

The Journal of International Trade & Economic Development

An International and Comparative Review

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/rjte20

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To cite this article: Emmanuel Sukadi A. Sukadi (14 Jul 2024): Impact of special economic zones on export diversification in sub-saharan Africa, The Journal of International Trade & Economic Development, DOI: [10.1080/09638199.2024.2378088](https://doi.org/10.1080/09638199.2024.2378088)

To link to this article: <https://doi.org/10.1080/09638199.2024.2378088>



Published online: 14 Jul 2024.



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Impact of special economic zones on export diversification in sub-saharan Africa

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ABSTRACT

This paper presents a comprehensive analysis of the impact of special economic zones (SEZs) on export diversification in Sub-Saharan Africa (SSA). With export diversification being a key concern for SSA policymakers, many countries in the region have implemented SEZ programs over the last three decades to stimulate industrial development and export-led growth. By providing incentives to attract investment, SEZs aim to enhance the business environment and draw firms from both traditional and emerging sectors. Using a difference-in-differences approach on a panel dataset covering 32 SSA countries from 1970 to 2014, this study investigates the effects of SEZ adoption on overall export diversification, as well as on the extensive and intensive margins of exports. The findings suggest that SEZ adoption has led to a more balanced distribution of export shares among traditional sectors, thereby promoting greater export diversification in SSA countries. However, the effectiveness of SEZs in fostering the creation of entirely new sectors appears to be limited.



KEYWORDS SEZ; export diversification; intensive margin; extensive margin; TWFE

ARTICLE HISTORY Received 23 May 2023; Accepted 26 June 2024

1. Introduction

Export diversification is a persistent concern and objective for policymakers in developing countries, particularly those endowed with abundant natural resources (Cadot, Carrère, and Strauss-Kahn 2011). This focus stems from the recognition that increased levels of export diversification often correlate with enhanced economic growth. By deriving export earnings from a broader array of sectors, countries can shield themselves from volatility in GDP growth, employment rates, and real exchange rates. Such stability is crucial for preserving social welfare and domestic productivity in sectors reliant on international trade. Moreover, the pursuit of greater export diversification is also associated with improved learning-by-doing across multiple sectors, a factor known to contribute to sustained long-term growth (Agosin 2008).

Figure 1 illustrates the evolution of the export diversification index (EDI) as developed by Cadot, Carrère, and Strauss-Kahn (2011), aggregated by region from 1962 to 2014. It is important to note that while referred to as a diversification measure, the EDI

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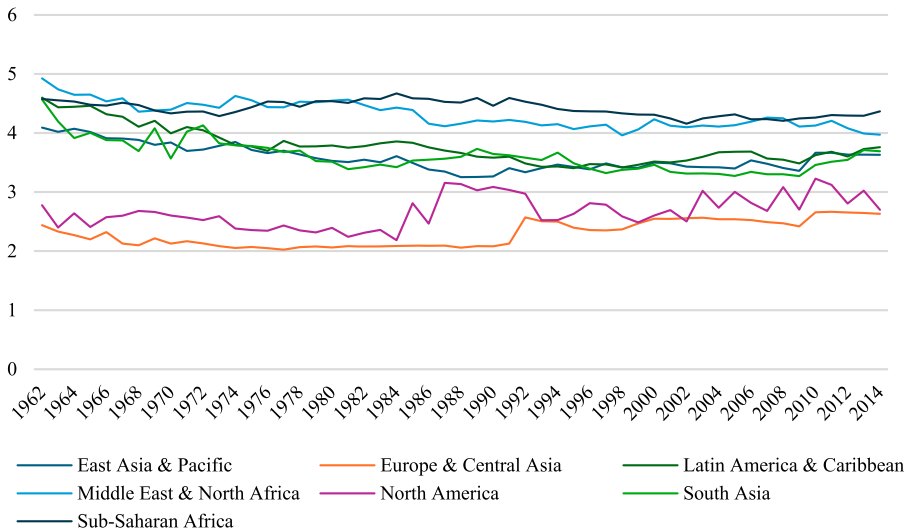


Figure 1. EDI per region. Source: IMF

represents a Theil index, where higher values signify lower levels of diversification, indicating greater concentration of exports within specific sectors. The Europe & Central Asia region exhibited the lowest levels of export concentration, with a mean EDI of 2.37 during the observed period, followed by North America with a mean of 2.67 (see Table 1). However, both regions experienced trends of re-specialisation in the 1990s and 1980s, respectively, consistent with the U-shaped pattern in specialization observed by Imbs and Wacziarg (2003), predicting a progressive re-specialisation of more advanced economies. East Asia & Pacific (3.57), South Asia (3.59), and Latin America & Caribbean (3.75) followed with mean EDI levels below 4. The Middle East & North Africa and Sub-Saharan Africa were identified as the least diversified regions, with mean EDI levels of 4.31 and 4.41, respectively.

Beside exhibiting the highest levels of concentration, Sub-Saharan Africa (SSA) experienced the smallest evolution of the Theil index towards greater diversification (-0.21) over the observed period. Furthermore, a trend of re-specialisation has been observed in the region since the 2000s. Various factors have contributed to this setback in export diversification in SSA, including the tightening of trade and investments during the global financial crisis and the industrial boom in Asian countries, which increased demand for African natural resources and led to a concentration of exports in commodity sectors (Whitfield and Zalk 2020; UNCTAD 2021). Concentration in resource sectors

Table 1. Statistics on EDI per region.

Region	Mean	Std. Dev.	Min. (Year)	Max. (Year)	2014	Frequency
East Asia & Pacific	3.5706	1.0921	3.2541 (1988)	4.0915 (1962)	3.6297	1,385
Europe & Central Asia	2.3656	1.0168	2.0264 (1977)	2.6660 (2011)	2.6315	1,801
Latin America & Caribbean	3.7543	0.8660	3.4041 (1995)	4.5993 (1962)	3.7603	1,820
Middle East & North Africa	4.3082	1.3196	3.9604 (1998)	4.9266 (1962)	3.9706	1,058
North America	2.6692	1.3648	2.1867 (1984)	3.2272 (2010)	2.6996	159
South Asia	3.5938	0.9483	3.2694 (2009)	4.5681 (1962)	3.6905	360
Sub-Saharan Africa	4.4094	0.8989	4.1581 (2002)	4.6696 (1984)	4.3652	2,217

have further exacerbated sectoral concentration due to Dutch disease dynamics, posing competitiveness issues for non-resource traded sectors (Corden and Neary 1982). Additional structural challenges, such as political instability, violent conflicts, limited access to power, and infrastructure and logistics gaps, hinder diversification efforts in SSA, negatively impacting infrastructure development and attractiveness for investors, thus impeding the emergence of new industries and the access to foreign markets (Pitigala and Lopez-Calix 2020).

To surmount these obstacles and catalyse export-led growth and diversification, many SSA nations have instituted special economic zones (SEZs) (Newman and Page 2017). SEZs are instruments of industrial policy, consisting in delineated geographically bounded areas governed by bespoke administrative, regulatory, and fiscal frameworks, typically more permissive than those prevailing in broader national contexts. Within SEZs, enterprises benefit from a suite of incentives, including reduced customs duties, tax exemptions, regulatory flexibilities, and enhanced access to scarce inputs, premium infrastructure, and social amenities (Farole 2011; Bost 2019).

