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INFRASTRUCTURE, INFORMALITY AND TRADE COSTS UNDER THE AFCFTA: A GRAVITY MODEL ANALYSIS OF THE CAMEROON-NIGERIA CORRIDOR

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Abstract:
This paper examines the structural determinants of bilateral trade between Cameroon and Nigeria, within the framework of the African Continental Free Trade Area, with particular emphasis on infrastructure, informality, and trade costs along the Nigeria–Cameroon corridor. Despite geographic proximity, shared borders, and long-standing economic ties, formal trade between the two countries remains significantly below theoretical expectations predicted by the Gravity Model of Trade. Using an augmented gravity model, this study integrates key real-world frictions, namely transport infrastructure deficiencies, regulatory fragmentation between the Economic Community of West African States and the Central African Economic and Monetary Community, and the pervasive role of informal cross-border trade, into the analytical framework. The study further introduces an informality parameter to capture the extent to which unrecorded trade distorts observed trade flows and undermines policy effectiveness. The findings reveal that high trade costs, weak infrastructure, and significant levels of informality jointly explain the persistent gap between potential and observed trade. While AfCFTA provides an institutional platform for enhancing regional integration, its effectiveness is constrained by structural bottlenecks that extend beyond tariff barriers. The study concludes that meaningful trade expansion in the Nigeria–Cameroon corridor requires coordinated investments in infrastructure, digital trade facilitation systems, institutional harmonization, and policies aimed at formalizing informal trade. By advancing a corridor-based analytical framework and explicitly incorporating

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informality into the gravity model, this paper contributes to the literature on intra-African trade and offers policy-relevant insights for optimizing the gains from AfCFTA in structurally constrained environments.

JEL: F15, F13, F14, O18, R42, O55, K42

Keywords: AfCFTA; gravity model of trade; trade costs; infrastructure; informal cross-border trade; Nigeria–Cameroon corridor; regional integration; ECOWAS; CEMAC; trade facilitation; Africa

1. Introduction

1.1 Background to Intra-African Trade

For decades, post-colonial African trade remained heavily linked to former European powers, with little to no intra-African trade. Nonetheless, since the 1960s, Regional Economic Communities (RECs)[ii] were established to foster integration through customs unions, free trade areas and harmonized regulatory frameworks (UNCTAD, 2019). Yet intra-African trade has persistently lagged, accounting for only 15-18% of total trade compared to 60-70% in Europe and Asia (UNCTAD, 2019). In fact, of all the RECs, only SADC has consistently had high levels of regional trade. Indeed, despite their common boundary, ECOWAS and CEMAC have continued to experience high declines in trade volumes, with intra-community trade standing at only 12% of total trade.

The African Continental Free Trade Area (AfCFTA[iii]), launched in 2021, was envisioned to overcome structural barriers such as poor infrastructure, fragmented markets, and limited trade finance, and to raise intra-African trade to 40-50% (UNCTAD, 2019). Despite this lofty ambition, significant heterogeneity persists across African bilateral trade relationships. For instance, since its creation, intra-African trade has remained historically low, accounting for only 16% of Africa's total trade in 2023, compared with around 70% in Europe and 60% in Asia, in the same year. In fact, intra-Africa trade only grew by 3.2% in 2023, a sharp drop from 10.9% in 2022 (African Export-Import Bank [Afreximbank], 2024). Such weak integration is even more striking at the level of specific borders, like that between ECOWAS and CEMAC or Nigeria and Cameroon, which stretches approximately 1,975 kilometers.

Nigeria's bilateral economic relationship with Cameroon dates to pre-colonial times, facilitated by geographic closeness (Funteh, 2015). To foster both countries'

[ii] The Economic Community of West African States (ECOWAS), the East African Community (EAC), the Central African Monetary and Economic Community (CEMAC) and the South African Development Community (SADC),

[iii] African Continental Free Trade Area (AFCFTA) is the African Union's Agenda 2063, flagship project the (AfCFTA) which exists to provide a member-driven road map for achieving sustainable and inclusive development on the continent. Its objective is to create an integrated market for the trade in goods and services, as well as the free movement of people and capital. Particularly, it aims to enable the free flow of goods and services across the continent and boost the trading position of Africa in the global market. As part of its mandate, the AfCFTA is to eliminate trade barriers and boost intra-Africa trade. The Agreement entered into force on 30 May 2019 for the 24 countries that had deposited their instruments of ratification by this date. Start of trading under the AfCFTA.

economic relationship, numerous agreements have been signed since the 1960s, notably covering various aspects of cooperation, movement of goods and people, and trade (Bonchuk & Majuk, 2015), with the expectation to improve formal cross-border trade.

Standard trade theories, like the gravity model (Tinbergen, 1962), state that substantial trade flows should prevail between neighboring economies due to reduced transport costs and geographic proximity. Yet, even under AfCFTA, empirical evidence from the Nigeria–Cameroon corridor reveals the opposite, despite their long border, socio-cultural ties, and multiple bilateral agreements. Between 2019 and 2024, for instance, Nigeria's exports to Cameroon declined at an annualized rate of 20.5%, falling from US$412m to US$131m, while Cameroon's exports to Nigeria only rose modestly, by 19.1%, between 2022 and 2023 (UN Comtrade Database, 2024).

This study, therefore, investigates the modalities through which infrastructure development influences bilateral trade within the Nigeria-Cameroon corridor under AfCFTA and proposes policy recommendations to strengthen regional trade through corridor-based development. By using the gravity model to understand trade costs and infrastructural constraints, the paper contributes to the literature in three key ways: First, unlike key studies on the bilateral trade relationship between Nigeria and Cameroon, (Kouam et al., 2022; Funteh, 2015; and the World Bank, 2013), it provides an empirical and analytical perspective grounded on a five-year post-AfCFTA kickoff context, since January 2021, and comes at least three years after the November 2022 inauguration of a major upgrade of the key Nigeria-Cameroon border crossing at Mfum-Ekok. Secondly, it advances a corridor-based framework for understanding intra-African trade, emphasizing the strategic importance of "integration nodes" between regional blocs. Third, it bridges the gap between theoretical trade models and real-world institutional complexities, particularly in fragile and conflict-affected border regions, while integrating a corridor-level analyses of informal trade to explain trade relations between ECOWAS and CEMAC, within the context of AfCFTA.

