Data-driven Industrial Upgrading in Africa with New Structural Economics

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Abstract

Africa's development trajectory has been uneven despite abundant natural resources and a rapidly expanding labor force. This paper explores opportunities for sustained industrial transformation with new structural economics, identifying feasible manufacturing opportunities for African countries through the analysis of Africa's trade data from 1995 to 2020. Using revealed comparative advantage (RCA), product relatedness, and product complexity metrics, I rank potential industries aligned with each country's evolving factor endowments and existing capabilities. The results reveal that most African countries remain specialized in agricultural products, minerals, and materials, while feasible manufacturing opportunities concentrate in intermediate goods and value-added products proximate to current production structures. The findings demonstrate that sustainable industrial upgrading can proceed through market generation and value-chain entry rather than seeking market dominance. I show that industrial transformation is viable even for small economies when governments align public investments with identified feasible industries, maintain market discipline through performance-based incentives, and pursue regional integration strategies. Drawing on insights from adaptive political economy, I emphasize that successful industrial policy requires treating upgrading as a dynamic discovery process with embedded feedback mechanisms rather than fixed prescriptions. This paper provides actionable, data-driven guidance for policymakers seeking to facilitate structural transformation while avoiding the pitfalls of past industrial strategies in Africa.

Keywords: Data-driven Trade, Structural Transformation, New Structural Economics, Adaptive Political Economy, Africa

Introduction

Africa holds approximately 30 percent of the world's known mineral resources and is projected to account for a significant share of global population growth over the coming century (Vandome and Dechambenoit, 2020; Goldstone, 2019). In principle, the combination of abundant natural resources and a rapidly expanding labor force should provide a strong foundation for sustained economic growth and structural transformation. In practice, however, Africa's development trajectory has been uneven, with many countries struggling to translate resource endowments into diversified, industrialized economies (van der Ploeg,

2010).

This paper examines how African countries can pursue data-driven industrial upgrading through the framework of new structural economics (NSE), supported by empirical analysis of trade data. Specifically, it identifies feasible entry points into goods and industries that align with countries' evolving comparative advantages. In doing so, the paper moves beyond abstract policy prescriptions to provide a framework for identifying actionable, context-specific opportunities for structural transformation.

NSE emphasizes that while markets are central to resource allocation, governments play a facilitating role in structural transformation by addressing coordination failures, externalities, and information asymmetries (Lin, 2010, 2019). Unlike earlier structuralist approaches, it advocates for industrial upgrading aligned with countries' evolving factor endowments. Within this framework, comparative advantage is dynamic, reflecting not only current production patterns but also industries that are adjacently feasible given existing capabilities, infrastructure, and knowledge. It can be shaped over time through investment, learning, and institutional coordination.

To operationalize this approach, the paper draws on concepts from economic complexity. Product relatedness captures the proximity between goods based on shared capabilities, while product complexity reflects the knowledge intensity embedded in production. Together, these measures help identify industries that are both feasible and capable of supporting upgrading. The analysis is complemented by insights from adaptive political economy, which views development as a process of experimentation, feedback, and iterative policy adjustment (Ang, 2025).

Historically, African countries have pursued multiple development strategies with mixed outcomes. Post-independence industrial policies, particularly import substitution industrialization (ISI), generated early manufacturing growth but struggled to transition toward competitive, market-oriented production. In many cases, industrial strategies were characterized by misalignment with underlying factor endowments, driven by limited information and weak feedback mechanisms, resulting in inefficient allocation and limited productivity gains. Subsequent market-oriented reforms corrected some macroeconomic imbalances but did not consistently deliver structural transformation.

These experiences highlight a central challenge: designing industrial policies that are both economically feasible and dynamically adaptive. While NSE provides a theoretical foundation, there remains limited empirical work identifying viable industries at the country level in Africa. This paper addresses this gap by applying measures of revealed comparative advantage, product relatedness, and complexity to identify feasible industrial entry points. It further frames industrial upgrading as a process of continuous discovery, experimentation, and scaling.

The remainder of the paper is structured as follows. Section 2 outlines the theoretical framework and methodology. Sections 3 through 5 present and analyze the empirical findings across key themes of industrial upgrading. Section 6 concludes with implications and policy recommendations.

Theoretical Framework

This paper draws on new structural economics (NSE) (Lin, 2010, 2014, 2019), complemented by insights from adaptive political economy (Ang, 2025). Together, these frameworks conceptualize industrial upgrading as both structurally grounded and dynamically adaptive.

