

Can Commodity Specialisation Explain the Pattern of Structural Change in Africa? Evidence from Direct and Indirect Transmission Channels

Paul Terna Gbahabo



Transforming Africa's Trade

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This paper examines the long-term consequences of commodity specialisation on structural change by decomposing it into commodity windfall and price effects to estimate their direct and indirect transmission channels. The paper relies on data from 38 African economies from 1970 to 2017. A panel quantile estimator finds the commodity windfall transmission channel to have a direct diminishing effect on tradable and non-tradable sectors. In contrast, real commodity prices mostly depress growth in the tradable sectors. Neither commodity windfall nor prices directly impact the agricultural sector. Additionally—and contrary to the theoretical prediction—the paper reveals that the Dutch disease effect is more pronounced in the non-tradable sectors. It identifies the loss in non-resource commodity export competitiveness and declining commodity terms of trade as significant indirect transmission channels through which commodity specialisation affects structural change. The study recommends diversifying economies—specifically, moving them away from commodity specialisation to avoid destabilising effects and expedite the structural change process in Africa.

Keywords: Structural change; Commodity specialisation; Dutch disease; Africa

JEL Classification: C21; O13; Q33; O47; O55

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Can Commodity Specialisation Explain the Pattern of Structural Change in Africa?

Evidence from Direct and Indirect Transmission Channels

Paul Terna Gbahabo¹

paultg@sun.ac.za

Stellenbosch Business School, Bellville Park Campus
Carl Cronje Drive, Bellville, Cape Town, 7535, South Africa

Abstract

This paper examines the long-term consequences of commodity specialisation on structural change by decomposing it into commodity windfall and price effects to estimate their direct and indirect transmission channels. The paper relies on data from 38 African economies from 1970 to 2017. A panel quantile estimator finds the commodity windfall transmission channel to have a direct diminishing effect on tradable and non-tradable sectors. In contrast, real commodity prices mostly depress growth in the tradable sectors. Neither commodity windfall nor prices directly impact the agricultural sector. Additionally—and contrary to the theoretical prediction—the paper reveals that the Dutch disease effect is more pronounced in the non-tradable sectors. It identifies the loss in non-resource commodity export competitiveness and declining commodity terms of trade as significant indirect transmission channels through which commodity specialisation affects structural change. The study recommends diversifying economies—specifically, moving them away from commodity specialisation to avoid destabilising effects and expedite the structural change process in Africa.

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¹ Corresponding author: Paul Gbahabo at paulgbahabo@gmail.com.

I. INTRODUCTION

This paper investigates the long-term consequences of commodity specialisation as a driver of structural change by decomposing commodity specialisation into commodity windfall and commodity price effects to assess how specialisation, directly and indirectly, affects economic sectors. Commodity windfall refers to unexpected increases in foreign capital inflows due to some exogenous events, such as commodity price booms or a significant mineral discovery, rather than planned production decisions (Michaels 2010). In contrast, commodity prices refer to the export prices of natural resources, including energy resources such as coal, crude oil, and natural gas, as well as base and precious metals, such as aluminium, zinc, copper, nickel, gold, and silver (Bain 2013). Commodity prices are determined by global supply and demand factors, including production costs, technology, and other supply constraints (Kilian 2008; Bain 2013).

Structural change—the reallocation of productive factors and outputs across various economic sectors—has long been recognised as a key aspect of economic development. However, the forces driving this process remain debated (Nickell et al. 2008; Herrendorf et al. 2014). With a wealth of economic literature highlighting the connection between structural change and inclusive growth, dating back to the seminal works of Lewis (1954) and Kuznets (1955), it is increasingly important to identify the specific drivers of structural change. Understanding the idiosyncratic role of each driving force is pertinent to policy implications.

Trade specialisation is but one of several theoretical explanations of structural change patterns. The trade specialisation hypothesis suggests that comparative advantages are a fundamental driving force of structural change (Herrendorf et al. 2014; Dauth et al. 2017). However, empirical observations often appear at odds with some structural change theories. For instance, given that the relative price hypothesis emphasises technological differences as a theoretical basis for cross-country variation in structural change patterns, countries at a similar technological frontier should, in principle, exhibit identical patterns of structural change. However, the reality could not have been further from expectations. Consider that, in 2022, the Japanese and U.S. economies had similar competitive industrial performance index scores, averaging 0.28 and 0.29, respectively. However, the Japanese economy was ranked 9th-most industrialised in the world, with an index value of 0.55, while the United States was ranked 39th-most industrialized, with an index value of 0.36, according to United Nations Industrial Development Organization’s 2024 Competitive Industrial Performance data. Even similar exposure to globalisation often results in distinct patterns of structural change in different countries, as highlighted in the contrast between the United States and Germany by Dauth et al. (2017).

Using the Dutch disease hypothesis, this paper examines the role of commodity specialisation as an explanation for cross-country variation in structural change patterns.² The Dutch disease hypothesis is an empirical regularity common to commodity-dependent economies, especially developing economies, which suggests an inverse relationship between the discovery of natural resources or a boom in commodity prices and the output growth of the non-resource tradable sector (manufacturing and agriculture). Real exchange rate appreciation, a boom in the non-tradable sector

² Despite subtle conceptual differences, the literature often uses the Dutch disease and natural resource curse terms interchangeably to describe the damaging effects of commodity specialisation and dependency on non-resource sector growth, particularly economic growth, through myriad transmission channels (Sala-i-Martin and Subramanian 2013)

(construction and services sectors), and a lagging non-resource tradable sector often accompany the phenomenon (Corden and Neary 1982). Given that commodities accounted for approximately 78.63% of Africa's total merchandise exports between 2021 and 2023, to what extent can the Dutch Disease hypothesis explain the observed variations in structural change across countries in the region??

The Dutch disease hypothesis seems plausible, in part, because it directly links Africa's commodity specialisation and natural resource dependence to the observed pattern of structural change on the continent. Notwithstanding the hypothesis's direct relevance, the empirical evidence on the structural implications of commodity specialisation within the context of Africa is scanty. The vast majority of this literature is cross-country studies with a global focus (see Kuralbayeva and Stefanski 2013; James 2015; Gerelmaa and Kotani 2016; McGregor 2017; Amiri et al. 2019 for global panel studies) and country-specific panel studies focusing on North American economies (see Marchand and Weber 2017 for a survey of North American studies) and a few other regions (see Looney 1990 for Saudi Arabia; Sachs and Warner 1999 for Latin America; Apergis et al. 2014 for the Middle East and North Africa; and Fleming and Measham 2014a,b for Australia).

Notable exceptions include Dorinet et al. (2021) and Kaba et al. (2022), which focus on Sub-Saharan African economies. Dorinet et al. (2021) explored the impact of commodity prices on agricultural productivity and manufacturing value-added growth, revealing that commodity price fluctuations hinder structural change. In contrast, Kaba et al. (2022) examined how structural change affects trade, finding that while commodity exports impeded structural change, manufactured exports facilitated a shift from agriculture value addition to manufacturing. However, neither study decomposed commodity specialisation into windfall and price effects to analyse the direct transmission channels and crowding-out hypotheses. Additionally, they did not assess the effects of Dutch disease at various levels of disaggregation, which the current study addresses.

Given the dearth of empirical studies on the long-term consequences of commodity specialisation on structural change in Africa, the current study attempts to contribute to the literature on commodity specialisation within the context of Africa. It appears to be the first to decompose commodity specialisation effects into commodity windfall and price effects to estimate the effect of commodity specialisation's direct and indirect transmission channels on structural change in Africa at various levels of disaggregation.³ Decomposition of these effects will help policymakers understand transmission channels.

The paper is organized as follows: Section 2 reviews theories of commodity specialisation and structural change. Section 3 reviews indirect transmission channels. Section 4 reviews the empirical literature on commodity specialisation and structural change. Section 5 discusses the data and research design. Sections 6 analyses the results. Section 7 presents policy implications.

2. THEORIES OF COMMODITY SPECIALISATION AND STRUCTURAL CHANGE

The two primary theories addressing the effects of long-term specialisation in commodity exports are the Dutch disease and the Prebisch-Singer hypotheses (Singer 1950; Prebisch 1950; Corden and Neary 1982). The Dutch disease theory examines the negative impact of commodity specialisation

³ In this paper, "decomposition" is used as an analytical framework to dissect the manifestation of commodity specialisation into its fundamental components. This approach enables an understanding of each component's contribution to the phenomenon's overall structure, function, and behaviour, providing valuable insights for policy development.

on structural reallocation of economic activities via commodity windfalls and price volatility. In contrast, the Prebisch-Singer hypothesis focuses on the deteriorating terms of trade as the mechanism through which trade specialisation patterns affect structural change. These theories provide a theoretical framework for analysing the relationship between commodity specialisation and structural change.

2.1 Dutch Disease Theory

Dutch disease theory suggests that the discovery of natural resources or a boom in commodity prices can stifle growth in tradable sectors, especially in commodity-dependent economies (Corden and Neary 1982). This phenomenon often leads to the reallocation of economic activity from productive tradable to non-tradable sectors, causing stagnation in tradable industries. Palma (2014) offers an alternative interpretation, arguing that the Dutch disease induces countries to shift their focus from generating trade surpluses in manufactured goods to prioritising those from commodity exports after discovering natural resource wealth. The three major components of the Dutch disease theory are the commodity windfall effect, the commodity price volatility effect, and factor reallocation.

2.1.1 Commodity Windfall Spending Effects

Commodity windfall and subsequent spending lead to excessive allocation of commodity revenues to final consumption, which particularly benefits non-tradable sectors such as construction and services. This sudden infusion of large capital funds into the domestic economy results in a boom in non-tradable sectors, ultimately constraining the tradable sectors, such as manufacturing and agriculture. While sustained high commodity prices drive the initial boom, aggregate demand stemming from the resource windfall fuel the growth in non-tradable sectors. This imbalance leads to higher wages and rising consumer prices in the construction and services sectors, resulting in real currency appreciation and loss of competitiveness in the tradable manufacturing sector. The result can be stagnation in the tradable manufacturing sector or even premature de-industrialization (Corden and Neary 1982; Sachs and Warner 1999).

2.1.2 Commodity Price Volatility Effects

Commodity price volatility has profound implications for the growth of economies (De V. Cavalcanti et al. 2015). This volatility impacts economies through both direct and indirect channels. Directly, it creates aggregate demand and supply shocks that strain budgetary constraints and induce real business cycles. Indirectly, it drives factor reallocation and generates uncertainty for businesses, affecting their investment, spending, and savings decisions (Van der Ploeg and Poelhekke, 2009).

Additionally, commodity price shocks can trigger fluctuations in exchange and interest rates, hindering productivity and innovation. Over time, these dynamics can lead to diminished capital accumulation and de-industrialization. Thus, the effects of commodity price volatility are substantial for both developed and developing economies (Kilian 2008, 2014).

2.1.3 Factor Reallocation Effect

The factor reallocation effect plays a crucial role during commodity booms by enhancing marginal productivity in booming commodity sectors such as mining and cash crops while stimulating demand in non-tradable construction and service sectors. These dynamics prompt a shift of

labour and capital from the tradable sectors such as manufacturing (Corden and Neary 1982). As commodity booms elevate wages and prices in the commodity sector, they attract resources away from the tradable manufacturing sector, inducing a "cost disease." A phenomenon which occurs when similar wage costs in a highly productive sector manifest in a lower productive sector (Gylfason 2001).

2.2 Prebisch-Singer Hypothesis

The Prebisch-Singer hypothesis suggests that developing countries specialising in commodity exports experience declining living standards due to a persistent deterioration in commodity terms of trade relative to manufactured goods (Singer 1950; Prebisch 1950). This decline in commodity terms of trade stems from a drop in the income elasticity of demand for commodity goods, causing commodity prices to rise less proportionately during market upswings, and large productivity gaps between commodity producers in developing countries and manufacturing producers in industrial countries (Hadass and Williamson 2003; Harvey et al. 2010). The secular decline in commodity terms of trade in commodity-dependent developing economies is associated with a slower pace of structural change, due to the resultant slower pace of capital accumulation. A spike in terms of trade in an economy is linked to productivity growth and per capita income growth (Deaton and Miller 1995; Blattman et al. 2007).

Mathematically, the Prebisch-Singer hypothesis can be modelled using the following trend stationary (TS) approach:

$$Y_t = \alpha + \beta t + \mu_t, t = 1 \dots T \quad (1)$$

where Y_t denotes the log series of commodity terms of trade, t indicates the time trend, and μ_t denotes the error term. The β parameter denotes the average compound rate of improvement of the commodity terms of trade ($\beta > 0$) or deterioration ($\beta < 0$).