The rest of the paper is structured as follows: Section 2 presents some stylized facts and empirical trends in Nigeria-Cameroon trade relations. Section 3 is a review of relevant theoretical and empirical literature. Section 4 presents the methodology of the study while Section 5 provides a theory-driven analyses of AfCFTA-related infrastructure and corridor dynamics. Section 6 then presents the policy implications and conclusion.

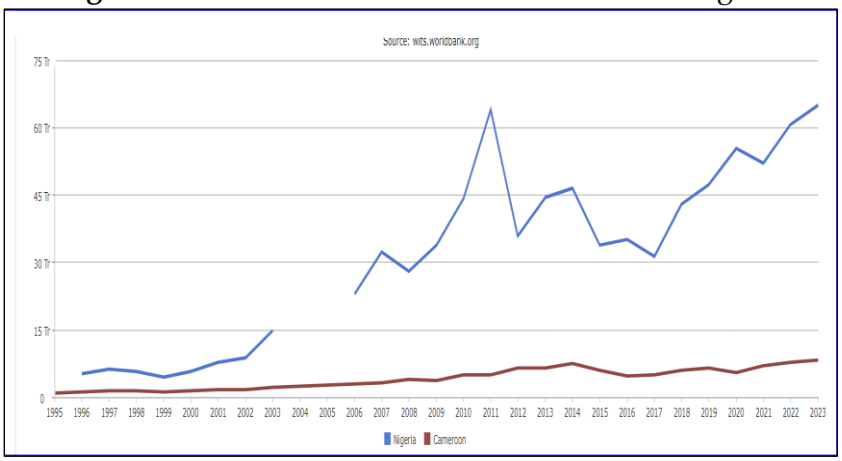
2. Stylised Facts and Trade Patterns in the Nigeria-Cameroon Corridor

Despite geographic proximity and shared borders between Cameroon and Nigeria, formal trade flows have remained limited and structurally imbalanced, as the following stylised facts show.

2.1 Trends and Structure of Bilateral Trade

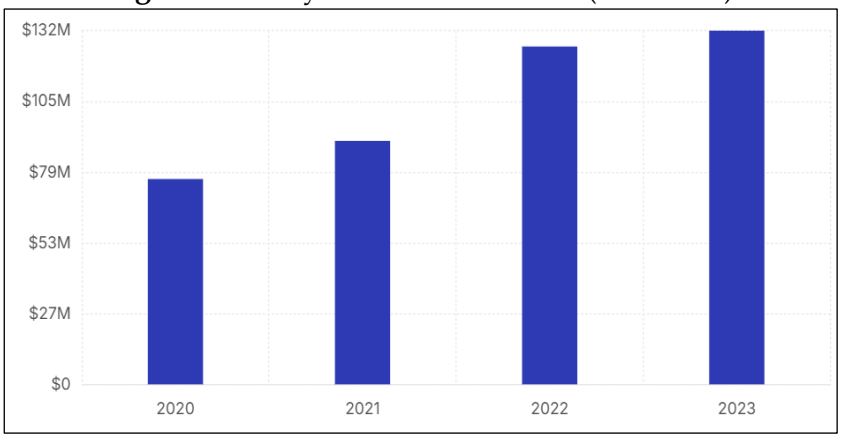
Available trade data indicates a persistent asymmetry in the Nigerian-Cameroon trade relationship, with Nigeria maintaining a dominant export position, reflecting differences in industrial capacity, market size and export diversification. In 2023, for example, bilateral trade between Cameroon and Nigeria exhibited a robust growth trajectory, with a 19.82% growth rate and total trade peaking at US$131.1m in 2023. Notably, the trade balance transitioned from a deficit to near-equilibrium in 2023. In 2024, meanwhile, Nigerian exports to Cameroon were valued at US$131m, while Cameroonian exports to Nigeria earned just US$1.77m (Trading Economics, 2024). Specifically, in the five-year period between 2019 and 2024, Nigerian exports to Cameroon dropped from US$412m to US$131m, whereas Cameroon's exports to Nigeria dropped from US$39m to US$1.56m.

Figure 1: Formal Trade between Cameroon and Nigeria



Source: World Bank Development Indicators (WDI, 2023).

Figure 2: Four-year Trade Overview (2020-2023)

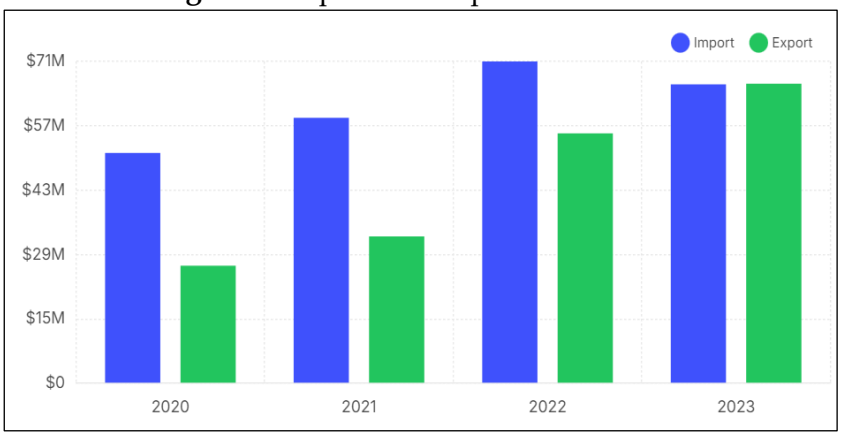


Source: World Bank Development Indicators (WDI, 2023).

Total trade volume between the regions demonstrated consistent growth over the four-year period between 2020 and 2023. Starting at US$76.2m in 2020, the value rose to US$131.1m by 2023. This steady expansion, particularly the sharp increase between 2021

and 2022, highlights a strengthening commercial relationship and increasing market activity.

