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Abstract

Kenya Vision 2030 aims to transform Kenya into a globally competitive economy, but its current export performance constitutes a significant impediment to realizing this objective. By systematically accounting for supply- and demand-side factors, this study identifies new products that can help to diversify and upgrade Kenya's economy. In a supply-side analysis, we first use economic complexity methods to identify 70 complex target products - primarily in the Machinery & Electronics and Metals sectors - that Kenya can learn to export competitively given the current structure of its economy. In a demand-side analysis, we then use gravity models to predict a high export potential among target products in sectors like Vehicles & Transport Equipment, Machinery & Electronics, Chemicals, and Metals. We predict that many of Kenya's current trade partners could be key importers of the target products, but we also find a high demand in several underexploited markets such as Australia, Canada, Italy, Japan, Nigeria, South Africa, Spain, and Zambia.

Key words: Economic complexity, industrial policy, trade, Kenya, structural transformation

1. Introduction

The Kenya Vision 2030 has an ambitious aim of transforming the country into a globally competitive and successful economy with a higher standard of living by 2030 (GoK 2007), but Kenya's current export performance constitutes a significant impediment to realizing this objective. During the past two decades, Kenya's export-to-Gross Domestic Product (GDP) ratio declined from around 25% to just above 10%. Meanwhile, Kenya consistently ran a trade deficit. It is also a concern that Kenya's non-service export is dominated by a few unsophisticated products. Over 70% of its non-service export revenue comes from agricultural, stone, and mineral products, with just three products—tea, cut flowers, and coffee—accounting for more than 30%.

These statistics ought to catch the eye of policymakers, particularly when seen in the light of recent research showing that countries' ability to produce and export complex products is a strong predictor of sustained economic growth (Hidalgo et al. 2007; Hidalgo and Hausmann 2009). In this paper, we argue that Kenya needs to formulate an industrial policy strategy to upgrade and diversify its economy with a particular emphasis on revitalizing its export portfolio. Put simply, Kenya needs to boost its economic complexity.

The economic complexity of a country is a measure of the amount of productive capabilities it has (i.e. its productive capacity). A country's economic complexity rank is thus a proxy for a range of different things including general human and physical capital, technology, specific know-how, endowment of natural resources, institutional capacity, regulations, infrastructure, etc.[1] The complexity of a country can be measured by its ability to export complex products, because countries with many productive capabilities should know how to export many complex goods. In turn, a complex product is difficult to produce and export because it requires many productive capabilities as inputs. The complexity of a product can therefore be measured by the number of countries exporting it, weighted by the complexity of the exporting countries. Based on this intuition, a successful industrial policy in Kenya should support the accumulation of the specific productive capabilities needed for the country to begin exporting more complex products.

What could such an industrial policy strategy for Kenya look like? Which specific products (and sectors) could Kenya diversify into to increase the

[1] Differences in countries' complexity is a result of *nontradable* capabilities that cannot be diffused through international trade and needs to be developed locally.

complexity of its economy? Which complex products have the highest export potential? And, which export markets have the potential to drive the demand for Kenya's complex products?

This study addresses these questions in a two-step, supply-and-demand analysis. We first use methods from the economic complexity literature to conduct a supply-side analysis, identifying 70 complex "target products" that would be relatively easy for Kenya to develop given the current structure of its economy. In a demand-side analysis, we then use product-level gravity models to rank the export potential of these target products across different export markets.

We find the most target products in sectors such as Machinery & Electronics and Metals, and we estimate high export potential for target products in sectors such as Vehicles & Transport Equipment, Machinery & Electronics & Electronics, Chemicals, and Metals. We also find that many of Kenya's largest current trade partners (e.g. China, Germany, Great Britain, India, Tanzania, Uganda, United Arab Emirates, and the US) could be important importers of Kenya's target products. Meanwhile, we also identify unexploited opportunities in markets such as Australia, Canada, Italy, Japan, Nigeria, South Africa, Spain, and Zambia.

2. Problem description

Related literature: economic complexity and economic growth

The analysis in this paper rests on two seminal ideas developed in the literature on economic complexity.[2] The first idea states that countries' economic prosperity is a function of the productive capabilities they possess and can combine for productive purposes. Countries endowed with more productive capabilities (so-called complex countries) can produce and export many complex goods, which is correlated with higher levels of income (Hidalgo et al. 2007; Hidalgo and Hausmann 2009). It follows that economic complexity is strongly related to concept export diversification.[3]

Figure 1 shows the positive correlation between countries' Gross Domestic Product (GDP) per capita and their rank in the Economic Complexity Index (ECI).[4] Countries with a higher ECI rank tend to be wealthier. Of course, this is not a causal relationship, because the causality could run in the opposite direction, for instance, if more wealthy countries invest more in R&D activities

[2] See Hidalgo (2021) for a detailed review of the economic complexity literature.

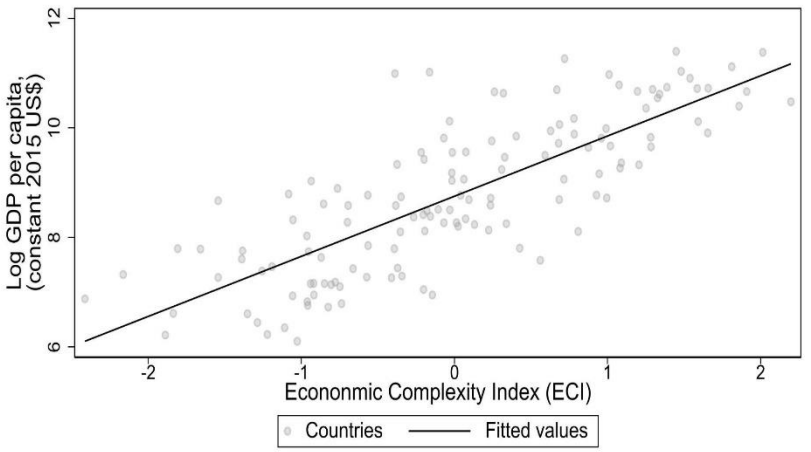
[3] A related literature studies the effect of export diversification on economic growth and resilience to shocks (see e.g. Abd Rahman et al. 2022; Lee and Zhang 2022).

[4] We describe how to calculate the ECI in detail in Section 3.2.

allowing them to produce and export more complex goods. It could also be that a third factor drives the positive correlation. This would be the case, for instance, if countries that have implemented free trade policies both experience higher growth and can diversify into more complex products. Yet, the deviations from the regression line (the residuals) are predictive of future economic growth. Countries located below the line are poorer than what we would expect given the complexity of their economies. Consistent with the theory, these countries tend to experience higher growth rates (Hausmann et al. 2013). The link between economic complexity and economic growth has been confirmed in multiple studies (Hoeriyah, Nuryartono, and Pasaribu 2022; Jurado-González and Gómez-Barroso 2022). Furthermore, economic complexity indicators generated from trade, technology, and patent data have been found to explain variations in inclusive green growth and income inequality in addition to economic growth (Stojkoski, Koch, and Hidalgo 2023). Based on this theory and evidence, improving Kenya's economic complexity is key to improving economic growth and realizing the goal of Kenya Vision 2030.

How does a country like Kenya acquire new capabilities to improve the complexity of its economy? The second seminal idea in the economic complexity literature states that it is easier for a country to undertake 'related diversification', gradually moving into economic activities similar to those that they already know how to undertake (Hidalgo et al. 2007). If a country already knows how to produce automobiles, it may only miss a few capabilities before it can produce trucks. On the other hand, it may need to develop an entirely new set of unrelated skills to develop a microchips industry. In other words, the structural transformation process is incremental and path-dependent because productive capabilities are complementary to varying degrees. Importantly, product complementarity (or product proximity, as it is often called in literature) means that the development of one product has consequences for the development of others. Put differently, the development of new products entails externalities. This justifies government intervention through industrial policy.

Figure 1: Economic Complexity and GDP per capita



Source: authors' calculations based on trade data from Growth Lab (2023) and the World Bank (2023).

In combination, these two seminal ideas lay the foundation for developing the supply-side of our industrial policy strategy for Kenya. The strategy should aim at moving Kenya into new and complex products that are easy to develop given the productive capabilities that the country already has. Our study thus builds on a long literature arguing that industrial policy is critical to ensuring inclusive growth. Industrial policy can drive required shifts in innovation and industrial performance by redefining competitiveness to include desirable objectives (Siddiqui & Saleem, 2010). For instance, it has been argued that good industrial policy entails establishing long-term, explicit, and transparent goals to facilitate a transition to a new growth path that is socially inclusive, environmentally sustainable, and technologically sophisticated (Gherardini et al., 2022). China's and India's experiences offer significant insights into the effectiveness of industrial strategies in attaining inclusive growth. These examples emphasize the significance of a social contract approach, in which industrial policy is viewed as part of a larger plan to provide paths to inclusive growth (Kaur & Singh, 2013).

Specifically, our study is related to a growing literature using the methods of economic complexity to guide industrial policies in developing countries (see e.g. Hausmann et al. 2014, 2019; Hausmann, Santos, and Obach 2017; Hausmann and Chauvin 2015; Hidalgo 2011; Oiro et al. 2019). Oiro et al. (2019) conducted an economic complexity analysis in Kenya, where they identified "frontier products" that can improve the country's export portfolio and

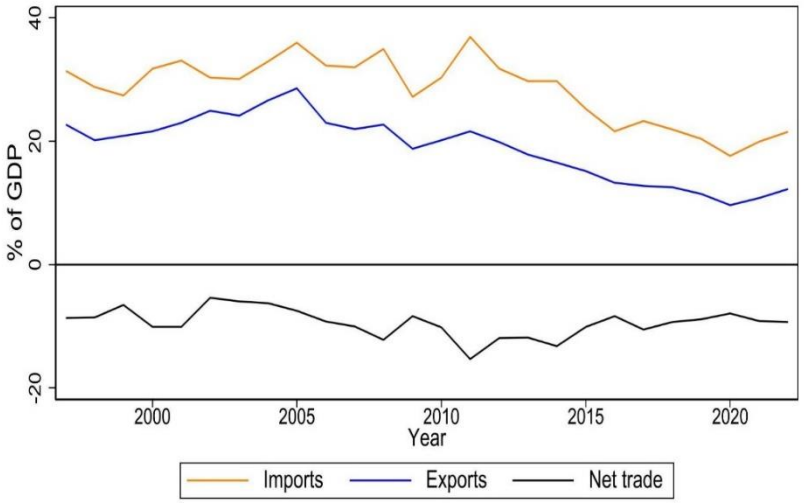
simultaneously boost inclusive growth and ensure broad-based employment. We add to this literature by combining supply-side focused complexity analysis with a demand-side analysis using gravity models. A similar approach has previously been applied in Ukraine (Hartog, Lopez-Cordova, and Neffke 2020), Mozambique (Sørensen et al. 2020), and Tanzania (Estmann et al. 2022). Our analysis follows closely the methodology developed in the latter two studies.

Stylized facts: Kenya's export structure and economic complexity

In this section, we present nine stylized facts about the current state, and historic development, of Kenya's export structure and economic complexity. The main conclusion is that Kenya is becoming less trade intensive, that its export portfolio remains relatively unsophisticated, although it is diversified and slightly more complex than one would expect given its level of income. Yet, from a historical perspective, it appears that the structure of Kenya's exports, and thereby its economic complexity, has not improved much during the past two decades.

Fact 1: Kenya is becoming less trade intensive and is consistently running a trade deficit. During the past two decades, Kenya's overall trade performance has been disappointing. This is clear from Figure 2 showing trends in the country's exports, imports and trade balance from 2000 to 2022. Both Kenya's exports and imports relative to GDP have declined during this period, and the country has consistently been running a trade deficit. The trade balance has, however, improved since 2011, due to a faster decline in imports compared to exports.