NSE positions markets as the primary mechanism for resource allocation while assigning the state a facilitative role in addressing coordination failures, information asymmetries, and externalities. Its central proposition is that sustainable growth emerges

when countries develop industries aligned with their evolving factor endowments. Rather than prematurely targeting capital-intensive sectors, countries upgrade incrementally into industries proximate to existing capabilities. Within NSE, comparative advantage is dynamic, evolving as countries accumulate capital, skills, and technological capacity. Industrial policy, therefore, is not about selecting fixed "winning sectors," but about enabling continuous structural transformation.

A central debate in development economics concerns whether industrial policy should conform to or deliberately defy a country's existing comparative advantage. In the New Structural Economics framework, Lin (2010, 2014, 2019) argues that sustainable industrial upgrading is most likely when countries move incrementally in line with their evolving endowment structures, thereby minimizing coordination failures and avoiding premature entry into excessively capital-intensive sectors. In contrast, Chang contends that comparative advantage is not a hard structural constraint, and that successful industrializers have often defied their existing specialization patterns through strategic intervention and capability building (Lin and Chang, 2009). Nevertheless, Lin and Chang also acknowledge that countries initially deviating too far from their comparative advantage are to be avoided, as this translates to higher costs to accumulate capabilities in new industries (Lin and Chang, 2009).

This paper situates itself between the aforementioned positions. It does not treat comparative advantage as a static constraint to be dogmatically followed, nor as a concept to be entirely bypassed. Instead, it conceptualizes comparative advantage as an evidence-based representation of current capability distribution, which is informative for identifying feasible entry points but incomplete as a guide for long-term transformation. From this perspective, industrial upgrading is not achieved by strictly adhering to or rejecting comparative advantage, but by systematically identifying the adjacent set of activities into which capabilities can pragmatically expand.

This interpretation aligns with adaptive political economy, in which policy effectiveness depends on iterative experimentation under uncertainty. Initial specialization patterns provide a starting information set for policy design, but transformation occurs through feedback-driven movement into nearby sectors in the product space rather than through either rigid adherence or wholesale defiance of existing comparative advantage structures.

Since NSE is less explicit on how governments can operationalize this process under uncertainty, this paper incorporates adaptive political economy, which emphasizes experimentation, decentralized problem-solving, and iterative policy adjustment. Under this lens, industrial policy is treated as a process of discovery, whereby feedback mechanisms shape outcomes over time. In contexts of weak institutional capacity as is common across many African economies, the interaction between these frameworks becomes particularly important. NSE provides an externally observable structure of feasibility through trade patterns and product space relationships, reducing reliance on high-quality internal planning information. Adaptive political economy then compensates for institutional constraints by emphasizing iterative, feedback-driven adjustment mechanisms that allow policy to learn even under uncertainty and imperfect enforcement environments.

Combined, these frameworks provide both a directional logic via new structural economics to identify feasible industries. They also provide a governance logic through adaptive political economy as a lens for policy implementation and refinement.

Research Methodology

To operationalize the preceding insights, the paper adopts a data-driven approach using trade

data from the BACI dataset (CEPII), harmonized from United Nations Comtrade (Gaulier and Zignago, 2010), alongside product-level data from the Observatory of Economic Complexity (OEC, 2012). Three indicators are used for the analysis.

Revealed comparative advantage (RCA), which measures export specialization relative to global trade patterns, product relatedness, which captures proximity between goods based on shared production capabilities, and product complexity, which reflects the knowledge intensity needed for the manufacturing of a product, are utilized. The analysis identifies products in which countries do not currently specialize but that exhibit high relatedness to existing exports. These are interpreted as feasible entry points into new industries, thereby requiring relatively modest capability accumulation.

This framework offers three key strengths. First, it grounds industrial policy in observable economic structures, reducing the risk of misalignment between policy and capabilities. Second, it provides a systematic and replicable method for identifying country-specific opportunities. And third, integrating adaptive political economy introduces a dynamic element, emphasizing feedback, experimentation, and policy learning.

The approach also has several limitations. Trade data may not fully reflect domestic productive capacity due to re-exports or reporting discrepancies. Measures of relatedness and complexity capture structural proximity but do not account for constraints such as infrastructure, institutions, or political feasibility. Additionally, while the methodology identifies feasible industries, it does not specify detailed implementation pathways. Cross-country variability in implementation conditions also exists due to differences in institutional capacity, infrastructure endowments, and policy execution effectiveness.

These limitations are mitigated in two ways. First, results are treated as diagnostic rather than prescriptive, serving as a starting point for deeper, context-specific analysis. Second, the framework incorporates an adaptive perspective, emphasizing verifiable metrics and iterative experimentation to refine industrial strategies over time rather than prescribed implementation plans.