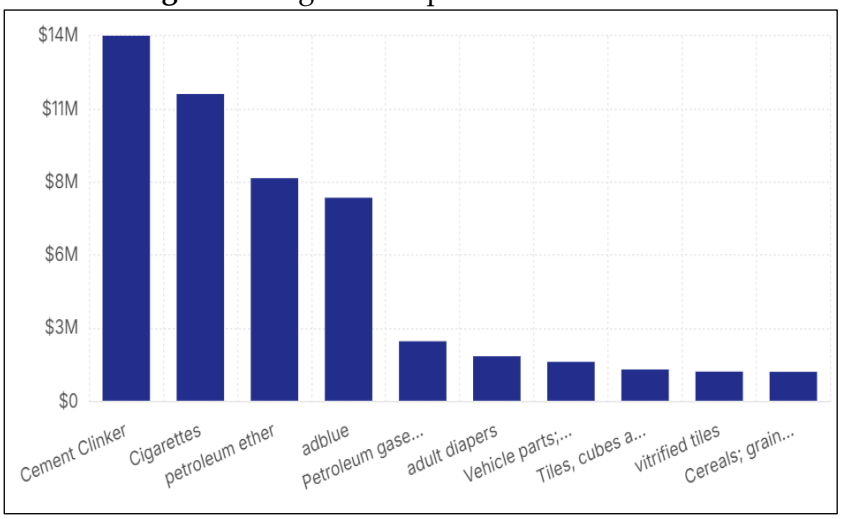
Figure 3: Import and Export Breakdown



Source: World Bank Development Indicators (WDI, 2023).

Trade dynamics have evolved from a significant deficit to near-parity. In 2020, imports (valued at US$50.4m) heavily outweighed exports (valued at US$25.7m). By 2023, exports reached US$65.6m, effectively balancing with US$65.5m in imports. This shift underscores Nigeria's growing export capacity and a more balanced bilateral exchange. The structure of trade is also highly concentrated. For instance, while Nigeria primarily exports manufactured goods, such as cement, fertilizer, footwear and construction materials like ceramic tiles and bricks, as well as used ships, Cameroon's main exports to Nigeria include agricultural goods, such as cocoa, seeds, oils, as well as timber and aluminum, including scrap vessels (OEC, 2026).

Figure 4: Nigeria's imports from Cameroon

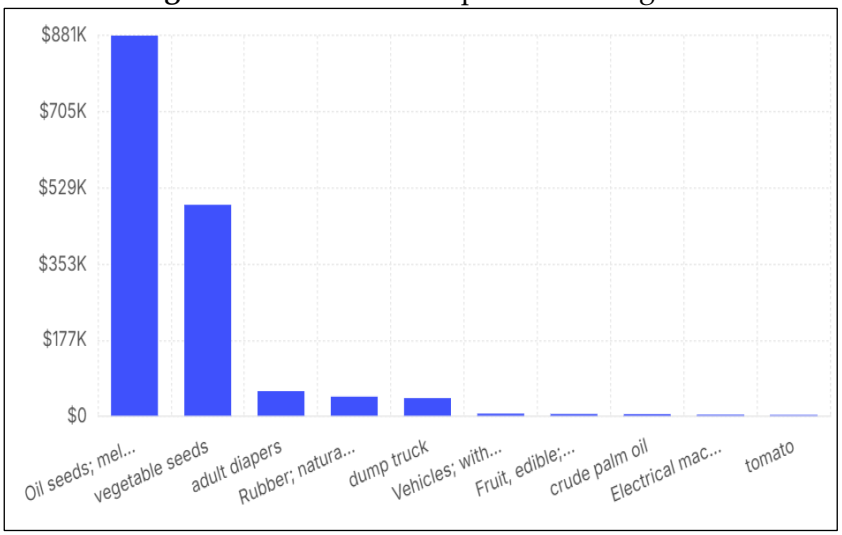


Source: World Bank Development Indicators, 2024.

In 2024, Cameroon's exports to Nigeria were heavily concentrated in the agricultural sector. Oil and melon seeds (valued at US$880,470) and vegetable

seeds (valued at US$489,340) were the primary value drivers. Other significant imports included rubber latex and industrial vehicles, reflecting a mix of raw materials and specialized equipment.

Figure 5: Cameroon's Imports from Nigeria



Source: World Bank Development Indicators (WDI, 2023)

The bilateral market is expanding at a robust growth rate of 19.82%. This double-digit expansion indicates a highly dynamic trading environment and suggests increasing economic integration and commercial opportunities between the two countries and regions. This pattern reflects postulates of classical international trade theories where differences in factor endowments and industrialization levels tend to shape comparative advantage. However, it also reflects deeper structural rigidities that limit the expansion of diversified and high-value trade between the two economies.

2.2 Informal Cross-Border Trade Dynamics

A defining feature of the Nigeria–Cameroon trade relationship is the dominance of Informal Cross-Border Trade (ICBT), that is trade that is not included in a country's, or region's, domestic and international trade statistics (Hummels, 2006). Empirical studies suggest that informal trade flows may exceed formal trade flows by a substantial margin, with under-reporting rates estimated to be as high as 50% in official data (World Bank, 2013). This implies that the true scale of economic exchange between the two countries is significantly larger than recorded statistics suggest.

According to data from Cameroon's National Institute of Statistics (INS, 2024), Nigeria was Cameroon's second-largest informal trade partner that year, accounting for 30.8% of informal trade flows. This is mainly due to the illegal export of cocoa beans, which alone represented 63.9% of informal revenues, or about US$73.3m (FCFA 41.4bn). That figure marks a sharp increase of 145.6% in one year.

2.3 Infrastructure Constraints and Spatial Frictions

2.3.1 Roads and Borders

Infrastructure deficiencies remain a central constraint on bilateral trade along the Nigeria-Cameroon corridor. The primary transport axis linking the two countries, the Bamenda–Enugu corridor, which is part of the Lagos-Mombasa Trans-African Highway, has historically suffered from poor road quality, limited capacity, and security issues, such as the Anglophone Crisis on the Cameroonian side, from Ekok to Mamfe. Recent investments, including the modernization of the Mfum–Ekok border crossing between 2021 and 2022, with a new bridge measuring 408 meters, were made to improve traffic across the border.

Also, the two Northern border crossings between Nigeria's Borno State and Cameroon's Far North Region; the Banki-Mora crossing, which goes through Maiduguri, the Borno State capital, and has been important to regional trade, and the Gamboru-Fotokol crossing, have both been affected by the Boko Haram insurgency, resulting in the latter being closed in 2015 and reopened in 2021.

In addition, Nigeria is constructing a 35-kilometer road linking Taraba State, in Nigeria's North-Eastern region and on the Mambilla Plateau, the Gembu-Mbamnga-Yang Road, which will connect to Donga Mantung, a division in Cameroon's Northwest Region. Construction started on January 13, 2025 and by February 2026 had attained 30% completion. The fact that the road had been previously neglected for 65 years shows renewed commitment by Nigeria to boost trade ties with Cameroon.

