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**SMART STRATEGIES FOR ECONOMIC DIVERSIFICATION AND
INCLUSIVE GROWTH IN MOZAMBIQUE**

Geraldo Adriano Timbe

Dissertation

presented as partial requirement for obtaining the Master's Degree Program in Data Science and Advanced Analytics

**NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação**

Universidade Nova de Lisboa

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Dissertation presented as partial requirement for obtaining the Master's degree in Advanced Analytics, with a Specialization in Data Science.

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July 2022

STATEMENT OF INTEGRITY

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism or any form of undue use of information or falsification of results along the process leading to its elaboration. I further declare that I have fully acknowledged the Rules of Conduct and Code of Honor from the NOVA Information Management School.

DEDICATION

I would like to dedicate this work to my wonderful family. To my parents, Adriano Timbe and Milagrina Joaquim Chaú, who in life did everything for my academic and professional formation. To my son Adriano Geraldo Timbe, my inspiration source. To my brothers for their trust, strength and support.

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“No matter how brilliant your mind or strategy, if you’re playing a solo game, you’ll always lose out to a team.” – Reid Hoffman.

ABSTRACT

A growing literature has shown that effective industrial policies are essential for economic transformation. However, often these efforts have failed to achieve the desired goals. This dissertation uses international trade data and methods from Economic Complexity — a framework that combines methods from machine learning and network science to explain, understand, and predict countries' economic development trajectories — to benchmark Mozambique's past Industrial Policies and Foreign-Direct Investment (FDI) driven development, but also to identify opportunities for smart diversification and inclusive growth. The results show that Mozambique's growth in GDP was not matched by an improvement in the country's export diversification and sophistication. Although the export volume increased significantly, it was concentrated on a few simple products (e.g., agricultural and extractive sectors) and in a reduced number of partner countries. Past Industrial Policies perform rather poorly, prioritizing related (e.g., agriculture and foodstuff) and high-income (e.g., natural resources) products while failing to enter on highly complex and sophisticated activities. Furthermore, historically FDI tended to target simple products in the mining and quarrying sectors. Moreover, we test four possible strategies: two focuses on development feasibility criteria, which mainly target products from the vegetable and foodstuff sectors, thus trapping the country in producing relatively simple products; and two strategies propose shifting to more sophisticated and inclusive industries such as manufacturing and machinery. The latter are challenging to implement but crucial for structural transformation. Although close to simple products, Mozambique has potential for diversification into complex and highly beneficial sectors since it already has achieved minimal comparative advantage and relatedness value. The study shows that economic complexity and network science methods provide a valuable framework to reveal structural constraints and opportunities for smart diversification and inclusive growth. Therefore, contributing to formulate and implement policies aiming to transform Mozambique's productive structure.

KEYWORDS

Industrial policies; Diversification opportunities; Economic complexity; Inclusive growth; Sustainable development; Mozambique.

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LIST OF ABBREVIATIONS AND ACRONYMS

ECI - Economic Complexity Index (Indicator)
FDI – Foreign Direct Investment
GDP - Gross Domestic Product
GDPpc - Gross Domestic Product Per Capita
HDI - Human Development Index
HS - Harmonized System of International Trade Classification
INE – Instituto Nacional de Estatística – Mozambique
IPS – Industrial Policy and Strategy
MIC - Ministério da Indústria e Comércio – Mozambique
OECD - Organization for Economic Co-operation and Development
PCI - Product Complexity Index (Indicator)
PGI - Product Gini Index (Indicator)
PRODY - Product Income Index (Indicator)
PS - Product Space
RCA - Revealed Comparative Advantage
SADC - Southern African Development Community
SITC - Standard International Trade Classification
SSA - Sub-Saharan Africa
UN - United Nations
UNCTAD – United Nations Statistic Division
UNDP - United Nations Development Program
XGINI – Export Gini Index

1. INTRODUCTION

A growing literature has shown that effective industrial policies are essential for economic transformation and diversification. Recently, there has been a revival of industrial policy discussions across Africa and beyond due to past failures and new opportunities (Behuria, 2022; M. Walter, 2021). Governments use industrial policy tools/plans to promote smart industrialization and diversification (W. Walter et al., 2020). However, in many cases, these efforts have failed to achieve the desired goals, especially in developing countries.

Economic diversification, away from excessive dependence on a single dominant sector or a few, typically natural-resource-based commodities, requires a change toward increased products/activities with increased complexity, which translates into the improved quality of national output (Felipe et al., 2012). Diversification is valuable because it reduces the risks and vulnerabilities associated with a narrow economic base and enhances a nation's ability to produce high-quality items that other countries may wish to buy (Gylfason, 2016). Mojekwu (2019) argues that a diversified economy helps to support multiple businesses, offering more excellent employment opportunities in growing sectors to compensate for the losses in declining sectors. Hence, some policymakers and regional economists refer to diversification as "employment insurance."

The economic complexity approach involves the use of machine learning and network techniques to predict and explain the economic trajectories of countries, cities and regions by applying dimensionality reduction techniques to data on the geography of activities, such as products export, employment by industry, or patents by technology (Hidalgo, 2021).

Research on economic complexity has shown that productive structures condition a country's opportunities for smart diversification, inclusive and sustainable growth (Hartmann et al., 2019, 2020; C. Hidalgo et al., 2007; Pinheiro et al., 2022; Romero & Gramkow, 2021). Countries that export a varied set of complex products — such as cars or medical equipment — tend to have a significantly lower level of income inequality and a higher level of GDP per capita than countries that depend on few resources exploiting products (such as soybeans, copper or crude petroleum) (Ferraz et al., 2021; Hartmann et al., 2017, 2021, 2022; Hausmann et al., 2014; Pinheiro et al., 2022).

Mozambique is an example of a developing country that has enjoyed a significant annual growth average during the last two decades — above the Sub-Saharan Africa region and world average — and has become one of the three most attractive economies for foreign direct investment (FDI) in sub-Saharan Africa. However, this growth was not followed by structural transformation and diversification of the economy (Castel-Branco, 2014; Langa, 2017; Mosca, 2021). Moreover, the country remains among the poorest and the most unequal in the world. It ranked 181st out of 189 countries and territories on the Human Development Index (HDI). Mozambique has about half its population living in absolute poverty (Cunguara & Hanlon, 2010).

The Mozambican government has, over the years, mapped a policy strategy to promote the diversification of the economy, but the implementation is far from being achieved. Although it is believed that Mozambique has the potential to accelerate economic growth and reduce inequality, it is far from achieving such promise under the current development policies. The recent Mozambique's natural resources boom with large-scale mining, oil, and gas investments increases the challenge of diversification to avoid Dutch disease.

In this dissertation, were applied methods from economic complexity and network science to approach the following questions:

- 1) What are the structural constraints and opportunities for economic diversification and inclusive growth in Mozambique?
- 2) Which are the most feasible and desirable activities to diversify Mozambique's economy to achieve the aimed development goals?

This dissertation intends to benchmark different development paths and identify their costs and benefits with these questions.

The dissertation is organized into four additional chapters. Section 2 presents the literature review, beginning with a general framework of Mozambique's industrial policy and strategy, then economic diversification and inclusive growth. Data and method descriptions are provided in section 3. Section 4 presents results and discussion. Section 5 draws the conclusion and remarks, and finally, in section 6, discusses limitations and recommendations.

2. LITERATURE REVIEW

2.1. MOZAMBIQUE'S INDUSTRIAL POLICY FRAMEWORK

The current stage of industrialization in Mozambique is strongly influenced by its history and the phases it has gone through. While Portuguese colonial (second half of the 19th century), the main tasks of the Mozambican economy were to be: (1) a source of raw material for Portuguese industries; (2) a supplier of cheap labour; (3) an export market for Portuguese manufactured goods; (4) a labour market for Portuguese unemployed. Thus, agricultural goods such as cotton, sisal, cashew nuts, and palm oil were promoted while imposing restrictions on the local production of manufactured goods that posed an immediate threat to Portuguese exports to Mozambique (Cruz et al., 2016).

Mozambique became independent in 1975 and, two years later, began a war of destabilization, which over time became a civil war that ended sixteen years later with the General Peace Agreement (GPA) (Pitcher, 2002). Since the GPA and the first democratic elections in 1994, Mozambique has experienced a peaceful transition towards democracy, underpinned by successive local and national elections (Buur et al., 2012).

The post-independence government adopted a central planning economy with nationalist and socialist policies. The first government failed and plunged the country into a deep economic crisis, which led in 1984 to join the Bretton Woods Institutions (IBW) to access external financial resources (Cruz et al., 2016). In 1987, a transition from a public-driven economy to a market-driven one followed an international trend with the collapse of the socialist bloc countries and the end of the Cold War era (Pitcher, 2002).

Since then, several strategies have been formulated and implemented to reverse the economic crisis. The current Mozambican industrial development pattern, a mix of private sector initiative and public sector licensing mechanisms, replaced the tradition's post-independence public sector-led industrialization of the central planning countries (Cruz et al., 2016).

In 1997, the government approved the first Industrial Policy and Strategy (IPS97) (MIC, 1997). Ten years later, it was updated to a more articulated and multi-sectoral industrial dynamic approach, the Industrial Policy and Strategy 2007 (IPS07), (MIC, 2007). The most recent policy (IPS16) update was guided by the possibility of exploiting natural resources—such as gas, coal, iron ore, limestone, heavy sands, graphite, copper, and precious and semi-precious stones —, among others, which are expected to be the basis for industrial development (MIC, 2016). The overall objective of the ongoing IPS16 is to make industry the primary vehicle for achieving the country's prosperity and welfare through generating the most jobs, production, and contribution to the enhancement of natural resources.

The IPS16 prioritized the following sectors: food and agro-industry; clothing, textiles, and footwear; non-metallic minerals; metallurgy and manufacture of metallic products; wood and furniture processing; chemicals, rubber and plastics; paper and printing. The IPSs followed an approach of industrialization in which the state was to orient, regulate, and supervise industrial development while building appropriate conditions for robust industrial activity. The intervention channel included the establishment of several different industrial policy instruments, ensuring the promotion of a proper business environment for producers and investors.

In addition to the IPS16, the government has several other instruments to guide the process of industrialization. These include the Government Five Year Programs (PQG); the National Development Strategy; Sub-sectoral Strategies (Textiles and Apparel); Natural Gas Master Plan, Industrial Activity Licensing Regulation; Strategy for the Improvement of the Business Environment (EMAN II); and the Small and Medium Enterprises Strategy.

A growing literature has shown that smart industrial policies are essential for economic transformation (Chang & Andreoni, 2020; Hartmann et al., 2021; Rodrik et al., 2004). Hence, governments are explicitly using their tools to promote industrialization. However, in many cases, these efforts have failed to achieve the desired goals (M. Walter, 2021). Research on economic complexity has shown that productive structures condition a country's diversification opportunities, a strong gravitation force crucial for industrial policies' efficacy (Adam et al., 2021; Hartmann et al., 2017; Hidalgo et al., 2007; Hidalgo & Hausmann, 2009).

2.2. ECONOMIC DIVERSIFICATION AND INCLUSIVE GROWTH

2.2.1. Economic growth, productive structures, and income inequality

One of the main goals of Mozambique industrial policy is to reduce the level of inequality. According to Hartmann et al. (2017), over the years, there have been several attempts to find factors that explain variations in income inequality. Kuznets (1955) suggested an inverted U-shaped relationship describing the connection between a country's average level of income and its level of income inequality. It implies that as an economy develops, market forces increase and then decrease income inequality. In the past, it has been proved that this relation was challenging to be verified; it failed to hold if several Latin American countries were removed from the sample (Deininger & Squire, 1998), and the upward side of Kuznets' curve vanished as inequality in many low-income countries has increased (Palma, 2011).

These findings support the idea that considering only GDP per capita as a measure of economic development is not enough to explain variations in income inequality (Kuznets, 1973; Stiglitz, 2009). To understand income inequality, we require additional factors. For instance, an economy's factor endowments (Sokoloff & Engerman, 1997), geography (Gustafsson & Johansson, 1999), institutions and social capital (Acemoglu et al., 2001), and returns to capital (Palma, 2014). The fact that this set of factors is reflected in a country's outputs (e.g., product export basket) has been exploited to develop indirect measures (Bahar et al., 2014; Hausmann & Hidalgo, 2013; Pinheiro et al., 2022).

Country's ability to both generate and distribute income are related to its productive structure (Hartmann et al., 2017). Hidalgo & Hausmann (2009) introduced a series of complexity indicators to capture the knowledge of a country by interpreting trade data as a bipartite network, in which countries are connected to the products they export (detail calculation in the methods section). The fundamental idea behind this indicator is that complex economies will produce and export a wide variety of goods (high diversity); including many that globally are exported by few countries because they are challenging to produce (non-ubiquity). In contrast, non-complex economies are expected to produce and export few products (low diversity) and, in general, made by many countries (high ubiquity), as their production is not very difficult to be extracted or produced. Furthermore, the

authors provided strong evidence suggesting that high economic complexity predicts high income per capita growth.

Figure 2.1A represents a key result from the economic complexity literature, showing a direct relationship between the ECI of countries and their economic level. The deviations from this relationship are predictive of future growth (Hausmann & Hidalgo, 2013). Thus, countries below the linear regression line tend to grow faster. Like most Southern African Development Community (SADC) countries, Mozambique has a low income per capita but is expected to grow faster considering its level of economic complexity and thus is expected to grow faster.

Hartmann et al. (2017) have shown that a country's mix of products not only predicts its potential economic growth but also explains reasonably well its level of income inequality. The authors show that economic complexity is a significant and negative predictor of income inequality. This relationship is robust in controlling for aggregate measures of income, institutions, export concentration and human capital (represented in Figure 2.1B). Furthermore, they argue that economic complexity captures information about an economy's level of development relevant to how it generates and distributes its income. Mozambique is a low complex country, although the inequality level is higher than expected.