3. TRANSMISSION CHANNELS

3.1 Real Exchange Rate Appreciation

Dutch disease is characterised by real effective exchange rate appreciation linked to a booming domestic sector, which can adversely affect export-oriented industries, particularly manufacturing (Corden and Neary 1982). The discovery of natural resources or rising commodity prices can increase revenue, causing higher prices and wages in non-tradable sectors than in tradable sectors. This spike in local prices results in real exchange rate appreciation, undermining the competitiveness of tradable sectors (Corden and Neary 1982; Gylfason 2001). As non-tradable sector prices rise relative to tradable sector prices, the real exchange rate can become overvalued, stifling investment in tradable industries. Conversely, a decline in non-tradable sector prices relative to tradable sector prices promotes real exchange rate undervaluation, which fosters investment and boosts export-oriented growth (Rodrik 2008; Campbell 2020).

3.2 Trade

The trade effects of the Dutch disease typically manifest in two fundamental ways. First, commodity windfalls during episodes of commodity price booms induce commodity specialisation by shifting the export composition of an economy away from manufacturing and tradable services with adverse changes in the structural composition of the economy (Gylfason 2001). Second,

the deteriorating commodity terms of trade reduces overall export revenue and diminishes competitiveness in non-commodity sectors such as manufacturing (Gylfason 2001; Papyrakis and Gerlagh 2004).

3.3 Investment

The crowding-out effects of capital investments stemming from commodity specialisation have been widely reported as a crucial mechanism through which Dutch disease impedes structural change (Papyrakis and Gerlagh 2004, 2007; Gylfason and Zoega 2006). These crowding-out effects arise from the frequent revenue surges linked to commodity windfalls, discouraging savings and investment in commodity-dependent economies (Gylfason and Zoega 2006; Papyrakis and Gerlagh 2006). Additionally, the inherent volatility of commodity prices creates macroeconomic instability and uncertainty, further deterring investment in these economies (Gylfason and Zoega 2006; Papyrakis and Gerlagh 2006).

3.4 Education

The Dutch disease can negatively impact human capital accumulation through two main mechanisms. First, a focus on exporting low-skilled and low-tech agricultural products, along with energy and mineral resources, discourages investment in the human capital needed for high-tech manufacturing and service sectors in commodity-dependent economies (Matsuyama 1992; Gylfason 2001; Papyrakis and Gerlagh 2006). Second, resource abundance often leads to weak government institutions and misaligned policy priorities, resulting in inadequate physical and human capital investment because current expenditures take precedence (Papyrakis and Gerlagh 2006).

4. EMPIRICAL LITERATURE

The empirical evidence on commodity specialisation and the Dutch disease hypothesis is diverse and often analysed at different levels of disaggregation and according to different transmission channels (Van der Ploeg and Poelhekke 2017; Marchand and Weber 2017; Badeeb et al. 2017, for surveys). This section reviews the evidence on the structural change effects of the different economic channels of commodity specialisation, as highlighted in the theoretical section.

4.1 Structural Change Effects of Commodity Windfall Spending

The empirical literature on the effects of commodity windfall spending revolves around the resource dependence-abundance dichotomy. Resource dependence measures the flow of resource revenues in total gross domestic product (GDP) exports, or government revenue. In contrast, resource abundance considers the absolute endowment of natural resources, measured by geological reserves, natural wealth per capita, or the physical stock available in an economy. Most studies examining natural resource dependence highlight the multifaceted channels through which natural resource dependence constrains structural change, including stifling growth in manufacturing and agriculture. Conversely, empirical studies using resource abundance measures indicate that natural resource wealth abundance is not a curse by itself and may even induce improved developmental outcomes when mediated with robust institutional quality and industrial policy.

Sachs and Warner (1999) found that a significant decline in manufacturing exports in Latin American countries was associated with a high share of natural resource exports in the countries' GDP. Kuralbayeva and Stefanski (2013) found that natural resources significantly reduce employment growth in manufacturing exports but slightly increase growth in manufacturing

productivity. The study revealed a minute decline in non-manufacturing productivity. Additionally, Apergis et al. (2014) demonstrated that oil rents induce substantial declines in agricultural value-added growth. Conversely, Michaels (2010) found that oil abundance did not affect manufacturing employment shares but did enhance its employment per square mile. Fleming and Measham (2014a, b) observed that coal seam gas and mining sector employment boosted non-tradable employment growth but significantly decreased agriculture employment growth.

Overall, the literature suggests that natural resource wealth has differing effects on various sectors, depending on the measures employed and specific country or regional contexts.

4.2 Structural Change Effects of Commodity Price Volatility

The literature suggests that commodity price volatility and deteriorating terms of trade can shrink tradable sectors over the long run. Black et al. (2005) studied 171 U.S. counties from 1970 to 1989 and found that the manufacturing sector experienced a persistent decline in employment and earnings but exhibited productivity growth during commodity price booms. However, mining, and non-tradable sectors expanded during booms but contracted during busts. McGregor (2017) analysed 30 resource-rich, low-income countries from 1994 to 2013 and observed that commodity price booms led to declines in agricultural and manufacturing value additions but stimulated growth in transport and telecommunication sectors. Dorinet et al. (2021) examined 38 Sub-Saharan African economies from 1991 to 2006 and concluded that commodity price variations induced a significant structural decline in manufacturing value additions and agricultural productivity. Marchand (2012) reported findings for 74 Canadian Census divisions from 1971 to 2006, revealing that real crude oil and natural gas prices generated growth in the energy and non-energy sectors during boom-bust periods. This study observed robust growth in manufacturing, retail, and other services, with construction displaying pro-cyclical trends (Marchand 2012).

4.3 Structural Change Effects of Dutch Disease via the Real Exchange Rate Channel

The literature on the real exchange rate channel demonstrates that commodity currencies lead to a decline in tradable sectors and growth in non-tradable sectors. Research on this topic, mainly based on time series data, highlights a consistent pattern of commodity-backed currencies inducing a decline in tradable sectors. For example, Beine et al. (2012) analysed Canadian data from 1972 to 2007 and found that the variation in the currency component of the real exchange rate significantly impacted the Canadian manufacturing sector. Similarly, Poncela et al. (2017) studied Colombian data from 1972 to 2013 and concluded that real exchange rate appreciation negatively affected manufacturing output relative to non-tradable goods or services. McGregor (2017) demonstrated that real exchange rate appreciation decreased manufacturing output growth in 38 resource-rich economies from 1994 to 2013. Harding et al. (2020) observed that a significant oil discovery led to an appreciation of the real exchange rate and a decline in manufacturing employment shares in 23 Organisation for Economic Co-operation and Development countries from 1970 to 2013. This area of research ties into the Balassa-Samuelson hypothesis and its association with real exchange rates, productivity growth, and structural change (Bahmani-Oskooee and Nasir 2005; Tica and Družić 2006).

4.4 Prebisch-Singer Hypothesis of Deteriorating Commodity Terms of Trade

The Prebisch-Singer hypothesis regarding the deteriorating commodity terms of trade has been a subject of extensive debate and analysis. Spraos (1980), Sapsford (1985), and Grilli and Yang (1988) concluded that there is robust evidence of a deteriorating trend in the relative prices of commodity

exports. However, Cuddington and Urzúa (1989) argued that the trend of real commodity prices evidenced not a secular downward decline but rather an abrupt drop in prices in 1920.

In the post–2000s era, evidence has favoured the deteriorating terms of trade. Athukorala (2000) found robust evidence for the Prebisch-Singer hypothesis, suggesting that the transition from structurally weak commodities to manufacturing can lead to gains in global trade exchange. Cashin and McDermott (2002) also observed a downward trend in real commodity prices with increasing variability in price movements since the early 1900s. Harvey et al. (2010) studied four centuries of data and concluded that a declining secular trend is a constant feature for many commodities. Arezki et al. (2014) re-examined the Prebisch-Singer hypothesis and commodity volatility over four centuries. They found that while the trend behaviour of commodity relative prices is mixed, most commodities exhibited a downward slope, with an increased tendency for volatility in recent years. These studies highlight the importance and relevance of understanding commodity price trends and their implications for international trade and economic development.

4.5 Summary of the Empirical Literature

Dutch disease and its impact on structural change is examined in several studies, focusing on Africa's heavy reliance on commodity exports. While existing literature largely supports the adverse effects of Dutch disease on structural change, and particularly on tradable sectors, evidence of these effects in the African context is lacking. Studies often concentrate on commodity windfall effects and overlook the price volatility channel. Furthermore, the regional scope of these studies is limited. To address these gaps, the current study advances the existing literature by examining the Dutch disease effect on African structural change at both aggregate and disaggregated levels. Specifically, this study seeks to analyse the various economic channels through which Dutch disease affects structural change within the African context.

5. DATA, MODEL, AND RESEARCH DESIGN

5.1 Data and Measurement

The data analysis is longitudinal, comprising a sample of 38 African economies between 1970 and 2017.⁴ Due to missing observations and data availability constraints, the study is necessarily an unbalanced panel. The implication is that some observations are lost because the model automatically drops some samples to balance out the sample, leading to an even smaller sample size.⁵ However, the sample size remains large. Tables 1 and 2 present detailed data descriptions, sources, and summary statistics.

5.1.1 Outcome Variable: Structural Change

Two distinct perspectives on defining the structural change phenomenon are the reallocation and compositional perspectives. While some studies define structural change as reallocations among

⁴ These countries are Algeria, Egypt, Morocco, Sudan, Tunisia, Botswana, Eswatini, Lesotho, Namibia, South Africa, Mauritius, Malawi, Zambia, Mozambique, Madagascar, Ethiopia, Kenya, Tanzania, Uganda, Rwanda, Burundi, Cameroon, Central African Republic, Congo DRC, Congo Republic, Gabon, Benin, Burkina Faso, Cote d'Ivoire, Gambia, Ghana, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, and Togo.

⁵ For instance, the non-resource export competitiveness variable is a ratio of the sum of domestic manufacturing and service exports to the global average, with missing observations for all countries across different periods and sometimes for whole countries. However, Algeria, Sudan, Zambia, and Zimbabwe were the only countries with a full variable sample.

sectors, others define it as compositional changes in economic activities or changes in the relative importance of sectors (Syrquin 2008; Herrendorf et al. 2014).

Clark (1940) defines structural change as the transition of the working population from agriculture to manufacturing and eventually to commerce and services. Kuznets (1973) expands this definition, noting that structural change encompasses not only this shift but also changes in the scale of productive units, a movement from personal to impersonal organisations, and changes in the occupational status of labour. Similarly, Herrendorf et al. (2014) define structural change as the reallocation of economic activity among the primary sectors—agriculture, manufacturing, and services—associated with modern economic growth.

However, Chenery (1986) describes structural change as changes in the composition of demand, trade, production, and factor utilisation as per capita income rises. Dixon's (1987) definition focuses on changes in the industrial composition of GDP, regional economic activity, and the demand for labour. Pasinetti (1993) describes it as a complex process involving continual changes in the proportions of sectoral output, consumption, and, most crucially, employment across different sectors.

Following the literature, we observed that structural change could be measured in many ways but for data limitation. The share of value added in GDP and sectoral employment shares in total employment are the most-used measures. Data on sectoral value-added shares of GDP are more commonly available than data on sectoral employment shares in total employment. Furthermore, the former are better suited when the focus of analysis is changes in economic output. Therefore, this study adopted sectoral value-added shares of GDP as the preferred measure of structural change (Herrendorf et al. 2014).