Analysis and Discussion

Summarized findings for each African country are presented in Tables 1 and 2. A complete set of data, including complementary metrics such as the Trade Value RCA and Trade Value Relatedness for each product per country are available in a linked GitHub repository (Kamau, 2022). The GitHub repository contains a harmonized panel constructed by merging BACI trade flows with product classifications from the Observatory of Economic Complexity and covers 52 African countries. Trade values were processed to compute revealed comparative advantage, product relatedness, and product complexity at the country–product level using standardized formulas consistent with established implementations in economic complexity research. All transformations, including data cleaning, aggregation, and indicator construction, are fully reproducible and documented within the repository to ensure transparency and validation of the dataset.

Resource-based Economies and Value Addition

A dominant pattern in Table 1 is the high degree of specialization of African economies in raw materials, agricultural commodities, and mineral resources. Across a wide range of countries, including Algeria, Angola, Nigeria, Zambia, and the Democratic Republic of the Congo, exports are concentrated in unprocessed or minimally processed goods such as crude petroleum, ores, and primary agricultural products.

Table 1: African Countries and Their Most Specialized Products

Country	**Most Specialized Products by Trade Value RCA**
Algeria	Nitrogenous Fertilizers, Petroleum Gas, Ammonia, Calcium Phosphates, Hydrogen
Angola	Crude Petroleum, Granite, Diamonds, Petroleum Gas, Bran
Benin	Raw Cotton, Coconuts, Brazil Nuts, and Cashews, Other Oily Seeds, Other Vegetable Residues, Other Pure Vegetable Oils
Botswana	Diamonds, Salt, Carbonates, Bovine, Synthetic Reconstructed Jewellery Stones
Burkina Faso	Other Oily Seeds, Zinc Ore, Raw Cotton, Gold, Coconuts, Brazil Nuts, and Cashews
Burundi	Tin Ores, Niobium, Tantalum, Vanadium and Zirconium Ore, Tea, Coffee, Other Fermented Beverages
Cameroon	Cocoa Beans, Cocoa Butter, Cocoa Paste, Rough Wood, Veneer Sheets
Cape Verde	Processed Fish, Non-fillet Frozen Fish, Molluscs, Fishing and Hunting Equipment, Footwear Parts
Central African Republic	Rough Wood, Sawn Wood, Diamonds, Raw Cotton, Refined Copper
Chad	Insect Resins, Other Oily Seeds, Crude Petroleum, Gold, Raw Cotton
Comoros	Vanilla, Scrap Vessels, Essential Oils, Recreational Boats, Vacuum Flask
Democratic Republic of the Congo	Cobalt Oxides and Hydroxides, Cobalt, Refined Copper, Tin Ores, Raw Copper
Djibouti	Chlorides, Other Animals, Sheep and Goats, Palm Oil, Dried Legumes
Egypt	Aluminum Powder, Phosphatic Fertilizers, Calcium Phosphates, Preserved Vegetables, Hand-Woven Rugs
Eritrea	Zinc Ore, Copper Ore, Gold, "Non-Knit Men's Shirts", Tobacco Processing Machines
Eswatini	Scented Mixtures, Raw Sugar, Zippers, Jams, Industrial Fatty Acids, Oils and Alcohols
Ethiopia	Other Oily Seeds, Cassava, Tanned Sheep Hides, Coffee, Cut Flowers
Gabon	Manganese Ore, Veneer Sheets, Manganese, Sawn Wood, Crude Petroleum
Gambia	Fish Oil, Coconuts, Brazil Nuts, and Cashews, Ground Nut Oil, Non-fillet Frozen Fish, Other Oily Seeds
Ghana	Cocoa Beans, Cocoa Paste, Cocoa Butter, Coconuts, Brazil Nuts, and Cashews, Cocoa Powder
Guinea	Aluminum Ore, Gold, Aluminum Oxide, Cocoa Beans, Coconuts, Brazil Nuts, and Cashews
Guinea Bissau	Coconuts, Brazil Nuts, and Cashews, Non-fillet Frozen Fish, Fish Oil, Other Oily Seeds, Cassava
Kenya	Tea, Cut Flowers, Tin Ores, Titanium Ore, Legumes