Figure 2: Exports, imports, and trade deficit relative to GDP



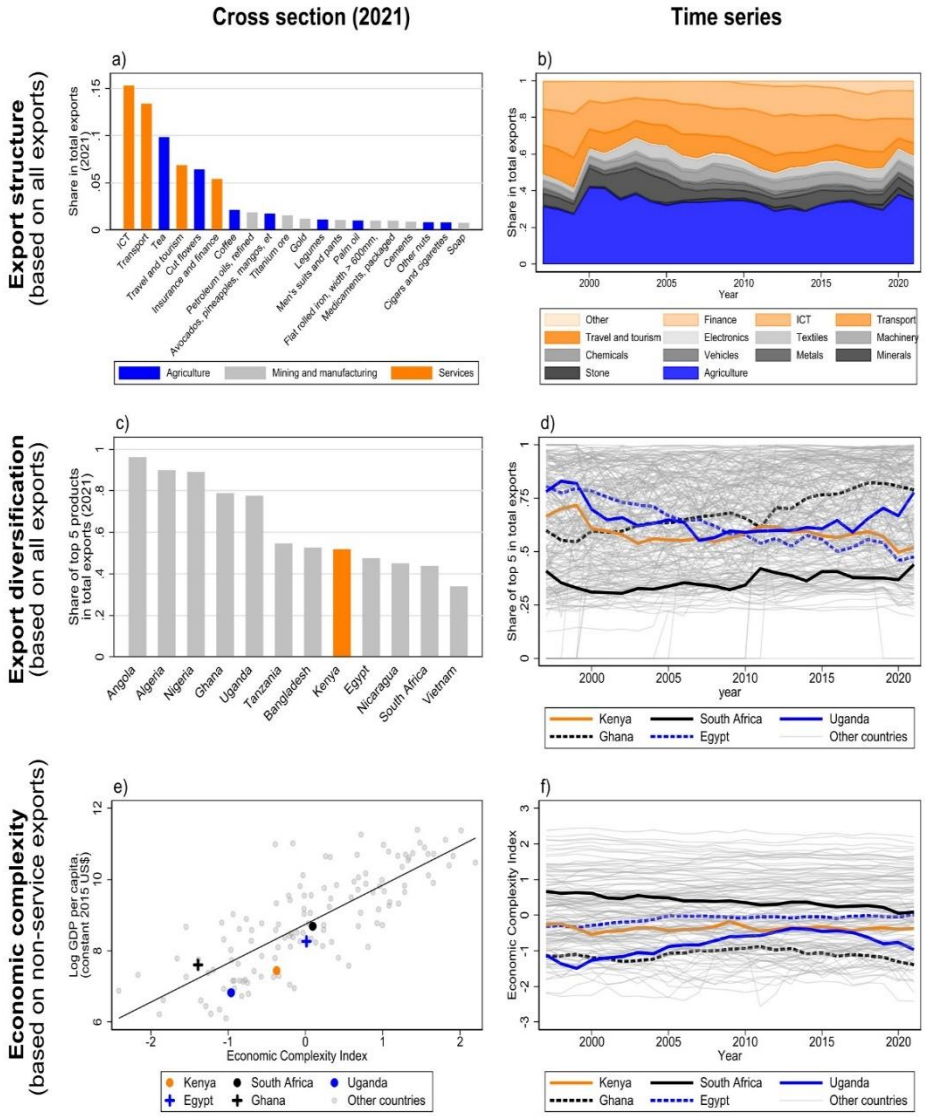
Fact 2: Kenya's top exports are unsophisticated and come mainly from services and agriculture. Figure 3a shows Kenya's 20 largest export products and services relative to the country's total exports in 2021. The top seven are comprised only of agricultural products and service sector exports. Since manufacturing is characterized by a high capacity to generate jobs and has a higher complexity, it is important to improve the productivity and competitiveness of this sector.

Fact 3: The structure of Kenya's exports has remained largely unchanged in recent decades. Figure 2b shows the share of Kenya's total exports by broad product and service group from 1995 to 2021. The composition has remained remarkably stable over time. In 2021, 40% of Kenya's export revenue came from services; 35% came from agricultural products; and the remaining 25% came from mining and manufacturing products. The largest product categories in the mining and manufacturing segment were textiles, minerals, and chemical products accounting for about 5.5% of total exports each. This export mix has remained largely unchanged since the turn of the century.

Fact 4: Compared to similar countries, Kenya's exports basket is relatively diversified. Figure 3c shows the share of Kenya's total exports in 2021 coming from the five largest products/service exports relative to similar countries. The top five exports accounted for 51.8% of Kenya's total exports in 2021. While this indicates a significant scope for further diversification, Kenya is not doing that bad when compared to similar countries. For instance, the same statistic

is just below 80% for both Ghana and Uganda, and 47.5% for a country like Egypt.

Figure 3: Current and historic development of Kenya's export structure, export diversification, and economic complexity



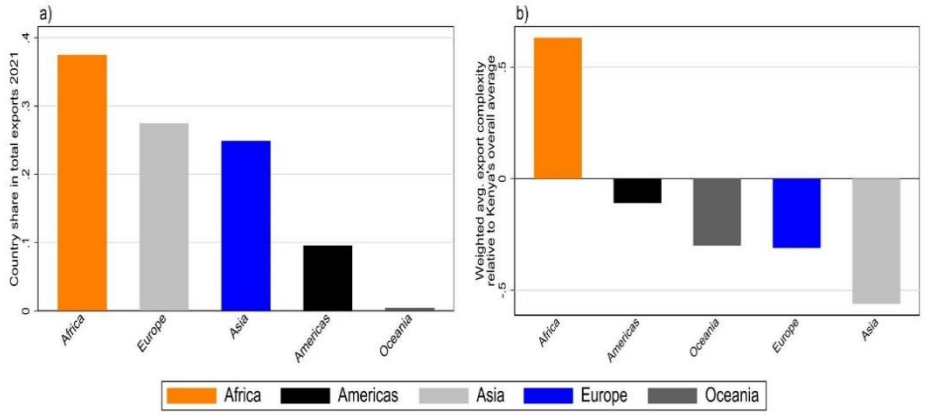
Source: authors' calculations based on trade data from the Growth Lab (2023) and the World Bank (2023).

Fact 5: Kenya's export diversification is improving over time. Figure 3d shows Kenya's reliance on its top five exports over time (orange line) in comparison to South Africa (solid black, green line), Uganda (solid blue line), Ghana (dashed black line), Egypt (dashed blue line), and other countries (grey lines). The figure highlights the gradual diversification of Kenya's export basket. In 1997, the top five exports accounted for 66.5%, a figure that has decreased by 14.7% since then. Of the comparison countries, only Egypt have diversified more over the same period.

Fact 6: The complexity of Kenya's non-service exports is higher than what one would expect given the country's level of development. Despite the fall in Kenya's export-to-GDP ratio, the average complexity of Kenya's non-service exports is in fact slightly higher than what one would expect given Kenya's GDP per capita. This is illustrated in Figure 3e, and it indicates a potential for moderate economic growth for Kenya in the year to come. The 2031 Growth Projections by the Growth Lab from Harvard University (which pioneers the economic complexity framework) estimates Kenya's annual growth to be 4.3% for the incoming decade, placing it within the top quartile of countries globally (Growth Lab 2023).

Fact 7: Yet, the complexity of Kenya's economy, relative to other countries, has not improved during the past two decades. Figure 3f presents Kenya's economic complexity score over time, which has not improved at all over the past two decades. In comparison, both Uganda and Egypt have seen upward movements in their complexity score. To improve, Kenya needs to diversify into new and more complex products.

Figure 4: Kenya's export destinations by share and avg. complexity (2021)



Source: authors' calculations based on trade data from the Growth Lab (2023).

Fact 8: African constitutes Kenya's biggest export market. Figure 4a shows the share of Kenya's total non-service exports flowing to different regions of the world. Other African countries bought 37.5% of Kenya's total exports in 2021. European and Asian countries imported respectively 27.5% and 24.9% of Kenya's exports. Less than 10% were exported to countries in North America, South America and Oceania, although the US alone is Kenya's second-largest export market. Finding ways to grow exports to all these markets must be a key priority for Kenya.

Fact 9: Kenya's exports to Africa are significantly more complex than their exports to other markets. Figure 4b shows the value-weighted average complexity of the products Kenya exported to different regions in 2021. Exports to African countries are of significantly higher complexity, indicating that the African market could be important in driving demand for complex products produced in Kenya in the future. Figure 3b also highlights the need for Kenya to find a way to competitively export sophisticated products to the large regional markets in Europe, Asia, and the Americas. In the demand-side analyses of this study, we will return to these issues and identify specific countries with a demand for a set of complex products wherein Kenya has an opportunity to develop a comparative advantage.

Current policy initiatives

Over the years, the government of Kenya has adopted several policies and initiatives aimed at driving the country's industrial transformation and sustainable economic development. These policies collectively demonstrate a vision of Kenya becoming a newly industrialized, middle-income country with a diverse and competitive manufacturing sector.

Previously, Kenya's endeavor to industrialize was anchored in the Sessional Paper No. 2 of 1996 on the Industrial Transformation to the Year 2020 (GoK 1996), that sought to realize sustained economic growth and rapid employment creation through industrialization. Key features of the policy included shifting the role of the government from control and regulation to an enabling role through institutional reforms, infrastructure support, incentives, and promotion of the private sector. Further, it underscored a two-phase approach to industrialization. In the first phase, the focus was on sectors with a low capital intensity and a high labor intensity, primarily agro-processing, building and construction materials. The second phase comprised more capital-intensive industries like metals, pharmaceuticals, machinery, electrical and electronic products. While the policy document provided a strong foundation for Kenya's current policies, its success was constrained by weak implementation such as poor diversification beyond conventional

sectors and insufficient legislative support for sustainable industrial development.

Related to economic complexity, key current policies specify Kenya's industrial and trade policies. The overarching long-term blueprint is the Kenya Vision 2030 (GoK 2007) that seeks to transform Kenya into a high middle-income country by 2030. It recognizes barriers to growth of the industrial sector, notably low competitiveness, narrow product ranges with high concentration in low technology products, and an inability to adequately penetrate export markets. To address these constraints, key policy priorities are an improved business environment to lower cost of production through infrastructure development, access to affordable credit and lower cost of credit.

The Sessional Paper No. 9 of 2012 on the National Industrialization Policy Framework for Kenya, 2012 - 2030 (GoK 2012) is the key policy document guiding development of the industrial sector. It has ambitious growth targets and strives to position Kenya as Africa's most competitive industrial investment destination. The proposed solutions include the establishment of industrial parks and zones, the adoption of sector-specific regulations and incentives, and the improvement of trade facilitation measures. Like the Sessional Paper No. 2 of 1996 on the Industrial Transformation to the Year 2020 and the Kenya Vision 2030, this policy document emphasizes aspects of competitiveness and diversification. In terms of diversification, it recognizes three broad product categories: Labor-intensive sectors (agro-processing, textiles and apparel, leather and leather goods), medium and high technology sectors (iron and steel, machinery, pharmaceuticals), and advanced manufacturing (biotechnology and nanotechnology industrial products). However, issues such as insufficient coordination and implementation procedures, insufficient resource allocation, limited access to finance for Micro, Small and Medium Enterprises (MSMEs), and lax enforcement of regulations and policies persist, demanding coordinated efforts to overcome these impediments and achieve long-term economic growth.