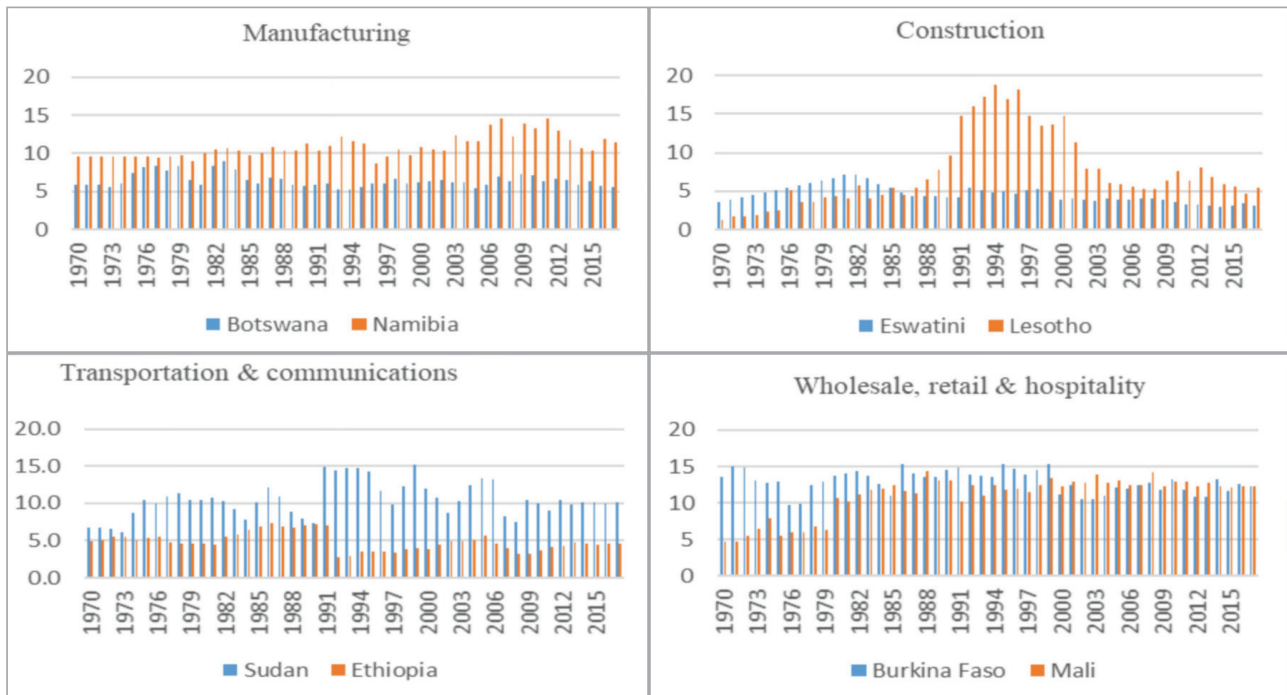
Consistent with Dutch disease theory, the study broadly classifies the sectoral value-added shares into two aggregate economic models: tradable and non-tradable (Corden and Neary 1982). The tradable sector includes agriculture (ISIC A-B) and manufacturing (ISIC D). In contrast, the non-tradable sector comprises construction (ISIC F), wholesale, retail, hotels and restaurants (ISIC G-H), transportation, storage and communications (ISIC I), and other services (ISIC J-P) comprising finance, insurance, real estate, and business professional services; community, social and personal services; and government services (hereafter, government and financial services).

The study further disaggregates the economy into the seven aggregate model sectors to gain further insights into the relationship. The data are sourced from the United Nations Conference on Trade and Development database.

5.1.2 Context of Cross-Country Variation in Structural Change in Africa

The literature suggests that structural change is heterogeneous across countries and sectors (Herrendorf et al. 2014). The current study observes this cross-country and subregional variation in the data, as illustrated in figures 1, 2, and 3.

Figure 1: Cross-country variation in structural change (share of GDP) for selected African countries, 1970–2017



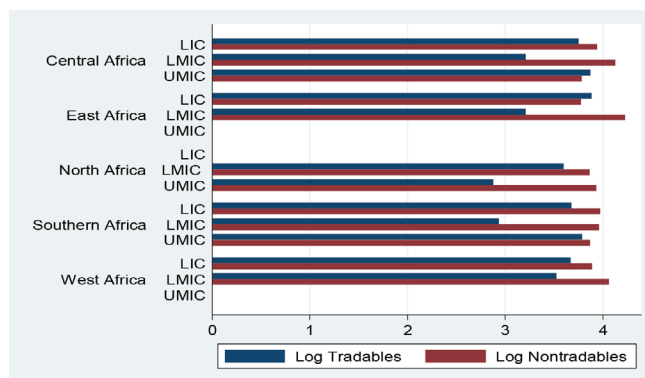
Source: United Nations Conference on Trade and Development database.

Figure 1 shows structural heterogeneity in the pattern and evolution of sectoral value-added shares among countries with similar income levels and neighbourhood effects such as environmental and socio-cultural ties. Figure 2a reveals significant disparities between the value-added shares of tradable and non-tradable sectors across various African income and subregional groups. A key observation is the dominance of non-tradable sectors—particularly construction and services—over tradable sectors such as agriculture and manufacturing in all African subregions. This trend is especially evident in low-income countries, except those of East Africa, raising concerns about premature structural change. Such change refers to the shift from agriculture and natural resource dependence to a non-tradable sector, often at the expense of manufacturing.

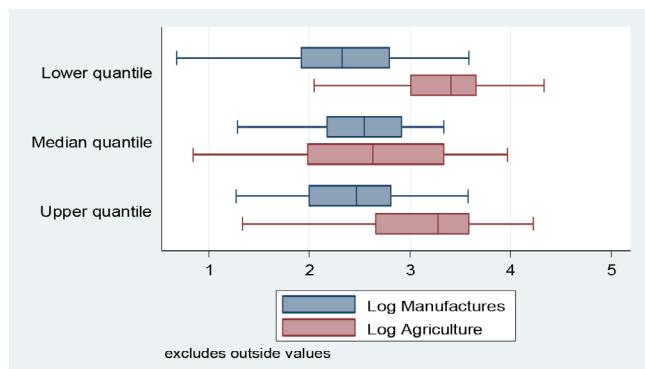
Figure 2b decomposes the tradable into disaggregated manufactures and agriculture over quantiles to gain better insights. The Figure reveals that the agricultural sector dominates the tradable sector even amongst the top distributional quantile countries. Economies at the lower quantiles exhibit larger agricultural value-added shares than those at the median and upper quantile distribution, consistent with theory and empirical expectations.

Figure 2: Disparities between the value-added shares of tradable and non-tradable sectors across various African income and subregional groups, 1970–2017

(a) Patterns of tradable and non-tradable value-added shares



(b) Conditional distribution of manufactures and agriculture value-added shares across income quantiles



Source: United Nations Conference on Trade and Development database.

Notes: UMIC denotes upper-middle-income countries, LMIC denotes lower-middle-income countries, and LIC denotes low-income countries.

5.1.3 Policy Variables: Resource Dependence and Transmission Channels

The paper examines the Dutch disease hypothesis's economic transmission mechanisms through two direct channels: commodity windfall/spending effects, which are captured as the share of natural resource rents in GDP (Badeeb et al. 2017; Marchand and Weber 2017), and *commodity price effects*, which are measured as the real commodity price index consistent with Collier and Goderis (2012). The selected policy variables aim to capture resource dependence and the impact of commodity price fluctuations on the economy. The study justifies the choice of these variables by highlighting their significance in reflecting the negative spending effects of resource windfalls and the vulnerability of economies to commodity price shocks. It emphasises the exogeneity of commodity export prices and their role as a transmission channel, particularly in developing countries. Real commodity prices are identified as essential in capturing the volatility effect and influencing other transmission mechanisms.

The impact of commodity export prices on real exchange rates and the broader economy is significant. Commodity export price fluctuations drive real exchange rate movements, increasing public spending in non-export sectors and inducing real exchange rate appreciation. Commodity export prices are closely linked to commodity terms of trade and influence both domestic and foreign capital investments. Real exchange rate appreciation contributes to the loss of competitiveness in tradable sectors, aligning with the Dutch disease hypothesis. The real effective exchange rate is a key variable, reflecting currency appreciation and capturing multilateral competitiveness changes. These dynamics form essential indirect transmission channels within the economy.

Export competitiveness crowd-out: Export competitiveness is classified as total export competitiveness and non-resource export competitiveness. While the total export competitiveness is measured as the ratio of a country's national export share in GDP to its global export share in GDP, consistent with the African Centre for Economic Transformation (ACET) (2014), the non-resource export competitiveness measure is calculated as the ratio of domestic to global manufacturing and service exports.

Deteriorating commodity terms of trade: The study measures commodity terms of trade as the ratio of commodity export-to-import price weighted by total commodity trade flows (Athukorala 2000; Gruss and Kebhaj 2019). The commodity terms of trade capture the secular tendency of commodity terms of trade to deteriorate relative to manufactures, as postulated by the Prebisch-Singer hypothesis (Papyrakis and Gerlagh 2004; Harvey et al. 2010).

Gross domestic investment crowd-out: This crowd-out is measured as the gross fixed capital formation share in GDP. Papyrakis and Gerlagh (2004) and Gylfason and Zoega (2006) argue that the decline in the share of gross domestic investment is the main equilibrating channel of the Dutch disease. The underlying mechanism, through a combination of low savings and investment, is induced by the prevalence of commodity windfall, uncertainty, and macroeconomic volatility stemming from recurrent commodity boom-bust cycles.

Human capital development crowd-out: This crowd-out is measured as the average years of schooling and returns to education consistent with Gylfason (2001) and Papyrakis and Gerlagh (2004). Insofar as the level of human capital development in an economy is intrinsically linked with the industrialisation of the non-resource sector, specialisation in commodities would crowd out the learning-by-doing typical of modern industry, especially, manufacturing (Gylfason 2001). Notably, a significant negative regression coefficient captures the effect in all instances of crowding out or deterioration. Table 3 shows detailed variable measurements.

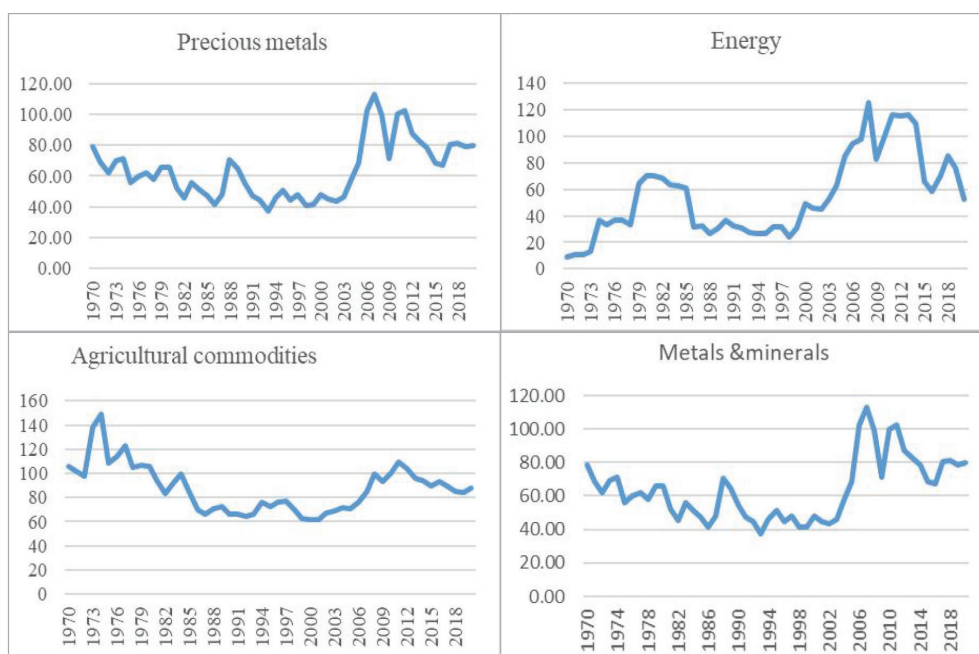
Figures 3 and 4 present real commodity price trends and subregional variation in commodity windfalls and prices. Figure 3 shows that commodity prices are volatile, with energy, precious metals, and base metals exhibiting greater price volatility than agricultural commodities. Figure 4 shows that Central and East African countries accumulated more commodity windfalls as a percentage of GDP than other subregions. North and Southern African countries earned less commodity windfalls as a share of GDP, thus reflecting a crucial aspect of structural change—the secular trend in commodity dependency gradually declines as the economy matures (Koren and Tenreyro 2007). Commodity export prices vary little across subregions relative to commodity windfalls.

Appendix 2 illustrates the commodity exports and their share in total merchandise exports for selected African economies in 2021-2023. On average, commodity exports account for 78.63%

of total merchandise exports across these nations, with a median of 87% and a range from 20% to 99%. These data highlight the significant yet varied reliance on commodity exports of African economies, making them suitable for exploring the Dutch disease hypothesis.

Notably, West, and Central African economies exhibit the highest levels of commodity dependence, averaging approximately 86%. East Africa follows at about 82%, while Southern and North Africa display relatively lower dependence at 71% and 61%, respectively.

