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Situating Africa in the exports patterns of China's Belt and Road Initiative: A network analysis

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Abstract

This study analytically examines the structure and characteristics of China's Belt and Road Initiative (BRI) and African trade networks by applying network analysis techniques through a critical and in-depth description of the international trade of Eastern African countries as part of the world trade network. Sixty-four countries' trade flow data between 2000 and 2018 from the International Monetary Fund, was used, and the network indices indicate that the BRI significantly enhances the trade network's connectivity. The empirical results indicate that density, the degree of centralization, and average node intensity are typically growing, and China is in the central position of the network. Furthermore, East African intra-regional trade tends to be more densely connected under the BRI. This, in effect, demonstrates that the BRI countries have experienced a rise in intra-regional trade at different levels of economic development. Therefore, this study recommends that policymakers should consider the BRI's critical role in reforming trade policies to build a resilient and sustainable African economy.

1 | INTRODUCTION

A myriad of literature has presented analytical studies on the lasting effect of China's trade with the rest of the Belt and Road Initiative (BRI) members, most notably on Sino-African bilateral trade (Pigato Miria & Tang, 2015). In addition to discussions on the relationship between trade and development, prior researchers have also profoundly reported the geographical patterns of trade based on export destinations' critical roles in determining China's trade pattern and the rest of the BRI countries' development path. This is done by examining the concept of trade holistically (Zhouying et al., 2018). The BRI is a crucial element of China's pragmatic effort in foreign and economic policies. In principle, the motivating factor of the BRI is building an overland network of trading routes to link China to the rest of the globe (Europe, Asia, and East Africa) (Lau et al., 2020). This initiative is seen as a mechanism to improve China's foreign trade, particularly with the BRI route. Various East African countries (notably Burundi, Eritrea, Somalia, Djibouti, Ethiopia, Kenya, Rwanda, Uganda, and Tanzania) constitute an essential and critical part of the BRI. For instance, due to Djibouti's ports, Ethiopia proliferates its manufacturing potential, and the area has marshaled projects to link road, rail, and energy channels for mutual interest (Baniya et al., 2020). This makes it possible for both international and local participants to optimize their mutual gains thereafter. Scholars posit that the BRI development has the capability

to substantially reduce the cost of trade, increase investment and growth, enhance connectivity and also create a sustainable intra-regional trade agreement among members (Yang et al., 2020).

The BRI entails East African nations, including Djibouti, Ethiopia, Egypt, Tanzania, and Kenya, as shown in Figure 1. For infrastructure to play an essential role in China and Africa's economic collaboration, the African Union (AU) and China jointly signed several Memoranda of Understanding (MOUs) in 2015 and 2016. These constitute a cross-continental infrastructural growth of roads, ports, rails, and corridors, which are all among the African Union Agenda 2063s top priorities (Githaiga et al., 2019). East African countries are part of the four groups leading regional economic integration: the East African Community (EAC), the Common Market for Eastern and Southern Africa (COMESA), the Intergovernmental Authority on Development (IGAD), and the Southern African Development Community (SADC) (see AfDB, 2019).

Massive infrastructural development and economic networking are the principal contributions to the framework. Simultaneously, the program has been expanded in scope, with various investment initiatives, people-to-people exchange, logistics facilities, financial support, trade facilitation, and policy cooperation to relieve bottlenecks among the participating countries (Shahriar et al., 2019). In particular, there is still a shortage of cross-border infrastructure and communication growth in Africa; thus, the BRI is deemed as China's most important project for Africa (Z. Wang et al., 2020). For example, the power industry requires US$450 billion to fulfill its 2030 development targets, whereas the oil and natural gas sectors collectively require US$2 trillion to harness the endowment of natural resources (Z. Wang et al., 2020). Moreover, Africa still needs US$37 billion for infrastructure and $38 billion for service and repair per year to maintain its current growth pace (Z. Wang et al., 2020). The BRI genuinely has an immeasurable positive consequence on Africa via the 'China Development Model' for infrastructural development to promote outward investment and exchange (Allou et al., 2020).

The BRI is considered to be very appealing to developing countries for a variety of purposes relative to its advantages. For instance, in the case of Africa, it might fulfill the continent's enormous infrastructure funding needs, which is estimated at US$130–170 billion annually (AfDB, 2018). This is key to the achievement of growth in trade on the continent, international development, industrialization, and economic growth ambitions. The BRI is synonymous with convenient and cost-effective Chinese technology, accessibility to resources and facilities, and improved