On the trade front, Kenya has in place the National Trade Policy (MITC and SDT 2017) and the Integrated National Export Development and Promotion Strategy (SDT and MITC 2018). Kenya's National Trade Policy is designed to promote international trade, increase exports, and create an environment conducive to trade and investment. Its primary goal is to improve market access, streamline trade facilitation processes, and stimulate export diversification to boost economic growth and industrialization. Despite its successes in improving trade ties and growing export volumes, obstacles remain in eliminating trade barriers, expanding global market

competitiveness, and maintaining effective trade policy implementation and enforcement. The Integrated National Export Development and Promotion Strategy provides a detailed framework to implement the national trade policy. This strategy strives to grow the country's international trade by enhancing the export competitiveness of Kenyan goods and services in the global market. Key achievements of the strategy include the establishment of sector plans, frameworks to enhance market access and trade facilitation measures such as the Single Customs Territory (SCT), which has reduced import and export costs and times at the border points. However, full implementation of the strategy has been hampered by funding gaps and other constraints.

Acknowledging the aspirations in various industrialization and trade policies adopted by Kenya to diversity its product range and export destinations, the analysis in this paper provides a new and data-driven way to identify high-potential products and sectors in Kenya with a specific focus on improving economic complexity and increasing export revenue.

3. Supply-side analysis

Data

The supply-side analysis relies on world trade data at the country-product-level from 1994 to 2021 collected by the United Nations Statistical Division (COMTRADE), and cleaned by the Growth Lab at Harvard University using the Bustos-Yildrim Method (Growth Lab 2023). When we exclude all observations on services and unspecified products, the dataset covers 242 countries and 1,241 unique products defined by the four-digit codes from the 1992 revision of the United Nations Harmonized System (HS). We then try to reduce further noise in the data in several ways. We exclude all products with exports of less than US$10 million on average from 2018-21. We also exclude small countries with average yearly exports from 2018-2021 of less than US$1 billion and with less than 1.25 million inhabitants in 2021 according to the World Development Indicators (World Bank 2023). We also exclude countries with unreliable trade statistics (Chad, Iraq, Macau, and Afghanistan). Finally, we exclude all products and countries that are not observed in the data every year. There are 4.58 million observations, 135 countries, and 1,212 products in the final sample.

There are three main limitations to the international trade data used in the analysis. First, the non-tradable part of Kenya's economy will be "invisible" in our analysis. We therefore must assume that the complexity of Kenya's tradable sector is a good proxy for its overall productive capabilities. We think that this is a reasonable assumption for several reasons. One reason is that

countries only export the goods in which they are most productive. Exports thereby reveal in which areas countries have strong productive capabilities. Another reason is that Saltarelli et al. (2020) have shown that countries' non-service exports tend to reflect their domestic production of physical goods. Countries' exports are thus reasonable approximations of their overall productive capabilities. Second, and related to the earlier point, the analysis only accounts for tradable *products* due to the lack of detailed data on tradable *services*. This is a significant limitation of the study given the large role of the service sector in Kenya's overall trade (see Figure 3a and 3b). Finally, the international trade data used in this analysis does not allow us to distinguish between domestic production and re-exports. We may therefore incorrectly attribute re-exports to productive capabilities in Kenya (and other countries).

Methodology: economic complexity variables

This section explains how we develop the supply-side of the industrial policy strategy for Kenya. Aligning with the ideas from the literature of economic complexity, the strategy aims at moving Kenya into new and complex products that are easy to develop given the productive capabilities that the country already has. To develop this strategy, we need a measure of the complexity of different products that Kenya could potentially target, and a measure of how easy it would be for Kenya to develop a comparative advantage in these products. The next sections explain how we calculate these measures.

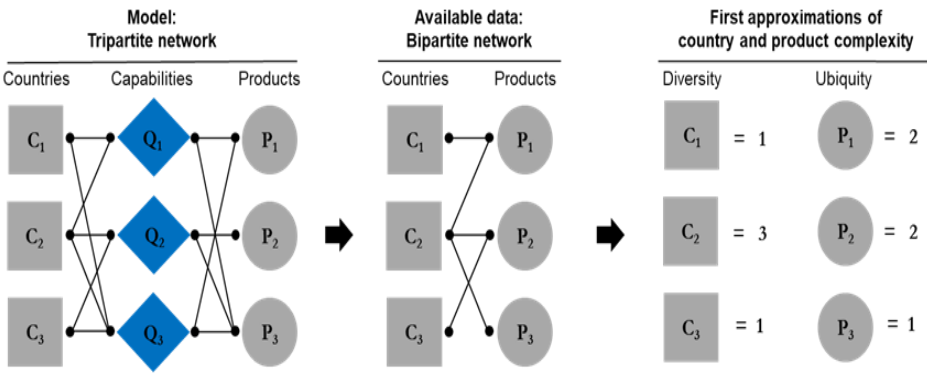
First, however, it is important to point out that while the strategy developed in this section is based on key variables from the literature on economic complexity (the next section will consider the demand side), a policymaker might want to take a broader set of objectives into account when developing an industrial policy. For instance, other policy objectives such as the job generation or tax revenue potential, of each sector should potentially also be evaluated before any industrial policy is implemented. Furthermore, the analysis does not quantify the cost of implementing the industrial policy, and our recommendations are therefore not based on a fully informed cost-benefit analysis.

Measuring the complexity of countries and products

Different studies in the literature of economic complexity have proposed different methods to measure countries' productive capabilities and products' sophistication. Yet, all approaches rely on the same basic intuition developed in Hidalgo and Hasumann (2009).[5] The intuition is illustrated in Figure 5.

[5] *See Tacchella et al. (2012) for a different method.*

Figure 5: The hidden capabilities layer



Source: reproduced from Sørensen (2020), originally based on Cristelli et al. (2013).

Countries are connected to products via their productive capabilities. It is impossible to observe these capabilities directly. Instead, we can infer how many complementary capabilities a country has (and that products require in their production) through the country-product network embedded in world trade data. The country-product network simply links countries to products through their exports. The idea is that countries that can export many products can be assumed to have many productive capabilities. A first approximation of countries' complexity is therefore their export diversity. Following the same logic, products that only a few countries can export must be difficult to produce, so their production requires rare productive capabilities that are hard to acquire. The ubiquity of a product (how many countries can produce it) is therefore a first approximation of product complexity. The higher the ubiquity, the lower the complexity.

To measure country and product complexity, we follow the approach in Hidalgo and Hausmann (2009). We first use Balassa's (1965) who revealed comparative advantage (RCA) to measure whether a country *c* exports a product *p* competitively in year *t*:

$$RCA_{cpt} = \frac{X_{cpt}}{\sum_{c} X_{cpt}} \Big/ \frac{1}{4} \sum_{i=t}^{t-3} \frac{\sum_{pt} X_{cpi}}{\sum_{cpi} X_{cpi}},$$

where X denote export value. We smooth the denominator in the equation over four years to make the measure less volatile. We can now define the country-product network from Figure 1 formally. Define:

$$M_{cpt} = \begin{cases} 1 & \text{if} \quad RCA_{cpt} \geq 1 \\ 0 & \text{otherwise} \end{cases}$$

as a binary indicator of whether a country has revealed a comparative advantage in a product. If M_{cpt} equals one, there is a link between product *p* and country *c* in time *t.* If countries' exports to a product fluctuate around the threshold, their M_{cpt} may turn on and off several times. These jumps are more likely to be caused by price fluctuations, exchange rate volatility, or global business cycles than by actual year-to-year changes in countries' productive capabilities that are assumed to be slow-moving. To avoid this scenario, we fill-in temporary jumps in M_{cpt} using the lead and lagged values of RCA_{cpt}. Going forward we drop all time subscripts to avoid notation clutter, because all analysis is conducted on the yearly cross-section of the data.

We can use M_{cp} to measure the complexity of countries and products. Following the intuition described above, a first measure of a country's complexity is that amount of products that it exports, which we call *diversity*:

$$Diversity_c = k_{c,0} = \sum_p M_{c,p}.$$

Likewise, the *ubiquity* of a product is a (inverse) measure of its complexity:

$$Ubiquity_p = k_{p,0} = \sum_c M_{c,p}.$$

Ubiquity and diversity are imperfect approximations of product and country complexity. Consider diamonds as an illustration: only a handful of countries can export them, yet they don't require many sophisticated capabilities to mine. Furthermore, the few countries that do export diamonds (like Botswana) tend not to be complex economies that export many other goods. To address these nuances, we can refine our initial proxy for diamond complexity by considering the complexity of the countries producing them, that is, by weighting the ubiquity measure for diamonds with the diversity of the countries that export diamonds. Similarly, our initial measure of the country's complexity can be adjusted by considering the ubiquity of the products a country can manufacture. In fact, it is possible to jointly and iteratively adjust the measures of country and product complexity by weighting one measure with the other. This procedure is known as the Method of Reflections (Hidalgo and Hausmann 2009):

$$k_{c,N} = \frac{1}{k_{c,0}} \sum_p M_{c,p} \times k_{p,N-1}$$

and

$$k_{p,N} = \frac{1}{k_{p,0}} \sum_c M_{c,p} \times k_{c,N-1}$$

where k_c and k_p are measures of country and product complexity after N iterations of the algorithm. As $N \to \infty$ the measures converge to fixed points. These fixed-point solutions can also be formulated as eigenvector problems. The eigenvectors associated with the second-largest eigenvalues capture the largest variance in the system. We define standardize the values in these vectors within each year and define them as the Economic Complexity Index (ECI) for countries and the Product Complexity Index (PCI) for products following Hausman et al. (2013).

Measuring the relatedness of, and distance to, products

We measure the degree to which products rely on similar capabilities in their production by constructing the 'product space' network proposed in Hidalgo et al. (2007). The network links products that rely on similar capabilities. In this network, products are 'close' to each other if their production requirements are similar. Measuring the production similarity - or proximity - between products rests on a simple idea: if the countries exporting one product are observed to also export another product, then these two products must require similar capabilities in their production. Take the example of paper clips, needles, and jet engines. Many of the countries that export paper clips with a revealed comparative advantage will also export needles. These products have a high proximity. On the other hand, only a few of the countries that export paper clips and needles can produce jet engines. The capabilities required to produce jet engines are therefore not very close to the capabilities required to produce needles and paper clips. Formally, we define the proximity $\phi_{p,p'}$ between product p and p´ as the minimum pairwise probability that they are co-exported by countries:

$$\phi_{\mathrm{p,p'}} = min(P(M_{\mathrm{cp}} = 1 \mid M_{\mathrm{cp'}} = 1), P(M_{\mathrm{cp'}} = 1 \mid M_{\mathrm{cp}} = 1))$$

We can use the proximity between products to measure how far Kenya's current productive capabilities are from a given product. We call this measure distance. It captures how difficult it would be to develop a given product for Kenya. Formally, for any country c, their distance to product p is given by:

$$Distance_{cp} = \frac{\sum_{p'}(1 - M_{cp'})\phi_{p,p'}}{\sum_{p'}\phi_{p,p'}}.$$

Measuring opportunities for further diversification

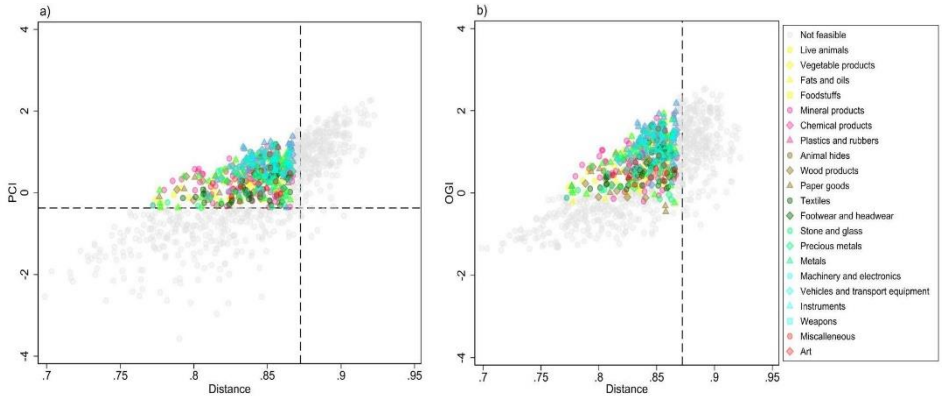
Following Hasumann et al. (2013), we finally combine the proximity and product complexity variables to create a measure of the extent to which developing a new product makes it easier to diversify into other complex products in the future. Formally, let product p's Opportunity Gain Index (OGI) be defined as follows:

$$\mathrm{OGI}_p = \sum_{p'} \frac{\phi_{p,p'}}{\sum_{p''} \phi_{p',p''}} (1 - M_{c,p'}) PCI_{p'}$$

Methodology: Selecting target products

From the view of economic complexity theory, Kenya's industrial policy strategy should support the production of highly complex products (measured by PCI) and products that rely on capabilities used in many other products, thereby opening paths to future diversification (measured by OGI). Yet, products with these characteristics are situated farther away from Kenya's productive knowledge (measured by distance). The trade-off between PCI/OGI and distance is seen in Figure 6, plotting the 1,009 products that Kenya did have a comparative advantage in exporting in 2021. In the next sections, we define a range of 'feasible products' based on this trade-off and outline the process of refining them into 'target products' using weights.