Country	Most Specialized Products by Trade Value RCA
Lesotho	Wool, Diamonds, Bedspreads, "Knit Men's Shirts", "Knit Women's Suits"
Liberia	Rubber, Scrap Vessels, Cocoa Beans, Passenger and Cargo Ships, Iron Ore
Libya	Iron Reductions, Crude Petroleum, Live Fish, Scrap Copper, Gold
Madagascar	Vanilla, Titanium Ore, Graphite, Raw Nickel, Niobium, Tantalum, Vanadium and Zirconium Ore
Malawi	Raw Tobacco, Tea, Ground Nuts, Dried Legumes, Raw Sugar
Mali	Insect Resins, Other Oily Seeds, Gold, Rough Wood, Raw Cotton
Mauritania	Fish Oil, Iron Oxides and Hydroxides, Animal Meal and Pellets, Molluscs, Non-fillet Frozen Fish
Mauritius	Other Animals, Processed Fish, Vanilla, "Non-Knit Men's Shirts", Raw Sugar
Morocco	Calcium Phosphates, Phosphoric Acid, Phosphatic Fertilizers, Legumes, Mixed Mineral or Chemical Fertilizers
Mozambique	Titanium Ore, Niobium, Tantalum, Vanadium and Zirconium Ore, Graphite, Raw Tobacco, Raw Aluminum
Namibia	Raw Copper, Radioactive Chemicals, Wood Charcoal, Cobalt Oxides and Hydroxides, Fish Fillets
Niger	Other Oily Seeds, Radioactive Chemicals, Gold, Aircraft Launch Gear, Tanned Sheep Hides
Nigeria	Scrap Vessels, Tin Ores, Tanned Sheep Hides, Other Oily Seeds, Cocoa Beans
Republic of the Congo	Tin Ores, Refined Copper, Special Purpose Ships, Rough Wood, Niobium, Tantalum, Vanadium and Zirconium Ore
Rwanda	Niobium, Tantalum, Vanadium and Zirconium Ore, Tin Ores, Tea, Coffee, Gold
Sao Tome and Principe	Cocoa Beans, Palm Oil, Gas Turbines, Other Nickel Products, Aircraft Parts
Senegal	Phosphoric Acid, Niobium, Tantalum, Vanadium and Zirconium Ore, Ground Nuts, Titanium Ore, Soups and Broths
Seychelles	Recreational Boats, Processed Fish, Non-fillet Frozen Fish, Animal Meal and Pellets, Fish Oil
Sierra Leone	Titanium Ore, Niobium, Tantalum, Vanadium and Zirconium Ore, Aluminum Ore, Rough Wood, Cocoa Beans
South Africa	Chromium Ore, Manganese Ore, Niobium, Tantalum, Vanadium and Zirconium Ore, Granulated Slag, Titanium Ore
South Sudan	Forage Crops, Crude Petroleum, Insect Resins, Onions, Gold
Sudan	Other Oily Seeds, Insect Resins, Sheep and Goats, Ground Nuts, Ground Nut Oil
Tanzania	Tin Ores, Coconut and Other Vegetable Fibers, Coconuts, Brazil Nuts, and Cashews, Precious Metal Ore, Quicklime
Togo	Calcium Phosphates, Plaiting Products, Other Oily Seeds, Fake Hair, Cement
Tunisia	Pure Olive Oil, Phosphinates and Phosphonates, Phosphoric Acid, Fluorides, Utility Meters
Uganda	Cereal Flours, Coffee, Vanilla, Cocoa Beans, Bran

Country	Most Specialized Products by Trade Value RCA
Zambia	Raw Copper, Sulfuric Acid, Quicklime, Precious Stones, Refined Copper
Zimbabwe	Nickel Ore, Raw Tobacco, Granite, Nickel Mattes, Chromium Ore

Source: Self-generated by the Author Using Data from Observatory of Economic Complexity (OEC) and Centre d'Etudes Prospectives et d'Informations Internationales (CEPII) data (1995-2020)

This pattern reflects a structural characteristic of many African economies: production systems oriented toward extraction rather than transformation. While such specialization is consistent with existing factor endowments, it also limits the potential for productivity growth, employment generation, and income diversification. The central issue, therefore, is not whether these countries should abandon their current specializations, but how they can leverage them as entry points into higher value-added activities.

There are two broad perspectives on how resource-based economies should approach industrialization. The first emphasizes resource-based industrialization through value addition. This view argues that countries should build on their existing comparative advantages by moving downstream into processing and manufacturing activities. For example, crude oil exporters can invest in refining and petrochemicals, while agricultural producers can expand into food processing and branded consumer goods. This approach is consistent with new structural economics, as it leverages existing capabilities while facilitating incremental upgrading.

The second perspective is more skeptical of resource-based pathways, emphasizing the risks of resource dependence and the so-called "resource curse." According to this view, reliance on natural resources can crowd out manufacturing, distort incentives, and entrench rent-seeking behavior. From this perspective, successful industrialization requires diversification away from resource sectors into unrelated manufacturing industries, even if this involves significant state intervention.

The empirical results presented in Table 1 support the observation that most African countries are currently specialized in primary commodities. Nevertheless, Table 2 provides additional nuance by identifying products that are both proximate to existing capabilities and offer opportunities for diversification.

In many cases, the identified products suggest adjacent moves within resource-based value chains rather than immediate shifts into unrelated industries. For instance, countries specialized in agricultural exports show high relatedness to processed food products, oils, and intermediate agricultural goods. Similarly, mineral-exporting countries exhibit proximity to basic processed materials and intermediate inputs.

