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DETERMINANTS OF GLOBAL VALUE CHAINS PARTICIPATION FOR LANDLOCKED COUNTRIES

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ABSTRACT

The aim of this research is to investigate factors influencing the participation in global value chains within 17 landlocked countries. We emphasize the impact of these determinants between African landlocked countries and Non-African landlocked countries. Using data from the recent global value chains indexes developed by Research Institute for Global Value Chains at University of International Business and Economics, we notice that most African landlocked countries are located in upstreamness, i.e., provide mainly raw materials to the different networks of value chain.; while non-African landlocked countries are highly engaged in the downstream production close to the final consumers. Moreover, the econometric analysis at the country and sector levels shows that the determinants of global value chains influence differently the participation of the two groups of landlocked countries. In overall, the study reveals that Non-African landlocked countries perform better than their counterparts located in Africa. The findings of this research should allow national authorities to conceive and implement not only a new generation of economic policies but also promote infrastructure development that would trigger the engagement in cross-border value chains trade.

Keywords: policy-based and structural determinants, global value chains; landlocked countries.

1. INTRODUCTION

Over the last three decades, significant changes in transportation modes, communication technology and the progressive removal of barriers to trade and investment, among others, have profoundly altered the landscape of international trade. As a result, the global production of goods and services has become increasingly fragmented into specific tasks (see e.g. Feenstra, 1998; Hummels et *al.*, 1998, 2001; Grossman & Ross-Hansberg, 2008; Johnson & Noguera, 2012b; Foster-McGregor & Stehrer, 2013; Amador and Cabral, 2014; Amador et *al.*, 2015; Johnson, 2014, 2018). This new phenomenon generally known as offshoring or global value

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chains (GVCs) has emerged as the most striking feature of globalization: "different stages of the production process of a single output can be carried out in different parts of the world, depending on the comparative advantages of alternative production sites" (Sachs, 1998, p.98).

In such a context, the country-centric view of production requiring a full range of domestic industries to assemble a final good has simply become outdated. Instead, one observes the rising of cross-border value chain networks linking economic players worldwide and based on their factor cost disparities. Due to the interconnectedness of the economies, the growing trend of trade in intermediate goods exceeds by far trade in final products. In this regard, Johnson and Noguera (2012a, p.224) report that "trade in intermediate inputs accounts for as much as two thirds of international trade". Consequently, conventional measures of trade flows are no longer reliable in the framework of GVCs because they provide misleading figures of the current economic exchanges. The importance of the GVCs phenomenon has stimulated researchers to develop statistics and analysis based on the value added in trade (Dollar, 2017)[1].

Furthermore, there exists a large consensus among trade economists that the participation in GVCs is viewed as a stepping-stone for economic upgrading in particular within developing countries (see Venables, 2009; Bhatia, 2013; Gereffi, 2014; Cheng et *al*., 2015; Kowalski et *al*., 2015; Gereffi and Fernandez-Stark, 2016; Ahmad and Primi, 2017; UNCTAD, 2018; among others). For instance, UNIDO (2015, p.13) suggests that "global production networks or global value chains (GVCs) constitute important opportunities for developing countries to become part of the global economy, to absorb knowledge and technology and add value to their products. (…). Developing countries should look for ways to enter into GVCs in a gainful way". Likewise, Kummritz et *al*. (2017) affirm that "the emergence of GVCs has opened up new ways for development and industrialization. Developing countries can now join existing supply chains instead of building complete chains domestically".

However, all developing economies do not enjoy the same geographical characteristics: some do have a direct access to deep-sea ports while others do not. This location factor has a profound impact on the scope and the dynamics of these countries' integration in the global trading system (UNCTAD, 2014). Indeed, the countries depending upon their coastal neighbor to get access to ports face multiple challenges for their development. One of the penalizing facts is the high transportation costs due to border fees and road tolls imposed by the transit countries. Accordingly, most states without ports experience higher prices of goods which affect the well-functioning of their domestic economies. In addition, the existing literature based on traditional trade measurements provides sound evidence according to which landlocked countries

[1] The paper by Ahamad (2013) is very insightful and explaining why and how value added in trade is estimated.

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underperform in trade and most economic indicators compared to their coastal counterparts (see e.g. MacKellar & others, 2000; Limão and Venables, 2001; Faye et *al*., 2004; Carmignani, 2015). Even though the empirical results of the previous research remain valuable, they are nevertheless limited in the framework of global production sharing.

With the rise of GVCs in recent years, various so-called new policy measure, going beyond traditional trade policy, have become important factors of trade (van der Marel, 2015, p.2). The burgeoning studies closely related to our aim examine the determinants of GVC participation by using a panel set of countries (e.g. Cheng and others, 2015; Kowalski et *al*., 2015; Lopez-Gonzalez, 2016; Allard et *al*., 2016; Tinta, 2017) regardless their differences in geographical situation which really matters in trade. Yet Dollar (2017, p.6) affirms that "the involvement of developing countries in GVCs, geography clearly matters". Additionally, their statistics describing the engagement in GVCs come from two main databases namely OECD-WTO TiVA and EORA Global MRIO. The drawback of these databases is that the participation in GVCs is not divided into value-added trade flows crossing borders only once and many times.

To the best of our knowledge, we fall short of knowledge regarding the determinants of GVCs involvement within landlocked developing countries and particularly those located in Africa given that (Dollar, 2016, p.13) affirms that "African economies have little involvement in GVCs". We aim to fill this gap.

In this paper, our contribution to the literature of global value chains participation is threefold. First, we investigate the determinants of being involved to value-added trade within landlocked developing countries with a special attention to African landlocked nations. This special attention is motivated by the fact that some basic indicators reveal an outstanding difference in the economic performance (see Table 1). As we notice in most selected indicators on average, African landlocked countries lag behind compared to their Non-African compeers. Moreover, Table 2 shows that the level of participation in GVCs is overall lower for African landlocked economies than Non-African landlocked states. In the view of the foregoing, the challenge consists of understanding driving factors and handicaps on GVC participation in both groups of countries.

Second, unlike earlier papers, our study relies on a new value-added statistics developed by the Research Institute for Global Value Chains at University of International Business and Economics (UIBE) following the work by Wang, Wei, Yu and Zhu (WWYZ, 2017a,b). These data have not yet been applied in the context of landlocked economies in particular. The UIBE GVC index system has the distinctiveness of decomposing total GVC participation (both in forward and backward linkages) in simple GVCs and complex GVCs.

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Third, most researchers in the literature of trade in value-added determine the country's location along the value chain by computing its distance from final demand (see e.g. van der Marel, 2015). In contrast with this calculation, we estimate for the first time the GVC position index for landlocked countries based on Antras & Fally Upstreamness index and Antras & Chor Downstreamness index from the UIBE GVC index system.

