

An Export-led Growth for Kenya: Where is the niche?

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Abstract

Structural Transformations has been identified as a solution to Africa's over reliance on agriculture and natural resource for strong economic growth and development. To this end, Kenya adopted the Kenya Vision 2030, an economic blueprint, to guide the transition to a newly industrializing middle-income country providing a high quality of life to its citizens by the year 2030. Achievement of this goal is hinged on diversification of the economy from agriculture to manufacturing and development of an export-oriented economy. The process of structural transformation entails the accumulation of skills and capabilities that can help an economy move from production of low complexity agricultural products to high complexity manufactured products and creating broad based employment opportunities for all its citizens. This study utilizes the economic complexity methodology to identify frontier products that could improve the country's export portfolio while at the same time promoting inclusive growth and providing broad-based employment.

It was established that sectors like: wood and wood products; animal and animal products; machinery/electrical products and metals just to name a few offered the best chance for the economy to build its complexity while creating employment opportunities. To achieve this, it was important for the country to address the major challenges hindering development of complex products which are namely: the inadequacy of skills and capabilities for the development of sophisticated products; having an unfavorable micro or macro-economic environment; and finally, the absence of a strong institutional environment within which technical innovation and skill development can thrive. It was recommended that the country addresses matters of: skills gap, the cost of doing business and counterfeiting just to name a few, for it to enhance its economic complexity.

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1. Introduction

Achieving high and sustainable levels of economic growth and translating the same into inclusive growth that reduces poverty and inequality – and creates opportunities for productive employment and shared prosperity – remains a critical development challenge for Kenya. The Kenya Vision 2030 set targets for annual gross domestic product (GDP) growth at 10 percent, in the context of a transformation agenda that would see poverty reduction and increased job creation. Kenya's growth experience reveals that economic growth has been quite episodic: with two decades of stagnation between 1990 and 2002; a period of accelerated growth between 2002 and 2007 (with a peak of 7 percent in 2007); economic slowdown between 2008 and 2010 occasioned by several shocks (key among them the 2007 post-election violence); and a rebound since 2010, even though growth has stabilized at lower levels compared to set targets.

This notwithstanding, the country has several opportunities that it can exploit to maintain and raise its growth performance. These include taking advantage of the tripartite trade agreement between the Southern African Development Community (SADC), East Africa Community (EAC), Common Market for Eastern and Southern Africa (COMESA), and the recent Africa Continental Free Trade Area (AfCFTA). This can boost opportunities for trade and economic growth given that Kenya has a set of transit port and airport facilities, an efficient road and railway network, and is becoming a regional financial hub (KIPPRRA, 2017). Further, commercialization of oil production is expected to support the country's transformation process by reducing the cost of energy and stimulating the manufacturing of petrochemicals, plastics, and related products.

Kenya has a youthful and educated population. Using the African Union definition of the youth as individuals aged 15-34 years, it is estimated that approximately 34.9 percent of the Kenyan population comprise of the youth. In addition, the youth comprise 63.4 percent of the country's working age population. However, with approximately 83.2 percent of the country's workers employed in the informal sector, it means that a huge proportion of the youth are absorbed in the informal sector. Losch (2016) observes that the youth are more vulnerable to unemployment than other segments of the society. Women similarly experience higher unemployment rates than men – by two percentage points – and are vulnerable to underemployment and under payment. Results from the KIHBS (2015/16) show that youth unemployment is at 3.5 percent while women labour participation is at 75.6 percent compared to men at 79.2 percent. Further, according to KIHBS (2015/16) about 30 percent of the population reported to have attained secondary, college and university education while 51.4 percent reported primary level education as the highest level of education attained. In terms of gender, a similar proportion (51 percent) of the total male and total female had attained primary level education. However, more males (22 percent and 9.4 percent) compared to females (20 percent and 7.6 percent) had secondary education and attained university or college education.

There are however, several downward risks to the country's growth prospects. First, Kenya has experienced limited structural transformation, as the agriculture sector still has low productivity – albeit contributing significantly to the growth of the economy. Further, the performance of the manufacturing sector has stagnated and it faces competition from cheap imports while the manufactured exports have declined with the growing manufacturing activity in the EAC region. Other risk factors include the continued sluggish growth of key export destinations, political uncertainty during the electioneering period that wanes investor confidence, and security threats from terrorism that adversely affect the tourism sector.

In his contribution to the growth debate, Hausmann et al. (2011) argues that the process of structural transformation and long-term growth involves accumulation of capabilities, which enable a country to move from less complex primary products towards increasingly more complex manufactured products. Thus, the philosophy of economic complexity provides an alternative view of economic development, from a thinking of aggregate GDP growth and production through a combination of factors of production, to a focus on products and production through a combination of knowledge/know-how/capabilities. The extent of knowledge is determined by the diversity of collective knowledge, and how the knowledge can be brought together in a complex network of interactions. Large amounts of productive knowledge will therefore require increasingly complex webs of human interaction. Thus, development is seen as the accumulation of know-how, which is created through the production of a greater diversity of increasingly complex products. The simple idea is that an economy can generate economic complexity through building capabilities in the product space closest to the products that are currently being produced (Hausmann et al., 2014; Hildago et al., 2009).

There is broad consensus that integration into the global economy is a reliable way for countries to grow, which supports the view of countries pursuing an export-led growth path (Kali et al., 2013). Further, there is empirical evidence that has shown that more complex economies have higher levels of growth. This approach has been previously applied for the analysis of Rwanda's export diversification (Hausmann & Chauvin, 2015); Uganda's growth prospects (Hausmann et al., 2014); Algeria's export diversification (Hausmann et al., 2010) and; product space analytics of Brazilian exports (De La Cruz & Riker, 2012). Thus, encouraging growth of economic dynamism and complexity in both manufacturing and agricultural sectors would lead to inclusive growth – which when achieved through long-run employment generation, especially for women and youth – would result in poverty reduction in Africa.

The key question from an economic policy perspective, is how to build economic complexity in Kenya. This study takes cognizance of the notable absence of a dynamic and complex agriculture and manufacturing base in Kenya, despite rapid economic growth. The focus of the paper is on understanding the lack of complexity in Kenya, and then crafting a set of potential strategies to increase economic complexity, by identifying a set of products the country can diversify into. This paper is part of a broader project whose main objective is to provide policy options and channels through which countries can achieve structural transformation in a way that expands economic opportunities for disenfranchised youth and women. The specific objective of this paper is, following the *detailed analysis of the degree and extent of economic complexity and product space*, to provide concrete policy options that enable Kenya to move from low productivity to high productivity-high growth sectors, which in turn generate broad-based employment opportunities.

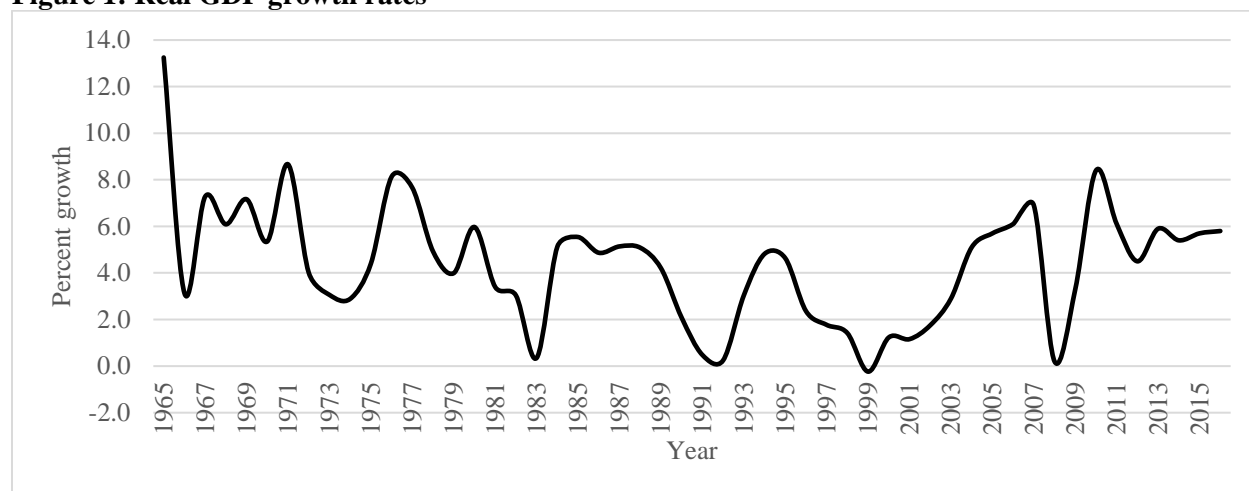
2. Background information

2.1 Economic growth trends

Kenya has had an episodic growth pattern explained by external and internal shocks, and policy environment. For example, after independence in 1963, the economy experienced a period of rapid economic growth averaging 6.6 percent for a decade, mainly promoted through public investment, encouragement of smallholder agricultural production, and incentives for private (often foreign) industrial investment (Figure 1). The economy was mainly agriculture based, whereby the sector contributed 37 percent to GDP at independence, as compared to 16 percent from trade, restaurants and hotels, 8 percent government services, and 7 percent manufacturing.

The economy experienced external shocks in the 1970s and Kenya started implementing structural adjustment programmes in the 1980s, as economic performance deteriorated. While the coffee boom of 1977 saw a temporary increase in growth rates, there was an eventual decline in 1978. This was mainly occasioned by a decline in the agricultural sector that experienced cumulative effect of the drop in world prices for coffee and tea, and the adverse weather. The poor performance of the manufacturing sector was largely due to a weak incentive system that favoured production for the domestic market over production for export, and diminishing opportunities for efficient import substitution (Republic of Kenya, 1997). The collapse of the East African Community in 1977 further exacerbated the situation, given that the EAC served as the traditional market outlet for Kenya's industry.

Figure 1: Real GDP growth rates



Source: Own compilation for Economic Surveys, various issues

Notes: 2007-2015 is rebased GDP growth rates

Kenya's economic performance in the mid-1980s was satisfactory, with an average real GDP growth rate of 5.1 percent in 1984-1988. Growth in the agricultural sector was partly hampered by the 1984 drought. The performance of the manufacturing sector was supported by: the trade liberalization policy that removed selective restrictions on imports of raw materials; export promotion measures which encouraged exports of manufactured goods; and higher domestic demand for manufactured goods. An industrial sector adjustment programme was mounted in 1988 as one of the measures to raise the growth of investment and exports from the industrial sector.

The economy slowed down in the early 1990s, which was attributed to the deceleration in the agricultural sector due to unfavourable weather (drought in 1991/92), the increase in oil prices resulting from the Gulf war, ethnic clashes in 1992, and low world coffee prices. Further, bilateral and multilateral donors suspended program aid to Kenya in 1991, and again in 1997. The government began a major program of economic reform and liberalization in 1993, which entailed elimination of price controls and import licensing, removal of foreign exchange controls, privatization of several publicly owned companies, retrenchment in the civil service, and the introduction of conservative fiscal and monetary policies. Further, the period saw constitutional reforms making Kenya a multiparty state in the process to deepen democracy.

The economy has been on a recovery path since 2003 (except for 2008 because of post-election violence), following the implementation of the government's blueprints i.e. the Economic Recovery Strategy for Wealth and Employment Creation (2003-2007) and the Kenya Vision 2030. However, the share of agriculture, forestry and fishing has declined from 38 percent in the 70s to an estimated 32.1 percent in 2016, as reported in Table 1. Similarly, while the share of manufacturing in total output increased between the 1970s and 1990s, it declined in the 2000s to an estimated 9.1 percent in 2016.

Table 1: Sectoral Sources of growth

| Industry | 1970 | 1980 | 1990 | 2000 | 2013 | 2014 | 2015 | 2016* |
|-------------------------------------|------------|------------|------------|------------|------------|------------|------------|------------|
| Agriculture, forestry and fishing | 37.69 | 32.1 | 30.2 | 26.4 | 26.4 | 27.5 | 30.2 | 32.1 |
| Manufacturing | 10.96 | 13.0 | 13.3 | 13.1 | 10.7 | 10.0 | 9.4 | 9.1 |
| Construction | 0.56 | 0.7 | 1.7 | 1.6 | 4.5 | 4.9 | 4.9 | 5.0 |
| Wholesale and retail trade; repairs | 7.84 | 11.8 | 11 | 12.5 | 8.0 | 8.0 | 7.5 | 7.3 |
| Transport and storage | 8.6 | 5.5 | 5.9 | 6.1 | 8.0 | 8.6 | 8.1 | 7.8 |
| Information and communication | - | - | - | - | 1.4 | 1.2 | 1.5 | 1.4 |
| Financial and insurance activities | 4.1 | 6.3 | 7.9 | 10.6 | 6.6 | 6.8 | 6.7 | 7.0 |
| Other Sectors | 30.25 | 30.6 | 30 | 29.7 | 34.4 | 33 | 31.7 | 30.3 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

Source: Own compilation for Economic Surveys, various issues

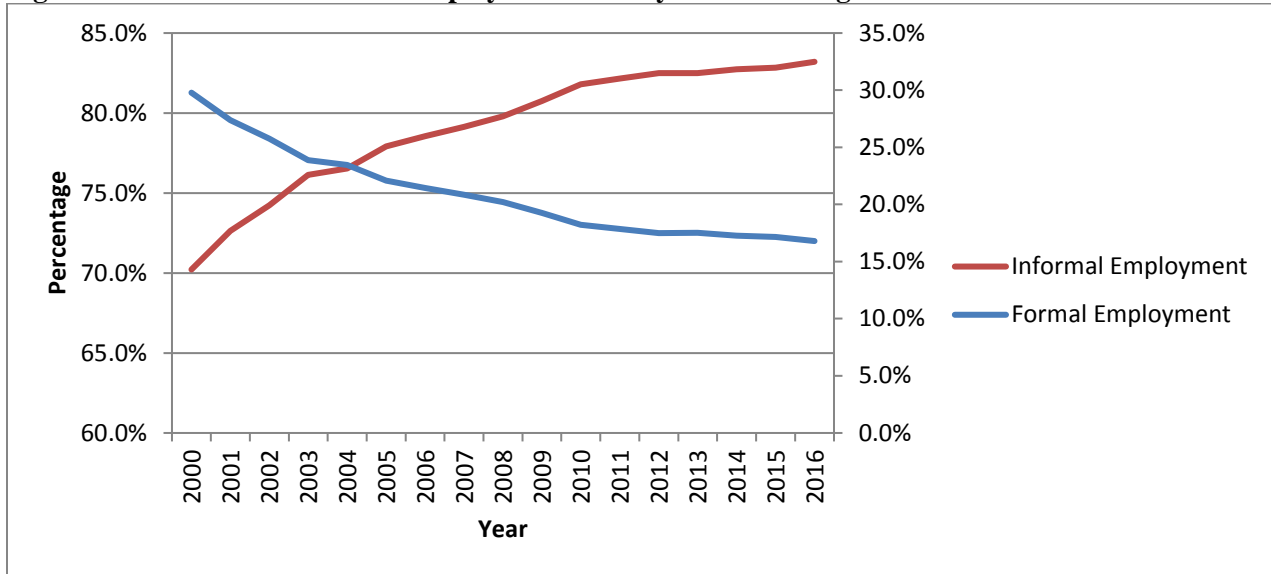
2.2 Employment Trends in Kenya

According to Pollin (2009), there are three broad types of employment in the Kenyan labor market; agriculture self employed, formal and informal sector employment. Agricultural self-employed workers refer to employees who are not contracted on wage employment as farm workers; informal sector workers encompass employment in unregistered household enterprises and wage employees of informal employers; formal sector encompasses the public sector, self-employed in registered nonagricultural enterprises and salaried employees of formal enterprises.

As demonstrated in figure 2, Kenya's informal sector takes a bigger proportion of the country's share of workers. In the year 2000, the share of workers in formal employment was approximately 70 percent while the remaining 30 percent were in formal employment. By the year 2016, the ratio had changed significantly to 83 percent of workers being in the informal sector and the remaining 17 percent occupied in the formal sector. Informal employment outgrew formal sector employment

because there was a slowdown in employment within the public sector and in addition to this, a number of businesses moved from formality to informality.

Figure 2: Formal and Informal Employment in Kenya in Percentage

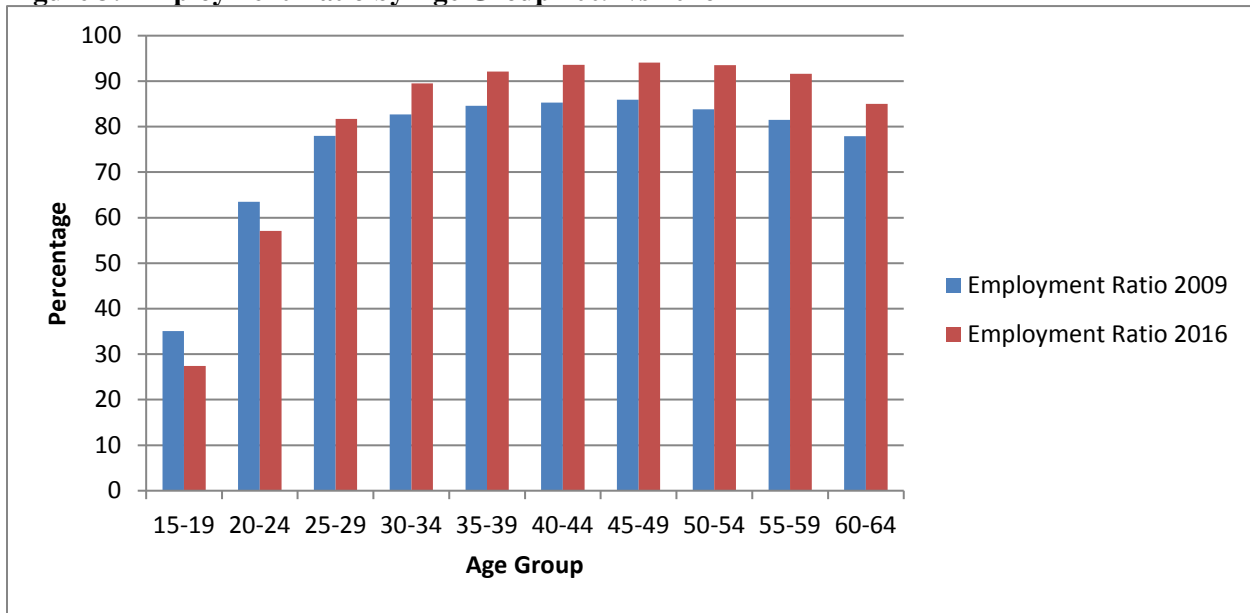


Source: Republic of Kenya (2017)

The formal sector employs 17 percent of Kenya’s labour force while the remaining 83 percent are employed in the informal sector and agriculture. Kenya’s youth comprised 63.4 percent of the country’s working age population in the year 2015/16 and out of these, only 42.7 percent were economically active. Analysis of labour participation rate by sex showed that male participation was higher than female across all age cohorts. Among the working-age population, males had a 79.2 percent labour participation rate compared to 75.6 percent for the females (KNBS, 2018). According to figure 3, young people are more affected by unemployment compared to the more experienced cohorts. The most common reasons are cited as lack of skills or specialized training that can give them competitive edge in the job market. This together with lack of experience makes them vulnerable to unemployment (NEPAD, 2016). Kenyan youth are mostly engaged in informal activities as majority of the new jobs created in the country are within the informal sector.

It is observed from figure 3 that only the two cohorts age 15-19 and 20-24 had lower employment ratios in 2016 compared to 2009. The rest of the age groups had higher employment ratios in 2016 compared to 2009. The youth had lower employment ratios compared to other cohorts, including the eldest, aged 60-64. This implying that youth are more vulnerable in the labour market.