The pattern indicates that resource-based economies possess latent capabilities that can support industrial upgrading without requiring large, discontinuous jumps in production structures. The feasibility of these transitions is further reinforced by the relatively moderate levels of product complexity associated with many of the identified opportunities.

Taken together, the evidence suggests that value addition within existing resource sectors represents a pragmatic and feasible pathway for industrial upgrading in many African economies. Thus, rather than viewing resource dependence as an inherent constraint, it can be reframed as a starting point for capability accumulation. Entry into processing and intermediate manufacturing allows firms to develop technical skills, improve quality standards, and integrate into broader value chains. These processes generate learning effects that can, over time, support further diversification into more complex industries. At the same time, this pathway requires careful policy design to avoid the pitfalls highlighted by the resource curse literature. In particular, policies must ensure that value addition activities remain competitive, are subject to

market discipline, and do not become vehicles for sustained protection or rent extraction. In this context, the role of the state is not to replace markets, but to facilitate coordination, reduce transaction costs, and support the development of complementary infrastructure and capabilities that enable firms to move up the value chain.

Feasible Industrial Entry and Value Chain Participation

A second key issue revealed by the data is the nature of feasible industrial entry in African economies. The products identified in Table 2 are not concentrated in high-end, globally dominant manufacturing sectors. Instead, they are primarily intermediate goods, standardized manufactures, and products that are closely related to existing export structures. The pattern in Table 2 suggests that the most viable opportunities for industrialization lie not in immediate large-scale competition with established global producers, but in incremental entry into industries that are proximate to current capabilities.

Table 2: New or Nascent Products Most Aligned With Each African Country's Comparative Advantage

Country	**Potential Export Opportunities by Trade Value Relatedness**
Algeria	Gold, Soap, Other Oily Seeds, Raw Lead, Raw Cotton
Angola	Gold, Cocoa Beans, Sulphur, Niobium, Tantalum, Vanadium and Zirconium Ore, Chromium Ore
Benin	Cocoa Beans, Bran, Dried Legumes, Crude Petroleum, Molasses
Botswana	Raw Cotton, Manganese Ore, Gold, Other Oily Seeds, Raw Sugar
Burkina Faso	Manganese Ore, Cocoa Beans, Other Ores, Insect Resins, Dried Legumes
Burundi	Cocoa Beans, Other Oily Seeds, Palm Oil, Manganese Ore, Insect Resins
Cameroon	Palm Oil, Manganese Ore, Coconut Oil, Coconuts, Brazil Nuts, and Cashews, Other Oily Seeds
Central African Republic	Cocoa Beans, Non-fillet Frozen Fish, Niobium, Tantalum, Vanadium and Zirconium Ore, Other Oily Seeds, Bran
Democratic Republic of the Congo	Manganese Ore, Uranium and Thorium Ore, Gold, Coal Briquettes, Nickel Mattes
Chad	Petroleum Gas, Manganese Ore, Cocoa Beans, Niobium, Tantalum, Vanadium and Zirconium Ore, Dried Legumes
Comoros	Cocoa Beans, Coconut Oil, Fish Fillets, Crustaceans, Fish Oil
Cote d'Ivoire	Aluminum Ore, Niobium, Tantalum, Vanadium and Zirconium Ore, Other Oily Seeds, Crude Petroleum, Insect Resins
Djibouti	Gold, Cocoa Beans, Niobium, Tantalum, Vanadium and Zirconium Ore, Bananas, Crustaceans
Egypt	Raw Tobacco, Crustaceans, Other Nuts, Other Vegetables, Chromium Ore
Eritrea	Cocoa Beans, Niobium, Tantalum, Vanadium and Zirconium Ore, Tin Ores, Aluminum Ore, Precious Metal Ore
Eswatini	Knit Sweaters, Molasses, Other Knit Garments, Crustaceans, Knit Men's Undergarments