2.3.2 Sea Corridors

The major ports connecting Nigeria and Cameroon, on the Cameroonian side, include the busy hub ports of Douala and Kribi, in addition to wharves in Tiko and Limbe. On the Nigerian side, the nearest port is that of Calabar, but there is also traffic from the new Lekki Deep Seaport in Lagos and the Onne Port, near Port Harcourt, in Nigeria's oil-rich Niger Delta region. However, trade by sea between Cameroon and Nigeria mostly passes through the towns of Tiko, Limbe and Idenau, in Cameroon, and Calabar and Oron, in Nigeria. Also, there is only limited bilateral trade through the Douala port, largely because of high customs clearance costs (African Development Bank, 2008) and the fact that Douala is much further away than Tiko, Limbe and Idenau.

On the whole, transport costs in the corridors are disproportionately high, often accounting for a substantial share of the final value of traded goods. Other challenges include delays at border posts, inefficient logistics systems, and inadequate inter-modal transport options, which further increase these costs. So far, most customs posts are not digitalized, and no cross-border railway infrastructure exists, which should eliminate delays, reduce costs and boost bilateral trade flows.

2.4 Security and Political Economy Constraints

Aside from the physical infrastructural challenges, insecurity plays a very significant role in the trade dynamics between Cameroon and Nigeria. On the Nigerian side, the Boko

Haram insurgency in Northern Nigeria has consistently impeded trade volumes along the northern corridors from Maiduguri in Nigeria, to Kousseri or Maroua, in Cameroon. In 2014, for instance, the violent extremist group planned attacks on Cameroon from Banki, a major cross-border trade hub between Cameroon and Nigeria. Consequently, the Amchidé-Banki border post, like several others between Cameroon and Nigeria, was closed by Nigeria. In fact, Boko Haram incursions also led to the closing of the Fotokol-Gambaru border crossing after the 2015 Gamboru battle and attacks on other nearby border posts. The Amchidé-Banki border was reopened in 2019, followed by the Fotokol-Gambaru crossing in 2021 (Institute for Security Studies, 2025).

But Boko Haram has not been defeated and still presents a security threat to both countries. While border reopening has undoubtedly revitalised the regional economy, it has also benefited the insurgents – by allowing them to regroup and target traders and local communities, on the road, and often at night.

The Enugu-Bamenda corridor, which passes through the border between Mfum (in Nigeria's Cross River State) and Ekok (in Cameroon's Southwest Region) through Batibo to Bamenda, on the Cameroonian side, has been marred by insecurity following the Anglophone Crisis that has persisted since 2016, albeit intermittently. The conflict has had significant cross-border effects on Nigeria, particularly in border communities like Ikom, Obanliku, Boki, and Etung Local Government Areas of Cross River State, as well as parts of Benue and Taraba States.

2.5 Implications for AfCFTA-led Integration

From the foregoing, the gap between the objectives of the AfCFTA and the realities on the ground, in the context of the Nigeria-Cameroon corridor, is clearly visible. For instance, AfCFTA aims to reduce tariffs and harmonize trade policies, but non-tariff barriers, infrastructure deficits and institutional weaknesses remain. Also, the dominance of informal trade suggests that formal liberalization alone is insufficient to transform trade patterns. Instead, infrastructure investments, security improvements, trade facilitation and institutional and regulatory reforms are required to unlock the full potential of the corridor.

3. Literature Review

3.1 Theoretical Literature

Trade dynamics along the Nigeria–Cameroon corridor under AfCFTA are backed by classical and modern trade theories. The Heckscher–Ohlin (H-O) framework suggests that countries export goods that intensively use their abundant factors, implying Nigeria's labor-intensive products and Cameroon's resource-based goods could complement each other (Leitão, 2024). Yet, persistent infrastructure deficits distort these predictions by raising transaction costs and limiting factor mobility (Gulseven, 2023). Likewise, described by De Benedictis and Taglioni (2011) as "the workhorse" of international trade, the Gravity Model posits that trade between two countries is

positively related to their country size and by their GDP, and negatively related to the distance separating them (Timbergen, 1962; Anderson, 1979). Indeed, the gravity model of trade has been used in many studies aimed at analyzing bilateral flows of trade and the effects of regional trading arrangements on trade.

3.2 Empirical Literature

Empirical evidence on AfCFTA and corridor trade shows both prospects and constraints for Nigeria and Cameroon. Using the Gravity Model, Letlala and Johnson (2024) show that AfCFTA enhances intra-African trade, but infrastructural bottlenecks along border corridors reduce integration gains, including in COMESA and SADC, as Marinov and Zlatinov (2022) confirm. Amin and Hoppe (2013) investigate cross-border trade between West and Central Africa, using the border countries of Nigeria and Cameroon, and find that Nigeria-Cameroon trade is characterized and hampered by informal payments, corruption and poor infrastructure. Ugwunna et al. (2025) demonstrate that trade logistics and infrastructure are key for diversification, with poor transportation raising costs and weakening competitiveness. Likewise, Eze and Okoro (2023) show that Nigeria's 2019 border closures disrupted corridor flows, illustrating how policy shocks increase trade costs. Similarly, Wahab (2024) found that Nigeria's inefficient transport and ICT infrastructure hinders trade, a finding corroborated, on the Cameroonian side, by Nfor and Tchouassi (2022), citing Cameroon's weak customs infrastructure.

3.3 Research Gaps

Most studies rely on aggregate national data, overlooking corridor-level spatial and infrastructural trade dynamics. Informal trade is rarely integrated into gravity models, leading to underestimation and misinterpretation of flows. Limited research examines how infrastructure, trade costs, and AfCFTA interact within a unified framework. This study fills these gaps by applying an augmented gravity model to the Nigeria–Cameroon context, explicitly incorporating infrastructure and informal trade.

4. Methodology

4.1 Research Design and Analytical Strategy

This study adopts a qualitative, theory-driven research design anchored in an augmented gravity model framework to investigate the determinants of bilateral trade between Nigeria and Cameroon under AfCFTA, a theoretically justified approach, given the complex nature of key variables such as informality, institutional frictions, and security-related trade disruptions. Rather than relying on purely econometric estimations, the study employs an analytical and interpretive strategy that integrates conceptual modelling with empirical observations drawn from policy documents, institutional reports, and sectoral analyses, enabling a deeper understanding of causal mechanisms that cannot be adequately captured through quantitative techniques alone.