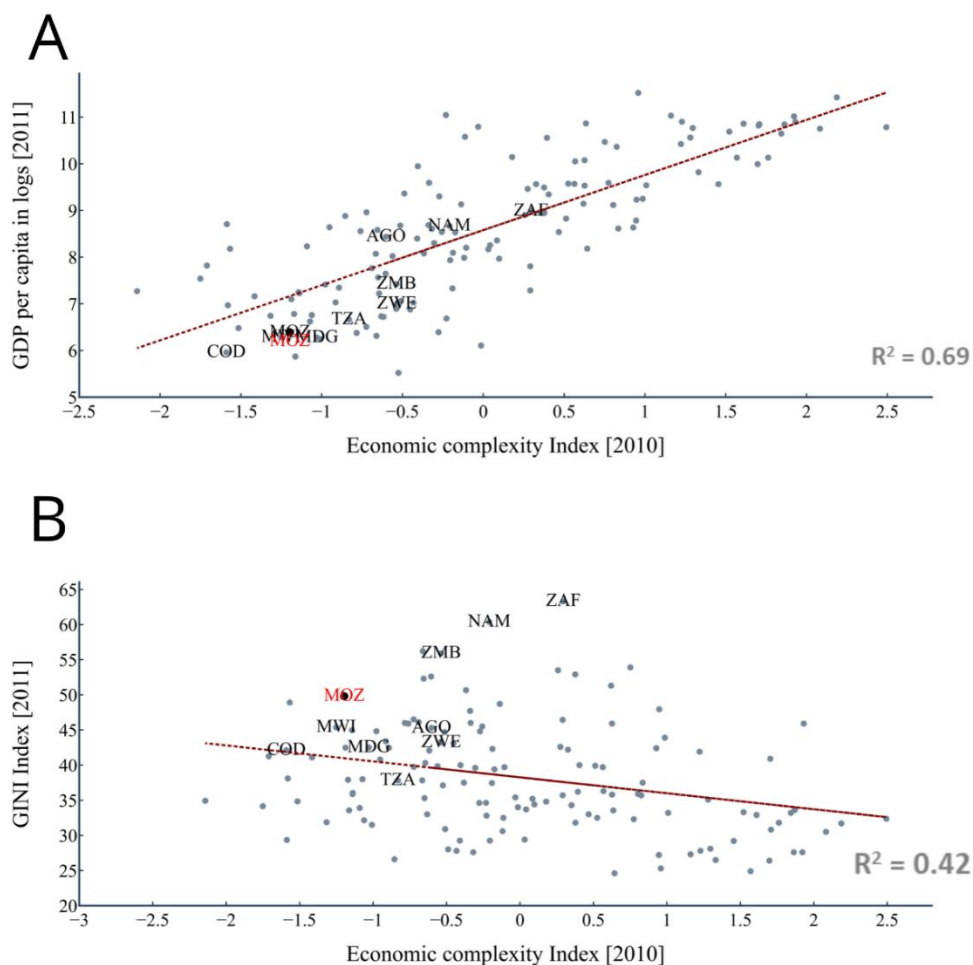


Figure 2.1 - Relationship between income per capita and (a) the economic complexity index (ECI), (b) income inequality (GINI) year 2011. Mozambique (red) and SADC countries (black) are highlighted.

Hidalgo (2015) stressed that less complex and resource-based countries (like Sub-Saharan Africa) produce a very limited number of simple products — such as crude petroleum, copper, soybeans, or cocoa beans — have a low ECI and Income per capita. Conversely, sophisticated products — medical, imaging devices or electronic components — are typically produced in diversified economies with inclusive institutions and high levels of human capital like Japan, Germany or Switzerland, with a high level of ECI and income per capita. Hence, it is not surprising to find that, in 2019, Mozambique was one of the least complex economies in the world, ranking 110 out of 136 countries. It was also the fifth least complex in the SADC region (see Table 2.1). Almost all the SADC countries have negative ECI except South Africa.

Table 2.1 - Mozambique ECI ranking and additional comparator variables, year 2019

| Country | ECI (rank) | ECI (value) | GDP per capita (U\$S) | Gini | Population (in millions) |
|--|------------|---------------|-----------------------|-----------|--------------------------|
| TOP 5 IN ECI | | | | | |
| Japan | 1 | 2,47 | 40 196 | 32,9 | 126,9 |
| Switzerland | 2 | 2,15 | 75 455 | 32,7 | 8,6 |
| Republic of Korea | 3 | 2,06 | 42 813 | 35,4 | 51,2 |
| Germany | 4 | 1,99 | 51 655 | 31,9 | 83,5 |
| Singapore | 5 | 1,91 | 65 641 | 45,9 | 5,8 |
| SADC (Southern African Development Community) Countries | | | | | |
| South Africa | 55 | 0,14 | 12 515 | 63 | 58,6 |
| Malawi | 86 | - 0,47 | 1 190 | 44,7 | 18,6 |
| Namibia | 91 | - 0,54 | 9 514 | 59,1 | 2,5 |
| Tanzania | 92 | - 0,56 | 2 480 | 40,5 | 56,4 |
| Zambia | 100 | - 0,76 | 3 151 | 57,1 | 17,9 |
| Mozambique | 110 | - 0,91 | 1 264 | 54 | 30,4 |
| Zimbabwe | 111 | - 0,94 | 2 915 | 44,3 | 14,6 |
| Angola | 118 | - 1,02 | 6 980 | 51,3 | 31,8 |
| D.R. Congo | 119 | - 1,03 | 1 043 | 42,1 | 86,8 |
| Madagascar | 124 | - 1,15 | 1 667 | 42,6 | 27,0 |
| BOTTOM 5 IN ECI | | | | | |
| Iraq | 132 | - 1,54 | 11 595 | 29,5 | 39,3 |
| Nigeria | 133 | - 1,57 | 5 007 | 35,1 | 201,0 |
| Guinea | 134 | - 1,69 | 2 568 | 33,7 | 12,8 |
| Burkina Faso | 135 | - 1,78 | 2 045 | 35,3 | 20,3 |
| Chad | 136 | - 2,66 | 1 566 | 43,3 | 15,9 |

2.2.2. Structural transformations and economic complexity

Economic development usually requires structural transformations, which implies growing the variety and sophistication of economic output (Felipe et al., 2012; Saviotti & Frenken, 2008). Several studies show that there is a need to consider multiples factors to ensure that a structural transformation takes place, for instance, institutional changes (Mokyr, 1992), modern management structures (Chandler, 1994; Rosenberg & Birdzell, 2008), modern research and development activities (Freeman & Soete, 1997), and adequate education (Claudia Goldin & Katz, 2009).

Mozambique has enjoyed consistent and high growth in the last two decades. However, it has seen no transformation of the country's productive structure and, therefore, no structural change either (Castel-Branco, 2014; Langa, 2017; Mosca, 2021). Mosca (2021) argued that there was an accumulation pattern that is not based on the productive sector but specifically on the extractive sector, penalizing domestic consumption, oriented towards the exterior, with low labour productivity, with high population growth, acceleration of the rural-urban flow and an increase in external dependence¹.

The lack of structural transformation can be related to the diversification strategy applied. Figure 2.2 presents a Mozambique diversification path opportunity. Considering that Mozambique has a comparative advantage in agriculture products – such as cashew nuts – the industrial policies tend to promote most related products – such as palm oil – and the FDI tend to target high-income extractive product – such as mineral coal, while there are opportunities to diversify to a more complex and inclusive product – such as threshing machine – available with considerable RCA (0.08) as agriculture machine. These last sets of products could open up a path to a new linkage of sophisticated and productive sectors that transform the economy structurally.

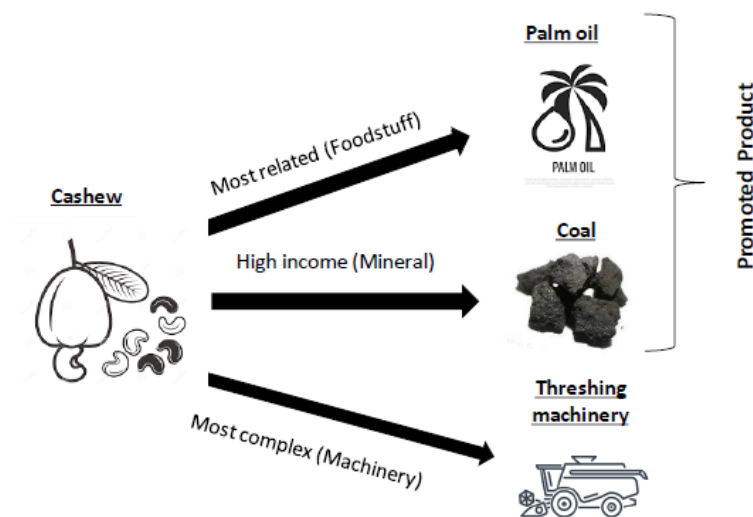


Figure 2.2 - Overview of the Mozambique's diversification path opportunities. Examples of product with RCA (cashew nuts) and products promoted by the industrial policy (palm oil & coal) and the most complex available opportunities (machinery).

Research on economic diversification and complexity has shown that productive structures condition a country's opportunities for smart, inclusive, and sustainable growth. According to Hartmann et al. (2019), one crucial step for structural transformation is to identify the constraints and opportunities for economic diversification and sustainable growth of each country. As Hidalgo et al. (2007) presented, the complexity research methods constitute a robust framework to reveal region-specific constraints and identify development opportunities.

Hidalgo et al. (2007) introduced network analysis measures to estimate the relatedness/proximity. The Product Space is a network that connects products according to their proximity in terms of the

¹ Descriptive data and qualitative analysis of Mozambique's economic structure evolution between 2000 and 2020 from production and expenditures, individualizing the external sector, and employment can be found in Mosca (2021).

necessary capabilities to export both (calculation detail in the methods section). For example, economies that are good at exporting shirts can easily learn to produce trousers but would find it more challenging to export cars. That is because the prerequisites for producing shirts and trousers are very similar regarding the necessary raw materials, machinery, skills and institutions. Hence, the Product Space offers a map to understand the path-dependence of economic diversification and transformation. In particular, the Product Space suggests that economies are more likely to develop new products that are related (close in the Product Space) to those they already export or have in their basket.

Figure 2.3 depicts the Product Space for 2019 using the HS96 4 digits product classification. The size of each node (product) is proportional to the volume of world trade and the color represents the group to which the product belongs. Mineral products such as Petrol, coal and gas tend to have a high-value share and are on the periphery. In contrast, sophisticated and knowledge-intensive products — such as machinery, transportation and chemicals — tend to be at the core of the Product Space.

The underlying methods used to estimate the Product Space and complexity indicators have also been used to study economic development at the regional level. Boschma et al. (2015) show that regions are more likely to develop toward related activities. The principle of relatedness (Hidalgo et al., 2018) has been expanded to other areas like technologies (Rigby, 2015) and research areas (Alshamsi et al., 2018; Guevara et al., 2016).

International partners can partially fulfil the supply of specialized inputs and innovative consumers, yet, the existence of related industries in a particular region or country is also an essential element in building up the technological and productive capabilities needed to become competitive in complex industries (Hidalgo et al., 2018). This implies that each country or region faces unique development constraints and opportunities determined by its current productive structure (Hartmann et al., 2019). Lin (2012) used the complexity approach to map and quantify the path dependencies that govern the structural transformation of economies.

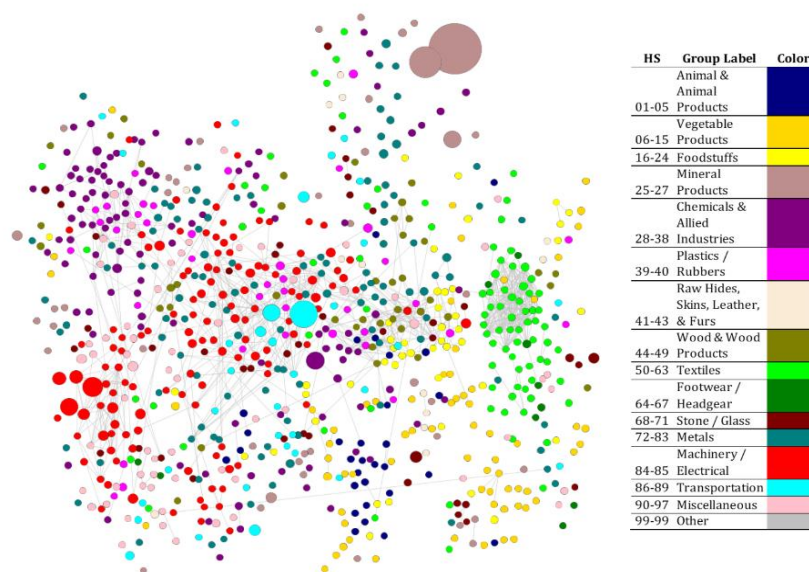


Figure 2.3 - Global Product Space 2019, a denser area is more likely to emerge new product. Each node is a product (HS 4 digit), the size of the node is proportional to the volume of trade in relation to the world total, and the color represents the group. Source: proper visualization.

3. METHODOLOGY

3.1. DATA SOURCE AND CLEANING

We use data on international trade sourced from the Growth Lab at Harvard University (<https://dataverse.harvard.edu/dataset>). The dataset covers the trade between 242 countries between 2001 and 2019 on 1260 traded products classified according to the Harmonized System (HS) at the 4-digit level. The choice of HS over other alternatives (e.g., SITC) was made as it provides a more comprehensive and detailed list of products for the analysis period.

Several steps have been taken in order to pre-process the data and reach a working dataset. Export values have been smoothed using a three-year moving average. Moreover, and in line with Pinheiro et al. (2018), was further reduced noise coming from underreporting and variation in the size of the economies of countries and products by excluding countries with a population of fewer than 2 million citizens and GDP of less than 1.5 million USD in the year of 2008. Finally, the exclusion of observations after 2019 was done to avoid the effects caused by the COVID-19 pandemic, which is expected to dominate the world economy in the short term; however, it is still unclear how they can be controlled. The final dataset contains information about the trade activities of 136 countries on 1242 products. It represented 99.27% of global GDP and 77.84% of global trade in 2008.

Additional data was collected from several secondary sources. The country's GDP and population size were sourced from Penn World Tables V10.0 (Feenstra et al., 2015) and the Gini inequality index from the World Development Indicator database (<https://databank.worldbank.org/>). Moreover, we obtained Mozambique specific data on trade activity, GDP, and population from the National Institute of Statistics of Mozambique (INE) and FDI from the Bank of Mozambique (BM). Official documents on industrial policy and strategy (IPS97, IPS07, and IPS16) were used to identify the priority development sectors and link these to exports. In that sense, conversion tables sourced from the United Nations (<https://unstats.un.org/unsd/classifications/Econ>) were used to convert first from ISCI rev4 to CPC rev2.1, then from CPC 2.1 and HS classification.

3.2. METHODS

3.2.1. Economic Complexity Indicators

The key measure of Economic Complexity is the ECI. To calculate the ECI, the first step is to identify products that a country is relatively "good" at producing (the products they export more than what we expect based on a country's total exports and a product's global market, because many large countries produce almost every good in some quantity). This can be obtained by filtering trade data through the Balassa (1965) definition of revealed comparative advantage (RCA), formally defined:

$$RCA_{cp} = \left(\frac{X_{cp}}{\sum_c X_{cp}} \right) / \left(\frac{\sum_p X_{cp}}{\sum_{c,p} X_{cp}} \right) \quad (1)$$

where x denotes the export quantum, while subscripts c and p denote country and product, respectively. Then the country's diversity and product ubiquity are defined as:

$$Diversity = k_{c0} = \sum_p M_{cp} \quad (2)$$

$$Ubiquity = k_{p0} = \sum_c M_{cp} \quad (3)$$

Where M_{cp} is a discrete matrix equal to 1 if country c has RCA in product p and 0 otherwise.