Table 1: The disparity in economic variables between African and Non-African countries

	African countries	Non-African countries
Tariffs rate (applied weighted mean)	7.61	5.69
Foreign direct investment	2.96	7.19
Quality of overall infrastructure	2.92	2.72
Institutional quality	–0.49	–0.80
Domestic credit to private sector	17.06	26.6
Domestic market size	1.22E+10	2.74E+10
Industrialization level	9.07	10.59
Skill intensity	0.86	1.87
Output per worker	3587.388	6270.367
Human development index (hdi)	0.45	0.64
Tertiary education	5.54	31.68
GDP growth	6.38	6.97
Total trade (in final goods)	62.19	87.68

Source: The authors' calculation

Note: All values are in average. Variables from hdi to total trade are not include in the regression.

The roadmap of this study is as follows: section 2 presents the description of global value chains data; section 3 is devoted to a brief literature review; section 4 is the model specification; section 5 is the benchmark results and section 6 refers to conclusion.

2. DESCRIPTION OF GLOBAL VALUE CHAINS DATA

2.1. The participation in GVCs

Following the critical work by Wang and others (2017a) and based on the GTAP-ICIO database, the Research Institute for Global Value Chains at University of International Business and Economics (UIBE) computes a set of indicators to quantify domestic and foreign value-added in

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the cross-border production-sharing activities[2]. For the purpose of this study, we are particularly interested in the indexes related to the participation in GVCs.

The UIBE GVC index system presents the involvement in trade of factor content both on the supply side of value chains or forward linkage (index1) and the demand side of value chains or backward linkage (index2). Moreover, the singularity of this database is the disassociation of total GVC participation (forward and backward) into two components. The first is about simple GVCs, i.e., the share of domestic or foreign value-added that crosses borders only once and embodied in the intermediate inputs to produce final goods which are consumed in the direct importing trade partner. The second refers to complex GVCs, in other words, the percentage of factor content coming from the local economy or abroad that passes on two borders in minimum.

In Table 2, we examine the participation in value added trade between African landlocked countries and Non-African landlocked countries. It is clearly shown that the comprehensive engagement in global value chains of African landlocked countries accounts for 40 percent while the one of Non-African economies is 50 percent. A similar tendency is observed when the overall GVCs is split into forward and backward linkages.

In particular, total GVC participation in forward relationship represents 18% and 21% respectively for landlocked countries in Africa and those outside Africa. Likewise, the exports of value-added that cross borders only once (simple GVC) is 10 percent for African nations without ports, in contrast Non-African landlocked states display a level of 14 percent. Both groups of countries have the same percentage in complex GVC participation (7%).

[2]The full UIBE GVC Index System is available on the Baidu cloud service at https://pan.baidu.com/s/1-yr2V-1tUZ4pAhjasqTYMg. The GTAP-ICIO covers 122 countries but for this research, we focus on 17 landlocked nations. Data are only available in three reference years (2004, 2007 and 2011). Given that our period of study spans from 2004 to 2011, we fill data of the missing years by using a basic econometric technique which consists of running the variables with missing values on the period of study. Next, we perform a linear prediction and replace the predicated values where there are lacking.

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Table 2: The level of GVC participation within landlocked economies

African countries			Non-African counties		
GVC participation					
40%			50%		
I	II	III	IV	V	VI
Forward linkage					
Total GVC	Simple GVC	Complex GVC	Total GVC	Simple GVC	Complex GVC
18%	10%	7%	21%	14%	7%
Backward linkage					
Total GVC	Simple GVC	Complex GVC	Total GVC	Simple GVC	Complex GVC
22%	10%	13%	28%	11%	17%

Source: The authors' calculations

Note: The level of GVC participation is computed based on the three reference years (2004, 2007, 2011).

In respect of backward linkage, total GVC involvement stands at 22 percent within sampled African landlocked economies whereas Non-African landlocked countries present a value of 28%. The level of simple GVC participation is very close: 10% for landlocked countries located in Africa and 11% for non-African landlocked countries. There is a gap of 4% in favor of Non-African landlocked nations when it comes to the foreign value-added crossing borders at least twice (complex GVC).

2.2. The GVC position index

The second critical paper by Wang and others (2017b) has enabled to get different measurements of the production length along the international value chain. More importantly, these four authors take advantage of Antras et *al.* (2012) and Antras & Chor (2013) to calculate two indices of the production line position.

For every single sector, Wang et *al.* (2017b) compute the so-called "Antras and Fally Upstreamness index" showing the position of the sector in upstream activities: the higher the value the higher the standing in the upstream production value chain. Similarly, the researchers develop another measure known as "Antras and Chor Downstreamness index" to identify where a sector is located in the downstream specialization. Likewise, the higher the value the higher the rank in the downstream activities.

Thus, the difference between the two previous index provides the relative location of the sector (or country) along the global production system. Given that we perform the first index minus the second, the result with a positive sign denotes the prevalence of upstream production while the negative sign stands for downstream activities. The higher the positive value the deeper the

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sector in upstreamness. Conversely, the higher the negative value the deeper the sector in downstream production[3].

As observed in Table 3, the full sample of landlocked countries covered by this analysis displays a positive mean. This reveals that on average, the geographically disadvantaged economies are on the whole involved in upstream production. Once the sample is split into two groups, the dissimilarity has emerged: African landlocked countries, on average, are strongly engaged in upstream specialization since the mean is positive; on the other hand, their Non-African counterparts are mainly players in downstream activities.

Table 3: The index of the country's position in GVC

	Mean	Min.	Max.
Full sample	0.014	–2.53	3.49
African landlocked countries	0.086	–2.33	3.49
Non-African landlocked countries	–0.049	–2.53	3.29

Source: The authors' calculation

Note: A mean with a positive sign denotes the upstream position whereas the one associated with the negative sign represents the downstream position.

Furthermore, the graphical analysis by country and by sector delivers a deep insight (see Appendix D). Figure 1 shows the GVC position index for African landlocked countries. We observe that five out of eight countries are located in upstream production with Zambia the most involved economy. On the other side, Malawi has the highest position in downstream production. When it comes to Non-African landlocked countries, Figure 2 reveals that the bulk of states are engaged in in downstream activities. In particular, Laos and Nepal have respectively the topmost ranks. In contrast, Mongolia is strongly positioned in upstream specialization.

The analysis by sector proves once more that African landlocked countries are basically engaged in upstream sectors. The tertiary activities have the largest share afterwards come those of the primary sector (see Figure 3). On the other hand, Non-African landlocked countries are indeed

[3] According to Inomata (2017, p.27): "if a country's representative production chains towards final products are longer than those toward primary products, the country is considered to operate in a relatively upstream position. Conversely, if a country's representative production chains toward final products are shorter than those toward primary products, the country operates in a relatively downstream position". Among the pioneers of measuring the relative production positions of countries there are Dietzenbacher et *al*. (2005), Inomata (2008), Fally (2011) and Escaith and Inomata (2013).

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downstream producers. It is shown that the secondary sector is the most dynamic and thereafter the primary sector (refer to Figure 4).