Ethiopia	Crustaceans, Cocoa Beans, Non-Knit Women's Undergarments, Melons, Raw Tobacco
Gabon	Cocoa Beans, Gold, Tin Ores, Aluminum Ore, Petroleum Gas
Gambia	Cocoa Beans, Crustaceans, Palm Oil, Non-fillet Fresh Fish, Bananas
Ghana	Petroleum Gas, Raw Cotton, Raw Sugar, Niobium, Tantalum, Vanadium and Zirconium Ore, Crustaceans
Guinea	Manganese Ore, Niobium, Tantalum, Vanadium and Zirconium Ore, Palm Oil, Tin Ores, Tapioca
Kenya	Raw Sugar, Bananas, Crustaceans, Cassava, Melons
Lesotho	Knit Women's Undergarments, Other Cloth Articles, Packing Bags, Other Knit Clothing Accessories, House Linens
Liberia	Aluminum Ore, Manganese Ore, Crude Petroleum, Niobium, Tantalum, Vanadium and Zirconium Ore, Crustaceans
Libya	Ammonia, Non-fillet Frozen Fish, Raw Aluminum, Refined Petroleum, Cocoa Beans
Madagascar	Tea, Jute Woven Fabric, Nutmeg, mace and cardamons, Other Cloth Articles, Fake Hair
Malawi	Gold, Cocoa Beans, Palm Oil, Bananas, Manganese Ore
Mali	Cocoa Beans, Palm Oil, Niobium, Tantalum, Vanadium and Zirconium Ore, Ground Nuts, Raw Sugar
Mauritania	Manganese Ore, Cocoa Beans, Crude Petroleum, Tropical Fruits, Petroleum Gas
Mauritius	Other Cloth Articles, Bananas, Packing Bags, Crustaceans, Other Women's Undergarments
Morocco	Knit Mens Undergarments, Other Knit Clothing Accessories, Pepper, Raw Tobacco, Insect Resins
Mozambique	Manganese Ore, Cocoa Beans, Tin Ores, Insect Resins, Crude Petroleum
Namibia	Niobium, Tantalum, Vanadium and Zirconium Ore, Cocoa Beans, Wool, Raw Cotton, Precious Metal Ore
Niger	Cocoa Beans, Raw Cotton, Niobium, Tantalum, Vanadium and Zirconium Ore, Manganese Ore, Tropical Fruits
Nigeria	Manganese Ore, Gold, Raw Cotton, Palm Oil, Tropical Fruits
Republic of the Congo	Petroleum Gas, Manganese Ore, Gold, Non-fillet Frozen Fish, Scrap Vessels
Rwanda	Manganese Ore, Cocoa Beans, Other Oily Seeds, Insect Resins, Palm Oil
Sao Tome and Principe	Collectors' Items, Scrap Copper, Non-fillet Frozen Fish, Precious Metal Scraps, Surveying Equipment
Senegal	Cocoa Beans, Raw Sugar, Spices, Bananas, Crude Petroleum
Seychelles	Crustaceans, Scrap Vessels, Crude Petroleum, Molluscs, Processed Fish
Sierra Leone	Coconut Oil, Tin Ores, Rubber, Manganese Ore, Gold
South Africa	Raw Cotton, Crude Petroleum, Petroleum Gas, Dried Legumes, Pharmaceutical Animal Products
South Sudan	Petroleum Gas, Raw Cotton, Cocoa Beans, Other Oily Seeds, Wool
Sudan	Manganese Ore, Cocoa Beans, Niobium, Tantalum, Vanadium and Zirconium Ore, Tropical Fruits, Other Hides and Skins

Tanzania	Insect Resins, Other Ores, Palm Oil, Crustaceans, Raw Sugar
Togo	Bananas, Insect Resins, Molasses, Crustaceans, Niobium, Tantalum, Vanadium and Zirconium Ore
Tunisia	Packing Bags, Knit Men's Coats, Knitted Hats, Processed Crustaceans, Pepper
Uganda	Manganese Ore, Niobium, Tantalum, Vanadium and Zirconium Ore, Crustaceans, Other Hides and Skins, Coconuts, Brazil Nuts, and Cashews
Zambia	Niobium, Tantalum, Vanadium and Zirconium Ore, Cocoa Beans, Tropical Fruits, Other Oily Seeds, Tin Ores
Zimbabwe	Manganese Ore, Tin Ores, Cocoa Beans, Coal Briquettes, Other Oily Seeds

Source: Self-generated by the Author Using Data from Observatory of Economic Complexity (OEC) and Centre d'Etudes Prospectives et d'Informations Internationales (CEPII) data (1995-2020)

Two contrasting perspectives shape the debate on industrial entry. The first emphasizes leapfrogging, arguing that developing countries should bypass lower-value industries and directly enter advanced sectors through technology adoption and strategic investment. Proponents point to examples of rapid technological diffusion and argue that latecomer advantages can enable countries to catch up quickly.

The second perspective emphasizes incremental upgrading, whereby countries build capabilities gradually by entering industries that are closely related to existing production structures. This approach highlights the importance of learning-by-doing, capability accumulation, and risk minimization.

The results in Table 2 support the incremental upgrading perspective. The identified products tend to exhibit high relatedness to existing exports, indicating that countries already possess a significant portion of the capabilities required for their production.