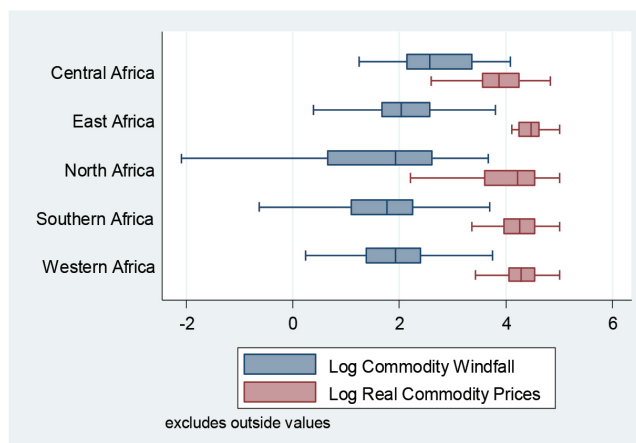
Figure 3: Weighted average annual real commodity export price indices



Source: Data are from the World Bank's Commodity Price Data (The Pink Sheet) for 2021.

Note: The energy price index includes coal, crude oil, and natural and liquefied natural gas. The metals and minerals index include aluminum, copper, zinc, nickel, tin, iron, and steel. Gold, platinum, and silver comprise the precious metals index. The agricultural commodities index includes timber, grains, beverages, oilseeds, and meals.

Figure 4: Commodity windfall and real commodity price index across African subregions, 1970–2017



Sources: Data are from the World Bank's Commodities Price Data (The Pink Sheet) for 2021 and World Development Indicators for 2022.

5.1.4 Covariates

Following extant theoretical and empirical literature, the study collected a wide range of covariates that are probable explainers of structural change: aggregate labour productivity, real aggregate consumption, population density, credit-to-deposit ratio, and social-cultural infrastructure index (Ngai and Pissarides 2007; Bustos et al. 2020). Table 1 presents detailed data descriptions, measurement, and sources.

5.1.5 Descriptive Statistics

Table 2 presents descriptive statistics illustrating the mean effects of commodity specialisation and changes in sectoral value addition across quantiles and African subregions from 1970 to 2017. Notably, it highlights a significant contrast between tradable and non-tradable value-added shares in GDP. Even in lower quantiles, in which one might expect capital and labour to be reallocated to goods production, the non-tradable sector, primarily driven by government, business, and financial services, remains dominant over the lagging tradable sector centred on agriculture.

Regarding subregional disparities, the non-tradable sector is consistently larger than the tradable sector, except in East Africa and West Africa. At a more granular level, the highest manufacturing outputs are in Southern Africa (16.4%) and North Africa (14%) and the lowest in East Africa (9.4%). Conversely, mining output as a share of GDP is largest in Central Africa (19.2%) and North Africa (12%).

The analysis also reveals that commodity revenue relative to GDP is most substantial in Central Africa (19.4%) and East Africa (10.3%), indicating that these regions have a greater resource dependence due to their smaller economies. The average commodity windfall share is lowest in Southern Africa (7%), reflecting that region's reduced reliance on natural resources.

Moreover, in terms of natural resource commodity terms of trade, East Africa (268) and West Africa (182) excel, and Central Africa (108) and North Africa (95) lag. Finally, when examining global export competitiveness in non-natural resource commodities, North Africa and East Africa emerge as leaders, with Central Africa falling behind.

Table 1: Data description, measurement, and sources

Variables	Measurement	Sources and databases
Outcome variables		
Tradable	Value-added (%) of GDP	Computed with data from the United Nations Conference on Trade and Development (UNCTAD)
Agriculture	Value added (%) of GDP	UNCTAD
Manufacture	Value added (%) of GDP	UNCTAD
Mining and utilities	Value-added (%) of GDP	UNCTAD
Non-tradable	Value-added (%) of GDP	Computed with data from UNCTAD
Construction	Value added (%) of GDP	UNCTAD
services	Value added (%) of GDP	UNCTAD
Transport and communication	Value added (%) of GDP	UNCTAD
Retail and hospitality	Value added (%) of GDP	UNCTAD
Government, finance, and business services	Value added (%) of GDP	UNCTAD
Policy variables		
Commodity windfall	Sum of national rents from oil, natural gas, coal, minerals, and forests as a percentage of GDP	World Development Indicators (WDI)
Real commodity price index	Country-specific weighted composite index of annual averages of world commodity prices deflated using the manufacturing unit value index	Allocated with World Bank Commodity Price Data (The Pink Sheet) and World Trade Organization commodity exports
Transmission channels		
Real effective exchange rate	LCU measured against the currencies of 171 trading partners divided by CPI	Bruegel database
Export competitiveness	Ratio of export share in GDP to global export share in global GDP	Computed with data from WDI
Non-resource export competitiveness	Ratio of domestic manufacturing and service exports to global manufacturing and service exports	Computed with data from WDI
Commodity terms of trade	Country-specific ratio of commodity export to import price indices weighted by the percentage of exports to total commodity exports	International Monetary Fund Primary Commodity Prices Database

Variables	Measurement	Sources and databases
Gross domestic investment	Gross fixed capital formation (%) of GDP	UNCTAD
Human capital	Number of years of schooling and returns to education	Penn World Tables 9.0
Additional Covariates		
Labour productivity	Real GDP per person employed	Computed with data from PWT9.1
Real aggregate consumption	Sum of government and household consumption expenditure (%) of GDP	UNCTAD
Population density	Population per land area	WDI
Credit-to-deposit ratio	Ratio of private credit to bank deposits	Global Financial Development Database
Sociocultural index	Composite average of institution and culture indices	Computed with data from and Gurr (2020) Polity 5 project and ELF HIEF Dataset (Dražanová 2020)

Notes: Institution index denotes the sum of Polity V (autocracy-adjusted democracy) and legal origin, wherein civil law = 0 and common law = 1. The culture index represents the sum of ethnolinguistic fractionalisation and religion, wherein predominantly Christian nations = 0 and non-Christian nations = 1. Commodity price indices denote a composite of 45 commodities: energy—coal, crude oil, and natural gas; metals—aluminium, copper, gold, iron ore, lead, nickel, tin, uranium, and zinc; food and beverages—bananas, barley, beef, cocoa, coffee, corn, fish, fish meal, groundnuts, lamb, olive oil, oranges, palm oil, poultry, rapeseed oil, rice, shrimp, soybean meal, soybean oil, soybeans, sugar, sunflower seed oil, swine meat, tea, and wheat; and agricultural raw materials—cotton, hard logs, hard-sawn wood, hides, natural rubber logs, soft-sawn wood, and wool.

Table 2: Mean commodity specialisation and structural change by quantile and regions in Africa, 1970–2017

Variable	25th quantile	50th quantile	75th quantile	North Africa	Southern Africa	Central Africa	West Africa	East Africa	Obs.
Tradable	30	39.8	48.9	32.6	32.9	31.7	45.2	48.2	1873
Non-tradable	44.7	52.9	59.2	55.7	56.8	49.1	48.9	48.9	1873
Agriculture	13.7	26.4	36	18.9	16.6	19.9	32.9	38.8	1874
Manufacture	7.6	11.6	17.3	13.7	16.4	11.9	12.3	9.4	1873
Mining and utilities	2.0	5.5	11	11.7	10.3	19.2	5.9	2.9	1873
Construction	2.7	4.1	5.6	6	4.8	4.2	3.9	4.3	1873
transport, and telecommunication	4.8	6.8	9.2	8.6	7.1	8.0	6.7	6.3	1873
Retail and hospitality	10.8	14	16.3	15.2	14.9	13.0	15.6	12	1873
Government, finance, and business services	20.5	25.9	30.9	25.9	30.1	23.9	22.6	26.4	1873
Commodity windfall	4.0	7.4	12.2	9.1	6.8	19.4	8.6	10.3	1872

Variable	25th quantile	50th quantile	75th quantile	North Africa	Southern Africa	Central Africa	West Africa	East Africa	Obs.
Real commodity prices	55.0	70.8	94.7	67.7	72.8	55.4	75.5	88.2	1872
Real effective exchange rate	98.8	114	157.7	146.1	119.4	157.1	146.5	141.1	1824
Export competitiveness	0.7	1.1	1.7	1.2	1.9	1.9	1.2	0.7	1872
Commodity terms of trade	98.5	130.9	208.2	95.1	179.0	108	182.4	267.5	1762
Gross domestic investment	13.4	19.1	25.6	23.3	20.7	25.2	19.1	18.1	1872
Human capital	1.2	1.5	1.8	1.6	1.8	1.6	1.3	1.4	1872
Non-resource export competitiveness	43.5	504.5	960.5	650.6	478.6	431.4	565.6	619.6	1872

Notes: All values are ratios of GDP except real commodity prices, real effective exchange rate, export competitiveness, commodity terms of trade, and human capital, which are indices. Non-resource export competitiveness is a ratio of global non-resource export competitiveness.

5.2 Theoretical Framework and Model Specification

The model used in this study's estimation strategy is based on the neoclassical trade and production model, accounting for cross-country differences in consumer preferences, technology, and factor endowment. It assumes technological progress with constant returns to scale and incorporates the concepts of Hicks-neutral technological change and Hirschman's forward and backward linkages to address sectoral interdependence. The model also includes industry controls to capture the impact of intersectoral linkages (Corden and Neary 1982; Nickell et al. 2008). Therefore, following Papyrakis and Gerlagh (2004 2007), this study specifies the following system of equations:

$$\log (SC)_{it}^j = \alpha_{it}^j + \beta \log ((X)/(Z))_{it} + \gamma \log (W)_{it} + d_{it}^j + L_{it}^j + \varepsilon_{it}^j \dots (2)$$

Equation (2) can be rewritten to account for the quantile distribution as follows:

$$\begin{aligned} \log (SC)_{it}^j &= \beta \log (X/Z)_{it} + \gamma \log (W)_{it} + d_{it}^j + L_{it}^j \\ &+ \varepsilon_{it}^j, Quant_{\theta}(SC_{it}/(X/Z))_{it} = \hat{X}_{it} \beta_{\theta} \end{aligned} \dots (3)$$

Following Equation (3), Equation (4.4) is specified to model the endogeneity of indirect transmission channels (Z):

$$\begin{aligned} \log (Z)_{it}^j &= \beta \log (X)_{it} + \gamma \log (W)_{it} + d_{it}^j + L_{it}^j + \varepsilon_{it}^j, Quant_{\theta}(Z_{it}/X)_{it} = \\ &\hat{X}_{it} \beta_{\theta} \end{aligned} \dots (4)$$

Following both equations (3) and (4), the relative importance of each transmission channel (Z) is computed as follows:

$$RIZ = \frac{(Z_{direct} * Z_{indirect})_i}{\sum_{i=1}^n (Z_{direct} * Z_{indirect})_i} = Z_1 + Z_2 + Z_3 \dots + Z_n \quad \dots (5)$$

where $Quant_{\theta} (SC_{it} / (X/Z))_{it}$ denotes the 25th, 50th, and 75th conditional quantile of the vector of SC ($_{0.25, 0.5, \text{ and } 0.75}$) conditioned on a vector of X and Z . Similarly, $Quant_{\theta} (Z_{it} / (X))_{it}$ also denotes the 25th, 50th, and 75th conditional quantile of the vector of Z ($_{0.25, 0.5, \text{ and } 0.75}$). It was conditioned on a vector of $X(s)$. SC denotes structural change measured as value-added shares in GDP at the aggregate two-sector level comprising tradable and non-tradable sectors and at the disaggregated multi-sector level. X denotes the direct policy variables of interest comprising commodity windfall and real commodity prices. Z denotes the vector of endogenous transmission channels comprising real effective exchange rate, export competitiveness, commodity terms of trade, gross domestic investment, and human capital. W assumes a vector of exogenous control variables that are probable drivers of structural change, including aggregate labour productivity, real aggregate consumption, credit-to-deposit ratio, and sociocultural infrastructure. j denotes the sector. d_{it}^j indicates country-specific and quadratic time trends that control for time-invariant unobserved confounders unique to different countries, such as real business cycles, exchange rate fluctuations, energy and commodity prices, technological change, and policy variables common across countries and industries. L denotes intersectoral linkages capturing the dynamic forward and backward linkages across sectors in individual countries over time (Hirschman 1958; Carmignani and Mandeville 2014). ε_{it}^j and μ_{it}^j denotes the stochastic error term, and the subscript denotes the country and period. RIZ signifies the relative importance of the vector of the transmission channel (Z), and Z_{direct} and $Z_{indirect}$ denote the coefficient of the vector of Z from equations (4.3) and (4.4), respectively.