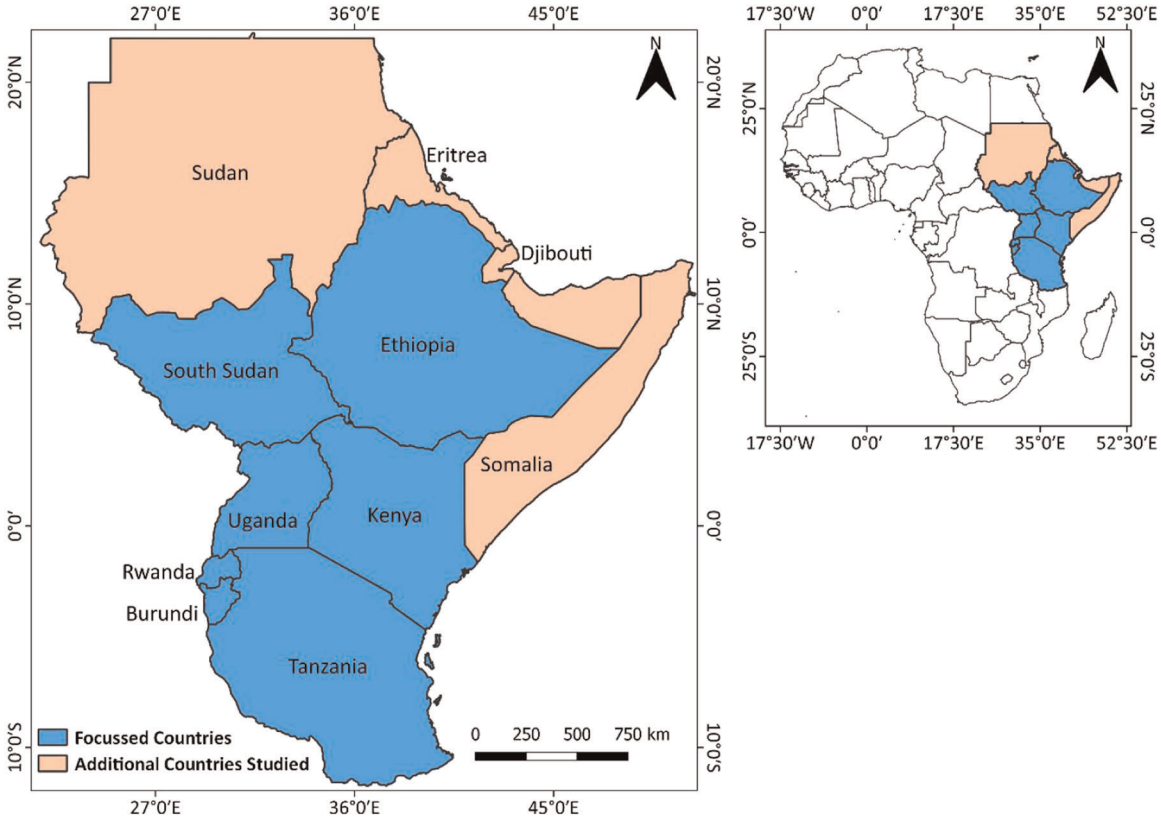

FIGURE 1 Map of East African Community Member States. *Source*: Geographic Information System software QGIS 3.16

infrastructural development. It is also considered to have improved competitiveness for infrastructural programs. Moreover, it has created an avenue for emerging economies to efficiently seek decent economic advantages with Western nations. Furthermore, the BRI has established a management paradigm for China's foreign affairs. According to L. Liu (2020), the BRI is a modern form of global governance and regional cooperation.

Similarly, G. Wang (2017) agreed with this opinion and claimed that the BRI is indeed a conflict resolution system for global countries. Moreover, Chaisse and Matsushita (2018) conducted a thorough study on the BRI program, which has appeared as a core element of China's foreign economic governance since 2013. Lida (2018), for example, claimed that Japan has not been hesitant to accept the BRI; however, Japan's constructive engagement with the BRI seeks to accomplish two diplomatic objectives: to reduce China's impact on BRI-based third world countries and strengthen bilateral ties with China. Critics share a variety of other questions regarding Chinese investment in emerging economies. In the case of Africa, this is perceived as the avenue to increase Africa's debt; lack of transparency and discriminatory (contracting) policies, constraints or lack of technology transfers; and restricted job development of local people, among others (Lisinge, 2020).

There has being a growing interest in the application of network theories, concepts and instruments to international trade analysis in extant literature (Saracco et al., 2016). Against this backdrop, social network method is, therefore, required to better understand the socioeconomic impact of China's trading partnership with Belt and Road economies. From the lens of social network analysis, the BRI countries' trade ties are the dynamic and interconnected networks in the present study. World trading networks have long been analyzed by sociologists, economists, mathematicians, and international relations experts using a network analysis scope (Cepeda-López et al., 2019).

To the best of our knowledge, only a few articles have studied China's transport-related projects and their effect on the BRI in terms of trade networks with a prime focus on Sino-Eastern African bilateral trade. Moreover, none of the existing studies (Jiang et al., 2019; Z. Liu et al., 2018) addressed the burning questions on the BRI trading network formation and the dynamics in the Sino-Eastern Africa bilateral trade network from 2009 to 2018. This, therefore, leaves a gaping hole in prior studies. Thus, the present study is intended to explore the bilateral trade patterns of China and the Eastern Africa sub-region as a whole with an explicit focus on the trade relations across the four regional trading blocs—SADC, EAC, COMESA, and IGAD—by adopting a social network analysis method.

The contributions of this study are threefold. First, we empirically used the networks of international trade, whereby countries are considered as nodes connected through international trade to systematically analyze the bilateral trade patterns of the China–Africa sub-region. Second, the study contributes to the stream of literature on Sino-Eastern African bilateral trade and development. Third, the study presents a comprehensive fact on the BRI in Africa with specific emphasis on trading patterns, including the bulk of SSA (26) nations involved in the initial proposal uncovered in previous studies.

The rest of the paper is structured as follows. Section 2 presents a brief literature review. Section 3 offers the profile of the current BRI/China–Africa trade pattern, its prospects, and the methods/application of the social network analysis concept to China–African trade. Section 4 presents the data set settings and implementation details of the analysis. Section 5 presents the study findings, and Section 6 provides the conclusion aspect of the study.