The analytical strategy reconstructs the theoretical expectations of bilateral trade flows using the standard and augmented gravity models, systematically maps real-world frictions, including infrastructure deficits, trade costs, and institutional constraints, and interprets the implications of these distortions within the AfCFTA context, thereby linking empirical observations to policy-relevant conclusions.

4.2 Justification for a Qualitative Approach

The choice of a qualitative methodology is because the Nigeria–Cameroon trade corridor is characterized by data limitations, structural informality, and institutional complexity, which significantly constrain the reliability of quantitative analyses.

5. Theory-driven Analyses of Infrastructure and Corridor Dynamics

5.1 The Standard Gravity Model of Trade

The first attempt to give a theoretical basis for gravity models was made by Anderson (1979) using the Armington assumption, where goods are differentiated by country of origin. Applying gravity models to trade was initially criticized as lacking a basis and foundation from trade theory, although the models exhibited high statistical explanatory power (Matyas et al., 2000). The Gravity Model posits that bilateral trade flows between two countries are determined by their economic size and the distance between them. In its basic multiplicative form:

$$Trade_{ij} = G \cdot \frac{GDP_i^{\alpha} \cdot GDP_j^{\beta}}{Distance_{ij}^{\gamma}} \tag{5.1}$$

Where:
$Trade_{ij}$: Trade flow from country i to j
GDP_i, GDP_j: Economic sizes
$Distance_{ij}$: Bilateral distance
G: Constant of proportionality

To improve empirical tractability, the model is typically log-linearized:

$$\ln Trade_{ij} = \alpha_0 + \alpha_1 \ln GDP_i + \alpha_2 \ln GDP_j - \alpha_3 \ln Distance_{ij} + \epsilon_{ij} \tag{5.1.2}$$

Under this formulation, trade is expected to increase with economic size and decrease with distance. Given their proximity and market size, the model predicts relatively high trade flows between Nigeria and Cameroon. However, empirical observations contradict this prediction, showing that additional factors must be incorporated into the model. To account for real-world frictions, the Gravity Model is extended to include trade costs in the section that follows.

5.2 Augmented Gravity Model with Trade Costs

The extended version of the Gravity Model is provided as follows

$$Trade_{ij} = G \cdot \frac{GDP_i^{\alpha} \cdot GDP_j^{\beta}}{Distance_{ij}^{\gamma}} \cdot e^{-\tau_{ij}} \quad (5.2.1)$$

Where:

τ_{ij}: Composite trade cost factor

Trade costs can be decomposed as:

$$\tau_{ij} = f\left(Transport_{ij}, BorderDelays_{ij}, Tariffs_{ij}, NTBs_{ij}, Security_{ij}\right) \quad (5.2.2)$$

Expanding the log-linear form:

$$\ln Trade_{ij} = \alpha_0 + \alpha_1 \ln GDP_i + \alpha_2 \ln GDP_j - \alpha_3 \ln Distance_{ij} - \alpha_4 TradeCosts_{ij} + \epsilon_{ij} \ldots (5.2.3)$$

The above equation presents trade costs as a negative exponential force, reducing trade flows even when economic size and proximity are favorable. This formulation is particularly relevant to the Nigeria–Cameroon trade corridor, where trade costs are perceived to be very high and formal trade remains far below gravity model expectations. Empirical evidence attributes this to weak corridor infrastructure, regulatory frictions between ECOWAS and CEMAC, and the dominance of informal trade, as confirmed by multilateral institutions, including the African Development Bank (AfDB), the World Bank, the International Monetary Fund (IMF), and official government reports.

5.2.1 Structural Determinants of Low Formal Trade

5.2.1.1 Weak Corridor Infrastructure

The 443km Bamenda–Enugu corridor road project (203km in Cameroon and 240km in Nigeria) was designed to facilitate trade in manufactured and agricultural products between Cameroon and Nigeria, by reducing overall transport costs. Supported by the AfDB in 2008, the highway was expected to become a catalyst for regional trade between the CEMAC and ECOWAS regions. Unfortunately, although scheduled for completion in 2013 (African Development Bank Group, 2008), as of 2026, the project has remained unfinished due to repeated delays and funding challenges.

In addition, customs delays at the Ekok–Mfum crossing can extend truck turnaround times to 2–3 days, undermining the corridor's trade facilitation role (World Bank CEMAC Transport Facilitation Project, 2022). In fact, ECOWAS estimates an US$80bn infrastructure gap across West Africa (ECOWAS Commission, 2020), while IMF reports have highlighted severe customs harmonization problems within CEMAC (IMF, CEMAC Regional Economic Outlook, 2023).

These weaknesses explain why geographic proximity has not automatically translated into higher formal trade in the Nigeria-Cameroon corridor. Instead of

benefiting from reduced transport costs, traders face high logistics costs—estimated at 20–30% of product value in Cameroon, compared to 8–10% in OECD countries (Bougna & Noumba Um, 2023). As a result, many traders resort to informal cross-border exchanges, bypassing official customs systems to avoid delays and costs. This erodes state revenue, weakens competitiveness, and undermines AfCFTA's goal of boosting intra-African trade by 52% by 2025 (ECOWAS Commission, 2020).

5.2.2.2 Regulatory Frictions between ECOWAS and CEMAC

Trade between Cameroon and Nigeria is constrained by regulatory and institutional frictions owing to their membership in different regional blocs. Nigeria belongs to the Economic Community of West African States (ECOWAS), which applies the ECOWAS Common External Tariff (CET) and the Community Customs Code, adopted in 2013, to harmonize tariffs across member states (ECOWAS Commission, 2012). Cameroon, by contrast, is a member of the Central African Economic and Monetary Community (CEMAC), which enforces its own CET and customs framework, including VAT harmonization and preferential origin certificates (CEMAC Commission, 2019; IMF, 2023). This separate regional bloc membership creates overlapping tariff regimes and inconsistent enforcement at the Cameroon–Nigeria border, complicating trade flows and raising transaction costs. In fact, the World Bank's Cameroon–Nigeria trade corridor study found that traders face multiple layers of bureaucracy at border posts, including the duplication of documentation requirements and repeated inspections, which inflate costs and delay shipments.