5.3 Testable Hypothesis

Null hypothesis 1: Commodity windfall and commodity prices do not directly affect structural change. The empirical expectation is that the direct commodity windfall and price effects on structural change are not statistically and significantly different from zero. $H_0: \beta = 0$

Null hypothesis 2: There are no indirect transmission channels through which commodity windfall and prices affect structural change. The empirical expectation is that the indirect transmission channels are not statistically and significantly different from zero. $H_0: \beta = 0$

5.4 Research Design

The study adopts the following research design to identify the long-term consequences of commodity specialisation on the conditional distribution of structural change. First, it estimates the direct commodity windfall and price shock effects on the conditional distribution of structural change as specified in Equation (2). Second, it estimates the indirect transmission channels using quantile regression as Equation (3) specified. The study empirically substantiates the endogeneity of the transmission channels (Z) using quantile regression and OLS with OLS Driscoll-Kraay standard errors (Driscoll and Kraay 1998).

The quantile panel regression model offers three advantages. First, it addresses heterogeneity bias by capturing the conditional distributional effects of the response variable based on the covariates, making it relevant for structural change analysis. Second, it is a robust estimator that mitigates outlier effects and exhibits equivariance to monotone transformations. Third, although quantile regression often encounters problems when N is significantly larger than T , it assumes a normal distribution when N and T approach infinity or when N is fixed but T approaches infinity—a condition his study’s dataset fulfils: T (48) is significantly larger than N (38) (Koenker 2004; Canay 2011).

The major disadvantage of quantile regression is interpreting the estimated coefficients. The literature does not give ordinary quantile regression models in empirical studies a causal interpretation due to the endogeneity issues among covariates. Hence, the estimated covariates are interpreted as conditional on the quantile distribution (Firpo et al. 2009). However, recent advances in identification strategy have introduced a range of endogenous quantile treatment estimators and error correction mechanisms under conditions of endogeneity (Chetverikov et al. 2016; Powell 2020).

The panel structure helps control for unobserved heterogeneity within and across countries, reducing endogeneity and biases. Fixed effects are consistent in finite samples, but panel quantile regressions require asymptotic identification, especially with many groups (Canay 2011). Quantile regression presents a different approach, using conditional quantiles instead of conditional means for estimation (Chetverikov et al. 2016).

To overcome the identification challenge in panel quantile regressions, this study introduces country-specific linear and quadratic time trends, which are like country and time-fixed effects but completely flexible and unrestrictive (Friedberg 1998). Like the country and time fixed effects, country-specific trends and quadratic time trends can partial-out significant omitted covariates and unobservable differences across countries that are likely to confound the identification of commodity specialisation effects on structural change. Some potential unobserved heterogeneities that could bias this analysis include differences in geographic, climatic, and demographic propensities to specialise in commodity exploitation; entrepreneurial ethos and inventiveness; work ethic and absorptive capacities; trade and industrial policies; and government effectiveness.

However, unlike the country and time-fixed effects, the country-specific linear and quadratic trends do not impose a constant trend in the propensity of commodity windfall and prices to affect structural change. Assuming a constant movement could bias the underlying effects of Dutch disease and confound the variation induced by changes in commodity windfalls and prices. Therefore, this study’s model allows country-specific linear quadratic trends to eliminate within-country variations in the effects of Dutch disease (Friedberg 1998).

6. EMPIRICAL RESULTS

This section presents the main results for Dutch disease direct and indirect transmission effects on structural change using quantile regression. It includes the direct Dutch disease estimates in Table 3, adjusted direct Dutch disease effects in Table 4, and quantile plots in Figure 5. Additionally, it presents the results of the indirect transmission channels in Table 5 and the weight of each indirect transmission channel in Table 6.

The following empirical principles are noteworthy in understanding these results. Within the framework of Equation (2), the Dutch disease effect assumes a direct effect interpretation if, after controlling for the vectors of (Z_{it}) , the conditional distribution of $Quant_{\theta} (SC_{it}/(X)_{it})$ remains nontrivial in magnitude and statistical significance. Where the direct effect of the Dutch disease on structural change denotes the direct reallocation of factor inputs across sectors, it often manifests in commodity windfall effects and commodity price effects.

Conversely, if after controlling for the vectors of Z_{it} in Equation (2), the conditional quantile distribution $Quant_{\theta} (SC_{it}/(X)_{it})$ approaches zero in magnitude ($Quant_{\theta} (SC_{it}/(X)_{it}) \approx 0$) or in statistical significance ($H_0: Quant_{\theta} (SC_{it}/(X)_{it}) = 0$), while maintaining a robust statistical significance in Z_{it} , commodity specialisation indirectly crowds out structural change SC_{it} through the vector of endogenous channels captured in Z_{it} . Any comparable statistical and economic difference between the direct effects of commodity windfalls and prices in tables 5 and 6 assumes some indirect transmission interpretation often referred to as the crowding-out effect (Sachs and Warner 2001; Papyrakis and Gerlagh 2004, 2007).

6.1 Direct Effects of Dutch Disease on the Conditional Distribution of Structural Change Patterns in Africa

6.1.1 Tradable Sectors

Panel A of tables 3 and 4 shows the direct effects of Dutch disease on the aggregate and disaggregated tradable sectors.

The study observed a marked difference between tables 3 and 4 at the aggregate level. Although the estimates of commodity windfall in the tradable sector remain negative and statistically significant across the distribution, the marginal effects diminish after including endogenous transmission channels. Figure 5 shows that the adverse impact decreases with rising income levels across the distributional quantile. However, the commodity price effects move from statistically zero to positively significant at the lower to median quantile and, when the vector of transmission channels is included as an additional covariate, from negatively significant to statistically zero at the 75th quantile.

At the disaggregated level, the study observed a robust divergent pattern regarding the direct transmission mechanism. Panel A of tables 3 and 4 shows a substantial difference between commodity windfall and commodity price effects. After including the endogenous transmission channels as covariates, considerable changes in the statistical significance, direction of causation, and marginal effects were observed. However, agricultural commodity windfall and commodity price effects remain marginally and statistically zero across all quantile distributions except for the 75th quantile, where weak negative significance was observed.

Similarly, no material difference was observed except that the effect of commodity windfall on manufacturing induces a structural decline at the 25th quantile, where the negative statistical significance decreases from 10% to 1%. In contrast, the commodity price shock effect remains relatively stable with negative statistical significance, suggesting direct transmission of commodity price shocks to the manufacturing sector. Overall, the manufacturing sector exhibits an indirect transmission of commodity windfall effects, indicating a direct price shock effect. Similarly, the

mining and utility sector remains stable despite the additional controls and transmission variables, suggesting robust evidence of a direct transmission effect across the distributional quantile and, hence, an indirect crowding-out effect in the aggregate tradable sector but a direct effect in the disaggregate tradable sectors, especially in agriculture, mining, and utilities and in the higher quantiles of manufacturing.

Table 4 results suggest that the Dutch disease probably has no direct adverse effect on agricultural sector growth. First, the commodity windfalls and real commodity prices exhibit zero marginal and statistical significance of a direct transmission across the quantile distribution. Second, the direct regressive effect of commodity windfalls on manufacturing is present only at the lower 25th quantile (-0.021). However, some robust evidence exists of the direct negative impact of commodity price effects across the distributional quantiles (- 0.106 for the 25th quantile, -0.128 for the 50th quantile, and -104 for the 75th quantile, respectively). Third, mining is the only tradable sector that responds positively to changes in commodity windfall across the distributional quantile (0.123, 0.113, and 0.120, respectively). Conversely, fluctuations in commodity prices inhibit growth in the mining sector across the distributional quantile (-0.229., -0.261., and -0.160, respectively).

Table 3: Quantile estimates of natural resource commodities on structural change in Africa without adjusting for transmission channels, 1970–2017

	Commodity Windfall			Commodity Prices		
	0.25	0.5	0.75	0.25	0.5	0.75
Panel A Tradable sector						
Tradable	-0.026 ^a	-0.014 ^a	-0.012 ^a	-0.005	0.001	-0.020 ^b
	(0.003)	(0.003)	(0.003)	(0.011)	(0.015)	(0.008)
Agriculture	-0.005	-0.000	-0.001	-0.013	-0.001	-0.015 ^c
	(0.001)	(0.002)	(0.009)	(0.017)	(0.010)	(0.008)
Manufacture	-0.015 ^c	0.007	0.018	-0.163 ^a	-0.126 ^a	-0.089 ^a
	(0.009)	(0.009)	(0.013)	(0.026)	(0.027)	(0.029)
Mining and utilities	0.176 ^a	0.133 ^a	0.127 ^a	-0.326 ^a	-0.180 ^a	-0.131 ^a
	(0.022)	(0.014)	(0.015)	(0.045)	(0.042)	(0.043)
Panel B Non-tradable sectors						
Non-tradable	-0.035 ^a	-0.020 ^a	-0.018 ^a	-0.048 ^a	-0.032 ^a	-0.013
	(0.003)	(0.002)	(0.003)	(0.010)	(0.006)	(0.009)
Construction	-0.079 ^a	-0.050 ^a	-0.045 ^a	-0.039	-0.110 ^b	-0.103 ^b
	(0.014)	(0.010)	(0.010)	(0.046)	(0.046)	(0.047)
Transport	-0.039 ^a	-0.037 ^a	-0.023 ^b	-0.034	-0.084 ^a	-0.066 ^b
	(0.012)	(0.009)	(0.010)	(0.026)	(0.032)	(0.027)
Retail	-0.031 ^b	-0.031 ^a	-0.031 ^a	-0.011	-0.007	0.020
	(0.013)	(0.008)	(0.007)	(0.022)	(0.018)	(0.023)
Government, finance, and business services	0.030 ^a	0.023 ^a	0.018 ^a	-0.027 ^c	-0.017 ^b	-0.013
	(0.010)	(0.004)	(0.005)	(0.015)	(0.008)	(0.013)

	Commodity Windfall			Commodity Prices		
	0.25	0.5	0.75	0.25	0.5	0.75
Panel B Non-tradable sectors						
Transmission channels	No	No	No	No	No	No
Covariates	Yes	Yes	Yes	Yes	Yes	Yes
Intersectoral linkages	Yes	Yes	Yes	Yes	Yes	Yes
Country-specific trends	Yes	Yes	Yes	Yes	Yes	Yes
Nonlocal shocks	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Statistical significance is denoted as follows: $a = 1\%$, $b = 5\%$, and $c = 10\%$. Bootstrap standard errors are in parentheses. The dependent variables are the value-added shares of GDP; commodity windfalls and real commodity prices are the policy variables. The tradable sector comprises agriculture and manufacturing; the non-tradable sector comprises construction and services. Services comprise transport and communications, retail, distribution, and hospitality. Others comprise government, financial, and business services. Covariates include aggregate consumption, population density, credit-to-deposit ratio and social-cultural index. Non-local shocks refer to any tumultuous event in any given year that affects all countries in the sample.

6.1.2 Non-tradable Sectors

Panel B of tables 3 and 4 presents the results of both the aggregate and disaggregated non-tradable sectors.

At the aggregate level, the study observed homogeneous, significantly negative effects of commodity windfalls on the non-tradable sector in Table 3 without adjustment for endogenous transmission channels and in Table 4 with adjustment for transmission channels. This finding implies that changes in commodity windfall directly contract the non-tradable sector across the distribution. Similarly, variation in commodity price effects directly induces a significant decline in the non-tradable sector at the 25th and 50th distributional quantile. Figure 5 shows that the negative impact of commodity windfalls and commodity prices in the non-tradable sector deteriorates across the higher quantile distribution.

At the disaggregated level, the study also observed a homogeneous pattern of commodity windfall effects on the construction, transportation, communication, retail and hospitality, and government and financial service sectors presented in Panel B of tables 3 and 4. The results of the two panels do not substantially differ in statistical significance, direction of causation, and marginal effects. This finding implies evidence of a direct transmission effect, that is, the impact of commodity windfalls on non-tradable sectors is direct.

Specifically, the disaggregated results of Table 4 show that non-tradable sectors appear relatively worse off from the direct adverse effects of commodity windfalls than the tradable sectors; the most-affected sectors are construction (-0.083, -0.072, and -0.072), transport and communication (-0.040, -0.034, and -0.015), and retail and hospitality (-0.032, -0.029, and -0.046). The only positive effect of commodity windfalls on the non-tradable sector is observed in the government, finance, and business services sectors (0.017, 0.019, and 0.022). These findings contradict the Dutch disease theory, which suggests that commodity windfall effects should make tradable sectors worse off than non-tradable sectors.