2 | A BRIEF LITERATURE REVIEW OF NETWORK ANALYSIS TO INTERNATIONAL TRADE

Over the past few decades, economists have viewed international trading as a channel for socioeconomic partnership (Chaney, 2014). From a network viewpoint, the commercial flows of goods and services between two nations can be defined as edges (trade links) relating to two nodes that reflect the two trading partners. By taking into consideration trading flows as a network, we examined the interaction within the nations in the network and the entire network architecture, consistent with prior literature on foreign trade. The earliest studies to use dynamic networks to examine foreign trade are Snyder and Kick (1979) and Smith and White (1992), who analyzed the trade network and explored the global economic framework's structure. The stream of study that accompanied their work examined the evolution, layout, and statistical features of the trade networks (Xu & Cheng, 2016). A seminal study by Rauch and Trindade (2002) demonstrates that ethnic Chinese channels' existence facilitates trading among countries, especially in differentiated products. Although Chaney (2014) focused on the impact of migrant networks on foreign trading, the scale of the impacts, as well as the relative accuracy with which researchers can measure the ethnic proximity between the two nations, illustrate why the study had a significant and enduring effect on the analysis of networks in international

trade. According to Roth and Dakhli (2015), network study aims to assess the attractiveness of a country's location in the regional and world trading framework.

The studies by Snyder and Kick (1979) and Smith and White (1992) support the idea that the network approach provides visibility into any preferential skews that could occur within trading partners. De Benedictis and Tajoli (2011) further used the network approach to analyze the features of foreign trade networks. They demonstrated that the nature of global trading networks ranges across industrial sectors. Some industries' trading flows offer a dense, widespread network with several connections, whereas other industries provide a centralized network. In the same vein, Nguyen and Vallée (2017) employed network analysis to assess ASEAN+3's economic integration properties. The authors proposed that trading and foreign direct investment integration are different amongst the ASEAN+3 member countries from 1990 to 2012.

In the perspective of the BRI, trading networks among the 65 BRI economies have also become a major topic of interest among scholars (Chong & Pan, 2019) with the implementations of the social network, fuzzy analytical network, and consistent subgroups techniques to expose the features of the BRI trading networks (Zhang et al., 2019). For instance, Y. Wang et al. (2020) analyzed spatial-temporal dynamics and the topological frameworks on the development of the BRI exchange network. In particular, the authors examined the community dynamics of the trading networks by employing a community recognition algorithm and subsequently evaluated the various exchange groups' spatial interaction. The results established three trading groups and two subgroups in the BRI trading routes: China, Russia (the sub-center of the largest trade group), and India. On the contrary, Zhang et al. (2019) also used a social network approach to examine the BRI members' structural features and petroleum trade data patterns. The authors found that the critical framework of the trading network remains constant. Coherence and core-peripheral research findings show that China has established a strong partnership with other governments, and fewer nations retain more trading ties although trading is still related to geopolitics. The regional exchange network is, therefore, resilient. Quadratic assignment method findings indicate that efficient scale has a substantial positive effect on trading in these regions. The study further indicated that surrounding nations prefer to develop strong commercial links, and the extent of diplomatic collaboration and coordination between countries needs further reinforcement. Moreover, cultural integration has specific characteristics and, thus, subsequent follow-up partnerships ought to be further intensified.

Other researchers have used sophisticated techniques of network analysis to analyze the BRI trading networks for particular goods (Z. Wang et al., 2020). However, existing research has not paid attention to the BRI trade network's topological structure and its status within the SSA trading network. Trading ties and trade volumes between the BRI countries and the SSA trading systems have not been adequately studied, especially the Eastern African BRI trading network. Overall, current literature indicates that using network analysis to examine foreign trade problems may offer exciting insights. Nevertheless, network analysis methods have often been employed to analyze the trading network architecture at the global level. Therefore, we used network analysis to shed light on the improvement of trading exchange and network structure at the regional level by using the SSA as a case study.

3 | AFRICA-CHINA'S EMERGING TREND OF ECONOMIC ENGAGEMENT

The current Chinese economic projects in Africa usually focused on the export of energy and metals in return for Chinese imported products and the development of infrastructure and the extractive industries by the Chinese Trans National Corporations (TNCs) through Chinese funding. This endowment differential creates the potential for mutually beneficial trade (Kummer-Noormamode, 2014; Schiere et al., 2010). Against this framework, the next section concentrates on the pattern and volume of trade between China and Africa.

3.1 | The Africa–China pattern of trade

In the last 18 years, bilateral trade between China and Africa has steadily increased, as shown in Figure 2. Since the year 2000, China has been positioned as Africa's biggest trading partner. Chinese direct expenditure in loans to African countries has both overstuffed and overgrown (Pigato Miria & Tang, 2015). After the 2008 global financial crisis, China emerged as an alternate market to conventional importers of African goods that had undergone a deep economic