3. A BRIEF LITERATURE REVIEW

The empirical literature dealing with factors that influence the countries' participation in global value chains is relatively recent and only a handful of authors has explored this research path. As far as we know, the early evidence comes with Kowalski et *al*. (2015). The authors use data from the OECD-WTO TiVA database and a group of 57 countries over 22 years to perform panel ordinary least square. After including the lagged explanatory variables to address the problem of endogeneity, they find out the determinants that affect negatively (tariffs, level of industrialization and GDP) and positively (FDI, level of industrialization) the participation in forward and backward linkage.

In the same vein, Cheng et *al*. (2015) use the same dataset and construct others measures such as economic complexity index and distance to final demand to examine the influence on GVC participation. Their regression includes some conventional control variables. The issue of endogenous variables is tackled like the previous authors. Cheng and others reveal that tariffs and investment restrictiveness, trade restrictiveness affect negatively the engagement in GVC. The impact of real GDP depends whether the participation is in high-tech or low-tech manufacturing. In addition, it is shown that distance to final demand and economic complex index impacts positively the involvement in cross-border value chains.

Lopez-Gonzalez (2016) employs a sample of developed and emerging economies to investigate the determinants of domestic value added in exports. His factor content data comes from the OECD ICIO database. The benchmark result based on a fixed effect model with control of country-sector and year features. On the whole, he identifies capital to labour ratio, skill intensity, output per worker, FDI and sophistication of exports as drivers to GVC participation. But tariffs and distance to economic activity are main handicaps. However, the influence of the factors are not the same within both groups of countries.

Similarly, Allard et *al*. (2016) study the determinants of foreign value added coming from the EORA database. They use an unbalanced panel data for 185 countries and spanning the period 2007-11 and explanatory are lagged to avoid simultaneity bias. The scholars show that tariffs and GDP impact negatively and significantly foreign value-added. By contrast, real GDP per capita, domestic credit to private sector, education, rule of law and quality of infrastructure promote the absorption of value-added coming from abroad.

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The work by Tinta (2017) focuses exclusively on African countries and GVC participation data are from the OECD TiVA and EORA databases. Using a gravity model with panel fixed effects, the author proves that the impact of structural and policy-based factors is dependent on their engagement in forward and backward linkages. For instance, tariffs influence positively foreign value-added while its detrimental effect is observed on exports of factor content. Likewise, industrialization level is negatively associated with backward participation but the sign turns into positive regarding forward engagement.

4. MODEL SPECIFICATION

Our model specification is based on papers dealing with factors that influence the participation of countries in GVCs (see Cheng & others, 2015; Kowalski et *al.*, 2015; Lopez-Gonzalez, 2016; Tinta, 2017). To do so, we regress the dependent variable on a set of explicative variables as follows:

$$\log(GVC)_{c,s,t} = \beta_0 + \beta_n * \mathrm{X}_{c,t-1} + \mu_c + \lambda_s + \delta_t + \varepsilon_{c,s,t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Here, *GVC* stands for GVC participation (forward and backward linkages) as dependent variable; *X* is the set of explanatory variables; β_0 symbolizes the constant term; β_n (with $n \geq 1$) illustrates the matrix of the coefficients to be estimated; *c*, *s* and *t* denote country, sector and time; μ_c, λ_s and δ_t represent respectively fixed effects for country, sector and time; ϵ is the error term; log is the short form of logarithm.

For the benchmark equation (1), we perform panel ordinary least square with fixed effects as suggested in the literature examining the determinants of GVC participation. According to the empirical studies, simultaneity bias or reverse causation may exist between the dependent variable and some explanatory variables. If so in our study, it is likely to get biased coefficients. Thus, to address the potential endogeneity issues, we follow what most previous researchers have done in the GVC framework by including the lagged explanatory variables[4].

In accordance with the literature of GVC trade, the explanatory variables can be divided into two main groups (see e.g. Cheng et *al.*, 2015; Kowalski et *al.*, 2015; Lopez-Gonzalez, 2016; Tinta, 2017)[5]. The first group is about policy-based factors and for the need of this study we have selected five (5): Tariffs (faced and charged), foreign direct investment, quality of overall

[4] To avoid outliers in the estimated coefficients, we standardize all the variables in conformity with empirical papers of trade in value added. The technique of standardization consists of subtracting the sample mean of each variable from every single value.

[5] Refer to Tables C2 and C3 (Appendix C) respectively for variables description and descriptive statistics.

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infrastructure, institutional quality and access to domestic credit. The second group includes four (4) indicators namely domestic market size, industrialization level, skill intensity and output per worker.

For the robustness check, we use a two stage least squares estimator for panel data. The chosen endogenous variable is access to domestic credit as the measure of financial development. The instrumental variable is the legal origin of countries as suggested in the literature between financial development and international trade (see e.g. Beck, 2003; Hur and others, 2006).

Indeed, the Global Competitiveness index from World Economic Forum establishes an index of market size and its world rank. It goes without saying that these two variables are intrinsically linked and therefore their correlation cannot be equal to zero. In contrast, the rank of market size has no relationship with the participation in GVCs as provided by the GVC index system. In the light of the foregoing, we consider that our instrumental variable is valid.

After performing instrumental variable regression for panel data with country, sector and year fixed effects, we provide two tables (Tables B1 and B2) in appendix B to confirm how close are the robust results to the benchmark ones.

5. BENCHMARK RESULTS

5.1. Country-level results: African landlocked countries versus Non-African landlocked countries

The analysis of Table A1 unveils that tariffs faced impact negatively and significantly the supply side of simple and complex value chains for African landlocked countries most involved in upstream specialization. On the side of Non-African landlocked countries most engaged in downstream production, tariffs faced strongly compress and exclusively the share of simple foreign value added in forward linkage. This empirical result suggests that tariffs faced represent a tremendous obstacle to the involvement in the supply side of value chains. Moreover, its effect is insignificant for economies participating in downstream complex GVCs[6].

The impact of FDI within African countries without ports is highly significant and positive in forward linkage but foreign value added used directly at home is affected negatively. This implies that investments coming from abroad boost domestic value added to exports towards direct and indirect partners but reduce the percentage of foreign value added directly used at home. When it comes to Non-African landlocked countries, FDI has a positive and significant

[6] Tariffs charged impact harmfully but weakly the demand side of complex value chains for Non-African landlocked countries.

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sign on simple GVCs forward and backward. The explanation is as follows: FDI raises the share of domestic and foreign value added consumed in the direct partners. In overall, the pattern of FDI differs between African landlocked countries engaged in upstream activities and Non-African landlocked countries involved in downstream production.

The coefficient associated with access to domestic credit is statistically significant and negative for African and Non-African nations geographically disadvantaged in forward linkage. By contrast, domestic credit impacts positively and significantly the share of foreign value added directly consumed in Non-African landlocked countries while its effect is meaningless in Africa. The finding reveals that domestic banking industry in African landlocked countries does not play a vital role in promoting forward and backward GVC participation. Inversely, Non-African landlocked economies benefit from the support of their local banks in the backward linkage.