By influencing the locational preferences of firms towards strategically attractive zones, SEZs foster the emergence of industrial clusters and agglomeration economies (Combes and Gobillon 2015; Newman and Page 2017). Consequently, these enclaves are envisaged to offer propitious settings for attracting foreign direct investment (FDI) and nurturing the cultivation of nascent industries, thereby serving as drivers of export-oriented economic expansion.

Special economic zones have been integral to development policies for decades, with the inception of the first modern industrial zone in Shannon, Ireland, dating back to 1959. Since then, SEZs have proliferated globally, experiencing a notable surge, particularly in East Asia and Latin America during the 1970s (Zeng 2021). This economic development tool has garnered increasing attention from policymakers in low – and middle-income countries, resulting in a twentyfold surge in the number of SEZs since the 1980s. Presently, the tally stands at an estimated 5400 zones distributed across 127 countries (UNCTAD 2019; Frick and Rodríguez-Pose 2023).

Africa is a latecomer in the implementation of special economic zones (SEZs), with their utilization remaining sporadic on the continent until three decades ago. By 1990, only 20 SEZs had been established across Africa. However, over the past two decades, there has been a remarkable shift in policy, with many African nations embracing SEZ initiatives. This period has witnessed a substantial increase in the number of zones, surpassing a tenfold rise. As of 2020, there were 238 operational SEZs spanning 31 out of 54 African countries, with an additional 7 countries in the planning stages for SEZ development (UNCTAD 2021). Farole (2011) presents compelling evidence regarding the role of African special economic zones as drivers of FDI. The study demonstrates that African SEZs generally underperform compared to their counterparts outside the continent in terms of FDI inflows. For instance, the research reveals that in 2008, the total FDI stock within SEZs in countries such as Kenya, Nigeria, and Tanzania remained below \$250 million USD. In stark contrast, a relatively smaller nation like the Dominican Republic attracted FDI exceeding \$2.6 billion USD during the same period. These figures pale in comparison to Vietnam, which attracted nearly \$37 billion USD in SEZ-related FDI in 2008.¹ Despite the seemingly modest levels of investment in African zones, Farole (2011) reveals that SEZs on the continent tend to represent relatively high proportions of national inflows of FDI. For instance, during the period 2000-2008, SEZs contributed

18% of total national FDI in Tanzania, 48% in Ghana, and 20% in Kenya. These percentages are comparable to those of non-African SEZ adopters such as Bangladesh (30%) and the Dominican Republic (18%). This suggests that the challenges faced by African SEZs in attracting FDI may not stem solely from deficiencies within the zones themselves, but rather from unfavourable business environments at the national level. Additionally, it implies that African SEZs may struggle to fully offset the adverse effects of inauspicious national investment climates.

The prevailing consensus suggests that African special economic zones have generally fallen short of expectations and exhibited subpar performance when compared to SEZs in non-African regions. This discrepancy is attributed to various factors, including inadequate planning and implementation, as well as constrained national economic and institutional capacities. Additional causes explaining the underperformance of African SEZs are associated with the (bad) timing of their implementation on the continent. It is argued that early adopters may have taken the advantage in the race for attracting FDI through incentives for foreign firms, as exemplified by the entrenched position of 'Factory Asia'. In this scenario, latecomers in SEZ adoptions may be less likely to reap similar benefits compared to those that embraced such policies before the 1980s (Farole 2011; Narula and Zhan 2019; Woodgate 2021). Additionally, SEZs typically exhibit sluggish growth during their initial decade of operation. Given that a majority of African SEZs (approximately 60%) have been established since the 2000s, it may be premature to fully ascertain their influence (Farole 2010; UNCTAD 2021). Despite these discouraging observations, Africa has persistently demonstrated enthusiasm in the deployment of special economic zones. One reason for this fervor for SEZ policies lies in the convenience and cost-effectiveness of implementing liberal and export-oriented reforms in delimited geographic areas, as opposed to nationwide structural reforms. This approach holds particular appeal for policymakers in developing countries characterized by weak economic and institutional capacities, as is the case for many Sub-Saharan African (SSA) countries (Rodríguez-Pose et al. 2022).

Notwithstanding the proliferation of special economic zones in Sub-Saharan Africa, there remains a notable scarcity of studies aimed at assessing the impact of this development policy tool on the crucial objective of export diversification. Farole (2010) undertakes an endeavour in this regard, focusing on the cases of Ghana, Kenya, Lesotho, Nigeria, Senegal, and Tanzania over the period 2000-2008. The study reveals an increase in non-traditional exports in Tanzania, including services and minerals, as well as a rise in manufacturing exports coupled with a decline in agricultural exports in Kenya. Nevertheless, no discernible links seem to exist between these shifts in export structures and the presence of SEZs. The case of Nigeria is further examined by Harry (2016). The study contends that despite the inception of the Nigerian Special Economic Zone (SEZ) program in 1992, its impact on national export diversification remained negligible. This assertion is supported by empirical evidence showing that mineral oil exports retained their dominance, comprising approximately 90% of the country's total exports by 2011. On a positive note, Cling, Razafindrakoto, and Roubaud (2005) and Gum (2014) highlight the success stories of Madagascar and Mauritius, respectively, in leveraging SEZs for economic development and export diversification. The establishment of the *Zone Franche* in Madagascar in 1990 led to a significant transformation in the country's export composition. This included a reduction in the predominant share of agricultural products, such as coffee, vanilla, and cloves, and a corresponding increase in manufacturing exports, particularly in clothing products originating from the zone. On the other side,

Mauritius boasts one of the earliest and most successful SEZ experiences in Africa, having adopted this strategy in the early 1970s to reduce its reliance on the sugar industry, which accounted for over 90% of its exports at the time. The introduction of various incentives within the SEZ framework rapidly attracted foreign investors. By the mid-1980s, exports of manufactured goods from Mauritius' zones had surpassed those of sugar. This transformation facilitated steady economic growth, enabling Mauritius to evolve from a low-income, sugar-dependent economy to a diversified middle-income country with an appealing business environment. Presently, Mauritius holds the 13th position in the Doing Business Index, surpassing nations such as Germany, China, Japan, and France.

While informative, these previous contributions primarily rely on descriptive and single-country analyses, limiting their scope and generalisability. Furthermore, these studies often approach export diversification predominantly from the perspective of activating non-traditional export sectors. However, the journey toward diversification is more apt to commence with a more equitable distribution of shares among existing industries (i.e. the intensive margin of exports) rather than the creation of entirely new export sectors (i.e. the extensive margin of exports). Indeed, as highlighted by Narula and Zhan (2019), the likelihood of foreign affiliates investing in unrelated industries is influenced by a progressive learning effect, wherein they become more acquainted with the SEZ and the host country's knowledge infrastructure and location advantages. Furthermore, the relatedness literature suggests that the success of a region venturing into new activity sectors is not only dependent on firms' ability to assimilate new knowledge but also on the cognitive and technological proximity between the new sector and the region's prior activities (Hidalgo 2021). Given the early development stage of many SSA countries and their latecomer status in SEZ policies, diversification through the intensive margin of exports may thus be more feasible for them than through the activation of non-traditional activities. In a recent study encompassing data from 21 African and Asian nations, Davies and Mazhikev (2019) discern that enterprises situated within SEZs demonstrate a heightened inclination toward export-focused activities across both the intensive and extensive margins in contrast to their counterparts located outside of such zones. It is important to note, however, that within the context of firm-level analysis, the concepts of intensive and extensive margins pertain respectively to the value of exports and the likelihood of firms engaging in export endeavours, thereby circumventing a detailed examination of the sectoral composition of national exports within their study framework.