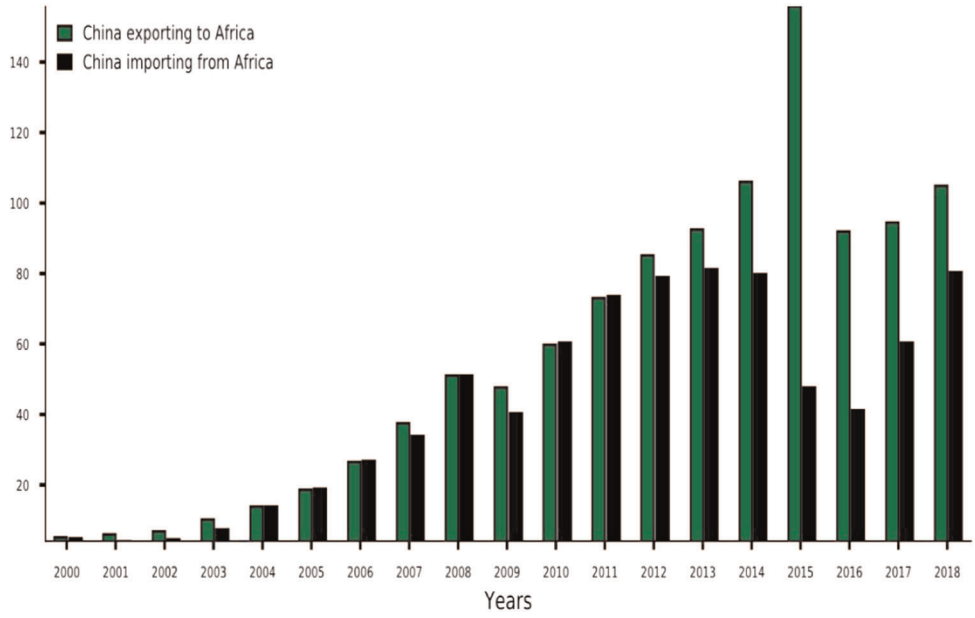

FIGURE 2 China–Africa bilateral trade. *Source*: Authors' computation based on UN-Comtrade data, 2019

downturn. Since then, China has been a primary trading partner for Africa. In 2009, China became Africa's most significant trading partner, exceeding the United States (Geda & Seid, 2015).

In the year 2014, China was the leading importer of products and services from sub-Saharan Africa. This, in effect, translated into the quintupling of exports of raw materials from Africa between 1995 and 2015. According to Xu (2020), the trading level between China and Africa rose astronomically from US$765 million in 1978 to US$170 billion in 2017. This resulted in a transfer of US$10 billion in 2000 and US$198 billion in 2012 (Regissahui et al., 2019). Lau(2020) stated that trade between China and Africa had grown more than once from 1978 to 2017 and translated into an upsurge in trade volumes from US$765 million to US$170 billion. Also, the volume of trade exceeded the monetary value of US$82 billion in the first five months of 2018, with a percentage growth of 17.7 per year.

3.2 | The character of commodities traded between Africa and China

The majority of African imported goods from China are diversified manufactured goods. This dominates the export of goods from China to Africa. On the contrary, most of the exported goods from Africa to China and other BRI countries comprise unprocessed primary commodities (Geda et al., 2018). As demonstrated in Figure 3, sub-Saharan Africa imports more capital assets than other assets. Moreover, African nations have recently earned an outstanding Chinese funding via infrastructural projects that are supported by the BRI (Baniya et al., 2020). As explicitly demonstrated in Figure 4, consumer goods occupy a significant share of China's importation to the SSA countries. The importation of semi-finished goods from China rose from US$5 billion in 2007 to US$9 billion in 2017, hitting a record high of US$11.8 billion in 2013. This indicates the manufacturing sector's outstanding development in sub-Saharan African countries. However, China exports fewer feedstocks from the SSA due to the abundance of raw materials in Africa as a whole.

Figure 3 also demonstrates that the bulk of the exports of SSA countries to China are raw materials (Diaw & Lessoua, 2013). On average, the volume of exported raw materials from sub-Saharan Africa to China has been estimated to be US$30 billion since 2009, and it reached a peak of US$53.7 billion in 2012. Intermediate goods exports also increased from US$1.5 billion in 2007 to about US$4 billion in 2017, peaking at US$4.9 billion in 2013. Consumer and capital goods are at a deficient level. The foregoing indicates the difficulties of African countries to export these goods to China, primarily due to China's competitive advantage regarding capital goods production.

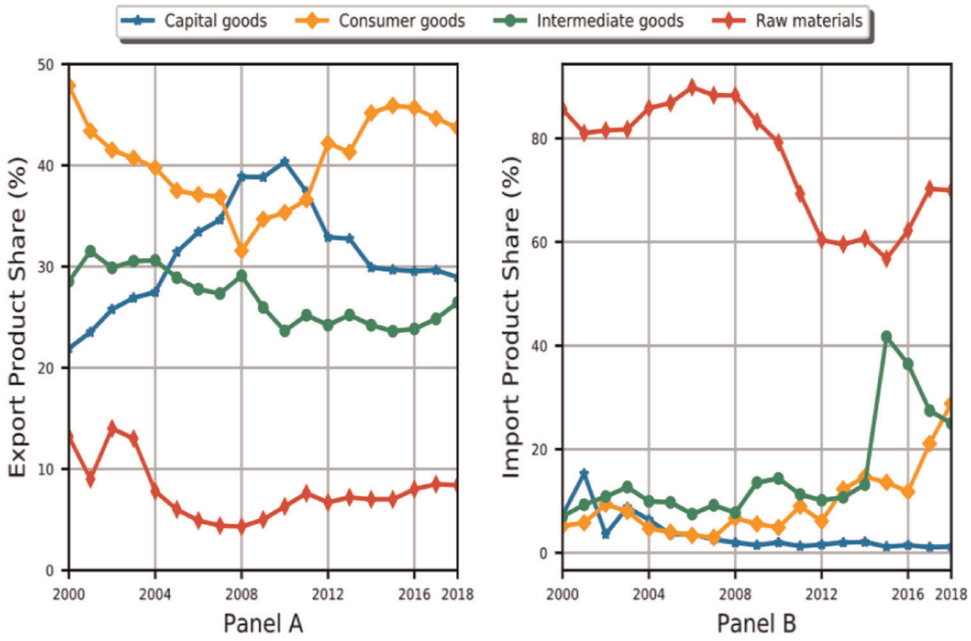

FIGURE 3 Panel (A) and Panel (B) represent sub-Saharan African countries' exports to China and imports from China, respectively, between 2000 and 2018. In Panel (A), the raw material scale was multiplied by 10 to fit into the plot. In Panel (B), the capital and consumer goods scale were also multiplied by 10 to fit in with the plot. *Source*: Authors' computation based on the World Integrated Trade Solution (WITS) database, 2019

