-3.176	-3.405	-0.229
	(5.663)	(49.92)	(1.273)	(5.219)	(3.048)	(5.807)
Country-Sector FEs	yes	yes	yes	yes	yes	yes
Country-Year FEs	yes	yes	yes	yes	yes	yes
Sector-Year FEs	yes	yes	yes	yes	yes	yes
Observations	210	210	210	234	234	234
R-squared	0.687	0.721	0.087	0.412	0.617	0.350
Number of countries	15	15	15	16	16	16

Notes: GVC and LM indicators are in natural logarithm. For readability main effects for moderating variables are suppressed. Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table C 11: Moderating effect of African Infrastructure Development Index - Primary Sector

	(1)	(2)	(3)	(4)	(5)	(6)
	Employment	**Labour Compensation**	**Average Wage**	**Employment**	**Labour Compensation**	**Average Wage**
Backward GVC integration	1.112*	0.613**	-0.499			
	(0.623)	(0.257)	(0.403)			
Forward GVC integration				1.489***	1.148***	-0.341
				(0.536)	(0.178)	(0.432)
Interaction with….						
African Infrastructure Development Index	**-0.0184***	-0.00378	**0.0147****	**-0.0208****	**-0.00856****	**0.0122****
	(0.00910)	(0.00464)	(0.00614)	(0.00794)	(0.00367)	(0.00539)
Constant	-9.987	4.139	14.13***	-15.75**	-3.608	12.14**
	(7.702)	(3.228)	(4.984)	(7.456)	(2.515)	(5.956)
Country-Sector FEs	yes	yes	yes	yes	yes	yes
Country-Year FEs	yes	yes	yes	yes	yes	yes
Sector-Year FEs	yes	yes	yes	yes	yes	yes
Observations	410	410	410	441	441	441
R-squared	0.714	0.951	0.855	0.741	0.950	0.867
Number of country-sectors	32	32	32	34	34	34

Notes: GVC and LM indicators are in natural logarithm. For readability main effects for moderating variables are suppressed. Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table C 12: Moderating effect of African Infrastructure Development Index - Manufacturing

	(1)	(2)	(3)	(4)	(5)	(6)
	Employment	Labour Compensation	Average Wage	Employment	Labour Compensation	Average Wage
Backward GVC integration	0.301	0.328	0.0272			
	(0.343)	(0.304)	(0.228)			
Forward GVC integration				0.510**	1.240***	0.730*
				(0.208)	(0.312)	(0.410)
Interaction with…						
African Infrastructure Development Index	-0.0158	-0.0137	0.00209	-0.01000	-0.0154	-0.00536
	(0.00951)	(0.00988)	(0.00867)	(0.00923)	(0.0118)	(0.0138)
Constant	-2.816	-61.99	6.714*	-3.168	-6.054	-2.886
	(4.765)	(67.70)	(3.284)	(2.617)	(3.537)	(5.250)
Country-Sector FEs	yes	yes	yes	yes	yes	yes
Country-Year FEs	yes	yes	yes	yes	yes	yes
Sector-Year FEs	yes	yes	yes	yes	yes	yes
Observations	178	178	178	192	192	192
R-squared	0.444	0.577	0.291	0.324	0.612	0.419
Number of countries	15	15	15	15	15	15

Notes: GVC and LM indicators are in natural logarithm. For readability main effects for moderating variables are suppressed. Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table C 13: Moderating effect of African Infrastructure Development Index - Services