Similarly, the study observed homogeneous patterns of significantly negative commodity price effects on the construction, transport, communication, retail, and hospitality sectors in tables 3

and 4, with and without transmission channels as covariates. The implication is that the effect of commodity price fluctuations on these sectors is direct. However, there is a marked difference in the effects of commodity prices on government, finance, and business services. While the commodity price estimates show a significantly negative association across the distribution in the models without endogenous transmission channels, the estimates become nonsignificant across the distribution with endogenous covariates. These findings imply that the effect of commodity prices on the government, finance, and business services is indirect.

Specifically, changes in commodity price effects induce a long-term decline in construction (-0.125, -0.078, and -0.105), transport and communication (-0.035, -0.062 and -0.078) and retail and hospitality (-0.031, -0.040, and -0.035) across the distributional quantile. We cannot reject the null hypothesis of symmetry of coefficients of commodity windfall across the distribution for the transport and communication sector and the retail and hospitality sector; however, the null is rejected for the construction, government, finance, and business services sectors. Similarly, commodity price shocks retard growth in non-tradable sectors with asymmetric marginal effects across the quantile distribution. Therefore, the null hypothesis of equality of coefficients across the distribution is rejected for all non-tradable sectors.

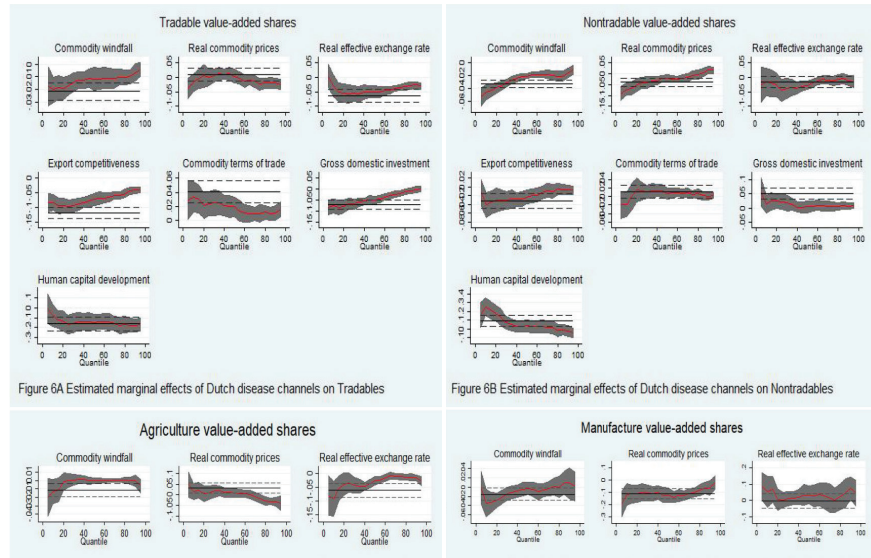
Table 4: Quantile estimates of natural resource commodities on structural change in Africa adjusted for transmission channels, 1970–2017

	Commodity Windfall			Real Commodity Prices		
	0.25	0.5	0.75	0.25	0.5	0.75
Panel A Tradable sector						
Tradable	-0.023 ^a	0.019 ^a	0.013 ^a	0.039 ^a	0.023 ^b	-0.003
	(0.004)	(0.006)	(0.005)	(0.013)	(0.012)	(0.008)
Agriculture	0.000	-0.001	-0.000	0.007	0.007	-0.017
	(0.004)	(0.002)	(0.001)	(0.016)	(0.010)	(0.012)
Manufacture	-0.024 ^a	-0.004	0.001	-0.106 ^a	-0.128 ^a	-0.104 ^a
	(0.008)	(0.007)	(0.009)	(0.034)	(0.028)	(0.020)
Mining and utilities	0.123 ^a	0.113 ^a	0.120 ^a	-0.229 ^a	-0.261 ^a	-0.160 ^a
	(0.020)	(0.014)	(0.012)	(0.038)	(0.044)	(0.047)
Non-tradable	-0.036 ^a	-0.021 ^a	-0.020 ^a	-0.045 ^a	-0.021 ^b	-0.007
	(0.004)	(0.002)	(0.004)	(0.015)	(0.008)	(0.010)
Construction	-0.083 ^a	-0.072 ^a	-0.072 ^a	-0.125 ^a	-0.078 ^a	-0.105 ^a
	(0.012)	(0.009)	(0.014)	(0.024)	(0.030)	(0.031)
Transport and communication	-0.040 ^a	-0.034 ^a	-0.015 ^c	-0.035	-0.062 ^c	-0.078 ^a
	(0.012)	(0.011)	(0.008)	(0.030)	(0.035)	(0.026)
Retail and wholesale	-0.032 ^b	-0.029 ^a	-0.046 ^a	-0.031	-0.040 ^b	-0.035 ^b
	(0.013)	(0.009)	(0.007)	(0.025)	(0.019)	(0.016)

	Commodity Windfall			Real Commodity Prices		
	0.25	0.5	0.75	0.25	0.5	0.75
Panel B Non-tradable sectors						
Government, finance, and business services	0.017 ^a	0.019 ^a	0.022 ^a	-0.018	-0.011	-0.014
	(0.006)	(0.005)	(0.005)	(0.015)	(0.011)	(0.011)
Transmission channels	Yes	Yes	Yes	Yes	Yes	Yes
Covariates	Yes	Yes	Yes	Yes	Yes	Yes
Intersectoral linkages	Yes	Yes	Yes	Yes	Yes	Yes
Country-specific trends	Yes	Yes	Yes	Yes	Yes	Yes
Nonlocal shocks	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Statistical significance is denoted as follows: $a = 1\%$, $b = 5\%$, and $c = 10\%$. Bootstrap standard errors are in parenthesis. The tradable sector comprises agriculture and manufacturing; the non-tradable sector comprises construction and services. Services comprise transport and communications, retail, distribution, and hospitality. Others comprise government, financial, and business services. The model adjusts for five commonly used transmission channels: real effective exchange rate, export competitiveness, commodity terms of trade, gross domestic investment, and human capital development. Covariates include aggregate labour productivity, consumption, population density, credit-to-deposit ratio, and social-cultural index. Non-local shocks refer to any tumultuous event in any given year that affects all countries in the sample. All variables are expressed in natural logs.

Figure 5: Estimated marginal effects of Dutch disease channels on structural change



Notes: For brevity, the study limited the quantile plots to the aggregate two-sector model and disaggregated agriculture and manufacturing.

6.2 Discussion of Empirical Results

The results indicate that the commodity windfall transmission channel has a directly diminishing effect on tradable and non-tradable sectors. In contrast, real commodity prices mostly depress growth in tradable sectors. Neither commodity windfalls nor prices directly impact the agricultural sector.

These findings are consistent with a strand of the Dutch disease hypothesis, which suggests that commodity windfalls or any other sudden foreign capital inflows induce the reallocation of economic activities away from the productive and exportable sector—especially manufacturing (Corden and Neary 1982; Sachs and Warner 1999; Rajan and Subramanian 2011).

Regarding the generalisability of this study's estimates, the commodity windfall estimates are consistent with Michaels (2010) and Weber (2014) for samples of U.S. counties. Further, the results are consistent with Kuralbayeva and Stefanski (2013) for a panel of 46 countries and with Kaba et al. (2022) for a sample of 34 Sub-Saharan African economies. These studies found that commodity windfalls decrease growth in manufacturing while boosting growth in the mining sector, irrespective of the level of data disaggregation. Similarly, the commodity price estimates are consistent with McGregor's (2017) panel of 30 low-income countries and Dorinet et al.'s (2021) sample of 38 Sub-Saharan African countries, showing that commodity prices induce a significant decline in manufacturing value-added shares and agriculture labour productivity. Similarly, in separate time-series studies for Russia and Azerbaijan, Algieri (2011) and Hasanov (2013) found significant declines in the manufacturing sector correlated with changes in oil export prices.

The pattern observed in these findings (for the non-tradable sector) is in sharp contrast with the strand of the Dutch disease hypothesis that emphasises that the damaging effects of commodity specialisation are more noticeable in the tradable sectors and, conversely, that the non-tradable sectors (construction, retail and hospitality, and transport and communication) expand at the expense of the tradable sectors (manufactures and agriculture) (Corden and Neary 1982; Sachs and Warner 1999; Rajan and Subramanian 2011). This study's estimates suggest that Dutch Disease affects not only the tradable sectors but the entire economy, making the non-tradable sectors, particularly construction, transport and communication, and retail and hospitality, worse off.

The estimates of the disaggregated non-tradable sectors in Table 4 are generalisable and consistent with the findings reported in the literature. For instance, Kuralbayeva and Stefanski (2013) reported a contraction in the construction sector induced by commodity windfalls. Similarly, Betz et al. (2015) documented a negative relationship between natural resource exploitation and growth in retail, the accommodation sector, and entrepreneurship in a sample of continental U.S. counties.

The commodity windfall-induced expansion of government, finance, and business services in our results is consistent with the conjecture in a case study of the natural resource curse in Nigeria by Sala-i-Martin and Subramanian (2013). According to these researchers, wasteful spending of commodity windfall revenue likely induces the expansion of government and public services at the expense of non-commodity sectors.

6.3 Indirect Transmission Channels of Dutch Disease

Tables 5 and 6 present the results of indirect transmission channels and the relative importance of the different transmission channels, respectively. The logic of the indirect transmission mechanism

is the supposed crowding-out effects of commodity specialisation (Gylfason 2001; Sachs and Warner 2001). According to the literature, the Dutch disease can impact the economy through multiple channels, many of which are structural change channels. However, this study restricts the choice of transmission channels to the five commonly used in the literature: real effective exchange rate, export competitiveness, commodity terms of trade, gross domestic investment, and human capital development (Gylfason, 2001; Sachs and Warner, 2001; Mo, 2000; Papyrakis and Gerlagh, 2004; 2007).

6.3.1 Real Effective Currency Appreciation Channel

Table 5 presents contrary evidence to the Dutch disease literature that emphasizes the equilibrating role of currency appreciation as a significant transmission channel. That evidence proves that neither commodity windfalls nor commodity prices significantly induce real effective currency appreciation across the distributional quantile. This finding is consistent with the findings of Sala-i-Martin and Subramanian (2013). They report weak correlations between commodity prices and real effective exchange rates for Nigeria and rule out the currency appreciation channel. Similarly, Harding and Venables (2016) allude to the elusiveness of finding the Dutch disease-real currency appreciation evidence in empirical studies.

Further, analysis of the relative importance of the transmission channels in Table 6 shows that the commodity windfall-real effective exchange rate connection is of minute significance across the distribution for the non-resource tradable sectors. However, the relative importance of real effective currency depreciation induced by commodity prices is more feasible in Africa's tradable sectors. Therefore, the findings reject real effective exchange rate appreciation as a transmission mechanism.

6.3.2 Export Competitiveness Channel

This study explores the loss of export competitiveness as a transmission mechanism from two perspectives: total export competitiveness and non-resource export competitiveness. Lost non-resource export competitiveness due to commodity specialisation could be the most damaging crowding-out Dutch disease transmission channel over the last 50 years.

In Table 5, the study observed a significant positive effect of commodity windfall on total export competitiveness across the distribution quantiles (0.051, 0.054), implying that the export competitiveness of most African economies is intrinsically linked to natural resource commodity specialisation. For instance, Bahar and Santos (2018) reported a positive relationship between commodity specialisation and export concentration, especially amongst non-OECD economies. Conversely, the study observed a significant negative effect of commodity prices on total export competitiveness across the quantile distribution (-0.152, -0.091), implying that the export competitiveness of African commodity-dependent economies is subject to the vagaries of commodity export prices, thus rendering many of these economies' volatile. This finding is corollary to Campbell (2020) who reported evidence of temporary price shocks stemming from real exchange rate appreciation and high oil prices in both US and Canada correlates with decline in manufacturing exports.

However, the significant negative effect of commodity windfalls on non-resource export competitiveness implies that commodity specialisation significantly constrains the competitiveness of the manufacturing and services sectors (-0.063, -0.062). Conversely, the marginal effect of

commodity prices on non-resource export competitiveness shows no statistical relationship across the quantile distribution. These results are consistent with Papyrakis and Raveh (2014), who reported a significant inverse relationship between resource windfall and non-mineral exports in a panel of Canadian provinces and territories. Similarly, Harding and Venables (2016) documented panel evidence of adverse effects of resource windfall on non-resource goods and services exports in 41 countries. Therefore, the relative importance of the loss of export competitiveness, especially in the non-resource sectors, is likely one of the most crucial indirect transmission channels through which commodity windfalls constrain the growth of the tradable non-resource sectors.