Indeed, not all countries seem to be at the same level of AFCFTA framework implementation, which impedes trade, especially between nations at different levels, like Cameroon and Nigeria. In particular, Kouam (2025), reviewing Cameroon's AfCFTA implementation, cited a case where a fertilizer distributor who previously imported from Ukraine had to switch to Nigeria and import from the Dangote Fertilizer. The import to Cameroon from Nigeria could not take place under AfCFTA because Nigeria has not completed its domestic processes and made available the AfCFTA tariff book at the border, as well as the AfCFTA Certificate of Origin. At this level, formal exchange tends to suffer the same fate, as though AfCFTA did not exist and therefore obstructs smooth corridor trade flows.

5.3 Infrastructure as a Trade-Enhancing Factor

Infrastructure plays a pivotal role in facilitating trade connectivity (Husseini et al., 2024). In the Nigeria–Cameroon context, the most critical forms of infrastructure include transport networks, border facilities, port systems, and digital platforms.

To address Objective (ii), infrastructure is explicitly introduced as a trade-cost-reducing variable within the gravity framework. Infrastructure, therefore, enters the Gravity Model as a trade cost-reducing variable:

$$Trade_{ij} = G \cdot \frac{GDP_i^{\alpha} \cdot GDP_j^{\beta}}{Distance_{ij}^{\gamma}} \cdot Infrastructure_{ij}^{\theta} \cdot e^{-\tau_{ij}} \quad (5.3.1)$$

Where:
$Infrastructure_{ij}$: Quality of transport, logistics, and digital systems,
$\theta > 0$: Elasticity of trade with respect to infrastructure.

The above model reveals that improved infrastructure reduces effective distance and enhances connectivity between Cameroon and Nigeria. Conversely, weak infrastructure increases transport time and costs, thereby reducing trade volumes.

To illustrate how infrastructure operates as a trade-cost-reducing variable in practice, the following subsections examine specific dimensions of Nigeria–Cameroon connectivity, beginning with transport infrastructure.

5.4 Transport Infrastructure

While road networks, such as the Bamenda-Enugu Highway and the under-construction 35-kilometer road between Nigeria's Taraba State and Cameroon's Northwest Region, which runs through the Gembu-Mbamnga-Yang Road, form the backbone of physical connectivity, border facilities and customs procedures equally determine the efficiency of cross-border trade flows.

5.4.1 Border Infrastructure and Customs Delays

In 2022, the construction of the new 408-meter-long Joint Border Bridge and Joint Border Post (JBP) at the Mfum/Ekok border, which connects Nigeria's Cross River State to Cameroon's Southwest Region, was completed and put into operation. Funded by the African Development Bank, the bridge is a major upgrade to the previous single-lane bridge. Also, coupled with the secure checkpoint at the JBP that supports 24-hour operations, the new border infrastructure has the capacity for bigger and more efficient trucks that will greatly reduce delays in customs procedures. As of late 2025, clearance for containerized cargo in Nigeria took about 5 working days. In February 2026, in an effort to eliminate the bureaucratic red tape and bring clearance time down to 48 hours, Nigeria's Customs Service launched a digital One-Stop-Shop (OSS) policy (National Orientation Agency, Nigeria, 2026).

Other factors causing border and customs delays and increasing transport costs between Nigeria and Cameroon are the Anglophone Crisis in Cameroon's English-speaking regions, especially in towns near the border, like Mamfe and Ekok (Attah and Godslove, 2023) and the continued existence of several unofficial border checkpoints (OECD, 2019). Beyond land crossings, maritime gateways play a decisive role in shaping bilateral trade, making port infrastructure a critical component of Nigeria–Cameroon exchange.

5.4.2 Port Infrastructure (Douala and Kribi, and Lagos and Calabar)

Nigeria's port infrastructure is being modernized to improve efficiency and reduce losses, estimated at billions of US dollars (OAL, 2025), through initiatives or deals like the ₦6.43tn (US$4.2bn) PPP approved in December 2025 by Nigeria's government, which covers the Bakassi Deep Seaport in Cross River and the Ondo Deep Seaport in Ondo State, and the £746m (US$998m, or ₦1.38tn) UK-Nigeria deal, signed in March 2026, to develop Lagos ports. The major ports connecting Nigeria and Cameroon, on the Nigerian side, include Calabar, which is the nearest one, as well as the new Lekki Deep Seaport in Lagos, and the Onne Port near Port Harcourt.

Meanwhile, Cameroon's port infrastructure consists mainly of the Port of Douala, which handles over 85% of trade flows into Cameroon and is a major gateway into Central Africa, and the modern Deep Seaport in Kribi, which has been in operation since 2018 and is Central Africa's only deep seaport (International Trade Administration, 2024). In recent years, Cameroon has focused on expanding and modernizing its ports to improve efficiency. For example, on March 19, 2026, the Port Authority of Douala and the Douala Port Railway Investment Company signed a 25-year deal for the modernization and extension of the port area rail network (Business in Cameroon, 2026).

5.5 Digital Infrastructure

To ease congestion and customs delays at its borders, on February 24, 2026, the Nigeria Customs Service (NCS) announced that its new digitalization policy will go into effect in December 2026 (National Orientation Agency, Nigeria, 2026). The new system will see the physical inspection of cargo replaced entirely by digital technologies, including scanning, data analytics and the use of Artificial Intelligence. On its part, on October 2, 2023, to reduce procedural hurdles and customs delays, Cameroon introduced its Single Exit Document system, backed by digital receipts and based on a new Cameroon Customs Information System (CAMCIS) (Business in Cameroon, 2023). Complementing physical transport and port systems, digital technologies are increasingly central to reducing procedural bottlenecks and accelerating clearance processes. Taken together, these infrastructural dimensions converge along the Nigeria–Cameroon trade corridor, where efficiency is ultimately measured in terms of time savings, cost reductions, and the mitigation of bottlenecks.

5.6 Corridor Efficiency (Time, Cost, Bottlenecks)

The Nigeria-Cameroon trade corridor is an important economic and trade corridor in West and Central Africa, because it doubles as the border between West and Central Africa (Amin & Hoppe, 2013) and the two regional trade organizations of ECOWAS and CEMAC.