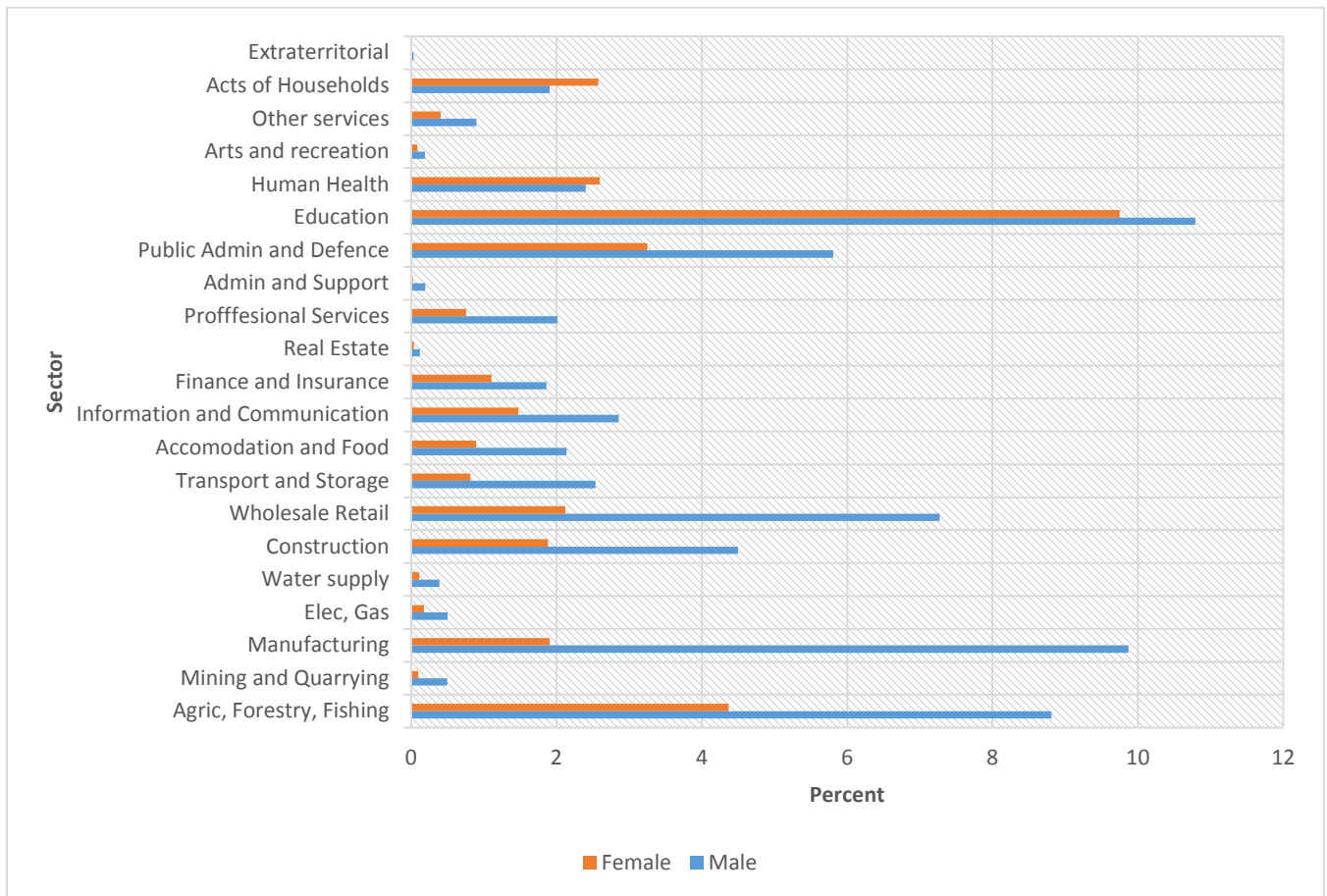
Figure 3: Employment Ratio by Age Group 2009 vs 2016



Source: Kenya Integrated Household Budget Survey (2016)

As at the year 2016, the formal sectoral composition of workers by gender was as depicted in figure 4. Education employed 10.8 percent of males and 9.7 percent of females; manufacturing employed 9.9 percent of males and 1.9 percent of females; agriculture, forestry and fishing accounted for 8.8 percent of males and 4.4 percent of females; the wholesale and retail sector accounted for 7.3 percent of males and 2.1 percent of females; public administration and defence employed 5.8 percent of males and 3.2 percent of females; construction services had 4.5 percent of males and 1.9 percent of females. It is noteworthy that the only two sectors where females had higher employment percentages than males were in Acts of Household employees and provision of Human Health services.

Figure 4: Sectoral Composition of Workers by Gender in the Formal Sector



Source: Republic of Kenya (2017)

2.3 Exports of goods and services

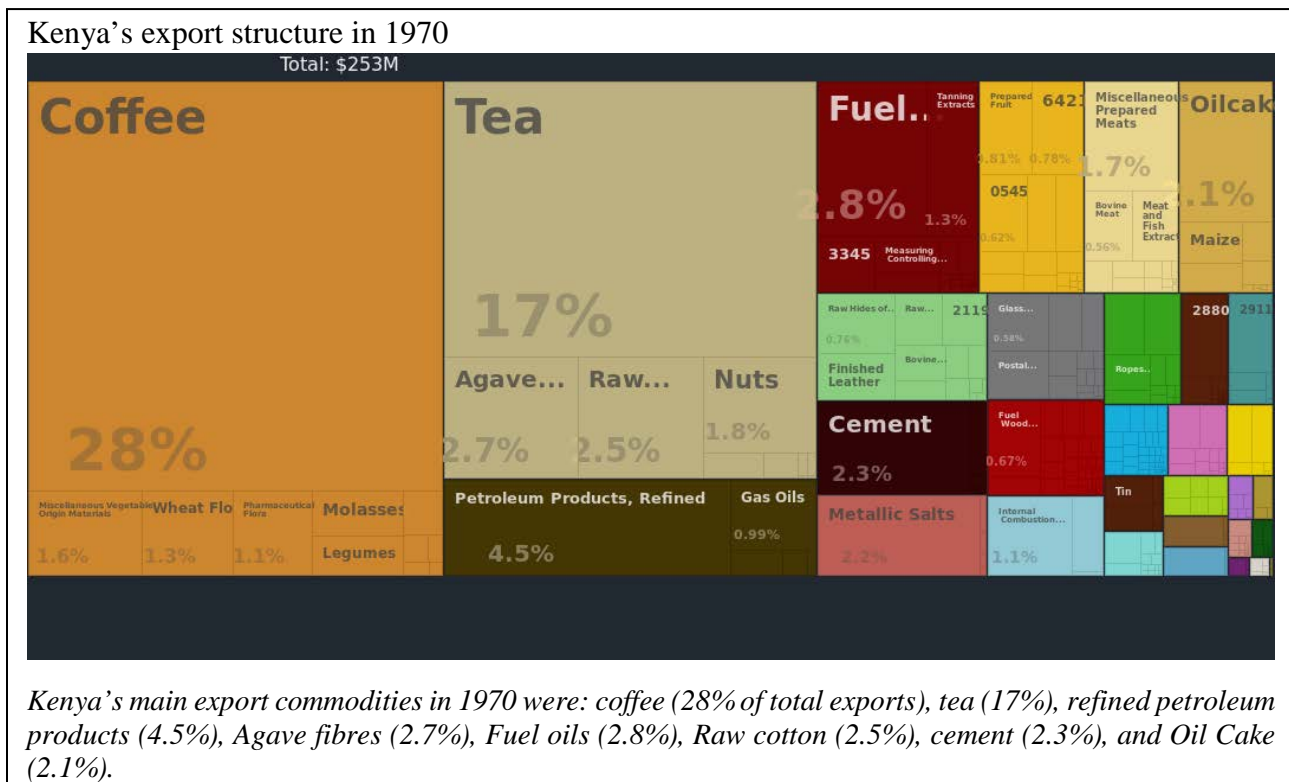
Since independence, Kenya’s export commodities have been dominated by coffee, tea and horticultural products, followed closely by manufactured products, which constitute a small proportion of the country’s exports, as reported in Figure 2. Agricultural commodities dominated the country’s exports due to favorable climatic and edaphic (soil) conditions. These products however remain vulnerable to price fluctuations in the world commodity market. The import substitution strategy, implemented a decade after independence, was meant to address the challenge of over dependence on agricultural commodities for export. This strategy entailed diversifying the country’s export commodities, by creating infant industries and protecting them from external competition by restricting imports. Effectively, locally produced commodities displaced imports in the Kenyan market, and this created a manufacturing industry that was biased towards local consumer goods. This explains the trend in Kenya’s post-independence export performance in the decade following independence (Oiro, 2015).

The import substitution strategy had to be abandoned in favor of a more outward looking policy in 1986, following the mismanagement of the funds arising from the coffee boom in the late ‘70s, oil shocks, and collapse of the EAC. These events brought about acute balance of payment problems, prompting the country to restructure its economy towards more openness, greater competitiveness, and gradual elimination of the anti-export bias. Sessional Paper No.1 of 1986 on

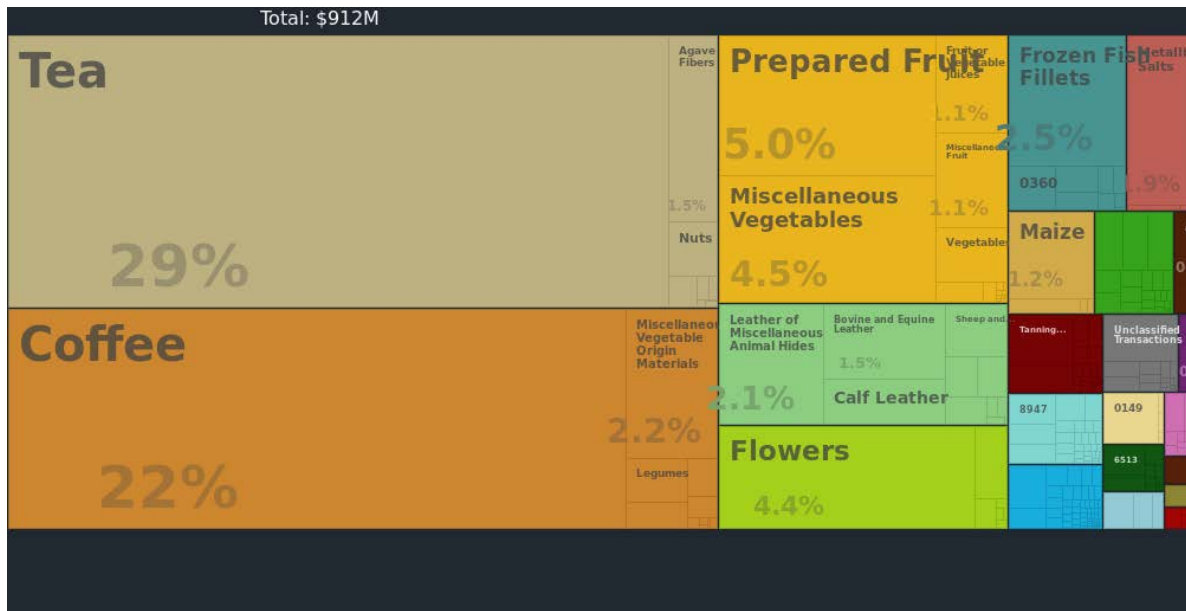
Economic Management for Renewed Growth, coupled with other development plans, jump-started the country's trade policy reforms. In addition, the economic crisis emanating from reduced donor funding compelled the government to embrace economic reforms. This entailed undertaking tariff reductions in 1987-1992, followed by lifting of current and capital account restrictions in 1993-1994.

The country's exports responded positively to the trade liberalization efforts undertaken in the mid-90s, and have been on an upward trend ever since – whilst slowing with the 2008 Global Financial crisis, which affected the demand for Kenya exports. Signing of various Regional Trade Agreements (RTAs) have also contributed positively to the growth in the country's exports over time. The EAC, COMESA and European Union are the country's largest export destinations as a result of the free trade agreements signed by the partner states. Other agreements like Africa Growth Opportunity Act (AGOA) also contribute positively to the country's exports.

Figure 5: Exports Composition

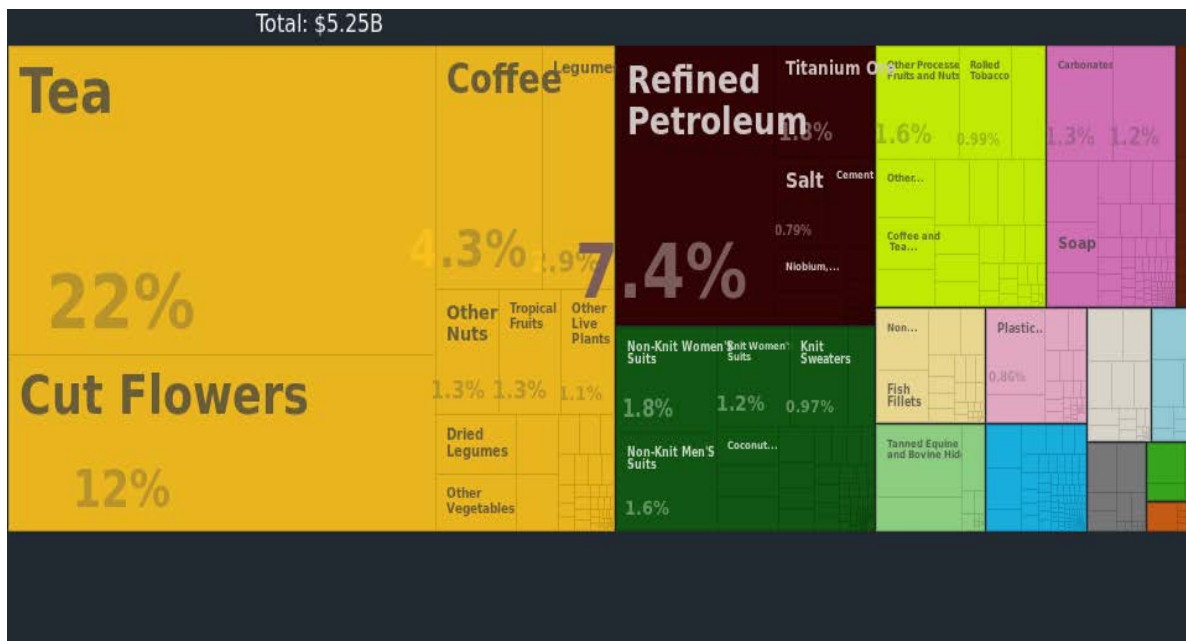


Export structure in 1990



Kenya's main export commodities in 1990 were: tea (29 % of total exports), coffee (22%), Prepared fruit (5%), miscellaneous vegetables (4.5%), Leather of miscellaneous animal hides (2.1%), flowers (4.4%), frozen fruit (2.5%), metallic salts (1.9%), and maize (1.2%).

Export structure in 2015



In 2015, the main exports were tea (22%), cut flowers (12%), refined petroleum (7.4%), coffee (4.3%), legumes (2.9%), titanium ore (1.8%), Non-knit women's suits (1.8%), Non-knit men's suits (1.6%), Other processed fruits and nuts (1.6%), tropical fruits (1.3%), other nuts (1.3%), carbonates (1.3%), and knit women's suits (1.2%).

A Tripartite Free Trade Area (TFTA), which was launched in June 2015 by three Regional Economic Communities (RECs); EAC, COMESA and the SADC – to address the challenge of overlapping membership of partner states in various RECs – also aims at boosting intra-regional trade among member states. The challenge with RTAs however, is that elimination of tariff barriers gives rise to non-tariff barriers, which are counterproductive in terms of increasing intra-regional trade.

2.4 Complimentary Sectoral Policies Affecting the National Trade Policy

The Kenya National Trade policy provides the guiding principles on which the country's trade promotion strategy is anchored. Kenya aims to develop an efficient domestic trade market, which gives rise to a competitive and efficient export market. Being an agriculture-based economy, attainment of efficiency in the domestic trade market is heavily dependent upon the productivity of the primary sector, which then creates surplus to be exchanged in the external market. In this regard, successful implementation of the Agricultural Sector Development Strategy (ASDS), alongside the National Livestock Policy, served to critically contribute in improving productivity of agricultural sector.

The ASDS intended to address the challenges facing the sector by; allocating 10 percent of the government's budget as per the Maputo declaration; revitalizing agricultural extension services; increasing access to affordable credit to farmers; reducing waste in pre and post-harvest crop losses; reducing livestock losses to disease and pests; developing coherent land policies; use of early warning systems and increasing disaster preparedness; and addressing the issue of multiple taxation of agricultural produce by local authorities; among others. It is expected that these actions would reduce food insecurity by 30 percent, increase contribution of agriculture to GDP by more than Ksh 80 billion, and revitalize agricultural research institutions and regulatory bodies to make them more effective and efficient.

The Industrialization policy envisions Kenya as a leading industrialized nation in Africa with a robust, diversified and globally competitive manufacturing sector. The guiding principles behind this policy include; productivity and competitiveness; market development; value addition and product diversification; market diversification; technology and innovation; fair trade practices; and education and human development; among others. Some of the challenges facing this sector include: low value addition; insufficient market information resulting in low market access; a narrow export base; inadequate space for industrial enterprises; inadequate human capital development; a lack of product diversification; the high cost of industrial land; an influx of counterfeit products and dumping; and low attraction of local and foreign investment; among other things. The sector has recently appeared to be more inward-looking, with 82 percent of products sold locally, 6.1 percent destined for the EAC, and 12 percent to the rest of the world. Lack of product diversification explains the country's inability to take advantage of Africa Growth and Opportunity Act (AGOA's) 6,000 tariff lines, only making use of 5 tariff lines – which are mainly textiles and apparels (Republic of Kenya, 2012).

Further, Foreign Direct Investment is needed to unlock the country's export potential. Investment in sectors that require high capital inputs and advanced technical know-how is essential to move the country's investments towards the frontier. The draft Investment policy targets development of a regulatory framework that promotes the SME growth and inclusion into the global value chain. The following are some key challenges associated with investment promotion for export development in Kenya: limited coordination of the investment function creates confusion due to

the existence of multiple agencies dealing with investment promotion; barriers to entry due to restrictive market entry requirements for FDI and discrimination in national treatment act as obstacles to attracting foreign investors; and the lack of policy coherence between the two levels of government discourages investment due to conflicting legislation (Republic of Kenya, 2017).

2.5 The Research Methodology

The research described in this paper entails utilising the framework tools of economic complexity and product space analytics. The broad thrust of the research entails firstly deriving a country-level analysis of economic complexity, and then secondly carrying out product space analytics, which would greatly contribute to a significant innovative shift in current thinking around economic growth and development analytics at the country level.

The approach entails examining the degree and extent of Economic Complexity. The focus of the economic complexity is:

- Firstly, to *understand and measure economic complexity at the country level* for selected economies, and to provide a ranking at the cross-country and cross-regional level of economic complexity for the economy under consideration. This alone would be a novel and highly innovative and policy-relevant piece of work for sub-Saharan Africa.
- Secondly, an *analysis of economic complexity and its drivers and determinants* within the context of how complexity constraints operate in Agriculture and Manufacturing.
- Undertake a *detailed Product Space Analysis* that maps product spaces and tries carefully to link these product space opportunities to those products where the economic returns for young people and women are maximised. This methodological approach would therefore:
- Lead to a focus on *those product spaces where the economy can move into* more easily than others given its existing capabilities, but with a clear rank-ordering and bias towards those products where opportunities for young people and women would be.

3. Measuring Economic Complexity

Given the difficulty in assessing the magnitude of productive knowledge, the authors of economic complexity indirectly measure the ECI by looking at what products countries produce and export (Hausmann et al., 2014; Hildago et al., 2009). Diversity (the number of products that a country produces) and ubiquity (the number of countries that produce a specific product) provide insights into the productive knowledge or capabilities embodied in a country and product, respectively. Thus, diversity and ubiquity are crude approximations of the variety of capabilities that a country has, which can be used as measures of economic complexity.

Hausmann et al. (2011) use the scrabble analogy to explain the intuition behind economic complexity. In scrabble, players use tiles containing single letters to make words. Each product is represented by a word, and each capability is represented by a letter. It is assumed that each player has plenty of copies of the letters. The measure of economic complexity corresponds to estimating what fraction of the alphabet a player possesses, knowing only how many words he or she can make, and how many other players can also make those same words. Players who have more letters will be able to make more words. So, we can expect the diversity of words (products) that a player (country) can make to be strongly related to the number of letters (capabilities) that s/he (country) has. Long words can only be put together by players with many letters, so they will tend to be rare. Therefore, the number of players that can make a word provides us with insights on the variety of letters each word requires. Longer words tend to be less ubiquitous, while shorter words tend to be more common. Similarly, ubiquitous products are more likely to require few capabilities, and less ubiquitous products are more likely to require a large variety of capabilities.

