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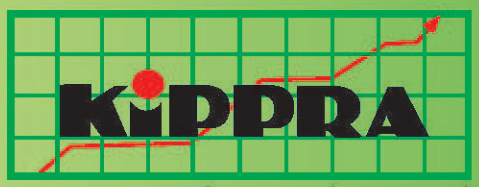

The KENYA INSTITUTE for PUBLIC POLICY RESEARCH and ANALYSIS

Tracking Economic Transformation for Sustainable Development in Kenya

Corazon Milimu and Dire Dika

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THE KENYA INSTITUTE FOR PUBLIC POLICY RESEARCH AND ANALYSIS (KIPPRA)

YOUNG PROFESSIONALS (YPs) TRAINING PROGRAMME

Tracking Economic Transformation for Sustainable Development in Kenya

Corazon Milimu and Dire Dika

Kenya Institute for Public Policy
Research and Analysis

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Abstract

Monitoring of economic transformation is key in tracking the implementation of economic reform measures. Limited work has been done on a framework to monitor economic transformation in Kenya. This paper sought to establish a framework that would be utilized to monitor economic transformation in Kenya in a bid to spur economic growth and development. The index was constructed using the Distance to Frontier Methodology while Principal Component Analysis served to measure robustness of the indicators. The key dimensions identified as critical to Kenya's economic transformation were human capital, growth in productivity, macroeconomic stability, environmental conservation, essential infrastructure, and ICT and innovation. Kenya's score in economic transformation for the period between 2010 and 2020 was 0.48, signifying half-way growth in economic transformation for the country. Across the various dimensions, there were variations, with human capital and ICT and innovation scoring highly at 0.62 and 0.63, respectively. Low scores were observed in macroeconomic stability (0.32) and environmental conservation (0.35). ICT and innovation had the highest improvement in the period under review, which can be attributed to the increased investment in digital infrastructure by the government. These scores imply that Kenya is still on the path towards economic transformation, and that measures to accelerate economic transformation in the country need to be enacted and implemented. The study therefore recommends strengthening of education policies to enhance pupils' transition rates; improving labour force contribution to GDP to enhance labour productivity by leveraging on industrialization for job creation and skills growth; strengthening of fiscal policies and boosting local production to create a stable macroeconomic environment; accelerating rural electrification and sanitation; increasing production and utilization of clean energy products to enhance environmental conservation and utilization of technology, innovation, and skills development to enhance productivity.

Abbreviations and Acronyms

ACET	Africa Centre for Economic Transformation
ATI	Africa's Transformation Index
COMESA	Common Market for East and Southern Africa
GDP	Gross Domestic Product
GOK	Government of Kenya
ICPD	International Conference on Population and Development
ICT	Information, Communication and Technology
KETI	Kenya's Economic Transformation Index
KMO	Kaiser-Meyer-Olkin
KNBS	Kenya National Bureau of Statistics
LNOB	Leave No One Behind
NHIF	National Hospital Insurance Fund
OECD	Organization for Economic Cooperation and Development
PCA	Principal Component Analysis
SDG	Sustainable Development Goals
SSA	Sub-Saharan Africa
ST-I	Science, Technology, and Innovation
TOPSIS	Technique for Order of Preference by Similarity to Ideal Solution
UNECA	United Nations Economic Commission for Africa
UNIDO	United Nations Industrial Development Organization
UNSDG	United Nations Sustainable Development Goals

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1. Introduction

Economic transformation is one of the core policy objectives of governments across the globe with an aim of enhancing economic growth and development. According to UN SDG (2020), economic transformation is marked by an increase in the productivity of a country. These consequently lead to increased and better employment status, equitable income and wealth distribution, provision of better services to the public and environmental conservation. One of the fundamental changes expected in the economy for it to deliver the expected opportunities is structural changes. Similarly, UNECA (2018) describes structural change as entailing elemental changes in the economic and social structures that accelerate development that is inclusive and sustainable.

Gabardo, Pereima and Einloft (2017) describe structural change as an economic process where the structures of production and employment in an economy change within and between all sectors of the economy. It is also marked by the development of new sectors. While structural change has been marked as the foundation for economic transformation, characterized by sectoral changes and the shift of resources to enhance productivity, economic transformation goes beyond this concept. Successful economic transformation requires the social and environmental factors. The 2030 Agenda for Sustainable Development calls for economic transformation that is characterized by enabling environments for investments, economic diversification, utilization of appropriate technologies and innovation, inclusive growth and environmental protection.

Continentally, transformation of economies forms the fourth goal of the African Union's Agenda 2063. The framework prioritizes manufacturing, industrialization and value addition that is driven by science, technology, and innovation, and economic diversification. The Kenya Vision 2030 (Government of Kenya, 2007) and the Constitution of Kenya form the main transformational layout for the country. The Kenya Vision 2030 aims at transforming Kenya into a globally competitive and prosperous country providing a high quality of life by 2030. The Vision is anchored on three pillars (economic, social, and political) and several foundations. On the economic front, the aspiration is to maintain sustained economic growth of 10 per cent per annum over the next 25 years. The Vision aims to achieve this through ensuring macroeconomic stability, increased formal employment creation to raise productivity, income levels and revenue for the country's economic growth.

Despite the progress realized by the country in various sectors, the Kenyan economy still faces several challenges. The growth rate has been slow since 2008 and below the 10 per cent target. The real Gross Domestic Product (GDP) is

estimated to have grown by 7.5 per cent in 2021 compared to a contraction of 0.3 per cent in 2020 (KNBS, 2022). Economic growth in 2021 was accelerated by improved performance in key sectors of the economy, such as manufacturing (6.9%), wholesale and retail trade (7.9%), real estate (6.7%), transportation and storage (7.2%), and financial and insurance activities (12.5%). However, some of the sectors have not achieved the set targets, which are critical towards achieving overall economic transformation.

While there is need to put in place measures to hasten Kenya's economic growth to 10 per cent per annum as per the Kenya Vision 2030 and to explore the potential of various sectors in achieving economic transformation, it is important to track the progress of sectors in achieving their economic transformative targets. Monitoring of economic transformation is crucial to identifying key structural stumbling blocks to Kenya's economy, and especially those that have an influence on competitiveness and inclusive growth, selecting and prioritizing economic reform measures and tracking progress of economic reform implementation and immediate outputs and outcomes of reforms (OECD, 2018). Furthermore, it is critical to monitor and identify strategies to sustain economic performance in the wake of shocks and fluctuations, conflict, and climate change (UN SDG, 2020). Consequently, this provides an arena for discussion among government institutions, policy makers, academia, and other key stakeholders on best practices that enhance economic transformation. Additionally, empirical studies and theoretical perspectives in relation to economic transformation are extant. Therefore, this study also examined and consolidated relevant empirical and theoretical work that informed Kenya's economic transformation index.

In 2014, the African Centre for Economic Transformation released the African Economic Transformation Index (ATI) report. The index analyzed economic transformation among 21 countries and was based on a composite of the five elements: diversification of production, making exports competitive, increase in productivity, technological advancement, and human economic well-being. The index confirmed the slow progress of most African countries through 2010, with widely varying performance on the five depth sub-indices (ACET, 2014). However, the index focused on a comparison of Kenya to other countries, leaving a gap on monitoring Kenya's progress towards economic transformation based on its sectoral and overall economic targets. Kenya's economic transformation blueprint, the Kenya Vision 2030 contains key pillars backed by enablers that are critical for economic transformation. While the African Transformation Index (2014) has made effort to incorporate key aspects of development as encapsulated in the Kenya Vision 2030, there is still need for a framework that monitors the progress of economic transformation in Kenya that is reflective of the pillars of the Vision.

Based on the need for measures to accelerate economic transformation and a tool to monitor economic transformation in Kenya, this study aimed to assess the factors that underpin Kenya's economic transformation. The Economic Transformation Index for Kenya was constructed through the study. Additionally, the study tracked Kenya's progress in economic transformation. Nonetheless, the study was limited to dimensions that have been identified to be critical to economic transformation in Kenya. Many aspects have been brought forth by various empirical work regarding economic transformation, but the study limited itself to the most critical dimensions. Further, this study captured a time frame considered as foundational for economic transformation, given that major frameworks such as the Kenya Vision 2030 and the Constitution of Kenya were developed during this period.

The rest of the paper is organized as follows: section 2 reviews sector policies, while section 3 discusses key theoretical and empirical underpinnings of the study. Section 4 discusses the methodology of the study, including the description of the dimensions, steps in computing the index and the data sources. Results and findings of the study are presented in section 5 while section 6 provides the conclusion and recommendations of the study.

2. Sector Development and Policy Review

The Sustainable Development Goals (SDGs) are the global transformational blueprint for sustainable development. The goals aim at transformation in countries for the overall goal of inclusive and resilient development. The goals focus on economic, social, and environmental sectors as key towards sustainable development. On the economic front, SDGs seek to strengthen economic foundations in countries to accelerate economic growth. Specifically, various issues that seek to be addressed are shared wealth, income inequalities, youth employment, women's economic empowerment and decent employment for all. Additionally, human capital development has been identified as being critical towards productivity. Health and education are given as critical components towards building a productive workforce. Furthermore, productivity is also identified as vital for economic growth and catapulted by diversification, advancement in technology and innovation while targeting value addition and labour productivity. Financial inclusion, sustainable agriculture, industrialization, contemporary energy, transport, and resilient infrastructure have been considered as critical components for transformation in economies. Science, technology, and innovation are also pointed out as drivers of sustainable consumption and production.

The African Union's Agenda 2063 through its aspiration of a prosperous Africa based on inclusive growth and sustainable development highlights that structural transformation in economies is geared towards equitable wealth creation, decent employment opportunities, and inclusive economic growth. The key transformational outcomes of Agenda 2063 are improvements in living standards characterized by increase in real per-capita incomes, employment opportunities, access to basic and tertiary education, reduction in malnutrition, maternal, child and neo-natal deaths, increased access to safe drinking water and sanitation, electricity supply and Internet connectivity. Additionally, Agenda 2063 targets for African economies to be transformed, inclusive and sustainable through increased GDP growth of 7 per cent, manufacturing that is labour-intensive, value addition and increase in total agriculture factor productivity, ICT penetration and contribution to real GDP.

The East African Commission's Vision 2050 is the regional blueprint for socio-economic transformation and development. It provides a broad perspective through which resources within the region can be used to enhance productivity and social well-being of its citizens. The Kenya Vision targets that by 2050, per capita incomes will increase tenfold to move the region to upper-middle income status, macroeconomic stability will be achieved, higher savings and investment rates will be witnessed and there will be a stable business environment that will

nurture private sector investment and consequently secure an economic growth rate of 10 per cent per annum. The Vision is anchored on five (5) pillars centred on infrastructure development; agriculture, food security and rural development; good governance, defence, peace, and security; industrialization; environment and natural resource management; tourism, trade and other services development; and human capital development. These five pillars have been identified as key in transformation, enabling diversification, and creating value addition and growth that is necessary for accelerating momentum for sustained long-term economic growth.

Kenya through its Vision 2030 aims to transform its economy to be one that is centred on industrialization and providing high quality of life for its citizens by the year 2030. The Vision also aims to create a human resource base that is globally competitive and adaptive, and which will accelerate industrialization in the country. The Vision rests upon three pillars: economic, political, and social. The economic pillar of the Kenya Vision 2030 recognizes agriculture, manufacturing, and service sectors as key engines of the economy. The vision is targeted at achieving an average GDP growth rate of 10 per cent per year up to the year 2030. The social pillar seeks to build a society that is centred on justice, cohesion, social equity, and environmental conservation. Macroeconomic stability, equity, wealth creation; reforms in governance reforms; infrastructure; energy; science, technology, and innovation; land reforms; human capital development, public service and security are the foundations of the Kenya Vision 2030. The Kenya Vision 2030 is implemented in five-year medium-term plans that provide targets and strategies aimed at achieving the Vision.