The *raison d'être* of this paper is to address the limitations observed in prior research regarding the influence of SEZ adoption on export diversification, with a focus on the Sub-Saharan African context. The uniqueness of this study is threefold: Firstly, it encompasses a comprehensive analysis covering a broad panel of 32 SSA countries spanning the period from 1970 to 2014. This approach offers a more expansive perspective on the SSA landscape compared to the narrower focus of single-country case studies. Secondly, the study employs a robust difference-in-differences (DiD) methodology to rigorously assess the impact of SEZ adoption on the critical objective of export diversification within the region. Lastly, the analysis examines both the intensive and extensive margins of export diversification, recognizing the early developmental stage of most countries in the region and the relatively recent implementation of SEZ policies, which may limit their immediate impact on the emergence of new, unrelated sectors. This suggests that initial diversification efforts in the region may be more inclined towards achieving a

more balanced distribution of sectoral contributions from existing activities, rather than catalysing the development of non-traditional industries. To the best of the author's knowledge, this study represents the first of its kind.

Following this introductory section, the subsequent parts of this paper are structured as follows: Section 2 offers a comprehensive review of notable theoretical and empirical contributions to the SEZ debate, with a focus on studies targeting the impact of zones on exports diversification. The theoretical framework underpinning the analyses, along with the DiD procedure employed and the results of the estimations are discussed in section 3. Finally, the conclusions drawn from the analyses are presented in section 4.

2. Literature review

2.1. Theoretical literature

2.1.1. Types of SEZs

The comprehensive definition provided earlier encompasses diverse specifications that may vary depending on the characteristics of each SEZ. The literature commonly identifies five types of SEZs, as outlined by Zeng (2016), Lavissière and Rodrigue (2017), Bost (2019), and UNCTAD (2021):

- Free trade zones (FTZs): These are designated duty-free areas strategically located near international transport nodes, such as ports, airports, and land borders. These zones offer facilities tailored for various trade logistics activities, including warehousing, storage, and distribution, to support seamless trade operations.
- Export processing zones (EPZs): Fenced-in areas with industrial activities geared toward foreign markets, providing incentives like free-trade conditions and relaxed regulatory constraints for export-oriented enterprises.
- Freeports: These zones closely resemble FTZs as they are typically situated near ports and major trade routes. However, they occupy larger areas and are not limited to logistics and warehousing activities, offering incentives to firms engaged in a wider array of industrial activities.
- Special economic zones: Extensive zones that may encompass entire cities or regions. Beyond merely facilitating exports and attracting investments, they serve broader objectives such as regional industrial development.
- Industrial parks (or industrial zones): Smaller-scale areas housing a concentration of firms predominantly engaged in manufacturing activities, also offering incentives and benefits to participating enterprises.

Note that the term 'special economic zone' (SEZ) is utilized both broadly to encompass all types of zones and specifically to denote the particular type of zone discussed in this subsection (UNCTAD 2021). To avoid potential confusion arising from this dual usage, this study opts to use 'SEZ' as a generic term for all types of zones throughout the analyses, following the recommendation of Frick and Rodríguez-Pose (2023). The authors contend that the decision of many foreign firms to invest in developing countries is influenced by the presence of an SEZ in the area, regardless of the specific type of zone. Hence, while distinguishing between zone types may offer utility, it is not necessarily essential for evaluating the impact of SEZs in the SSA context.

2.1.2. Rationale for SEZ implementation

Despite yielding mixed results, SEZs have been mushrooming in developing countries with a notable recent surge in the SSA region. The literature has drawn upon several theoretical frameworks to understand the global attraction towards SEZs. Aggarwal (2006) employs the cluster approach (Porter 2000) to explain the competitive advantages of SEZs. The zones are conceptualized as industrial clusters that harness external economies of scale to lower costs, cultivate competitive production systems, and draw FDI. The author underscores the high expectations of developing countries regarding the role of SEZs in driving industrialization and economic growth. This perspective emphasizes the strategic positioning of SEZs as focal points for economic activities, with the aim of leveraging agglomeration effects to enhance competitiveness and attract investment. Similarly, Newman and Page (2017) emphasize the significance of agglomeration economies in justifying the establishment of SEZs. They argue that SEZs concentrate investments, social services, and infrastructure, creating environments conducive to industrial clustering. Through clustering, firms benefit from productivity spillovers, which contribute to economic acceleration. The authors highlight SEZ incentives such as tax breaks and subsidies, which aim to attract investment and stimulate employment, further enhancing productivity gains. This perspective underscores the role of SEZs as catalysts for spatial industrial policies and the creation of economic clusters with positive externalities.

Using an institutionalist approach, Hazakis (2014) provides a nuanced understanding of SEZs as dynamic entities that operate within specific institutional contexts. The author highlights SEZs' role in mitigating negative bureaucratic externalities, rent-seeking behaviours, risks arising from uncertainty and economic complexity, and deficiencies in innovation performance. This perspective underscores the significance of institutional frameworks in shaping the behaviour of economic agents within SEZs. Hazakis emphasizes that the effectiveness of SEZs relies on the continual adaptation of rules and norms to motivate and facilitate their implementation. SEZs are portrayed as mechanisms to navigate through institutional challenges and foster an environment conducive to economic development. With a similar institutional view, Moberg (2015) contributes a robust political economy framework to analyse the conditions under which SEZs can contribute to economic progress. Within this framework, SEZs are viewed as instruments that can either promote growth or lead to resource misallocation and rent-seeking, depending on the institutional context. The author emphasizes the importance of overcoming the knowledge problem (i.e. the concentration of decisional power within the hands of centralized political authorities who, despite being benevolent social welfare maximisers, may be too distant from the market and thus lack sufficient knowledge for designing the best model and structure for new SEZs) and aligning incentives to ensure SEZ success. Private zone development is proposed as a solution to address both knowledge gaps and incentive misalignments, as it allows decision-making to be driven by market knowledge and aligns developers' interests with SEZ success. This framework highlights the complexities of policymaking and the institutional environment in which SEZs operate.

Contrasting with previous contributions, Hartwell (2018) considers interactions between the micro-institutions of the zones and the outside world. The author questions the ability of SEZs to radiate beyond their physical borders and positively influence the national context in which they are raised. Hartwell introduces the concept of SEZs

as ‘small countries in a large country,’ highlighting their potential role in institutional development. SEZs are portrayed as distinct entities within existing institutional structures, capable of facilitating the transmission of institutional improvements back to the host country. This transmission is facilitated by the fact that SEZs maintain strong cultural, linguistic, and institutional ties with the host country, making it plausible for them to pass institutional development to the surrounding areas. Additionally, the competition created by SEZs can lead to institutional improvement through trade channels. Indeed, as shown by Levchenko (2013), trade between countries with similar endowments in terms of technology tends to increase ignite a ‘race to the top’ in institutional quality as it becomes an important element of differentiation. However, Hartwell (2018) acknowledges the limitations of SEZs in promoting broad-based institutional development. An important shortcoming in that sense is that SEZs tend to focus on a narrow set of institutions related to attracting investment and facilitating trade, such as property rights and investor protection, neglecting broader political and economic institutions. Furthermore, devolution of power to SEZs may cause inefficiencies, and economic institutions created in the SEZ environment may not survive integration into national life. The author suggests that African SEZs might have failed to transmit improvements because they relied on importing foreign institutions into the zones instead of leveraging existing indigenous institutions. This reducing the plausibility of a harmonious integration in the national context and thus compromising the transmission of improvements beyond the confines of the zones.