Figure 6: Identifying the set of feasible products for Kenya



Source: authors' calculations based on trade data from Growth Lab (2023).

Feasible products

To identify feasible products that Kenya could potentially diversify into, we first apply two filters to exclude some of the 1,009 products that Kenya's is not currently exporting with a comparative advantage. The filters are represented by dotted lines in Figure 6, and the feasible products are those colored in both Figure 6a and 6b. The first filter excludes products with a complexity score lower than Kenya's current average complexity. These products would not increase the complexity of Kenya. The second filter, adopted from Hausmann and Chauvin (2015), excludes all products that are located far away from

Kenya's current capabilities. Specifically, we drop all products beyond the 75th percentile of distance.

By applying the two filters, the set potential products for Kenya to target drops from 1,009 to 633 feasible products. There are obviously still too many products for any meaningful targeting. In the next section, we lay out a method to filter out more products such that we end up with limited set of 'target products' from the pool of 'feasible products.

Choosing a weighting scheme

To refine the product selection, we adopt the weighting-scheme approach suggested in the literature (Hausmann et al. 2014, 2019; Hausmann and Chauvin 2015). Target products are chosen through a new index, calculated as a weighted sum of standardized values for distance, PCI, and OGI. Standardization facilitates direct comparison of variables and enables us to assign an importance to each through weights. Notably, when we assign a weight to distance we are, in fact, assigning a weight to its inverse - density - measuring Kenya's proximity to a product. We propose four weighting schemes (based on two strategies, each with two components). The weighting schemes are depicted in Table 1. We picked the top 25 products selected from each of the four weighting schemes.

Table 1: Weighting scheme

Strategy	Component	Weights		
		Distance	PCI	OGI
Low-Hanging Fruits	Leverage & Support (0.1<RCA<1)	0.65	0.10	0.25
	Diversify & Scale (RCA<0.1)	0.80	0.05	0.15
Strategic Bets	Leverage & Support (0.1<RCA<1)	0.40	0.15	0.45
	Diversify & Scale (RCA<0.1)	0.70	0.10	0.20

Source: authors' construction.

Below, we motivate our choice of weighting schemes with three propositions based on Sørensen et al. (2020).

Proposition 1: Kenya's industrial policy must find a balance between prioritizing industries that can develop relatively quickly (industries with a low distance to Kenya's current productive capabilities) and more complex industries that can only develop over the longer term (industries located further away from Kenya in the Product Space). To address both priorities, we develop two weighting strategies: a 'low-hanging fruits' component, where

distance has a high weight, and a 'strategic bets' component, favoring substantial leaps into high OGI and PCI products.

Proposition 2: As argued in Sørensen et al. (2020), it is easier for a country to establish a comparative advantage in a product it already exports (0<RCA<1). In other words, a country's distance from a product does not matter as much if it already exports that product non-competitively. The reason is that if a country already has some exports in a product, it must also already have some of the capabilities to export that product. Based on these observations, we divide each weighting strategy into two components. The Leverage & Support component focuses on products that Kenya already exports semi-competitively (0.1<RCA<1). Here, we can assign a smaller weight to distance (Kenya already has capabilities related to the product) and higher weights for PCI and OGI. The Diversify & Scale component prioritizes entirely new product sectors in which Kenya has no exports or has very little current exports (RCA<0.1). Because it is difficult for Kenya to move into these products, we assign a high weight to distance in this strategy and lower weights to PCI and OGI

Proposition 3: It is reasonable to assume that market actors have an incentive to export products of high complexity. Therefore, industrial policy does not have to incentivize the development of these complex products (assuming that there are no additional learning-by-doing externalities in complex products that entrepreneurs cannot internalize). On the other hand, market actors may not internalize the externalities associated with developing products that make it easier for entrepreneurs to move into other products (high OGI-products). We therefore always assign a higher weight to OGI than to PCI.

Three additional comments related to the weighting schemes and selection of target products are worth highlighting. First, it is important to note that choosing a weighting scheme is more an art than an exact science. It is ultimately a political choice. We motivate our choice of weights based on the three propositions above, but ultimately the weights should be seen as illustrative and purposefully capturing a wide range of possible products that Kenya could target. In the final section of the supply-side analysis, we show how sensitive the selection of target products is to the choice of weights.

Second, it is also important to highlight that a policymaker may value additional objectives other than the three criteria used in our weighting scheme (distance, OGI, PCI). In Kenya, for instance, a key policy concern is generating new jobs. Suggestive evidence in Estmann et al. (2022) indicates that complex products tend to be less labor-intensive, so incorporating a

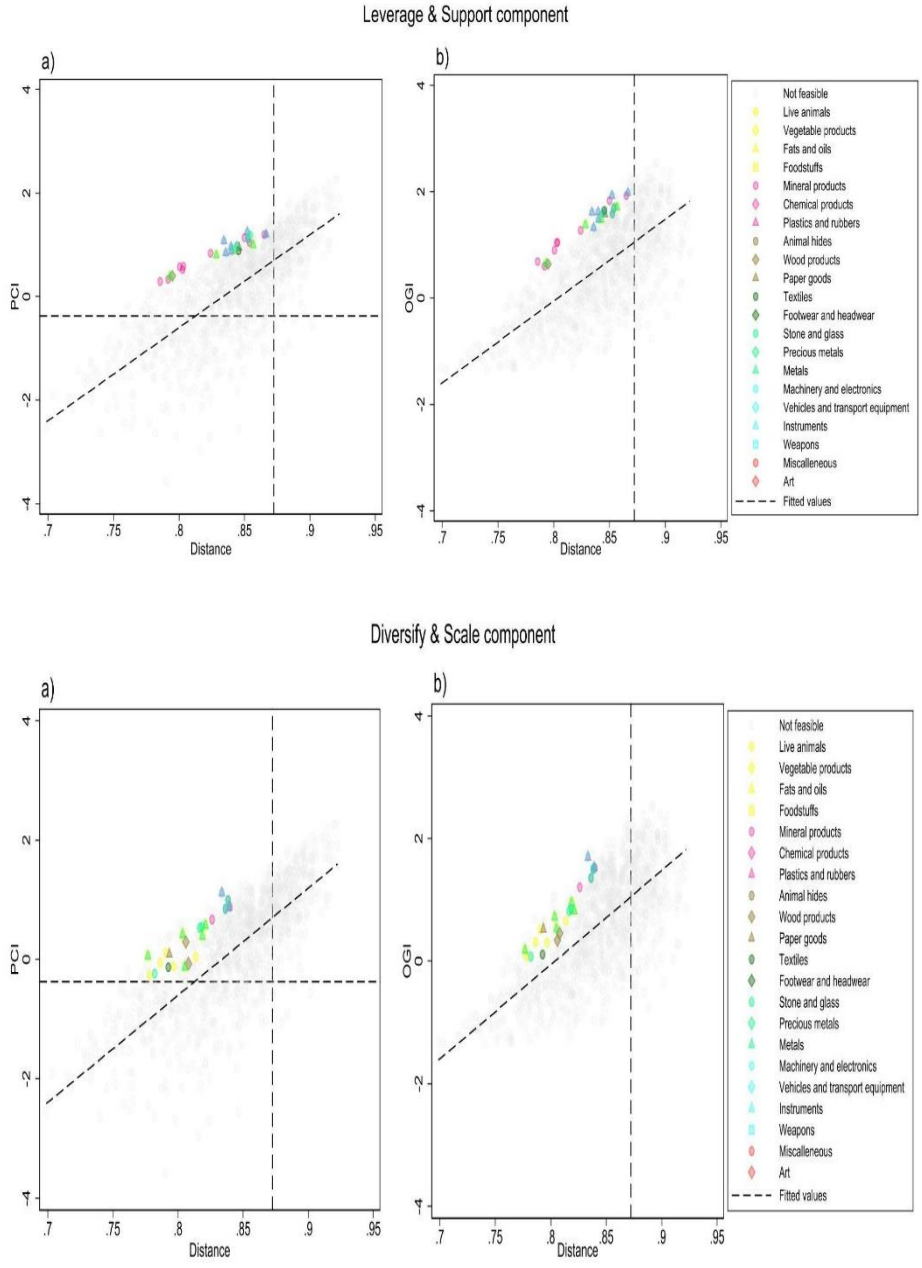
measure of labor absorption into the weighting would likely change the selection of some target products. An advantage of our analysis is that such considerations could easily be incorporated if data is available.

Finally, we also note that the distance measure used in our weighting scheme is constructed from general patterns of co-exportation of products across different countries (see description in Section 3.2). The product proximities used to construct the measure are not context specific. In fact, the only context-specific element of the distance measure is each country's pattern of specialization. Distance is thus a rough measure of how difficult it would be for Kenya to develop a comparative advantage in a new product. In Kenya, some sectors face context-specific constraints - such as the lack of raw materials and inputs - which may make Kenya's *actual* distance to a new product deviate significantly from our applied distance measure. We therefore view our analysis as providing a systematic identification of products and sectors that are *potentially* viable to develop in Kenya. Further in-depth analysis of context-specific constraints would be advisable before any industrial policy measures are implemented. We will return to this discussion at the end of the paper, where we discuss the policy recommendations from our analysis.