3. Literature Review

3.1 Theoretical Literature

Economic Transformation Theory

Economic growth among countries cannot be separated from economic transformation. There is no single definition of economic transformation, since it is a process that incorporates changes in structures of the economy. Economic transformation is a result of structural change that accompanies economic development (Mensah et al., 2018). Economic transformation is marked by changes in the economic structures through rapid industrialization that increases the share of manufacturing in the economy, increased labour productivity in the sectors, increased urbanization, and shared growth.

The African Centre for Economic Transformation (ACET) through its African Transformation Report (2014) recognizes the need for growth in African economies that goes hand in hand with depth; that is, through diversification of production, making exports competitive, increase in productivity, technological advancement, and human economic well-being. This has been backed up by the development of the Transformation Index that compared economic transformation for 21 African countries, including Kenya. The index has been considered a starting point for national dialogue on key areas for developing economic transformation strategies.

Production Theory

Long term economic growth is dependent upon sustained productivity growth (Kahn and Rich, 2007). The production theory conceptualizes the production function, which is how various inputs are combined to produce output. Measuring productivity is critical towards assessing the effectiveness of inputs such as labour and capital and addressing the required changes that may improve output. Growth in productivity is also a critical element in modelling the productive capacities of economies. According to OECD (2001), measurement of productivity is key in tracking the impact of technology on outputs, evaluation of efficiency in production, identifying cost-savings in production and assessment of living standards. Different measures are used for productivity, such as labour productivity based on gross output and value added, capital-labour multifactor productivity based on value added, capital productivity based on value added, and multifactor productivity. Multi-factor productivity is critical in evaluating changes in industries and sectors. Economic transformation tends to lean towards evaluating sectoral output in the overall economy.

Structural Change Theory

The structural change theory provides a path for monitoring economic transformation in Kenya. Structural change as part of economic development involves changes in the structure of production and employment. Under the structural change, focus is laid upon how economies can transform from traditional subsistence agriculture to an economy that is characterized by diversified manufacturing and services (Agbenyo, 2020). UNECA (2018) describes the tenets of structural transformation such as diversification, technological upgrading, employment creation and human well-being.

Clark (1940) theorized structural change by relating sectoral changes to growth in productivity and Engel effects. Lewis (1940) and Kuznets (1950) emphasize that structural transformation is central to modern economic growth (AfDB, 2017). Their analysis led to the search for uniform features that define development and growth. Kuznets developed a summary of modern economic growth based on his analysis of measures of national product and its tenets and which focused specifically on labour and population. Rosenstein-Rodan (1943) viewed economic transformation in agrarian-based countries as anchored on investments in infrastructure and human capital. He further argued that economic transformation was also characterized by changes in labour productivity across the sectors.

As much as these works have influenced the conceptualization of structural transformation, they have been limited by being focused on a single modern economic sector. Recent attempts have tried to focus on catalysts of economic transformation within multiple sectors. This has led to identification of four theoretical determinants of economic transformation: changes in income, sectoral prices, input-output linkages, and comparative advantages. According to Natera and Castellacci (2021), economic performance is realized when economies embrace structural changes. Economies that have the required capacities to take up structural changes progressively become more complex, achieving a more dynamic economic performance through time. Nations lacking these talents are unable to make the necessary changes and fall into poverty traps that impede economic development. The importance of various aspects has been highlighted in research on economic growth in the Schumpeterian tradition, and include human capital, physical capital, innovation and imitation capacity, infrastructure, industrial structure, and the calibre of institutions and systems of governance.

Economic systems change during the growth and development process, moving from a lower to a higher degree of complexity. The number of elements or growth engines that direct the economic development process is referred to as complexity in this context. The authors contend that at lower levels of complexity and development, a small number of factors such as the accumulation of capital control

the dynamics of economics. Economies that are more complex and advanced are frequently driven by a wide range of factors, including physical and human capital, innovation, industrial changes, exports, foreign direct investments, and the interactions and feedback effects among these elements.

Transformational complexity quantifies a country's rate of structural change over time and is based on the premise that an economy is more complicated if multiple forces can push the system out of equilibrium and into new growth trajectories. Based on the notion that an economy is more complicated if its growth path is simultaneously driven by numerous co-evolving causes, systemic complexity provides a measure of a country's total number of interactions or causal links that connect together its primary capacities.

3.2 Empirical Literature Review

Human capital

Economic development is fundamentally enabled by human capital. By claiming that it reflects the knowledge, skills, capacities, health, and ideas component of the productivity function within an economy, Dankyi et al. (2022) emphasize the significance of human capital in economic progress. Furthermore, they believe that enhancing people's knowledge, abilities, health, and resilience can result in increased output, adaptability, and innovation for long-term economic progress. Jiya, Sama, and Ouedraogo (2020) emphasize the significance of human capital endowments and institutions and policy reforms in education in accelerating economic transformation in their study on infrastructure, trade openness, and economic transformation in the Common Market for Eastern and Southern Africa (COMESA) member countries. This is similar to how Chen et al. (2018) emphasized the impact of human capital on the evolution of the economy. Based on an updated TOPSIS methodology, their study assessed the economic transformation and upgrading of resource-based cities in Shaanxi Province (China). The study used the index system to show improvements in the employment level, living standards, and capacity for social development which were the three secondary indices of the social indicator.

Growth in productivity

Productivity growth is a result of structural change. Relative sectoral productivity is variable and affects structural change, according to UNIDO (2010). Variation, however, is essential for overall success. Aggregates may exist not just at the level

of the entire economy but also at the level of each individual sector, such as the industrial, agriculture, and service sectors. Productivity has been shown to be essential for economic change. Agriculture, industry, and service sector sectoral shares of GDP have been highlighted as essential for economic transformation (Ibrahim, 2020). He found that the effects of trade and financial inclusion are complementary to each other in highlighting cross-country differences in the levels of structural transformation among African countries through his study, which examined the effects of trade and financial integration on structural transformation in 32 African countries using a sample splitting estimation technique from 1985 to 2015. A multi-dimensional structural transformation index that was created using factor analysis was used in the study.

Breisinger and Diao have also emphasized the significance of productivity (2008). According to their study, which examined economic structural change in 15 middle income countries drawn from South America, Asia, and Africa, an opportunity for the non-agricultural sectors of the economy, such as industry and services, to become more significant for economic growth was presented by the declining role of agriculture in the economy. The study exemplified Thailand's transformation, which had a huge structural impact on both industry and agriculture. Agriculture had a major role in the transformation's early years, but it was later fuelled by significant private investments that encouraged the expansion and growth of industry that was driven by exports. Economic transformation in Thailand was characterized by labour-intensive, technology manufacturing-led growth with significant ties to agriculture and external markets.

Macroeconomic stability

Macroeconomic stability is essential for economic growth and development. This is so that a stable business climate can be created, and pricing may be regulated. When important economic linkages such as those between domestic demand and output, the balance of payments, fiscal revenues and expenditures, savings, and investments are in balance, macroeconomic stability exists (Ames, 2001). As long as they can be financed in a sustainable way, imbalances such as fiscal and current account deficits or surpluses are typically compatible with economic stability. Current account and fiscal balances that are compatible with low and declining debt levels, inflation in the low single digits, and rising per capita GDP are typically indicators of stability.

According to Jiya, Sama and Ouedraogo (2020), the variation in the rate of economic transformation between nations is mostly due to financial development and fiscal changes. The authors highlight the importance of macroeconomic

variables in structural change through their analysis of infrastructure, trade openness, and economic transformation in Common Market for Eastern and Southern Africa (COMESA) member nations.

Environmental conservation

Environmental conservation is one of the critical elements of economic transformation. Kenya is a signatory to the Paris Agreement, which calls for reduction in carbon dioxide emission to below 2 degrees and desirable 1.5 degrees. The SDG 13 calls upon countries to take up socio-economic development or rather low carbon economic growth by combating climate change and its impacts. Higher economic growth must be supported while preserving environmental welfare by reducing carbon dioxide emissions (Murshed et al., 2022). The impact of African economies' structural development on global value chains was examined by Ali and Guinigue in 2022. They also evaluated whether African economies are promoting environmental issues while pursuing structural transformation through global value chains, and the effects of structural transformation on environmental damage. They used a structural transformation index to measure the weight of various economic sectors, the variety and sophistication of exports, and the reallocation of labour among various economic sectors. Between 1990 and 2018, panel data for 41 African nations were used, along with the Driscoll and Kraay estimation method and cross-sectional dependence test. According to their research, renewable energy, digitalization, and participation in global value chains are crucial for Africa's structural change. Moreover, their study also validated that structural transformation in African economies is critical towards reduction of environmental pollution, which is highly linked with global value chain participation. Chen et al. (2018) incorporated environmental conservation as an indicator in a study to evaluate economic transformation and upgrading of resource-based cities in Shaanxi Province (China). The study examined the progress of the cities in their capacity to treat pollution and the degree of pollution emission against their progress in economic transformation.

Essential Infrastructure

Network infrastructure investments typically speed up economic growth (UN 2020). The Kenya Vision 2030 states that effective, reachable, and reliable infrastructure is a necessary component of development and poverty reduction. Similar to this, improved infrastructure lowers company costs, boosts security, enhances livelihoods, and boosts the nation's competitiveness abroad. In hospitals, vaccines and pharmaceuticals may be safely stored, and food can be conserved at

home, which has significant positive effects on health. Electricity also increases the rates of primary and secondary transitions and completions.

Similarly, increased access to power lowers corporate expenses and boosts investment, which promotes economic growth. Communities in rural locations can relocate to urban areas thanks to improved transportation networks. Better transportation also cuts back on the time and costs associated with moving goods, therefore improving competitiveness, helping create more jobs and boosting incomes. Breisinger and Diao (2008) highlight how crucial infrastructure is to accelerate economic change. The supply of infrastructure by governments encouraged economic development by fostering a safe and alluring environment for the private sector. This is according to their study that looked at economic structural change in 15 middle-income nations from South America, Asia, and Africa. Large public infrastructure investments were also made, with a focus on transportation and energy production creating the economic foundation for rapid expansion.

ICT and innovation

Investment in ICT as a capital good increases labour productivity and deepens overall capital (OECD, 2004). This is done through setting up the necessary ICT infrastructure, such as ICT networks, and the necessary hardware and software to support enterprises, firms, and other transactional processes. Rapid multi-factor productivity development in the ICT producing industry may be facilitated by quick technology advancements in the manufacturing of ICT goods and services. ICT use grows as businesses become more efficient, which raises multi-factor productivity. Utilizing ICT also has a network effect that lowers transaction costs and speeds up innovation, improving economic efficiency overall and resulting in economic transformation.

Science, technology, and innovation are crucial forces behind economic development that profit customers, companies, and the economy. Innovation is the creation and use of concepts and technology that enhances products or services or increases the effectiveness of their production. According to Freire (2021), innovation boosts productivity through increased output through higher levels of both good and service production. Innovation is the driving force behind technological development. Innovation can be divided into two categories: product innovation, which refers to production that is novel to the market, and process innovation, which refers to changes made to existing production processes to boost output and cut costs. Both types of innovation result in changes to output, income, consumption, employment, and economic structures.

Through input-output relationships between industries, or the change in final product pricing because of the change in intermediate product prices, technological change has an impact on economic structure. When innovation shifts an economy's structure from lower productivity to higher productivity sectors that are linked to higher levels of technology, this is referred to as technological transformation. Product innovation typically results in increased productivity through future learning-by-doing and process innovation, and economic diversification and the emergence of new industries with new employment prospects. The fundamental objective of the Kenya Vision 2030 is to make the nation a middle-income economy, and it acknowledges that research and innovation are key drivers of both economic growth and development.