4 | STRUCTURE OF AFRICAN NETWORK WITHIN CHINA'S BRI

The BRI was established to facilitate networking along the modern Silk Road in five main fields: policy alignment, access to infrastructure, financial collaboration, trading facilitation, and people-to-people bond (Yang et al., 2020). Trade facilitation is one of the top five priorities of China's BRI. There is no doubt that Africa's relationship with

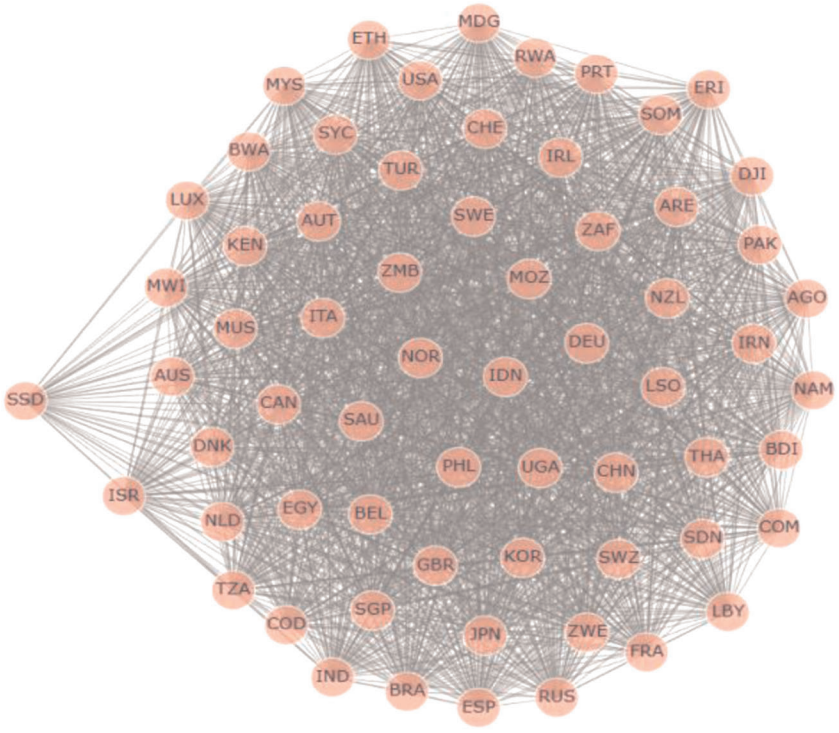

FIGURE 4 Visualization of the BRI trade networks for the period 2009–2018. Link width denotes bilateral trade flows, and node size denotes the country's exports. Full names corresponding to ISO3 country codes are provided in Table 3. BRI: Belt and Road Initiative. *Source*: Authors' computation based on IMF data, 2019

China has strengthened developmental prospects on the continent since 2000 to 2013 (Geda, 2018). Most African countries involved in the process currently have incentive to promote Africa's developmental agenda under the normative priorities of Agenda 2063. The following section focuses on the scientific contributions that put the formation and dynamics of the Eastern African trading network within China's BRI at the center of scholarly debate and the application of network analysis to empirically examine the intercountry export patterns of the BRI neighboring countries.

4.1 | The trade networks data set

From a social network analysis perspective, global commerce includes a network in which the nodes are nations, and the trade relations between these countries are links between nodes or edges (Fagiolo & Schiavo, 2008). As stated by the exporting nation and expressed in US dollars, our trade statistics are the aggregate bilateral exports published in the IMF Trade Statistics Directorate. This happens to be the most commonly used trading database. Thus, it offers details on the global delivery of exports and imports of each country. This is due to the fact that most countries disclose imports in CIF (cost, insurance and freight) values and exports in FOB (free on board) values. The overall world imports reported outweighed that of exports. In the following, we used export data to analyze the network structure (Matevž, 2015). The trading data between the period 2000 and 2018 has been used to examine the structure and the formation of the BRI neighboring countries' trade network within Eastern Africa (Z. Liu et al., 2018). Also, to explore the influence of trade networks from the global financial crisis and the BRI, adjustments were made in the BRI trading networks in 2009 and 2013, as well as 2014 and 2018. The Python software was employed to define some of the basic properties and the development of the BRI trading network from 2009 to 2018.

The study draws upon four primary data sources in Table 1. The core indicators above are detailed below.

Following the seminal contribution of Gui and Du (2019), we used the social network analysis to show the structure of the China–Africa global trade network: degree centrality, closeness centrality, and betweenness centrality.

4.2 | Centrality measures

Degree centrality ($C(\tilde{x})$) implies that the number of edges are connected directly to the node $\tilde{x}$ (Barabási et al., 2016). Thus, the degree of centrality in the network is the number of nations with which i operates. Algebraically,

$$C(\tilde{x}) = \sum_{J=1}^{N} d(\tilde{y}, \tilde{x}) \tag{1}$$

where $d(\tilde{y}, \tilde{x})$ portrays an adjacency matrix, $d(\tilde{y}, \tilde{x}) = 1$ when a tie occurs between nation i and nation j, and $d(\tilde{y}, \tilde{x}) = 0$ otherwise.