The quality of overall infrastructure affects positively and significantly forward linkage concerning African and Non-African landlocked countries. This result suggests that as the quality of overall infrastructure improves, both groups of countries are likely to increase their participation in domestic value added to exports towards direct and indirect trading partners.

Unlike the positive effect of overall infrastructure, we observe that institutional quality tends to shrink the engagement in GVC participation for African and Non-African landlocked countries. Indeed, the average quality of institutions among the sampled landlocked economies is relatively low and therefore represents a barrier to the participation in international fragmentation of production.

The domestic market size, proxied by real GDP, affects in a positive and significant way landlocked countries located in Africa and used in our study particularly in forward linkage. On the other hand, its impact is in overall strongly negative on Non-African landlocked states except for forward complex GVCs. This finding points out that the size of the domestic market is likely to expand trade in value added for countries specializing in upstream activities in contrast to those in the downstream side. Nevertheless, there is an expansion of domestic value added to export involved in complex GVCs among landlocked countries outside of Africa.

The degree of industrialization impacts adversely and significantly African landlocked countries only in forward complex GVCs. With respect to their Non-African counterparts, the effect is prevailed by the positive sign in forward GVC participation. This empirical evidence shows that although the industrialization level is very low, its influence differs depending on countries. In particular, the lower the degree of industrialization the lower the share of domestic value added to exports in complex GVC activities in Africa. For Non-African countries, the industrialization level promotes the engagement in forward simple GVCs.

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The measure of skill intensity is negatively associated with simple participation in forward linkage concerning African landlocked nations. When it comes to Non-African landlocked economies, the impact is positive on forward linkage and backward complex GVCs, but skill intensity influences harmfully the percentage of foreign value added consumed domestically. On the whole, we notice that the higher the percentage of high-skilled workers compared to low-skilled as it is for Non-African landlocked countries the higher the participation in forward GVC.

The productivity per worker is significant only for Non-African landlocked countries. In particular, output per worker affects favorably simple forward and backward linkages. But the positive sign is observed in forward complex GVCs. We may suggest that activities requiring higher productivity are those associated with domestic value added to export towards the direct partners and foreign value added that is entirely used by the direct importer.

5.2. Sector-level results[7]: African landlocked countries versus Non-African landlocked countries

At the sectoral level (Tables A2 & A3), we notice that the distortionary effect of tariffs (faced) in simple and complex GVCs is more pronounced on the three groups of sectors among African landlocked countries compared to sectors within Non-African landlocked states. This result suggests that tariffs in the destination countries and imposed on intermediate goods are mainly distressing for landlocked nations in Africa.

The coefficient associated with FDI affects positively and significantly the three groups of sectors in simple and complex GVCs among African landlocked countries. However, investments coming from abroad impacts in a positive way the primary and tertiary sectors in simple GVCs while the sign turns into negative when it comes to Non-African landlocked countries. This finding implies that countries geographically disadvantaged in Africa are most attractive in terms of FDI relative to Non-African landlocked nations. Additionally, the pattern of FDI is different between sectors of the two groups of countries.

The quality of overall infrastructure influences positively and significantly the sectors (secondary and tertiary) in both groups of countries. This evidence supports the idea according to which that improving infrastructure even within landlocked countries plays a key to promote the participation in value added trade.

[7] We do not present in the section the results of the backward linkage because only very few coefficients are significant. Results are provided on request.

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The quality of institutions has a negative and statistically significant impact on the three groups of sectors only in simple GVCs for African. Meanwhile, institutional quality influences negatively the secondary sector in simple and complex GVCs. Following this result, we understand that the low average value of the rule of law within both groups of landlocked countries is detrimental for their engagement in GVCs.

The measure of access to domestic credit has a harmful effect on the sectoral level participation in simple and complex GVCs within African landlocked countries. With respect to Non-African landlocked countries, the results are meaningless. It goes without saying that the underdevelopment of financial systems in Africa is basically handicapping for their integration in the cross-border production chain.

The size of the domestic market impacts positively and significantly the secondary and tertiary sectors in simple and complex GVCs within African landlocked countries. On the side of Non-African landlocked nations, the domestic market size has a negative effect on the tertiary sector in simple GVCs while the secondary sector in complex GVCs is affected favorably. This finding reveals the influence of the domestic market size is different between the two groups of countries. Its effects are more beneficial for landlocked states located in Africa.

The level of industrialization displays a negative and statistically significant coefficient over the primary sector in simple GVCs and the secondary and tertiary sectors in complex GVCs regarding African landlocked nations. By contrast, the degree of industrialization affects positively and significantly the secondary and tertiary sectors in domestic value added to exports towards the direct partners within Non-African landlocked states. This evidence shows that despite the low level of industrialization within the sampled landlocked countries, the impact is divergent between the two groups of countries but tends to be stimulant for Non-African countries without access to ports.

In simple GVCs, the indicator of skill intensity albeit weakly significant has a negative effect on the secondary sector for African landlocked countries while the coefficient turns into positive on the secondary sector for Non-African landlocked states. The analysis of complex GVCs reveals a statistically significant and positive impact on the secondary and tertiary sectors for Non-African landlocked countries. This implies that the share of domestic value added to export decreases in economies where the percentage of low-skilled workers exceeds the one of high-skilled workers, but it increases in the opposite situation.

The measure of the productivity per worker affects significantly and negatively the secondary sector within African and Non-African landlocked countries respectively in simple and complex

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GVCs. But the tertiary sector is affected positively by output per worker in simple GVCs for Non-African landlocked nations.

6. CONCLUSION

The purpose of this research is to investigate factors influencing the participation in global value chains within landlocked countries. We emphasize the impact of these determinants between African landlocked countries and Non-African landlocked countries. In addition, our study employs the recent GVC indexes developed by Research Institute for Global Value Chains at University of International Business and Economics. The particularity of these data is to split factor content into simple value-added, i.e., directly absorbed by the direct partners, and complex value-added used indirectly by others participants.

The benchmark and robust results are quite similar without any significant difference. Regarding the full sample, it is shown that tariffs, especially those imposed by others partners, impact negatively the export of value-added. Likewise, institutional quality and industrialization level hinder the participation in GVCs. But the effects of access to domestic credit and output per worker depend on the sort of engagement in GVCs. Foreign direct investment, quality of overall infrastructure and skill intensity promote the engagement in forward and backward linkages.

However, a striking divergence is observed when we divide the sample into two groups of countries. The distortionary effect of tariffs is more prominent on African landlocked. In the same vein, institutional quality, access to domestic credit, industrialization level and skill intensity affect adversely the economies in Africa without access to ports. By contrast, the impact on Non-African landlocked nations changes in function of the nature of their involvement in value-added trade. Moreover, we notice that the coefficients associated with structural factors are more significant and positive when it comes to Non-African landlocked economies.