These contributions provide valuable insights into the rationale for implementing SEZs, emphasizing the importance of institutional frameworks, agglomeration economies, industrial clustering, and the potential for institutional transmission. Understanding these dynamics is essential for policymakers seeking to leverage SEZs as tools for economic development while addressing challenges such as rent-seeking behaviour and resource misallocation.

2.2. Empirical studies

2.2.1. SEZ adoption in Africa

Special economic zone programs have proliferated in Africa over the past 30 years. The number of SEZs on the continent has increased from 20 in 1990–238 in 2020. As of 2020, 31 out of 54 countries in Africa had embarked on SEZ deployment, and 7 additional countries were planning to do so. Approximately half of the zones on the continent are concentrated in East Africa, with Kenya itself hosting 61 SEZs as depicted in Figure 2. The subregion is followed by West Africa, accounting for approximately 24% of African SEZs boosted by Nigeria and its 38 zones. Other major SEZ hosts on the continent include Ethiopia (38 SEZs), Egypt (10 SEZs), and Cameroon (9 SEZs) based on 2020 figures (UNCTAD 2021).

Figure 3 displays the repartition of African SEZs by type of zones. On the continent, EPZs represent the most prevalent type of SEZ (31%), closely followed by FTZs (27%), industrial parks (21%), and SEZs in the narrower sense (19%). Freeports, on the other hand, are the least common type of SEZ in Africa, with only five zones identified as of 2020. These include the Mauritius freeport, the Mtwara freeport in Tanzania, the freeport of Monrovia in Liberia, and the Assab and Massaura freeports in Eritrea (Newman and Page 2017; UNCTAD 2021).



Figure 2. African countries with the most SEZs. Source: UNCTAD

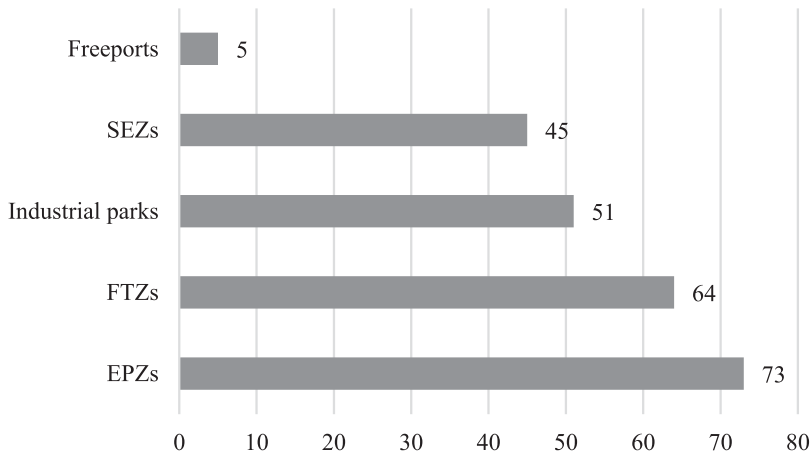


Figure 3. Number of African SEZs by type. Source: UNCTAD

As illustrated in Figure 4, fiscal incentives stand out as the most prevalent instruments utilized in African SEZ programs to entice firms and investments. As of 2020, approximately 87% of SEZs on the continent offered such incentives. Typical fiscal measures include tax exemptions extending up to 10 years, reduced tax rates, and tax deductions for skill enhancement programs targeting local workers employed within SEZs. Following closely, the second most commonly employed instrument in African SEZ policies (73%) is the implementation of special customs regimes. These typically involve duty-free imports of raw materials, machinery, equipment, and furniture for companies operating within SEZs.

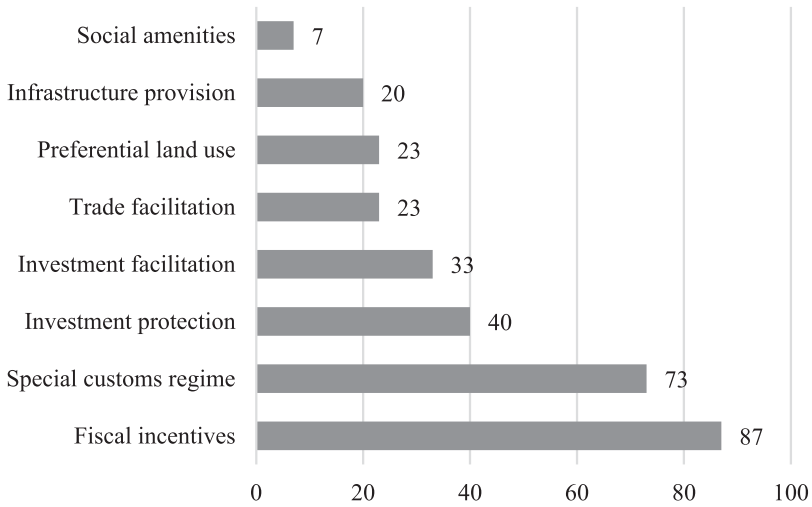


Figure 4. Incentives and services offered by SEZs (in percent). Source: UNCTAD

Investment protection and facilitation measures rank as the third and fourth most common instruments, reflecting the significant risk investors face in African countries due to political instability and institutional weaknesses compared to other regions. Protection measures often include safeguards against expropriation and assurances of equal treatment for foreign and domestic investors. Facilitation measures, on the other hand, frequently involve streamlining establishment procedures and providing technical assistance to SEZ firms. Additional facilitation actions may encompass relaxing constraints on the employment of foreign workers and profit repatriation for foreign-owned firms.

Trade facilitation measures aim to smooth trade flows by simplifying import and export formalities, such as removing import license requirements or developing online platforms for tax procedures. Some SEZ programs also offer preferential land use to hosted firms, including reduced lease and rent payments. Approximately 20% of African SEZs aim to attract firms by providing access to infrastructure, ranging from guaranteed provision of utilities to preferred access to ports and airports.

Social amenities, such as hospitals, educational institutions, recreational areas, prayer centres, and shopping facilities, are the least employed attraction tool in African SEZ programs, with only 7% of SEZs providing such services (UNCTAD 2021; Newman and Page 2017).

The effectiveness of fiscal incentives, traditionally the cornerstone of African SEZ policies, is increasingly subject to scrutiny. Despite their widespread use, fiscal incentives may prove insufficient or ineffective in attracting investment to developing countries. This inefficacy could arise from various factors, including low productivity, skill shortages, and other structural economic deficiencies that fiscal incentives fail to address. Rather than tackling the underlying causes of limited competitiveness in African nations, fiscal incentives may merely mask these structural economic deficits. Moreover, the uniformity of tax incentives offered within SEZs across different countries may diminish their appeal as a distinguishing factor for investment. This suggests that fiscal incentives

alone may not suffice to attract investment, especially when other countries offer similar incentives. Additionally, fiscal incentives, particularly when contingent on specific performance requirements, may run afoul of WTO regulations. This could result in legal challenges and trade disputes, undermining the attractiveness of SEZs as investment destinations. The provision of industrial infrastructure, including transportation networks, energy facilities, and communication systems, emerges as a critical aspect of SEZ policies. Infrastructure investment can enhance the appeal of SEZs by improving the business environment and operational efficiency (Narula and Zhan 2019; Rodríguez-Pose et al. 2022; Frick and Rodríguez-Pose 2023).