Moreover, many of the products occupy positions within global value chains, serving as inputs into downstream manufacturing processes. This suggests that industrialization can proceed through participation in specific segments of production rather than through full vertical integration. For example, the prevalence of products such as processed agricultural goods and the mass-manufacturing of intermediate materials reflects opportunities to enter value chains at stages that require moderate levels of capital and infrastructure. These entry points reduce exposure to intense global competition while still enabling firms to accumulate productive capabilities. At the same time, economies can adopt leapfrogging strategies for the means of production by adopting and integrating the latest technology into production processes for quality and efficiency gains.

The findings point to a model of industrialization grounded in the concept of the "adjacent feasible": i.e. the set of industries that can be feasibly entered given a country's current capabilities. Rather than attempting to construct entire industries from scratch, firms and policymakers can focus on specific segments of value chains where entry barriers are lower and learning opportunities are significant. Over time, success in these segments can enable movement into more complex and higher value-added activities. This approach also aligns with a non-zero-sum view of global production. Participation in value chains expands overall economic activity rather than displacing incumbents, allowing developing countries to integrate into existing systems while gradually upgrading their positions.

Structural Transformation in a Constrained Global System

Industrial upgrading does not occur in isolation. African economies operate within a global system characterized by unequal access to capital, technology, and markets. These constraints shape both the feasibility and trajectory of structural transformation.

At the same time, the increasing importance of services and digital technologies is reshaping the nature of industrial ecosystems, generating new pathways for participation in global trade. One perspective emphasizes the constraints imposed by the global system, arguing that late industrializers face structural barriers that limit their ability to compete with established economies. These barriers include limited access to finance, intellectual property restrictions, and geopolitical competition. The alternative perspective emphasizes the potential for non-zero-sum growth and regional integration, arguing that countries can expand their economic activity through cooperation, specialization, and the development of regional value chains.

While the data in this paper focus on manufactured goods, the identified opportunities implicitly depend on a broader ecosystem that includes tradable services such as logistics, finance, engineering, and digital platforms. These services play a critical role in reducing transaction costs, improving coordination, and enabling participation in value chains. In many cases, investments in services may offer faster and more scalable returns than investments in capital-intensive manufacturing.

In addition, regional trade integration expands the effective market size for firms, allowing them to achieve scale without immediate exposure to global competition. This dynamic is particularly relevant in the African context, where intra-regional trade remains underdeveloped relative to other regions. Recent scholarship on the African Continental Free Trade Area (AfCFTA) emphasizes its potential to increase trade volumes, reduce trade costs, strengthen regional value chains, and enable industrial specialization by establishing larger integrated markets for intermediate goods and manufactured products (Cannon and Nguyen, 2025; United Nations Economic Commission for Africa, 2025; Wanyonyi and Chemnyongoi, 2020). Within this context, regional integration becomes a critical enabling condition for capability accumulation and progressive upgrading along adjacent product spaces.

The evidence suggests that structural transformation in Africa is best understood as an adaptive process operating within constraints. New structural economics provides a framework for identifying feasible industries, while an adaptive political economy perspective emphasizes the importance of experimentation, feedback, and institutional learning. Together, these approaches highlight that the success of industrial policy depends less on initial conditions and more on the ability to iteratively refine strategies over time.

Crucially, the process is not zero-sum. By focusing on feasible entry points, leveraging regional markets, and integrating services into production systems, countries can expand their economic capabilities while contributing to broader patterns of global growth.

Conclusions and Recommendations

This paper examined industrial upgrading in African countries through a data-driven application of new structural economics, complemented by adaptive political economy. Using trade data from 1995 to 2020, it identified products aligned with countries' evolving comparative advantage based on revealed comparative advantage, product relatedness, and complexity.

Across Sections 3 to 5, three core findings emerge. First, industrial upgrading is the pevalent pattern in Table 2 suggesting that the most viable opportunities for industrialization lie not in immediate large-scale competition with established global producers, but in incremental entry into industries that are proximate to current capabilities.being feasible when approached as

a process of market generation, whereby firms enter proximate product spaces and gradually accumulate capabilities rather than competing immediately in complex global industries. Second, value-chain entry, particularly through intermediate goods and standardized manufacturing, provides a practical pathway for learning and upgrading. Third, industrialization in African contexts follows a non-zero-sum dynamic, whereby countries expand tradable sectors through domestic and regional markets before scaling outward. The analysis also highlights the complementary role of tradable services and the importance of adaptive, feedback-driven policy systems.

The findings carry broader implications. Industrial policy is most effective when grounded in data-driven governance, using observable production patterns to reduce coordination failures and improve resource allocation. Industrial upgrading should be understood as an iterative process of discovery, whereby governments and firms continuously test and refine activities. Moreover, the results challenge zero-sum views of industrialization, showing that regional integration and intermediate market participation can support expansion without direct competition with global leaders. Finally, incorporating tradable services expands structural transformation beyond manufacturing, reflecting their growing role in modern production systems.