ICT is significant as a driver of economic growth, according to Hussain, Batool, Akbara, and Nazir (2021). ICT penetration was found to have a long-term beneficial effect on economic growth of South Asian economies. Through their study that aimed to identify the relationship between ICT and economic growth in South Asian economies, economic growth was significantly impacted by expansion of Internet users and mobile phone customers. Three fundamental ICT indicators were used in the study: fixed phone subscribers, mobile phone subscribers, and Internet users. These indicators were used both individually and as composite indices created using the Principal Component Analysis. The use of smart phones by farmers had significant effects on the transformation of rural economies by facilitating the employment of farmers' family members off-farm, the cultivation of non-grain crops, and crop specialization, as shown by Min, Liu, and Huang's (2020) study that examined the impact of ICT on rural economic transformation in China.

4. Methodology

This section provides a description of the dimensions used in the computation of Kenya's Economic Transformation Index, the data used, and the index computation steps.

4.1 Introduction

Economic transformation is a process that encapsulates higher productivity among sectors in the economy, leading to overall economic growth and improvement in the quality of life of citizens (UN SDG, 2020). Kenya's economic transformation is spearheaded by the Kenya Vision 2030, national policies, international and regional commitments that serve as the blueprints for strategies that are focused on transformation. Transformation is a process which draws output from different sectors in building up to total transformation for the country. Based on this, Kenya's Economic Transformation Index has six dimensions that are critical towards economic transformation. Theoretical and empirical literature review has also guided the choice of these dimensions and the subsequent indicators.

4.2 The Dimensions of Kenya Economic Transformation Index

Human capital

Economic transformation is characterized by highly skilled labour who can partake in skilled jobs. GDP per capita is key in assessing household economic well-being. Assessing transition rates is critical in determining the level at which the population is growing in its skills and competencies that are necessary for productivity. Pupils transitioning from primary to secondary schools are likely to transition to tertiary levels of education including joining polytechnic, colleges and universities, hence gaining skills and knowledge that will contribute to higher productivity. Kenya is working towards achieving universal basic education by ensuring 100 per cent transition of pupils from primary to secondary education by 2022. The country also aims to raise the completion rate for basic education to 100 per cent by 2030 (ICPD25).

Health is a critical component in building up a healthy population that can contribute to increased production in different sectors. The study focuses on non-stunted children to determine health outcomes. Additionally, Kenya aims to achieve universal health coverage by 2030 to realize the goal of Kenya's Vision 2030 of providing high quality of life to its citizens. Furthermore, the Constitution chapter on Bill of Rights puts a heavy responsibility on the health sector to ensure

realization of the right to health. Human capital dimension is measured as:

- GDP per capita
- Transition rate from primary to secondary
- Percentage of non-stunted children

Growth in productivity

Productivity is critical in structural change. The study focuses on productivity across three sectors; manufacturing, agriculture, and services to point out the levels of value added productivity across the three sectors. Growth in productivity is measured as:

- Gross value added per worker in manufacturing sector
- Gross value added per worker in agriculture sector
- Gross value added per worker in services sector

Macroeconomic stability

Macroeconomic stability is critical for economic growth and economic transformation. Macroeconomic stability is key in provision of a stable environment for investment that is critical in enhancing productivity. The macroeconomic dimension is measured as:

- Inflation rate
- Current account balance (% of GDP)
- External debt (% of GDP)
- Fiscal deficit (% of GDP)

Environmental conservation

Access to clean fuels and technologies in rural areas has been selected as an indicator in a bid to measure green transformation, which is crucial for economic transformation to be sustainable. Kenya aims at attaining 100 per cent clean energy by 2030. Additionally, Kenya aims to achieve 10 per cent forest cover by 2022. Forest contributes highly to the country's livelihoods and economic development. Forest underpins diverse economic sectors, including agricultural, horticulture, tourism, wildlife and energy.

The dimension on environmental conservation is measured as:

- Access to clean fuels and technologies for cooking, rural (% of rural population), Kenya
- Forest cover (%)

Infrastructure

Infrastructure as a dimension has been selected since it serves as an enabler for economic transformative processes across sectors such as investments, education, and health. Infrastructure is measured as:

- Access to electricity (% of population)
- People using at least basic drinking water services (% of population)
- People using safely managed sanitation services, rural (% of rural population)

Information, Communication, Technology, and Innovation

ICT and innovation are essential for economic transformation. They are key in improving productivity and value addition. Innovation as a dimension is measured as:

- Number of total transactions in millions
- Internet subscribers per 100 inhabitants (wireless and fixed), represents population of three (3) years and above
- Undergraduate Science, Technology, Engineering and Mathematics (STEM) enrolments

4.3 Data Sources

The study used secondary data sources. The data was collected from various sources, including Economic Surveys for various years (KNBS), reports from the Central Bank of Kenya and World Bank.

4.4 Steps for Constructing Kenya Economic Transformation Index

The following steps were undertaken to construct the KETI:

1. Identification and categorization of KETI indicators

The first step involved transformation of raw data from different sources into percentages, which are comparable across the dimensions. Additionally, in this step, mean in Excel was used to impute the missing values.

2. Distance to frontier methodology

The second step was to convert the percentages into scores on a scale of zero (0) to one (1) using an adapted Distance to Frontier methodology. The methodology was adopted because the economic transformation on indicators was measured against national aspirations as recorded in different best practices such as Sustainable Development Goals, Kenya's ratified treaties and conventions, the Kenya Vision 2030 and the government set targets.

The datasets were examined and classified in terms of the best (here-in referred to as the frontier) and the worst. In constructing KETI, the best performance on the indicator formed the frontier for the indicator, which also referred to as the benchmark, best practices, the standards/norms, SDGs, Kenya's Vision 2030, ratified treaties, and government set targets. The indicator's worst performance was taken to indicate the worst. Equation one (1) shows how the score for the indicators were calculated.

$$Score=(Worst-y)/(Worst-frontier) \quad 1$$

Where y is the value of dataset for each indicator, worst represents worst performance while frontier shows best performance in each indicator represented by benchmark. The scores range from zero (0) to one (1). Equation 1 gives the score for value in the dataset. This approach gave an indication of how far each dimension in each year was from the best practice.

Table 1: Computation of KETI sub-indices

Dimensions	Indicators	Scoring of the indicators
Human capital	GDP per capita	The GDP per capita is computed as: = (0-y)/ (0-100), where worst is the GDP per capita is 1,035 and the frontier is 4,045. This is according to World Bank targets for GDP per capita ($) for lower-middle income countries: 1,035-4,045
	Transition rate from primary to secondary	The transition rate from primary to secondary score is computed as: =(0-y)/ (0-100), where the worst is when the percentage of transition rate is 0 (%) and the frontier is 100 (%). According to Kenya's Vision 2030, Kenya seeks to attain 100 (%) transition rates from primary to secondary
	Stunted children under-five	The non-stunted growth score is computed as: =(100-y)/ (100-14.5), where the worst is when the percentage of stunted children is 100 (%) and frontier is 14.5 (%). According to Vision 2030, Kenya seeks to reduce the stunted growth rate to 14.5 (%)
Productivity	Productivity in manufacturing sector	The productivity in the manufacturing sector was obtained by gross value added divided by worker output in manufacturing sector. The productivity in manufacturing sector score is computed as: =(Worst-y)/(worst-frontier), where worst is the worst performance in the data set and best performance is the best performance in the data set
	Productivity in Agricultural sector	The productivity in the agricultural sector was obtained by gross value added divided by worker output in manufacturing sector. The productivity in agricultural sector score is computed as: = (Worst-y)/(worst-frontier). Where worst is the worst performance in the data set and best performance is the best performance in the data set
	Productivity in services sector	The productivity in the services sector was obtained by gross value added divided by worker output in services sector. The productivity in services sector score is computed as: =(Worst-y)/(worst-frontier), where worst is the worst performance in the data set and best performance is the best performance in the data set

Macroeconomic stability	Inflation rate	DTF was used to compute index: =(2.5-y)/ (2.5-5) or =(7.5-y)/ (7.5-5) CBK targets: 2.5<5>7.5
	Current account balance	The current account balance score is computed as: =(Worst-y)/(worst-frontier), where worst is the worst performance in the data set and best performance is the best performance in the data set
	External debt	=(100-y)/ (100-40), where the worst is when the external debt as percentage of GDP is 100 (%) and frontier is 40 (%) according to IMF
	Fiscal deficit	=(3-y)/ (3-0), where the worst is when the fiscal deficit is 3(%) and the frontier is 0(%), according to IMF, East Africa countries seeks to achieve a fiscal deficit of 3(%) to attain debt sustainability
Environmental conservation	Access to clean fuels and technologies for cooking, rural	=(0-y)/ (0-100) Where the worst is when the percentage of transition rate is 0 (%) and the frontier is 100 (%). According to the Vision 2030, Kenya seeks to achieve target of 100% use of clean energy by 2030
	Forest cover	The Forest cover score is computed as: =(Worst-y)/(worst-frontier), where worst is the worst performance in the data set and best performance is the best performance in the data set
Essential infrastructure	Access to electricity	Kenya targets to have 100 (%) access to electricity, which forms the benchmark (frontier). The worst is where the country the country has 0 (%) of population with access to electricity. Access to electricity score is measured as: =(0-y)/ (0-100)
	Access to improved water	According to Vision 2030 and SDG6, Kenya is working towards all the households having access to improved water by 2030. Therefore, access to improved water score is measured as: =(0-y)/(0-100), where the worst is when the percentage of households with access to improved water is 0 (%), and the frontier is 100 (%)
	Access to improved sanitation	According to KESHP Kenya is working towards all the households having access to improved sanitation by 2030. Therefore, access to improved sanitation is computed as: =(0-y)/(0-100), where the worst is when the percentage of household with access to improved sanitation is 0 (%), and the frontier is 100 (%)

ICT	Average number of mobile transactions	Average number of transactions per customer/ month is >2.5 (McKinsey), therefore, customer/ year is >30. Thus, the score is computed as: =(0-y)/ (0-30)
	Access to Internet	Access to the Internet score is computed as: =(0-y)/(0-100), where the worst is the when the percentage of Internet subscribers per 100 inhabitants is 0%, and the frontier is a 100 (%) (benchmark – where all the inhabitants subscribe to the Internet)
	STEM enrollments	The STEM enrolments score is computed as: =(Worst-y)/(worst-frontier), where worst is the worst performance in the data set and best performance is the best performance in the data set

Further, a score for dimension was obtained by taking arithmetic mean of all the scores for the indicators.

3. Computation of KETI

The overall KETI score is a composite index of 6 dimensions, comprising of human capital, productivity, macroeconomic stability, environment, water, sanitation and health (WASH) and ICT dimensions. For each dimension, key indicators are used to construct an index specific to the dimension. Therefore, the overall KETI is constructed using simple equal weighted average of the dimension scores. Equal weights are used to circumvent the usual criticism, supported by index number theory, that weights tend to be so arbitrary that they may be manipulated to generate target indices. Therefore, the following is used to generate the equal weighted composite KETI:

KETI Index = (Human capital+Productivity+Macroeconomic stability+ Environment+WASH+ICT)/6 (number of dimensions)

Robustness of composite indicators

In the computation of the KETI, two reliability tests were conducted; that is, the Cronbach's alpha test and the Principal Component Analysis (PCA). The tests were important in gauging whether the indicators included in the construction of the index conformed with reliability and consistency statistical requirements. The test results are discussed in the Appendix.