Results: Kenya's target products

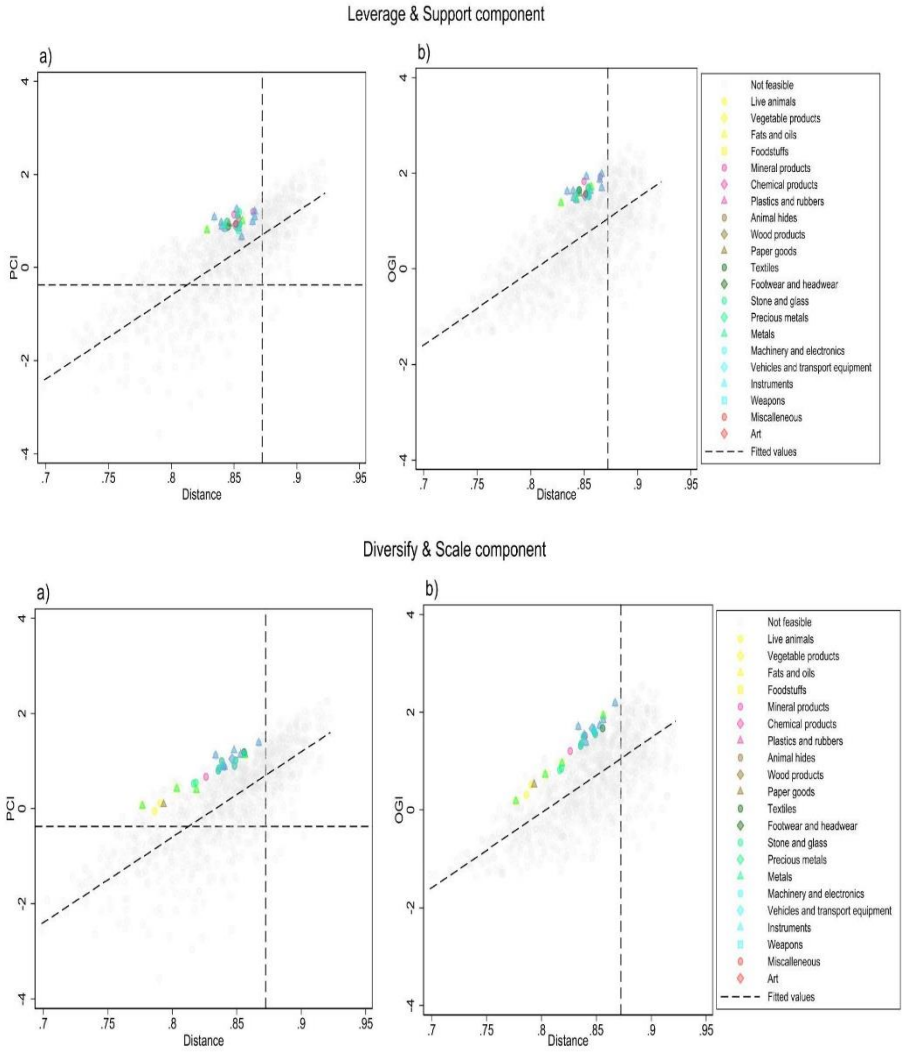
We select the top 25 products from each of the four weighting schemes in Table 1. We end up with 70 target products for Kenya because some products are selected with multiple weighting schemes. Figure 7 and 8 shows the 70 target products that we pick out. The weighting schemes pick out products that both lie far away and very close to Kenya's current productive knowledge. We also provide a detailed description of these products in Tables A1-A4 in the Appendix.

Figure 7: Target products in Low-Hanging Fruits strategy



Source: authors' calculations based on trade data from Growth Lab (2023).

Figure 8: Target products in Strategic Bets strategy



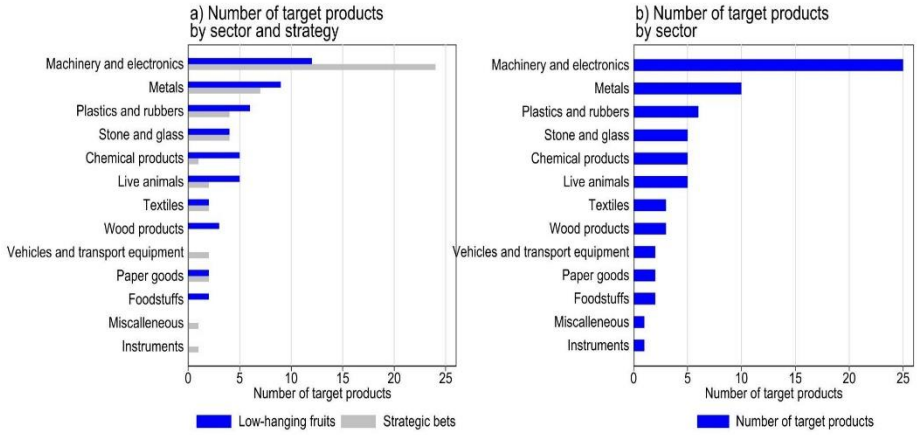
Source: authors' calculations based on trade data from Growth Lab (2023).

To summarize our findings, Figure 9a shows the number of target products selected with each weighting strategy within broad product sectors. Since 30 of the 70 products are selected by both strategies, we plot the total number of unique products selected by both strategies within each sector in Figure 9b. From Figure 9a both strategies identify target products in a wide range of sectors. This suggests that an optimal industrial policy for Kenya should generally be broad in scope and not focus on one specific sector. This is

especially true if Kenya wants to follow the Low-Hanging Fruits strategy, where we identify the most equal distribution of target products across sectors.

It is important to note, however, that some sectors seem especially promising. This is particularly true for the Machinery & Electronics sector, where we find 25 out of the 70 unique target products. The sector is attractive because many products in the sector are highly complex and rely on complementary capabilities that make it easier to diversify into other related products. Interestingly, Machinery & Electronics is the most attractive sector irrespective of the weighting strategy applied. However, the distribution is particularly skewed towards specialization in this sector if Kenya decides to pursue high-complexity products with the Strategic Bets strategy, which identifies 24 out of 50 target products from the sector. In addition to Machinery & Electronics, we also find many target products related to the production of Metals (10 out of 70). These two sectors therefore seem to be important for increasing diversification and industrial upgrading of Kenya's economy.

Figure 9: Number of target products, by HS product section and strategy



Source: authors' calculations based on trade data from Growth Lab (2023).

As a robustness check, we also conduct a simulation to explore how our choice of weights influences the target product selection. We describe the simulation in detail in the Appendix 2 and present the results in Figure A1. The simulation shows that the selection of target products is sensitive to the weighting scheme applied. This is not cause for concern, however, because the selection of target products is exactly intended to depend on the choice of weights. Yet, the analysis does highlight that one needs to be mindful that choosing target products is not an exact science but depends on political choices.

4. Demand-side analysis

This section takes demand-side factors into account. Taking the target products identified above as given, the section first identifies which of these target products have the highest export potential. Then the section studies which countries constitute the biggest export markets for these products. The analysis builds on a gravity model framework accounting for product-specific factors (such as transportation costs), import market factors (such as product-specific demand in different countries), and exporter-importer relevant factors (such as the physical distance between countries).

Data

We use two datasets in the analysis. The first dataset is world trade data at the importer-exporter-product-level covering the last decade (2012–21). Like the data used in the supply-side analysis, this data is also collected by United Nations Statistical Division (COMTRADE) and compiled and cleaned by the Growth Lab at Harvard University (Growth Lab 2023). First, we drop countries with unreliable trade data (Chad, Iraq, Macau, and Afghanistan). Then we drop all non-target products, because we are only interested in measuring the export potential for Kenya in their target products. Finally, we 'square' the dataset, inserting zeroes for any missing exporter-importer-product-year combination. The final data contains 36,964,480 observations, describing the trade pattern between 49,952 exporter-importer pairs in Kenya's 70 target products.

We combine the trade data with information from the Gravity dataset compiled by the Centre d'Études Prospectives et d'Informations Internationales (Conte, Cotterlaz, and Mayer 2023). The dataset contains information needed for our gravity model estimations such as the physical distance between countries, their language similarity, past colonial relationships, and whether they are part of the same regional trade agreements.

Methodology: gravity model

Estimating the gravity model

We use gravity model estimates to predict Kenya's trade potential in each product, and to predict which importers will drive demand for Kenya's products. We estimate a gravity model for each target product thereby allowing for product-specific slope parameters and fixed effects. The models are estimated in their multiplicative form with a Poisson Pseudo Maximum Likelihood (PPML) estimator. The PPML estimator has several advantages over log-linearized ordinary least squares (OLS) estimation. Santos Silva and

Tenreyro (2006) show that the PPML estimator is more robust heteroskedasticity, and that it produces consistent estimates in cases where the dependent variable contains many zeroes (as is the case with our bilateral, product-level trade data). Another neat feature of the PPML estimator is that it automatically produces predicted export flows that sum to the actual trade flows observed in the data (Fally, 2015).

The product-level PPML regressions are given by:

$$X_{cit}^{\{p\}} = \exp\left(\alpha^{\{p\}} + \beta^{\{p\}}\mathrm{D}_{cit} + \gamma_{ct}^{\{p\}} + \lambda_{it}^{\{p\}}\right) \times u_{cit}^{p}$$

where $X_{cit}^{\{p\}}$ is the export volume from exporting country c to importing country i in year t in product p. D_{cit} is a vector of 'distance variables' understood in the broadest sense between each exporter-importer pair. It includes the (log of) the physical distance between the most populous cities in each country and along with a set of dummy variables indicating whether country c and i share a border (contiguity), a common language, former colonial ties, or a common colonizer. These distance variables neither vary over time or across products. In addition, D_{cit} includes one-time varying indicator for whether an exporter-importer pair is part of a common regional trade agreement (hence the t subscript).[6]

Table 2: Average coefficient estimates and standard errors across target products

	OLS	PPML
	(1)	(2)
Distance	-1,14	-0,83
	(0,04)	(0,06)
Contiguity	0,74	0,57
	(0,11)	(0,13)
Common language	0,49	0,47

[6] The distance variables are included to proxy for trade costs. We include the 'standard' distance variables commonly used in the literature in our regressions, but the model's predictions could potentially be improved through the inclusion of better proxies for trade cost such as the actual cost of shipping a container between countries; travel time by ship, air, and road; product-country-pair level measures of tariff and non-tariff barriers; and so forth.

	(0,08)	(0,14)
Colonial tie	0,51	0,03
	(0,13)	(0,17)
Common colonizer	0,66	0,49
	(0,12)	(0,26)
RTA	0,26	0,58
	(0,07)	(0,13)
Importer-year FE	yes	yes
Exporter-year FE	yes	yes

Note: dependent variable is trade volume (PPML) and log of trade volume (OLS) in the years 2012–21; coefficients and standard errors refers to averages across regressions (one for each target product); standard errors clustered at the importer-exporter level in parentheses.

Source: authors' calculations based on data from Growth Lab (2023), and CEPII (CEPII 2021; Mayer and Zignago 2011) as described in the data section.

Because we run the gravity regression separately for each of Kenya's 70 target product, all coefficient estimates vary at the product level, indicated by the superscript $\{p\}$. $\alpha^{\{p\}}$ indicates a common intercept, and $\lambda_{it}^{\{p\}}$ and $\gamma_{ct}^{\{p\}}$ denote country-year and importer-year fixed effects, respectively. Using fixed effects to control for exporters' output, importers' expenditure, and their respective multilateral resistance terms is widely considered the theory-consistent gold standard in gravity estimation (Head and Mayer 2014). $u_{cit}^{\{p\}}$ is the error term.

Table 2 presents the *average* coefficient estimates and standard errors (clustered at the importer-exporter level) across all 70 regressions. For comparison, we show OLS estimates in column 1, but we will rely on the PPML estimates from column 2 to predict trade flows. The estimates are in line with what is typically found in the literature (see Head and Mayer (2014) for a meta-analysis). The average distance elasticity found in the literature (-0.93) is slightly larger in magnitude than our estimate, suggesting that the target products we select for Kenya have a relatively low transport cost.

Predicted export potential

We use the product-specific coefficients from each gravity regression to forecast the export potential of Kenya's target products and the market potential of its trade partners. Let the predicted export value from country *c* to an importer *i* in target product *p* at time *t* be defined as:

$$\hat{X}_{cit}^{\{p\}} = \exp(\hat{\alpha}^{\{p\}} + \hat{\beta}^{\{p\}}\mathbf{D}_{cit} + \hat{\lambda}_{it}^{\{p\}})$$

Note that we leave out leave out importer-year fixed effects when predicting the export in a product. This is because we want to prevent Kenya's *current* export capacity from influencing our assessment of its *future* export potential in the target products. We seek to predict demand while holding the supply side constant.

We first use the predicted export values to rank products according to their export potential for Kenya. We do so by creating a product export potential (PEP) index, that is defined as the sum of the total predicted export volume from Kenya to its trade partners in all target products across ten years (2012-2021):

$$\mathrm{PEP}_p = \sum_{it} \hat{X}_{cit}^{\{p\}} \times \mathbf{1}[c = Kenya]$$

where $\mathbf{1}[\cdot]$ is an indicator function taking the value one if the expression in square brackets is true. PEP_p is a measure of the potential trade volume Kenya can achieve in each of its target products. The product-level variation comes from different import volumes across products and product-specific slope parameters.