Building on the preceding insights, a number of policy recommendations are tendered. First, targeted infrastructure and capability development should align public investment with the needs of feasible industries, focusing on binding constraints such as energy, logistics, and skills rather than generalized expansion. Second, incentives must be paired with market discipline. Temporary support such as through tax relief, finance, or industrial land, should be conditional on verifiable performance metrics, with clear exit mechanisms to prevent dependency.

Third, regional value-chain integration should be prioritized to expand market access and enable specialization. Reducing trade frictions and strengthening cross-border production networks can increase scale and competitiveness. Fourth, governments should institutionalize verifiable metrics and feedback loops. Tracking indicators such as production output, infrastructure delivery, and capacity utilization improves accountability and supports adaptive policy adjustment.

Fifth and fnally, adaptive policy design is essential. Industrial policy should be implemented through structured experimentation, defined as time-bound programs that test and scale capability-building pathways within an empirically derived feasibility space. Rather than arbitrary policy pilots, these interventions focus on value addition and capability accumulation in sectors identified through revealed comparative advantage and product relatedness, with clear performance thresholds guiding whether support is scaled, adjusted, or withdrawn. This experimental approach and the linking of policy trials to measurable positions in the product space distinguishes the operationalization of experiments from adaptive policy implementation.

Taken together, thee findings suggest that successful industrial upgrading depends less on selecting optimal industries ex ante and more on building systems that enable continuous discovery, disciplined experimentation, and coordinated investment. By combining data-driven analysis with adaptive governance, African countries can develop robust pathways toward sustained structural transformation.

References

Ang, Y. Y. (2025). Adaptive political economy: Toward a new paradigm. *World Politics, 77* (1, Suppl.), 51–67.

Cannon, A. and Nguyen, T. (2025). *The African Continental Free Trade Area: Opportunities*

and challenges. African Journal of Development Economics. https://afea-jad.com/article/the-african-continental-free-trade-area-opportunities-and-challenges-5/

CEPII. (2022). *BACI: International trade database at the product-level* (version 2022). https://www.cepii.fr/CEPII/en/bdd_modele/bdd_modele_item.asp?id=37

Gaulier, G. and Zignago, S. (2010). BACI: International trade database at the product-level. The 1994-2007 version (CEPII Working Paper No. 2010-23). *Centre d'Études Prospectives et d'Informations Internationales*. http://www.cepii.fr/CEPII/fr/publications/wp/abstract.asp?NoDoc=2726

Goldstone, J. A. (2019, January 14). Africa 2050: Demographic truth and consequences. *Hoover Institution*. https://www.hoover.org/research/africa-2050-demographic-truth-and-consequences

Kamau, S. (2022). Africa trade data [Data set]. GitHub. https://github.com/flow254/africa_trade_data

Lin, J. Y. (2010). New structural economics: A framework for rethinking development (World Bank Policy Research Working Paper No. 5197). World Bank. https://doi.org/10.1596/1813-9450-5197

Lin, J. Y. (2019). New structural economics: The third generation of development economics. *Asian Education and Development Studies, 9(3),* 279-286.

Lin, J. Y. (2014). Growth identification and facilitation: The new industrial policy for inclusive and sustainable industrial development (UNIDO Working Paper). United Nations Industrial Development Organization. https://www.unido.org/sites/default/files/2014-07/GIFF-New_Industrial_Policy_for_Inclusive_and_Sustainable_Industrial_Development_Justin_Lin_0.pdf

Lin, J. Y. and Chang, H.-J. (2009). Should industrial policy in developing countries conform to comparative advantage or defy it? A debate between Justin Lin and Ha-Joon Chang. *Development Policy Review, 27*(5), 483–502. https://doi.org/10.1111/j.1467-7679.2009.00456.x

Observatory of Economic Complexity. (2012). Observatory of economic complexity (OEC): Methods. https://oec.world/en/resources/methods

United Nations Economic Commission for Africa. (2025). AfCFTA benefits will be across sectors – Economic Report on Africa 2025. https://www.uneca.org/stories/afcfta-benefits-will-be-across-sectors-%E2%80%93-economic-report-on-africa-2025

van der Ploeg, F. (2010). *Natural resources: Curse or blessing?* (CESifo Working Paper No. 3125). https://www.econstor.eu/handle/10419/38934

Vandome C. and Dechambenoit L. (2020). African Agency in mineral resource governance. *Chatham House*. https://www.chathamhouse.org/2020/10/african-agency-mineral-resource-governance

Wanyonyi, R. and Chemnyongoi, R. (2020). Estimating effects of the AfCFTA (COMESA Working Paper). Common Market for Eastern and Southern Africa. https://www.comesa.int/wp-content/uploads/2020/10/Estimating-effects-of-AfCFTA-15-09-20-Rodgers.pdf