2.2.2. SEZ and export diversification

The proliferation of special economic zones has prompted a surge in studies assessing their impact on various aspects of economic development, including FDI attraction, trade promotion, job creation, and economic diversification. Aggarwal (2019), Narula and Zhan (2019), and Zeng (2021) offer comprehensive surveys of this literature. This section focuses on empirical contributions regarding the impact of SEZ implementation on export diversification in developing countries.

Aggarwal, Hoppe, and Walkenhorst (2008; 2009) provide insights from South Asia, analysing the cases of India, Sri Lanka, and Bangladesh. These countries, early adopters of SEZ policies, witnessed the establishment of their first zones in 1966, 1975, and 1983, respectively. The authors find evidence of SEZs stimulating export diversification in Sri Lanka and Bangladesh, both through the intensive and extensive margins. SEZs facilitated the expansion of existing export sectors in both countries, suggesting they facilitated the addition of production capacity and reallocation of existing products. In the context of Bangladesh, the analysis reveals that certain sectors, including clothing, footwear, leather, and textile products, had been significant exporters even before the establishment of special economic zones. However, following the creation of SEZs, the exports of these sectors experienced gradual growth, indicating a positive trajectory prior to the introduction of zones. Similarly, in Sri Lanka, sectors such as wearing apparel, leather, non-metallic mineral products, and food, beverages, and tobacco exhibited notable export volumes before the advent of SEZs. With the establishment of zones, the share of exports from these sectors within the SEZs expanded in parallel with existing export activities, underlining a trend of coalescence rather than a radical departure from pre-existing export dynamics. Moreover, SEZs played a role in creating new export sectors, adding certain product categories to the export portfolios of both countries. Following the creation of SEZs in the two countries, certain product categories, such as tents, fishing reels, camera parts and golf equipment, mainly originating from the zones, were added to the export portfolios of the two countries (Fakir, Miah, and Hossain 2013).

The general view states that the performance of SEZs in sub-Saharan Africa has been less promising than in other regions, with many countries experiencing limited success in attracting investments and promoting export-oriented activities (Farole 2011; ADB 2018; Aggarwal 2019). On average, SEZs in Africa have contributed no more than 25% to total exports, in stark contrast to the higher contributions observed in regions such as Russia, Honduras, Nicaragua, the Dominican Republic, China, the Philippines, and Asia, where figures range from 41% to as high as 82% (Karambakuwa et al. 2020). Mixed results characterize the relatively scarce literature on SEZ impact on export breakdown in SSA. For instance, Harry (2016) conducted an analysis of Nigeria's SEZ experience since its adoption in 1992, revealing no discernible impact on the country's export structure,

which has remained largely reliant on oil-based exports. The experiences of Madagascar and Mauritius serve as compelling success narratives within the sub-Saharan African region. Cling et al. (2005) underscore the pivotal role played by the *Zone Franche*, Madagascar's inaugural export processing zone established in 1990, in catalysing a significant surge in Malagasy exports. Remarkably, the *Zone Franche* accounted for nearly three-quarters of the increase in the country's exports from 1991 to 2001. Furthermore, the authors demonstrate that the *Zone Franche*, alongside other Malagasy zones, played a transformative role in reshaping the country's export structure. This transition involved a notable shift away from traditional agricultural products towards manufactured goods, notably clothing. Similarly, Gum (2014) conducted a study on Mauritius, highlighting the effectiveness of the country's SEZs in attracting foreign investment. The comprehensive range of incentives offered by Mauritius' zones, including a 10-year tax holiday, duty exemptions on imported equipment and raw materials, and freedom to repatriate capital, proved instrumental in swiftly attracting foreign investors, particularly from Hong Kong and other East Asian countries. This influx of FDI, combined with the proliferation of SEZs across Mauritius, facilitated a transformation in the country's export composition. Previously reliant heavily on sugar exports, Mauritius diversified its export portfolio to encompass textiles, apparel, processed fish and seafood, chemicals, among other sectors.

A recent empirical study by Davies and Mazhikeyev (2019) delves into the impact of special economic zones on firms' export behaviour across both the extensive (i.e. whether to export at all) and intensive (i.e. how much to export) margins. Drawing on data from 11,161 firms spanning 21 African and Asian countries, the authors conducted a rigorous analysis to estimate the effects of SEZ presence on firms' probability of exporting, export intensity, and the value of exports. The findings of the analysis reveal several notable insights. In open economies, SEZ firms were found to be 25% more likely to export compared to their non-SEZ counterparts. However, in closed economies, the presence of SEZs had a negative impact on exporting, suggesting variations in enforcement across different countries. At the intensive margin, SEZs were observed to increase the value of exports, particularly in countries where barriers to imports were prevalent, indicating a potential reduction in the cost of intermediate inputs. However, there was limited evidence suggesting that SEZs affected the share of sales earned from exporting. Overall, the study underscores the nuanced impact of SEZs on firm exports, revealing a conditional effectiveness based on the prevailing economic environment. SEZs appeared to positively influence the number of exporting firms in open economies, while their effects on value of exports were more limited. In closed economies, the introduction of SEZs may lead to greater exports spread across fewer firms.

This review of the literature underscores the potential of special economic zones in fostering export diversification, although their effectiveness appears less pronounced in the Sub-Saharan Africa region. Despite being informative, the existing body of literature, with the exception of the notable study by Davies and Mazhikeyev (2019), consists primarily of single-country analyses. Consequently, these studies offer limited insight into the broader regional patterns regarding the impact of SEZs on export structures. This paper seeks to address this gap in the literature by providing a comprehensive analysis of the impact of SEZs on export structures across the SSA region. Given the increasing prominence of SEZs within the spectrum of export-enhancing development policies in the region, such a study holds significant importance for informing policy decisions and advancing our understanding of the efficacy of SEZ interventions.

3. Empirical analyses

The proliferation of special economic zones is anticipated to foster the attraction of firms across diverse sectors, fostering technology spillovers and agglomeration economies that could support export diversification. To conceptualize the influence of SEZs on exports, this section employs a framework derived from the influential Melitz's trade model. Some testable hypotheses on the impact of zones on overall export diversification as well as on the intensive and extensive margins are then formulated. Subsequently, a difference-in-differences (DiD) approach is employed to evaluate these hypotheses and quantify the influence of SEZ programs on export diversification in Sub-Saharan Africa. In addition to the primary two-way fixed effects model estimated to assess the treatment effect of zones on exports diversification, a suite of alternative and state-of-the-art estimation techniques are employed to bolster the robustness of the findings.

3.1. Conceptual framework of exports diversification

Trade models featuring heterogeneous marginal costs at the firm level, alongside fixed market entry costs² and fixed costs associated with developing new products, as illustrated by the contributions of Baldwin (2005) and Helpman, Melitz, and Rubinstein (2008), which build upon Melitz's model, offer valuable insights into the variation in export diversification among countries (Dennis and Shepherd 2011). Under the assumption of monopolistic Dixit-Stiglitz competition, each firm is linked with a range of products that it can opt to sell either on the domestic market and/or export, incurring additional costs such as tariffs and transportation fees. In such HMCFMEC model, firms encounter three sunk costs prior to production. Initially, they must cover the standard Dixit-Stiglitz fixed cost of product development, denoted as F_i . Additionally, they face two fixed market entry costs linked to introducing their product into a market. These costs, designated as F_d and F_e for the domestic and export markets respectively, encompass a range of market-specific expenses, including compliance with market standards and regulations, establishment of brand identity, and setting up distribution channels (Baldwin 2005).