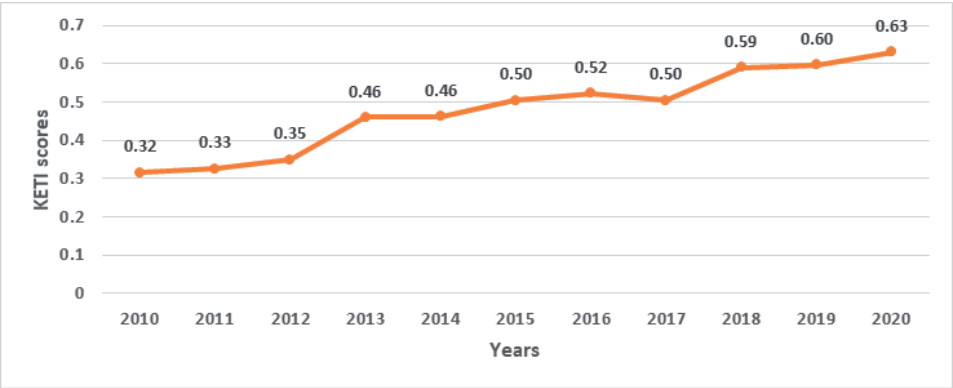
5. Kenya Economic Transformation Index (KETI)

The KETI constituted a total of 6 dimensions, namely: human capital, productivity, macroeconomic stability, environmental conservation, essential infrastructure, and ICT.

5.1 Kenya Economic Transformation Index Scores

Figure 5.1 shows Kenya Economic Transformation Index (KETI) scores from 2010 to 2020. KETI's average score is 0.48, which means that the country is still on its path to economic transformation. The economic transformation has been on an upward trend from 2010 to 2020, with a steep rise experienced in 2013 (0.46) and a slight drop in 2017 (0.50). The highest score was observed in 2020 at 0.63. Kenya's upward trajectory in economic transformation has been fueled by key development frameworks such as the Constitution of Kenya (2010) and the Kenya Vision 2030 (2008). Sectoral frameworks and institutional reforms that emanated from the two frameworks have been key in setting the stage for the transformational agenda in Kenya. KETI's score was highest in 2020 despite the COVID-19 pandemic. This can be attributed to increased resource allocation to key sectors such as health, improved and increased utilization of ICT infrastructure and innovation, and social protection measures.

Figure 5.1: Kenya Economic Transformation Index scores, 2010-2020



Source: Authors' computation

5.2 Dimension Scores

Table 2 shows that ICT had highest score (0.63) followed by human capital (0.62) and productivity (0.51). The lowest scores were on environmental conservation (0.35) and macroeconomic stability (0.32).

Table 2: Dimensions scores, 2010-2020

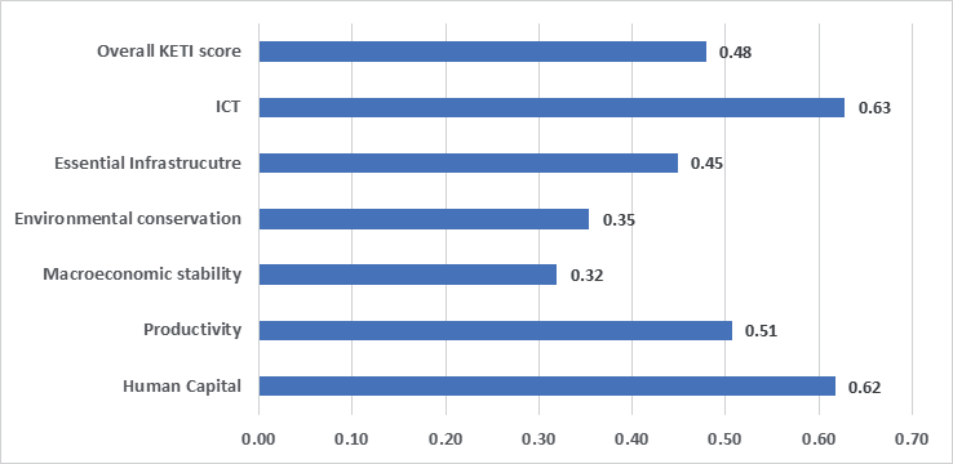
Dimensions / Years	Human Capital	Productivity	Macro economic stability	Environment	Essential Infrastructure	ICT	KETI score
2010	0.51	0.00	0.48	0.29	0.34	0.28	**0.32**
2011	0.52	0.09	0.23	0.30	0.40	0.41	**0.33**
2012	0.55	0.13	0.22	0.31	0.41	0.49	**0.35**
2013	0.56	0.43	0.38	0.37	0.42	0.61	**0.46**
2014	0.59	0.50	0.24	0.37	0.41	0.68	**0.46**
2015	0.61	0.59	0.29	0.37	0.43	0.74	**0.50**
2016	0.64	0.61	0.35	0.38	0.47	0.70	**0.52**
2017	0.67	0.67	0.14	0.37	0.48	0.70	**0.50**
2018	0.69	0.74	0.43	0.38	0.50	0.81	**0.59**
2019	0.71	0.82	0.42	0.38	0.53	0.72	**0.60**
2020	0.73	1.00	0.33	0.38	0.54	0.80	**0.63**
Average Score	**0.62**	**0.51**	**0.32**	**0.35**	**0.45**	**0.63**	**0.48**

Source: Authors' computation

High scores in ICT and human capital can be attributed to increased utilization of ICT in various sectors to ease transaction processes or to support sectoral activities. Financial technology, better known as fintech, has grown through increased utilization of mobile banking services, e-commerce, and digital employment opportunities. Similarly, ICT has gained prominence in education through e-learning that has been adopted as an alternative mode of learning. Scores in human capital can be linked to increased resources allocated to the education sector, and implementation of policies targeted to ensure 100 per cent transition of pupils from primary to secondary school. Additionally, improvements in the health centre brought about by devolution of the health sector has led to increased financial resources, health facilities and medical personnel and consequently

improved healthcare systems. Macroeconomic stability bears low scores in the index, which can be attributed to Kenya's external debt and inflation, which have been increasing over the years. Environmental conservation also achieved a low score in the index, demonstrating that there is still low uptake of clean energy in Kenya.

Figure 5.2: Average scores for dimensions



Source: Authors' computation

5.2.1 Human capital

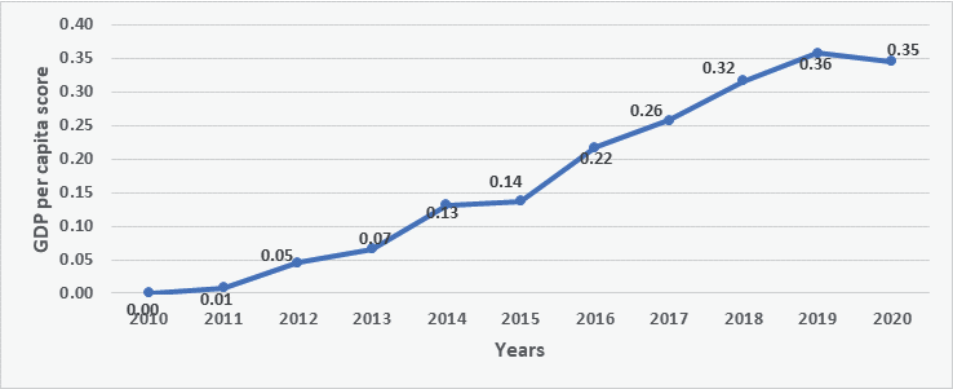
The human capital dimension comprised of three indicators: GDP per capita, transition rate from primary to secondary, and non-stunted children under five. The scores for each indicator ranged from 0 to 1, with the final human capital score also ranging from 0 to 1. From Table 3, the human capital score gradually rose from 2010 to 2020. The highest scores were observed for non-stunted children under-five while GDP per capita achieved the lowest scores in the human capital dimension.

Table 3: Human capital scores

Indicators Years	GDP per capita	Transition rate from primary to secondary	Non-Stunted children under-five (%)	Human capital score
2010	0.00	0.73	0.81	**0.51**
2011	0.01	0.73	0.83	**0.52**
2012	0.05	0.77	0.84	**0.55**
2013	0.07	0.75	0.86	**0.56**
2014	0.13	0.76	0.87	**0.59**
2015	0.14	0.82	0.89	**0.61**
2016	0.22	0.81	0.90	**0.64**
2017	0.26	0.83	0.91	**0.67**
2018	0.32	0.83	0.92	**0.69**
2019	0.36	0.86	0.93	**0.71**
2020	0.35	0.91	0.94	**0.73**

Source: Authors' computation

Figure 5.3: GDP per capita score

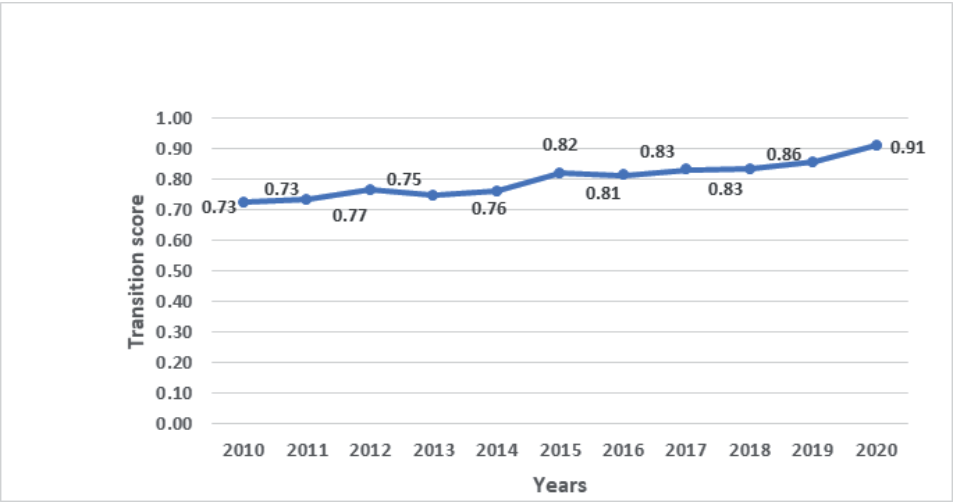


Source: Authors' computation

According to the World Bank, the targets for GDP per capita is US$ 1,035 to US$ 4,045 for lower-middle income countries. Figure 5.3 shows that the GDP per capita score increased gradually from 2010 to 2020, which shows gradual improvement in household economic well-being over the period. The World Bank declared Kenya a lower middle-income country in 2014 after it met the threshold

of GDP per capita of becoming lower middle-income country. However, the score is low, with the highest score being observed in 2019 at 0.36. This demonstrates the presence of low household incomes, consequently leading to household poverty and low quality of life.

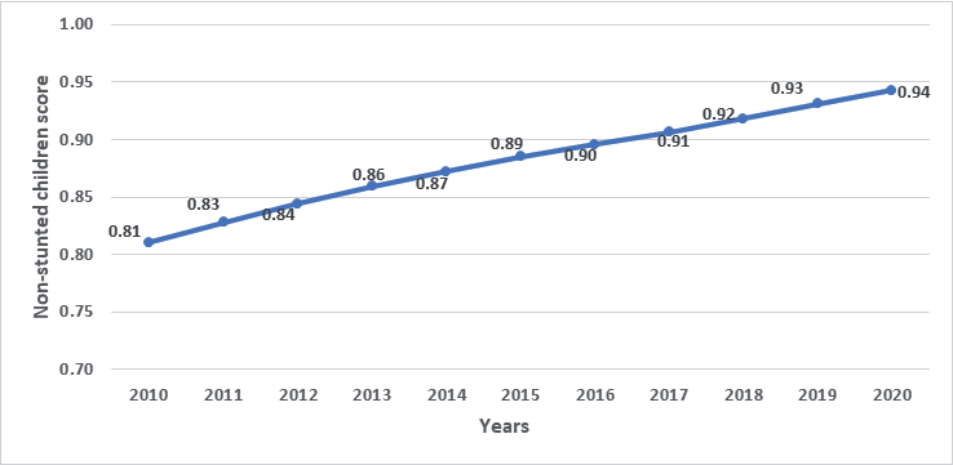
Figure 5.4: Transition rate from primary to secondary score



Source: Authors' computation

According to the Kenya Vision 2030, Kenya seeks to attain 100 per cent transition rate of pupils from primary to secondary education in a bid to build up a skilled workforce necessary for economic transformation. Figure 5.4 shows an upward trend in the rate of pupils' transition from primary to secondary education, with 2020 bearing the highest transition rates in Kenya at 91 per cent suggesting a positive trend in human capital formation that is necessary for economic productivity.