The Economic Complexity Index (ECI) and Product Complexity Index (PCI) are defined by assuming that the complexity of an economy is the average complexity of the products it exports, and the complexity of a product is the average complexity of the countries exporting it. This circular argument gives rise to the following iterative mapping:

$$ECI_c = \frac{1}{k_c} \sum_p M_{cp} PCI_p \quad (4)$$

$$PCI_c = \frac{1}{k_p} \sum_c M_{cp} ECI_p \quad (5)$$

Putting (5) into (4) provides an eigenvalue equation whose solution is a country's economic complexity index.

$$ECI_c = \frac{1}{k_c} \sum_p \frac{M_{cp}}{k_p k_c} \sum_{c'} M_{c'p} ECI_{c'} \quad (6)$$

The solution for the PCI can be obtained by using equation (6) on (5).

Hausmann et al. (2007) built a measure of "sophistication" or "productivity content" for the traded goods by linking products and income countries. The authors called this measure the PRODY index, which is calculated as the weighted average income per capita of the countries exporting a product with an RCA. Formally, for each product, p is defined as:

$$PRODY_p = \frac{1}{N_p} \sum_c M_{cp} s_{cp} GDP_c \quad (7)$$

where, GDP_c is the real per capita GDP in country c , s_{cp} denotes the share of country c 's exports represent ($s_{cp} = X_{cp} / \sum_{p'} X_{cp'}$), and N_p is a normalising factor that ensures $PRODY_p$ is the weighted average of the Gini ($N_p = \sum_c M_{cp} s_{cp}$). Therefore, the high value of PRODY indicates that the products

are typically traded by countries with high income and with RCA for this product. To have a baseline comparison at the country level, the authors created an index called EXPY as the average sophistication (PRODY) level of a country's export basket of goods.

Using the same approach, Hartmann et al. (2017) reveal the relationship between a country's mix of products and its structural constraints on inequality reduction. The authors created a product-level estimator of the income inequality that is expected for the countries exporting a given product called the Product Gini Index (PGI), formally:

$$PGI_p = \frac{1}{N_p} \sum_c M_{cp} s_{cp} Gini_c \quad (8)$$

where $Gini_c$ is the Gini coefficient of country c , likewise, to have a baseline comparison at the country level, XGINI (Export Gini Index) is calculated as the simple average of PGI.

3.2.2. Relatedness and Product Space

Economic structural change is highly path-dependent. Each country's productive structure influences its growth and development possibilities. We use methods from research on the product space (Hidalgo et al., 2007) to analyze the evolution of countries' productive structural constraint, and diversification opportunities. The product space is a network connecting products according to the conditional probability of co-exporting (see Figure 2.3). According to Hidalgo et al. (2007), each product requires a specific set of capabilities that may be similar or different to the capabilities needed in the production process of other products. The connection/relatedness between the pair of products p and p' can be formally represented as:

$$\varphi_{pp'} = \frac{\sum_c M_{cp} M_{cp'}}{\max(k_p k_{p'})} \quad (9)$$

The distance between products in the product space reveals that the closer a product is to another, the more likely both products require similar capabilities. Thus, it can be analyzed how the productive experience with one product can be useful to produce other products. To that end, is estimated the relatedness between the products that a country exports and each of the products it does not export commonly referred to as the density, ω_{cp} of product p in country c and is computed as:

$$\omega_{cp} = \frac{\sum_{p'} M_{cp'} \varphi_{pp'}}{\sum_{p'} \varphi_{pp'}} \quad (10)$$

Moreover, the distance of Mozambique's export portfolio to complex products between 2001 and 2019 was analyzed by measuring the Pearson correlation between density (ω_{cp}) and the Product Complexity Index (PCI).

To assess how of each strategy and current industrial policy would change the productive structure, income (EXPY), complexity (ECI), and inequality (XGINI) level, was introduced the proposed product in the actual product basket (assuming Mozambique can achieve the RCA) and then plot the product space and calculate the simple average of the PRODY, PGI and PCI. Hartmann et al. (2019) state that the simple average of PRODY, PGI, and PCI is strongly correlated with EXPY, XGINI, and ECI, respectively, so their analysis has the same qualitative value.

4. RESULTS AND DISCUSSION

4.1. MOZAMBICAN ECONOMIC FRAMEWORK AND STRUCTURAL TRANSFORMATION, 2001-2019

In the last 20 years, Mozambique has registered a high annual real GDP growth rate - 6.8% on average. In this period, the annual growth rate has been above the Sub-Saharan Africa region and world average. The primary sector has dominated the economy. The agriculture, forestry and fisheries sectors continue to be the most important productive Sector over the year, with about a quarter of the GDP.

The trade flow of goods (type of goods and volume of exports/imports) are important indicators for understanding the country's situation in terms of production, capacity, and international trade, which can help to take measures capable of correcting the country's less favorable position in global economy (Saviotti & Frenken, 2008). Foreign trade has played an increasingly important role in facilitating economic growth. The share of foreign trade (Imports + Exports) in GDP has been growing rapidly compared to regional and world averages (Figure 4.1).

The other driver of this growth was the Foreign Direct Investment (FDI) primarily due to the investment in mega projects for natural resource exploitation (see Figure 4.1 and annexed Figure A1). Mosca (2021) stated that this scenario is expected to continue with the extractive sector's potential in the coming years.

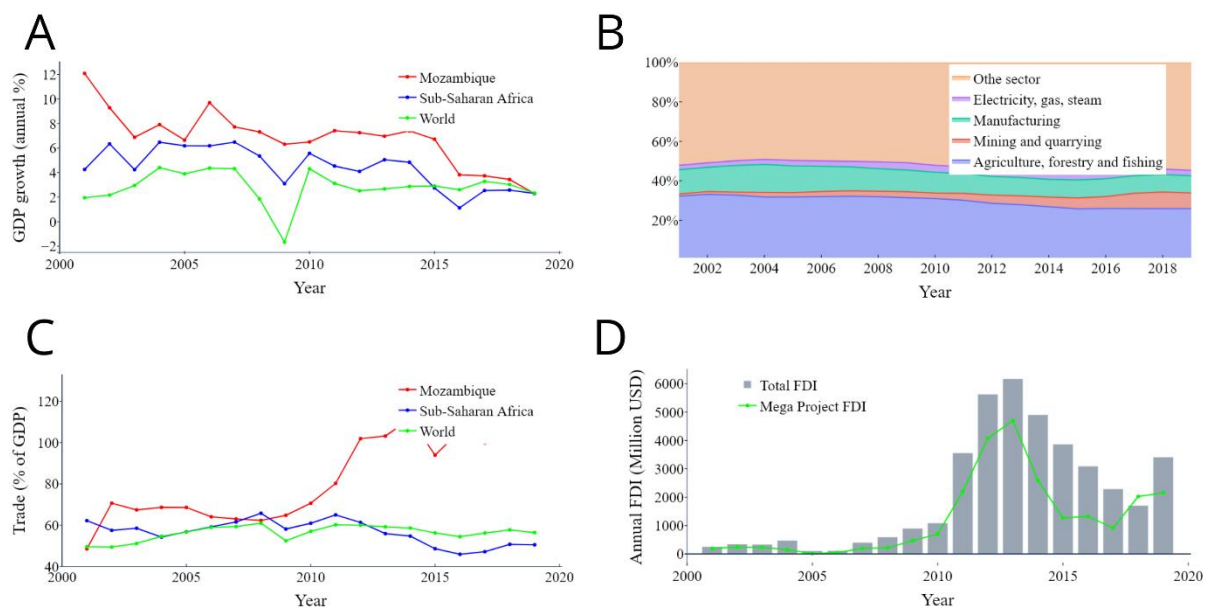


Figure 4.1- Evolution of Mozambique economic global indicators, (a) GDP growth, (b) GDP by productive sector, (c) trade openness, and (d) FDI, year 2001 to 2019.

The nature of the products exported by Mozambique has significantly changed volumes and types of products over the years. The value has more than tripled, going from US\$ 703 million to US\$ 3588 million. Traditionally, the export portfolio comprised crustaceans- shrimp, lobster, and crab - and cash crops - nut and cashew nuts, cotton, tobacco, and sugar - representing around 80% of total export

values until 2000. The significant increase in foreign investment impacted the export portfolio from 2001 onwards. In 2001 the export of aluminium (HS code=7601, PCI = -1.046) accounted for more than half of the total value of exports (about 54% of total), worsening the country's diversification. With the production and export of natural gas, heavy sands, and mineral coal, aluminium decreases the country share, which in 2019 was already 21% of total export. Therefore, these four products currently represent almost two-thirds (60%) of exports, while the traditional sector (agricultural and fishing) are decreasing the country share - currently below 10% despite the export of new cultures like a banana (see Figure 4.2).

Associate the partner countries diversification to the products diversification is desirable. Gylfreson (2016) stressed that selling the same product to several customers spreads risk similarly to selling several other products to the same customer. Figure 4.2 shows the top 10 central trade partner countries according to the export/ value for the years 2001 and 2019. Over the years, Mozambique has been trading products with a few countries, and only ten partner countries receive more than 75% of the total export. South Africa is the leading partner, as it shares borders.² Moreover, it is the second economy in Africa (25% of continental GDP in 2019) and the main one in the region (80% of GDP). During this period, there was a shift in the set of main trading partners from Europe to Asia. For example, countries like China and India began to take the top position; replacing countries like Portugal and Spain (see Figure 4.2).

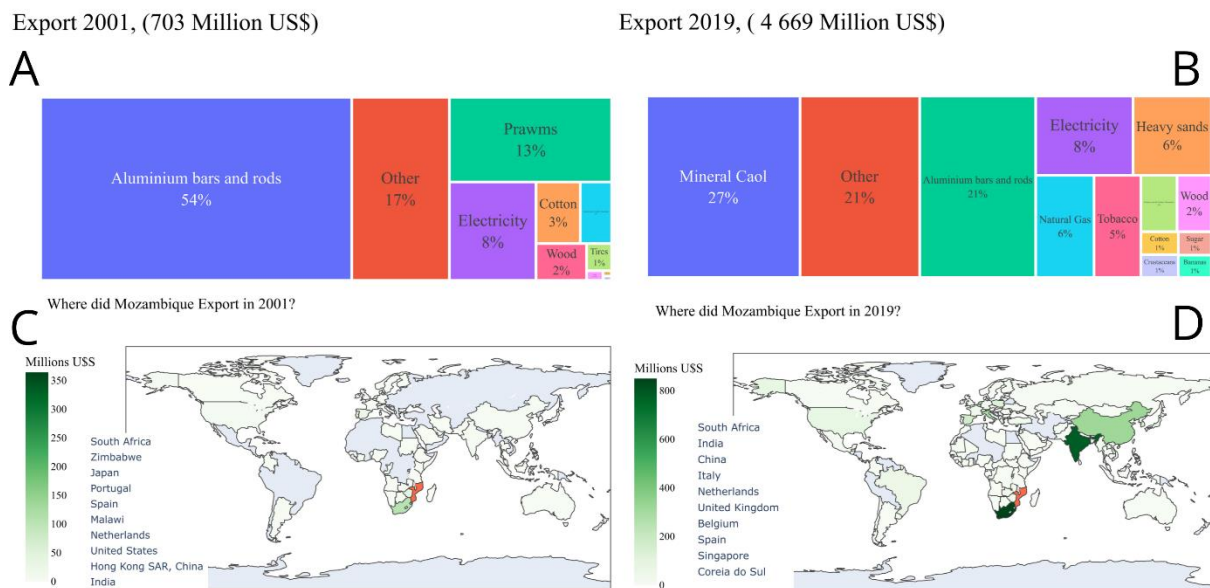


Figure 4. 4.2 - Mozambique external trade, (a) main product exported, and (b) main countries of destiny, 2001 and 2019.

² As supported by the gravity model theory (Baier & Standaert, 2020)

4.2. THE EVOLUTION OF COUNTRY COMPLEXITY INDICATORS

The economic complexity measures and product space further point to the lack of Mozambique's structural transformation. Therefore, the GDP growth is not aligned with the trends of the economic complexity indicators. The country remains one of the least diverse in the world. In 2019 Mozambique exported 702 out of 1242 HS products (56%) with only 127 products in relative advantage in global trade (10%) and is not showing a consistent increase. In the first decade, there was a slight improvement from 78 products with RCA in 2001 to 152 in 2009 (see Figure 4.3). Likewise, the economic complexity index is not showing clear progress. Mozambique remained in the group of the least complex among the 136 countries and was ranked from 95 to 110 during the two decades, presenting an oscillatory behavior. Therefore, similar behavior is observed in other country-level complexity measures; countries exporting similar products have a low-income average (EXPY) and high inequality average (XGINI) (Figures B2 annex).

The traditional products - fishery and cash crops - and the new portfolio products - mineral and extractive - are low-complexity products located at the edge of the product space. The most highlighted products that achieved RCA in this period were aluminium (HS92 code 7601) and mineral coal (HS92: 2701), with a high share of global trade (colored in rosy brown). However, both from the primary sector are in the product space's periphery. There are a small number of textile (green) and wood (olive) products in a relatively well-connected zone of the network (see Figure 4.3).

While countries may suffer from regional constraints related to developing their productive structure, they can also learn positive lessons from their neighbors. The SADC countries' economic complexity measures are generally similar to Mozambique. South Africa is the most diverse and complex economy in the regions (unique with $ECI > 0$ in 2019), significantly distant from the other (see Table 2.1)

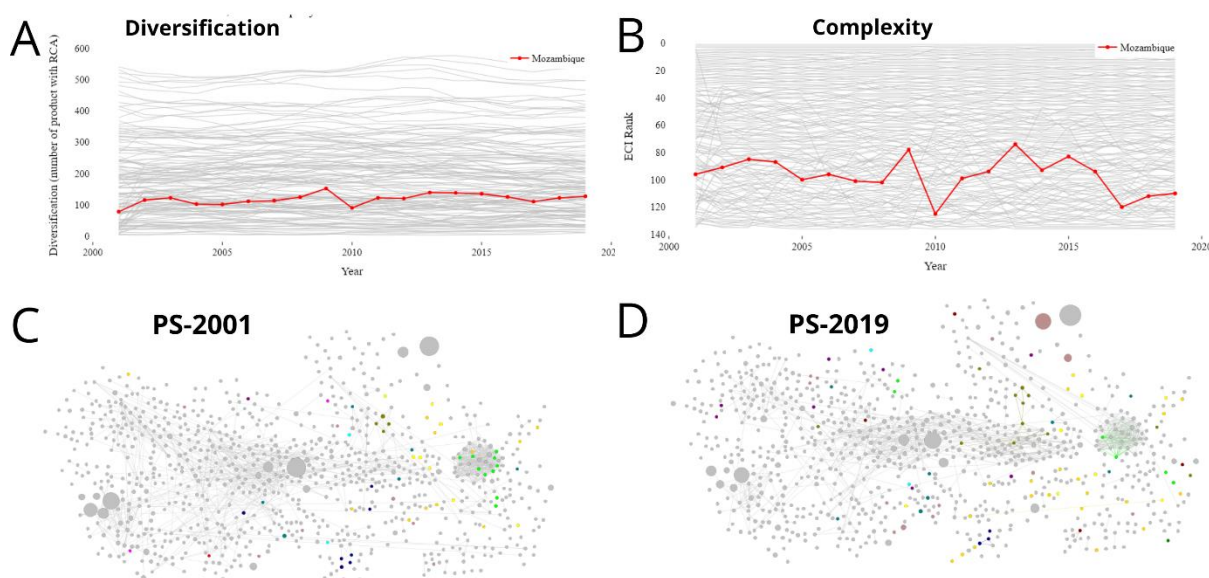


Figure 4. 4.3 - Evolution of (a) diversification rank and (b) economic complexity rank from 2001 to 2019; product space for (c) 2001 and (d) 2019.