For this framework to comprehensively serve the purpose of this study, it must incorporate the level of innovation associated with the products introduced to the markets. Indeed, while traditional goods may affect diversification on the intensive margin, only non-traditional products are pertinent to the extensive margin. Let δ represent a factor quantifying the degree of innovation of the products, ranging from 0 for traditional products to 1 for varieties never previously produced in the country. To incorporate the level of innovation, the initial fixed costs are adjusted as follows:

$$F_I = (1 + \delta)F_i \quad (1)$$

$$F_D = (1 + \delta)F_d \quad (2)$$

$$F_E = (1 + \delta)F_e \quad (3)$$

Following an Hopenhayn mechanism of development, firms are assumed to be randomly assigned a particular marginal production cost (a_j) generated from a density function $G[a]$ with $supp(G) = \{0 \leq a \leq a_0\}$. Assuming a Pareto distribution of production costs (i.e. productivity), it can be shown that high-productivity firms are less likely to be found than low-productivity firms (Baldwin 2005; Helpman, Melitz, and

Rubinstein 2008; Dennis and Shepherd 2011). Let a_j , a_I , a_d , a_D , a_e , a_E denote the breakeven points corresponding respectively to the fixed cost with similar subscript. Assuming all firms considered cover at least the cost of developing a product regardless of if they can actually serve a market or not, individual firms self-select into five categories: (1) non-producers (NP) regrouping firms endowed with $a_j > a_d$ which are thus unable profitably serve the domestic market, (2) firms producing traditional products solely for the domestic market (TD) as they cannot cover the costs of innovation and exports with $a_d \geq a_j > a_D$, (3) firms providing non-traditional products for the domestic market exclusively (NTD) with $a_D \geq a_j > a_E$, (4) producers of traditional products which can export (and serve the local market) profitably (TE) characterised by $a_e \geq a_j > a_E$, and (5) exporters of non-traditional products (NTE) endowed with $a_E \geq a_j$. The model operates under the assumption that only the most productive firms can engage in exporting – a notion supported by Van Biesebroeck (2005) in the context of Sub-Saharan Africa. It is further argued, as posited by Fu, Mohnen, and Zanello (2018), that within each market (domestic or export), only the most productive firms can shoulder the additional costs of innovation (i.e. $a_d > a_D$ and $a_e > a_E$). This model does not aim to provide insights into the productivity disparity between innovative non-exporters and non-innovative exporters. Consequently, these two categories are allowed to overlap, as it does not compromise the framework's accuracy in achieving the objectives of this paper. Indeed, it is sufficient that the model ensures that only the most productive firms can export non-traditional products, thereby contributing to the extensive margin of exports. An additional assumption accompanying this conceptual framework is therefore that $a_E < a_D$. As a result, the remaining firms may only be responsible for the intensive margin (in the case of the least productive exporting firms) or domestic diversification – a dimension not addressed in this analysis.

Figure 5 illustrates the distribution of firms across the different profiles. SEZs, acting as catalysts for FDI and fostering a conducive business environment alongside agglomeration economies, are anticipated to elevate overall productivity levels in host countries. This improvement is expected to manifest in a greater presence of high-productivity firms, either through the attraction of more productive foreign enterprises or the enhancement of domestic firms, thereby stimulating export activity. However, owing to the additional costs associated with innovation, the impact of SEZ deployment is projected to be more pronounced on the trade of traditional goods rather than on the extensive margin. These considerations translate into two hypotheses that the current study will intend to test:

Hypothesis 1: The presence of SEZs has a positive impact on the level of export diversification in SSA countries.

Hypothesis 2: The impact of SEZ deployment is greater on the intensive margin than on the extensive margin.

3.2. Econometric model

The methodology employed in this study involves comparing pre – and post-implementation periods of SEZ programs to evaluate their impact on export diversification in the Sub-Saharan Africa region. To achieve this objective, a difference-in-differences research design is utilised, a commonly employed approach to assess the causal effects of policy implementations (Angrist and Pischke 2009).

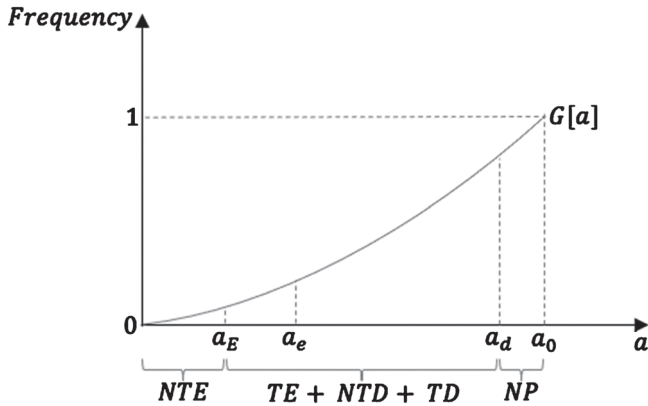


Figure 5. Distribution of firms.

The original configuration of Difference-in-Differences entails a model with two periods (pre – and post-treatment or policy implementation) and two groups (a treated group and a control group not exposed to the treatment). This setup allows estimation of the average treatment effect on the treated (ATT), assuming that in the absence of treatment, both groups would have followed parallel trends. However, the current analysis deviates from this canonical DiD format in several aspects. Firstly, it includes multiple periods both before and after treatment. Secondly, the timing of treatment varies among treated units, as countries’ adoption periods for Special Economic Zones (SEZs) may differ. Lastly, the parallel trends assumption may hold only after controlling for certain covariates. Following the approach outlined by Angrist and Pischke (2009), this DiD setup with staggered treatment can be addressed by estimating a two-way fixed effect (TWFE) model. The corresponding econometric model takes the following form:

$$Y_{i,t} = \alpha_i + \tau_t + \beta D_{i,t} + X'_{i,t} \Gamma + \varepsilon_{i,t} \tag{4}$$

The dependent variable, $Y_{i,t}$, represents the level of export diversification and is measured using the Theil export diversification index (EDI) proposed by Cadot, Carrère, and Strauss-Kahn (2011). This index comprises two components: the extensive margin index (EMI), which captures diversification resulting from the export of new products, and the intensive margin index (IMI), which assesses the balance of the mix of already exported products (IMF, 2014). Lower values of these indices indicate higher degrees of export diversification. Data on export diversification are sourced from the IMF’s Export Diversification and Quality database. The computation of these measures is discussed in appendix 1.

α_i and τ_t denote country and time fixed effects, respectively. $D_{i,t}$ is a treatment dummy variable that activates when a country establishes its first SEZ and remains active for all subsequent periods. Note that $D_{i,t} = 0$ for all observations in the control group. Information regarding SEZ creation periods is obtained from the research conducted by Newman and Page (2017), while the control group is identified based on the list of Sub-Saharan African countries without SEZs, as provided by UNCTAD (2021). Additional details on the treated and control groups are outlined in Table A1 (see appendix 2).

X' represents a vector of time-varying control covariates, which includes the logarithm of real GDP per capita, gross fixed capital formation (as a percentage of GDP), trade openness (the sum of exports and imports as a percentage of GDP), real effective exchange rate (the real value of a country's currency against a basket of 65 trading partners), and domestic credit to the private sector (as a percentage of GDP). Data on the real effective exchange rate (REER) are sourced from the Bruegel think tank database, while statistics on the other control variables are readily available in the World Bank database for the analysed period. Descriptive statistics of these variables are provided in Table A2 (see appendix 3).