This study adopts the measure of Economic Complexity as developed by Hildago et al. (2009). In this context, the Method of Reflections, is used to compute the levels of diversity ($k_{c,o}$) of a country's export structure and the ubiquity ($k_{p,o}$) of the product that comprise the structure. Both diversity and ubiquity provide insight into the productive knowledge or capabilities embodied in a country and product, respectively. Defining M_{cp} as a matrix where the rows represent the different countries (c) and the columns represent different products (p), and assuming an identity matrix when country c produces product p and 0 otherwise, then we can compute the average ubiquity of exported products and the average diversity of countries that manufacture the products as follows.

$$Diversity = k_{c,0} = \sum_p M_{cp} \quad (1)$$

$$Ubiquity = k_{p,0} = \sum_c M_{cp} \quad (2)$$

For more accurate measures of diversity and ubiquity, the measures are corrected by the average of the other as follows:

$$k_{c,N} = \frac{1}{k_{c,0}} \sum_p M_{cp} \cdot k_{p,N-1} \quad (3)$$

$$k_{p,N} = \frac{1}{k_{p,0}} \sum_c M_{cp} \cdot k_{c,N-1} \quad (4)$$

Substituting equation (4) into (3) gives

$$k_{c,N} = \frac{1}{k_{c,0}} \sum_p M_{cp} \cdot \frac{1}{k_{p,0}} \sum_c M_{cp} \cdot k_{c,N-2} \quad (5)$$

$$k_{c,N} = \sum_{c'} k_{c',N-2} \sum_p \frac{M_{cp} M_{c'p}}{k_{c,0} k_{p,0}} \quad (6)$$

Equation (6) can be re-written as

$$k_{c,N} = \sum_{c'} \tilde{M}_{cc'} k_{c',N-2} \quad (7)$$

Where

$$\tilde{M}_{cc'} = \sum_p \frac{M_{cp} M_{c'p}}{k_{c,0} k_{p,0}} \quad (8)$$

Equation (7) is fulfilled when $k_{c,N} = k_{c',N-2} = 1$, and this is the eigen vector of $\tilde{M}_{cc'}$ which is the largest eigen value. Being that the eigen value is a vector of ones, it is not informative. As such, an eigen vector associated with the second largest eigen value is sought and this is the measure of economic complexity (ECI) because it captures the largest variance in the system. Therefore, the Economic Complexity Index (ECI), which measures the knowledge of a country by considering the knowledge intensity of its exports, is defined as:

$$ECI = \frac{\vec{K} - \langle \vec{K} \rangle}{stdev(\vec{K})}$$

Where $\langle \rangle$ represents an average, stdev represents standard deviation and

\vec{K} = Eigenvector of $\tilde{M}_{cc'}$ associated with the second largest eigenvalue.

Because of the similarities in definition, for the Product Complexity Index (PCI), which measures the knowledge of a product by considering the knowledge intensity of its exporters, for the countries (c) can be substituted with that of products (p) to read:

$$PCI = \frac{\vec{Q} - \langle \vec{Q} \rangle}{stdev(\vec{Q})}$$

\vec{Q} = Eigenvector of $\tilde{M}_{pp'}$ associated with the second largest eigenvalue.

3.1 The Product Space Analytics

The methodology of product space builds upon the methodology of economic complexity by using visual images of the products that a country produces and exports, and uses the visual images to suggest a possible growth trajectory. The product space framework, developed by Hildago et al. (2007), is based on the intuition that the accumulation of productive capabilities, which is associated with higher levels of economic development, is aligned to the development of new industries that would use the existing knowledge. The product space has a core, which is comprised of relatively more proximate and connected products, and a periphery, which comprises products

that are less proximate and connected. Thus, if a country's production structure has a large number of products within the core of the product space, then it shows that it is easier for the country to diversify into new products with similar productive capabilities. This method suggests that the process of structural transformation is path dependent, given that countries tend to move from products that they are producing to nearby products.

The question then is, how do countries accumulate capabilities and produce new products that require such capabilities? It has been shown that countries are more likely to move into products that can make use of capabilities that the country already has, and is using in existing industries (Hausmann et al., 2014; Kali et al., 2013). Further, new capabilities are more easily accumulated if they are combined with others that already exist. This implies that countries will diversify by moving from the industries that already exist to others that require a similar set of capabilities e.g. shifting production from shirts to blouses will be easier as compared to shifting from shirts to machinery – given that the embedded knowledge in shirts is similar to that of blouses, but dissimilar to that of machinery.

There are several measures that are important in the product space analytics including revealed comparative advantage, proximity, distance opportunity value and opportunity gain.

Revealed Comparative Advantage

Measures of Revealed Comparative Advantage (RCA) have been used to help assess a country's export potential. The RCA index of country i for product j is often measured by the product's share in the country's exports in relation to its share in world trade:

$$RCA_{ij} = (x_{ij}/X_{it}) / (x_{wj}/X_{wt})$$

where x_{ij} and x_{wj} are the values of country i 's exports of product j and world exports of product j , and where X_{it} and X_{wt} refer to the country's total exports and world total exports. A value of less than unity implies that the country has a revealed comparative disadvantage in the product. Similarly, if the index exceeds unity, the country is said to have a revealed comparative advantage in the product. If hypothetically speaking, country i 's exports of commodity j was 10 units and its total exports for all commodities was 50 units, and the world total exports of commodity j is 500 units against the world's total exports of 5,000 units, country i 's RCA index for commodity j would be 2. An RCA of 2 is greater than unity so country i would be considered to have a Revealed Comparative Advantage in production of commodity j .

Measuring proximity

Products are measured as highly proximate if they tend to be exported together. Proximity between product i and j in year t equals:

$$\varphi_{i,j,t} = \min\{P(x_{i,t}|x_{j,t}), P(x_{j,t}|x_{i,t})\}$$

where for any country c

$$x_{i,c,t} = \begin{cases} 1 & \text{if } RCA_{i,c,t} > 1 \\ 0 & \text{otherwise} \end{cases}$$

and where the conditional probability is calculated using all countries in year t . This allows one to create a product-to-product network called a proximity matrix, that is used to generate the product space:

$$\varphi_{i,j} = \frac{\sum_c M_{ci} M_{cj}}{\max(k_{i,0}, k_{j,0})}$$

where $M_{c,i} = 1$ if country c exports product i with $RCA > 1$ and 0 otherwise, and where $k_{i,0}$ is the ubiquity of product i .

Distance

The measure quantifies the distance between the products that a country makes, and each of the products that it does not make i.e. how far each product is given a country's current export portfolio. It is defined as the sum of the proximities connecting a new product p to all the products that country c is not currently exporting. The distance is normalised by dividing it by the sum of proximities between all products and product p . If country c exports most of the products connected to product p , then the distance will be short i.e. close to zero. Conversely, if country c exports few of the products related to product p , then the distance will be large i.e. close to 1. The measure is written as:

$$d_{c,p} = \frac{\sum_p (1 - M_{c,p'}) \phi_{p,p'}}{\sum_{p'} \phi_{p,p'}}$$

Opportunity value

Hausmann et al. (2011) developed a measure of connectedness of a country's productive structure called the opportunity value index, which provides a measure of the opportunities that are implied by a country's position in the product space. The measure takes into consideration the economic complexity of the products that the country is not currently producing, weighted by how close the products are to the country's export structure. This analysis is highly disaggregated and would therefore enable identification of specific and implementable policy suggestions. A higher opportunity value implies being in the vicinity of more products and/or of products that are more complex. The Opportunity value is also known as the 'Complexity Outlook Index'. It is derived as:

$$Opportunity\ value_c = \sum_{p'} \frac{\phi_{p,p'}}{\sum_{p'} \phi_{p,p'}} (1 - M_{c,p'}) PCI_{p'} (1 - d_{c,p}) PCI_p$$

Opportunity Gain

This measure calculates the potential benefit to a country if it were to move to a particular new product i.e. the opportunity gain that country c would obtain from making product p . It is measured as the change in opportunity value that would come as a consequence of developing product p . It quantifies the contribution of a new product in terms of opening up doors to more and more complex products. This measure is also referred to as the 'Complexity Outlook Gain'. The measure is derived as:

$$Opportunity\ gain_{c,p} = \sum_{p'} (1 - d_{c,p}) (1 - M_{c,p'}) PCI_{p'}$$

Identifying the frontier products

While choosing products that an economy can move into, focus should be on products that: (i) advance the economic complexity of the economy by having a PCI greater than the country's ECI, (any product with a PCI below the existing average PCI of products was eliminated) (ii) are feasible given the country's productive knowledge (this refers to products below the mean distance), (iii) have potential for future diversification in order to sustain the growth process (i.e. have positive opportunity gain value – potential benefit to a country if it were to move to a particular new product), and (iv) increase employment opportunities for the economy.

3.2 Data Requirements

The measurement of *economic complexity* and the *product space* mainly makes use of available international trade data, at 4 digit level SITC4.

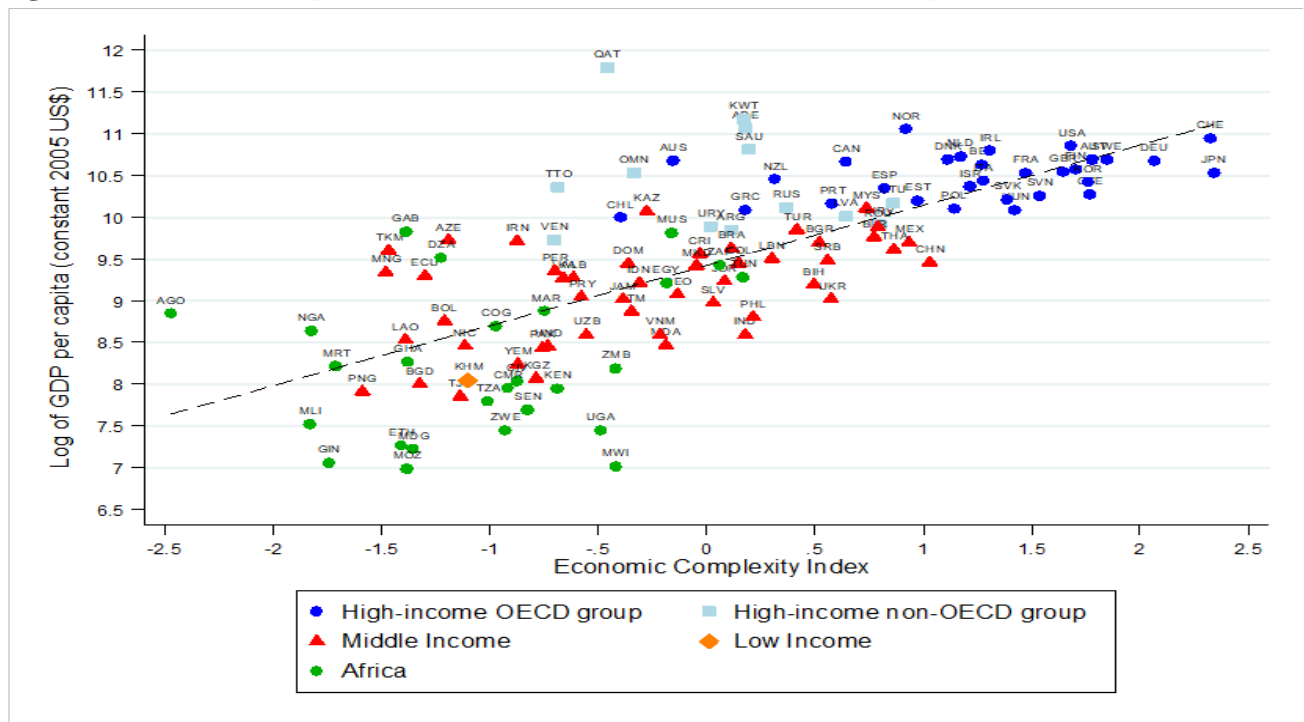
4. Research Findings

4.1 Kenya's Economic Complexity

As highlighted in section 2.3, Kenya's export structure has not undergone any fundamental changes over time. Agricultural products in their raw form account for the bulk of the country's exports since independence to the year 2015. This is an indicator that there hasn't been a fundamental shift in the underlying characteristics of the economy with regards to elements such as: the overall institutional framework; supporting infrastructure and the overall business environment. An assessment of the location of the respective country with respect to the fitted line of economic complexity reveals whether the country is exploiting its potential. For instance, Kenya, Rwanda and Uganda are below the fitted line, which implies that these countries could have higher GDP with their current ECI. Countries like Nigeria and Ghana are above the fitted line, mostly since they are resource rich countries. The BRIC nations have higher ECI and higher GDP, even though India and China could have higher GDP with their current ECI levels. Similarly, grouping the countries according to their income category reveals that high-income countries have higher ECIs as compared to the lower income countries.

The results indicate that Kenya has potential to increase its GDP level given the country's current level of ECI. By improving on the country's productive structure, there would be acquisition of more productive capabilities and subsequently an improvement in economic complexity and the country's general economic status.

Figure 6: Economic complexity and GDP across countries by income group (2014)

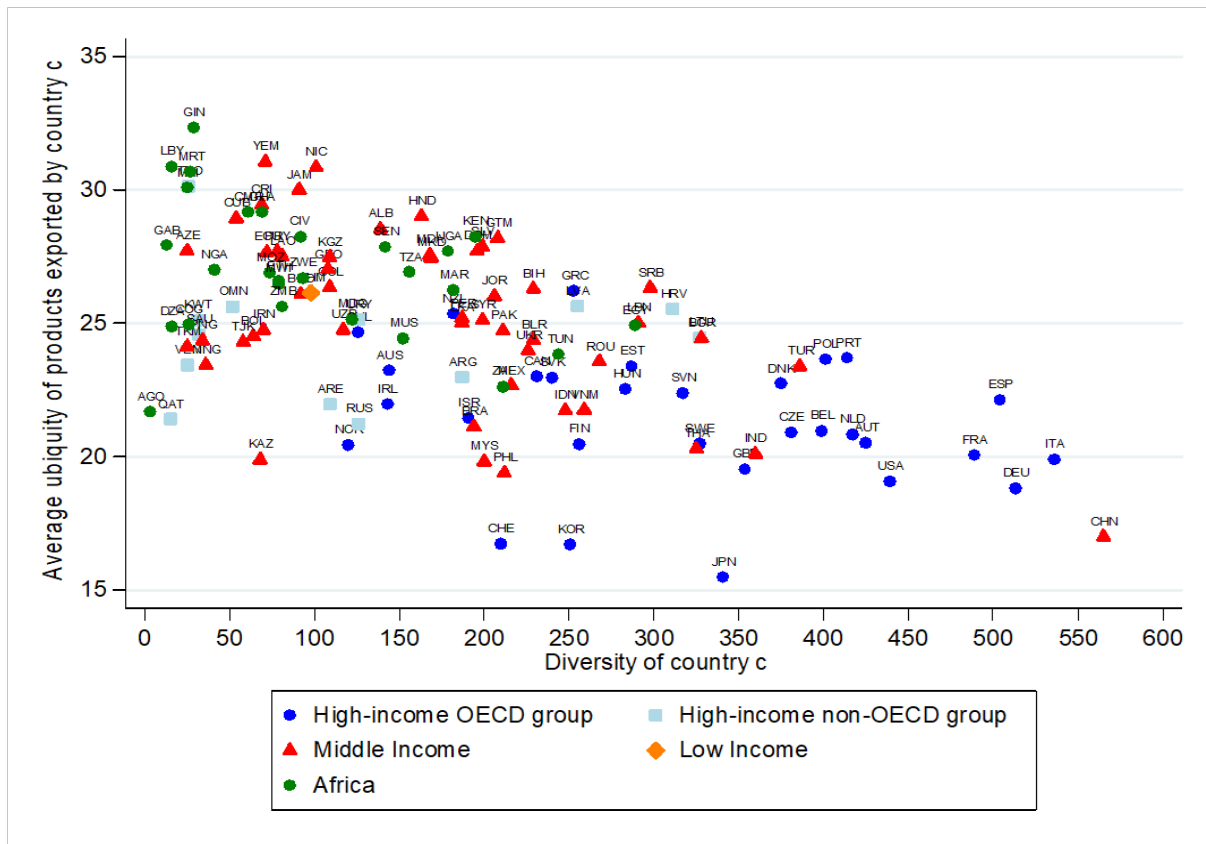


Source: Authors' Calculations based on Atlas of Economic Complexity Data

Figure 7 depicts a negative relationship between diversity of a country and the average ubiquity of its products. Diversity and ubiquity are indirect measures of a country's capabilities. A country

like Guinea is relatively highly ubiquitous but with a very low level of diversity for its products, same for Mauritania and Libya. Relatively diverse countries like Japan, France and China on the other hand have very low levels of ubiquity because they export products that few other countries produce. Kenya has a relatively high level of ubiquity and low level of diversity compared to the high-income countries but with almost similar levels of diversity and ubiquity with her neighbours Uganda and Tanzania. A comparison of diversity levels across selected African countries is shown that the countries with the highest levels of diversity are Egypt, Tunisia, South Africa, Kenya and Morocco. South Africa however has the highest diversity with a low average ubiquity.

Figure 7: Diversification and Ubiquity



Source: Authors' Calculations based on Atlas of Economic Complexity Data

Table 2 and 3 affirms what is depicted in figure 7 but at product level. Kenya's basket of commodities with a revealed comparative advantage has fluctuated overtime, as reported in Table 3. Kenya had the highest number of goods with $RCA > 1$ between 2005 and 2010, with the number of goods ranging between 229 and 245. This number declined to 177 by 2015. While the commodities with $RCA > 1$ are only about 17 percent of the total number of exported commodities, they on average accounted for about 90 percent of total exports. Thus, even though Kenya exported over 1000 goods, the level of diversity is low.

Table 2: Revealed Comparative Advantage and Export Share

| Year | Total number of exported goods | Number of goods with RCA>1 | % Share of exports of goods with RCA>1 in total exports |
|------|--------------------------------|----------------------------|---|
| 1995 | 1076 | 165 | 89 |
| 1996 | 1078 | 163 | 90 |
| 1997 | 1044 | 197 | 90 |
| 1998 | 1068 | 173 | 89 |
| 1999 | 1047 | 194 | 83 |
| 2000 | 1052 | 189 | 92 |
| 2001 | 1049 | 192 | 91 |
| 2002 | 1061 | 180 | 90 |
| 2003 | 1057 | 184 | 90 |
| 2004 | 1039 | 202 | 91 |
| 2005 | 1012 | 229 | 89 |
| 2006 | 995 | 245 | 88 |
| 2007 | 1002 | 239 | 84 |
| 2008 | 1002 | 238 | 85 |
| 2009 | 1005 | 235 | 84 |
| 2010 | 1006 | 233 | 77 |
| 2011 | 1042 | 198 | 86 |
| 2012 | 1038 | 202 | 89 |
| 2013 | 1007 | 233 | 87 |
| 2014 | 1239 | 195 | 89 |
| 2015 | 1061 | 177 | 91 |

Source: Authors' Calculations based on Atlas of Economic Complexity Data

Notably, some commodities that Kenya had revealed comparative advantage in in the mid-2000s, lost the same by 2015. The majority of such products were in the metals, and the chemicals and allied industries, community. In 2015, most of the commodities with RCA>1 were in vegetable products, textiles, and chemicals & allied products, but it is the commodities in minerals community that had the highest export value. While the commodities that lost their revealed comparative advantage in 2015 had, on average, positive PCI, those with revealed comparative advantage in 2015 had, on average, negative PCI as indicated in Table 4. Table 4 compares the two groups of commodities across the various communities, while Appendix 1 and 2 give a detailed list of these commodities. The communities that lost complexity most significantly were footwear, leather products, and metals. In terms of the number of products with RCA>1, the largest decline was in metals, minerals, and vegetable products. This decline in the number of exported metal products can largely be explained by the Kenyan government's restrictions on dealings in scrap metal (Scrap Metal Act Number 1 of 2015).

Table 3: comparing product with RCA>1 before and in 2015

| Community | Products with RCA>1 before 2015 (for 2006) | | Products with RCA>1 in 2015 | |
|-------------------------------|--|--------------------|-----------------------------|--------------------|
| | Average PCI | Number of products | Average PCI | Number of products |
| Animal & animal products | -0.844 | 15 | -0.897 | 12 |
| Mineral products | -0.769 | 20 | -1.501 | 12 |
| Wood & wood products | 0.287 | 16 | 0.038 | 11 |
| Vegetable products | -1.507 | 40 | -1.779 | 32 |
| Foodstuffs | -0.912 | 18 | -0.516 | 18 |
| Chemicals & allied industries | 0.508 | 26 | 0.806 | 24 |
| Transportation | 1.222 | 4 | 1.804 | 2 |
| Metals | 0.714 | 27 | 0.405 | 11 |
| Plastics/rubbers | 0.278 | 5 | 0.126 | 4 |
| Miscellaneous | 0.513 | 15 | 0.639 | 6 |
| Stone/glass | -0.283 | 7 | 0.095 | 6 |
| Machinery/electrical | 0.948 | 7 | 1.25 | 1 |
| Textiles/clothing | -1.743 | 31 | -1.571 | 29 |
| Leather products | -1.996 | 7 | -2.479 | 5 |
| Footwear | -0.982 | 7 | -2.2 | 4 |
| Total | | 245 | | 177 |

Source: Authors' Calculations based on Atlas of Economic Complexity Data

Looking at the individual commodities with RCA>1 in Appendix 1, we find that in 2015, Kenya had a high revealed comparative advantage in exports of agave, tea, cut flowers, legumes, titanium ore, minerals (Niobium, Tantalum, Vanadium and Zirconium Ore), tanned goat hides, coconut and other vegetable fibres, and textile fibres. However, the exports of some of the goods with high RCA were low e.g. exports of agave, minerals, tanned goat hides, vegetable fibres and textile fibres. Among the main export commodities, coffee, refined petroleum and textiles had a lower RCA compared to tea and cut flowers.