To assess how the Mozambican industrial strategy performs relative to the economic complexity approach, the average complexity (PCI), income (PRODY), and inequality (PGI) indicators were calculated for each HS group and FDI sector. The results show that the industrial strategy performs poorly concerning the economic complexity indicators (see Figure 4.3).

The current industrial policy (IPS16) prioritized the following sectors: food and agro-industry; clothing, textiles, and footwear; non-metallic minerals; metallurgy and manufacture of metallic products; wood and furniture processing; chemicals, rubber, and plastics; paper and printing.

Foodstuffs is one of the most related sectors in the actual productive structure. However, has negative complexity (PCI), low income (PRODY), and is associated with relatively high inequality. The *Agro-Industry sector* (vegetable and animal products group) is the most related to the current productive basket. However, it is the least sophisticated and least profitable while the one with the highest level of inequality is associated. The government strongly supports the clothing, textiles, and footwear sector (textile group) with the approval of the textile and apparel strategy³. Moreover, the country already has some know-how in this sector. It is relatively better than the first two in terms of complexity and equality, although it is low-income. *Mineral products*, abundant natural resources, and energy potential, with the discovery of significant⁴ amounts of mineral coal, natural gas, and other minerals make this sector very promising. In general, this sector has high-income products (PRODY); however, these products are not sophisticated (PCI) and are usually produced in a country with a high inequality level (PGI).

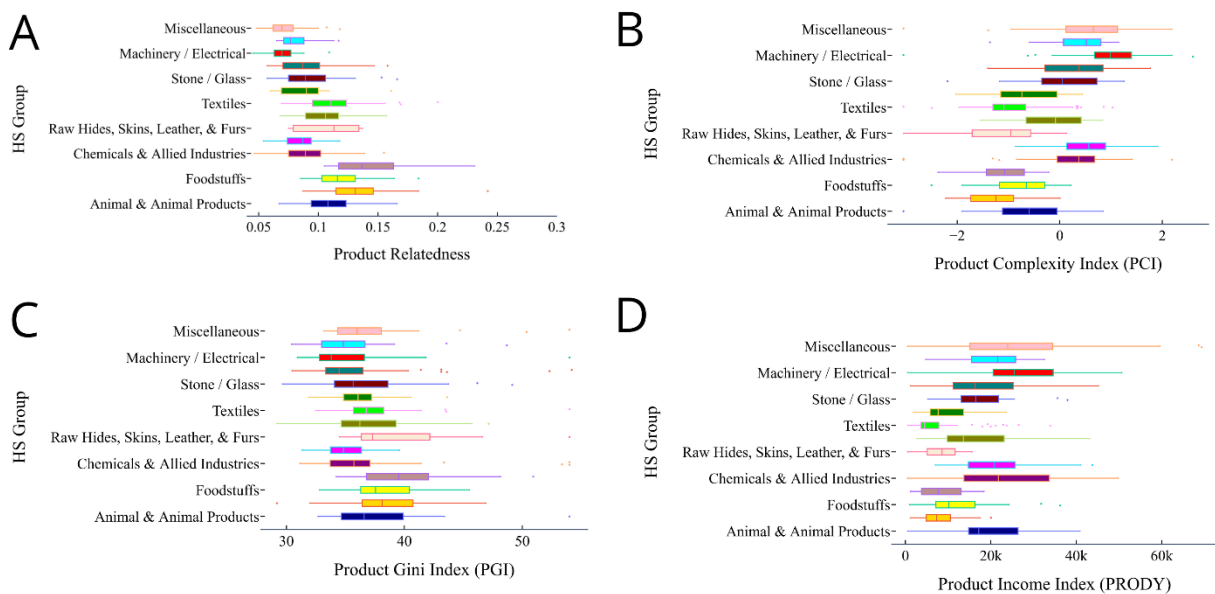


Figure 4.4 - Economic complexity indicators (average relatedness, PCI, PGI and PRODY) by HS group, 2019

³ Approved in 2008, the textile and garment strategy foresees high fiscal incentives for investors, namely a 10-year corporate tax exemption and the option of a further 50% reduction in corporate tax for the following five years.

⁴ Reserves are estimated at more than 20 billion tons of natural gas, with an estimated 277 trillion cubic feet, associated with abundant water resources whose potential is 18,000 MW (Natural Gas Master Plan 2014)

The industrial policy considers the attraction of FDI as an essential way to accelerate the implementation of the strategy for industrialization (MIC, 2016). The mining and quarrying sectors which contribute an average of 4.6% to GDP, have received a large part (69.2%) of the FDI. Therefore, these sectors are highly related to the actual export basket (relatedness) of the country. They are least sophisticated as they have a low PCI average and are generally associated with high levels of inequality (PGI) and are typically exported to low-income countries (PRODY), (Figure B3 annex).

4.3. SMART DIVERSIFICATION STRATEGY

4.3.1. Diversification Opportunities

The feasible and desirable opportunities for smart diversification and inclusive economic growth were identified using the economic complexity indicators. The method consists of defining criteria to select which products a country is not specialized in ($RCA < 1$) based on the complexity measure threshold - which ensures the improvement of the country indicator. The feasible criteria are based on the theory of relatedness approach by Hidalgo et al. (2007), previously explained and detailed in appendix, where it was shown that the probability that a country will develop RCA in a product tends to increase for a high-related product. The two feasible criteria are: the most related products ($density > 0.11$) and the existence of nascent or intermediate RCAs ($RCA > 0.5$).

The feasible criteria align with the IPS sector's prioritization, so they are chosen on the premise that these products are likely to be achieved. Therefore, desirable products to achieve can be further discriminated based on different socio-economic goals. Thus, in line with the approach introduced by Hartmann et al. (2019) for the desirability criteria we use the following assumptions and thresholds: trade value ($export > 1$ million USD), to include products with a significant direct impact on the income creation of the country; expected income ($PRODY = 25000$ USD), double the current GDPpc value, to fulfil the Lin and Monga (2011) proposition of entering products that are typically produced in countries with a GDP level that is 100% higher; product's complexity ($PCI > 0.0$), according to Hausmann & Hidalgo (2008) country must focus on more complex and knowledge-intensive product; assess if the product is primary or agro-based goods or a more technology-intensive product, in line with Lall (2000); and Product inequality ($PGI < 35$), to consider products typically produced by countries that with a lower level of income inequality.

The criteria were combined to develop and simulate four different diversification strategies/scenarios and assess their impact. It is important to note that the products selected based on these criteria are indicative, and the threshold can be tuned according to each country's socio-economic objectives and reality. However, establishing limits based on the feasibility and desirability principle is useful to significantly reduce the number of products and sectors in industrial policy design. It allows estimating the effect of each product/sector previously. The summary criteria and threshold for identifying products in each strategy are summarized in table 4.1.

Table 4.1 - Summary of criteria and threshold for the identification of products in each strategy

| Dimension/criteria | Strategy | | | |
|-----------------------------|----------|-------|--------|--------|
| | I | II | III | IV |
| Density | >0,11 | >0,11 | >0,05 | >0,05 |
| RCA | - | >0,5 | >0,05 | >0,05 |
| Export Value (Thousand USD) | - | - | - | >100 |
| PCI | - | - | - | >0 |
| PRODY | - | - | >25000 | >25000 |
| PGI | - | - | - | <35 |
| Primary or agro-based goods | - | - | - | No |

Strategy I - Focus on the most related product.

The first strategy focuses only on feasibility criteria and consists of identifying the top 20 most related products. The threshold was density higher than 0.11 – a total of 114 products satisfied this assumption. The set of selected products mainly belongs to the group of vegetables. However, the group of stone/lasse, textile, mineral, wood and plastic is represented (Table 4.2). Despite being the most feasible, this option may not reduce social inequalities due to the high level of PGI and not leverage the country for more sophisticated products due to low PCI. Moreover, the range of products proposed is located on the periphery of the product space (see Figure 2.3).

For countries like Mozambique that intends to catch up, this is not the best option, as these products will not have a significant impact on income and could put the country in a development trap as these products make it challenging to develop sophisticated and inclusive industries. Thus, the country could remain trapped in producing relatively simple products. Therefore, a strategy focused only on relatedness could not be the best approach; other criteria are needed.

Table 4. 2 - The top 20 most feasible options for Mozambique in terms of relatedness. Background color represents the product group

| HS | HS label | Density | RCA | PCI | PGI | Prody | export (USD) |
|------|---|---------|------|-------|------|-------|--------------|
| 7108 | Gold (including gold plated with platinum) unwrought | 0,17 | 0,01 | -2,19 | 38,6 | 5 769 | 980 914 |
| 1511 | Palm oil and its fractions; whether or not refined | 0,15 | 0,11 | -1,97 | 40,1 | 3 755 | 874 829 |
| 1211 | Plants and parts of plants (including seeds and fruits) | 0,15 | 0,23 | -1,85 | 36,8 | 4 989 | 185 703 |
| 0708 | Leguminous vegetables; shelled or unshelled, fresh | 0,15 | 0,01 | -1,90 | 42,6 | 3 038 | 4 596 |
| 1101 | Wheat or meslin flour | 0,15 | 0,62 | -1,32 | 37,4 | 5 690 | 757 410 |
| 1006 | Rice | 0,14 | 0,09 | -1,79 | 36,4 | 4 509 | 567 481 |
| 6305 | Sacks and bags, of a kind used for the packing of | 0,14 | 0,19 | -1,79 | 36,8 | 2 359 | 259 777 |
| 2523 | Portland cement, aluminous cement (ciment fondu), | 0,14 | 0,63 | -1,43 | 38,5 | 5 071 | 1 899 995 |
| 0303 | Fish; frozen, excluding fish fillets and other fish | 0,14 | 0,48 | -1,60 | 38,4 | 7 089 | 2 745 019 |
| 1212 | Locust beans, seaweeds and other algae, sugar beet | 0,14 | 0,23 | -1,71 | 36,9 | 3 734 | 62 969 |
| 4402 | Wood charcoal (including shell or nut charcoal), wood | 0,14 | 0,02 | -1,31 | 41,8 | 4 939 | 7 653 |
| 4103 | Raw hides and skins n.e.c.in headings no. 4101, 41 | 0,14 | 0,63 | -1,81 | 46,6 | 3 285 | 74 370 |
| 0902 | Tea | 0,14 | 0,82 | -1,93 | 40,9 | 1 715 | 1 599 701 |
| 0901 | Coffee, whether or not roasted or decaffeinated; whole | 0,14 | 0,00 | -1,52 | 41,5 | 2 888 | 27 347 |
| 3401 | Soap; organic surface-active preparations used as | 0,14 | 0,00 | -1,18 | 41,4 | 5 682 | 4 606 |
| 0910 | Ginger, saffron, turmeric (curcuma), thyme, bay leaf | 0,14 | 0,02 | -1,62 | 36,5 | 4 205 | 12 458 |
| 1516 | Animal or vegetable fats and oils and their fractions | 0,13 | 0,35 | -1,32 | 41,0 | 7 075 | 314 871 |
| 1102 | Cereal flours; other than of wheat or meslin | 0,13 | 0,87 | -1,41 | 42,0 | 3 844 | 213 085 |
| 2008 | Fruit, nuts and other edible parts of plants; prepared | 0,13 | 0,00 | -1,16 | 40,8 | 8 537 | 19 236 |
| 0703 | Onions, shallots, garlic, leeks and other alliaceous | 0,13 | 0,00 | -1,87 | 35,6 | 5 430 | 7 287 |

Strategy II – Focus on upgrading intermediate capabilities.

The second strategy focuses on the product Mozambique already enjoys intermediate comparative advantages ($0.5 < RCA < 1$) in addition to previous criteria. The country can produce and sell this set of products, thus can decide to promote further to achieve international competitiveness and reputation in these industries. Unlike the first strategies in this option, the top 20 (among 41) include products with significant complexity from a group of metals (aluminium products) and textile and foodstuffs (see Table 4.3).

The set of opportunities also includes (although only one of each) products from the most complex groups, such as machinery and transport—a significant improvement over the previous strategy. However, there is a need to develop more desirable strategies that focus more on sophisticated products and are associated with high levels of productivity and low levels of inequality to ensure an effective structural transformation of the economy. Hence, the following strategies focus on these aspects.

Table 4.3 - Products in which Mozambique has intermediate levels of revealed comparative advantages. Background color represents the product group.

| HS | HS label | Density | RCA | PCI | PGI | Prody | export (USD) |
|------|---|---------|------|-------|------|--------|--------------|
| 4304 | Artificial fur and articles thereof | 0,08 | 0,99 | -0,38 | 37,3 | 11 457 | 25 458 |
| 4017 | Hard rubber (e.g. ebonite) in all forms, including | 0,10 | 0,98 | -0,39 | 36,2 | 11 558 | 70 583 |
| 0710 | Vegetables (uncooked or cooked by steaming or boil | 0,11 | 0,97 | -0,56 | 37,7 | 13 485 | 1 700 659 |
| 7611 | Aluminium; reservoirs, tanks, vats and the like fo | 0,07 | 0,91 | 0,74 | 33,7 | 30 313 | 51 694 |
| 1102 | Cereal flours; other than of wheat or meslin | 0,13 | 0,87 | -1,41 | 42,0 | 3 844 | 213 085 |
| 7616 | Aluminium; articles n.e.c. in chapter 76 | 0,08 | 0,86 | 0,73 | 32,3 | 21 171 | 3 865 339 |
| 5209 | Woven fabrics of cotton, containing 85% or more by | 0,10 | 0,86 | -1,30 | 34,4 | 3 840 | 1 513 248 |
| 1504 | Fats and oils and their fractions of fish or marine | 0,12 | 0,86 | -1,67 | 36,1 | 9 339 | 404 164 |
| 8604 | Railway or tramway maintenance or service vehicles | 0,07 | 0,85 | -0,11 | 34,9 | 19 582 | 241 807 |
| 8430 | Moving, grading, levelling, scraping, excavating, | 0,09 | 0,83 | -0,62 | 34,0 | 30 793 | 2 316 302 |
| 0902 | Tea | 0,14 | 0,82 | -1,93 | 40,9 | 1 715 | 1 599 701 |
| 0604 | Foliage, branches and other parts of plants, with | 0,11 | 0,80 | -1,14 | 41,6 | 14 701 | 266 840 |
| 0807 | Melons (including watermelons) and papaws (papayas | 0,13 | 0,79 | -1,49 | 44,6 | 6 279 | 814 179 |
| 0814 | Peel of citrus fruit or melons (including watermel | 0,13 | 0,79 | -1,53 | 39,7 | 4 079 | 21 740 |
| 7307 | Tube or pipe fittings (e.g. couplings, elbows, sle | 0,07 | 0,78 | 1,13 | 34,6 | 28 912 | 3 561 730 |
| 1904 | Prepared foods obtained by swelling or roasting | 0,11 | 0,78 | -0,36 | 38,0 | 14 754 | 1 266 235 |
| 1704 | Sugar confectionery (including white chocolate), | 0,12 | 0,78 | -0,69 | 37,5 | 11 981 | 2 290 080 |
| 2205 | Vermouth and other wine of fresh grapes, flavoured | 0,08 | 0,76 | -0,29 | 42,4 | 9 121 | 104 534 |
| 7411 | Copper tubes and pipes | 0,07 | 0,75 | 0,68 | 34,0 | 17 704 | 1 248 751 |
| 5506 | Synthetic staple fibres, carded, combed or other | 0,07 | 0,72 | 0,35 | 39,8 | 3 628 | 63 757 |

Strategy III - Focus on related and higher-income products.