Figure 5.5: Non-stunted children score



Source: Authors' computation

The Kenya Vision 2030 seeks to reduce the stunted growth rate among children to 14.5 (%) in Kenya. Figure 5.5 shows an increase in the number of non-stunted children from 2010 to 2020, which demonstrates improvement in the health sector that is vital for building a healthy productive workforce.

5.2.2 Productivity

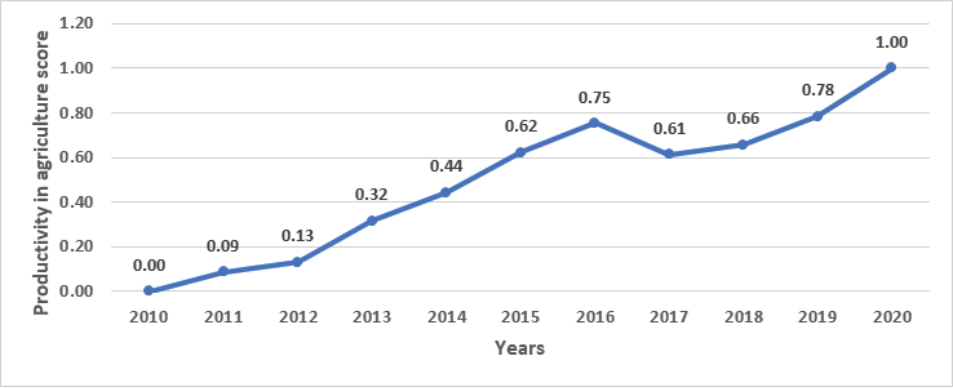
Productivity in the index was measured using the gross value added per worker. This was done across the three sectors to ascertain the rate of productivity among the various sectors and thus leading to the overall productivity score. The scores ranged from 0 (worst) to 1 (best). Table 4 shows the overall productivity score has gradually risen from 2010 to 2020, with the average score of 0.5 demonstrating the need for strategies to increase productivity in the country. Agriculture bears the highest scores for productivity given that Kenya is an agro-based economy.

Table 4: Productivity scores

Indicators Years	Productivity in Manufacturing sector	Productivity in Agricultural sector	Productivity in Services sector	Total Productivity score
2010	0.00	0.00	0.00	0.00
2011	0.09	0.13	0.07	0.09
2012	0.13	0.15	0.10	0.13
2013	0.32	0.70	0.27	0.43
2014	0.44	0.73	0.33	0.50
2015	0.62	0.81	0.32	0.59
2016	0.75	0.71	0.38	0.61
2017	0.61	0.68	0.72	0.67
2018	0.66	0.74	0.81	0.74
2019	0.78	0.78	0.90	0.82
2020	1.00	1.00	1.00	1.00
Average score	0.49	0.57	0.45	0.50

Source: Author's computation

Figure 5.6: Productivity in agriculture score

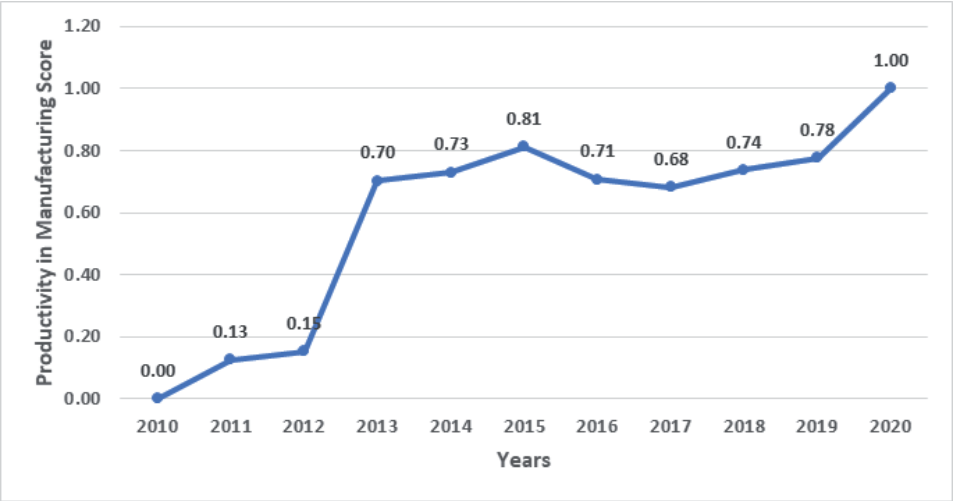


Source: Authors' computation

Productivity in agriculture has been steadily rising from 2010 to 2020 with a decline in 2017 as shown in Figure 5.6. The average score for agricultural productivity is 0.57, showing the need for strategies in agricultural transformation

that will accelerate the larger economic transformation. Innovation and ICT have been considered as ways that can increase value addition and productivity in the agricultural sector (Freire, 2021).

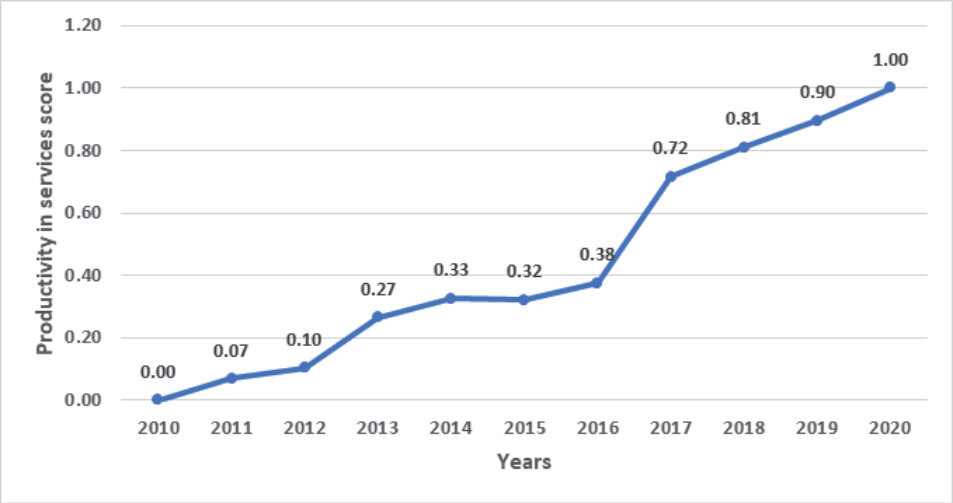
Figure 5.7: Productivity in manufacturing score



Source: Authors' computation

Figure 5.7 indicates that productivity in the manufacturing sector scored an average of 0.49, which is still low and thus necessitating efforts to accelerate industrialization, which is key in value addition and increased competitiveness, factors that are critical towards economic transformation. Performance in the manufacturing sector saw a sharp rise from 2012. This can be attributed to an enabling policy environment through development of the National Industrialization Policy Framework for Kenya (2012-2030), which spearheaded efforts targeted at industrialization as provided in the Kenya Vision 2030 and growth in infrastructure.

Figure 5.8: Productivity in services score



Source: Authors' computation

Figure 5.8 shows that productivity in services grew gradually from 2010 to 2020. The average score in productivity is 0.45, signifying a need for strategies to accelerate productivity in the services sector. Productivity in the services sector grew sharply from 2017 following the development and implementation of programmes under the Big Four Agenda, such as Universal Health Coverage and affordable housing.

5.2.3 Macroeconomic stability

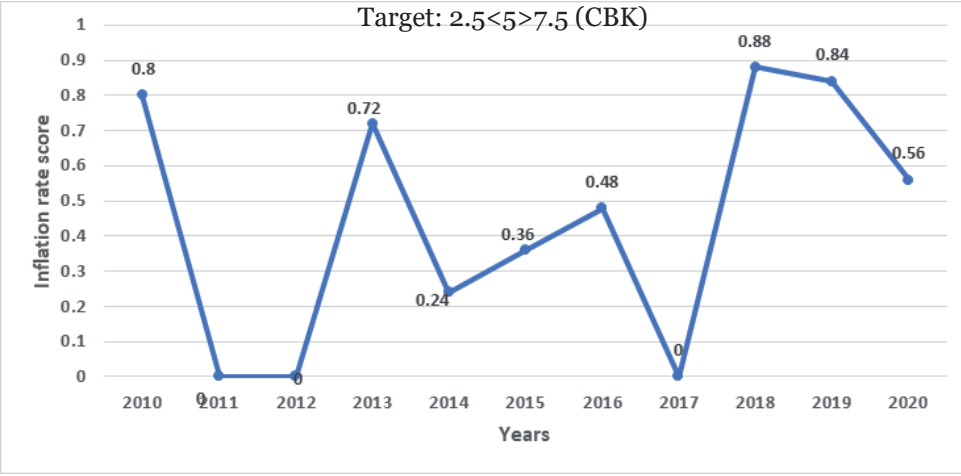
Macroeconomic stability is key in providing an environment that supports investments. Under the macroeconomic stability dimension, four indicators were considered, and the score ranged from 0 (worst) and 1 (best). Table 5 indicates that the highest score was achieved in 2010, while the lowest score was in 2017. Low scores were achieved under the external debt to GDP ratio indicator, fiscal deficit as a percentage of GDP indicator, and current account balance as a percentage of GDP.

Table 5: Macroeconomic stability score

Indicators Years	Inflation rate	External debt as a % of GDP	Fiscal deficit as % of GDP	Current account balance (% of GDP)	Macroeconomic stability index
2010	0.53	0.31	0.80	0.28	**0.48**
2011	0.49	0.39	0.00	0.05	**0.23**
2012	0.53	0.36	0.00	0.00	**0.22**
2013	0.51	0.29	0.72	0.00	**0.38**
2014	0.48	0.23	0.24	0.00	**0.24**
2015	0.38	0.01	0.36	0.39	**0.29**
2016	0.36	0.07	0.48	0.48	**0.35**
2017	0.21	0.00	0.00	0.33	**0.14**
2018	0.17	0.20	0.88	0.48	**0.43**
2019	0.13	0.22	0.84	0.50	**0.42**
2020	0.02	0.22	0.56	0.54	**0.33**

Source: Authors' computation

Figure 5.9: Inflation rate score

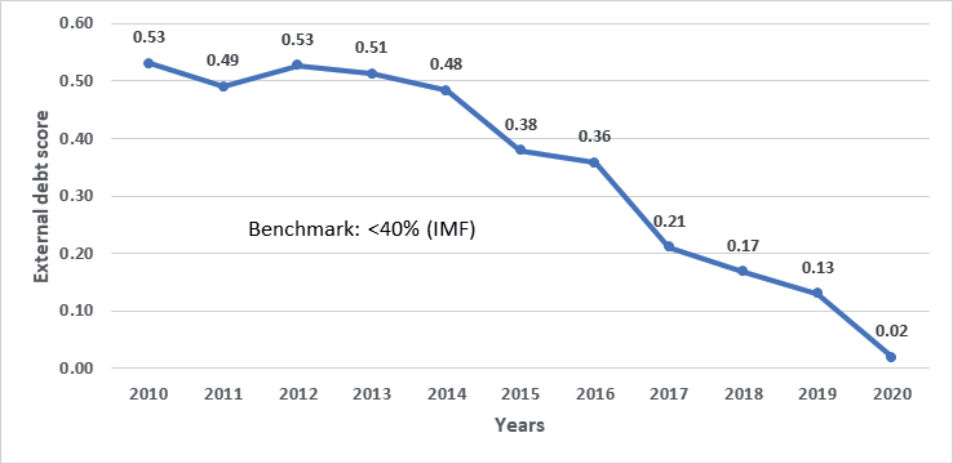


Source: Authors' computation

According to the Central Bank of Kenya, Kenya aims to contain inflation to range between 2.5 to 7.5, according to the Central Bank of Kenya (CBK). Over the period, Kenya has experienced varied rates of inflation. Scores for inflation were poor

between 2011 to 2012, signifying increase in inflation from 2010 as shown in Figure 5.9. There was a sharp rise in inflation scores in 2018, demonstrating a decline in inflation. However, the steady decline was short-lived as the COVID-19 pandemic led to economic downturn through decrease in production and therefore increased inflation in 2020.