An important element to consider is the level of product complexity, which reveals that most of Kenya's top exports have a low product complexity index: especially tea, cut flowers, coffee, legumes, titanium ore, and textiles. All have a negative average PCI implying a low product complexity. Some products with positive PCI – namely polishes and creams, silicates, and carbonates – have lower export share. This implies that the country has room to increase the export volume, which will also have a positive impact on the level of ECI, given that they are more complex products.

Product space analytics give a picture of the status of an economy's journey towards structural transformation. It shows the interconnectedness between products and provides an idea of the proximity of products an economy can diversify into given their knowledge and capabilities. Kenya has very few products at the core, meaning that it requires building capabilities before diversifying into more complex products. In addition to this, the product space (as shown in Figures 8 and 9) has not undergone a significant transformation between 1995 and 2015. Kenya's products are mainly on the periphery, an indication that it exports products in their raw form. This is evidenced by the share of raw commodities the country exports. Tea, cut flowers, coffee, and fruit and nuts dominated the country's exports in 1995, and similarly in 2015. The export of textiles

seems to have increased over the years, though there are opportunities to produce and export leather products.

Figure 8: Kenya’s Product Space 1995

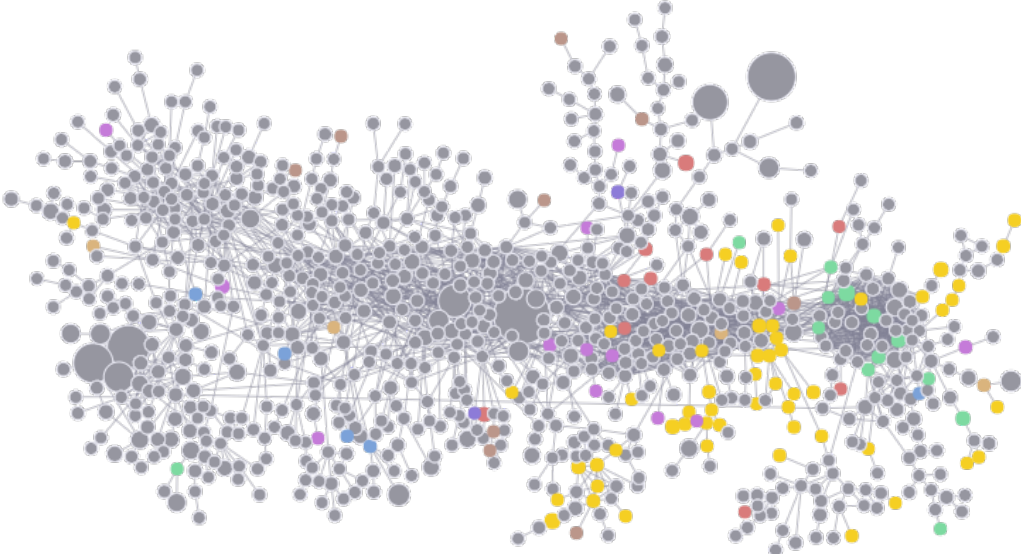
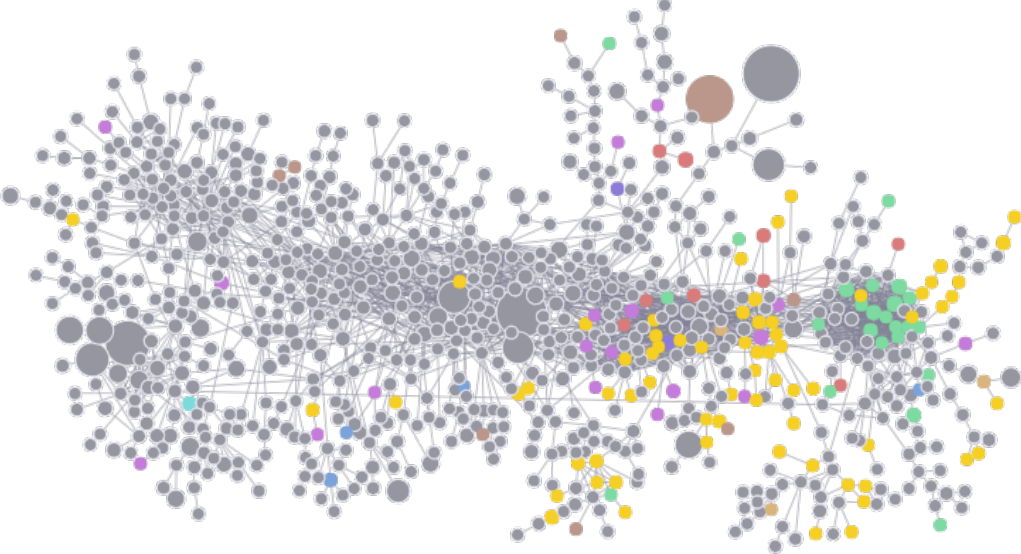


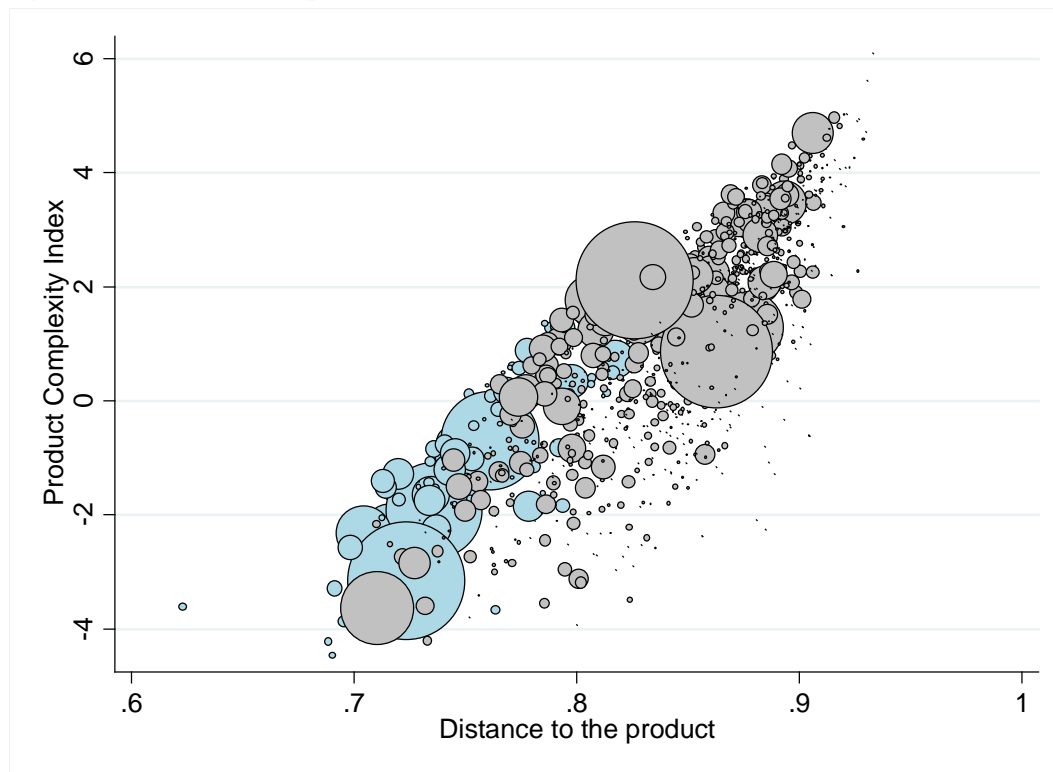
Figure 9: Kenya’s Product Space 2015



4.2 Identifying frontier products

While this study acknowledges measures the country has taken towards the development of more complex products via its Industrial Transformation Program and the Export Development Strategy, it uses findings from the Economic Complexity analytics to propose products for future diversification. In this regard, possibilities for the future product space was measured against the following parameters: Distance, Complexity and Opportunity gain. The blue bubbles in figure 10 represent Kenya’s export products with $RCA > 1$ but with low complexity, while the grey bubbles represent the non-RCA products which are high in complexity.

Figure 10: Product Complexity vs Distance (2014)

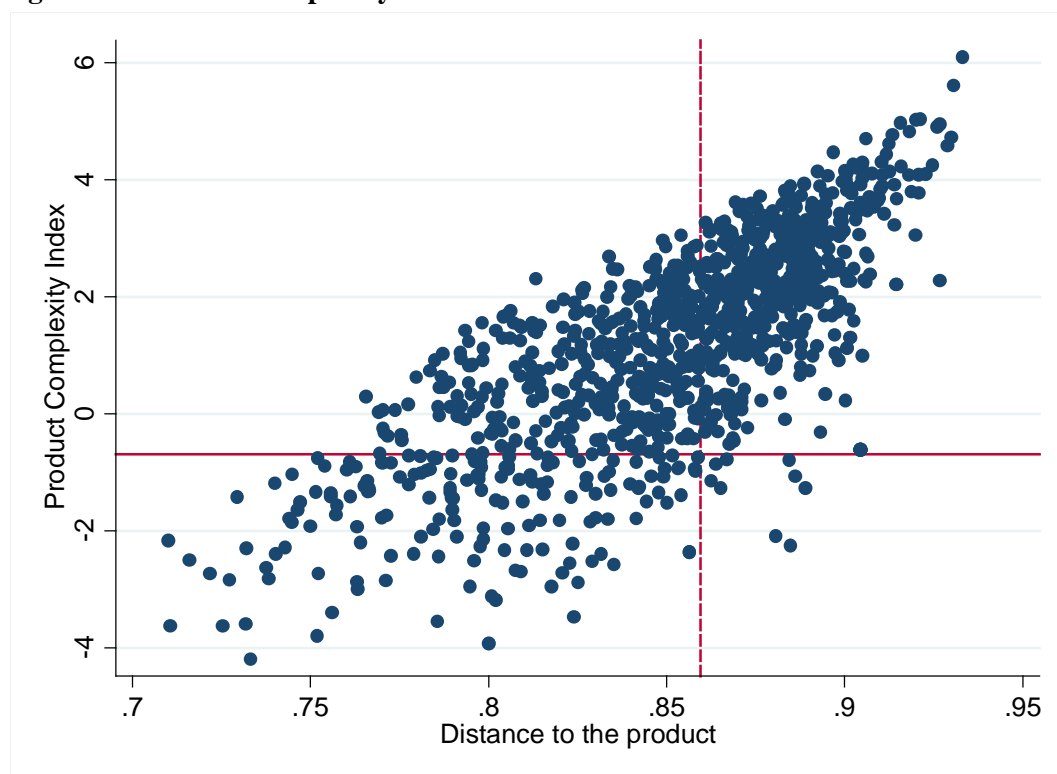


Source: Authors' Calculations based on Atlas of Economic Complexity Data

Figure 11 provided a basis upon which frontier products were chosen. The strategy was to first eliminate products with negative opportunity gain, then graph non-RCA products in a product complexity vs distance scatter plot. All products with a PCI below the average PCI (-0.6898) of Kenya's exports were then eliminated. Products with a distance above the mean distance 0.8595 were also eliminated. The frontier products are thus found in the first quadrant of the scatter plot presented in figure 11. The new products will therefore serve to increase Kenya's overall economic complexity. Given that there is a trade-off between PCI and distance, we find that most frontier products have higher distance as compared to the products that are closer to the existing product space.

Further, given that most of the products in the product space have a low PCI, Kenya must move a bit further from the product space to enhance its ECI, which will also contribute to higher growth.

Figure 11: Product Complexity vs Distance



Source: Authors' Calculations based on Atlas of Economic Complexity Data

Table 4 provides a community list of the frontier products in 2015 (see Appendix 5 for a detailed list of products). It shows that Kenya stands to gain, and even increase complexity, if it was to move to more manufacturing – especially with machinery, and in the chemicals and allied industries. For example, in the chemicals and allied industries, moving to packaged medicaments and glazier putty would allow for higher complexity. In the machinery community, soil preparations machinery and refrigerators would allow for higher complexity. However, this requires significant investment to improve the distance (which is highest), and therefore building capabilities is critical. For animal products, enhancing exports of whey, fermented milk products, and processed poultry products, would greatly enhance the country's economic complexity index. Despite the restrictions on dealings with scrap metal, the country has great potential in enhancing its complexity through exporting of products – especially iron and aluminium products.

An analysis of the ubiquity of the frontier products can give insights into the level of competition in the global market. If a product is less ubiquitous, then it has fewer exporters and is likely to be more complex. Appendix 6 shows the levels of ubiquity for the frontier products over time. The analysis reveals that the number of exporters of most of the products has increased over time between 1995 and 2015. Most metal products (iron, zinc and aluminium products) and chemical products (e.g. hydrochloric acid) have higher PCI and are less ubiquitous. This implies that Kenya could also focus on these products to enhance exports, and consequently increase its level of economic complexity.

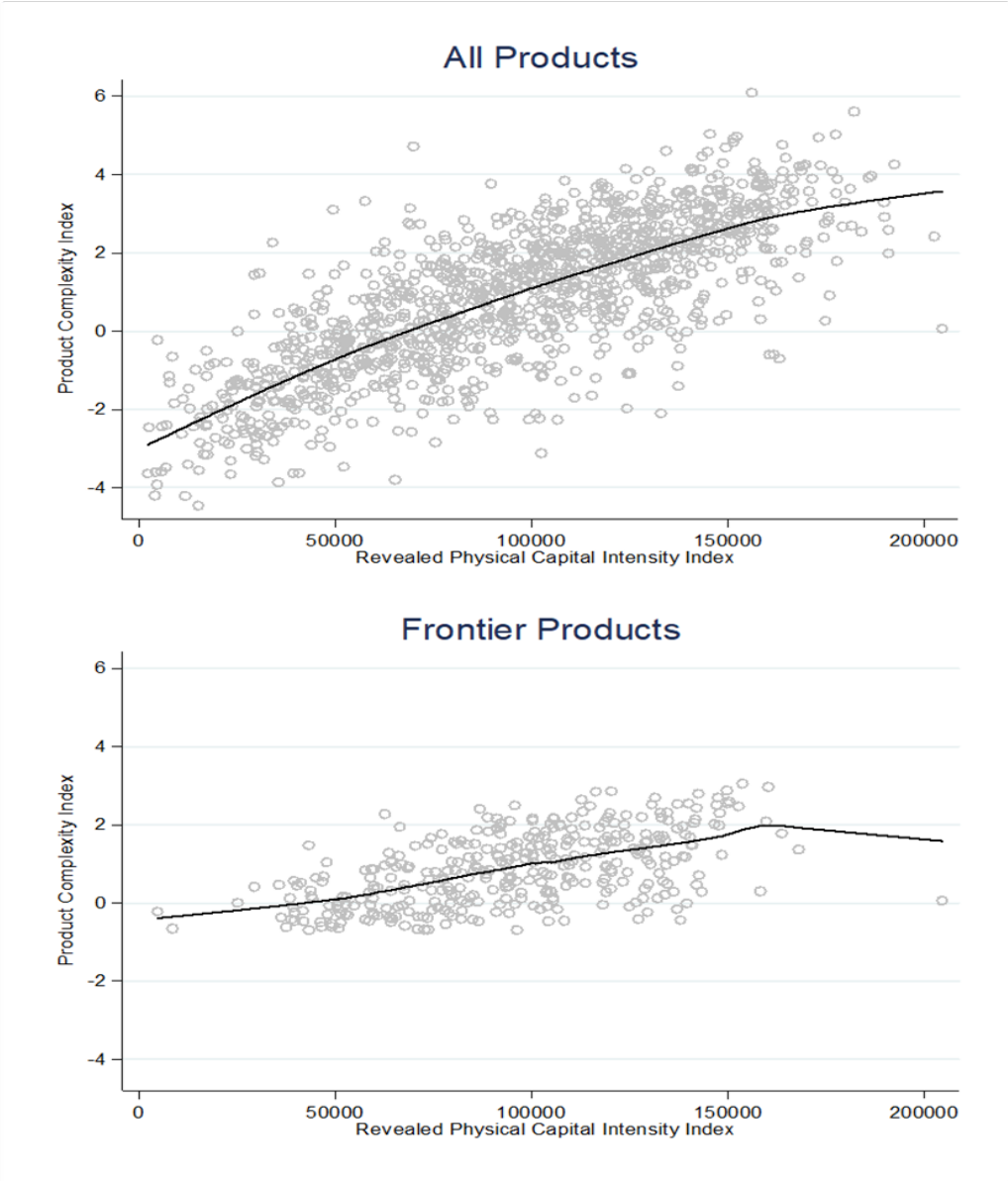
Table 4: Communities of frontier products

| | RCA | PCI | Opportunity gain | Distance |
|---------------------------------|--------|--------|------------------|----------|
| Animal and animal products | 0.0672 | 1.3998 | 0.6447 | 0.8373 |
| Food stuff | 0.3103 | 1.3077 | 0.6003 | 0.8390 |
| Chemicals and allied industries | 0.3512 | 1.6737 | 0.7982 | 0.8399 |
| Plastics/glass | 0.2987 | 1.6323 | 0.7560 | 0.8348 |
| Wood and wood products | 0.1683 | 1.3787 | 0.6390 | 0.8311 |
| Metal | 0.1952 | 1.5192 | 0.7147 | 0.8390 |
| Machinery | 0.2081 | 2.0276 | 0.8563 | 0.8493 |

Source: Authors' Calculations

Figure 12 demonstrates the trade off that takes place between product complexity and revealed physical capital intensity. Revealed Physical Capital Intensity indicates the amount of capital used by a one-person workforce. A high intensity assumes a higher allocation of capital in the manufacture of a product. When measured for all products considered in this study, revealed physical capital intensity has a positive relationship with product complexity, hence the steeper slope for the graph. This is influenced to a large extent by the heterogenous nature of products included in the scatter plot for all products. However, for frontier products, the gradient is a bit low indicating that the trade-off between employment intensity and building economic complexity is weak for frontier products.

Figure 12: Product Complexity vs Revealed Capital Intensity



Source: Authors' Calculations

5. Unlocking Growth through Diversification

For the country to achieve the vision of Kenya's economy becoming prosperous and globally competitive by 2030, the manufacturing sector in Kenya remains critical. The sector is the second largest by sectoral contribution to gross domestic product GDP (9.2 percent), after agriculture and forestry (32.6 percent). It recorded an average annual growth rate of 3.5 percent in the year 2016, compared to a growth of 3.6 in the year 2015 (KNBS, 2017). The sector is the main conduit for the country's integration into the global value chain and is characterized by activity from formal and informal firms. Manufacturing is a major source of employment: the sector had a total labour stock of 3 million – representing approximately 19 percent of the 15.9 million labour stock in the country – as of the year 2016. Further, informal sector manufacturing continues to dominate the total number of jobs in the manufacturing sector, with a total labour stock of 2.7 million – while the formal sector manufacturing had a labour stock of 300,900 as at 2016. In this section, the study highlights opportunities for diversification in the dairy and wood products industries. These two products were drawn from the larger communities of animal and animal products and wood and wood products, both being frontier products identified in section 4.2.

The Dairy Industry

It is projected that Kenya's dairy industry is currently growing at an average rate of 5 to 7 percent per year. According to KDB (2015), over the years, milk production, milk processing or value addition capacity and per capita milk consumption have grown at an average per annum rate of 5.3 percent, 7 percent, and 5.8 percent respectively. The country is experiencing a growing demand for milk and dairy products, driven by expanding urbanization and a rising middle class. This growth has maintained the status of the dairy industry as a key contributor to the economy. It is estimated that the sub-sector contributes 4 percent, 14 percent and 40 percent to the national, agricultural and livestock sector GDP respectively (KDB, 2015). This sub-sector plays a critical role in the livelihood of many Kenyans, employing over 1.2 million citizens (Rademaker et al., 2016).

Challenges Facing Development of the Dairy Industry in Kenya

The dairy sector is dominated by smallholder farmers at the production level who supply 80 percent of the milk consumed in Kenya. Kenya's dairy farming ranks fairly well within the Sub Saharan region, and presents numerous opportunities for growth and development. Urbanization and the relatively high per capita GDP levels have a positive influence on milk consumption – especially in the urban areas. The country's milk production is however characterized by a low input-low yield system that results into sub-optimal milk production. A survey conducted by USAID in 2012 concluded that the country's national yield fell 43 percent below the global average yield.

The dairy industry is affected by: limited ability of input suppliers to offer a wide range of services to milk farmers countrywide; small scale farmers being the major suppliers of milk across the country, which reduces their market penetration capabilities both within and outside Kenya; poor health and hygiene standards that pose challenges during transportation of milk; and the high cost of setting up milk bulking and cooling centres, that hinders the efficiency in collecting milk for processing. Finally, the institutions (both public and private farmers associations) charged with the task of supporting the dairy industry have not been able to provide adequate oversight and governance mechanisms that enhance the development of the industry.