The third option seeks a balance between the feasible and the desirable, establishing a minimum level of feasibility (RCA>0.05 and Density>0.05); from this group, select the products associated with the highest levels of income (Prody>25000). These criteria reduce the batch of products to only 36, of which the 20 best are mostly machinery linked to the textile and agricultural industries (Table 4.4 below). It is also important to note the presence of products derived from the fishing and forestry industry that were equally present in previous strategies and thus easier to diversify towards them.

In general, high-income product tends to be more complex and inclusive. However, some high-income products - such as oil and coal - are located in poorly connected areas of the product space, and thus make it even more challenging to move to denser and more complex parts of the product space, leading to a development trap. Therefore, there is a need to have a strategy that considers more complex and inclusive products in its criteria.

Table 4.4 - Best options based on Prody, RCA, and relatedness. Background color represents the product group.

| HS | HS label | Density | RCA | PCI | PGI | Prody | export (USD) |
|------|--|---------|------|-------|------|--------|--------------|
| 9101 | Wrist-watches, pocket-watches, stop-watches and ot | 0,06 | 0,05 | 0,96 | 37,3 | 69 315 | 186 599 |
| 9016 | Balances; of a sensitivity of 5cg or better, with | 0,06 | 0,08 | 1,53 | 33,8 | 59 624 | 9 885 |
| 8427 | Fork-lift and other works trucks; fitted with lift | 0,06 | 0,09 | 1,68 | 31,8 | 49 337 | 435 974 |
| 9024 | Machines and appliances for testing the hardness, | 0,05 | 0,10 | 1,69 | 33,2 | 45 280 | 63 026 |
| 4810 | Paper and paperboard, coated one or both sides wit | 0,07 | 0,49 | 0,84 | 29,7 | 43 093 | 3 418 882 |
| 2922 | Oxygen-function amino-compounds | 0,08 | 0,05 | 0,21 | 41,2 | 42 864 | 254 909 |
| 8515 | Electric (electrically heated gas) soldering, braz | 0,06 | 0,06 | 1,71 | 31,1 | 41 962 | 177 703 |
| 3813 | Preparations and charges for fire extinguishers; c | 0,07 | 0,65 | 0,99 | 33,7 | 39 003 | 45 246 |
| 8477 | Machinery; for working rubber or plastics or for t | 0,06 | 0,07 | 1,78 | 32,1 | 38 665 | 510 465 |
| 8420 | Machines; calendering or other rolling machines, f | 0,06 | 0,29 | 1,55 | 32,7 | 38 519 | 105 501 |
| 8412 | Engines and motors; n.e.c. (e.g. reaction engines, | 0,07 | 0,16 | 1,18 | 32,6 | 38 495 | 963 606 |
| 8434 | Milking machines and dairy machinery | 0,08 | 0,09 | 0,68 | 33,3 | 38 491 | 50 306 |
| 7004 | Glass; drawn glass and blown glass, in sheets, whe | 0,06 | 0,30 | 0,89 | 38,5 | 37 938 | 67 156 |
| 3811 | Anti-knock preparations, oxidation and gum inhibit | 0,07 | 0,09 | 0,74 | 36,4 | 36 935 | 271 228 |
| 3905 | Polymers of vinyl acetate or of other vinyl esters | 0,07 | 0,06 | 1,09 | 35,4 | 36 467 | 76 520 |
| 8444 | Textile machinery; for extruding, drawing, texturi | 0,05 | 0,33 | 1,60 | 33,8 | 36 273 | 89 452 |
| 8416 | Furnace burners for liquid fuel, for pulverised so | 0,07 | 0,32 | 1,02 | 32,7 | 36 102 | 213 511 |
| 8442 | Machinery, apparatus and equipment (excluding mach | 0,08 | 0,24 | 0,93 | 32,6 | 35 934 | 100 796 |
| 6805 | Abrasive powder or grain; natural or artificial, o | 0,07 | 0,19 | 1,13 | 33,9 | 35 619 | 221 885 |
| 0302 | Fish; fresh or chilled, excluding fish fillets and | 0,12 | 0,19 | -1,17 | 34,0 | 34 985 | 1 023 614 |

Strategy IV - Focus on higher-income, complex and inclusive products.

The fourth diversification strategy is more challenging since it aims to move for more complex and inclusive products switching from primary and resource-based manufacturers and combining the three criteria mentioned above. First, is identified products that achieve a minimum standard in all feasibility (Relatedness >0.05 and RCA >0.05). Then to guarantee an effective change in the productive structure, primary products or agro-based manufacturers are excluded, based on Lall's (2000) classification. For desirability criteria considered products with a certain minimum standard concerning complexity (PCI > 0), inequality (PGI < 35), income (Prody > 25000), and the export size of this product (export > 100 000 USD). The applications of this set of criteria result in 23 products, predominantly agricultural machinery, as seen in Table 4.4 above. The presence of the aluminium foundry industry creates possibilities for the country to diversify into products from the metallurgical industry. In this batch of products from this strategy, there are three of them.

Considering the country's current productive structure, this strategy will be challenging to implement; however, if successful could leverage the country to high levels of complexity, income, and inclusion. Thus, other aspects that may contribute to the success of this objective must be considered. Therefore, it should be noted that the country already has some competitiveness (average RCA=0.21) and proximity (average density=0.07) indicates the existing potential for diversification in these challenging and promising sectors.

Table 4.5 - Products with minimum standards in all categories and excluding primary and agro-based manufacturers. Background color represents the product group.

| HS | HS label | Density | RCA | PCI | PGI | Prody | export (USD) |
|------|--|-------------|-------------|-------------|-------------|---------------|----------------|
| 8477 | Machinery; for working rubber or plastics or | 0,06 | 0,07 | 1,78 | 32,1 | 38 665 | 510 465 |
| 8515 | Electric (electrically heated gas) soldering, | 0,06 | 0,06 | 1,71 | 31,1 | 41 962 | 177 703 |
| 8427 | Fork-lift and other works trucks; fitted with | 0,06 | 0,09 | 1,68 | 31,8 | 49 337 | 435 974 |
| 8420 | Machines; calendering or other rolling machin | 0,06 | 0,29 | 1,55 | 32,7 | 38 519 | 105 501 |
| 8484 | Gas knots and similar joints of metal sheeting | 0,07 | 0,15 | 1,51 | 33,6 | 33 723 | 156 042 |
| 8480 | Moulding boxes for metal foundry, moulding pa | 0,07 | 0,16 | 1,41 | 32,9 | 28 130 | 772 398 |
| 7223 | Stainless steel wire | 0,06 | 0,23 | 1,39 | 33,7 | 27 495 | 125 401 |
| 8547 | Insulating fittings; for electrical machines, | 0,06 | 0,11 | 1,35 | 31,0 | 25 508 | 173 877 |
| 8412 | Engines and motors; n.e.c. (e.g. reaction eng | 0,07 | 0,16 | 1,18 | 32,6 | 38 495 | 963 606 |
| 7307 | Tube or pipe fittings (e.g. couplings, elbows | 0,07 | 0,78 | 1,13 | 34,6 | 28 912 | 3 561 730 |
| 6805 | Abrasive powder or grain; natural or artifice | 0,07 | 0,19 | 1,13 | 33,9 | 35 619 | 221 885 |
| 8428 | Lifting, handling, loading or unloading machi | 0,07 | 0,07 | 1,11 | 31,3 | 33 317 | 592 089 |
| 8707 | Bodies; (including cabs) for the motor vehicle | 0,07 | 0,16 | 1,10 | 30,4 | 32 560 | 382 250 |
| 8431 | Machinery parts; used solely or principally w | 0,08 | 0,18 | 1,07 | 33,6 | 26 948 | 2 535 067 |
| 8701 | Tractors; (other than tractors of heading no | 0,07 | 0,07 | 1,04 | 34,3 | 28 995 | 1 035 221 |
| 8416 | Furnace burners for liquid fuel, for pulveris | 0,07 | 0,32 | 1,02 | 32,7 | 36 102 | 213 511 |
| 8442 | Machinery, apparatus and equipment (excluding | 0,08 | 0,24 | 0,93 | 32,6 | 35 934 | 100 796 |
| 7305 | Iron or steel (excluding cast iron); tubes an | 0,08 | 0,49 | 0,89 | 34,5 | 25 239 | 1 061 364 |
| 9020 | Breathing appliances and gas masks; excluding | 0,07 | 0,34 | 0,86 | 34,1 | 34 620 | 151 149 |
| 8545 | Carbon electrodes, carbon brushes, lamp carbo | 0,07 | 0,08 | 0,86 | 33,1 | 26 726 | 187 026 |
| 8433 | Harvesting and threshing machinery, straw and | 0,08 | 0,08 | 0,86 | 31,6 | 27 681 | 444 521 |
| 8432 | Agricultural, horticultural or forestry machi | 0,08 | 0,32 | 0,81 | 32,1 | 29 758 | 656 304 |
| 8426 | Derricks, cranes, including cable cranes, mob | 0,07 | 0,09 | 0,46 | 33,5 | 32 022 | 324 944 |
| | Average | 0,07 | 0,21 | 1,17 | 32,8 | 32 881 | 647 340 |

4.3.2. Implementation Impact

The implementation of strategy one that consists more of vegetables (colored in gold) and foodstuffs (colored in yellow) products would further push the productive structure into the periphery of the product space (Figure B 7.a annex). The impact of this strategy would worsen the actual situation, as it would decrease the complexity (PCI) and income (Prody) and not reduce the inequality (PGI) (Figure 4.4). The second strategy shows a slight improvement in the country's productive structure compared to the first. The product space highlighted some products from the textile and metal group located in a slightly more complex area (Figure B 7.b annex). The complexity indicators would also slight improvement compared to the current situation.

The third strategy is the best in terms of increasing the level of income, as it is the one that allows reaching the highest Prody. This strategy also improves the levels of complexity and inequality over the previous two. Push the product space to the central area with the entry of more connected products such as machinery (colored in red) and some chemical (in purple) products and allied industries (Figure B 7.c).

The fourth strategy significantly reduces inequality (PGI) and is the one that most increases complexity (PCI). Combining these behaviours with the positive effect on income is undoubtedly the best strategy in terms of desirability. The change in the production structure to more complex products can also be seen in the product space, where some products from the transport group are added (in blue) to the machinery and chemical groups of the previous strategy. These product groups are in zones with high concentration and connections (Figure B 7.d). This strategy also includes some products from the metallurgical industry. The successful implementation of the ongoing industrial policy (IPS16) would impact closer to strategy one.

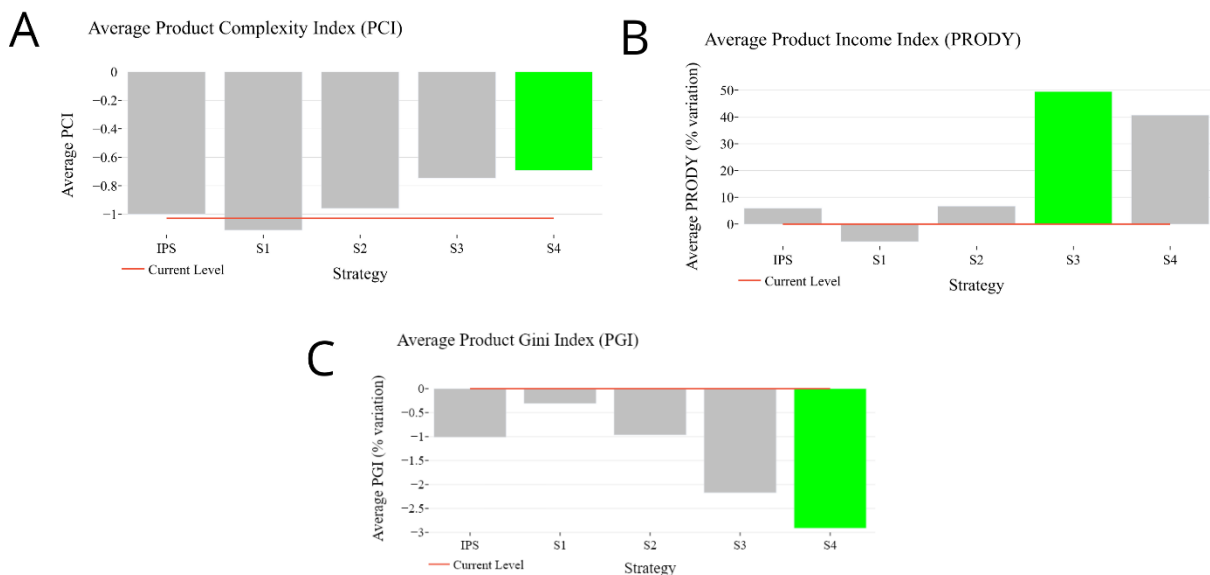


Figure 4.5 - How a successful implementation of the proposed S1-4 and the IPS would change Mozambique's (a) average PCI, (b) PRODY, and (c) PGI. The red line represents the current situation, and the green bar is the best option.

5. CONCLUSION

Economic Complexity combines machine learning and network science methods to unveil how productive structures condition a country's opportunities for economic diversification, inclusive and sustainable growth. Accelerate economic growth while ensuring structural transformation is one of the defining challenges of our time, particularly in developing and natural resource-rich countries.

Hence, in this dissertation, we benchmarked Mozambique's industrial policies and identified opportunities for smart diversification and inclusive growth. We did it using Economic Complexity as a framework. The result shows that Mozambique's growth in GDP was not matched by a healthy gain in export diversification and sophistication. Although the export volume increased significantly, such growth was concentrated in a few products and partner countries.