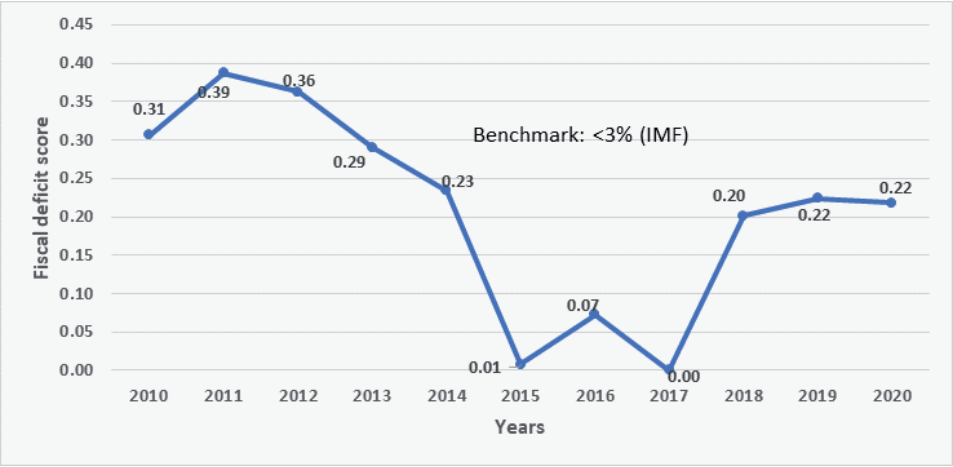
Figure 5.10: External debt score



Source: Authors' computation

The International Monetary Fund (IMF) recommends a benchmark of 40 per cent for debt sustainability. From Figure 5.10, Kenya's external debt score has been declining during the period 2010 to 2020. This implies that the country's external debt has been rising over the years, and consequently affecting opportunities for economic growth through investments. In 2020, Kenya's external debt as a percentage of GDP was 39.2, almost going beyond the target of 40 per cent.

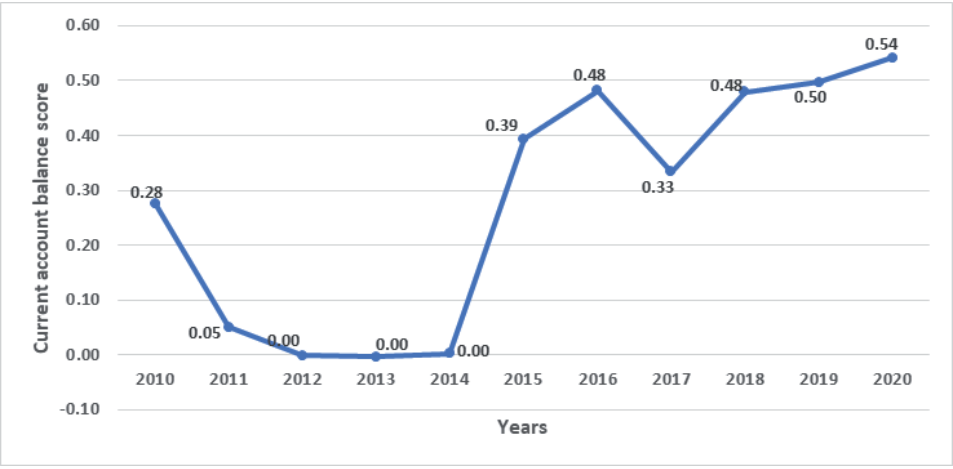
Figure 5.11: Fiscal deficit score



Source: Authors' computation

According to IMF, East Africa countries need to achieve a fiscal deficit of 3 percent to attain debt sustainability. From Figure 5.11, fiscal deficit has been fluctuating over the years with a steep decline experienced from 2011 to 2015 signifying increased fiscal deficit thus paving way for increased borrowing. Kenya's fiscal deficit was within the threshold of 3 per cent except for the 2015 and 2017 years.

Figure 5.12: Current account balance score



Source: Authors' computation

The account balance score for Kenya experienced a decline from 2010 to 2014 and a gradual rise from 2014 to 2020 as shown in Figure 5.12. However, the scores are low, implying that Kenya's value of imports is higher than that of exports, necessitating the need for strategies to accelerate trade competitiveness.

5.2.4 Environmental conservation

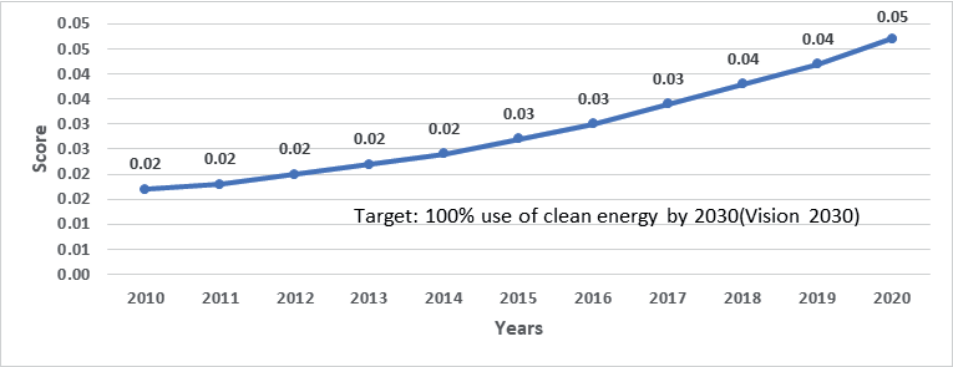
Environmental conservation is critical towards sustainable economic transformation. Environmental conservation as a dimension was measured by two indicators: access to clean fuels and technologies for cooking in rural areas and forest cover scores. The scores ranged from 0 (worst) to 1 (best). Table 6 shows that the scores under environmental conservation are low signifying measures required to strengthen environmental sustainability are imperative.

Table 6: Environmental conservation score

Indicators/ Years	Access to clean fuels and technologies for cooking, rural	Forest cover score	Environmental conservation score
2010	0.02	0.57	0.29
2011	0.02	0.58	0.30
2012	0.02	0.59	0.31
2013	0.02	0.72	0.37
2014	0.02	0.71	0.37
2015	0.03	0.72	0.37
2016	0.03	0.72	0.38
2017	0.03	0.71	0.37
2018	0.04	0.71	0.38
2019	0.04	0.71	0.38
2020	0.05	0.71	0.38

Source: Authors' computation

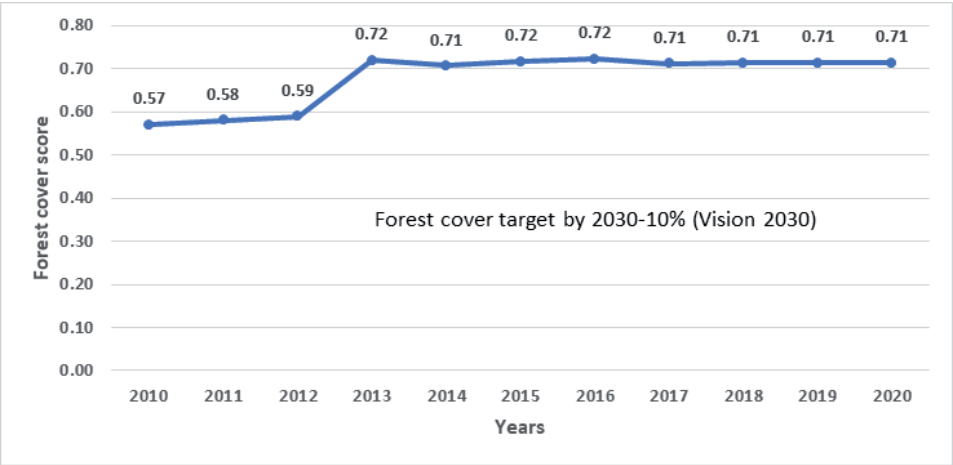
Figure 5.13: Access to clean fuels and technologies for cooking, rural



Source: Authors' computation

Kenya seeks to achieve a target of 100 per cent use of clean energy by 2030. From Figure 5.13, Kenya has experienced an upward trend in access to clean fuels and technologies for cooking in rural areas over the period. However, the progress has been very low. Access to clean fuels and technologies for cooking in rural areas was at 1.70 per cent in 2010 and 4.7 per cent in 2020, signifying that green transformation in rural areas still remains to be explored.

Figure 5.14: Forest cover score



Source: Authors' computation

Figure 5.14 indicates that the forest cover score in Kenya is at 0.71 in 2020 and has been stagnant since 2013. The forest cover is still lower than the targeted 10 per

cent forest cover by 2030. This implies that Kenya remains vulnerable to climatic conditions that threaten economic transformation through adverse impacts on sectors such as agriculture.

5.2.5 Essential infrastructure

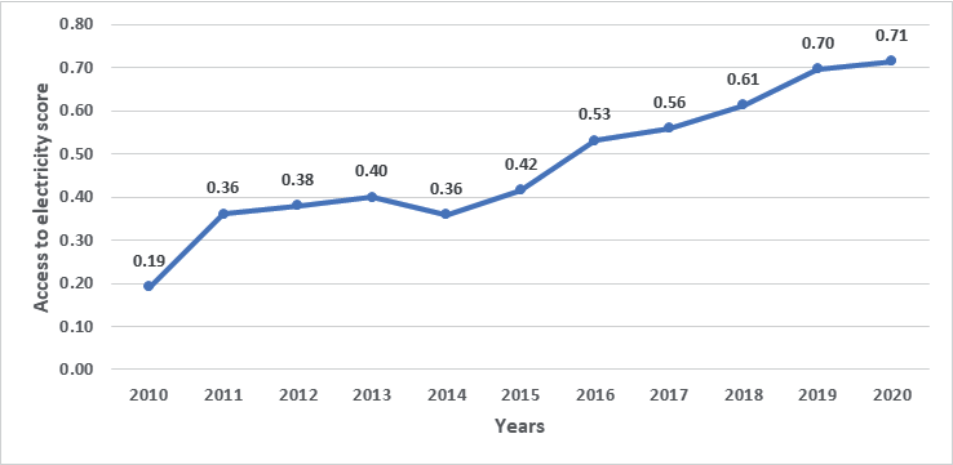
Essential infrastructure is a key enabler to economic transformative practices by enhancing productivity. Essential infrastructure as a dimension was measured by access to electricity, people using at least basic drinking water services and people using safely managed sanitation services in rural areas. The scores ranged between 0 (worst) and 1 (best). Table 7 shows that the highest score for the dimension was 0.54, which implies that efforts need to be put in place to develop infrastructure that will accelerate economic transformation. Higher scores were achieved under the access to basic drinking water services indicator and access to electricity while sanitation services among rural communities still remains an impediment to rapid economic transformation.