Analogously, we identify which export markets are likely to drive demand for Kenya's target products by summing Kenya's predicted exports of all target products to destination *i*. We call this the Market Export Potential (MEP) index:

$$\mathrm{MEP}_i = \sum_{pt} \hat{X}_{cit}^{\{p\}} \times \mathbf{1}[c = Kenya]$$

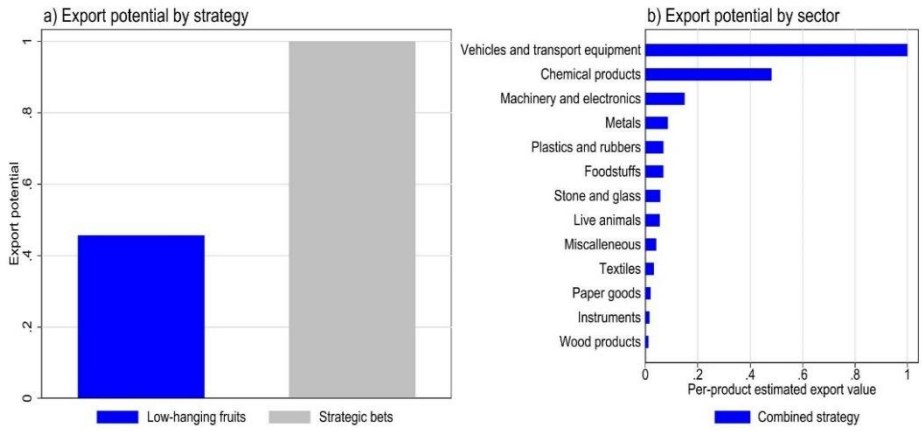
Results

Product Export Potential

Figure 10a shows the PEPs for Kenya's 50 target products identified by the Low-Hanging Fruits and Strategic Bets strategies. The figure illustrates the predicted export revenue with each strategy if Kenya were to export all target products with equal capability. Values normalized to a percentage of the total estimated exports for all target products identified by the Strategic Bets component to ease interpretation. We find the highest export potential in the complex products identified with the Strategic Bets strategy. Yet, as described

in the supply-side analysis, these are also the products that lie farthest away from Kenya's current productive capabilities. In contrast, the products identified with the Low-Hanging Fruits strategy require productive capabilities closer to the ones Kenya already have, but they are both of lower complexity and their estimated export potential is less than half that of the products from the Strategic Bets strategy.

Figure 10: Total PEP and average PEP by product section and strategy



Note: PEP estimates are based on the PPML regression with exporter-year and importer-year fixed effects (Column 2, Table 2).
Source: authors' calculations based on trade data from Growth Lab (2023).

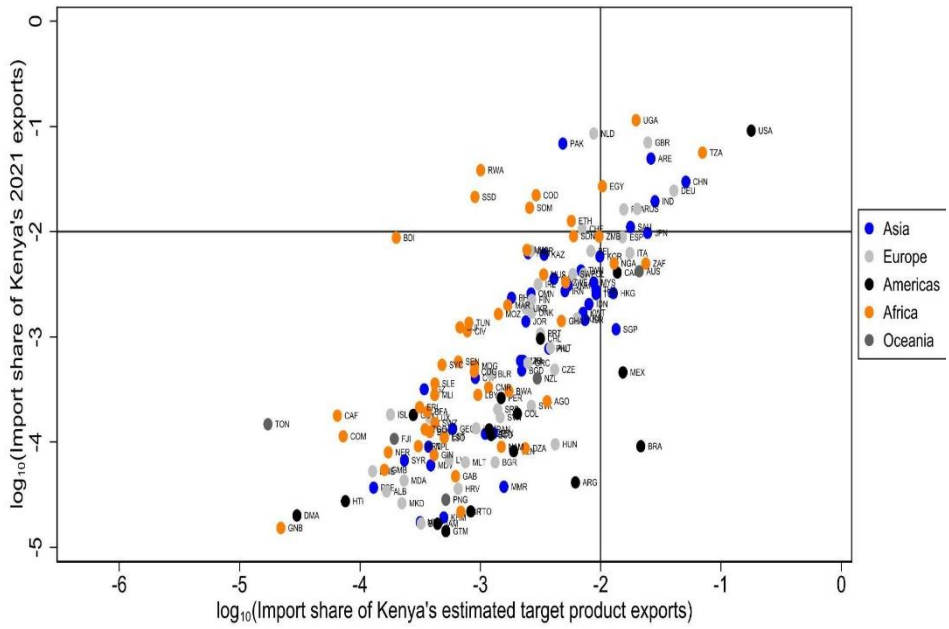
What is the estimated export potential across sectors? Figure 10b presents the PEP distribution averaged over the number of products within each section and strategy to provide a per-product export potential for comparison. Again, these average PEP values are normalized, with the highest average assigned the value 1. Figure 10b shows some important synergies between the supply-side analysis and the demand-side analysis. In the supply-side analysis, we identified many target products in the Machinery & Electronics sector (25), Metals (10), and Chemicals (5) to be important drivers of structural change. Products within these sectors all seem to have a high export potential for Kenya too. We also identified many Plastic and Rubber products in the supply-side analysis (6), but these seem to have a lower export potential. The two target products identified in Vehicles & Transport Equipment appear to have very high export potential too.

In addition to these sector-level statistics, we also present a detailed breakdown of each target product's export potential in Table A.5 in the appendix. The highest export potential is found in packaged medicaments.

Market Export Potential

Figure 11 displays the export potential of different markets for Kenya's target products (e.g. Kenya's MEPs). The top 50 markets are also listed in Table A.6 in the appendix. Figure 11 plots Kenya's trade partners according to their predicted import of Kenya's target products as a share of Kenya's cumulated predicted exports in these products (x-axis) and their current import share of Kenya's total exports (y-axis).

Figure 11: Import share of Kenya's 2021 exports versus import share of Kenya's estimated target product exports over ten years



Note: MEP estimates are based on the PPML regression with exporter-year and importer-year fixed effects (Column 2, Table 2).
Source: authors' calculations based on trade data from Growth Lab (2023).

Countries in the lower-left quadrant are countries that do not buy much of Kenya's current exports and are not predicted to drive demand for Kenya's target products. This is *a low-potential* export market. Countries in the upper-left quadrant are currently important for Kenya's exports, but their predicted

demand for Kenya's target products are low, i.e. *hard-to-exploit* export markets. Countries in the upper-right quadrant are *high-potential* countries. These countries are both important for Kenya's current exports and they will also be important export markets for Kenya's target products. The countries include China, Egypt, France, Germany, Great Britain, India, Russia, Saudi Arabia, Tanzania, Uganda, United Arab Emirates, and US.[7] We find *high-opportunity* markets in the lower-right quadrant. These countries are not currently important for Kenya's exports, but the nature of their demand and/or their 'closeness' to Kenya make them potential growth markets for Kenya's target products. These countries include, among others, Australia, Canada, Italy, Japan, Nigeria, South Africa, Spain, and Zambia.[8]

5. Conclusion and recommendations

Conclusion

We conduct a systematic analysis of Kenya's exports to identify products and sectors that can help Kenya achieve the ambitious goal of becoming a globally competitive and successful economy with a high standard of living by 2030.

Using network science methods from the field of Economic Complexity, we identify target products that i) are relatively easy for Kenya to develop; ii) are complex; and iii) will ease diversification into other complex products in the future. Using these criteria, we select target products with two strategies: a Low-Hanging Fruits strategy that prioritizes products close to Kenya's current capabilities, and a Strategic Bets strategy that prioritizes long jumps into sophisticated products.

We identify 50 target products with each strategy and 70 unique products in total. The target products come from a wide range of sectors, suggesting that an optimal industrial policy for Kenya should be broad and not focus on one specific sector. This is especially true if Kenya wants to follow the Low-Hanging Fruits strategy where we identify the most equal distribution of target products across sectors. It is noteworthy, however, that we find most target products in sectors like Machinery & Electronics and Metals. These promising

[7] The political situation in some of these countries may, of course, make it politically undesirable to promote exports to their markets.

[8] While we do identify some of Kenya's regional neighbors to lie in the right-most quadrants, it is important to highlight that our results may understate the importance of Kenya's regional trade partners since a significant share of regional trade flows are informal and therefore not captured by official trade statistics. The measurement error is, however, only problematic if Kenya's neighbors tend to import the target products through informal trade routes.

sectors are therefore important to support to increase diversification and industrial upgrading of Kenya's economy.

In a subsequent demand-side analysis, we use gravity models to estimate the export potential of Kenya's target products. We also analyze which markets are likely to drive demand for the products. Our findings are fourfold. First, we find a substantially higher export potential for the target products identified with the Strategic Bets strategy. Second, we find high export potential for target products in Machinery & Electronics and Metals, indicating that products in these sectors are also viable when considering the demand side. Third, target products from sectors like Vehicles & Transport Equipment and Chemicals have a very high export potential. Finally, many of Kenya's largest current trade partners also seem to be viable export markets for Kenya's target products. Yet, we also identify demand in countries that do not currently import much of Kenya's exports.

Recommendations

The analysis can be used to guide industrial policy, which should address both supply-side and demand-side constraints. The most important policy recommendations are listed below.

Recommendation 1: Identify and alleviate bottlenecks and constraints to growth in target sectors that already have a foothold in Kenya. From a supply-side perspective, the government must work to identify and alleviate current bottlenecks and constraints to growth in Kenya's target products and high-potential sectors. Alleviating constraints should take precedence over handing out market-distorting incentive schemes. This objective can be pursued in several ways. First, the government may consider facilitating more public-private dialogue to understand and solve the constraints faced by the private sector. This should be a dynamic and iterative process with an emphasis on continuous evaluation and monitoring of results. Second, the identification of key constraints could also be pursued through further in-depth, sector-specific research focusing on the high-potential products and sectors that this paper has identified.

Recommendation 2: Promote direct investments in target sectors with little current production. In target products that have little or no current presence in Kenya, and that are located further away from Kenya's current economic structure, the government cannot simply rely on helping existing actors thrive. Here, targeted investment promotion efforts may be an option to attract both domestic and foreign direct investments. Foreign companies could have a special role to play here because they often come with superior technology and know-how that is necessary to establish new industries and that can "spill

over" to domestic firms over time. Even "soft touch" information campaigns may attract foreign investors when they are made aware of the potential opportunities in Kenya.

Recommendation 3: Initiate export marketing campaigns for high-complexity sectors in high-potential and high-opportunity markets. From a demand-side perspective, our analysis suggests that Kenya should launch targeted marketing campaigns to promote the export of its target products and high-potential sectors such as Machinery & Electronics, Chemical products, and Metals. Such campaigns can raise awareness about Kenya's capabilities and offerings in these sectors, attract foreign buyers, and stimulate demand for Kenyan products. The campaigns could ideally be targeted to the countries we identify as high-potential and high-opportunity markets.