We compare multiple diversification strategies or scenarios. The industrial policy and strategy perform poorly regarding the product space and the country's complexity. The export basket is based on agricultural and extractive products and thus is on the periphery of the product space. Overall, there was almost no change in the country's export structure. Past and present industrial policies have prioritized related — agriculture and foodstuff — and high-income — natural resources — products but failed to expand the focus towards highly complex and sophisticated activities. Furthermore, FDI shifted from manufacturing to targeting simple products in the mining and quarrying sectors. These two aspects — FDI and a narrow industrial policy — contributed to Mozambique entering into a development trap that favors the continuous specialization in simple products with little potential for fostering a knowledge-based economy.

Complementary, we explored four strategies for smart and inclusive growth. Two focus on feasibility criteria — relatedness and intermediate comparative advantages — selecting mainly products from the vegetable and foodstuff sector. Thus, they align with most of the prioritization criteria in the current industrial policy. However, the country could remain trapped in producing relatively simple products. Two other strategies included desirability criteria and proposed a shift to more sophisticated and inclusive industries — such as manufacturing and machinery — therefore, they present a greater challenge to implement but also offer higher rewards. Namely, successfully implementing these two strategies would bring about the necessary structural transformation contributing to industrial convergence and inclusive growth.

Although close to simple products, Mozambique has the potential to diversify in these challenging but promising agricultural machinery and metallurgical industry sectors, since it already has achieved minimal advantage and relatedness. In this dissertation, we show that economic complexity and network science methods provide a useful framework to reveal structural constraints and opportunities for smart, sustainable and inclusive diversification. Therefore, contributing to formulate and implement policies aiming to transform countries' productive structure.

5.1. LIMITATIONS AND RECOMMENDATIONS FOR FUTURE WORKS

The main limitations of the study are:

- Definition of products is an arbitrary example, apple is just apple, but clothes can include skinny jeans and t-shirts, and therefore, it has more linkages. The Harmonized System classifications at the four-digit level used for some products are not specific.
- The analysis is based on merchandise export data (value), which is a worthy, therefore imperfect proxy of the country's productive structure and capabilities as it does not include services. The analysis also excludes the significant informal sector typical of developing countries such as Mozambique.
- FDI values are highly aggregated by sector, thus challenging to link with products.
- The productive structure is a significant factor, but it is not the only factor explaining income, complexity and income inequality; other important factors may be considered.

The main recommendations are:

- As Mozambique is a vast country with heterogeneous realities, opportunities and diverse production structures, it is suggested that a similar study should be carried out at an internal level to identify local strategies.
- Include other development goal indicators beyond income and inequality, such as environment, unemployment and institutional constraints.
- Strategy number four which would have a better impact indicates diversification toward machinery; thus, there is a need for additional and more specific studies of these industrial sectors to reformulate and adapt industrial policy and strategy to provide infrastructure, the attraction of the FDI and human resources with the necessary skills for these new industries.

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APPENDIX

Code Validation

To validate the code, the basic indicator was first computed and compared (correlation and top 10) with the indicator sourced from the Observatory of Economic Complexity (OEC)⁵ version 3.0. Then was compared the product of three countries with different levels of ECI, namely Japan (high), Chile (medium), and Guinea (low). Finally, the primary finding of the relatedness literature, the principle of relatedness - an empirical principle describing the probability that a region enters or exits an economic activity as a function of the number of related activities present in that location was reproduced.

The computer product and country complexity index are strongly correlated with the obtained from the OEC, both in value and rank (Table A1).

Table A 1 - Yearly product and country correlation with OEC indicator, 2001 to 2019. Source: atlas.media.mit.edu and proper calculations

| Year | PCI correlation | | ECI correlation | |
|----------------|-----------------|---------------|-----------------|---------------|
| | Value | Rank position | Value | Rank position |
| 2001 | 0.96 | 0.96 | 0.98 | 0.82 |
| 2002 | 0.96 | 0.96 | 0.99 | 0.80 |
| 2003 | 0.96 | 0.96 | 0.99 | 0.84 |
| 2004 | 0.96 | 0.97 | 0.99 | 0.86 |
| 2005 | 0.96 | 0.96 | 0.98 | 0.87 |
| 2006 | 0.96 | 0.96 | 0.98 | 0.92 |
| 2007 | 0.96 | 0.96 | 0.98 | 0.91 |
| 2008 | 0.96 | 0.96 | 0.98 | 0.94 |
| 2009 | 0.95 | 0.95 | 0.98 | 0.93 |
| 2010 | 0.95 | 0.95 | 0.98 | 0.93 |
| 2011 | 0.96 | 0.96 | 0.98 | 0.94 |
| 2012 | 0.94 | 0.96 | 0.98 | 0.96 |
| 2013 | 0.96 | 0.96 | 0.98 | 0.95 |
| 2014 | 0.96 | 0.96 | 0.98 | 0.95 |
| 2015 | 0.95 | 0.96 | 0.99 | 0.96 |
| 2016 | 0.95 | 0.96 | 0.99 | 0.95 |
| 2017 | 0.96 | 0.96 | 0.99 | 0.97 |
| 2018 | 0.97 | 0.97 | 0.99 | 0.97 |
| 2019 | 0.96 | 0.96 | 0.99 | 0.95 |
| Average | 0.96 | 0.96 | 0.98 | 0.92 |

⁵ OEC is an online data visualization and distribution platform focused on the geography and dynamics of economic activities. The OEC integrates and distributes data from various sources to empower analysts in the private sector, public sector, and academia

The product space for the country in three different levels of complexity is illustrated in Figure A 1. The node's size represents the world share of the product. The low complex country like Guinea has a smaller number of products with RCA and more of them in the periphery of the PS, while the high complex country like Japan tends to have many products with RCA and most of them in the dense part of the network.

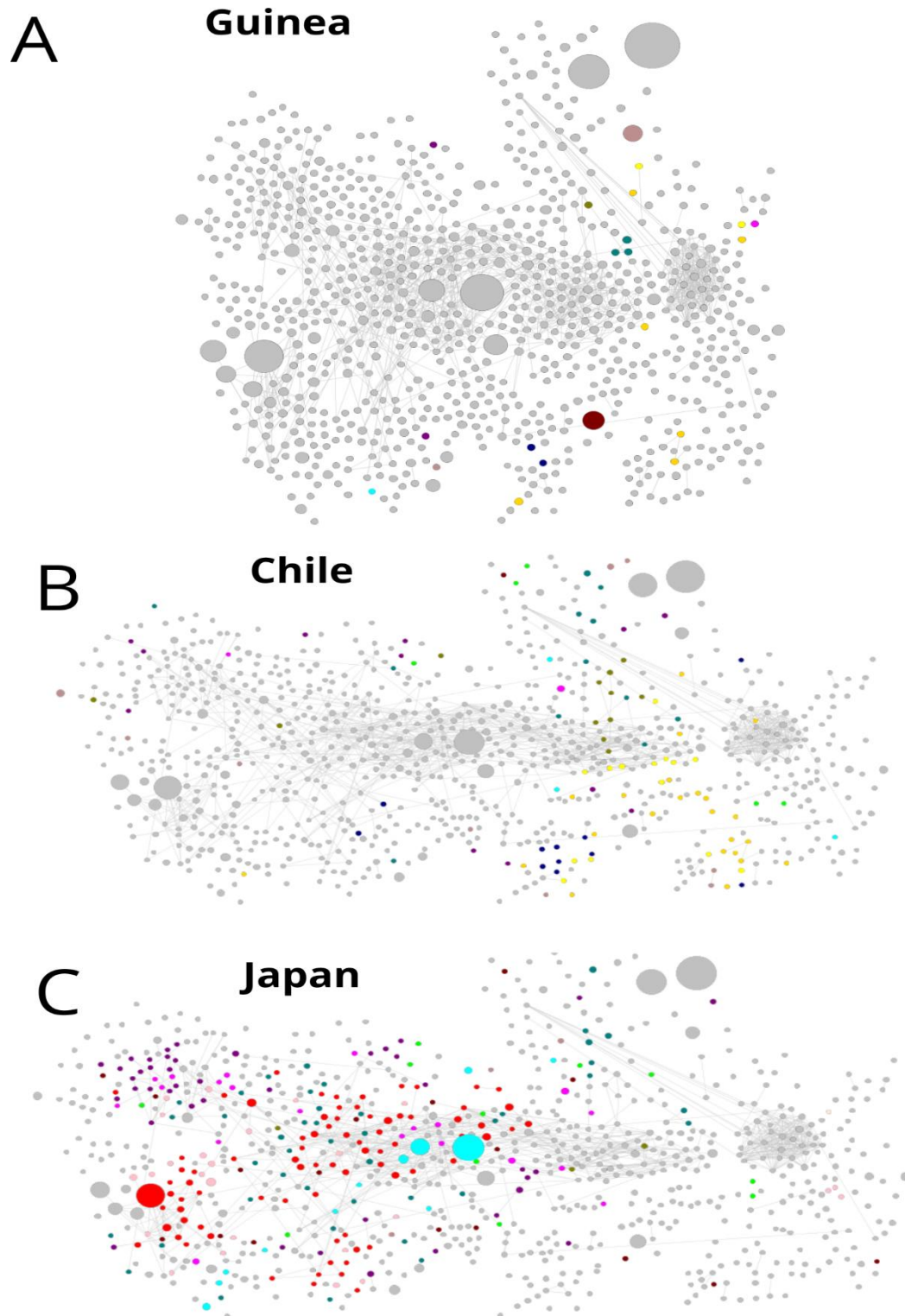


Figure A 1 - Code validation: Low (Guinea), medium (Chile), and high (Japan) complex economy product Space, 2019

The basic finding of the principle of relatedness (Hidalgo et al., 2018) can be seen in Figure 3.3, the probability that a country will develop a comparative advantage in a product as a function of relatedness density in two years tends to increase for high density. The results are consistent with the principle of relatedness, in that countries are more successful in entering activities for which they have relatively higher relatedness. In line with Pinheiro et al. (2018a) was considered that a country (c) enters a new product (p), between years y and y+2, when it can jump from RCA lower than 1.0 at year y to RCA above or equal to 1.0 at year y+2. To correct false positives was considered an additional condition as maintaining the RCA above 1.0 for the next two consecutive years and having RCA lower than 1.

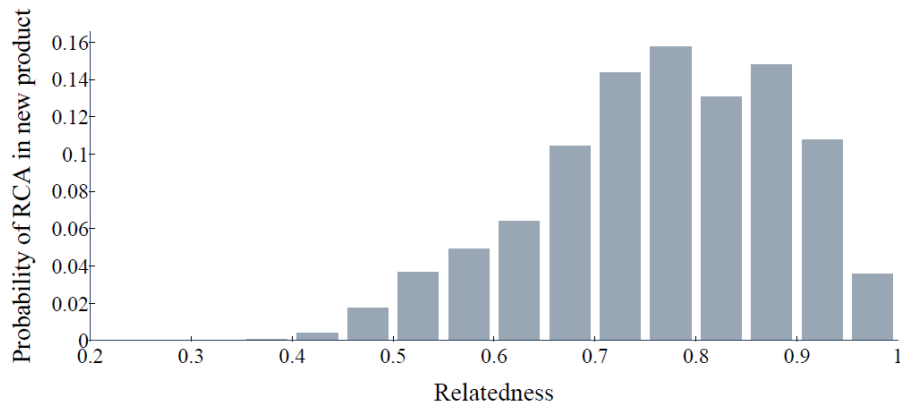


Figure A 2 - Probability that a country will develop a comparative advantage in a product in two years as a function of relatedness density (fraction of related products already exported by that country).
Source: atlas.media.mit.edu and proper calculations

Relatedness is an absolute measure, Hartmann et al. (2021) show that relatedness cannot be readily used for cross-country comparison. More complex economies tend to have higher relatedness values across all activities, so high-relatedness entry events are skewed to those of high complexity economies. Low relatedness entry events are skewed towards those of low complexity economies. Therefore, the principle of relatedness was also reproduced, illustrating the relation between the Density and Relative Complexity at the country level. Considering two years window from 2017 to 2019 was illustrated the diversification option sets and the products entered by low diversified countries (Guinea) and highly diversified countries (Japan). The New Guinea and Japan exports were highlighted in red and the average "direction" of a country's new exports in green. In 2017-2019 Japan tended to enter products that were more unrelated and sophisticated than the average options it had available. From figure 3.6 can be observed that most of the products that Japan entered in 2017-2019 had a low Relative Density and a high Relative Complexity. On the other hand, in the same period, Guinea entered products that were less sophisticated and more related than the average product in its options set (Figure 3.4).

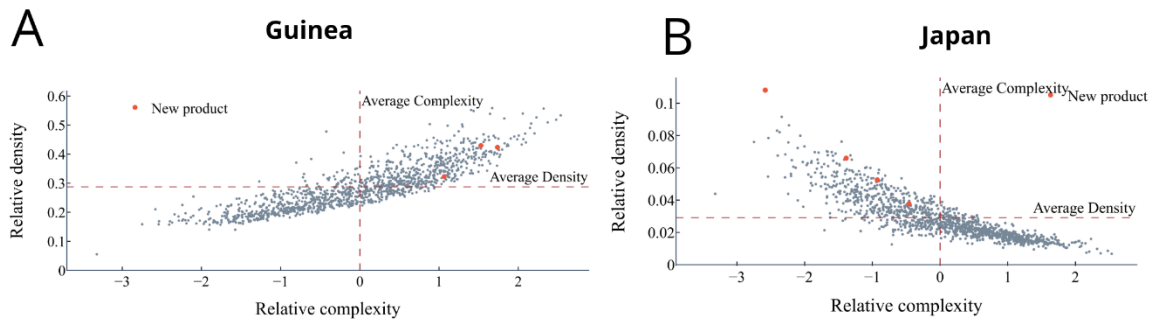


Figure A 3 - New export products (in red) developed by Guinea (a) and Japan (b) from 2017 to 2019.
 Source: atlas.media.mit.edu and proper calculations

ANNEXES

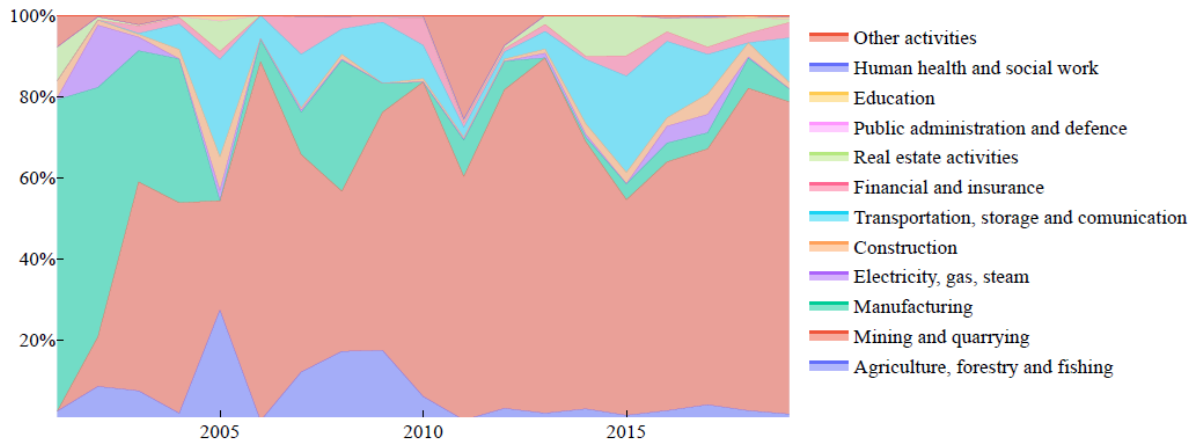


Figure B 1 - Evolution of Mozambique Foreign Direct Investment (FDI) by sector, 2001-2019