In overall, African landlocked countries are more penalized than their Non-African counterparts. The findings of this research should allow national authorities to conceive and implement not only a new generation of economic policies but also promote infrastructure development that would trigger the engagement in cross-border value chains trade.

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Appendix A: Benchmark results

Table A1: Determinants of forward and backward linkages (African versus Non-African landlocked countries)

variables	African landlocked countries				Non-African landlocked countries			
	forward linkage		backward linkage		forward linkage		backward linkage	
	I	II	III	IV	V	VI	VII	VIII
	Simple GVC	Complex GVC	Simple GVC	Complex GVC	Simple GVC	Complex GVC	Simple GVC	Complex GVC
Tariffs faced (applied weighted mean)	–0.101***	–0.096***	–	–	–0.160***	–0.019	–	–
	(0.027)	(0.014)			(0.042)	(0.015)		
Tariffs charged (applied weighted mean)	–	–	0.002	0.010	–	–	0.032	–0.042*
			(0.015)	(0.011)			(0.026)	(0.024)
Foreign direct investment	0.679***	0.454***	–0.119*	–0.059	0.157***	–0.018	0.026*	0.005
	(0.113)	(0.073)	(0.071)	(0.058)	(0.034)	(0.012)	(0.014)	(0.015)
Quality of overall infrastructure	0.096***	0.055***	–0.009	0.028	0.233***	0.049**	0.032	0.025
	(0.027)	(0.015)	(0.027)	(0.021)	(0.061)	(0.024)	(0.036)	(0.028)
Institutional quality	–0.493***	–0.148*	–0.113	–0.030	–0.241***	–0.060***	–0.080**	0.024
	(0.133)	(0.084)	(0.114)	(0.098)	(0.071)	(0.021)	(0.040)	(0.043)
Access to domestic credit	–0.621***	–0.417***	0.046	–0.120	–0.107**	–0.002	0.089***	0.006
	(0.114)	(0.064)	(0.089)	(0.081)	(0.046)	(0.014)	(0.024)	(0.021)
Domestic market size	0.814**	0.483***	–0.205	–0.053	–0.324**	0.090**	–0.191***	–0.094*
	(0.339)	(0.156)	(0.203)	(0.141)	(0.134)	(0.042)	(0.071)	(0.054)
Industrialization level	–0.002	–0.051***	–0.041	–0.022	0.202***	–0.039*	0.035	–0.006
	(0.051)	(0.019)	(0.028)	(0.025)	(0.062)	(0.022)	(0.025)	(0.022)
Skill intensity	–0.633**	–0.205	–0.047	–0.116	0.446***	0.197***	–0.196***	0.107**
	(0.267)	(0.148)	(0.270)	(0.229)	(0.160)	(0.054)	(0.067)	(0.050)
Output per worker	–0.189	–0.015	–0.035	–0.182	0.478**	–0.278***	0.324***	0.002
	(0.207)	(0.083)	(0.203)	(0.149)	(0.235)	(0.096)	(0.117)	(0.123)
Observations	2408	2408	2408	2408	2107	2107	2107	2107
Number of country-sector groups	344	344	344	344	301	301	301	301
R-squared (overall)	0.68	0.45	0.87	0.88	0.66	0.40	0.86	0.85

Source: The authors' estimates

Note: ***, ** and * denote respectively statistical significance at 1%, 5% and 10% levels. Robust standard errors in parentheses. In the regression, we include country-sector and year fixed effects. Constant estimated but not reported. Policy factors in blue; structural factors in green.

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Table A2: Determinants of forward simple GVCs by sector (African countries versus Non-African countries)

variables	African countries			Non-African countries		
	I	II	III	IV	V	VI
	primary	secondary	tertiary	primary	secondary	tertiary
Tariffs faced (applied weighted mean)	–0.009	–0.143***	–0.102**	–0.119	–0.081	–0.285***
	(0.063)	(0.042)	(0.042)	(0.088)	(0.070)	(0.061)
Foreign direct investment	0.578**	0.618***	0.817***	0.216***	0.071	0.231***
	(0.238)	(0.171)	(0.195)	(0.070)	(0.055)	(0.050)
Quality of overall infrastructure	0.071	0.084*	0.126***	0.026	0.387***	0.164*
	(0.049)	(0.044)	(0.044)	(0.135)	(0.094)	(0.091)
Institutional quality	–0.608**	–0.468**	–0.455**	–0.267	–0.446***	0.033
	(0.295)	(0.215)	(0.206)	(0.165)	(0.120)	(0.104)
Access to domestic credit	–0.566**	–0.662***	–0.601***	–0.179	–0.099	–0.073
	(0.261)	(0.168)	(0.194)	(0.121)	(0.068)	(0.073)
Domestic market size	0.129	1.174**	0.769	–0.004	–0.325	–0.513***
	(0.637)	(0.532)	(0.610)	(0.352)	(0.212)	(0.189)
Industrialization level	–0.157*	0.070	–0.002	0.009	0.334***	0.152*
	(0.090)	(0.084)	(0.081)	(0.142)	(0.102)	(0.083)
Skill intensity	–0.867	–0.862*	–0.204	0.140	0.752***	0.240
	(0.596)	(0.458)	(0.344)	(0.350)	(0.256)	(0.221)
Output per worker	0.072	–0.730**	0.339	0.796	–0.086	1.001***
	(0.353)	(0.292)	(0.407)	(0.486)	(0.382)	(0.367)
Observations	504	1064	840	441	931	735
Number of country-sector groups	72	152	120	63	133	105
R-squared (overall)	0.69	0.68	0.7	0.65	0.67	0.7

Source: The authors' estimates

Note: ***, ** and * denote respectively statistical significance at 1%, 5% and 10% levels. Robust standard errors in parentheses. Constant estimated but not reported. In the regression, we include country-sector and year fixed effects. Policy factors in blue; structural factors in green.

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Table A3: Determinants of forward complex GVCs by sector (African countries versus Non-African countries)

variables	African countries			Non-African countries		
	I	II	III	IV	V	VI
	primary	secondary	tertiary	primary	secondary	tertiary
Tariffs faced (applied weighted mean)	–0.095**	–0.087***	–0.108***	–0.015	–0.005	–0.040*
	(0.038)	(0.018)	(0.022)	(0.026)	(0.026)	(0.021)
Foreign direct investment	0.306**	0.449***	0.551***	0.030	–0.051**	–0.005
	(0.146)	(0.100)	(0.139)	(0.023)	(0.020)	(0.018)
Quality of overall infrastructure	0.045	0.041*	0.080***	0.040	0.089**	0.004
	(0.032)	(0.021)	(0.029)	(0.051)	(0.042)	(0.028)
Institutional quality	–0.102	–0.140	–0.185	–0.054	–0.124***	0.019
	(0.213)	(0.122)	(0.140)	(0.054)	(0.030)	(0.039)
Access to domestic credit	–0.253	–0.478***	–0.437***	–0.038	–0.012	0.033
	(0.157)	(0.094)	(0.105)	(0.037)	(0.018)	(0.024)
Domestic market size	0.529	0.399*	0.562**	0.007	0.206***	–0.006
	(0.338)	(0.228)	(0.275)	(0.094)	(0.068)	(0.061)
Industrialization level	–0.016	–0.056**	–0.066*	0.002	–0.046	–0.056
	(0.040)	(0.027)	(0.037)	(0.025)	(0.034)	(0.042)
Skill intensity	–0.098	–0.294	–0.157	0.147	0.271***	0.134*
	(0.394)	(0.217)	(0.225)	(0.120)	(0.091)	(0.072)
Output per worker	0.142	–0.026	–0.095	0.037	–0.602***	–0.056
	(0.103)	(0.088)	(0.205)	(0.185)	(0.167)	(0.124)
Observations	504	1064	840	441	931	735
Number of country-sector groups	72	152	120	63	133	105
R-squared (overall)	0.39	0.48	0.46	0.48	0.44	0.38