Wood Products

The wood and wood products sub-sector is expected to produce high quality furniture and wood-based products for export markets, to take advantage of the preferential market access within EAC, COMESA, the USA and EU countries. However, according to KNBS (2017), production of wood and wood products (primarily consisting of block boards and plywood) declined by 12.0 percent in 2016. On the contrary, manufacture of corrugated cartons registered a growth of 1.9 percent. Players in the sector can diversify into the manufacture of knock down furniture for supply to primary schools and offices, where there is a growing, ready market that some importers and local companies are already exploiting. The current ban on logging will necessitate the use of alternative raw materials for production. According to WITS¹ data, the sector currently faces stiff competition courtesy of imports from the Middle East and North African countries, and China and India.

Challenges Facing Wood Products

The competitiveness of the industry is hampered by constrained input supply, which either raises the production costs or lowers the quality of manufactured furniture. This has been worsened by the ban on logging, which has created scarcity of wood supply. The requirement for import licencing complicates efforts by manufacturers to cover for the shortfall of domestic supply of timber, by making it costly and complicated. In addition to this, there is very little market information on local timber demand and supply. Secondly, the local players in this sector are increasingly finding it difficult to access the domestic market due to competition from Chinese and Indian furniture products. The local manufacturers mostly use appropriate technology which is affordable to them, but that is also outdated – thus limiting their sawmill yields to between 20-30 percent, compared to 50 percent yields in other countries. Different segments of the wood and furniture value chain lack linkages with other players within the value chain. This limits peer to peer learning on matters of specialization, outsourcing and serial production (Republic of Kenya, 2015).

5.1 Paths for Future Diversification

Table 5 represents the products currently being manufactured, while Table 6 indicates the new products firms are willing to diversify into. To a large extent, the products currently under production are similar to what was identified as frontier products. Frontier products are exported in low proportions, and going by their export percentages, each of these products account for less than 1 percent of the country's total exports. Confectionaries, pharmaceutical products, floor tiles and water for example, were exported in very low proportions. The cross-cutting challenge hindering production of frontier products across all sectors was the lack of technical and managerial skills to steer production of complex products. Plant management, which requires both technical knowledge of production processes alongside managerial capabilities, was lacking in most firms. This prompts the hiring of expatriates to take up such roles.

¹ World Integrated Trade Solution.

Table 5: Products or Services Undertaken

| Products or services undertaken | | | |
|---------------------------------|--|----|--|
| 1 | Other Rubber products | 12 | Non-woven bags, industrial packing of polythene, polythene bags, packaging and agricultural bags |
| 2 | Blocks and concrete production | 13 | Decorative paints, adhesives, thinners |
| 3 | Furniture-sofasets, beds, wall units, tables, chairs, repair of ceilings | 14 | Corrugated boxes |
| 4 | Particle Board: Boards and doors (chipboard, plywoods, blockboard, laminated boards) | 15 | Sodas, juices, water |
| 5 | Confectionaries: Bread, sweets, bubble gums, toffee, toast, cream buns, sponge | 16 | Pipes and metal plates |
| 6 | School and corporate uniforms, designer made to measure outfits, ladies suits, men's trousers, girls dresses | 17 | Tread rubber and cushion gum |
| 7 | Fish leather products (shoes, belts, jackets) | 18 | Tough and laminated glass |
| 8 | Leather products (shoes, bags, wallets) | 19 | Packaging (ARVs) |
| 9 | Parchment coffee | 20 | Roofing sheets |
| 10 | Dairy products: cheese, raw milk and pasteurized milk | 21 | Printing |
| 11 | Transport, building and fencing poles, supplying seedlings | | |

Source: Data from Firm Interviews

Table 6: Frontier Products as Per Firm Interviews

| Frontier Products | | | |
|-------------------|--|----|---|
| 1 | Cabro | 12 | Water packaging |
| 2 | Making chipboard and Parquet | 13 | Steam production |
| 3 | Confectioneries, lollipops and candy | 14 | Metal products |
| 4 | Modern chairs, beds, TV cabinets | 15 | Floor tiles, toilet set-sanitary ware |
| 5 | Paper reels and tissue paper | 16 | Shopping paperbags and envelopes |
| 6 | Whey drink | 17 | Fish eyes/fish fibre for making thread |
| 7 | Household goods (pillows, bedsheets) | 18 | Wired product, roofing sheet, hot rolling coloured sheets |
| 8 | Dairy Products: Pasteurized milk, yoghurt, cheese, milk processing, flavoured milk, milk shake, whey powder, ghee processing | 19 | Glass furniture, Tamblers, mugs and silicate |
| 9 | Rabbit fur, chicken skin | 20 | Colour printing, brochures and books |
| 10 | Suitcases, bags | 21 | Macadamia and avocado farming |
| 11 | Essential oils, Herbal soap | | |

Source: Data from Firm Interviews

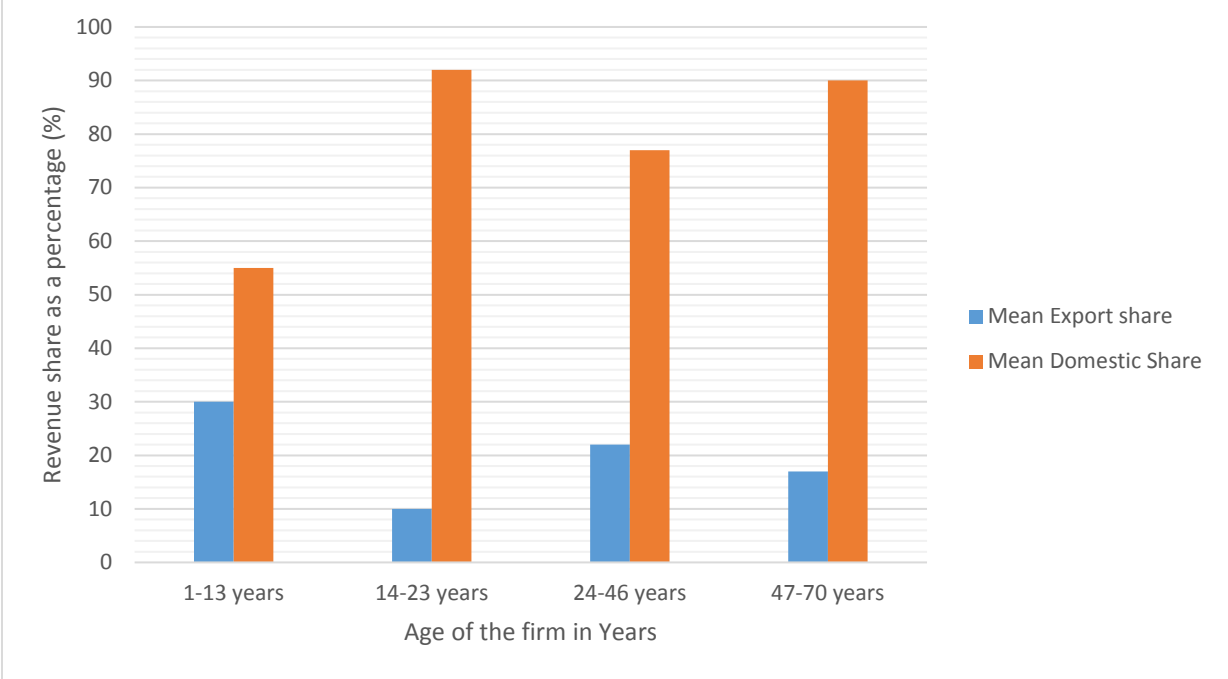
5.2 Findings from Firm and Industry Association Interviews

Exports and Markets – Findings

Figure 13 illustrates the export revenue vis-à-vis domestic revenue share, as per the age of the firm. The analysis shows that most firms, irrespective of their age, still depend on the domestic market

for their products, depicted by the high domestic revenue share. On the other hand, foreign markets for products are popular with firms within the age of 1-13 years, who have the highest share of export revenue share. This is indicative of the level of diversity and complexity of the country’s manufactured products. The low propensity to produce commodities for exports confirms the finding that not only does the country produce ubiquitous products, but its diversity is also very low. This graph offers insights into Kenya’s export survival in the international market.

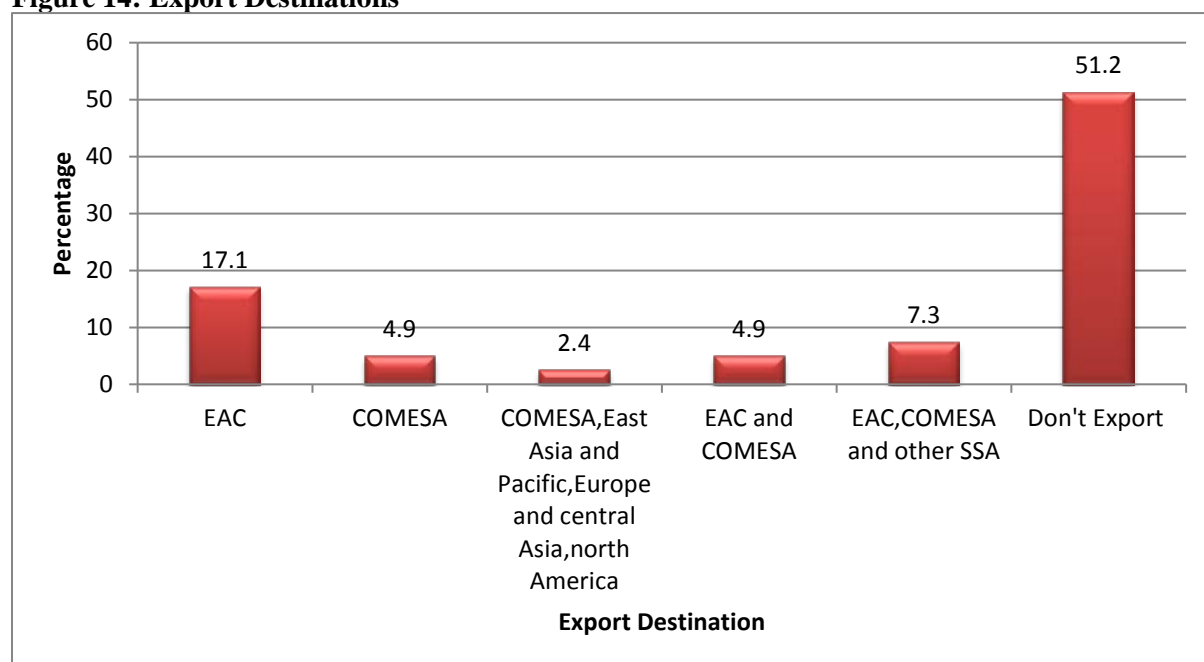
Figure 13: Export Revenue Vis a Vis Domestic Revenue Share According to Age of the Firm



Source: Data from Firm Interviews

Figure 14 displays the export destinations for Kenyan products. The results show that the majority of the firms sampled (51 percent) only sold their products in the domestic market, while 17 percent exclusively exported within the EAC region. Only 4.9 percent exported exclusively to the COMESA market, while 4.9 percent targeted the EAC and COMESA regions. Products were sold in the EAC, COMESA and other Sub Saharan Africa countries by 7.3 percent of firms, and finally, only 2.4 percent were able to export across the globe. The inability to venture into international trade is attributable to factors such as high cost of production; firms’ lack of capacity and low production levels; the lack of linkages to the foreign markets; low demand for products occasioned by new competing industries in export markets; and competition in key market segments from Chinese products. Most firms interviewed (60 percent) reported that the costs faced by their firms made them less globally competitive, with cost of raw materials /input costs being the highest. The firms reported that to increase global competitiveness, cost of production input (raw material, electricity, water) should be lowered. Further, infrastructure should be improved to ease access to the markets. Interest rates and taxes ought to be lowered, while the licencing regime should be streamlined. All these explain why the country’s export structure has barely transformed since independence. The institutional factors alongside the business environment have not permitted a shift in the country’s productive structure and by extension its productive capabilities and economic complexity.

Figure 14: Export Destinations



Source: Data from Firm Interviews

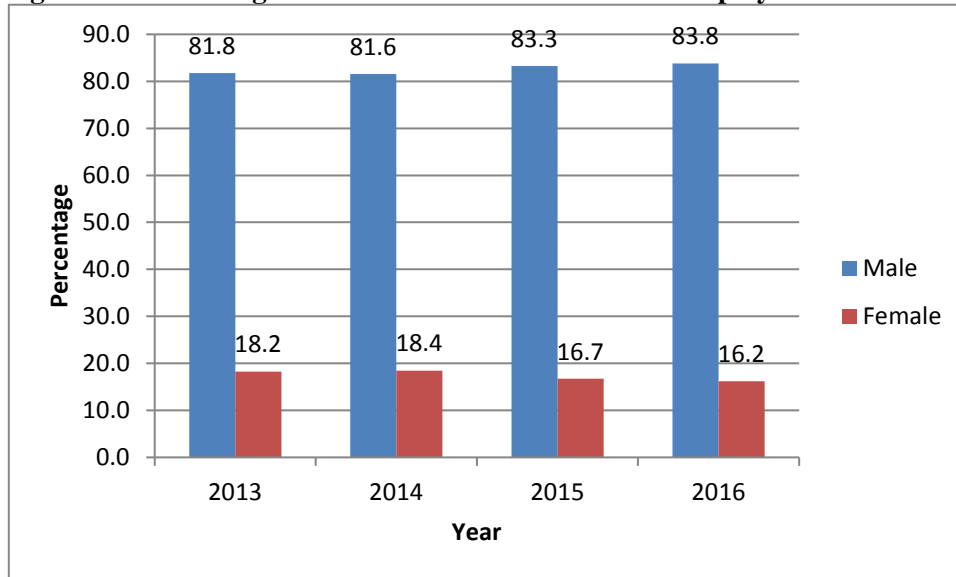
Employment in the Manufacturing Sector by Gender

Labour participation of women and youth is considered key in unlocking economic growth in developing economies because they represent almost half of the population's workforce and as such, their lack of participation in the employment activities implies an untapped resource with implications on efficiency at firm, industry and national level. Table 9 illustrates staff categorization by age and sex for the year 2016 and 2017. It is evident that males form the largest percentage of core staff for both years. These findings are consistent with the manufacturing sector's employment profile by age and sex as depicted in figure 15.

Table 9: Staff categorization by Age and Sex

| Staff Category | Percentage | |
|---------------------------------|--------------|--------------|
| | 2016 | 2017 |
| Youth male core staff | 49.4 | 29.1 |
| Youth female core staff | 6.0 | 4.3 |
| Non-youth male core staff | 15.8 | 30.3 |
| Non-youth female core staff | 3.0 | 3.4 |
| Youth male non-core staff | 14.5 | 6.8 |
| Youth female non-core staff | 2.7 | 1.7 |
| Non-youth male non-core staff | 7.0 | 22.1 |
| Non-youth female non-core staff | 1.7 | 2.3 |
| Total | 100.0 | 100.0 |

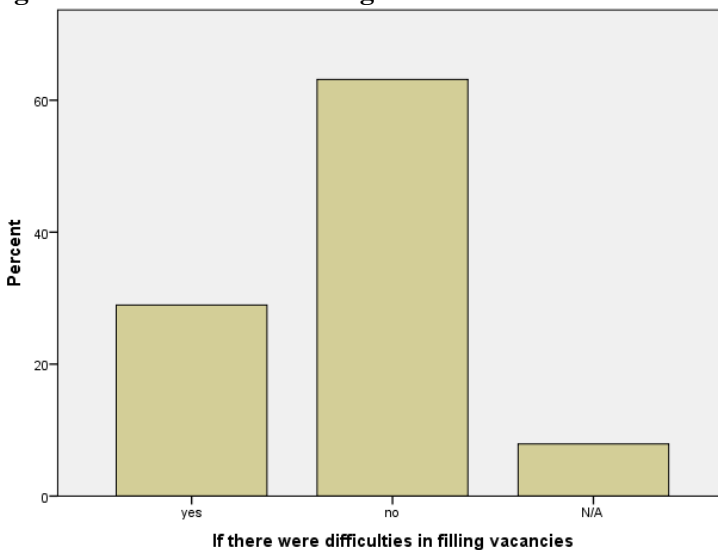
Figure 15: Percentage of Male Vs Female Permanent Employees in Manufacturing



Source: Economic Survey 2018

Figure 16 shows that more than half of the firms sampled reported that they did not find difficulty in filling vacant positions in their firms. However, the lack of skilled and technical labour, as well as high unsustainable wage bills, were some of the challenges the firms cited they faced while filling core worker positions. The sampled firms also reported that the most difficult skill set to attract and retain was that of technicians, managers, and quality controllers. To deal with the less than optimal employment rate, the majority of the firms reported that they had resorted to paying overtime and acting allowances, offering on-job training, engaging attachées and interns, upgrading machines, and offering salary increments. Others firms reported that they relied on foreign labour to provide the required skills. Part of the story behind the stagnation in the country's productive structure is the inadequacy of skills and capabilities to produce complex products. This challenge especially lies in the inadequacy of technical labor required for manufacturing and production of highly complex and competitive products.

Figure 16: Difficulties in filling vacancies

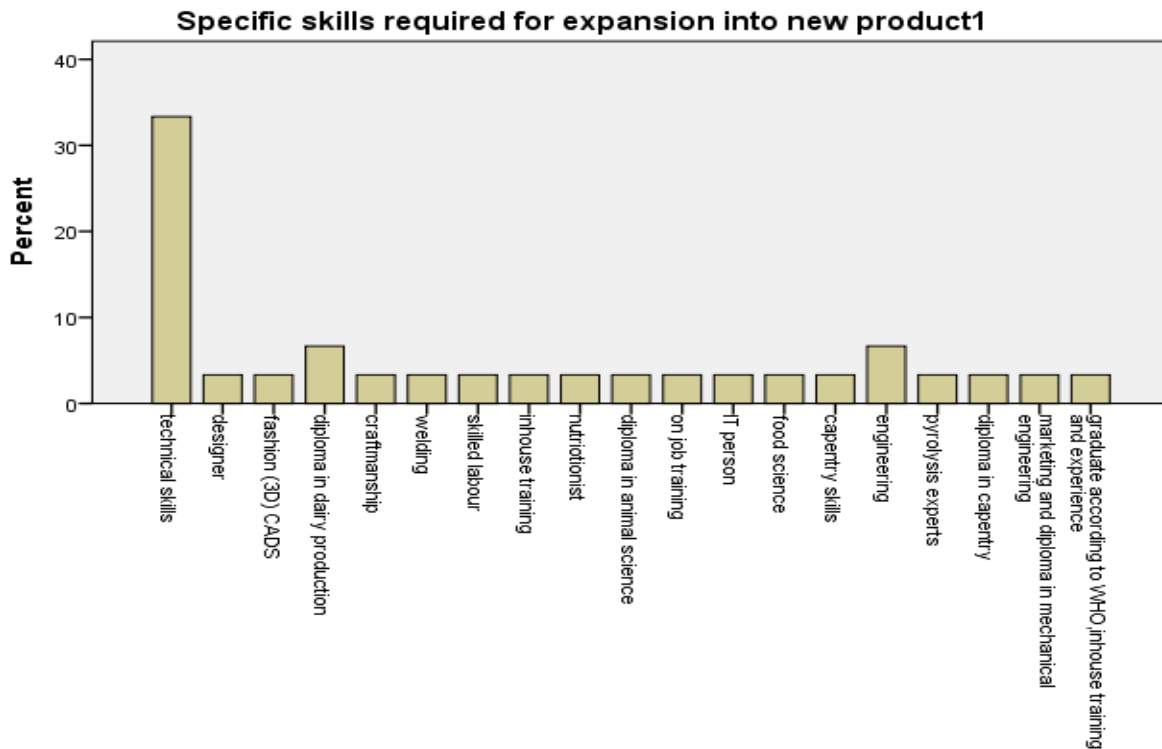


Source: Data from Firm Interviews

Product Space – Findings

Some of the skills required by firms to expand into new products are shown in Figure 17. More than 30 percent of the firms reported that they require technical skills. Dairy production and carpentry skills are also required by a number of firms in order to expand into new products. Additionally, more than 80 percent of the firms reported that their staff undergo training of various forms, hence they are able to deal with the diversified products.