Closeness centrality ($CC(\tilde{x})$) of a node is the average length of the shortest path between the node and all other nodes in the graph (Golbeck, 2013). Hence, the more medial a node is, the nearer it is to all other nodes and vice versa. Algebraically, the closeness centrality is expressed as

TABLE 1 Definition and sources of data

Data field	Details	Sources
Bilateral trade	China–Africa bilateral trade	UN-Comtrade, 2019
Exports (Panel A)	African countries export to China	WITS, 2019
Imports (Panel B)	African countries import from China	
Exports networks	China–Africa bilateral exports	IMF Direction of Trade Statistics

Source: Authors' own output.

$$CC(\tilde{x}) = \frac{1}{\Sigma_{\tilde{y}}(d(\tilde{y},\tilde{x}))} \tag{2}$$

where $d(\tilde{y},\tilde{x})$ is the distance between vertices $\tilde{x}$ and $\tilde{y}$.

On the other hand, *betweenness centrality* indicates the number of times a node lies between other nodes on the shortest pathway (Jackson, 2010). In a network, betweenness centrality attempts to measure the number of acts per node as a bridge between two other nodes along the shortest pathway. It is expressed algebraically as

$$CB(\tilde{x}) = \sum_{s\neq\tilde{s}\neq t\in X} \frac{\sigma_{st}(\tilde{x})}{\sigma_{st}} \tag{3}$$

where σ_{st} is the overall number of shortest paths from node s to node t and $\sigma_{st}(\tilde{x})$ is the number of those paths that pass via $\tilde{x}$.

In comparison with the static network studies Zhang et al. (2019), the present study takes a complex view by using 3-year trade flows results, which offer a more comprehensive network structure. The BRI trade network density was 95%, 97%, and 98% in 2000, 2013, and 2018 (see Table 2), respectively. Compared with the year 2000, the trade network density increased by 2.0% and 3.0%, respectively, in 2013 and 2018, after the Belt and Road plan was launched. This suggests that the overall degree of network connectivity of trade between the BRI countries was strengthened dramatically over the years (Yang et al., 2020). In other words, the progression of the China–Africa trade network has the propensity to be more strongly related to shifts in the network density (Z. Wang et al., 2020).

The size of the BRI network grew gradually. The numbers of nodes in Table 2 implies that in the year 2000, 63 countries joined the BRI trade network. By 2018, the number of countries rose to 64, which indicates that the network covered all nations and created a related graph. At the same time, there was a significant increase in the ties between the countries. In 2000, the number of edges was 1860, whereas in 2018 this amount grew to 1962.

However, the network density increased steadily from 0.95 in 2000 to 0.98 in 2018, inferring an exceedingly dense network. On the other hand, during the period under study, the average degree improved significantly from 59.05 to 61.8, implying a notable increase in the average number of members. Network cohesion in the BRI was, therefore, enhanced. Moreover, the average clustering coefficient steadily rose from 0.96 in 2000 to 0.99 in 2018, more extensive than a similar-size random network (0.95–0.98), exhibiting a heavily clustered network. The average path length between 2000 and 2018 declined from 1.048 to 1.038, indicating a narrowing distance network between countries.

The level of decentralization within the network is significant. Three indices (closeness centralization, betweenness centralization, and degree centralization) are moderately high (over 7) and show an upward trend. In particular, the degree of centralization increased from 0.0082 to 0.045 between 2000 and 2018; the centralization of closeness grew from 3.84 to 4.84, and the betweenness centralization grew from 2.33 to 7.68. Overall, the marginal rise in both density

TABLE 2 Topological characteristics of the China–Africa network

Indicators	2000	2013	2018
Nodes	63	64	64
Edges	1860	1952	1962
Density	0.95	0.97	0.98
Average degree	59.05	61.00	61.88
Diameter	2	2	2
Average distance	1.048	1.032	1.038
Average clustering coefficient	0.96	0.98	0.99
Degree centralization	0.0082	0.045	7.97
Betweenness centralization	2.33	0.156	7.68
Closeness centralization	3.84	0.048	4.84

Source: Authors' computation based on IMF data, 2019.

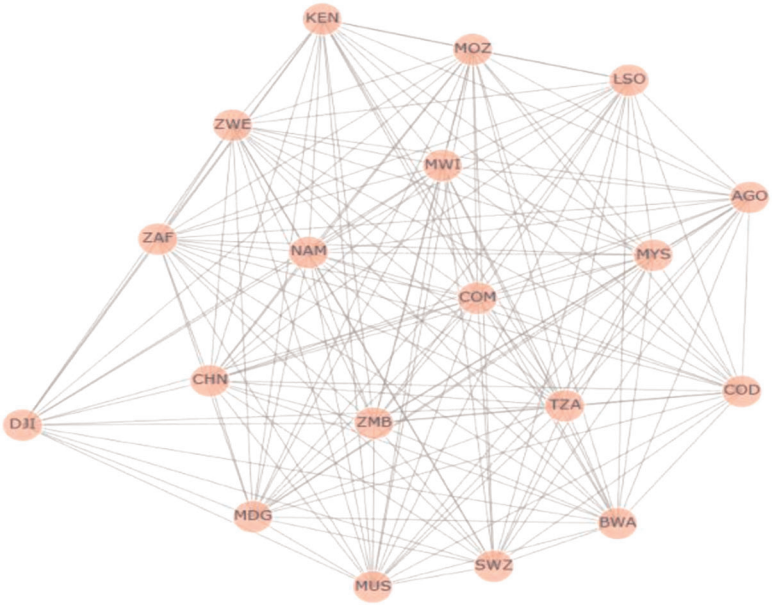

FIGURE 5 The BRI trade networks within SADC, 2009–2018. BRI: Belt and Road Initiative; SADC: Southern African Development Community. *Source*: Authors' computation based on IMF data, 2019

and the degree of centralization of the BRI trading network throughout this period indicates that the BRI members are experiencing a boost in African trade, regional integration, and economic transformation aspirations (Lisinge, 2020).