Source: The authors' estimates

Note: ***, ** and * denote respectively statistical significance at 1%, 5% and 10% levels. Robust standard errors in parentheses. Constant estimated but not reported. In the regression, we include country-sector and year fixed effects. Policy factors in blue; structural factors in green.

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Appendix B: Robustness check

Table B1: Determinants of forward and backward linkages (full sample)

variables	forward linkage		backward linkage	
	I	II	III	IV
	Simple GVC	Complex GVC	Simple GVC	Complex GVC
Tariffs faced (applied weighted mean)	–0.140***	–0.082***	–	–
	(0.022)	(0.010)		
Tariffs charged (applied weighted mean)	–	–	0.012	–0.012
			(0.015)	(0.013)
Foreign direct investment	0.127***	0.033***	0.013	–0.018
	(0.027)	(0.013)	(0.019)	(0.016)
Quality of overall infrastructure	0.118***	0.058***	–0.004	0.016
	(0.027)	(0.013)	(0.019)	(0.016)
Institutional quality	–0.183***	–0.014	–0.124***	–0.023
	(0.058)	(0.027)	(0.040)	(0.034)
Access to domestic credit	–0.145***	–0.050***	0.047**	–0.004
	(0.034)	(0.016)	(0.023)	(0.020)
Domestic market size	–0.309	0.142	0.115	–0.101
	(0.227)	(0.106)	(0.157)	(0.133)
Industrialization level	0.045	–0.100***	0.021	–0.008
	(0.039)	(0.018)	(0.027)	(0.023)
Skill intensity	0.432***	0.116***	–0.084	0.143***
	(0.079)	(0.037)	(0.054)	(0.046)
Output per worker	0.419**	–0.157	–0.031	–0.059
	(0.211)	(0.098)	(0.146)	(0.124)
Observations	5117	5117	5117	5117
Number of country-sector groups	731	731	731	731
R-squared (overall)	0.67	0.39	0.88	0.88

Source: The authors' estimates

Note: ***, ** and * denote respectively statistical significance at 1%, 5% and 10% levels. Robust standard errors in parentheses. In the regression, we include country-sector and year fixed effects. Constant estimated but not reported. Policy factors in blue; structural factors in green.

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Table B2: Determinants of forward and backward linkages (African versus Non-African landlocked countries)

variables	African landlocked countries				Non-African landlocked countries			
	forward linkage		backward linkage		forward linkage		backward linkage	
	I	II	III	IV	V	VI	VII	VIII
	Simple GVC	Complex GVC	Simple GVC	Complex GVC	Simple GVC	Complex GVC	Simple GVC	Complex GVC
Tariffs faced (applied weighted mean)	–0.124***	–0.112***	–	–	–0.213***	–0.040**	–	–
	(0.027)	(0.015)			(0.047)	(0.019)		
Tariffs charged (applied weighted mean)	–	–	0.003	0.015	–	–	0.045	–0.051*
			(0.020)	(0.016)			(0.030)	(0.028)
Foreign direct investment	0.772***	0.523***	–0.112	–0.084	0.135***	–0.020	0.022	–0.000
	(0.105)	(0.058)	(0.076)	(0.062)	(0.034)	(0.014)	(0.022)	(0.020)
Quality of overall infrastructure	0.107***	0.063***	–0.009	0.026	0.297***	0.078***	0.012	0.034
	(0.037)	(0.020)	(0.027)	(0.022)	(0.063)	(0.026)	(0.040)	(0.037)
Institutional quality	–0.501***	–0.158**	–0.123	–0.022	–0.024	0.038	–0.148**	0.056
	(0.135)	(0.074)	(0.098)	(0.080)	(0.109)	(0.045)	(0.069)	(0.064)
Access to domestic credit	–0.533***	–0.351***	0.052	–0.144**	–0.052	0.023	0.072**	0.014
	(0.123)	(0.067)	(0.089)	(0.073)	(0.055)	(0.022)	(0.035)	(0.032)
Domestic market size	1.924***	1.329***	–0.067	–0.391	–1.345***	–0.337***	0.089	–0.250
	(0.409)	(0.224)	(0.297)	(0.242)	(0.277)	(0.113)	(0.176)	(0.163)
Industrialization level	–0.043	–0.080**	–0.041	–0.013	0.296***	–0.005	0.016	0.009
	(0.064)	(0.035)	(0.046)	(0.038)	(0.074)	(0.030)	(0.047)	(0.043)
Skill intensity	–0.868***	–0.381**	–0.070	–0.049	0.435***	0.186***	–0.185***	0.107*
	(0.317)	(0.174)	(0.230)	(0.188)	(0.110)	(0.045)	(0.070)	(0.065)
Output per worker	–0.146	–0.002	–0.074	–0.167	1.464***	0.127	0.063	0.154
	(0.280)	(0.154)	(0.203)	(0.166)	(0.339)	(0.138)	(0.215)	(0.200)
Observations	2408	2408	2408	2408	2107	2107	2107	2107
No. of country-sector groups	344	344	344	344	301	301	301	301
R-squared (overall)	0.69	0.41	0.88	0.89	0.66	0.39	0.88	0.86

Source: The authors' estimates

Note: ***, ** and * denote respectively statistical significance at 1%, 5% and 10% levels. Robust standard errors in parentheses. In the regression, we include country-sector and year fixed effects. Constant estimated but not reported. Policy factors in blue; structural factors in green.