6.3.3 Commodity Terms of Trade Channel

The results in Table 5 show that commodity terms of trade induce a decline in commodity windfalls because of persistent Prebisch-Singer effects across the quantile distribution (-0.17, -0.42). The Prebisch-Singer hypothesis postulates a secular deterioration of commodity terms of trade for natural resource commodities relative to manufactured goods. Conversely, the study observed a positive and significant relationship across the quantile distribution between commodity prices and commodity terms of trade.

The adverse effects of commodity specialisation, via deteriorating commodity terms of trade, are the second-most important indirect channel through which commodity windfalls constrain tradable sectors across distributional quantiles. Notably, the relative effects are greater across the agricultural quantile distribution and are restricted to only the 75th quantile of the manufacturing sector distribution. This finding is consistent with Papyrakis and Raveh (2014), who also identified the decline of non-mineral exports in commodity-dependent Canadian provinces as the Dutch disease channel with the greatest relative importance, accounting for 51% of the total adverse effects.

6.3.4 Gross Domestic Investment Channel

The study observes from tables 5 and 6 that gross domestic investment is not a significantly viable transmission channel through which the Dutch disease constrains the African structural change process. The indirect relationship between commodity windfall and gross domestic investment is not significantly different from zero across all but the 75th quantile distribution, where a positive significant effect (0.025) was observed. Similarly, the indirect relationship between commodity prices and gross domestic investment is positively significant at the lower quantile distribution (0.091). A positive indirect relationship between commodity specialisation and gross domestic investment is consistent with Michaels (2010), who reported a marginal positive relationship between oil abundance and infrastructure development in a panel of 775 U.S. counties between 1940 and 1990. However, this study's findings differ from the findings of Papyrakis and Gerlach (2004, 2007), who reported the crowding-out effects of mineral production shares on gross domestic investment in a panel of 47 counties across 49 U.S. states between 1986 to 2001. This study observes that gross domestic investment is a relatively insignificant transmission mechanism of Dutch disease across sectors and across the conditional distribution (Table 6).

6.3.5 Human Capital Development Channel

The indirect relationship between commodity windfall and human capital development is not significantly different from zero across all quantiles. The indirect relationship between commodity prices and human capital development exhibits a null effect across all but the lower quantile, where the study observed evidence of marginal adverse effects of -0.019 at the 5% significance level. The

null effect of Dutch disease on human capital observed in Table 5 is consistent with Papyrakis and Gerlagh (2004), who also reported null effects in cross-country regressions. However, it differs from Papyrakis and Gerlagh (2007) and from Michaels (2010), who documented evidence of resource exploitation crowding out the human capital development in U.S. counties. Further, human capital is a relatively insignificant transmission channel across sectors (Table 6).

Table 5: Indirect transmission channels

	Real Effective Exchange Rate		Total Export Competitiveness		Non-Resource Export Competitiveness		Commodity Terms of Trade		Gross Domestic Investment		Human Capital	
Variables	0.25	0.75	0.25	0.75	0.25	0.75	0.25	0.75	0.25	0.75	0.25	0.75
Commodity windfall	0.005	0.012	0.051b	0.054a	-0.063a	-0.062b	-16.629c	-42.276b	0.004	0.025b	0.001	0.002
	(0.012)	(0.012)	(0.022)	(0.013)	(0.015)	(0.024)	(9.343)	(18.137)	(0.012)	(0.011)	(0.001)	(0.005)
Commodity prices	-0.039	-0.029	-0.152a	-0.091a	0.021	0.033	48.857b	112.478a	0.091a	0.045	-0.019b	-0.000
	(0.021)	(0.022)	(0.031)	(0.025)	(0.095)	(0.067)	(20.089)	(29.274)	(0.025)	(0.027)	(0.009)	(0.012)
Covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-specific trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quadratic time trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,632	1,632	1,670	1,670	1,600	1,600	1,670	1,670	1,670	1,670	1,670	1,670

Notes: Statistical significance is denoted as follows: *a* = 1%, *b* = 5%, and *c* = 10%. Robust standard errors are in parentheses. The Driscoll-Kraay robust standard errors are in parenthesis for the OLS models; the quantile regression standard errors are bootstrapped with 50 replications at a 95% confidence interval. Bootstrapped standard errors are robust to heteroskedasticity and AR(1) serial correlation. Non-resource export competitiveness is the ratio of non-fuels, metals, and mineral ores exports to total exports relative to the global export intensity of non-fuel, metals, and mineral ores. Controls are consistent with earlier models. Quadratic trends denote nonlinear time trends that in any given year affect all sample countries.

Table 6: Relative importance (%) of indirect transmission channels of Dutch disease on structural change in Africa, 1970–2017

	Tradable		Agriculture		Manufacture		Non-tradable	
	0.25	0.75	0.25	0.75	0.25	0.75	0.25	0.75
Direct commodity windfall effect	68	67	0	0	256	24	99	100
Real effective exchange rate	1	3	3	7	0	1	0.1	0
Total export competitiveness	22	21	36	32	-67	-4	0.4	0
Commodity terms of trade	6	4	50	87	-69	34	0.2	0
Gross domestic investment	1	3	2	-17	-6	13	0.0	0
Human capital development	1	2	8	-9	-14	32	-0.1	0
Total	100	100	100	100	100	100	100	100

	Tradable		Agriculture		Manufacture		Non-tradable	
	0.25	0.75	0.25	0.75	0.25	0.75	0.25	0.75
Direct commodity price effect	-7	134	47	115	85	99	115	132
Real effective exchange rate	15	-6	7	-2	0	0	-4	-7
Total export competitiveness	103	-30	32	-6	13	0	-12	-17
Commodity terms of trade	4	-2	6	-4	2	1	-1	-3
Gross domestic investment	-36	6	-14	-4	-8	-1	-5	-5
Human capital development	20	-2	23	1	9	1	7	1
Total	100	100	100	100	100	100	100	100

7. CONCLUDING REMARKS

This study provides empirical insights into the long-term effects of commodity specialisation on structural change in Africa by disentangling the direct and indirect transmission channels of commodity windfalls and price effects. The findings challenge conventional theoretical expectations, particularly regarding Dutch disease, revealing that its most pronounced contractionary effects emerge in the non-tradable sectors—most notably in construction, transport, telecommunications, retail, and hospitality—rather than in the tradable sectors. While manufacturing remains largely insulated from windfall shocks, real commodity prices significantly dampen its growth across distributional quantiles. In contrast, neither windfalls nor price effects directly impact agriculture.

At the aggregate level, commodity windfalls depress growth across both tradable and non-tradable sectors, exhibiting symmetrical effects across distributional quantiles. Real commodity prices, however, primarily weaken tradable sectors at upper quantiles while affecting non-tradable sectors at lower and median quantiles. Additionally, the study identifies the loss of non-resource commodity export competitiveness and declining terms of trade as the most significant indirect transmission channels, whereas real effective currency appreciation appears to be a statistical mirage. These findings underscore the urgent need for policy interventions aimed at reducing Africa's dependence on volatile commodity markets. Diversification into non-resource commodity exports—particularly in manufacturing—can mitigate the adverse effects of commodity specialisation on structural transformation and economic growth. By addressing these structural imbalances, African economies can foster industrial resilience, enhance competitiveness, and achieve sustainable development.

Appendix 1: Summary of the Empirical Literature on Dutch Disease and Structural Change

Study	Sample	Period and Frequency	Estimator	Dutch Disease Measure	Structural Change Measure	Summary of Findings
Commodity windfall channel						
Sachs and Warner (1999)	11 Latin American countries	1970–1989, annual	OLS	Natural resource exports-to-GDP ratio	Δ Manufactures export share	Increases in natural resource exports are associated with significant declines in manufacturing export share in the sample period.
Michaels (2010)	775 U.S. counties, including 171 oil-abundant counties	1940–1990, annual	Panel FE	Oil abundance (binary for counties with large oilfields)	Mining, manufacturing, and agriculture employment shares and densities	Oil abundance did not affect manufacturers' employment shares but did enhance density. On the other hand, oil abundance induced a rapid decline in the agricultural sector via employment shares and density.
Kuralbayeva and Stefanski (2013)	46 countries and 775 U.S. counties	1980–2006, annual	Panel FE	Natural resource exports (fuels, ores, and metals)-to-GDP ratio	Manufacturing employment and productivity, as well as non-manufacturing productivity	Natural resource exports induce significant declines in manufacturing employment growth while stimulating small growth in manufacturing productivity. However, they also induce small reductions in non-manufacturing productivity growth.
Aragón and Rud (2013)	Cajamarca province, Northern Highlands, Peru	1997–2006, household survey	DID	Gold mines' local inputs demand	Agricultural and services employment	Mines' demand for local inputs induces employment growth in both the urban services and rural agricultural sectors.
Brown (2014)	647 nonmetropolitan U.S. counties in a 9-state region	2001–2011, annual	IVE	Δ Natural gas production (billion cubic feet)	Δ Mining, manufacturing, construction, transportation, retail, and total services employment	Changes in natural gas production induce significant changes in employment in mining, manufacturing, construction, transportation, retail, and total services.

Study	Sample	Period and Frequency	Estimator	Dutch Disease Measure	Structural Change Measure	Summary of Findings
Commodity windfall channel						
Weber (2014)	362 U.S. counties	1995–2010, annual cross-section	IVE	Δ Natural gas production (billion cubic feet)	Δ Mining and manufacturing employment	Changes in natural gas production induced a positively significant change in mining employment but did not affect manufacturing employment.
Weinstein (2014)	3,060 counties in the lower 48 U.S. states	2001–2010, annual	OLS	Δ Oil and gas employment (including direct and support activities)	Δ Non-oil and gas sector employment	Oil and gas employment changes induced employment and earnings growth in the non-oil and gas sectors, driven by robust employment generation in the tradable sectors, but non-tradable sectors reported non-negative growth effects.
Papayrakis and Raveh (2014)	Northwest Territories, Yukon, and 10 Canadian provinces	1984–2008, annual	SURE	Mineral VA and export shares in GDP	% Δ Labour and capital in non-primary tradable sectors comprising manufacturing, wholesale, and retail	Mineral output and export changes are associated with increased capital intensity but also a decline in labour growth in the non-primary traded sectors.
Apergis et al. (2014)	Middle East and North African countries	1970–2011, annual	PDOLS	Oil rents	Agricultural VA	Oil rents stimulate the decline in agricultural value-added growth.
Fleming and Measham (2014a)	95 statistical local areas in Queensland, Australia	2001 2006, and 2011, annual	OLS	Δ Coal seam gas employment	Δ Non-mining sectoral employment spanning eight sectors	Changes in coal seam gas employment stimulate significant non-tradable sector employment in construction and professional services and non-negative employment growth in retail and hospitality. However, in the tradable sectors, it induces a significant decline in agricultural employment while maintaining non-negative growth in manufacturing.

Study	Sample	Period and Frequency	Estimator	Dutch Disease Measure	Structural Change Measure	Summary of Findings
Commodity windfall channel						
Fleming and Measham (2014b)	568 Australian local government areas	2001–2011	OLS	Δ Mining employment	Δ Non-mining sectoral employment spanning 18 sectors	Changes in mining employment induced significant employment elasticity in wholesale, hospitality, transport, and warehousing, finance, and real estate, but they had non-negative effects in manufacturing, utilities, construction, retail, business, public and health and education services. However, they led to a decline in employment in the agriculture, ICT and arts, and recreation services sectors.
Betz et al. (2015)	U.S. counties	1990–2010, decadal	IVE	Initial mining industry employment shares	Δ Accommodation and retail sector employment (%)	Cumulative changes in initial mining activities over the boom-bust cycles induce a long-term decline in the retail and accommodation sector.
James (2015)	111 countries	1970 and 2010, annual	OLS	Exports of fuels, minerals, metals, and agriculture in GDP	Non-resource output per capita growth; manufacturing and services	Natural resource wealth induces per capita output growth in non-resource sectors, especially in manufacturing and services, except in periods of oil price slumps.
Munasib and Rickman (2015)	U.S. non-metro counties, including 50 oil-and-gas counties across Arkansas (14), North Dakota (16), and Pennsylvania (20)	2001–2011	DID with Synthetic Control Method	Oil and natural gas production (million barrels and billion cubic feet)	Construction, retail, and accommodation and food services employment	Changes in oil and gas production induced a significantly positive variation in non-tradable employment in North Dakota and in extraction-intensive counties in Arkansas but had no significant effect in the rest of Arkansas and the whole of Pennsylvania.