Figure 17: Skills required to Expand into New Products



Source: Data from Firm Interviews

5.3 Employment Potential for Women and Youth

Results from the firm interviews presented in tables 7 and 8 revealed that timber processing, glass processing, production of pipes and plates, manufacture of soft drinks, and manufacture of dairy products, were the top five sectors that had a higher propensity to employ more workers. Manufacture of concrete products, paints, roofing sheets, textiles, and furniture, also had high employment opportunities – if they were to operate at optimal level. All these fell within the family of frontier products identified using the complexity methodology. It is expected that these products will advance the country’s complexity while at the same time increasing employment opportunities for women and youth. Firms engaged in the production of these frontier products were asked about the number of vacancies that would emanate from diversification of production by selected manufacturing firms. The estimates were as given below. Even though this might not really inform the economy on the number of jobs that would be created, it paints a general picture of the existing employment potential in the manufacturing sector.

Table 7: Top Ten Sectors in Terms of Employment Opportunities

| | Sector | Vacancies |
|----|---------------------------------|------------------|
| 1 | Timber Processing | 1828 |
| 2 | Processing glass | 650 |
| 3 | Production of Pipes and Plates | 300 |
| 4 | Manufacture of Soft Drinks | 280 |
| 5 | Manufacture of Dairy Products | 182 |
| 6 | Block Making, Concrete Products | 100 |
| 7 | Manufacture of paints | 83 |
| 8 | Roofing Sheets | 55 |
| 9 | Textile Manufacturing | 52 |
| 10 | Furniture and Wood Products | 32 |
| | | 3562 |

Source: Economic Complexity Firm Survey

Table 8: Number of Jobs to be created by Product Diversification

| Product | Number of Jobs |
|--|-----------------------|
| Rubber products | 1 |
| Blocks and concrete | 4 |
| Furniture-sofasets, beds, wall units, tables, chairs | 7 |
| Curtains and printing | 10 |
| Fish leather products (shoes, belts, jackets) | 18 |
| Shoes, bags, wallets | 3 |
| School and corporate uniforms, designer made to measure outfits | 1000 |
| Dairy products, cheese, yoghurt, Mala, Raw milk | 22 |
| Transport, building and fencing poles, supplying seedlings | 50 |
| Boards and doors (chipboard, plywoods, blockboard, laminated boards) | 500 |
| Non-woven bags, industrial packing of polythene | 13 |
| Pipes and metal plates | 300 |
| Bread, toast, cream buns, sponge | 4 |
| Tough and laminated glass | 8 |
| Printing | 2 |
| Parchment coffee, raw and pasteurized milk, yoghurt | 35 |
| Chair, beds, tables | 4 |
| Sweets, bubble gums, toffee | 50 |
| Furniture and repair of ceiling | 20 |
| Roofing sheets | 15 |
| Cooking oil and flour | 10 |
| Packaging (ARVs) | 100 |
| | 2180 |

Source: Economic Complexity Firm Survey

The existence of the skills gap however inhibits the employability of women and youth in the manufacturing sector. According to industry association members, and information from the firm interviews, there is a low likelihood of employing women or youth due to their deficiency in skills – especially in the technical stages of the manufacturing process. Industries such as glass processing, manufacture of dairy products, production of textiles, and manufacture of roofing sheets, demand technical skilled labour, which is scarce among women and youth. In the same

breath, the skills gap limits capital intensive production, because it requires highly specialized training or work experience.

Stakeholders in the manufacturing sector observed that the skills gap exists as a result of unwillingness of the youth to take up blue-collar jobs in the manufacturing sector. It follows that very few enroll into the technical training institutes to attain technical skills that are applicable in the manufacturing sector. As a result, there is a shortage of technical skills in manufacturing. The youth are not incentivized to get on-job training, because it takes time to develop adequate skills required in a given trade. There is a general preference for white collar jobs, without the inconvenience of going through the rigorous training designed for apprenticeship.

The labour intensive nature of the manufacturing process is a hindrance to the employment of women in the sector. The low level of automation and mechanization of the production process prevents women from participating because of the physical demands of the job. Naturally, the menial jobs are more favourable for men as opposed to women. Employers may also prefer men because they are obliged to give more days off to women: for example, time given to breastfeeding mothers or 3 months for maternity leave.

5.4 Identifying Capabilities for Future Diversification

One important capability that has to be developed in Kenya for manufacturing to thrive, is agricultural extension services. Agricultural extension service refers to the application of scientific research and knowledge to agricultural practices through farmer education. This directly impacts on production because farmers will get it right in terms of farming techniques, choice of fertilizer, and effective land use. Productivity is a function of the above factors, besides weather. Considering that Kenya's agricultural sector provides inputs or raw materials for manufacturing, the country should invest heavily in agricultural extension services so that farmers (more so the small holder farmers) can benefit from technical knowledge on how to yield more from their farms.

Before the shift to a devolved government structure, slaughter houses were owned by the National Government not the County Governments as currently prescribed by the 2010 Constitution of Kenya. Currently, the framework policies are not clear on the role of the two levels of government. The industry is currently suffering from the poor quality of hides and skins coming from the slaughter houses, that can't meet basic standards to make leather products. There lacks expertise at the county level to deal with the hides and skins. Extension services on the ground to advise the farmers on how to ensure quality of their leather products meet market requirements are therefore critical.

5.5 Constraints Facing Development of Complex Products

Constraints facing development of complex products are not only limited to macro and micro economic factors, but also encompass sector specific challenges that have been highlighted at the beginning of this section.

Macroeconomic Factors

Cost of Doing Business

According to industry players, the cost of doing business in Kenya is a hindrance to diversification into frontier products. The cost of utilities, labour and transport contribute greatly to the high cost

of doing business. High electricity bills for instance lower the competitiveness of manufactured goods both in local and international markets, because the burden is eventually borne by the final consumer. Labour costs are based on the minimum wage as opposed to productivity, and therefore manufacturers are obliged to pay a certain level of wages irrespective of the company's performance. This requirement makes it difficult for firms to venture into the production of new products. According to KAM (2018), a lot needs to be done to improve Kenya's ranking in terms of its logistic performance. The country was ranked 42nd out of 160 countries, an indication that plenty needs to be done to achieve some level of competitiveness relative to other countries. It costs between USD 500-1000 to transport a twenty foot cargo from the port of Mombasa to Nairobi. This cost is 60 percent over and above the cost of cargo transportation in the USA and Europe.

Limited Access to Credit

Entrepreneurs are faced with the challenge of low access to credit due to the law capping interest rates in Kenya. The law is meant to lower the cost of credit, an objective which has essentially been achieved in Kenya. This law has however resulted into fewer entrepreneurs accessing loans because of their high-risk profiles. The decline in capital investment is a direct threat to diversification and innovation, as research and development of new products is a capital-intensive activity.

Inadequate Infrastructural Support

The country's infrastructure network does not adequately support export growth. The poor condition of feeder roads, un-competitiveness of the maritime transport, and inadequate access to affordable electricity, present challenges to the export of commodities in the textile and apparels sector for example. The target market for textile and apparel exports is the USA, courtesy of the AGOA agreement for which the country faces competition from other exporters like South Africa, Mauritius and Botswana, among others.

As Kenya's competitors possess fairly advanced infrastructural support systems, the cost of production and time taken to export becomes lower, making their products relatively more competitive compared to Kenyan products. Apparel producers in Swaziland for example, have a relatively more reliable electricity supply at a lower cost of USD 0.023 per kWh, compared to Kenya where electricity costs USD 0.22 per kWh. South Africa, which also exports to the US under AGOA, has a competitive advantage over Kenya by virtue of having a well-developed maritime transport system due to the efficiency of the Durban port – hence exports take a shorter time to be shipped to the destination (Chemengich, 2010).

Microeconomic Factors

Technical Know How

The World Bank (2017) observes that skill building efforts in sub Saharan Africa, Kenya included, are yet to achieve the desired outcomes. Presently, skills development is not selective and demand driven. The skills required to increase the country's productivity should target higher education, technical and vocational training, and business support programs. Technological progress is needed to create more efficient production techniques, lower production costs, and generate competitive products for the global market. In addition to this, there is need to build local capacity on the standards, be they health or technical standards, for goods to be exported abroad. Small scale exporters find it difficult to break into the international market, due to the stringent requirements with regards to market access for certain products. Human capacity within the

country is therefore insufficient to support the country's efforts to optimize its productive capacity, and subsequently export capabilities (Muluvi et al., 2015).

Product Compliance Requirements

Innovation and development of new products entails undergoing standard tests to ascertain that technical and health standards are met by the inventions. These tests are normally carried out by the Kenya Bureau of Standards, a body mandated to ensure compliance with technical and health standards for new innovations. The certification process comes at a cost, which most of the time is inhibitive for small scale manufacturers or start-ups who are trying to venture into production.

During the field visit, an SME involved in the production of vegetable oils lamented on how the product compliance requirements hindered the licencing of their products. The high costs and multiplicity of agencies involved in the process made it difficult to have their products licensed and sold in the formal market.

During a field visit to a small-scale manufacturing firm, it was mentioned that lab tests could cost as high as USD 500 before approval for production is granted.

Most small-scale manufacturers are unable to raise such amounts, hence their products are either sold informally, or their innovations remain unregistered.

Trade in Counterfeit Goods

Trade in illicit and counterfeit products is one of the biggest threats to manufacturing and product innovation in Kenya. According to KAM (2018), manufacturers lose up to 40 percent of market share, 50 percent of revenue, and 10 percent of goodwill to counterfeit products. Counterfeit products infringe on intellectual property rights by virtue of the fact that a lot of capital input is required to undertake research and develop new products that meet consumer taste, health and technical standards. Counterfeits ride on existing brand reputation and loyalty to obtain product market share while denying government the much-needed revenue. Regulatory agencies charged with the mandate of enforcing anti counterfeit laws have been unable to curb the vice.

6. Conclusion and Policy Considerations

This study set out to carry out a detailed analysis of the degree and extent of economic complexity in Kenya, also analysing the country's product space, with the aim of providing policy options to enable Kenya to move from low productivity to high productivity, high growth sectors: Sectors which are expected to generate broad-based employment opportunities for women and youth. It was established that the expansion of Kenyan products in the export market over the years was not accompanied by product sophistication and economic complexity. In effect, this has not helped in achieving larger export shares globally, hence making little impact on the country's economic growth.

The transition from low to high productivity was hampered by several crosscutting issues and industry specific challenges. The issues were identified as: the high cost of doing business; the lack of access to finance; inadequate infrastructural support; skill deficiencies; trade in counterfeit products; and stringent product licensing requirements. Of the sectors that were considered for analysis, most were affected by supply side constraints that came as a result of poor production techniques, or sectoral policies – like the ban on logging that affected supply of wood for furniture products.

Competition from more efficient producers like China, India and Turkey, has affected Kenya's products both in the local and international market. Besides incurring lower production costs, producers from these countries take a shorter time to export and can respond to clients' orders faster than their Kenyan counterparts can. Additionally, they possess more superior production skills and technology that enable them to produce competitive goods that easily meet consumer expectations.

The product space analysis revealed that the dairy and wood sectors were potential employers of youth and women, if the existing opportunities for diversification were utilized. Utilization of existing opportunities is dependent upon having a conducive business environment, availability of technical and managerial capabilities, access to foreign markets, and fair-trade practices, among others.

Policy Recommendations

To address the skills gap in Kenya's agriculture and manufacturing value chain, there should be concerted efforts to upgrade workers' skills and competencies in the production process. To achieve this, the Ministry of Education – together with relevant stakeholders – should review the curriculum to ensure that the graduates being churned out of the learning institutions possess practical competencies and skills that meet global market demands. In addition to this, a framework for knowledge transfer between large and micro enterprises in the manufacturing industry needs to be developed, as a way of skills transfer. Where possible, the large manufacturers need to sub-contract to MSMEs and supervise the manufacture of quality products and create employment opportunities in the process.

To address the high cost of doing business emanating from high wage bills and energy costs, the Ministry of Labor – together with other stakeholders – needs to come up with a common ground to ensure the minimum wage is feasible for both parties. In addition to this, the country needs to

continue investing in transport infrastructure to ensure efficiency in the distribution of goods and services within and outside the country.

Counterfeit products pose a major challenge to manufacturing and product innovation. There is a need for regulatory agencies that are mandated to ensure that compliance with product health and technical standards is upheld by all manufacturers. The Kenya Revenue Authority, Kenya Bureau of Standards, and Anti Counterfeit Agency need to come up with a common strategy directed towards eliminating counterfeit products in the Kenyan market. The country needs to push for the adoption of a Trade Remedies Act within the EAC to ensure that unfair trading practices are dealt with in the Kenyan economy. A regional approach to resolving unfair trading practices will ensure that counterfeit goods do not access the Kenyan market through the EAC partner states.

Finally, there is a need to harmonize Intellectual Property Rights laws within the EAC and COMESA. This way, innovators will be able to earn royalties from their inventions. Such a policy intervention would also strengthen innovation, research and development in the manufacturing sector. The absence of harmonized laws across the region imply very weak safeguards for intellectual property.

To deal with the challenge of unfair competition from Indian and Chinese products, Kenya needs to push for the enactment of a trade remedies act at the EAC level. Implementation of the act within Kenya's borders cannot adequately address unfair trade practices, because some of these products are able to enter the Kenyan market via other partner states. A trade remedies act at regional level would restrict the possibility of such products gaining market access through such channels.

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Appendix

Appendix 1: Commodities that Kenya has Revealed Comparative Advantage in (2015)

| | Export value | RCA | PCI | Distance |
|---|---------------|---------|--------|----------|
| Tea | 1,130,000,000 | 483.488 | -2.687 | 0.750 |
| Cut Flowers | 626,000,000 | 233.185 | -1.966 | 0.745 |
| Refined Petroleum | 397,000,000 | 2.208 | -0.779 | 0.789 |
| Coffee | 226,000,000 | 21.507 | -2.179 | 0.745 |
| Legumes | 151,000,000 | 320.677 | -2.344 | 0.731 |
| Titanium Ore | 98,900,000 | 167.557 | -1.903 | 0.791 |
| Non-Knit Women's Suits | 89,900,000 | 4.363 | -1.868 | 0.758 |
| Other Processed Fruits and Nuts | 86,000,000 | 17.198 | -1.134 | 0.767 |
| Non-Knit Men's Suits | 81,700,000 | 5.106 | -1.780 | 0.754 |
| Carbonates | 72,500,000 | 37.808 | 0.059 | 0.819 |
| Other Nuts | 67,800,000 | 11.376 | -2.517 | 0.763 |
| Tropical Fruits | 67,700,000 | 20.863 | -2.407 | 0.721 |
| Knit Women's Suits | 60,800,000 | 5.064 | -2.087 | 0.746 |
| Other Live Plants | 55,900,000 | 22.533 | -0.795 | 0.761 |
| Tanned Equine and Bovine Hides | 55,300,000 | 9.311 | -1.782 | 0.756 |
| Rolled Tobacco | 50,200,000 | 6.822 | -0.936 | 0.768 |
| Knit Sweaters | 48,700,000 | 2.816 | -2.073 | 0.748 |
| Coated Flat-Rolled Iron | 45,000,000 | 3.165 | 1.349 | 0.841 |
| Salt | 44,300,000 | 47.599 | -1.675 | 0.756 |
| Cement | 44,200,000 | 12.133 | -1.439 | 0.740 |
| Dried Legumes | 43,400,000 | 12.524 | -2.344 | 0.737 |
| Plastic Lids | 43,200,000 | 2.763 | 0.352 | 0.787 |
| Other Vegetables | 38,700,000 | 8.858 | -1.709 | 0.740 |
| Scrap Copper | 31,400,000 | 5.145 | -0.964 | 0.776 |
| Confectionery Sugar | 31,300,000 | 8.972 | -0.142 | 0.774 |
| Other Processed Vegetables | 30,100,000 | 9.012 | -0.829 | 0.764 |
| Non-fillet Frozen Fish | 29,100,000 | 4.727 | -2.242 | 0.748 |
| Niobium, Tantalum, Vanadium and Zirconium Ore | 27,800,000 | 70.662 | -4.025 | 0.724 |
| Cleaning Products | 26,900,000 | 2.618 | 0.933 | 0.798 |
| Coffee and Tea Extracts | 25,600,000 | 9.860 | -0.586 | 0.783 |
| Tanned Goat Hides | 24,700,000 | 79.897 | -3.384 | 0.745 |
| Margarine | 23,500,000 | 14.512 | -0.712 | 0.767 |
| Fish Fillets | 22,900,000 | 3.397 | -1.491 | 0.754 |
| Feldspar | 22,400,000 | 57.676 | -1.045 | 0.801 |
| Soap | 22,000,000 | 10.474 | -1.052 | 0.753 |
| Knit Men's Suits | 22,000,000 | 5.287 | -2.626 | 0.748 |
| Coconut and Other Vegetable Fibers | 21,500,000 | 125.114 | -3.097 | 0.765 |
| Cabbages | 21,100,000 | 22.027 | -0.451 | 0.798 |
| Sowing Seeds | 21,000,000 | 9.619 | -0.716 | 0.802 |

| | Export value | RCA | PCI | Distance |
|---------------------------------------|---------------------|------------|------------|-----------------|
| Raw Tobacco | 19,800,000 | 4.735 | -2.633 | 0.720 |
| Processed Fish | 19,700,000 | 4.030 | -1.887 | 0.751 |
| Palm Oil | 17,100,000 | 1.817 | -3.298 | 0.716 |
| Knit Men's Shirts | 17,000,000 | 6.503 | -2.464 | 0.740 |
| Knit T-shirts | 16,900,000 | 1.218 | -2.271 | 0.740 |
| Alcohol > 80% ABV | 16,700,000 | 6.847 | -0.865 | 0.780 |
| Mixed Mineral or Chemical Fertilizers | 16,100,000 | 2.077 | -0.613 | 0.767 |
| Metal Stoppers | 15,700,000 | 7.613 | 1.708 | 0.822 |
| Paper Containers | 15,700,000 | 2.212 | -0.061 | 0.775 |
| Beer | 14,900,000 | 3.265 | 0.420 | 0.799 |
| Rubber Footwear | 13,400,000 | 1.053 | -1.844 | 0.813 |
| Tanned Sheep Hides | 13,200,000 | 33.723 | -2.923 | 0.734 |
| Other Printed Material | 13,000,000 | 3.828 | 2.099 | 0.825 |
| Trailers | 12,900,000 | 1.665 | 2.347 | 0.838 |
| Electric Batteries | 12,900,000 | 1.049 | 1.160 | 0.854 |
| Processed Fish | 12,600,000 | 7.452 | -1.914 | 0.742 |
| Video and Card Games | 12,400,000 | 1.730 | 1.921 | 0.852 |
| Pens | 12,200,000 | 6.388 | 1.434 | 0.857 |
| Pesticides | 12,000,000 | 1.107 | 1.427 | 0.823 |
| Sauces and Seasonings | 11,400,000 | 3.111 | -0.073 | 0.776 |
| Fruit Juice | 11,400,000 | 2.382 | -0.845 | 0.759 |
| Bran | 10,800,000 | 16.285 | -2.298 | 0.747 |
| Flavored Water | 10,600,000 | 1.801 | 0.442 | 0.777 |
| Aluminium Housewares | 10,500,000 | 6.631 | 0.633 | 0.841 |
| Non-Knit Active Wear | 10,500,000 | 2.728 | -1.640 | 0.756 |
| Other Pure Vegetable Oils | 9,889,090 | 7.624 | -0.595 | 0.788 |
| Other Small Iron Pipes | 9,872,900 | 1.426 | 0.185 | 0.789 |
| Sheep and Goat Meat | 9,737,179 | 4.595 | -1.392 | 0.791 |
| Postage Stamps | 9,609,138 | 14.141 | -0.304 | 0.814 |
| Buses | 9,427,067 | 1.800 | 1.263 | 0.855 |
| Brochures | 9,071,997 | 1.870 | 1.432 | 0.832 |
| Plastic Housewares | 8,416,954 | 1.464 | -0.793 | 0.780 |
| Glass Bottles | 8,211,888 | 2.644 | 0.033 | 0.789 |
| Processed Tobacco | 8,128,962 | 4.730 | -0.092 | 0.781 |
| Aqueous Paints | 7,974,166 | 4.185 | 1.606 | 0.815 |
| Non-Knit Babies' Garments | 7,927,253 | 9.185 | -1.903 | 0.778 |
| Polishes and Creams | 7,900,585 | 11.094 | 1.222 | 0.819 |
| Other Oily Seeds | 7,507,674 | 5.618 | -2.891 | 0.731 |
| Onions | 7,399,606 | 3.498 | -2.667 | 0.752 |
| Paper Notebooks | 6,982,594 | 4.967 | -0.252 | 0.776 |
| Cold-Rolled Iron | 6,759,467 | 1.429 | 1.250 | 0.841 |