Table 7: Essential infrastructure score

Indicators Years	Access to electricity	People using at least basic drinking water services	People using safely managed sanitation services, rural	Infrastructure index
2010	0.19	0.55	0.28	0.34
2011	0.36	0.55	0.29	0.40
2012	0.38	0.56	0.29	0.41
2013	0.40	0.57	0.29	0.42
2014	0.36	0.57	0.29	0.41
2015	0.42	0.58	0.29	0.43
2016	0.53	0.59	0.29	0.47
2017	0.56	0.60	0.29	0.48
2018	0.61	0.60	0.29	0.50
2019	0.70	0.61	0.29	0.53
2020	0.71	0.62	0.29	0.54

Source: Authors' computation

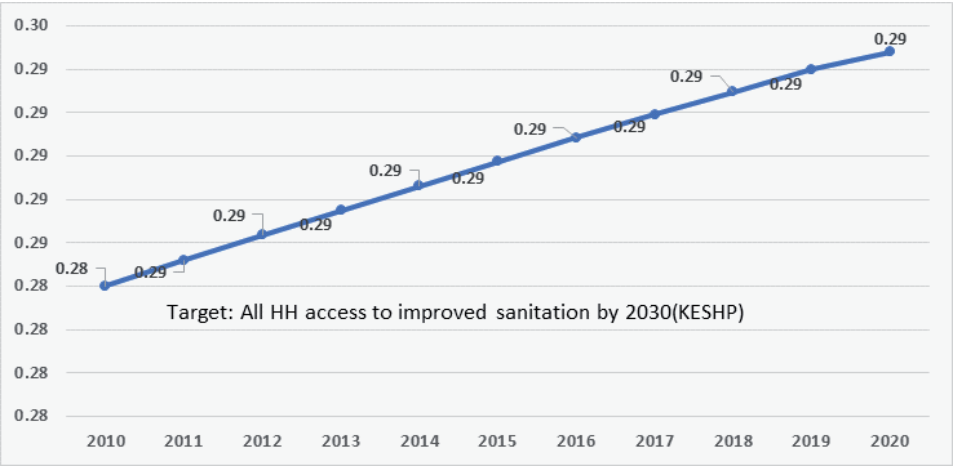
Figure 5.15: Access to electricity score



Source: Authors' computation

The Kenya Vision 2030 aims to achieve 100 per cent access to electricity by 2030. Kenya has experienced an upward trajectory in achieving the target. By 2020, the results in Figure 5.15 indicate that 71 per cent of Kenya's population access to electricity. This is quite significant since it provides an anchor through which economically productive activities across the sectors can be leveraged upon.

Figure 5.16: Access to improved water services, rural score

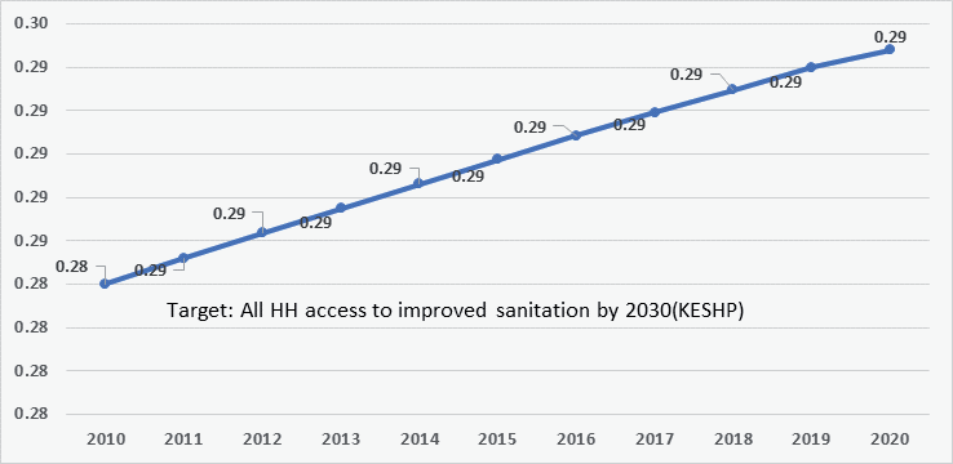


Source: Authors' computation

The Kenya Vision 2030 and SGD 6 target that all households will have access to improved water services. Access to improved water services by rural households

has been gradually rising but is still below the 100 per cent target. Water is critical in households in enhancing positive health outcomes that are critical towards increased productivity.

Figure 5.17: Access to improved sanitation services, rural score



Source: Authors' computation

KESHP targets that all households will have access to improved sanitation by 2030. Kenya has experienced an upward trend in achieving the target. However, the progress has been very slow in rural areas. In 2020, only 29 per cent of the population used safely managed sanitation services in rural areas. These findings suggest that households in rural areas are highly vulnerable to communicable diseases, thus affecting their overall productivity and hence slowing down the progress towards economic transformation.

5.2.6 ICT and innovation

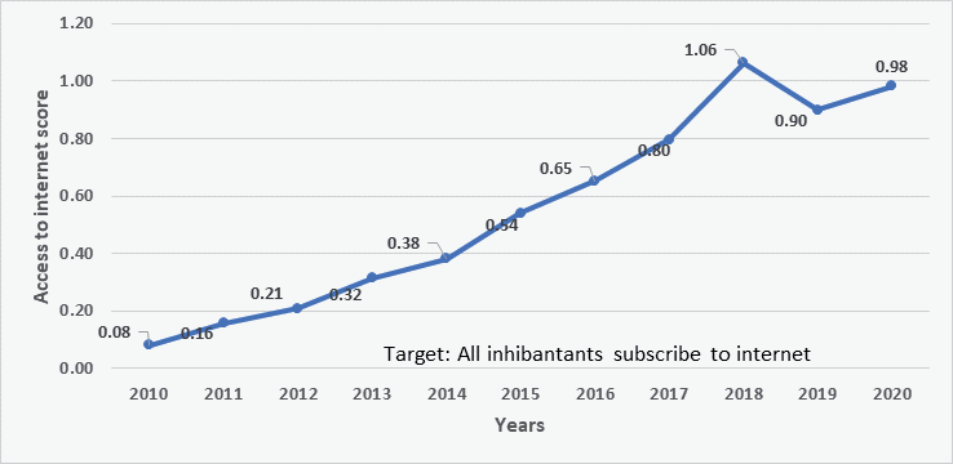
ICT and innovation are enablers for economic transformation by enhancing value addition and increasing productivity and competitiveness. According to Table 8, growth in ICT and innovation has been steadily rising from 2010 to 2020.

Table 8: ICT and innovation scores

Indicators Years	Internet subscribers per 100 inhabitants	Average number of mobile transactions per customer/month	STEM enrolments	ICT and innovation Index
2010	0.08	0.75	0	0.28
2011	0.16	0.98	0.09	0.41
2012	0.21	0.91	0.34	0.49
2013	0.32	1.00	0.50	0.61
2014	0.38	0.80	0.84	0.68
2015	0.54	0.68	1.00	0.74
2016	0.65	0.59	0.84	0.70
2017	0.80	0.55	0.75	0.70
2018	1.06	0.51	0.84	0.81
2019	0.90	0.44	0.82	0.72
2020	0.98	0.49	0.92	0.80

Source: Authors' computation

Figure 5.18: Access to Internet score

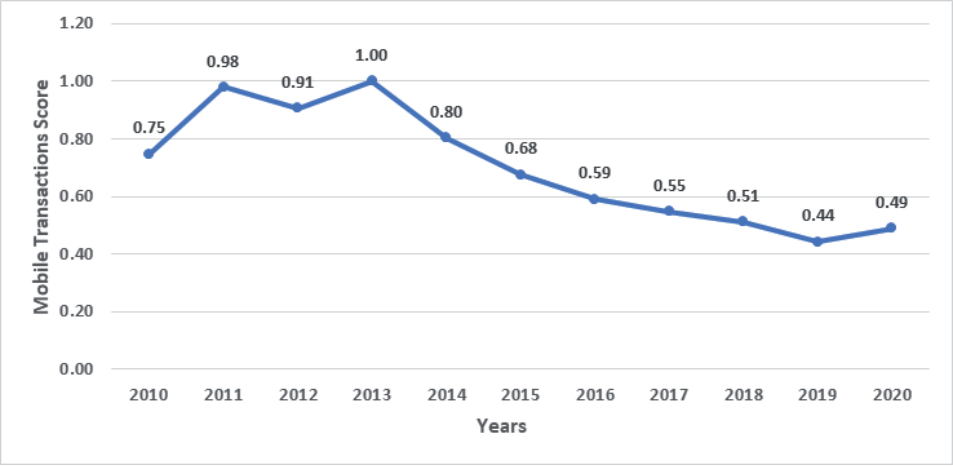


Source: Authors' computation

Kenya targets to ensure that all inhabitants are subscribed to the Internet. According to Figure 5.18, Internet subscription has been rising from 2010 to 2020

in the quest to achieve 100 per cent Internet subscribers. In 2018, Kenya surpassed the target of 100 per cent. In 2020, Internet subscribers per 100 inhabitants was at 98 per cent, which can be attributed to the increase in Figure 5.18 infrastructure enabling Internet penetration and the rise in demand for digital of services.

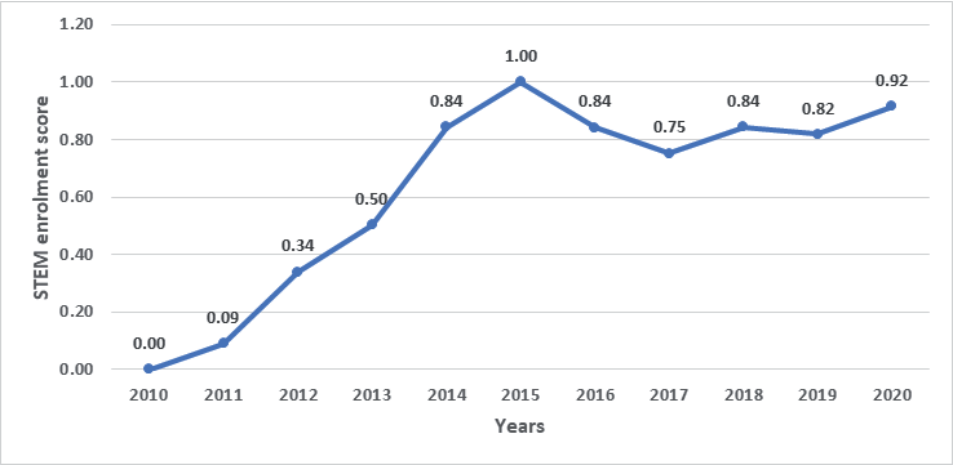
Figure 5.19: Mobile transactions score



Source: Authors' computation

The score of mobile transactions in Kenya has been varying from 2010 to 2020. Marked by a steady decline from 2013, scores have dropped to 50 per cent as of 2020 as indicated in Figure 5.19. This is against a benchmark 30 average transactions per customer per day and increased digital service provision across sectors.

Figure 5.20: STEM enrolment score



Target: Average number of transactions per customer/year is 30 (McKinsey)

Source: Authors' computation

Enrolment in STEM courses provides a leverage point for the development of human capacity that is key to enhancing innovation. According to Figure 5.20, Kenya has experienced an upward growth in terms of students enrolled in STEM courses, signifying an increase in the workforce that can support innovative practices that can increase Kenya's market competitiveness.

6. Conclusion and Recommendations

6.1 Conclusion

This study focused on assessing the factors underpinning economic transformation in Kenya. It also sought to construct the economic transformation index for Kenya. The study also tracked Kenya's progress in economic transformation. Analysis from the study established Kenya's score on Economic Transformation, which is 0.48. A closer look at Kenya's progress in economic transformation for the period under review shows that the country has been growing steadily in terms of economic transformation from 2010 till 2020. From the index, dimensions which scored highly are human capital (0.62) and ICT and innovation (0.63) and essential infrastructure (0.45) while low scores were observed under macroeconomic stability (0.32) and environmental conservation (0.35). ICT and innovation showed the most improvement while environmental conservation demonstrated the least improvement. Based on the findings, the study further demonstrated that:

The human capital dimension is characterized by growth in the rates of transition for pupils from primary schools to secondary schools, which signifies a population that bears at least some basic levels of education and skills that are necessary to steer productivity while at the same time demonstrating potential in acquiring higher levels of skills and knowledge. Improvements are also seen in health outcomes, and thus leading to a highly productive workforce. However, GDP per capita is low in Kenya, denoting low economic well-being among households, and thus the need for economic transformation that will improve incomes among households.