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7. Appendices

Appendix 1 – Target Products

Table A1: Target products from Low-Hanging Fruits strategy, Leverage & Support component

HS code	Name	Sector	Rank	RCA	Density	PCI	OGI	Weighted score
8419	Equipment for temperature change of materials	Machinery and electronics	1	0,11	-0,02	1,25	1,93	0,59
8431	Parts for use with hoists and excavation machinery	Machinery and electronics	2	0,60	0,12	1,07	1,61	0,59
3005	Wadding, gauze and bandages	Chemical products	3	0,37	0,00	1,14	1,83	0,57
3214	Glaziers' putty	Chemical products	4	0,70	0,37	0,58	1,05	0,56
3208	Paints and varnishes, nonaqueous	Chemical products	5	0,56	0,38	0,52	1,04	0,56
8421	Centrifuges	Machinery and electronics	6	0,11	0,08	0,96	1,62	0,55
3921	Other plastic plates, sheets etc.	Plastics and rubbers	7	0,28	0,39	0,57	0,90	0,54
3004	Medicaments, packaged	Chemical products	8	0,79	0,21	0,84	1,27	0,54
3305	Hair products	Chemical products	9	0,67	0,51	0,29	0,68	0,53
7326	Other articles of iron or steel	Metals	10	0,11	0,17	0,80	1,37	0,53
8538	Parts for electrical apparatus	Machinery and electronics	11	0,17	0,04	0,99	1,61	0,53
8468	Machinery for soldering	Machinery and electronics	12	0,12	-0,14	1,20	1,98	0,53
6805	Natural or artificial abrasive powder	Stone and glass	13	0,14	-0,04	1,19	1,71	0,52
5603	Nonwoven textiles	Textiles	14	0,12	0,03	0,88	1,64	0,52
4006	Unvulcanized rubber rods	Plastics and rubbers	15	0,66	-0,12	1,20	1,92	0,52
4902	Newspapers, journals and periodicals	Paper goods	16	0,20	0,03	0,94	1,57	0,51
8433	Harvesting or agricultural machinery	Machinery and electronics	17	0,12	0,08	0,87	1,48	0,51
3905	Polymers of vinyl acetate	Plastics and rubbers	18	0,56	-0,03	1,05	1,68	0,50
7308	Structures and their parts, of iron or steel	Metals	19	0,42	0,45	0,39	0,65	0,50
7320	Springs of iron or steel	Metals	20	0,34	0,06	0,91	1,47	0,50
8307	Flexible tubing of base metal	Metals	21	0,23	-0,06	1,00	1,71	0,49
8524	Tapes, cassettes, records and compact disks	Machinery and electronics	22	0,32	-0,02	1,11	1,58	0,49
8436	Other agricultural machinery	Machinery and electronics	23	0,11	0,11	0,85	1,32	0,49
3920	Other plates of plastics, noncellular and not reinforced	Plastics and rubbers	24	0,73	0,47	0,33	0,60	0,48
4415	Packing boxes	Wood products	25	0,12	0,44	0,40	0,64	0,48

Table A2: Target products from Strategic Bets strategy, Leverage & Support component

HS code	Name	Sector	Rank	RCA	Density	PCI	OGI	Weighted score
8419	Equipment for temperature change of materials	Machinery and electronics	1	0,11	-0,02	1,25	1,93	1,05
8468	Machinery for soldering	Machinery and electronics	2	0,12	-0,14	1,20	1,98	1,02
4006	Unvulcanized rubber rods	Plastics and rubbers	3	0,66	-0,12	1,20	1,92	0,99
3005	Wadding, gauze and bandages	Chemical products	4	0,37	0,00	1,14	1,83	0,99
8484	Gaskets and similar joints of metal sheeting	Machinery and electronics	5	0,11	-0,12	0,98	1,86	0,94
8431	Parts for use with hoists and excavation machinery	Machinery and electronics	6	0,60	0,12	1,07	1,61	0,94
6805	Natural or artificial abrasive powder	Stone and glass	7	0,14	-0,04	1,19	1,71	0,93
8421	Centrifuges	Machinery and electronics	8	0,11	0,08	0,96	1,62	0,90
3905	Polymers of vinyl acetate	Plastics and rubbers	9	0,56	-0,03	1,05	1,68	0,90
8307	Flexible tubing of base metal	Metals	10	0,23	-0,06	1,00	1,71	0,90
8538	Parts for electrical apparatus	Machinery and electronics	11	0,17	0,04	0,99	1,61	0,89
5603	Nonwoven textiles	Textiles	12	0,12	0,03	0,88	1,64	0,89
8524	Tapes, cassettes, records and compact disks	Machinery and electronics	13	0,32	-0,02	1,11	1,58	0,87
8441	Other machinery for making paper	Machinery and electronics	14	0,26	-0,14	1,07	1,69	0,87
4902	Newspapers, journals and periodicals	Paper goods	15	0,20	0,03	0,94	1,57	0,86
9402	Medical, dental or veterinary furniture	Miscalleneous	16	0,39	-0,01	0,94	1,57	0,84
8433	Harvesting or agricultural machinery	Machinery and electronics	17	0,12	0,08	0,87	1,48	0,83
6815	Articles of stone or of other mineral substances	Stone and glass	18	0,13	-0,03	0,79	1,59	0,82
7320	Springs of iron or steel	Metals	19	0,34	0,06	0,91	1,47	0,82
8701	Tractors	Vehicles and transport equipment	20	0,42	-0,01	0,91	1,51	0,81
8426	Ships' derricks; cranes	Machinery and electronics	21	0,20	-0,05	0,65	1,63	0,81
7326	Other articles of iron or steel	Metals	22	0,11	0,17	0,80	1,37	0,81
8501	Electric motors and generators	Machinery and electronics	23	0,29	-0,04	0,93	1,51	0,80
8417	Industrial furnaces	Machinery and electronics	24	0,14	-0,03	0,84	1,52	0,80
8474	Machinery for working minerals	Machinery and electronics	25	0,76	0,06	0,83	1,44	0,79

Table A3: Target products from Low-Hanging Fruits strategy, Diversify & Scale component

HS code	Name	Sector	Rank	RCA	Den-sity	PCI	OGI	Weighted score
7612	Aluminum containers, <300 liters	Metals	1	0,08	0,58	0,06	0,18	0,50
0401	Milk	Live animals	2	0,09	0,47	0,11	0,51	0,46
0407	Eggs, in shell	Live animals	3	0,02	0,57	-0,26	0,07	0,46
0406	Cheese	Live animals	4	0,03	0,51	-0,05	0,31	0,45
4808	Corrugated paper and paperboard	Paper goods	5	0,07	0,45	0,09	0,52	0,44
6809	Plaster articles	Stone and glass	6	0,08	0,54	-0,24	0,07	0,43
7610	Aluminum structures (bridges, towers etc)	Metals	7	0,06	0,37	0,42	0,72	0,43
8428	Other lifting machinery	Machinery and electronics	8	0,02	0,13	1,12	1,70	0,41
1602	Other prepared or preserved meat	Foodstuffs	9	0,02	0,40	0,15	0,42	0,39
1806	Chocolates	Foodstuffs	10	0,09	0,34	0,29	0,64	0,38
0506	Bones, simply prepared	Live animals	11	0,04	0,43	-0,12	0,30	0,38
5601	Wadding of textile materials	Textiles	12	0,01	0,46	-0,13	0,11	0,38
4016	Other articles of vulcanized rubber	Plastics and rubbers	13	0,08	0,19	0,67	1,20	0,36
7616	Other articles of aluminum	Metals	14	0,03	0,25	0,40	0,95	0,36
6810	Articles of cement, of concrete or of artificial stone	Stone and glass	15	0,05	0,27	0,53	0,81	0,36
7215	Other bars and rods of iron or nonalloy steel	Metals	16	0,08	0,36	-0,13	0,53	0,36
7019	Glass fibers	Stone and glass	17	0,06	0,25	0,55	0,85	0,36
8530	Electric signal and traffic controls	Machinery and electronics	18	0,09	0,09	1,00	1,50	0,35
4418	Wood carpentry for construction	Wood products	19	0,03	0,35	0,29	0,34	0,35
8412	Other engines and motors	Machinery and electronics	20	0,03	0,08	0,88	1,53	0,34
4008	Vulcanized rubber plates	Plastics and rubbers	21	0,01	0,08	0,88	1,52	0,34
8002	Tin waste and scrap	Metals	22	0,00	0,23	0,57	0,82	0,34
4413	Densified wood	Wood products	23	0,01	0,33	-0,07	0,45	0,33
0408	Egg yolks	Live animals	24	0,00	0,29	0,04	0,66	0,33
8503	Parts for use with electric generators	Machinery and electronics	25	0,02	0,11	0,85	1,36	0,33

Table A4: Target products from Strategic Bets strategy, Diversify & Scale component

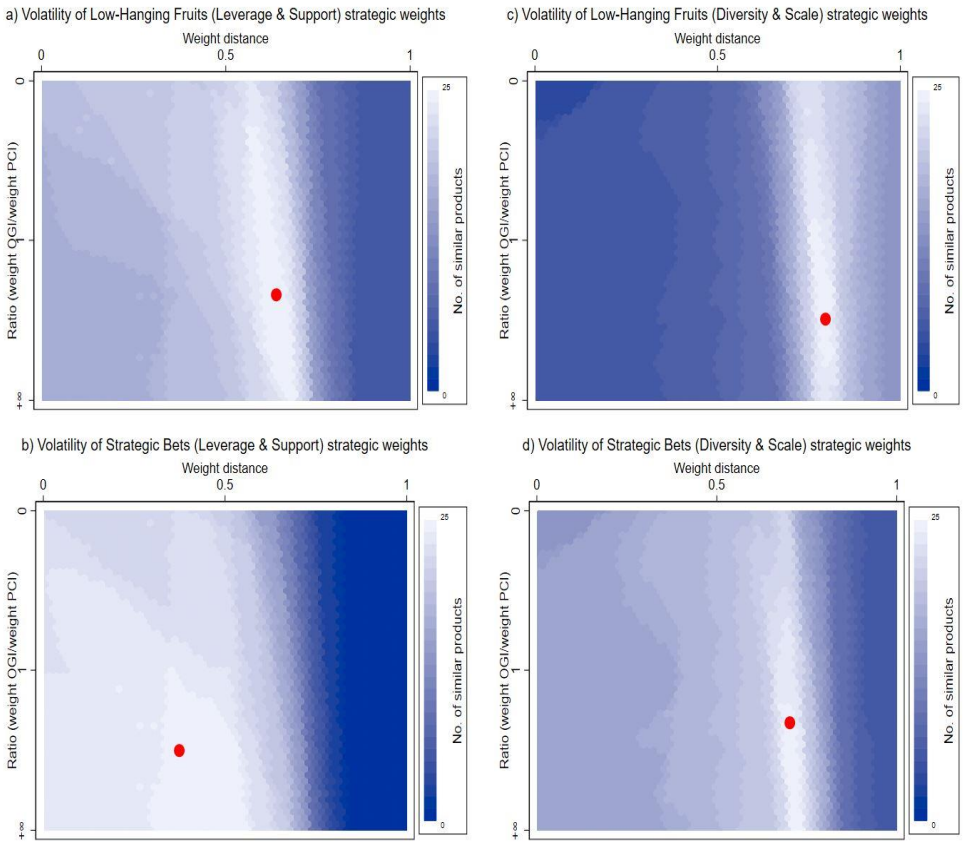
HS code	Name	Sector	Rank	RCA	Density	PCI	OGI	Weighted score
8428	Other lifting machinery	Machinery and electronics	1	0,02	0,13	1,12	1,70	0,54
8483	Transmission shafts	Machinery and electronics	2	0,05	-0,14	1,38	2,18	0,48
8530	Electric signal and traffic controls	Machinery and electronics	3	0,09	0,09	1,00	1,50	0,46
9033	Other parts for machines and appliances	Instruments	4	0,06	0,01	1,22	1,65	0,46
7307	Tube or pipe fittings of iron or steel	Metals	5	0,06	-0,05	1,13	1,93	0,46
8708	Parts of motor vehicles	Vehicles and transport equipment	6	0,04	0,03	1,04	1,66	0,46
8412	Other engines and motors	Machinery and electronics	7	0,03	0,08	0,88	1,53	0,45
7612	Aluminum containers, <300 liters	Metals	8	0,08	0,58	0,06	0,18	0,45
4008	Vulcanized rubber plates	Plastics and rubbers	9	0,01	0,08	0,88	1,52	0,45
8485	Machinery parts, not containing electrical features, n.e.c.	Machinery and electronics	10	0,05	-0,05	1,15	1,84	0,45
0401	Milk	Live animals	11	0,09	0,47	0,11	0,51	0,45
7610	Aluminum structures (bridges, towers etc)	Metals	12	0,06	0,37	0,42	0,72	0,44
4016	Other articles of vulcanized rubber	Plastics and rubbers	13	0,08	0,19	0,67	1,20	0,44
8422	Dish washing machines	Machinery and electronics	14	0,10	-0,03	1,13	1,72	0,44
8503	Parts for use with electric generators	Machinery and electronics	15	0,02	0,11	0,85	1,36	0,43
4808	Corrugated paper and paperboard	Paper goods	16	0,07	0,45	0,09	0,52	0,43
8546	Electrical insulators of any material	Machinery and electronics	17	0,07	0,11	0,80	1,31	0,42
5911	Textile articles for technical use	Textiles	18	0,03	-0,05	1,18	1,67	0,42
8526	Radar	Machinery and electronics	19	0,10	0,00	1,01	1,55	0,42
8512	Electrical lighting equipment used for motor vehicles	Machinery and electronics	20	0,01	0,01	0,90	1,59	0,41
0406	Cheese	Live animals	21	0,03	0,51	-0,05	0,31	0,41
8434	Dairy machinery	Machinery and electronics	22	0,07	0,07	0,87	1,37	0,41
7616	Other articles of aluminum	Metals	23	0,03	0,25	0,40	0,95	0,40