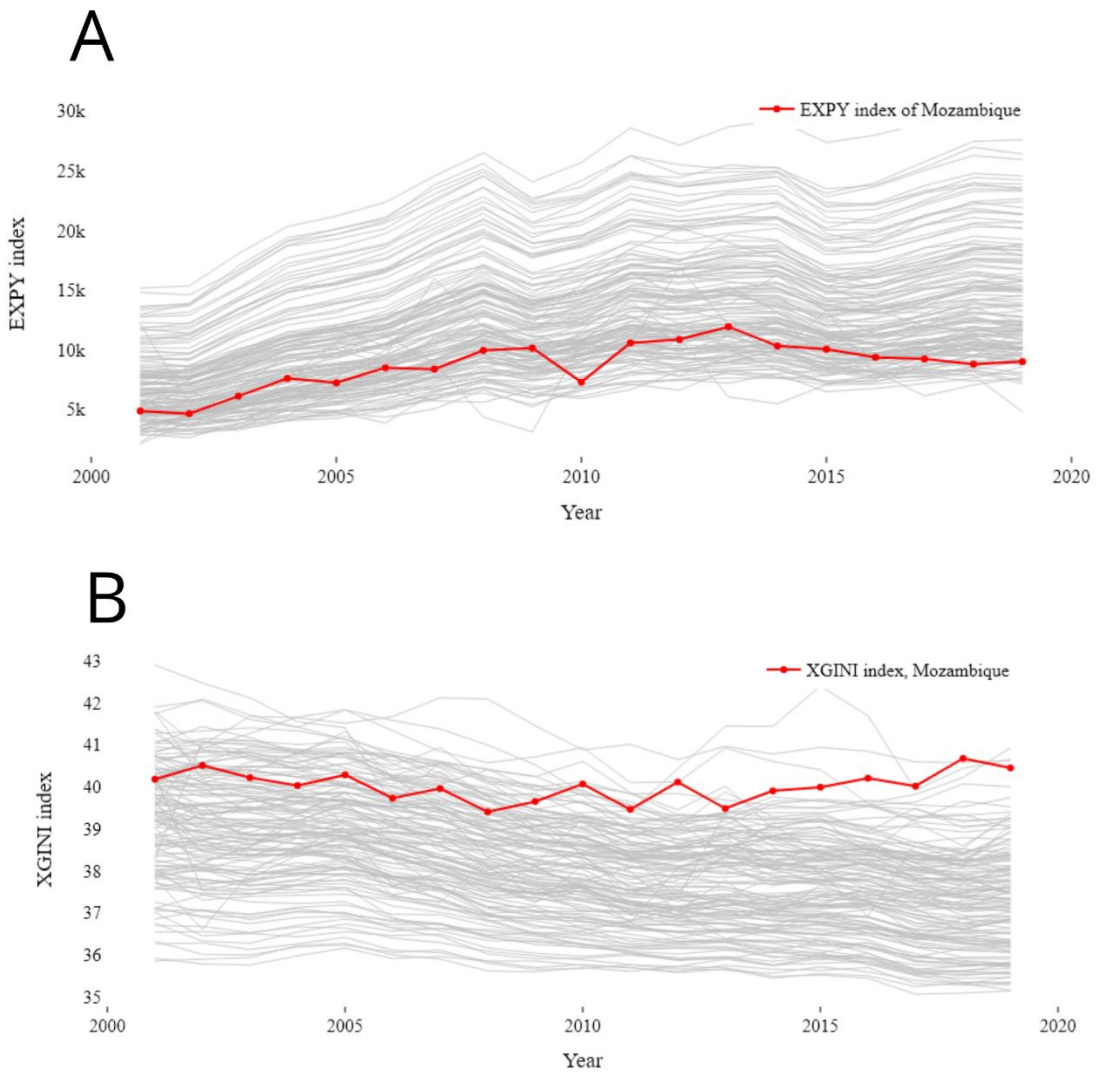


Figure B 2 - Evolution of (a) Expy and (b) XGINI Index, Mozambique, 2001-2019

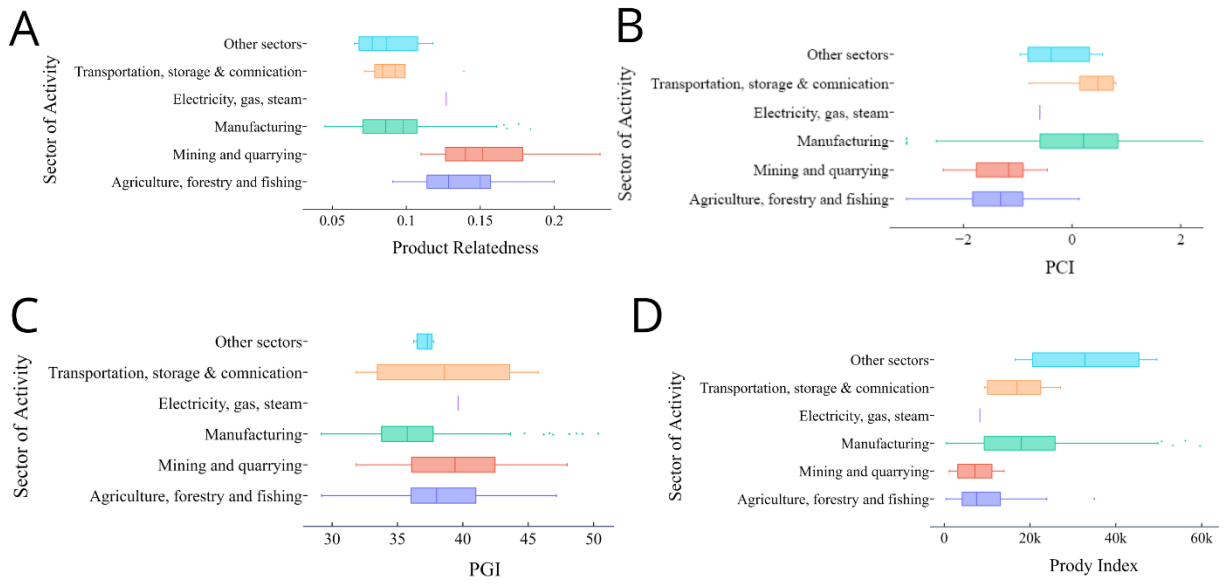


Figure B 3 - Economic complexity indicators (average relatedness, PCI, PGI and PRODY) by activity sectors, 2019

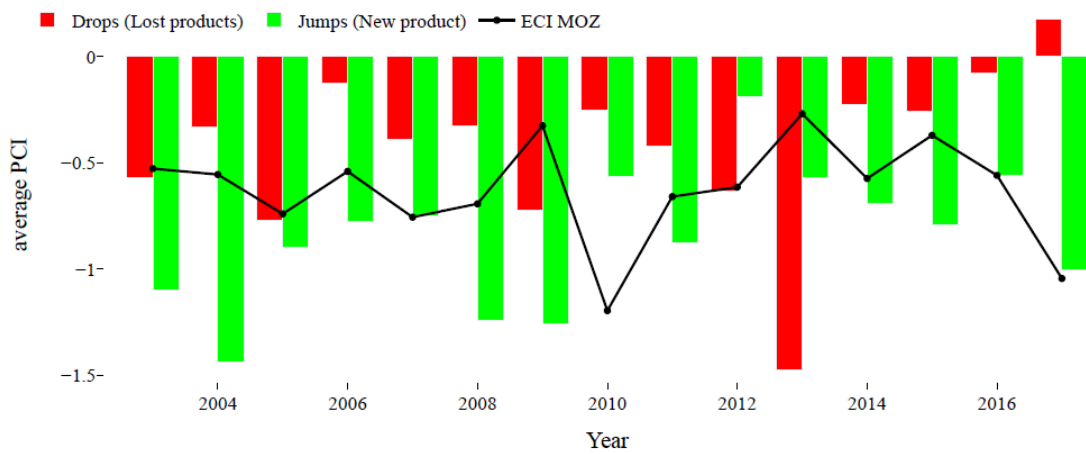


Figure B 4 - Evolution of average PCI of product that Mozambique lost RCA and achieved RCA, years 2003-2017.

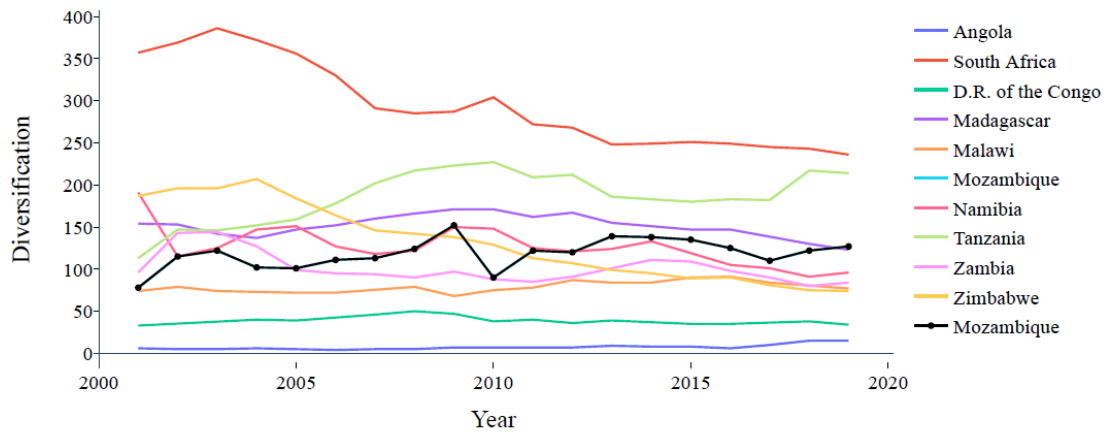


Figure B 5 - Evolution of country diversification (number of products with RCA), Mozambique vs SADC, 2001-2019

Table B 1 - Mozambique's productive portfolio in comparison with neighbours' countries

| Country | ECI | XPY | XGINI | # of RCAs (Diversity) | Nº of close products (density > 0,12) | Exports [Average 2017-2019] Billions USD |
|-----------------------|--------------|---------------|-------------|-----------------------|---------------------------------------|--|
| SADC Countries | | | | | | |
| South Africa | 0,14 | 19 890 | 38,4 | 236 | 1 207 | 96,2 |
| Malawi | -0,47 | 16 398 | 38,3 | 77 | 6 | 0,8 |
| Namibia | -0,54 | 17 419 | 39,2 | 96 | 47 | 4,7 |
| Tanzania | -0,56 | 15 135 | 38,3 | 214 | 1 070 | 4,5 |
| Zambia | -0,76 | 14 408 | 40,0 | 84 | 29 | 6,6 |
| Mozambique | -0,91 | 13 819 | 40,5 | 127 | 185 | 4,8 |
| Zimbabwe | -0,94 | 14 086 | 39,7 | 74 | 9 | 3,0 |
| Angola | -1,02 | 16 178 | 40,7 | 15 | - | 32,5 |
| D.R. of the Congo | -1,03 | 12 719 | 40,9 | 34 | - | 7,1 |
| Madagascar | -1,15 | 11 820 | 38,7 | 123 | 267 | 2,8 |

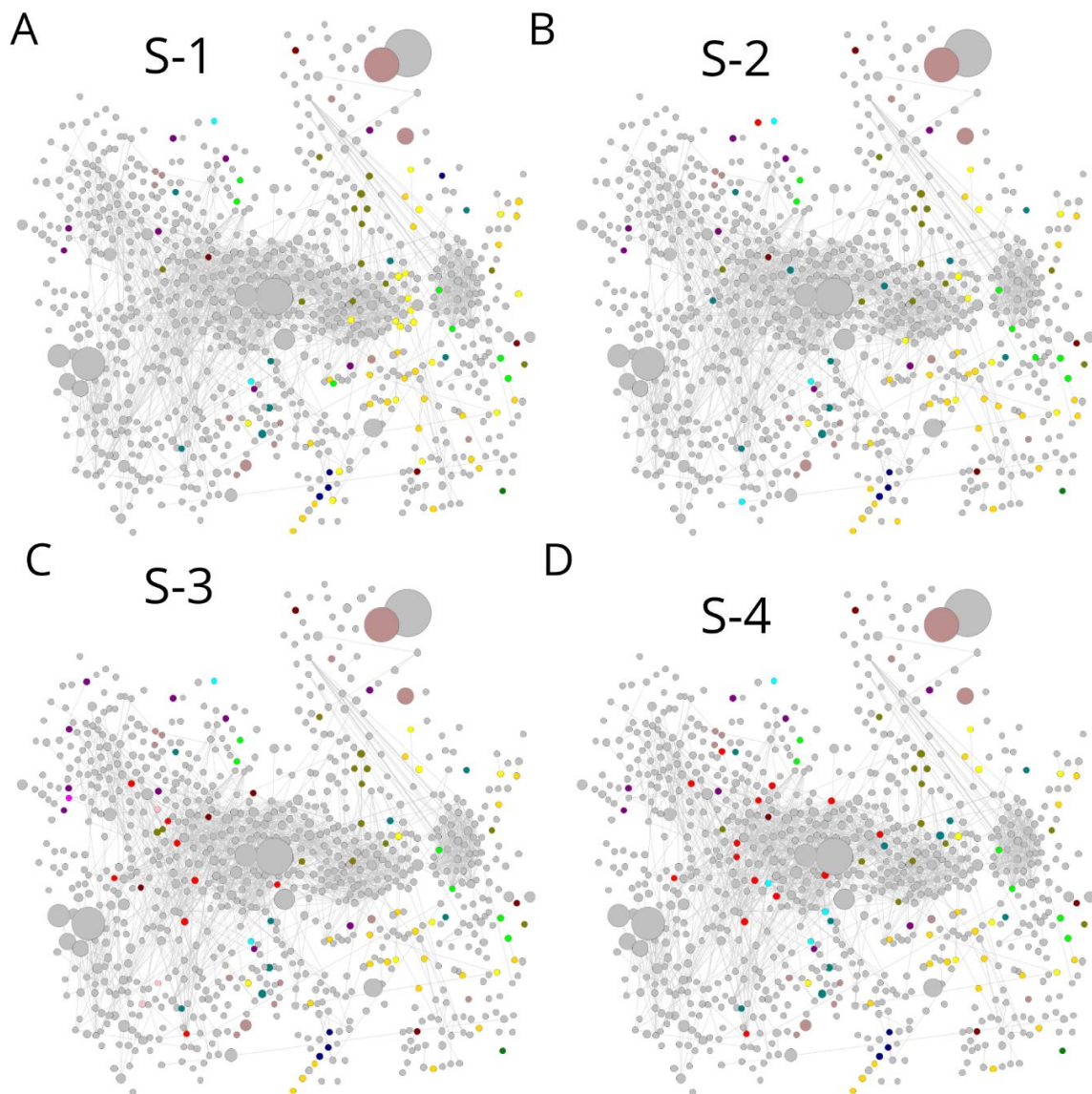


Figure B 6 - How successfully implementing the strategies S1-4 might change Mozambique's productive structure.