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Appendix C: Others tables

Table C1: Sampled landlocked countries (17)

African countries	Non-African countries
1. Botswana	9. Armenia
2. Burkina Faso	10. Azerbaijan
3. Ethiopia	11. Bolivia
4. Malawi	12. Kazakhstan
5. Rwanda	13. Kyrgyzstan
6. Uganda	14. Laos
7. Zambia	15. Mongolia
8. Zimbabwe	16. Nepal
	17. Paraguay

Source: The authors

Table C2: Variables description

variables	description	source
GVC participation indexes	Percentage of engagement in forward and backward value added trade	UIBE-Global Value Chain Indexes database
Production line position index	Position in upstreamness and downstreamness specialization	UIBE-Global Value Chain Indexes database
Tariffs (faced and charged)	Weighted mean applied tariff are, all products (%)	World Development Indicators
Foreign direct investment	Investments coming from abroad, net inflows (% of GDP)	World Development Indicators
Quality of overall infrastructure	Average value of railroad, port & air infrastructures ranging from 1 to 7	Global Competitiveness Index - WEF
Institutional quality	Rule of law ranging from approximately -2.5 to 2.5	World Governance Indicators
Access to domestic credit	Domestic credit to private sector (% of GDP)	World Development Indicators
Domestic market size	Real GDP at constant 2011 national prices (in mil. 2011 US$)	Penn World Table, version 9.0
	GDP (constant 2010 US$)	World Development Indicators
Legal origin of countries	Dummy variable taking 1 if the country belongs to a particular legal origin; 0 otherwise.	LaPorta et *al.* (1999)
Industrialization level	Manufacturing value added (% GDP)	World Development Indicators
High-skilled workers	Employment of workers (male & female) with skill levels 3 and 4 (%)	International Labour Organization (ILO)
Low-skilled workers	Employment of workers (male & female) with skill level 1 (%)	International Labour Organization (ILO)
Skill intensity	High-skilled workers divided by low-skilled workers	
Output per worker	GDP constant 2010 US$	International Labour Organization (ILO)

Source: The authors

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Table C3: Descriptive statistics (full sample)

	Observations	Mean	Std.deviation	Min.	Max.
Total forward GVC	2193	0.20	0.21	0	1
Simple forward GVC	2193	0.12	0.13	0	0.81
Complex forward GVC	2193	0.07	0.09	0	0.83
Total backward GVC	2189	0.26	0.16	0	1
Simple backward GVC	2189	0.11	0.11	0	0.78
Complex backward GVC	2189	0.15	0.17	0	0.98
Policy factors					
Tariffs faced (applied weighted mean)	4687	6.47	4	0.82	16.60
Tariffs charged (applied weighted mean)	5848	6.67	5.06	0.44	30.03
Foreign direct investment	5848	5.21	7.24	–2.5	54.36
Quality of overall infrastructure	3870	3.02	0.82	1.68	4.68
Institutional quality	5848	–0.66	0.52	–1.85	0.7
Access to domestic credit	5203	21.85	13.45	4.56	59.18
Structural factors					
Domestic market size (log) - Real GDP at constant 2011	5848	10.4	0.82	9.07	12.77
Domestic market size (log) - GDP (constant 2010 US$)	5848	23.26	0.84	21.98	25.79
Industrialization level	5805	9.87	3.69	3.99	20.53
Skill intensity	5848	1.4	1.2	0.04	4.55
Output per worker	5848	8.01	1	6.22	9.86

Source: The authors' calculation

Table C4: Sector classification

code	primary	code	secondary	code	tertiary
grn	Grain production	met	Meat and Dairy products	ely	Electricity
ocr	Other crop production	ofd	Food products nec	gdt	Gas manufacture and distribution
ani	Animal hunsbudry	b_t	Beverages and tobacco products	wtr	Water,
pfb	Cotton and wool production	tex	Textiles	cns	Construction
frs	Forestry	wap	Wearing apparel	trd	Trade
fsh	Fishing	lea	Leather products	otp	Other transportation
coa	Coal	lum	Wood products	wtp	Water transportation
oil	Oil and gas	ppp	Paper products publishing	atp	Air transportation
omm	Minerals nec	p_c	Petroleum coal products	cmn	Comunication
		crp	Chemical rubber plastic products	ofi	financial services nec
		nmm	Mineral products nec	ins	insurance
		i_s	Ferrous metals	obs	business services nec
		nfm	Metals nec	ros	recreational and other services
		fmp	Metal products	osg	public admin and defence education health
		mvh	Motor vehicles and parts	dwe	Dwellings
		otn	Transport equipment nec		
		ele	Electronic equipment		
		ome	Machinery and equipment nec		
		omf	Manufactures nec		

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Source: The authors

Note: The classification of the GTAP sectors in primary, secondary and tertiary is made

Table C5: Sectors and codes

number	code	GTAP sectors (GSC2)
1	grn	Grain production
2	ocr	Other crop production
3	ani	Animal hunsbudry
4	pfb	Cotton and wool production
5	frs	Forestry
6	fsh	Fishing
7	coa	Coal
8	oil	Oil and gas
9	omm	Minerals nec
10	met	Meat and Dairy products
11	ofd	Food products nec
12	b_t	Beverages and tobacco products
13	tex	Textiles
14	wap	Wearing apparel
15	lea	Leather products
16	lum	Wood products
17	ppp	Paper products publishing
18	p_c	Petroleum coal products
19	crp	Chemical rubber plastic products
20	nmm	Mineral products nec
21	i_s	Ferrous metals
22	nfm	Metals nec
23	fmp	Metal products
24	mvh	Motor vehicles and parts
25	otn	Transport equipment nec
26	ele	Electronic equipment
27	ome	Machinery and equipment nec
28	omf	Manufactures nec
29	ely	Electricity
30	gdt	Gas manufacture and distribution
31	wtr	Water
32	cns	Construction
33	trd	Trade
34	otp	Other transportation
35	wtp	Water transportation
36	atp	Air transportation
37	cmn	Comunication
38	ofi	financial services nec

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39	ins	insurance
40	obs	business services nec
41	ros	recreational and other services
42	osg	public admin and defence education health
43	dwe	Dwellings

Source: Purdue University and University of International Business and Economics

Note: GTAP stands for Global Trade Analysis Project. GSC denotes GTAP sectoral classification.