The selection of control variables is informed by previous empirical studies on the determinants of export diversification. Research by Imbs and Wacziarg (2003) and Cadot, Carrère, and Strauss-Kahn (2011) suggests that countries at early stages of development tend to diversify their exports as their income level increases before beginning to specialise after reaching a certain income threshold. The IMF (2014) identifies this threshold at GDP per capita levels of around \$25,000-\$30,000. Given the relatively low income levels among SSA countries, it is anticipated that the logarithm of GDP per capita will exhibit a negative coefficient in the estimations.

The effect of trade openness on diversification is ambiguous. While traditional trade models predict specialisation based on comparative advantage, greater openness can reduce protectionism, fostering expansion in tradable sectors. Espoir (2020) observes a positive impact of trade openness on export diversification in the Southern African Development Community (SADC), while Agosin, Alvarez, and Bravo-Ortega (2012), based on a broader panel, provide evidence that trade openness induces specialisation rather than diversification.

The expected influence of the remaining control variables on export diversification measures is more clear-cut. Higher levels of gross fixed capital formation, indicating investments in production capacities and infrastructure, are expected to positively influence export diversification. This anticipation arises from the notion that increased investment in productive assets enhances a country's capacity to produce a variety of goods for export markets. Thus, gross fixed capital formation is expected to have a negative coefficient in the estimations, reflecting its positive effect on export diversification. Increased private sector credit alleviates liquidity constraints for firms and signifies improvements in the health of the financial sector (Agosin, Alvarez, and Bravo-Ortega 2012). Higher private sector credit levels are expected to correlate with lower levels of sectoral export concentration. Appreciations of the REER imply losses of competitiveness for domestic traded sectors compared to international counterparts (Darvas 2021). These losses in competitiveness may hinder local firms' access to foreign markets and lead to further concentration of exports. Therefore, real appreciations are expected to have a positive coefficient in the estimations, indicating the negative impact of the REER on export diversification.

Other potential determinants of exports diversification may include the efficiency of institutions and the availability of quality logistic infrastructure. However, these indicators were discarded from the TWFE estimations due to the lack of sufficient data for the SSA region. The study covers the period from 1970 to 2014 and includes data from 32 SSA countries.

3.3. Parallel pre-treatment trends assumption

Consider the observations $\{(Y_{i,1}, \dots, Y_{i,T}, D_{i,1}, \dots, D_{i,T}, X_{i,t})\}_{i=1}^N$ are independent and identically distributed. Following Callaway and Sant'Anna (2021), let $G_{i,g}$ be a cohort dummy variable taking value 1 if country i is first treated in period g , and zero otherwise; and let C be a dummy variable taking value 1 for the 'never treated' countries (i.e. the control group). Recall that once a country receives the treatment (i.e. starts a SEZ program), it remains treated for all periods onward.

The implementation of difference-in-differences seeks to estimate the average treatment effect on the treated units, expressed as:

$$ATT(g, t) = \mathbb{E}[Y_{i,t}(g) - Y_{i,t}(0)X, G_g = 1], \forall t \geq g \quad (5)$$

The identification of $ATT(g, t)$ requires pre-treatment parallel trends between the treated and the control group conditional on observed covariates. This implies that:

$$\mathbb{E}[Y_{i,t}(0) - Y_{i,t-1}(0)X, G_g = 1] = \mathbb{E}[Y_{i,t}(0) - Y_{i,t-1}(0)X, C = 1], \quad (6)$$

$\forall g \in G$ and $t \geq 2$.

Following the methodologies outlined in Jacobson, LaLonde, and Sullivan (1993) and He and Wang (2017), the conditional parallel pre-treatment trends assumption is tested by estimating the following equation:

$$Y_{i,t} = \alpha_i + \tau_t + \sum_{k=-6, k \neq -1}^5 \gamma_k D_{i,t}^k + X'_{i,t} \Gamma + \varepsilon_{i,t}, \quad (7)$$

with dummies $D_{i,t}^k = 1\{t - G_i = k\}$ indicating that country i is k periods away from the initial treatment time G_i . Five periods prior to and after the treatment are considered here. Note that $k = -1$ is omitted so that the post-treatment effects are relative to the last period before the start of the SEZ program. The parallel treatment assumption is said to hold if $\gamma_k = 0$ for all $k \leq 2$, meaning that the leads of treatment have no significant impact on $Y_{i,t}$ (He and Wang 2017).

Figure 6 displays the coefficients obtained from the estimation of Equation 7, with the 95% confidence interval represented by vertical lines. Notably, all pre-treatment coefficients for the three dependent variables are found to be nonsignificant. This tends to corroborate the conditional parallel trends assumption. Over the five years following treatment implementation, no significant effects of SEZ adoption on the overall diversification index and extensive diversification index are detected. However, SEZ programs appear to significantly contribute to more evenly balancing the mix of already exported products. On the other hand, SEZ programs seem to contribute significantly to balancing more evenly the mix of already exported products. Indeed, some significant coefficients are observed for the intensive component of diversification at the year zero. This preliminary analysis indicates that SEZ adoption may have primarily fostered export diversification in SSA countries through the enhancement of existing export lines rather than the development of new sectors.

3.4. Results

Table 2 presents the results obtained from the TWFE estimations for the three exports diversification indices. The analyses show some negative effects of SEZ adoption on

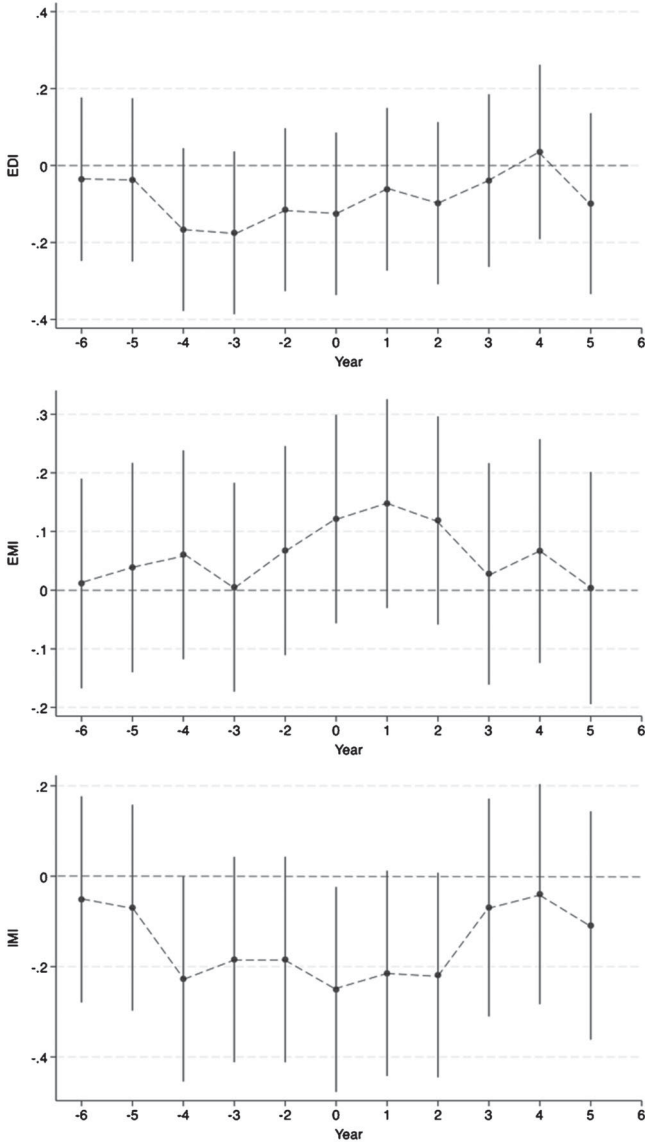


Figure 6. Time passage relative to year of SEZ adoption (vertical bands represent 95% confidence interval).