	(1)	(2)	(3)	(4)	(5)	(6)
	Employment	Labour Compensation	Average Wage	Employment	Labour Compensation	Average Wage
Backward GVC integration	0.0186	-0.0852	-0.104			
	(0.111)	(0.111)	(0.0691)			
Forward GVC integration				0.839***	0.750***	-0.0887
				(0.185)	(0.127)	(0.147)
Interaction with….						
African Infrastructure Development Index	0.000238	**0.00851****	**0.00827***	**-0.0138****	**-0.00886****	0.00493
	(0.00426)	(0.00417)	(0.00432)	(0.00545)	(0.00435)	(0.00386)
Constant	0.995	10.43***	9.438***	-7.890***	2.033	9.924***
	(1.291)	(1.321)	(0.929)	(2.457)	(1.657)	(1.899)
Country-Sector FEs	yes	yes	yes	yes	yes	yes
Country-Year FEs	yes	yes	yes	yes	yes	yes
Sector-Year FEs	yes	yes	yes	yes	yes	yes
Observations	926	926	926	1,039	1,039	1,039
R-squared	0.779	0.884	0.730	0.835	0.922	0.758
Number of country-sectors	76	76	76	83	83	83

Notes: GVC and LM indicators are in natural logarithm. For readability main effects for moderating variables are suppressed. Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table C 14: Moderating effect of Infrastructure Sub-Indices - Primary Sector

	(1) Employment	(2) Labour Compensation	(3) Average Wage	(4) Employment	(5) Labour Compensation	(6) Average Wage
Backward GVC integration	0.815	0.568**	-0.247			
	(0.558)	(0.273)	(0.344)			
Forward GVC integration				1.131**	1.065***	-0.0656
				(0.423)	(0.218)	(0.293)
Interaction with…						
Transport Infrastructure	0.0125	0.00335	-0.00911	0.0123	-0.00331	-0.0156
	(0.0280)	(0.0138)	(0.0211)	(0.0324)	(0.0127)	(0.0256)
ICT Infrastructure	-0.0100	-0.000896	**0.00914***	**-0.0146****	**-0.00771***	0.00691
	(0.00614)	(0.00284)	(0.00519)	(0.00600)	(0.00172)	(0.00508)
Electricity Infrastructure	-0.0362	-0.0150	0.0212	-0.0176	0.000403	0.0180
	(0.0275)	(0.0112)	(0.0171)	(0.0145)	(0.00559)	(0.0127)
Constant	-3.165	4.192	7.357*	-5.887	-3.045	2.842
	(5.852)	(2.902)	(3.635)	(4.850)	(2.545)	(3.380)
Country-Sector FEs	yes	yes	yes	yes	yes	yes
Country-Year FEs	yes	yes	yes	yes	yes	yes
Sector-Year FEs	yes	yes	yes	yes	yes	yes
Observations	410	410	410	441	441	441
R-squared	0.726	0.952	0.859	0.745	0.951	0.869
Number of country-sectors	32	32	32	34	34	34

Notes: GVC and LM indicators are in natural logarithm. For readability main effects for moderating variables are suppressed. Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table C 15: Moderating effect of Infrastructure Sub-Indices - Manufacturing

	(1) Employment	(2) Labour Compensation	(3) Average Wage	(4) Employment	(5) Labour Compensation	(6) Average Wage
Backward GVC integration	0.278	0.318	0.0395			
	(0.359)	(0.315)	(0.239)			
Forward GVC integration				0.508**	1.252***	0.744
				(0.212)	(0.316)	(0.426)
Interaction with…						
Transport Infrastructure	0.0121	-0.0113	-0.0233	0.0198	-0.0138	**-0.0336***
	(0.0140)	(0.0158)	(0.0163)	(0.0131)	(0.0126)	(0.0167)
ICT Infrastructure	-0.00462	-0.0197	-0.0151	-0.000421	0.00750	0.00792
	(0.0174)	(0.0166)	(0.0197)	(0.0168)	(0.0123)	(0.0120)
Electricity Infrastructure	-0.0206	0.0118	0.0324	-0.0206	0.00371	0.0243
	(0.0202)	(0.0221)	(0.0206)	(0.0205)	(0.0158)	(0.0199)
Constant	0.498	-47.25	5.016	-1.022	-4.898	-3.876
	(4.491)	(98.61)	(3.181)	(2.399)	(3.950)	(4.666)
Country-Sector FEs	yes	yes	yes	yes	yes	yes
Country-Year FEs	yes	yes	yes	yes	yes	yes
Sector-Year FEs	yes	yes	yes	yes	yes	yes
Observations	178	178	178	192	192	192
R-squared	0.433	0.576	0.341	0.319	0.612	0.432
Number of countries	15	15	15	15	15	15