5.6.1 Time Savings

The Enugu-Bamenda Road corridor, which is part of the Trans-African Highway, in general, and the new Joint Border Bridge and Joint Border Post over the Mfum-Ekok

border, in particular, have greatly improved connectivity and reduced travel time between Nigeria and Cameroon.

5.6.2 Trade Costs

Transportation costs between Nigeria and Cameroon are high. For example, in 2024, ground freight costs were said to have risen by 8-9% (Business in Cameroon, 2024). Bus transportation between the two countries takes about 15 hours and costs roughly US$90. In terms of transporting goods, transportation can take up to 45% of the value of some goods.

5.6.3 Bottlenecks

The main bottlenecks in the Nigeria-Cameroon Trade Corridor include border delays, security issues, and the dominance of informal trade flows. Border delays are mainly due to non-tariff barriers, such as burdensome administrative procedures, numerous security checkpoints and significant differences in regulations.

In fact, after examining how transport and trade-related elements of ICT infrastructure affect bilateral trade flows between Nigeria and its major trading partners, Wahab, B. A. (2024) found that providing substantial transport and ICT infrastructure leads to improvements in trade, while the lack of such infrastructure hinders trade.

5.7 Informal Trade as a Structural Distortion

A key contribution of this study is the explicit incorporation of informal trade into the theoretical framework.

Let:

$$TotalTrade_{ij} = FormalTrade_{ij} + InformalTrade_{ij} \quad (5.7.1)$$

Observed trade data captures only:

$$ObservedTrade_{ij} = FormalTrade_{ij}$$

Thus:

$$ObservedTrade_{ij} < TotalTrade_{ij}$$

We introduce an informality parameter ϕ_{ij}, representing the proportion of trade that is informal:

$$FormalTrade_{ij} = (1 - \phi_{ij}) \cdot TotalTrade_{ij} \ldots\ldots (5.7.2)$$

Substituting into the gravity model:

$$ObservedTrade_{ij} = (1 - \phi_{ij}) \cdot G \cdot \frac{GDP_i^{\alpha} \cdot GDP_j^{\beta}}{Distance_{ij}^{\gamma}} \cdot Infrastructure_{ij}^{\theta} \cdot e^{-\tau_{ij}} \ldots\ldots (5.7.3)$$

Where $0 \leq \phi_{ij} \leq 1$.

Standard gravity models implicitly assume that all trade is formally recorded. However, in many African contexts, a substantial portion of trade occurs outside formal channels. The above formulation shows that higher informality will reduce measured trade, and that informality acts as a measurement distortion and institutional failure. In the Nigeria–Cameroon corridor, high levels of informal trade imply that actual trade flows are underestimated and policy interventions based on formal data may be misguided.

The African Development Bank (AfDB) highlights that informal trade is a defining feature of Cameroon–Nigeria economic relations. In its Cameroon Country Strategy Paper 2023–2028, the AfDB notes that weak transport infrastructure and overlapping customs regimes push traders into informal channels, reducing the effectiveness of formal trade agreements (AfDB, 2023).

5.8 Equilibrium Interpretation and Trade Gap

Combining the above elements, the equilibrium trade level can be expressed as:

$$Trade_{potential} = G \cdot \frac{GDP_i^{\alpha} \cdot GDP_j^{\beta}}{Distance_{ij}^{\gamma}}$$

$$Trade_{observed} = (1 - \phi_{ij}) \cdot Trade_{potential} \cdot e^{-\tau_{ij}} \cdot Infrastructure_{ij}^{\theta} \quad (5.8.1)$$

Thus, the trade gap is:

$$TradeGap_{ij} = Trade_{potential} - Trade_{observed} \quad (5.8.2)$$

This gap is driven by:
High trade costs (τ_{ij})
Weak infrastructure
Informality (ϕ_{ij})

5.8.1 Trade Costs (τ_{ij}) – The Dominant Constraint

In the Nigeria–Cameroon corridor, trade costs are significantly elevated due to non-tariff barriers. These include customs delays, multiple checkpoints, and administrative inefficiencies. Empirical evidence shows that transport and logistics costs in Sub-Saharan Africa can account for up to 40–60% of the final value of goods, making them more binding than tariffs (World Bank, 2020).

In practical terms, this means that even if $GDP_i$and $GDP_j$are large (as in Nigeria's case), the exponential term $e^{-\tau_{ij}}$significantly reduces trade. Thus, high τ_{ij}compresses observed trade, explaining why proximity does not translate into high trade flows.

5.8.2 Infrastructure ($Infrastructure_{ij}$) – Reducing or Amplifying Distance

Infrastructure enters the model as a trade-enhancing elasticity factor **($\theta > 0$)**. However, in the Nigeria–Cameroon corridor, infrastructure remains weak and uneven. Evidence shows that Cameroon's total exports were about US$4.97bn in 2023, reflecting limited trade integration capacity (World Bank, 2024). Poor logistics, port congestion, and weak corridor connectivity reduces the effective value of $Infrastructure_{ij}^{\theta}$.

Additionally, Cameroon acts as a transit hub with large informal and unrecorded trade flows, indicating inefficiencies in formal infrastructure systems (International Trade Administration, 2026). Therefore, weak infrastructure increases effective distance **($Distance_{ij}^{\gamma}$)**, and as such, reduces the expected gains from geographic proximity.

5.8.3 Informality (ϕ_{ij}) – The Hidden Trade Distortion

The informality parameter ϕ_{ij}captures the proportion of trade that is unrecorded. In the Nigeria–Cameroon context, this is particularly significant. For instance, empirical evidence shows that informal trade between Cameroon and neighboring countries reached US$381m (CFA 215bn) in 2024, nearly 88% of formal cross-border trade in the region (Cameroon National Institute of Statistics).

Cameroon's informal sector accounts for about 50% of GDP and 90% of employment. Similarly, Nigeria's statistical authorities confirm that official trade data largely excludes informal cross-border flows, which are substantial (Central Bank of Nigeria; IMF).

By implication, therefore, the model:

$Trade_{observed} = (1 - \phi_{ij}) \cdot (\dots)$ reveals that a high $\phi_{ij} \rightarrow$ large portion of trade is invisible. Therefore, observed trade underestimates actual trade, creating measurement bias, policy misalignments and overall government revenue losses.