Productivity has experienced a gradual rise across the sectors, but the scores indicate the need for measures to accelerate productivity and consequently enhance economic transformation in the country. Growth in sectoral productivity also needs to be realized to catalyze productivity in the other sectors.

Macroeconomic stability as a dimension has experienced variation across the years, and consequently affecting investments that may spur productivity across various sectors. Inflation rates, external debt, current account balance and fiscal deficit play a critical role in provision of a stable macroeconomic environment necessary for increased productivity.

Environmental conservation as a measure for sustainability in economic transformation is an area to be explored and enhanced. Kenya's efforts towards containing climate change needs to begin with environmental conservation. This will pave way for ensuring productivity is not diminished especially in sectors

such as agriculture that are directly affected by climate change variations.

Essential infrastructure is key in catalyzing productivity. Improvements have been realized in the penetration of electricity and basic water services, although growth in access to sanitation services remains evasive. It is therefore imperative that measures are put in place to ensure increased access to electricity, water, and sanitation services since they are key in enhancing productivity.

ICT and innovation increase efficiency, enhance competitiveness and value addition. Growth in utilization of Internet services is a significant indicator of improved business processes. Increased workforce that can spearhead innovative approaches denotes diversification of production and improvement in services and products. Utilization of mobile phones platforms demonstrates increased efficiency in the production cycle.

6.2 Policy Recommendations

To enhance economic transformation that promotes productivity in all sectors discussed, the government in partnership with development partners may consider implanting the following recommendations:

Human capital

Strengthen education policies that will ensure increased transition of pupils from primary to secondary schools to build human capital that will enhance productivity across the sectors. In terms of health, gains in health outcomes of stunting in children need to be maintained especially in the aftermath of the COVID-19 pandemic, which was a huge setback for the health and nutrition sector. Strategic reforms to improve labour force contribution to annual GDP need to be made in innovation, technology, skills, and training and consequently reducing dependency.

Productivity

Accelerate agricultural productivity through utilization of climate-smart innovation and technology. Strategies to enhance value addition, and market competitiveness need to be considered in relation to productivity in manufacturing. Increasing skills and education among the labour force is critical in advancing productivity in the services sector.

Macroeconomic stability

Ensure stability in the macroeconomic environment by maintaining growth-friendly and stable fiscal policy and accommodative monetary policy with price stability. Also, develop and implement strategies that advance local production to

enhance revenue mobilization, increase export growth and serve as a catalyst for increased investment opportunities.

Environmental conservation

Develop policies to promote and encourage manufacturing and utilization of clean energy products such as biogas and solar power to reduce dependency on non-renewable energy sources.

Essential infrastructure

Strengthen policies related to rural electrification that will enhance penetration of electricity among rural communities. Establishment of a coordination framework to enhance collaboration among players in the WASH sector to improve access to water and sanitation facilities among rural communities.

ICT and innovation

Expand ICT infrastructure across the country to ensure increased access to ICT services and efficiency in service provision and production. Increase education infrastructure to enhance capacity building in science, technology, mathematics, and engineering.

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Appendix

Appendix I: Cronbach's Alpha

Cronbach's alpha is used to estimate the significance and internal consistency of each category at the normalized indicator level. Cronbach's alpha is defined as follows:

$$\alpha=M_i/(M_j\text{-}1)(1-(\sum(j=1)M_i\ \sigma Ij,i)/\sigma i)$$

Where M_i is the total number of weighted indicators in category *i*

j,i is the variance of the indicator *j* and

I is the variance of category *i*.

The Cronbach alpha results range from 0 to 1 in giving out the overall assessment of a measure's reliability. Generally, the higher the Cronbach's alpha, the more intercorrelated the indicators are among themselves. For this case, the rule of thumb is that:

- Alpha values close to 0 indicate uncorrelated indicators or share no covariance.
- Alpha values close to 1 indicate highly correlated indicators.
- Negative alpha values indicate negatively correlated indictors.
- Alpha values of below 0.50 are unacceptable.
- Alpha values between 0.65 and 0.80 (or higher in many cases), indicate a good coefficient (Pallant, 2020).

If the indicators are used to describe a single dimensional latent construct, namely one of the KETI categories, the alpha values should be significantly different from 0.f the KETI categories, the alpha values should be significantly different from 0.

Table 9: Cronbach's alpha results

Dimensions	Indicators scores	Cronbach's Alpha	Decision
Human Capital	GDP per capita Transition rate from primary to secondary Stunted children under-five (%)	Scale reliability coefficient: 0.84 Average inter-item covariance: 0.005 Number of items in the scale:3	The alpha results present a good coefficient. Hence, all indicators were included in the construction of index.

Productivity	Productivity in manufacturing sector Productivity in Agricultural sector Productivity in services sector	Scale reliability coefficient: 0.94 Average inter-item covariance: 0.096 Number of items in the scale: 3	The alpha results present a strong reliability therefore all indicators were included in the computation of index
Macroeconomic stability	Inflation rate Current account balance (% of GDP) External debt as a (% of GDP) Fiscal deficit as % of GDP (Debt to GDP ratio)	Scale reliability coefficient:0.69 Average interim covariance:0.020 Number of items in the scale:4	The alpha results of 0.69 present a strong reliability hence all the indicators were included
Environment	Access to clean fuels and technologies for cooking, rural (% of rural population Forest cover (%)	Scale reliability coefficient:0.51 Average inter-item covatiance:0.002 Number of items in the scale: 2	With the alpha coefficient of above 0.50, it indicates a good reliability. Thus, the 2 were included in the computation of the index
Essential infrastructure	Access to electricity (% of population) People using at least basic drinking water services (% of population) People using safely managed sanitation services, rural (% of rural population)	Scale reliability: 035 Average inter-item covariance: 0.001 Number of items in the scale: 3	The alpha results present a poor coefficient. Therefore, more indicators can be included
ICT and innovation	Number of total transactions Internet subscribers per 100 inhabitants Stem enrolments, undergraduates	Scale reliability coefficient: 088 Average inter-item covariance: 0.067 Number of items in the scale: 3	The alpha results indicate a good coefficient and strong reliability, thus all indicators were included in the computation

Source: Authors' computation

Appendix II: Principal Component Analysis

The Principal Component Analysis (PCA) is a technique applied to reduce the dimensions of data by extracting a group of factors that best represent the original data. The key outputs for the PCA includes the eigenvalues, the proportion of the variance that the component explains, the coefficient and the eigenvectors. The

rule of thumb is that the larger the absolute value (regardless of the direction, whether positive or negative), the more important the corresponding variable is in calculating the component. The results of PCA under each dimension are discussed below.

Human capital

Table 10: Principal Component Analysis human capital dimension

Principal Components (Correlation)			Principal Components (Eigenvectors)			
Component	**Eigen value**	**Cumulative**	**Indicators**	**Comp1**	**Comp2**	**Comp3**
Comp1	2.72	0.91	GDP per capita	0.59	-0.08	-0.80
Comp2	0.22	0.98	Transition rate from primary to secondary	0.57	-0.66	0.49
Comp3	0.059	1.00	Stunted children under-five (%)	0.57	0.75	0.35

Source: Authors' computation

The results in Table 10 show that the first one (1) component out of the three (3) components have eigenvalues greater than 1. Component one explains 90.77 per cent of the variations in the data. The results show that the first principal component analysis has a large positive association with the GDP per capita, transition rate from primary to secondary and stunted children under-five (%). Thus, all the variables are suitable for the index computation.

Productivity

Table 11: Principal Component Analysis productivity

Principal Components (Correlation)			Principal Components (Eigenvectors)			
Component	**Eigen value**	**Cumulative**	**Indicators**	**Comp1**	**Comp2**	**Comp3**
Comp1	2.72	0.91	Productivity in agricultural sector	0.59	-0.08	-0.80
Comp2	0.22	0.98	Productivity in manufacturing sector	0.57	-0.66	0.49
Comp3	0.06	1.00	Productivity in services sector	0.57	0.75	0.35

Source: Authors' computation

The results in Table 11 indicate that the first component out of the four components have eigenvalues greater than 1. The first component explains 90.77 per cent of the variations in the data. The results show that the first principal component analysis has large positive associations with productivity in agricultural, manufacturing and services sectors. Therefore, all the variables are suitable for the index computation.

Macroeconomic stability

Table 12: Principal Component Analysis macroeconomic stability

Principal Components (Correlation)			Principal Components (Eigenvectors)			
Component	**Eigen value**	**Cumulative**	**Indicators**	**Comp1**	**Comp2**	**Comp3**
Comp1	2.41	0.60	Inflation rate	-0.34	0.77	0.46
Comp2	1.03	0.86	Current account balance (% of GDP)	-0.62	0.03	-0.05
Comp3	0.45	0.97	External debt (as a % of GDP)	0.57	0.03	0.66
Comp4	0.11	1.00	Fiscal deficit (as % of GDP)	0.42	0.63	-0.59

Source: Authors' computation

From the above results, the first two (2) components out of four (4) components have eigenvalues greater than 1. The two components explain 85.86 per cent of the variations in the data. The results in Table 12 show that the first principal component analysis has large positive associations with the external debt and fiscal deficit. The second component analysis has large positive associations with the inflation rate and all other indicators. Therefore, all the variables are suitable for the index computation.

Environmental conservation

Table 13: Principal Component Analysis environment conservation

Principal Components (Correlation)			Principal Components (Eigenvectors)		
Component	**Eigen value**	**Cumulative**	**Indicators**	**Comp1**	**Comp2**
Comp1	1.63	0.82	Access to clean fuels and technologies for cooking, rural	0.71	0.71

Comp2	0.37	1.00	Forest cover	0.71	-0.71

Source: Authors' computation

The results in Table 13 indicate that the first component out of the two components have eigenvalues greater than 1. The first component explains 81.54 per cent of the variations in the data. The results show that the first principal component analysis has large positive associations with access to clean fuels and technologies for cooking and forest cover. Thus, all the variables are suitable for the index computation.

Essential infrastructure

Table 14: Principal Component Analysis essential infrastructure

Principal Components (Correlation)			Principal Components (Eigenvectors)			
Component	**Eigen value**	**Cumulative**	**Indicators**	**Comp1**	**Comp2**	**Comp3**
Comp1	2.35	0.78	Access to electricity	0.64	-0.22	-0.74
Comp2	0.62	0.99	Access to improved water	0.61	-0.44	0.66
Comp3	0.31	1.00	Access to improved sanitation	0.48	0.87	0.15

Source: Authors' computation

Table 14 shows that the first component out of the three components have eigenvalues greater than 1. The first component explains 78.20 per cent of the variations in the data. The results show the first principal component analysis has large positive associations with access to electricity, access to improved water and access to improved sanitation. Thus, all the variables are suitable for the computation of the index.

Information Communication and Technology (ICT)

Table 15: Principal Component Analysis ICT and innovation

Principal Components (Correlation)			Principal Components (Eigenvectors)			
Component	**Eigen value**	**Cumulative**	**Indicators**	**Comp1**	**Comp2**	**Comp3**
Comp1	2.55	0.85	Average number of mobile transactions	-0.58	0.59	0.56
Comp2	0.35	0.97	Access to Internet	0.60	-0.15	0.78

Comp3	0.08	1.00	STEM enrolments	0.55	0.79	-0.27

Source: Authors' computation

The results in Table 15 show the first component out of the three components eigenvalues greater than 1. The first component explains 85.09 per cent of the variations in the data. The results show that the first principal component analysis has large positive associations with Internet subscribers per 100 inhabitants and STEM enrolments. The results show that the second principal component analysis has large associations with STEM enrolments and average number of transactions. Thus, all the variables are suitable for the index computation.

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