| | Export value | RCA | PCI | Distance |
|--------------------------------------|---------------------|------------|------------|-----------------|
| Yeast | 6,723,799 | 9.255 | 0.034 | 0.782 |
| Non-Knit Women's Shirts | 6,489,539 | 1.410 | -1.646 | 0.767 |
| Silicates | 6,427,160 | 30.724 | 0.421 | 0.820 |
| Non-Knit Men's Shirts | 6,187,382 | 1.204 | -1.844 | 0.761 |
| Fake Hair | 5,723,972 | 3.946 | -4.231 | 0.759 |
| Awnings, Tents, and Sails | 5,544,770 | 4.152 | -0.611 | 0.801 |
| Prefabricated Buildings | 4,871,029 | 1.793 | 1.039 | 0.803 |
| Wool | 4,866,808 | 3.593 | -2.245 | 0.765 |
| Knit Babies' Garments | 4,615,260 | 1.940 | -2.435 | 0.751 |
| Spices | 4,566,879 | 5.936 | -2.381 | 0.742 |
| Cellulose Fibers Paper | 4,509,117 | 1.005 | 1.727 | 0.846 |
| Scrap Plastic | 4,455,565 | 2.307 | -0.618 | 0.770 |
| Waterproof Footwear | 4,382,859 | 8.612 | -1.043 | 0.776 |
| Jute and Other Textile Fibers | 4,347,382 | 59.227 | -4.582 | 0.705 |
| Packing Bags | 4,314,076 | 2.591 | -2.727 | 0.721 |
| Paper Labels | 4,289,029 | 2.948 | 0.718 | 0.791 |
| Essential Oils | 4,203,335 | 2.566 | -1.434 | 0.765 |
| Other Inorganic Acids | 4,087,585 | 3.052 | 0.574 | 0.827 |
| Milk | 3,851,105 | 1.519 | 0.594 | 0.796 |
| Other Knit Garments | 3,777,007 | 1.876 | -2.089 | 0.749 |
| Gypsum | 3,729,785 | 10.285 | -1.690 | 0.771 |
| Foliage | 3,657,029 | 9.443 | -0.532 | 0.775 |
| Bovine | 3,593,214 | 1.287 | 0.133 | 0.789 |
| Vegetable Saps | 3,588,556 | 1.774 | -1.706 | 0.784 |
| Fishing and Hunting Equipment | 3,288,375 | 3.440 | -0.141 | 0.806 |
| Coconuts, Brazil Nuts, and Cashews | 2,993,686 | 1.250 | -3.995 | 0.731 |
| Retail Artificial Staple Fibers Yarn | 2,973,048 | 22.693 | -0.827 | 0.822 |
| Dextrins | 2,966,826 | 2.684 | 2.059 | 0.869 |
| Large Iron Containers | 2,953,243 | 2.292 | 0.884 | 0.801 |
| Precious Stones | 2,922,466 | 1.146 | -1.327 | 0.785 |
| Knit Men's Coats | 2,775,110 | 3.179 | -1.603 | 0.760 |
| Blankets | 2,691,027 | 1.672 | -1.698 | 0.791 |
| Sausages | 2,688,009 | 1.819 | 1.459 | 0.806 |
| Other Animals | 2,541,006 | 6.455 | -1.750 | 0.747 |
| Vegetable or Animal Dyes | 2,412,730 | 6.260 | 0.864 | 0.835 |
| Stranded Aluminium Wire | 2,326,625 | 5.245 | -1.008 | 0.810 |
| Preserved Meat | 2,197,867 | 1.495 | 1.735 | 0.855 |
| Leather of Other Animals | 2,086,292 | 7.172 | -2.056 | 0.771 |
| Root Vegetables | 2,007,695 | 3.355 | -0.547 | 0.786 |
| Ice Cream | 1,874,313 | 1.667 | 0.530 | 0.794 |
| Live Fish | 1,868,023 | 3.603 | -0.895 | 0.781 |

| | Export value | RCA | PCI | Distance |
|---|---------------------|------------|------------|-----------------|
| Organic Composite Solvents | 1,809,879 | 3.452 | 0.773 | 0.795 |
| Lettuce | 1,791,681 | 2.001 | 0.283 | 0.816 |
| Poultry | 1,776,470 | 1.810 | 0.836 | 0.805 |
| Jams | 1,759,848 | 1.851 | 0.147 | 0.781 |
| Plastic Wash Basins | 1,732,633 | 1.505 | 1.563 | 0.819 |
| Other Paints | 1,695,780 | 6.428 | 0.869 | 0.807 |
| Non-Iron and Steel Slag, Ash and Residues | 1,684,667 | 1.065 | -0.299 | 0.819 |
| Insect Resins | 1,649,801 | 8.992 | -3.142 | 0.732 |
| Twine and Rope | 1,630,847 | 1.927 | -0.815 | 0.782 |
| Glycerol | 1,569,709 | 3.540 | 1.210 | 0.834 |
| Quicklime | 1,522,166 | 4.413 | 0.091 | 0.792 |
| Perfume Plants | 1,512,940 | 1.437 | -2.899 | 0.733 |
| Basketwork | 1,348,382 | 2.313 | -3.044 | 0.781 |
| Other Vegetable Oils | 1,273,194 | 1.244 | -1.758 | 0.744 |
| Waxes | 1,213,548 | 9.703 | -2.682 | 0.773 |
| Vegetable Tanning Extracts | 1,180,173 | 9.723 | -0.949 | 0.813 |
| Scrap Waste | 1,066,647 | 6.834 | -0.159 | 0.775 |
| Candles | 1,046,308 | 1.074 | 1.154 | 0.833 |
| Sulfates | 972,640 | 1.071 | -0.340 | 0.818 |
| Processed Hair | 947,216 | 4.309 | -1.682 | 0.822 |
| Sulfuric Acid | 943,708 | 2.777 | 1.234 | 0.848 |
| Wood Ornaments | 853,282 | 1.480 | -1.251 | 0.781 |
| Locust beans, seaweed, sugar beet, cane, for food | 784,327 | 1.298 | -2.357 | 0.749 |
| Roofing Tiles | 781,276 | 3.296 | 1.290 | 0.824 |
| Pearl Products | 755,836 | 1.047 | 0.335 | 0.840 |
| Netting | 727,335 | 1.291 | -0.595 | 0.792 |
| Other Ceramic Articles | 705,093 | 1.308 | 0.722 | 0.843 |
| Agave | 704,990 | 1,699.761 | -0.588 | 0.741 |
| Cereal Flours | 676,105 | 2.551 | -1.390 | 0.755 |
| Artificial Graphite | 633,787 | 1.147 | 2.353 | 0.878 |
| Hypochlorites | 605,802 | 3.486 | 0.055 | 0.798 |
| Tungsten Ore | 464,721 | 6.273 | -3.204 | 0.781 |
| Cereal Meal and Pellets | 430,789 | 1.218 | -0.639 | 0.772 |
| Synthetic Filament Tow | 407,065 | 1.081 | 0.896 | 0.846 |
| Developed Exposed Photographic Material | 379,032 | 1.213 | 4.255 | 0.895 |
| String Instruments | 364,425 | 1.126 | 1.102 | 0.855 |
| Buckwheat | 361,371 | 1.003 | -1.218 | 0.788 |
| Other Hides and Skins | 312,132 | 1.415 | -2.248 | 0.758 |
| Other Vegetable Fibers Yarn | 280,716 | 8.272 | -0.363 | 0.819 |
| Metal Signs | 257,564 | 1.154 | 1.667 | 0.843 |
| Pharmaceutical Animal Products | 255,155 | 3.965 | -2.214 | 0.765 |

| | Export value | RCA | PCI | Distance |
|---|---------------------|------------|------------|-----------------|
| Other Ores | 222,636 | 2.052 | -2.800 | 0.745 |
| Plaiting Products | 219,914 | 1.228 | -2.813 | 0.774 |
| Cloves | 198,597 | 1.891 | -2.891 | 0.765 |
| Barbed Wire | 173,889 | 2.326 | -1.094 | 0.765 |
| Bricks | 155,578 | 3.243 | -0.484 | 0.805 |
| Nitric Acids | 153,995 | 1.582 | 2.287 | 0.853 |
| Coral and Shells | 129,905 | 2.076 | -2.173 | 0.762 |
| Matches | 129,395 | 2.066 | -1.395 | 0.774 |
| Artificial Fibers Waste | 125,999 | 1.728 | 0.633 | 0.795 |
| Worked Ivory and Bone | 94,003 | 2.504 | -1.524 | 0.772 |
| Paper Pulp Filter Blocks | 77,369 | 1.522 | 2.163 | 0.853 |
| Chalk | 59,134 | 1.423 | 0.752 | 0.824 |
| Textile Wicks | 20,248 | 1.308 | 0.027 | 0.822 |
| Undeveloped Exposed Photographic Material | 11,833 | 1.751 | 2.976 | 0.863 |
| Hemp Fibers | 6,187 | 1.199 | -0.641 | 0.788 |

Source: Authors Calculations

Appendix 2: Products with RCA>1 in other years but not in 2015

| Product code | Commodity description | Community | PCI |
|--------------|--|-------------------------------|-------|
| 402 | Concentrated Milk | Animal & animal products | 1.364 |
| 403 | Fermented Milk Products | Animal & animal products | 1.354 |
| 601 | Bulbs and Roots | Vegetable products | 1.695 |
| 1107 | Malt | Vegetable products | 1.853 |
| 1210 | Hops | Vegetable products | 2.029 |
| 1702 | Other Sugars | Foodstuffs | 2.309 |
| 1901 | Malt Extract | Foodstuffs | 1.576 |
| 2512 | Siliceous Fossil Meals | Mineral products | 1.198 |
| 2518 | Dolomite | Mineral products | 1.066 |
| 2521 | Limestone | Mineral products | 1.428 |
| 2705 | Non-Petroleum Gas | Mineral products | 1.544 |
| 2708 | Pitch Coke | Mineral products | 2.508 |
| 2815 | Sodium or Potassium Peroxides | Chemicals & allied industries | 1.007 |
| 2824 | Lead Oxides | Chemicals & allied industries | 1.045 |
| 2832 | Sulfites | Chemicals & allied industries | 1.722 |
| 2845 | Other Isotopes | Chemicals & allied industries | 2.192 |
| 2915 | Saturated Acyclic Monocarboxylic Acids | Chemicals & allied industries | 2.489 |
| 2942 | Other Organic Compounds | Chemicals & allied industries | 2.462 |
| 3003 | Unpackaged Medicaments | Chemicals & allied industries | 1.856 |
| 3703 | Photographic Paper | Chemicals & allied industries | 3.154 |
| 3807 | Wood Tar, Oils and Pitch | Chemicals & allied industries | 1.866 |
| 3819 | Hydraulic Brake Fluid | Chemicals & allied industries | 1.797 |
| 3918 | Plastic Floor Coverings | Plastics/rubbers | 2.890 |
| 3921 | Other Plastic Sheetings | Plastics/rubbers | 2.774 |
| 4006 | Unvulcanised Rubber Products | Plastics/rubbers | 1.715 |
| 4014 | Pharmaceutical Rubber Products | Plastics/rubbers | 1.581 |
| 4411 | Wood Fiberboard | Wood & wood products | 1.377 |
| 4804 | Uncoated Kraft Paper | Wood & wood products | 1.651 |
| 4808 | Corrugated Paper | Wood & wood products | 1.310 |
| 4817 | Letter Stock | Wood & wood products | 2.074 |
| 4905 | Maps | Wood & wood products | 2.871 |
| 5404 | Synthetic Monofilament | Textiles/clothing | 2.382 |
| 5604 | Rubber Textiles | Textiles/clothing | 5.102 |
| 6815 | Other Stone Articles | Stone/glass | 2.885 |
| 7016 | Glass Bricks | Stone/glass | 1.191 |
| 7017 | Laboratory Glassware | Stone/glass | 2.944 |
| 7211 | Large Flat-Rolled Iron | Metals | 2.607 |
| 7212 | Large Coated Flat-Rolled Iron | Metals | 3.428 |
| 7215 | Other Iron Bars | Metals | 1.410 |
| 7216 | Iron Blocks | Metals | 1.465 |
| 7217 | Iron Wire | Metals | 1.075 |
| 7228 | Other Steel Bars | Metals | 2.443 |
| 7301 | Iron Sheet Piling | Metals | 1.846 |
| 7305 | Other Large Iron Pipes | Metals | 2.308 |
| 7314 | Iron Cloth | Metals | 1.903 |

| Product code | Commodity description | Community | PCI |
|---------------------|---------------------------------|----------------------|------------|
| 7603 | Aluminium Powder | Metals | 2.548 |
| 7605 | Aluminium Wire | Metals | 1.626 |
| 7606 | Aluminium Plating | Metals | 1.851 |
| 7611 | Large Aluminium Containers | Metals | 1.822 |
| 7903 | Zinc Powder | Metals | 1.505 |
| 7904 | Zinc Bars | Metals | 1.826 |
| 7906 | Zinc Pipes | Metals | 3.000 |
| 8006 | Tin Pipes | Metals | 3.459 |
| 8203 | Hand Tools | Metals | 2.089 |
| 8204 | Wrenches | Metals | 3.103 |
| 8206 | Tool Sets | Metals | 3.763 |
| 8304 | Filing Cabinets | Metals | 1.465 |
| 8405 | Water and Gas Generators | Machinery/electrical | 3.416 |
| 8410 | Hydraulic Turbines | Machinery/electrical | 2.553 |
| 8435 | Fruit Pressing Machinery | Machinery/electrical | 2.941 |
| 8437 | Mill Machinery | Machinery/electrical | 1.027 |
| 8452 | Sewing Machines | Machinery/electrical | 1.851 |
| 8453 | Leather Machinery | Machinery/electrical | 1.886 |
| 8468 | Soldering and Welding Machinery | Machinery/electrical | 3.467 |
| 8530 | Traffic Signals | Machinery/electrical | 3.839 |
| 8606 | Railway Freight Cars | Transportation | 1.269 |
| 8704 | Delivery Trucks | Transportation | 2.247 |
| 8706 | Vehicle Chassis | Transportation | 2.167 |
| 8709 | Work Trucks | Transportation | 2.432 |
| 9010 | Photo Lab Equipment | Miscellaneous | 3.833 |
| 9014 | Compasses | Miscellaneous | 1.165 |
| 9015 | Surveying Equipment | Miscellaneous | 1.597 |
| 9209 | Musical Instrument Parts | Miscellaneous | 1.712 |
| 9402 | Medical Furniture | Miscellaneous | 3.303 |
| 9617 | Vacuum Flask | Miscellaneous | 1.371 |
| 9702 | Prints | Miscellaneous | 4.310 |
| 9703 | Sculptures | Miscellaneous | 1.336 |

Source: Authors Calculations

Appendix 3: Kenya's main export products in 1995, 2005 and 2015

| 1995 | | | 2005 | | | 2015 | | |
|---------------------------------|--------|-------|---------------------------------|--------|-------|---------------------------------|-------|-------|
| Commodity | RCA | PCI | Commodity | RCA | PCI | Commodity | RCA | PCI |
| Coffee | 63.40 | -4.09 | Tea | 403.29 | -3.25 | Tea | 483.5 | -2.69 |
| Tea | 344.67 | -3.17 | Refined Petroleum | 3.83 | -1.07 | Cut Flowers | 233.2 | -1.97 |
| Cut Flowers | 72.79 | -2.83 | Cut Flowers | 163.49 | -2.54 | Refined Petroleum | 2.2 | -0.78 |
| Fish Fillets | 27.73 | -1.91 | Legumes | 469.39 | -2.49 | Coffee | 21.5 | -2.18 |
| Other Processed Fruits and Nuts | 34.94 | -1.48 | Coffee | 31.98 | -3.47 | Legumes | 320.7 | -2.34 |
| Cement | 31.04 | -0.53 | Non-Knit Women's Suits | 9.09 | -1.58 | Titanium Ore | 167.6 | -1.90 |
| Legumes | 327.38 | -2.01 | Coated Flat-Rolled Iron | 6.20 | 0.85 | Non-Knit Women's Suits | 4.4 | -1.87 |
| Coated Flat-Rolled Iron | 7.54 | 1.86 | Fish Fillets | 14.96 | -1.86 | Other Processed Fruits and Nuts | 17.2 | -1.13 |
| Vegetable Saps | 38.20 | -0.72 | Other Processed Fruits and Nuts | 21.05 | -1.27 | Non-Knit Men's Suits | 5.1 | -1.78 |
| Non-Knit Men's Shirts | 7.67 | -2.41 | Cement | 15.64 | -1.50 | Carbonates | 37.8 | 0.06 |
| Delivery Trucks | 1.48 | 2.25 | Non-Knit Men's Suits | 4.11 | -1.70 | Other Nuts | 11.4 | -2.52 |
| Carbonates | 30.54 | 0.37 | Rolled Tobacco | 7.45 | -0.49 | Tropical Fruits | 20.9 | -2.41 |
| Corn | 4.79 | -1.16 | Carbonates | 36.18 | 0.41 | Packaged Medicaments | 0.5 | 2.43 |
| Fruit Juice | 8.54 | -0.31 | Other Live Plants | 21.06 | -0.89 | Knit Women's Suits | 5.1 | -2.09 |
| Other Vegetables | 13.16 | -0.96 | Processed Fish | 13.01 | -2.08 | Other Live Plants | 22.5 | -0.80 |
| Tropical Fruits | 31.98 | -2.63 | Soap | 24.43 | -1.61 | Tanned Equine and Bovine Hides | 9.3 | -1.78 |
| Refined Petroleum | 0.69 | -1.35 | Other Vegetables | 12.10 | -1.40 | Rolled Tobacco | 6.8 | -0.94 |
| Other Processed Vegetables | 13.25 | -1.18 | Tropical Fruits | 20.99 | -2.30 | Knit Sweaters | 2.8 | -2.07 |
| Agave | 792.15 | -2.83 | Other Processed Vegetables | 13.86 | -0.99 | Coated Flat-Rolled Iron | 3.2 | 1.35 |
| Wheat Flours | 19.36 | 0.19 | Gold | 1.84 | -2.40 | Salt | 47.6 | -1.68 |
| Tanned Goat Hides | 49.18 | -2.40 | Packaged Medicaments | 0.41 | 2.73 | Cement | 12.1 | -1.44 |
| Non-Knit Men's Suits | 1.74 | -1.74 | Plastic Lids | 2.79 | 0.07 | Dried Legumes | 12.5 | -2.34 |
| Packaged Medicaments | 0.70 | 2.06 | Confectionery Sugar | 11.72 | -0.26 | Plastic Lids | 2.8 | 0.35 |
| Salt | 26.51 | -0.76 | Equine and Bovine Hides | 14.33 | -1.33 | Other Vegetables | 8.9 | -1.71 |
| Non-fillet Frozen Fish | 3.70 | -1.99 | Knit Women's Suits | 6.53 | -2.53 | Scrap Copper | 5.1 | -0.96 |
| Tanned Equine and Bovine Hides | 2.68 | -1.33 | Knit Sweaters | 1.58 | -2.52 | Confectionery Sugar | 9.0 | -0.14 |
| Coffee and Tea Extracts | 11.20 | -0.33 | Other Nuts | 7.70 | -1.68 | Other Processed Vegetables | 9.0 | -0.83 |
| Glass Bottles | 7.65 | 0.30 | Palm Oil | 4.95 | -3.52 | Non-fillet Frozen Fish | 4.7 | -2.24 |

| 1995 | | | 2005 | | | 2015 | | |
|-------------------------|------|-------|-------------------------|-------|-------|---|------|-------|
| Commodity | RCA | PCI | Commodity | RCA | PCI | Commodity | RCA | PCI |
| Equine and Bovine Hides | 5.51 | -0.99 | Coffee and Tea Extracts | 13.83 | -0.31 | Niobium, Tantalum, Vanadium and Zirconium Ore | 70.7 | -4.02 |
| Other Nuts | 6.41 | -1.28 | Feldspar | 56.01 | -0.76 | Cleaning Products | 2.6 | 0.93 |