Industrial Policy 1997, product priority technology classification (Lall 2000), and complexity indicators

| HS | HS label | Lall_Label | PCI | | PRODY | | PGI | |
|----------------|--|--|--------------|--------------|----------------|--------------|-------------|------------|
| | | | value | Rank | value | Rank | value | Rank |
| 302 | Fish; fresh or chilled, excluding fish f | Primary products | - 1.5 | 1140 | 6,471 | 793 | 41 | 950 |
| 303 | Fish; frozen, excluding fish fillets and | Primary products | - 1.5 | 1144 | 2,705 | 1076 | 41 | 933 |
| 306 | Crustaceans; in a shell or not, live, fres | Primary products | - 2.0 | 1218 | 1,619 | 1171 | 45 | 1158 |
| 708 | Leguminous vegetables; shelled or unshel | Primary products | - 2.1 | 1219 | 764 | 1222 | 44 | 1124 |
| 710 | Vegetables (uncooked or cooked by steami | Primary products | - 1.0 | 1015 | 5,865 | 832 | 43 | 1112 |
| 713 | Vegetables, leguminous; shelled, whether | Primary products | - 1.9 | 1200 | 1,574 | 1176 | 41 | 909 |
| 801 | Nuts, edible; coconuts, Brazil nuts and | Primary products | - 2.5 | 1238 | 650 | 1228 | 42 | 1013 |
| 803 | Bananas, including plantains; fresh or d | Primary products | - 2.2 | 1232 | 2,504 | 1093 | 53 | 1239 |
| 805 | Citrus fruit; fresh or dried | Primary products | - 1.0 | 1006 | 5,718 | 841 | 41 | 897 |
| 902 | Tea | Primary products | - 2.2 | 1230 | 630 | 1229 | 42 | 1046 |
| 1203 | Copra | Primary products | - 2.4 | 1237 | 1,250 | 1199 | 40 | 804 |
| 1701 | Cane or beet sugar and chemically pure s | Resource-based manufactures: agro-based | - 1.9 | 1201 | 1,996 | 1132 | 46 | 1182 |
| 1702 | Sugars, including lactose, maltose, gluc | Resource-based manufacturers: agro-based | - 0.1 | 680 | 11,218 | 483 | 39 | 752 |
| 2704 | Coke and semi-coke; of coal, lignite or | Resource-based manufacturers: other | 0.2 | 573 | 3,122 | 1043 | 37 | 512 |
| 2711 | Petroleum gases and other gaseous hydroc | Primary products | - 1.5 | 1151 | 5,918 | 830 | 37 | 525 |
| 5202 | Cotton waste (including yarn waste and g | Primary products | - 1.7 | 1176 | 1,587 | 1174 | 40 | 854 |
| 5203 | Cotton, carded or combed | Primary products | - 1.9 | 1202 | 495 | 1235 | 42 | 1021 |
| 6101 | Coats; men's or boys' overcoats, car-coa | Low technology manufactures: textile, ga | - 1.5 | 1145 | 1,937 | 1138 | 39 | 727 |
| 6102 | Coats; women's or girls' overcoats, car- | Low technology manufactures: textile, ga | - 1.4 | 1125 | 2,095 | 1128 | 39 | 789 |
| 6103 | Suits, ensembles, jackets, blazers, trou | Low technology manufactures: textile, ga | - 1.7 | 1182 | 1,581 | 1175 | 41 | 965 |
| 6401 | Footwear; waterproof, with outer soles a | Low technology manufactures: textile, | - 0.9 | 985 | 3,339 | 1022 | 40 | 858 |
| 6402 | Footwear; with outer soles and uppers of | Low technology manufactures: textile, ga | - 1.0 | 1026 | 2,570 | 1086 | 40 | 825 |
| 6810 | Cement, concrete or artificial stone; wh | Resource-based manufactures: other | 0.4 | 450 | 11,014 | 500 | 33 | 119 |
| 6901 | Bricks, blocks, tiles and other ceramic | Resource-based manufactures: other | - 0.5 | 836 | 11,293 | 479 | 36 | 474 |
| 6902 | Refractory bricks, blocks, tiles and sim | Resource-based manufactures: other | 0.3 | 499 | 6,862 | 765 | 39 | 742 |
| 7604 | Aluminium; bars, rods and profiles | Primary products | 0.0 | 652 | 4,223 | 957 | 42 | 1002 |
| Average | | | - 1.3 | 1,029 | 3,807.7 | 1,000 | 40.9 | 867 |

Table B 2 - Industrial Policy 2007, product priority technology classification and complexity indicators

| HS | HS label | HS Group label | Lall_Label | PCI | | PRODY | | PGI | |
|----------------|---|-------------------------------|---|--------------|--------------|----------------|--------------|-------------|------------|
| | | | | value | Rank | value | Rank | value | Rank |
| 801 | Nuts, edible; coconuts, Brazil nuts and | Vegetable Products | Primary products | - 2.5 | 1239 | 1,146 | 1215 | 42 | 1055 |
| 803 | Bananas, including plantains; fresh | Vegetable Products | Primary products | - 2.1 | 1221 | 3,834 | 1099 | 51 | 1239 |
| 805 | Citrus fruit; fresh or dried | Vegetable Products | Primary products | - 0.9 | 999 | 8,769 | 868 | 41 | 997 |
| 1101 | Wheat or meslin flour | Vegetable Products | Resource-based manufactures: agro-based | - 1.5 | 1154 | 4,081 | 1083 | 40 | 906 |
| 1102 | Cereal flours; other than of wheat or meslin | Vegetable Products | Resource-based manufactures: agro-based | - 1.6 | 1173 | 2,803 | 1159 | 45 | 1185 |
| 1201 | Soya beans, whether or not broken | Vegetable Products | Primary products | - 1.5 | 1153 | 4,863 | 1049 | 51 | 1241 |
| 1202 | Ground-nuts; not roasted or otherwise cooked, ... | Vegetable Products | Primary products | - 2.1 | 1224 | 2,150 | 1185 | 43 | 1127 |
| 1206 | Sunflower seeds; whether or not broken | Vegetable Products | Primary products | - 0.6 | 883 | 5,480 | 1011 | 37 | 600 |
| 1207 | Oil seeds and oleaginous fruits, n.e.c. | Vegetable Products | Primary products | - 2.0 | 1215 | 993 | 1226 | 37 | 611 |
| 1507 | Soya-bean oil and its fractions; whether or no... | Vegetable Products | Resource-based manufactures: agro-based | - 1.2 | 1065 | 5,237 | 1030 | 49 | 1235 |
| 1511 | Palm oil and its fractions; whether or not ref... | Vegetable Products | Resource-based manufactures: agro-based | - 2.0 | 1217 | 3,719 | 1108 | 44 | 1148 |
| 1513 | Coconut (copra), palm kernel or babassu oil an... | Vegetable Products | Resource-based manufactures: agro-based | - 1.7 | 1192 | 3,152 | 1134 | 43 | 1133 |
| 1701 | Cane or beet sugar and chemically pure | Foodstuffs | Resource-based manufactures: agro- | - 1.4 | 1143 | 3,953 | 1093 | 44 | 1166 |
| 1702 | Sugars, including lactose, maltose, | Foodstuffs | Resource-based manufactures: agro- | 0.1 | 588 | 13,656 | 659 | 38 | 708 |
| 2008 | Fruit, nuts and other edible parts of plants; | Foodstuffs | Resource-based manufactures: agro- | - 1.1 | 1042 | 8,973 | 856 | 42 | 1062 |
| 2009 | Fruit juices (including grape must) | Foodstuffs | Resource-based manufactures: | - 0.8 | 941 | 8,793 | 866 | 41 | 1014 |
| 2501 | Salt (including table salt and denatured | Mineral Products | Primary products | - 0.9 | 968 | 5,891 | 996 | 42 | 1071 |
| 2614 | Titanium ores and concentrates | Mineral Products | Resource-based manufactures: other | - 1.2 | 1089 | 2,582 | 1171 | 38 | 656 |
| 2615 | Niobium, tantalum, vanadium or zirconium | Mineral Products | Resource-based manufactures: other | - 2.0 | 1214 | 1,218 | 1214 | 49 | 1229 |
| 2704 | Coke and semi-coke; of coal, lignite or peat, ... | Mineral Products | Resource-based manufactures: other | - 0.3 | 782 | 3,163 | 1132 | 40 | 890 |
| 2711 | Petroleum gases and other gaseous hydrocarbons | Mineral Products | Primary products | - 1.4 | 1139 | 11,034 | 764 | 39 | 809 |
| 3801 | Artificial graphite; colloidal or semi- | Chemicals & Allied Industries | Medium technology manufactures: process | 0.3 | 501 | 19,949 | 449 | 35 | 299 |
| 7602 | Aluminium; waste and scrap | Metals | Resource-based manufactures: other | - 0.7 | 916 | 4,076 | 1084 | 42 | 1087 |
| 7604 | Aluminium; bars, rods and profiles | Metals | Primary products | 0.2 | 562 | 13,640 | 661 | 35 | 301 |
| Average | | | | - 1.2 | 1,026 | 5,964.8 | 1,005 | 42.0 | 949 |

Table B 3 - Industrial Policy 2016, product priority technology classification and complexity indicators

| HS | HS label | HS Group label | Lall_Label | PCI | | PRODY | | PGI | |
|----------------|-------------------------------------|-------------------------------|-------------------------------------|--------------|------------|----------------|------------|-------------|------------|
| | | | | value | Rank | value | Rank | value | Rank |
| 302 | Fish; fresh or chilled, excluding f | Animal & Animal Products | Primary products | - 1.4 | 1132 | 26,060 | 261 | 35 | 382 |
| 303 | Fish; frozen, excluding fish fillet | Animal & Animal Products | Primary products | - 1.4 | 1143 | 6,625 | 991 | 39 | 979 |
| 306 | Crustaceans; in shell or not, live, | Animal & Animal Products | Primary products | - 1.9 | 1203 | 5,798 | 1029 | 42 | 1128 |
| 708 | Leguminous vegetables; shelled or u | Vegetable Products | Primary products | - 1.9 | 1204 | 2,454 | 1195 | 42 | 1116 |
| 710 | Vegetables (uncooked or cooked by s | Vegetable Products | Primary products | - 0.8 | 937 | 10,531 | 823 | 39 | 917 |
| 713 | Vegetables, leguminous; shelled, wh | Vegetable Products | Primary products | - 1.9 | 1206 | 2,812 | 1184 | 37 | 778 |
| 801 | Nuts, edible; coconuts, Brazil nuts | Vegetable Products | Primary products | - 2.4 | 1230 | 1,547 | 1213 | 43 | 1151 |
| 803 | Bananas, including plantains; fresh | Vegetable Products | Primary products | - 1.8 | 1199 | 5,821 | 1028 | 46 | 1216 |
| 805 | Citrus fruit; fresh or dried | Vegetable Products | Primary products | - 1.3 | 1118 | 8,982 | 882 | 40 | 1026 |
| 902 | Tea | Vegetable Products | Primary products | - 1.9 | 1202 | 1,559 | 1212 | 41 | 1076 |
| 1701 | Cane or beet sugar and chemically p | Foodstuffs | Resource-based manufactures: agro-b | - 1.7 | 1174 | 4,271 | 1116 | 43 | 1158 |
| 1702 | Sugars, including lactose, maltose, | Foodstuffs | Resource-based manufactures: agro-b | - 0.0 | 657 | 17,110 | 523 | 39 | 935 |
| 3801 | Artificial graphite; colloidal or s | Chemicals & Allied Industries | Medium technology manufactures: pro | 1.2 | 152 | 31,145 | 162 | 32 | 98 |
| 3802 | Activated carbon; activated natural | Chemicals & Allied Industries | Medium technology manufactures: pro | - 0.8 | 941 | 4,670 | 1089 | 45 | 1210 |
| 3901 | Polymers of ethylene, in primary fo | Plastics / Rubbers | Medium technology manufactures: pro | 0.1 | 576 | 20,439 | 408 | 36 | 631 |
| 3902 | Polymers of propylene or of other o | Plastics / Rubbers | Medium technology manufactures: pro | 0.1 | 574 | 22,372 | 349 | 38 | 844 |
| 4401 | Fuel wood, in logs, billets, twigs, | Wood & Wood Products | Primary products | - 0.2 | 701 | 13,320 | 682 | 35 | 439 |
| 4402 | Wood charcoal (including shell or n | Wood & Wood Products | Primary products | - 1.5 | 1147 | 4,365 | 1111 | 42 | 1112 |
| 4403 | Wood in the rough, whether or not s | Wood & Wood Products | Resource-based manufactures: agro-b | - 1.5 | 1160 | 5,101 | 1068 | 46 | 1214 |
| 4419 | Tableware and kitchenware, of wood | Wood & Wood Products | Resource-based manufactures: agro-b | - 0.4 | 808 | 7,738 | 941 | 34 | 340 |
| 4420 | Wood marquetry and inlaid wood; cas | Wood & Wood Products | Resource-based manufactures: agro-b | - 1.0 | 999 | 7,458 | 957 | 37 | 715 |
| 5001 | Silk-worm cocoons suitable for reel | Textiles | Primary products | - 0.5 | 852 | 1,184 | 1225 | 34 | 247 |
| 5101 | Wool, not carded or combed | Textiles | Primary products | - 1.4 | 1126 | 27,797 | 221 | 38 | 784 |
| 6101 | Coats; men's or boys' overcoats, ca | Textiles | Low technology manufactures: textil | - 1.2 | 1071 | 3,724 | 1144 | 40 | 995 |
| 6103 | Suits, ensembles, jackets, blazers, | Textiles | Low technology manufactures: textil | - 1.6 | 1165 | 2,776 | 1185 | 39 | 904 |
| 6401 | Footwear; waterproof, with outer so | Footwear / Headgear | Low technology manufactures: textil | - 1.0 | 1017 | 7,340 | 962 | 38 | 868 |
| 6402 | Footwear; with outer soles and uppe | Footwear / Headgear | Low technology manufactures: textil | - 1.3 | 1110 | 6,063 | 1016 | 39 | 931 |
| 7605 | Aluminium wire | Metals | Primary products | - 0.5 | 851 | 5,713 | 1039 | 48 | 1222 |
| Average | | | | - 0.9 | 932 | 9,894.0 | 871 | 39.1 | 828 |



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