5 | THE NETWORKS STRUCTURE AND AFRICA IN THE BRI CONTEXT

As demonstrated in Figure 5, in 2009–2018, a close trading network was built between China and the BRI countries. China accounts for the highest number of commercial flows. More importantly, China is positioned as the main trading partner in the BRI exchange network of 64 nations. The whole network can be categorized into four sub-networks: African, Asian, European, and Central/North American, as demonstrated in Figure 4. The Eurasian subnetwork comprising 44 countries is the largest, with the bulk of countries. Figure 5 graphically demonstrates the overall BRI trade networks provided in Table 3. In other words, the BRI trading networks constitute the trading connections of the whole network. Consequently, we based the resulting analysis on the architecture of the subnetwork between China and Africa.

As depicted in Figure 5, the SADC network consists of Southern African countries which happen to be a well-connected trading bloc. This implies that the BRI could provide more momentum to intra-African export than the rest of the world. This also implies that the provision of infrastructure will promote regional reforms to strengthen intra-African trade, as expressed in the African Continental Free Trade Area (AfCFTA). This is consistent with the findings of Lisinge (2020). South Africa, Malawi, Democratic Republic of Congo, Comoros, Zimbabwe, Madagascar, and Namibia are centrally located, whereas Djibouti is considered the most dispersed country in the trade network. Furthermore, South Africa is the largest exporter, as evinced from its strong trade relations in the SADC's intra and extra-regional trading with Lesotho, Zimbabwe, and Namibia, Madagascar, Comoros, Malawi, China, and Mauritius. It is conspicuous that the economy of South Africa is the most developed in Africa. This means that South Africa has an excellent SADC network and export-trade links. The new development would entail several discussions on trade facilitation issues and drawing upon inward FDI for vital integration in this context.

The EAC network (Figure 6) is composed of countries in East Africa. They tend to be interconnected in moderation because each nation has a trade link with at least five of the seven networked countries. Uganda, Tanzania, Rwanda, Kenya, and China are the most centrally located, whereas one of the smaller economies, South Sudan, is the country with the most dispersed network. China, the largest node and the most powerful economy is at the center of the network, exporting to seven countries. In the last 10 years, bilateral trading between China and Eastern Africa has been markedly increased. This indicates that the BRI could promote a sharp rise in intra-regional trade (Z. Wang et al., 2020). China has long maintained outstanding diplomatic ties with East African countries and has ratified cultural cooperation, technological, and economic agreements with almost every Eastern African country (Abegunrin

TABLE 3 Economies covered by this study

	Economy	BRI-region		Economy	BRI-region
1	Angola	SSA	36	Luxembourg	ECS
2	Australia	EAS	37	Madagascar	SSA
3	Austria	ECS	38	Malawi	SSA
4	Belgium	ECS	39	Malaysia	EAC
5	Botswana	SSA	40	Mauritius	SSA
6	Brazil	LCN	41	Mozambique	SSA
7	Burundi	SSA	42	Namibia	SSA
8	Canada	NAC	43	Netherlands	ECS
9	China	EAS	44	New Zealand	EAS
10	Comoros	SSA	45	Norway	ECS
11	Congo, Dem. Rep.	SSA	46	Pakistan	SAS
12	Denmark	ECS	47	Philippines	EAS
13	Djibouti	MEA	48	Portugal	ECS
14	Egypt, Arab Rep.	MEA	49	Russian Federation	ECS
15	Eritrea	SSA	50	Rwanda	SSA
16	Ethiopia	ECS	51	Saudi Arabia	MEA
17	France	ECS	52	Singapore	EAS
18	Germany	EAS	53	Somalia	SSA
19	Hong Kong SAR, China	SAS	54	South Africa	SSA
20	India	EAS	55	South Sudan	SSA
21	Indonesia	MEA	56	Spain	ECS
22	Iran, Islamic Rep.	ECS	57	Sudan	SSA
23	Ireland	MEA	58	Seychelles	SSA
24	Djibouti	MEA	59	Swaziland	SSA
25	Egypt, Arab Rep.	MEA	60	Sweden	ECS
26	Eritrea	SSA	61	Switzerland	ECS
27	Ethiopia	ECS	61	Tanzania	SSA
28	France	ECS	62	Thailand	
29	Israel	ECS	63	Turkey	ECS
30	Italy	EAS	64	Uganda	SSA
31	Japan		65	United Arab Emirates	MEA
32	Kenya	EAS	66	United Kingdom	ECS
33	Korea, Rep.	EAS	67	United States of America	NAC
34	Lesotho	SSA	69	Zambia	SSA
35	Libya	MEA	70	Zimbabwe	SSA

Abbreviations: BRI, Belt and Road Initiative; EAS, East Asia & Pacific; ECS, Europe & Central Asia; MEA, Middle East & North Africa; NAC, North America; SAS, South Asia; SSA, Sub-Saharan Africa.

Source: Authors' own output.