6810	Articles of cement, of concrete or of artificial stone	Stone and glass	24	0,05	0,27	0,53	0,81	0,40
7019	Glass fibers	Stone and glass	25	0,06	0,25	0,55	0,85	0,40

Appendix 2 - Robustness

This section describes a simulation exercise used to diagnose how sensitive the selection of target products is to the weighting scheme applied. The results are shown in Figure A1 which presents one bivariate histogram for each of our four weighting schemes. The bivariate histograms show the number of target products that we select with our strategy and would simultaneously select with alternative weighting schemes. The alternative weighting schemes are presented with the weight given to distance on the horizontal axis and the OGI-to-PCI weight ratio on the vertical axis. The weights are constructed such that they always sum to one. Our actual choice of weighting schemes from Table 1 are indicated with red dots (approximate position). As an example of how to interpret the histograms, consider Figure 7d. It shows that an extreme strategy putting close-to-exclusive weight on distance would only identify 5 of the same target products as we identify with the Diversify & Scale component of the Strategic Bets strategy.

Figure A1: Weighting scheme robustness checks



Note: the figure shows bivariate histograms of the target product overlapping between various arbitrary weighting schemes and the target products chosen by (a) the Low-Hanging Fruits strategy, Leverage & Support component, (b) the Strategic Bets strategy, Leverage & Support strategy component, (c) the Low-Hanging Fruits strategy, Diversify & Scale component, and (d) the Strategic Bets strategy, Diversify & Scale component.

Source: authors' calculations based on trade data from Growth Lab (2023).

The simulation reveals that the OGI-to-PCI weight ratio has a minor influence on target product selection, holding the distance-weight constant. This is consistent across all four strategy-component pairs due to the strong positive correlation between OGI and PCI. However, a significant shift in identified target products occurs when the distance weight changes around 0.75, leading to large complete changes in the selection of target products.

The analysis shows that the selection of target products is sensitive to the weighting scheme applied. This is not a cause for concern because the selection of target products is intended to depend on the choice of weights.

We use the weighting schemes to select some products over others given their characteristics. Yet, the analysis does highlight that one needs to be mindful that choosing target products is not an exact science but depends on political choices.

Appendix 3 - Export Potential (PEP)

Table A5: Product Export Potential (PEP) of target products

HS code	Name	Sector	Rank	Kenya's export value, current USD in thousands (2021)	Normalized Product Export Potential (PEP)
3004	Medicaments, packaged	Chemical products	1	117713	1,00
8708	Parts of motor vehicles	Vehicles and transport equipment	2	5258	0,70
8701	Tractors	Vehicles and transport equipment	3	9201	0,21
8483	Transmission shafts	Machinery and electronics	4	1211	0,19
8421	Centrifuges	Machinery and electronics	5	3509	0,18
8431	Parts for use with hoists and excavation machinery	Machinery and electronics	6	13172	0,17
8501	Electric motors and generators	Machinery and electronics	7	6715	0,17
8422	Dish washing machines	Machinery and electronics	8	1187	0,14
7308	Structures and their parts, of iron or steel	Metals	9	8751	0,13
8419	Equipment for temperature change of materials	Machinery and electronics	10	1719	0,12
7326	Other articles of iron or steel	Metals	11	2331	0,10
8428	Other lifting machinery	Machinery and electronics	12	197	0,08
8474	Machinery for working minerals	Machinery and electronics	13	4854	0,08
8538	Parts for electrical apparatus	Machinery and electronics	14	2416	0,08
0401	Milk	Live animals	15	329	0,07
3920	Other plates of plastics, noncellular and not reinforced	Plastics and rubbers	16	18047	0,07
8412	Other engines and motors	Machinery and electronics	17	318	0,06
8426	Ships' derricks; cranes	Machinery and electronics	18	994	0,06
8512	Electrical lighting equipment used for motor vehicles	Machinery and electronics	19	162	0,06
8526	Radar	Machinery and electronics	20	663	0,06
7307	Tube or pipe fittings of iron or steel	Metals	21	444	0,06
4016	Other articles of vulcanized rubber	Plastics and rubbers	22	849	0,05

8433	Harvesting or agricultural machinery	Machinery and electronics	23	1138	0,05
6809	Plaster articles	Stone and glass	24	72	0,05
8503	Parts for use with electric generators	Machinery and electronics	25	162	0,04
0406	Cheese	Live animals	26	365	0,04
3921	Other plastic plates, sheets etc.	Plastics and rubbers	27	3297	0,04
7610	Aluminum structures (bridges, towers etc)	Metals	28	345	0,03
8485	Machinery parts, not containing electrical features, n.e.c.	Machinery and electronics	29	194	0,03
1806	Chocolates	Foodstuffs	30	1040	0,03
1602	Other prepared or preserved meat	Foodstuffs	31	151	0,03
5603	Nonwoven textiles	Textiles	32	840	0,03
7616	Other articles of aluminum	Metals	33	187	0,03
8441	Other machinery for making paper	Machinery and electronics	34	760	0,03
6815	Articles of stone or of other mineral substances	Stone and glass	35	405	0,03
6810	Articles of cement, of concrete or of artificial stone	Stone and glass	36	248	0,03
3208	Paints and varnishes, nonaqueous	Chemical products	37	3208	0,03
8524	Tapes, cassettes, records and compact disks	Machinery and electronics	38	177	0,03
3005	Wadding, gauze and bandages	Chemical products	39	1207	0,02
3305	Hair products	Chemical products	40	3893	0,02
8436	Other agricultural machinery	Machinery and electronics	41	334	0,02
3214	Glaziers' putty	Chemical products	42	2526	0,02
8417	Industrial furnaces	Machinery and electronics	43	217	0,02
7019	Glass fibers	Stone and glass	44	277	0,02
9402	Medical, dental or veterinary furniture	Miscalleneous	45	674	0,02
3905	Polymers of vinyl acetate	Plastics and rubbers	46	1169	0,02
7320	Springs of iron or steel	Metals	47	952	0,01
4418	Wood carpentry for construction	Wood products	48	211	0,01
8484	Gaskets and similar joints of metal sheeting	Machinery and electronics	49	176	0,01
8307	Flexible tubing of base metal	Metals	50	234	0,01
4808	Corrugated paper and paperboard	Paper goods	51	58	0,01
5911	Textile articles for technical use	Textiles	52	54	0,01
8546	Electrical insulators of any material	Machinery and electronics	53	60	0,01
0407	Eggs, in shell	Live animals	54	40	0,01
8530	Electric signal and traffic controls	Machinery and electronics	55	91	0,01

6805	Natural or artificial abrasive powder	Stone and glass	56	270	0,01
4008	Vulcanized rubber plates	Plastics and rubbers	57	21	0,01
9033	Other parts for machines and appliances	Instruments	58	72	0,01
4902	Newspapers, journals and periodicals	Paper goods	59	196	0,01
7215	Other bars and rods of iron or nonalloy steel	Metals	60	95	0,01
7612	Aluminum containers, <300 liters	Metals	61	191	0,01
8434	Dairy machinery	Machinery and electronics	62	54	0,00
8468	Machinery for soldering	Machinery and electronics	63	45	0,00
5601	Wadding of textile materials	Textiles	64	13	0,00
4415	Packing boxes	Wood products	65	227	0,00
4006	Unvulcanized rubber rods	Plastics and rubbers	66	117	0,00
0408	Egg yolks	Live animals	67	0	0,00
0506	Bones, simply prepared	Live animals	68	6	0,00
4413	Densified wood	Wood products	69	2	0,00
8002	Tin waste and scrap	Metals	70	0	0,00

Table A6: Market Export Potential (MEP) in target products, Top 50

Country	Region	Rank	Kenya's export value in target products, current USD in thousands (2021)	Normalized Market Export Potential (MEP)
United States of America	Americas	1	538	1.00
Tanzania	Africa	2	48271	0.39
China	Asia	3	86	0.29
Germany	Europe	4	722	0.23
India	Asia	5	509	0.16
United Arab Emirates	Asia	6	457	0.15
United Kingdom	Europe	7	519	0.14
Japan	Asia	8	32	0.14
South Africa	Africa	9	809	0.13
Brazil	Americas	10	32	0.12
Australia	Oceania	11	108	0.12
Russian Federation	Europe	12	9	0.11
Uganda	Africa	13	63904	0.11
Saudi Arabia	Asia	14	128	0.10

Italy	Europe	15	491	0.10
France	Europe	16	1985	0.09
Mexico	Americas	17	150	0.09
Spain	Europe	18	7	0.09
Canada	Americas	19	599	0.08
Singapore	Asia	20	21	0.08
Nigeria	Africa	21	2881	0.07
Hong Kong	Asia	22	106	0.07
Egypt	Africa	23	130	0.06
South Korea	Asia	24	11	0.06
Zambia	Africa	25	12369	0.05
Turkey	Asia	26	2	0.05
Thailand	Asia	27	150	0.05
Malaysia	Asia	28	0	0.05
Netherlands	Europe	29	674	0.05
Belgium	Europe	30	479	0.05
Indonesia	Asia	31	3	0.04
Israel	Asia	32	84	0.04
Poland	Europe	33	15	0.04
Kuwait	Asia	34	0	0.04
Switzerland	Europe	35	97	0.04
Taiwan	Asia	36	0	0.04
Romania	Europe	37	0	0.04
Argentina	Americas	38	0	0.03
Sudan	Africa	39	1308	0.03
Sweden	Europe	40	34	0.03
Ethiopia	Africa	41	10338	0.03
Vietnam	Asia	42	1	0.03
Zimbabwe	Africa	43	3142	0.03
Iran	Asia	44	0	0.03
Pakistan	Asia	45	22	0.03
Ghana	Africa	46	2754	0.03
Hungary	Europe	47	0	0.02
Czech Republic	Europe	48	2	0.02
Qatar	Asia	49	30	0.02
Austria	Europe	50	10	0.02

Mission

To strengthen local capacity for conducting independent,
rigorous inquiry into the problems facing the management of economies in sub-Saharan Africa.

The mission rests on two basic premises: that development is more likely to occur where there is sustained sound management of the economy, and that such management is more likely to happen where there is an active, well-informed group of locally based professional economists to conduct policy-relevant research.

Bringing Rigour and Evidence to Economic Policy Making in Africa

- Improve quality.
- Ensure Sustainability.
- Expand influence.

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