Study	Sample	Period and Frequency	Estimator	Dutch Disease Measure	Structural Change Measure	Summary of Findings
Commodity windfall channel						
Gerelmaa and Kotani (2016)	182 countries	1970–2010, annual	QR	Natural resource capital	Ratio of services to manufacturing VA	Changes in natural resource capital inhibit the growth of the ratio of services to manufacturing.
Tsvetkova and Partridge (2016)	U.S. counties	1993–2013	IVE	Δ Oil and gas employment growth	Δ Tradable and non-tradable employment growth rates	Changes in the oil and gas employment growth rate induce a decline in the tradable sectors while boosting employment growth in the non-tradable sectors.
Allcott and Keniston (2018)	U.S. counties	1969–2014, annual	Panel differenced regression	Interaction between county-level oil and gas reserves endowment per square mile and national oil and gas employment	Manufacturing employment and productivity performance, as well as other outcomes, including revenue, investment, and number of plants	Overall, oil and gas extraction does not crowd out manufacturing during boom periods, with the largest benefits accruing to upstream and locally traded subsectors. However, there is some evidence of temporary contraction in the highly tradable subsector during oil and gas booms.
Amiri et al. (2019)	28 resource-rich countries	2000–2016, annual	FE/RE	Natural resource rents in GDP	Servic-es-to-manufacturing VA ratio	Natural resource rents are associated with significant increases in the service-to-manufacturing ratio. However, this effect is reversed in favour of manufacturing in the presence of good-quality institutions.

Study	Sample	Period and Frequency	Estimator	Dutch Disease Measure	Structural Change Measure	Summary of Findings
Commodity price volatility channel						
Bjørnland (1998)	Norway and United Kingdom	1976–1994	SVAR	Energy booms (volume changes due to technical or windfall discovery) and spikes in real oil prices	Manufacturing output	The oil price boom and bust in the late 1970s and 1980s significantly accounted for growth and decline in Norway's manufacturing output. However, in the United Kingdom booms were associated with manufacturing decline and busts, with manufacturing revival.
Black et al. (2005)	171 U.S. counties	1970–1989, annual	IVE and OLS	Real price of coal during boom, peak, and bust periods	Employment, earnings, and earnings per worker in both mining and non-mining sectors	Mining and non-tradable employment, earnings, and earnings per worker exhibited significant growth during booms but significantly declined during bust periods. Manufacturing experienced a persistent decline in employment and earnings across periods but productivity growth during the boom period.
Algieri (2011)	Russia	Nov. 1993–Dec. 2009, monthly	VECM	Real oil prices	Manufacturing-to-services ratio and manufacturing industries' exports	A 10% shock in oil prices induces a 3% decline in relative manufacturing to service production.

Study	Sample	Period and Frequency	Estimator	Dutch Disease Measure	Structural Change Measure	Summary of Findings
Commodity price volatility channel						
Marchand (2012)	74 Canadian Census divisions	1971–2006, annual	IVE and OLS	The real price of crude oil and natural gas during boom-and-bust periods	Differential growth in employment, earnings, and earnings per worker in non-energy tradable and non-tradable sectors.	Both energy and non-energy employment, earnings, and earnings per worker exhibited significant growth during booms and busts, driven by robust growth in manufacturing, retail, and other services. However, growth in the construction sector was pro-cyclical.
Hasanov (2013)	Azerbaijan	2000–2007	VECM	Oil price	Non-oil tradable sector output	Variation in oil prices significantly explains the decline of the non-tradable sectors during the sample period.
McGregor (2017)	30 resource-rich low-income countries	1994–2013	SURE	Reserve-weighted commodity price index shock (boom)	Sectoral VA for agriculture, manufactures, construction, mining and utilities, transport and telecommunication, wholesale and retail, and other sectors	Commodity price booms induced significant declines in agriculture and manufacturing growth while stimulating a significant increase in the transport and telecommunication sectors. However, booms had non-negative effects in construction, mining and utilities, wholesale, retail, hotel and restaurants, and other economic activities.

Study	Sample	Period and Frequency	Estimator	Dutch Disease Measure	Structural Change Measure	Summary of Findings
Commodity price volatility channel						
Ito (2017)	Russia	Q1 2003–Q1 2013, quarterly	VECM	Oil price	Manufacturing VA	Changes in oil prices are positively associated with the growth of manufacturing output and a marginal short-run response to oil price shocks.
Dorinet et al. (2021)	38 Sub-Saharan African countries	1991–2006	Panel FE	Net commodity price index	Agricultural VA per worker and manufacturing VA	Variation in net commodity prices induces a significant structural decline in agricultural productivity and manufacturing value-added growth.
Real exchange rate appreciation channel						
Looney (1990)	Saudi Arabia	1970–1981	OLS	Real exchange rate	Sectoral VA for agriculture, mining, petroleum, manufactures, construction, transport and telecommunication, wholesale and retail, and ownership dwellings	There is robust evidence of skewed real exchange rate depreciation favouring the tradable sectors and a currency appreciation induced by high non-tradable prices and wages.
Beine et al. (2012)	United States and Canada	Q2 1972–Q4 2007, quarterly	IVE and OLS	Currency component of the exchange rate	Manufacturing industry employment spanning 21 industries	The currency component of real exchange rate variation accounted for a significant decline in the Canadian manufacturing sector.

Study	Sample	Period and Frequency	Estimator	Dutch Disease Measure	Structural Change Measure	Summary of Findings
Real exchange rate appreciation channel						
Poncela et al. (2017)	Colombia	1972–2013	VECM	Real exchange rate	Manufacturing relative to services VA	The long-run adverse effects of real exchange rate appreciation on relative manufacturing output were induced by changes in commodity prices.
McGregor (2017)	30 resource-rich low-income countries	1994–2013	IVE(2SLS) and GMM	Real exchange rate	Manufacturing relative to services VA	Manufacturing output growth was depressed by real exchange rate appreciation during the sample period.

Note: Δ = changes, VA = value-added share in GDP, OLS = ordinary least squares, FE = fixed effects, IVE = instrumental variable estimator, 2SLS = two-stage least squares, SURE = seemingly unrelated regression equation, GMM = Generalised Method of Moments, VAR = Vector Autoregressive Model, SVAR = Structural Vector Autoregressive Model, VECM = Vector Error Correction Model, PDOLS = Padroni Panel Co-integration, QR = quantile regression, and DID = differences-in-differences.

Appendix 2:

Main Commodity Exports for Selected African Countries, 2021-2023

Countries	Share of Major Commodity Exports in Total Merchandise Exports
Algeria	Energy (94)
Angola	Energy (92)
Benin	Agricultural products (69); Minerals, ores & precious stones (21)
Botswana	Minerals, ores & precious stones (92)
Burkina Faso	Minerals, ores & precious stones (81)
Burundi	Agricultural products (47); Minerals, ores & precious stones (41)
Cabo Verde	Agricultural products (41); Energy (24)
Cameroon	Agricultural products (35); Energy (54)
Central African Republic	Agricultural products (34); Minerals, ores & precious stones (51)
Chad	Agricultural products (7); Energy (66); Minerals, ores & precious stones (26)
Comoros	Agricultural products (46)
Democratic Republic of the Congo	Minerals, ores & precious stones (82)
Congo	Energy (63); Minerals, ores & precious stones (25)
Côte d'Ivoire	Agricultural products (67); Energy (14); Minerals, ores & precious stones (12)
Djibouti	Agricultural products (31); Energy (10)
Egypt	Agricultural products (17); Energy (27)
Equatorial Guinea	Energy (92)
Eritrea	Agricultural products (35); Minerals, ores & precious stones (58)
Eswatini	Agricultural products (36)
Ethiopia	Agricultural products (71); Minerals, ores & precious stones (14)
Gabon	Energy (60); Minerals, ores & precious stones (16)
Gambia	Agricultural products (70); Energy (8); Minerals, ores & precious stones (9)
Ghana	Agricultural products (23); Energy (27); Minerals, ores & precious stones (45)

Countries	Share of Major Commodity Exports in Total Merchandise Exports
Guinea	Energy (8); Minerals, ores & precious stones (85)
Guinea-Bissau	Agricultural products (92)
Kenya	Agricultural products (57); Minerals, ores & precious stones (9)
Lesotho	Agricultural products (13); Minerals, ores & precious stones (32)
Liberia	Agricultural products (16); Minerals, ores & precious stones (56)
Libya	Energy (95)
Madagascar	Agricultural products (34); Minerals, ores & precious stones (38)
Malawi	Agricultural products (90)
Mali	Agricultural products (11); Minerals, ores & precious stones (84)
Mauritania	Agricultural products (27); Minerals, ores & precious stones (71)
Mauritius	Agricultural products (36); Minerals, ores & precious stones (10)
Morocco	Agriculture (21)
Mozambique	Agricultural products (15); Energy (45); Minerals, ores & precious stones (36)
Namibia	Agricultural products (24); Minerals, ores & precious stones (51)
Niger	Agricultural products (13); Energy (10); Minerals, ores & precious stones (69)
Nigeria	Energy (90)
Rwanda	Agricultural products (35); Energy (5); Minerals, ores & precious stones (49)
São Tomé and Príncipe	Agricultural products (68)
Senegal	Agricultural products (27); Energy (21); Minerals, ores & precious stones (24)
Seychelles	Agricultural products (76); Energy (10)
Sierra Leone	Agricultural products (18); Minerals, ores & precious stones (62)
Somalia	Agricultural products (51); Minerals, ores & precious stones (48)
South Africa	Agricultural products (12); Energy (11); Minerals, ores & precious stones (40)
South Sudan	Energy (90)
Sudan	Agriculture (60); Minerals, ores & precious stones (30)

Countries	Share of Major Commodity Exports in Total Merchandise Exports
Tanzania	Agricultural products (32); Energy (5); Minerals, ores & precious stones (53)
Togo	Agricultural products (23); Energy (29); Minerals, ores & precious stones (33)
Tunisia	Agriculture (12); Energy (8)
Uganda	Agriculture (58); Minerals, ores & precious stones (19)
Zambia	Minerals, ores & precious stones (79)
Zimbabwe	Agricultural products (24); Minerals, ores & precious stones (63)

Sources: Data are from the World Bank's World Integrated Trade Solution database and the United Nations Conference on Trade and Development database.

Notes: Agriculture encompasses a wide range of commodities, including animals, vegetables, food products, wood, and agricultural raw materials. Fuels comprise mineral fuels, crude oils from petroleum or bitumen, natural gas, and other petroleum products.

Gemstones and precious metals comprise diamonds, gold, and silver. Minerals comprise salts and ores as well as slag and ash containing sodium, calcium, phosphate, and sulfur. Ores and metals comprise metalliferous ores and non-ferrous metals. The first column, which measures commodity export share, could be slightly understated for several countries because a few more important commodities are omitted. Only the export share of major commodities to these countries is listed and reported.

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Headquarters

72B El-Maahad El-Eshteraky Street
Roxy, Heliopolis, Cairo 11341, Egypt
info@afreximbank.com
T +(202) 2456 4100/1/2/3/4

Abidjan Branch

Immeuble Plaza Tower – 11eme étage,
Boulevard du Général de Gaulle
Front Lagunaire - Plateau
Adresse postale : 01 BP 5634, Abidjan
01, Côte d'Ivoire
abidjan@afreximbank.com
Tel: +(225) 20 30 73 00
Fax: +(225) 20 30 73 48

Caribbean Office

African Export-Import Bank
Banque Africaine d'Import-Export
Trident Insurance Financial center
Hastings, Christ Church,
Highway 7, Bridgetown,
Barbados BB5156
T +(246) 833 4636

Abuja Branch

Afreximbank African Trade Centre
Plot 1573, off Ralph Shodeinde
Street, Central Business District,
Abuja 900001, P.M.B 601, Garki 2,
Abuja, Nigeria
abuja@afreximbank.com
T: +(234) 9 460 3160

Harare Branch

Eastgate Building, 3rd Floor
(North Wing), Sam Nujoma Street
Harare, Zimbabwe P.O. Box CY 1600
Causeway, Harare, Zimbabwe
harare@afreximbank.com
T +(263) 4 700 904 / 941

Kampala Branch

Rwenzori Towers, 3rd Floor, Wing A,
Plot 6 Nakasero P.O. Box 28412
Kampala, Uganda
kampala@afreximbank.com
T +(256) 417 892 700
+(256) 312 423 700

Yaoundé Branch

National Social Insurance
Fund (NSIF) Headquarters Building,
Town Hall, Independence Square
P.O. Box 405, Yaoundé, Cameroon
yaoundebranch@afreximbank.com

afreximbank.com

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