5.8.4 Combined Effect: Explaining the Trade Gap

The Nigeria–Cameroon trade gap emerges from the interaction of all three variables:

$$TradeGap_{ij} = f(\tau_{ij}, Infrastructure_{ij}, \phi_{ij})$$

Empirically, high τ_{ij} raises transaction costs, low $Infrastructure_{ij}$ reduces trade efficiency and high ϕ_{ij} hides actual trade flows. Thus:

$$Trade_{observed} \ll Trade_{potential}$$

In conclusion, for Nigeria and Cameroon, the low level of recorded bilateral trade is not due to weak economic fundamentals but rather due to structural trade costs (τ_{ij}) , infrastructure deficiencies ($Infrastructure_{ij}$), and high informality (ϕ_{ij}). These factors jointly distort the Gravity Model outcome, creating a persistent trade gap between theoretical potential and observed reality.

5.9 Theoretical Implications for AfCFTA

Within the framework of the African Continental Free Trade Area, the model yields important insights:

5.9.1 Theoretical Implications for AfCFTA: A Structural Perspective

The extended Gravity Model developed in this study provides a robust analytical lens through which to reinterpret the determinants of intra-African trade under the AfCFTA framework. While AfCFTA is often seen as a tariff-reduction mechanism, the model shows that key trade constraints are structural in nature, including trade costs, infrastructure deficits, informality, and institutional fragmentation. Consequently, AfCFTA's effectiveness depends fundamentally on the extent to which it catalyses broader structural reforms beyond tariff liberalization across ECOWAS-CEMAC borders, with Cameroon and Nigeria as specific trade nodes.

5.9.2 Tariff Liberalization and the Limits of Market Integration

The model's central implication is that tariff reduction alone is insufficient to substantially boost intra-African trade. Although AfCFTA aims to eliminate tariffs on approximately 90% of goods, empirical evidence suggests that tariffs account for only a small share of total trade costs in Africa. According to the World Bank, most potential AfCFTA welfare gains—estimated to reach US$450bn by 2035—will derive from reductions in non-tariff barriers and improvements in trade facilitation, rather than tariff liberalization alone (World Bank, 2020).

5.9.3 Infrastructure as a Binding Constraint on Trade

The model also identifies infrastructure as a critical determinant of trade performance, operating through its effect on reducing effective economic distance. Infrastructure enhances connectivity, reduces transport time, and lowers transaction costs, thereby increasing the elasticity of trade with respect to economic size. Institutional evidence strongly supports this theoretical prediction. The UN's Economic Commission for Africa considers infrastructure deficits as one of the most significant impediments to intra-African trade, as they increase trade costs and limit market access (UNECA, 2021), and they have been found to raise logistics costs, which can account for up to 30–40% of the value of traded goods in some African corridors (AfDB, 2018).

5.9.4 Informality as a Structural Distortion

A distinctive contribution of this study is the explicit incorporation of informal trade into the theoretical framework. Informality represents a structural distortion that reduces observed trade flows, undermines fiscal capacity, and limits the effectiveness of trade policy. Empirical evidence indicates that Informal Cross-Border Trade constitutes a substantial share of total trade in Africa. The African Development Bank notes that high transaction costs, complex regulations, and weak enforcement mechanisms incentivize traders to operate outside formal channels (AfDB, 2019). Similarly, the World Bank

emphasizes that informal trade persists as a rational response to excessive bureaucratic barriers and regulatory inefficiencies (World Bank, 2019). Within the AfCFTA framework, this has important implications. The success of the agreement depends not only on increasing total trade but also on formalizing existing informal trade flows. This requires policy interventions aimed at reducing compliance costs, simplifying customs procedures, and improving the business environment for small-scale traders. Theoretically, reducing the informality parameter (ϕ_ij) increases the proportion of trade captured in official statistics, thereby narrowing the gap between potential and observed trade. This enhances revenue mobilization, improves data accuracy, and strengthens the effectiveness of trade policies.

5.9.5 Institutional Coordination and Trade Facilitation

The model further underscores the importance of institutional coordination in reducing trade costs. Fragmented regulatory systems, inconsistent customs procedures, and weak inter-agency coordination contribute significantly to high transaction costs. The World Bank identifies trade facilitation measures, such as streamlined customs procedures, digitalization, and regulatory harmonization, as critical drivers of trade integration under AfCFTA (World Bank, 2020). Similarly, the WTO Trade Facilitation Agreement highlights the importance of reducing administrative barriers and improving transparency in customs processes (WTO, 2022).

5.9.6 Implications for the Nigeria–Cameroon Corridor

Applying these theoretical insights to the Nigeria–Cameroon corridor reveals that the observed trade paradox is structurally determined. High trade costs, weak infrastructure, pervasive informality, and fragmented institutions collectively offset geographic proximity advantages, but the corridor also presents significant regional integration opportunities. As a strategic link between West and Central Africa, it has the potential to serve as a major trade hub under AfCFTA. Realizing this potential requires targeted interventions aimed at reducing trade costs, improving infrastructure, formalizing informal trade, and strengthening institutional coordination.

6. Policy Recommendations and Conclusion

While AfCFTA's tariff liberalization agenda is important, its real transformative potential lies in its comprehensive institutional framework that can help overcome the core structural trade constraints along the Nigeria–Cameroon border; informality (ϕ_{ij}), high trade costs (τ_{ij}), and weak infrastructure $(Infrastructure_{ij})$, through coordinated policy and institutional reforms. For example, AfCFTA offers a pathway to gradually formalize the highly informal trade between Nigeria and Cameroon by reducing formal market participation costs. Simplified bilateral trade regimes, digital registration platforms, and reduced compliance burdens can incentivize small-scale traders to transition into the formal economy, such as in the very informal agricultural commodities sector. By

integrating these actors into regional value chains, AfCFTA can increase recorded trade flows, improve access to finance, and enhance government revenue without undermining livelihoods.

Reducing the corridor's very high trade costs is also important, through one-stop border posts and digital customs systems, such as Nigeria's emerging electronic clearance platforms, and can greatly reduce clearance times and costs, thereby lowering $\tau_{ij}$and enhancing trade efficiency.

In summary, AfCFTA has the potential to significantly reduce informality, lower trade costs, and improve infrastructure effectiveness in the Nigeria–Cameroon corridor. However, its success depends on the extent to which these complementary reforms are implemented. Without addressing these structural constraints simultaneously, the gap between trade potential and observed trade will persist, limiting the transformative impact of regional integration.

Conflict of Interest Statement
The authors declare no conflicts of interest.

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