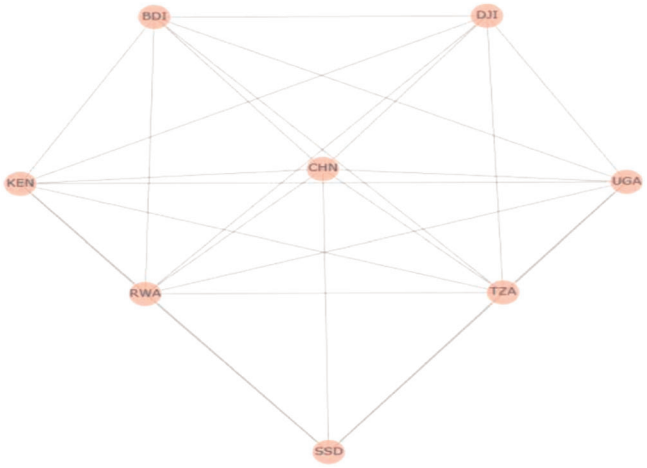

FIGURE 6 The BRI trade networks within EAC, 2009–2018. BRI: Belt and Road Initiative; EAC: East African Community. *Source*: Authors' computation based on IMF data, 2019

& Manyeruke, 2020a). Specifically, China focuses on the promotion of economic growth and state peace by involving East Africa in a global development and communications network which is centered on noninterference and governmental approval framework. China's BRI policy is a panacea and a holistic solution to East Africa's growth and peace (Odgaard, 2018). For instance, the BRI has explained significantly the bilateral trade in SSA (Abegunrin & Manyeruke, 2020b).

In the same vein, Mukwaya and Mold (2019) also demonstrated that the BRI might contribute to a marked rise in intra-regional trading in East Africa. Besides its national priorities and desires, the BRI focuses its systematic strategy on East Africa's historical, economic, political, and institutional identity. The means that to execute this plan involves the construction of physical infrastructure, such as railways, roads, ports, and a harbor (Labuschagne, 2018), which will lead to economic growth (Shahriar et al., 2019). An empirical study in Africa has demonstrated that infrastructural building positively impacts African development and trade (Mukwaya & Mold, 2019). For example, Ndzendze and Monyae (2019) studied the efficiency gains between the BRI and the AU's Agenda 2063. Their findings demonstrated that the BRI had a positive influence on Africa's manufacturing and logistics growth and, by extension, boosted intra-African trading. The key characteristics of the above five networks are verified by the network indicators given in Table 4. The SADC network shows the highest network intensity among the four trading blocs led by COMESA and EAC. Likewise, the clustering coefficient, which is the calculation of the degree to which nodes appear to cluster together within a network, depicts the same results. Based on the ongoing discussion, the SADC is leading while the IGAD is lagging behind. These findings are evident in the visualizations of the network given in Figures 5 and 6. With

TABLE 4 Descriptive statistics of the structure networks

	AFRICA	SADC	EAC	COMESA	IGAD
Number of nodes	32	19	8	24	10
Number of edges	470	166	26	265	37
Average degree	29.375	17.474	6.5	22.083	7.400
Density	0.948	0.971	0.929	0.960	0.822
Average distance	1.052	1.0714	1.056	1.040	1.178
SD distance	1.052	1.0714	1.056	1.040	1.178
Graph diameter	2	2	2	2	2
Number of components	1	1	1	1	1
Clustering coefficient	0.973	0.974	0.940	0.963	0.883

Abbreviations: COMESA, Common Market for Eastern and Southern Africa; EAC, East African Community; IGAD, Intergovernmental Authority on Development; SADC, Southern African Development Community.

Source: Authors' computation based on IMF data, 2019.

regard to countries' integration and connectivity within trading blocs, the COMESA has the lowest average distance with the EAC. However, the IGAD and the SADC have the highest average distance, respectively.

6 | CONCLUSION AND POLICY IMPLICATIONS

This is the first study that offers an analysis on the structure of the BRI and African trading. By employing network analysis, this study provides a new understanding of the BRI trading network's complex developments using a data set of 64 countries relating to the BRI. The network comprises four sub-networks, namely the COMESA SADC, EAC, and IGAD. As the largest subnetwork, this analysis uses the Eastern African subnetwork as an illustration to classify important nations in China's BRI trading networks by utilizing different metrics. In keeping with extant literature, our findings indicate that Eastern African countries that are part of the BRI provide a massive incentive for socioeconomic development on the continent as a whole (Mukwaya & Mold, 2019). The analysis of Eastern African trade within China's BRI offers a clearer picture of African economies' structural transformation cost from the period between 2000 and 2018.

The conclusion from this analysis and its implications are as follows. First, from the features of the whole network layout, compared with the year 2000, the trade network density has risen by 2.0% and 3.0%, respectively, in 2013 and 2018, after the Belt and Road plan was launched, suggesting that the overall degree of network connectivity in trade among the BRI countries has strengthened dramatically over the years. Second, the intra-regional trading network in Eastern Africa is more tightly connected. More importantly, the SADC network shows the highest network intensity among the four trading blocs led by COMESA and EAC. Third, the network on exports demonstrates that China has expanded its involvement and influence in the economic partnership, and its central role has been further consolidated with the introduction of the BRI.

The study has some relevant policy recommendations. First, China's BRI appears to have a strategy to engage with Africa. However, African countries' current state is hindering them from optimizing the BRI trade partnership's economic gains. This implies that African countries need to engage strategically with China for reconsideration of the rules of engagement. African leaders should bargain for new economic partnerships which are anchored on structural transformation and the need to build a resilient and sustainable African economy. Second, the focus needs to be on mitigating the potential effect of trading with China and related funding in the primary commodity sector of land-locked African countries. Third, selected protection and government assistance could be vital to the manufacturing sector.

For this to be actualized, pragmatic and realistic policies through good governance, capacity building, unwavering political will, and an all-inclusive sense of nation-building should be strategically aimed against the backdrop that Africa's market-driven specialization does not skew against its growing economy and development, as well as its structural transformation. The present study has empirically highlighted the growing challenges of Africa and its engagement in the BRI. These challenges are conspicuously motivated by the absence of informed policies. It is strongly believed that the absence of informed policies will eventually birth an unpalatable condition where the trade association with China and the countries of the world through the BRI will not have a meaningful effect on Africa (Anyanwu, 2014; Elu & Price, 2010; Geda, 2018).

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