Appendix D: Figures

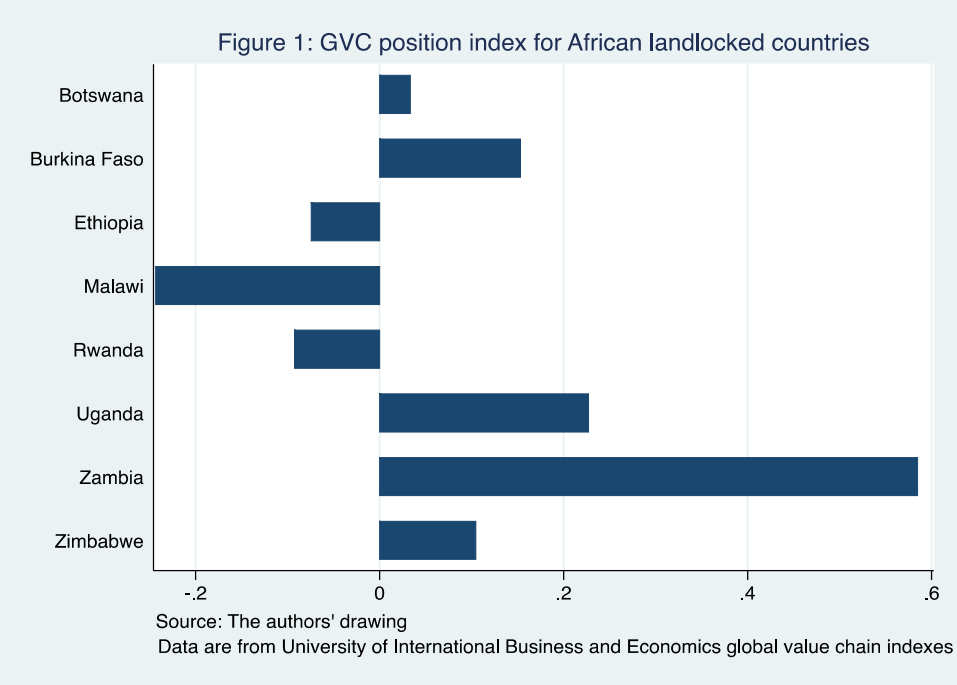

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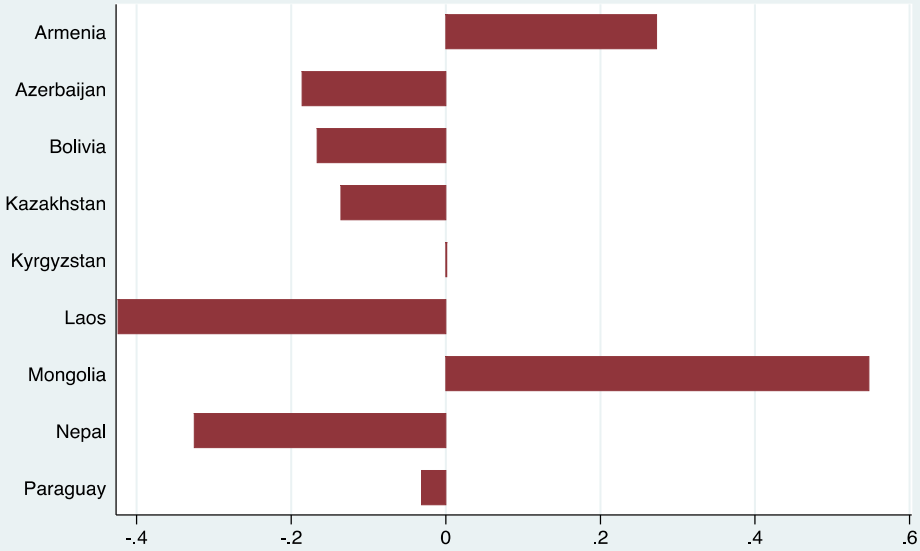
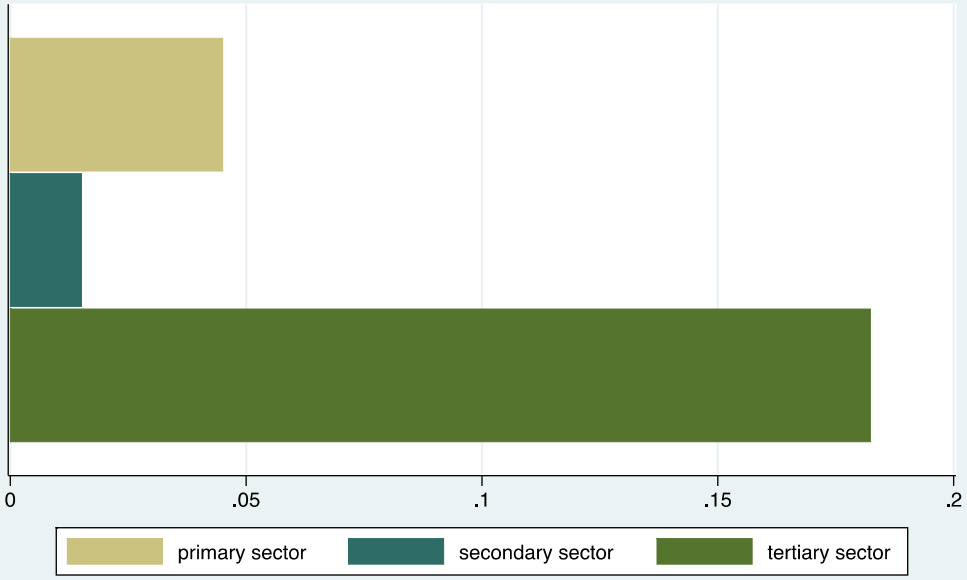
Figure 2: GVC position index for Non-African landlocked countries



Source: The authors' drawing

Data are from University of International Business and Economics global value chain indexes

Figure 3: GVC position index by sector for African landlocked countries



Source: The authors' drawing

Data are from University of International Business and Economics global value chain indexes

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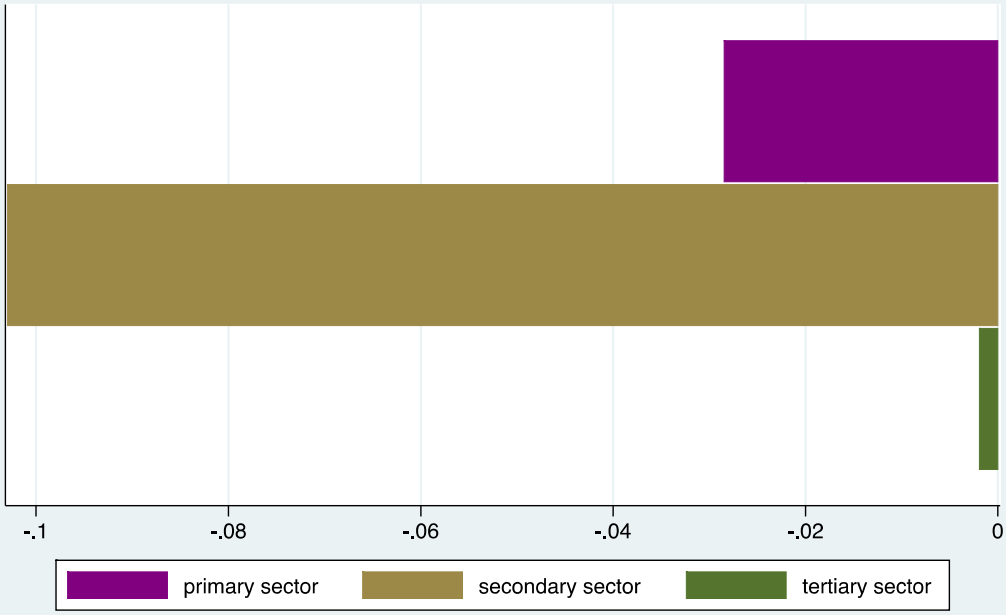
Figure 4: GVC position index by sector for Non-African landlocked countries



Source: The authors' drawing

Data are from University of International Business and Economics global value chain indexes