Source: Authors Calculations

Appendix 4: Kenya's export products with highest RCA

| 1995 | | | | 2000 | | | |
|---------------------------------|--------------------------------|-------|------|--------------------------------------|--------------------------------|-------|------|
| Product | Export value (US\$ million) | RCA | PCI | Product | Export value (US\$ million) | RCA | PCI |
| Agave | 15.60 | 792.2 | -2.8 | Agave | 8.69 | 690.1 | -1.8 |
| Tea | 244.00 | 344.7 | -3.2 | Legumes | 85.40 | 568.9 | -2.7 |
| Legumes | 48.10 | 327.4 | -2.0 | Tea | 460.00 | 506.8 | -2.5 |
| Cut Flowers | 100.00 | 72.8 | -2.8 | Textile Wicks | 1.46 | 136.4 | -0.1 |
| Vegetable Tanning Extracts | 4.42 | 67.8 | -0.8 | Cut Flowers | 134.00 | 111.8 | -2.4 |
| Coffee | 331.00 | 63.4 | -4.1 | Feldspar | 12.00 | 77.5 | -0.9 |
| Tanned Goat Hides | 11.60 | 49.2 | -2.4 | Other Mineral | 18.50 | 72.0 | -0.3 |
| Feldspar | 5.98 | 42.1 | -0.5 | Retail Artificial Staple Fibers Yarn | 3.33 | 71.1 | 0.1 |
| Vegetable or Animal Dyes | 4.16 | 39.3 | -0.9 | Vegetable Tanning Extracts | 3.33 | 61.8 | -0.3 |
| Vegetable Saps | 26.00 | 38.2 | -0.7 | Coffee | 170.00 | 54.0 | -4.0 |
| Other Processed Fruits and Nuts | 50.70 | 34.9 | -1.5 | Other Processed Fruits and Nuts | 41.40 | 32.9 | -1.3 |
| Tropical Fruits | 16.50 | 32.0 | -2.6 | Tanned Goat Hides | 5.10 | 29.6 | -2.1 |
| Cement | 50.10 | 31.0 | -0.5 | Salt | 8.85 | 28.1 | -1.3 |
| Carbonates | 19.80 | 30.5 | 0.4 | Carbonates | 16.50 | 26.8 | 0.8 |
| Postage Stamps | 5.28 | 29.8 | 1.6 | Scrap Tin | 0.30 | 26.1 | 0.3 |
| Other Hides and Skins | 2.68 | 28.8 | -2.2 | Tropical Fruits | 16.00 | 25.8 | -2.4 |
| Fish Fillets | 51.60 | 27.7 | -1.9 | Other Vegetables | 33.80 | 25.1 | -1.5 |
| Salt | 9.41 | 26.5 | -0.8 | Blankets | 7.60 | 22.0 | -1.2 |
| Other Vegetable Fibers Yarn | 1.12 | 20.0 | -2.5 | Polishes and Creams | 5.67 | 21.5 | 1.2 |
| Wheat Flours | 15.00 | 19.4 | 0.2 | Other Vegetable Fibers Yarn | 0.93 | 20.9 | -2.3 |
| Coral and Shells | 0.77 | 18.0 | -2.3 | Other Vegetable Products | 2.39 | 20.4 | -2.7 |
| Wood Ornaments | 3.81 | 13.3 | -2.3 | Vegetable Saps | 11.40 | 20.1 | -0.7 |
| Other Processed Vegetables | 16.30 | 13.2 | -1.2 | Fish Fillets | 40.00 | 19.3 | -1.6 |
| Blankets | 3.68 | 13.2 | -0.6 | Quicklime | 1.36 | 18.8 | 0.8 |
| Other Vegetables | 16.90 | 13.2 | -1.0 | Cloves | 0.67 | 17.1 | -4.3 |
| Insect Resins | 1.33 | 12.7 | -3.0 | Coral and Shells | 0.37 | 16.9 | -1.1 |
| Coffee and Tea Extracts | 8.49 | 11.2 | -0.3 | Postage Stamps | 3.34 | 16.9 | -0.8 |
| Quicklime | 0.93 | 9.7 | 0.7 | Cement | 23.70 | 16.6 | -1.4 |
| Precious Stones | 6.66 | 8.9 | -2.0 | Other Live Plants | 16.00 | 16.6 | -1.0 |
| Fruit Juice | 17.50 | 8.5 | -0.3 | Vegetable or Animal Dyes | 1.80 | 16.0 | -0.2 |

| 2005 | | | | 2010 | | | |
|--------------------------------------|--------------------------------|-------|------|---------------------------------------|--------------------------------|---------|------|
| | Export value (US\$ million) | RCA | PCI | | Export value (US\$ million) | RCA | PCI |
| Agave | 14.50 | 557.6 | -4.1 | Agave | 1.77 | 1,139.7 | -2.8 |
| Legumes | 162.00 | 469.4 | -2.5 | Tea | 987.00 | 466.7 | -2.7 |
| Tea | 509.00 | 403.3 | -3.2 | Legumes | 184.00 | 426.3 | -3.1 |
| Cut Flowers | 337.00 | 163.5 | -2.5 | Cut Flowers | 509.00 | 193.7 | -2.3 |
| Feldspar | 16.40 | 56.0 | -0.8 | Other Vegetable Products | 32.40 | 129.7 | -2.7 |
| Cloves | 1.47 | 41.1 | -3.0 | Coconut and Other Vegetable Fibers | 10.50 | 95.0 | -3.3 |
| Carbonates | 42.60 | 36.2 | 0.4 | Cloves | 2.52 | 56.2 | -3.0 |
| Tanned Goat Hides | 9.87 | 32.9 | -3.3 | Jute and Other Textile Fibers | 5.31 | 51.9 | -4.9 |
| Coffee | 146.00 | 32.0 | -3.5 | Perfume Plants | 35.50 | 49.5 | -3.0 |
| Perfume Plants | 12.10 | 27.3 | -2.7 | Tanned Goat Hides | 28.10 | 47.2 | -3.8 |
| Soap | 34.50 | 24.4 | -1.6 | Retail Artificial Staple Fibers Yarn | 4.81 | 43.0 | -1.2 |
| Tanned Sheep Hides | 8.10 | 21.9 | -2.2 | Bricks | 2.10 | 42.6 | -0.9 |
| Other Live Plants | 41.60 | 21.1 | -0.9 | Carbonates | 71.20 | 41.5 | 0.1 |
| Other Processed Fruits and Nuts | 53.50 | 21.0 | -1.3 | Silicates | 8.15 | 36.8 | 1.3 |
| Tropical Fruits | 31.40 | 21.0 | -2.3 | Coffee | 233.00 | 27.5 | -3.1 |
| Retail Artificial Staple Fibers Yarn | 2.23 | 20.7 | -0.5 | Salt | 28.10 | 25.6 | -1.7 |
| Silicates | 3.11 | 17.6 | 1.0 | Feldspar | 9.46 | 25.2 | -0.6 |
| Salt | 10.90 | 16.7 | -1.3 | Cement | 90.30 | 24.8 | -1.7 |
| Tungsten Ore | 0.59 | 16.6 | -2.7 | Waterproof Footwear | 10.90 | 24.7 | -0.8 |
| Cement | 46.00 | 15.6 | -1.5 | Soap | 50.90 | 23.3 | -1.4 |
| Margarine | 13.80 | 15.6 | -0.6 | Other Live Plants | 53.80 | 21.4 | -1.0 |
| Other Hides and Skins | 2.68 | 15.3 | -2.5 | Tanned Sheep Hides | 9.70 | 21.2 | -2.7 |
| Tin Ores | 1.05 | 15.0 | -3.2 | Other Vegetable Oils | 24.60 | 20.7 | -0.7 |
| Fish Fillets | 61.60 | 15.0 | -1.9 | Tropical Fruits | 43.70 | 19.0 | -2.4 |
| Equine and Bovine Hides | 20.20 | 14.3 | -1.3 | Sorghum | 8.48 | 18.4 | -2.7 |
| Vegetable Saps | 13.40 | 14.0 | 0.1 | Other Processed Fruits and Nuts | 58.00 | 16.4 | -1.0 |
| Other Processed Vegetables | 29.70 | 13.9 | -1.0 | Dried Legumes | 39.80 | 15.8 | -3.0 |
| Coffee and Tea Extracts | 17.60 | 13.8 | -0.3 | Margarine | 24.80 | 15.1 | -1.1 |
| Blankets | 10.90 | 13.7 | -2.1 | Aluminium Housewares | 21.00 | 14.9 | -0.6 |
| Polishes and Creams | 6.47 | 13.1 | 0.7 | Coffee and Tea Extracts | 33.50 | 14.8 | 0.2 |

Source: Authors Calculations

Appendix 5: Frontier products in 2015

| | Frontier products | Export value | RCA | PCI | Opportunity gain | Distance |
|----|---------------------------------|---------------------|------------|------------|-------------------------|-----------------|
| 1 | Raw Plastic Sheeting | 14,200,000.00 | 0.818 | 1.806 | 0.805 | 0.830 |
| 2 | Dairy Machinery | 434,483.00 | 0.760 | 2.099 | 0.804 | 0.840 |
| 3 | Small Iron Containers | 1,471,784.00 | 0.756 | 1.131 | 0.664 | 0.816 |
| 4 | Hydrochloric Acid | 52,807.00 | 0.602 | 1.084 | 0.508 | 0.844 |
| 5 | Letter Stock | 180,255.00 | 0.591 | 1.664 | 0.699 | 0.829 |
| 6 | Beauty Products | 6,390,489.00 | 0.542 | 1.689 | 0.892 | 0.851 |
| 7 | Packaged Medicaments | 60,900,000.00 | 0.529 | 2.425 | 1.022 | 0.850 |
| 8 | Glaziers Putty | 1,260,628.00 | 0.502 | 2.078 | 0.932 | 0.837 |
| 9 | Other Plastic Sheetings | 3,757,391.00 | 0.498 | 1.932 | 0.833 | 0.821 |
| 10 | Other Uncoated Paper | 1,726,243.00 | 0.476 | 1.263 | 0.661 | 0.845 |
| 11 | Coated Metal Soldering Products | 437,361.00 | 0.455 | 2.022 | 0.929 | 0.850 |
| 12 | Stone Processing Machines | 2,224,338.00 | 0.411 | 1.517 | 0.780 | 0.855 |
| 13 | Other Fermented Beverages | 185,213.00 | 0.392 | 1.547 | 0.634 | 0.839 |
| 14 | Iron Structures | 5,860,771.00 | 0.379 | 1.863 | 0.706 | 0.829 |
| 15 | Fermented Milk Products | 497,817.00 | 0.359 | 1.156 | 0.501 | 0.806 |
| 16 | Dental Products | 516,191.00 | 0.313 | 1.126 | 0.647 | 0.834 |
| 17 | Chocolate | 2,526,480.00 | 0.296 | 1.200 | 0.604 | 0.825 |
| 18 | Iron Cloth | 422,587.00 | 0.295 | 0.986 | 0.597 | 0.820 |
| 19 | Unpackaged Medicaments | 1,052,629.00 | 0.291 | 1.493 | 0.741 | 0.839 |
| 20 | Aluminium Bars | 1,446,794.00 | 0.272 | 1.399 | 0.652 | 0.827 |
| 21 | Rubber Tires | 6,484,897.00 | 0.267 | 1.198 | 0.542 | 0.836 |
| 22 | Other Sugars | 472,200.00 | 0.243 | 1.176 | 0.563 | 0.853 |
| 23 | Newspapers | 286,131.00 | 0.212 | 2.500 | 1.026 | 0.853 |
| 24 | Other Aluminium Products | 1,009,198.00 | 0.206 | 1.905 | 0.813 | 0.845 |
| 25 | Toilet Paper | 1,763,669.00 | 0.198 | 1.182 | 0.532 | 0.811 |
| 26 | Other Iron Products | 2,672,260.00 | 0.190 | 2.534 | 1.050 | 0.853 |
| 27 | Shaving Products | 640,704.00 | 0.174 | 1.664 | 0.753 | 0.827 |
| 28 | Other Cast Iron Products | 337,900.00 | 0.166 | 1.161 | 0.632 | 0.834 |
| 29 | Iron Stovetops | 503,451.00 | 0.153 | 1.277 | 0.653 | 0.854 |
| 30 | Hot-Rolled Iron | 1,969,300.00 | 0.150 | 1.284 | 0.543 | 0.844 |
| 31 | Soil Preparation Machinery | 318,145.00 | 0.145 | 2.252 | 0.850 | 0.850 |
| 32 | Dyeing Finishing Agents | 189,396.00 | 0.140 | 1.669 | 0.857 | 0.852 |
| 33 | Other Iron Bars | 104,070.00 | 0.139 | 1.414 | 0.690 | 0.826 |
| 34 | Glass Fibers | 385,220.00 | 0.106 | 1.891 | 0.803 | 0.852 |
| 35 | Corrugated Paper | 59,225.00 | 0.102 | 1.657 | 0.825 | 0.834 |
| 36 | Aluminium Cans | 125,445.00 | 0.079 | 1.279 | 0.588 | 0.819 |
| 37 | Plastic Building Materials | 245,973.00 | 0.079 | 1.409 | 0.601 | 0.818 |
| 38 | Refrigerators | 948,947.00 | 0.070 | 2.273 | 0.912 | 0.852 |
| 39 | Other Rubber Products | 556,867.00 | 0.068 | 2.255 | 1.015 | 0.853 |
| 40 | Nonaqueous Paints | 292,499.00 | 0.068 | 1.835 | 0.832 | 0.825 |

| | Frontier products | Export value | RCA | PCI | Opportunity gain | Distance |
|----|----------------------------------|---------------------|------------|------------|-------------------------|-----------------|
| 41 | Used Rubber Tires | 51,435.00 | 0.062 | 1.194 | 0.740 | 0.851 |
| 42 | Aluminium Pipe Fittings | 14,440.00 | 0.054 | 0.987 | 0.639 | 0.855 |
| 43 | Wood Carpentry | 239,762.00 | 0.049 | 1.136 | 0.441 | 0.823 |
| 44 | Electric Motor Parts | 250,457.00 | 0.046 | 1.842 | 0.798 | 0.841 |
| 45 | Particle Board | 92,687.00 | 0.040 | 1.229 | 0.580 | 0.829 |
| 46 | Cigarette Paper | 22,545.00 | 0.038 | 1.255 | 0.717 | 0.847 |
| 47 | Poultry Meat | 269,752.00 | 0.033 | 1.368 | 0.659 | 0.851 |
| 48 | Aluminium Structures | 98,895.00 | 0.026 | 1.431 | 0.656 | 0.835 |
| 49 | Seats | 611,360.00 | 0.025 | 1.053 | 0.484 | 0.836 |
| 50 | Low-voltage Protection Equipment | 670,035.00 | 0.024 | 2.075 | 0.958 | 0.854 |
| 51 | Wood Crates | 18,949.00 | 0.020 | 1.719 | 0.663 | 0.823 |
| 52 | Float Glass | 23,670.00 | 0.014 | 1.351 | 0.669 | 0.853 |
| 53 | Cement Articles | 37,259.00 | 0.013 | 1.714 | 0.701 | 0.839 |
| 54 | Asbestos Cement Articles | 4,745.00 | 0.012 | 1.319 | 0.680 | 0.847 |
| 55 | Vegetable Fiber | 1,574.00 | 0.010 | 1.569 | 0.621 | 0.855 |
| 56 | Other Prepared Meat | 50,188.00 | 0.010 | 1.220 | 0.607 | 0.825 |
| 57 | Whey | 972.00 | 0.001 | 1.787 | 0.863 | 0.850 |
| 58 | Paper Spools | 78.00 | 0.001 | 1.303 | 0.633 | 0.839 |
| 59 | Opto-Electric Instrument Parts | 501.00 | 0.001 | 2.135 | 0.892 | 0.853 |
| 60 | Other Zinc Products | 223.00 | 0.000 | 1.976 | 0.922 | 0.855 |
| 61 | Processed Egg Products | 15.00 | 0.000 | 1.341 | 0.596 | 0.840 |
| 62 | Scrap Tin | 0.00 | 0.000 | 1.936 | 0.723 | 0.852 |
| 64 | Rapeseed Oil | 0.00 | 0.000 | 1.527 | 0.642 | 0.852 |
| 66 | Zinc Powder | 0.00 | 0.000 | 1.242 | 0.693 | 0.849 |

Source: Authors Calculations

Appendix 6: Ubiquity of the frontier products

| | 1995 | 2000 | 2005 | 2010 | 2015 |
|---------------------------------|-------------|-------------|-------------|-------------|-------------|
| Raw Plastic Sheetting | 13 | 24 | 29 | 29 | 36 |
| Dairy Machinery | 14 | 14 | 16 | 29 | 30 |
| Small Iron Containers | 35 | 45 | 40 | 46 | 35 |
| Hydrochloric Acid | 28 | 35 | 34 | 35 | 26 |
| Letter Stock | 29 | 31 | 33 | 44 | 39 |
| Beauty Products | 14 | 19 | 22 | 27 | 31 |
| Packaged Medicaments | 28 | 31 | 28 | 30 | 30 |
| Glaziers Putty | 18 | 22 | 27 | 33 | 30 |
| Other Plastic Sheetting | 21 | 29 | 33 | 38 | 36 |
| Other Uncoated Paper | 27 | 34 | 28 | 23 | 27 |
| Coated Metal Soldering Products | 29 | 27 | 27 | 33 | 32 |
| Stone Processing Machines | 20 | 23 | 24 | 35 | 30 |
| Other Fermented Beverages | 20 | 26 | 34 | 38 | 38 |
| Iron Structures | 28 | 35 | 38 | 43 | 39 |
| Fermented Milk Products | 25 | 27 | 27 | 39 | 39 |
| Dental Products | 28 | 39 | 39 | 35 | 29 |
| Chocolate | 29 | 30 | 36 | 41 | 41 |
| Iron Cloth | 26 | 27 | 28 | 40 | 31 |
| Unpackaged Medicaments | 30 | 30 | 17 | 22 | 36 |
| Aluminium Bars | 37 | 43 | 43 | 40 | 38 |
| Rubber Tires | 29 | 32 | 31 | 28 | 31 |
| Other Sugars | 14 | 30 | 29 | 28 | 24 |
| Newspapers | 19 | 22 | 30 | 31 | 29 |
| Other Aluminium Products | 28 | 25 | 29 | 30 | 27 |
| Toilet Paper | 29 | 40 | 39 | 43 | 41 |
| Other Iron Products | 20 | 21 | 29 | 39 | 31 |
| Shaving Products | 26 | 25 | 33 | 30 | 41 |
| Other Cast Iron Products | 34 | 27 | 27 | 31 | 31 |
| Iron Stovetops | 28 | 32 | 30 | 30 | 22 |
| Hot-Rolled Iron | 28 | 30 | 28 | 25 | 30 |
| Soil Preparation Machinery | 26 | 29 | 31 | 33 | 30 |
| Dyeing Finishing Agents | 13 | 19 | 25 | 29 | 25 |
| Other Iron Bars | 25 | 29 | 29 | 35 | 34 |
| Glass Fibers | 24 | 26 | 28 | 29 | 28 |
| Corrugated Paper | 31 | 38 | 35 | 45 | 31 |
| Aluminium Cans | 29 | 36 | 35 | 38 | 34 |
| Plastic Building Materials | 25 | 22 | 32 | 38 | 47 |
| Refrigerators | 31 | 38 | 38 | 33 | 27 |
| Other Rubber Products | 17 | 21 | 25 | 26 | 27 |
| Nonaqueous Paints | 27 | 30 | 33 | 37 | 37 |
| Used Rubber Tires | 24 | 36 | 29 | 24 | 24 |
| Aluminium Pipe Fittings | 20 | 20 | 21 | 29 | 22 |

| | 1995 | 2000 | 2005 | 2010 | 2015 |
|----------------------------------|-------------|-------------|-------------|-------------|-------------|
| Wood Carpentry | 28 | 41 | 42 | 40 | 35 |
| Electric Motor Parts | 19 | 21 | 33 | 32 | 32 |
| Particle Board | 26 | 26 | 28 | 35 | 33 |
| Cigarette Paper | 11 | 12 | 20 | 22 | 29 |
| Poultry Meat | 15 | 16 | 18 | 23 | 24 |
| Aluminium Structures | 31 | 35 | 34 | 36 | 36 |
| Seats | 29 | 32 | 32 | 24 | 29 |
| Low-voltage Protection Equipment | 22 | 27 | 30 | 34 | 35 |
| Wood Crates | 30 | 34 | 33 | 41 | 42 |
| Float Glass | 19 | 22 | 20 | 23 | 26 |
| Cement Articles | 27 | 27 | 38 | 42 | 35 |
| Asbestos Cement Articles | 43 | 41 | 33 | 31 | 23 |
| Vegetable Fiber | 20 | 23 | 21 | 29 | 22 |
| Other Prepared Meat | 30 | 31 | 30 | 31 | 33 |
| Whey | 11 | 14 | 19 | 22 | 27 |
| Paper Spools | 15 | 22 | 26 | 29 | 27 |
| Opto-Electric Instrument Parts | 15 | 17 | 19 | 27 | 31 |
| Other Zinc Products | 21 | 21 | 24 | 29 | 24 |
| Processed Egg Products | 16 | 20 | 16 | 19 | 25 |
| Scrap Tin | 23 | 24 | 15 | 23 | 26 |
| Weapons Parts and Accessories | 7 | 14 | 17 | 16 | 25 |
| Rapeseed Oil | 12 | 20 | 21 | 22 | 24 |
| Zinc Powder | 12 | 15 | 19 | 16 | 24 |

Source: Authors Calculations