Notes: GVC and LM indicators are in natural logarithm. For readability main effects for moderating variables are suppressed. Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table C 16: Moderating effect of Infrastructure Sub-Indices – Transport Services

	(1) Employment	(2) Labour Compensation	(3) Average Wage	(4) Employment	(5) Labour Compensation	(6) Average Wage
Backward GVC integration	-0.339*	-0.262*	0.0769			
	(0.178)	(0.148)	(0.143)			
Forward GVC integration				0.241*	1.166***	0.926***
				(0.125)	(0.118)	(0.191)
Interaction with…						
Transport Infrastructure	0.00250	0.00312	0.000615	0.00131	0.00524	0.00392
	(0.00847)	(0.0113)	(0.00677)	(0.00949)	(0.00907)	(0.00771)
ICT Infrastructure	**0.00907***	**0.0116***	0.00252	**0.0139***	**0.0141***	0.000163
	(0.00297)	(0.00379)	(0.00246)	(0.00265)	(0.00266)	(0.00211)
Electricity Infrastructure	**-0.0143***	**-0.0126***	0.00169	0.000874	0.00290	0.00203
	(0.00196)	(0.00181)	(0.00134)	(0.00371)	(0.00345)	(0.00301)
Constant	5.626**	-237.3***	6.201***	0.0530	-2.652*	-2.705
	(1.920)	(60.52)	(1.596)	(1.327)	(1.349)	(2.083)
Country-Sector FEs	yes	yes	yes	yes	yes	yes
Country-Year FEs	yes	yes	yes	yes	yes	yes
Sector-Year FEs	yes	yes	yes	yes	yes	yes
Observations	197	197	197	216	216	216
R-squared	0.719	0.700	0.230	0.543	0.729	0.512
Number of country-sectors	16	16	16	17	17	17

Notes: GVC and LM indicators are in natural logarithm. For readability main effects for moderating variables are suppressed. Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table C 17: Moderating effect of Infrastructure Sub-Indices – Other Services

	(1) Employment	(2) Labour Compensation	(3) Average Wage	(4) Employment	(5) Labour Compensation	(6) Average Wage
Backward GVC integration	0.0194	0.0256	0.00615			
	(0.107)	(0.117)	(0.0654)			
Forward GVC integration				0.372**	0.912***	0.540***
				(0.159)	(0.0378)	(0.165)
Interaction with…						
Transport Infrastructure	0.0124	0.0165	0.00414	0.0157	-0.000945	-0.0166
	(0.0121)	(0.0122)	(0.00670)	(0.00907)	(0.00481)	(0.00993)
ICT Infrastructure	0.00649	**-0.0262**	**-0.0327**	**0.00680***	0.00236	**-0.00443*
	(0.0150)	(0.0103)	(0.0124)	(0.00227)	(0.00210)	(0.00224)
Electricity Infrastructure	-0.0169	-0.00407	0.0128	-0.000409	**-0.00374***	-0.00333
	(0.0199)	(0.0212)	(0.0101)	(0.00178)	(0.000851)	(0.00209)
Constant	1.749	-178.9***	7.143***	-1.152	0.261	1.413
	(1.112)	(39.12)	(0.646)	(1.593)	(0.346)	(1.695)
Country-Sector FEs	yes	yes	yes	yes	yes	yes
Country-Year FEs	yes	yes	yes	yes	yes	yes
Sector-Year FEs	yes	yes	yes	yes	yes	yes
Observations	193	193	193	218	218	218
R-squared	0.654	0.820	0.554	0.748	0.896	0.628
Number of country-sectors	16	16	16	17	17	17

Notes: GVC and LM indicators are in natural logarithm. For readability main effects for moderating variables are suppressed. Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.