the overall export concentration measure (-0.178), while the ATTs associated with the extensive and intensive margins appear to be non-significant. These results tend to corroborate the first hypothesis as the implementation of SEZs appears to be significantly associated with a greater diversification of exports in the region. The estimated higher impact of SEZ adoption on the intensive margin (-0.180) compared to the extensive margin (-0.0124) is in line with *hypothesis 2*. However, the model provides no convincing support to that second hypothesis given the non-significant ATTs on both margins.

Table 2. TWFE estimations.

Variables	EDI	EMI	IMI
	(1)	(2)	(3)
Constant	1.214 (1.699)	2.370 (1.828)	-1.015 (2.214)
ATT	-0.178** (0.0861)	-0.0124 (0.128)	-0.180 (0.143)
Log (GDP per capita)	0.441* (0.268)	-0.182 (0.259)	0.596* (0.320)
Trade openness	0.0048** (0.0019)	0.0005 (0.0025)	0.00431* (0.00244)
Investment	-0.0099** (0.0050)	-0.0018 (0.0023)	-0.0077* (0.0045)
REER	0.0007* (0.0007)	-0.0005 (0.0005)	0.0011* (0.0006)
Domestic credit	-0.0103 (0.0108)	-0.0006 (0.0039)	-0.0095 (0.0070)
Observations	1,015	1,015	1,015
Adj. R-squared	0.202	0.161	0.161

Bootstrap standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Unexpectedly, increases in the income level are found to induce further sectoral concentration of exports. The significant positive coefficient of GDP per capita in the intensive margin equation tends to indicate that SSA countries appear to exhibit a less balanced mix of export shares among the already traded sectors as their development level increases. It should be noted that the idea of a U-shaped pattern between income level and exports diversification may still hold when considering diversification through the creation of new industries as suggested by the negative coefficient associated with the logarithm of GDP per capita in the EMI equation. However, the non-significance of this coefficient calls out for cautiousness in the interpretation.

Trade openness is found to be a significant determinant of exports diversification almost exclusively via the intensive margin component. This indicates that as countries in the region become more open to foreign markets, they tend to re-centre around a fewer number of traditional sectors, as suggested by Ricardian trade theory. As expected, increased levels of capital investments are associated with greater degrees of export diversification overall. In addition, gross fixed capital formation is found to foster a more even distribution of exports among the traditional sectors. Higher levels of investments also appear to be associated with the introduction of new sectors in the exports basket. However, this effect is found to be non-significant.

Exports diversification appears to be significantly linked the ability of domestic firms in traded sectors to compete with foreign companies. The TWFE estimations show that the competitiveness issues of domestic traded sectors vis-à-vis foreign producers induced by REER appreciations tend to lead to a greater concentration of traditional exports. No significant effect of REER appreciations is detected in the EMI regression. Finally, in line with expectations, increases in domestic credits to the private sector appear to enhance export diversification on both margins. However, the coefficients associated with that covariate are found to be non-significant for the considered sample.

It should be noted that none of the independent variables appears to significantly influence the extensive margin of exports diversification in these estimations. Moreover,

the descriptive statistics show that exports diversification in the region over the period analysed has been mostly driven by the intensive margin component. This tends to corroborate the idea that for economies at early stages of development such as most SSA countries, diversification through a better distribution of export shares of traditional sectors is a more reachable strategy than the emulation of new export sectors.

3.5. Robustness checks

A recent literature on DiD has shown that although the TWFE estimator performs well in the canonical two groups/two periods configuration, it has several flaws in cases of staggered treatment and heterogeneous treatment effects (see Borusyak, Jaravel, and Spiess 2021; Sun and Abraham 2021; De Chaisemartin and d'Haultfoeuille 2020; Goodman-Bacon 2021; Callaway and Sant'Anna 2021).

One of the main pitfalls of TWFE outside of the canonical context is the 'negative weight problem' associated with the ATT. Theorem 1 in Goodman-Bacon (2021) states that the ATT from TWFE estimation is a weighted average of all possible two-by-two DiD estimators. De Chaisemartin and d'Haultfoeuille (2020) argue that some of these weights can be negative despite summing up to one. It is thus possible to obtain negative ATT from TWFE estimation, while the effect of participating in the treatment is in fact positive for all units in all periods (Callaway and Sant'Anna 2021). Beyond this, theorem 1 in Goodman-Bacon (2021) also implies that TWFE estimation is sensitive to the time length of the panel, to the size of each group and to the moment at which the treatment is administered.

To overcome these flaws, the ATT is estimated using some alternative robust approaches proposed by Gardner (2021) and Callaway and Sant'Anna (2021). The first one consists of a two-stage DiD estimation procedure for the multiple group/multiple treatment period case, which separates the estimation of group and time effects from the estimation of the ATT. The first stage of the procedure consists of estimating the following equation:

$$Y_{g,i,t} = \lambda_g + \gamma_t + X'_{i,t}\Gamma + \varepsilon_{i,t}, \quad (8)$$

using only nontreated and not-yet-treated observations and retaining the adjusted outcomes $\hat{Y}_{g,i,t} = Y_{g,i,t} - \hat{\lambda}_i - \hat{\gamma}_t - \hat{X}'_{i,t}\Gamma$. The second stage then consists of regressing $\hat{Y}_{g,i,t}$ on $D_{g,i,t}$.

Callaway and Sant'Anna (2021) propose a doubly robust estimation of ATT that, instead of averaging all possible 2×2 DiD estimates, only focuses on a subset of comparisons that matter. For each cohort g , the only baseline period considered is the period $g - 1$. Additionally, for each cohort's average effect estimation, the data that do not belong to the concerned cohort or to the control group are dropped. In the case where no covariates are included³, Callaway and Sant'Anna (2021) identify the ATTs as follows:

$$ATT(g, t) = \mathbb{E}[Y_t - Y_{g-1} | G_g = 1] - \mathbb{E}[Y_t - Y_{g-1} | C = 1] \quad (9)$$

The authors also provide an alternative estimation of the treatment effects using the not-yet-treated units as a control group:

$$ATT(g, t) = \mathbb{E}[Y_t - Y_{g-1} | G_g = 1] - \mathbb{E}[Y_t - Y_{g-1} | D_t = 0] \quad (10)$$

Tables 3 and 4 present the results of estimations based on two-stage difference-in-differences and on the Callaway and Sant'Anna (2021) approach, respectively.⁴ In line

Table 3. ATTs based on Gardner's (2021) two-stage DiD approach.

Variables	EDI	EMI	IMI
	(4)	(5)	(6)
ATT	-0.3639** (0.1851)	0.0592 (0.1361)	-0.3947* (0.2398)
Observations	1,050	1,050	1,050
Adj. R-squared	0.100	0.033	0.095

Bootstrap standard errors in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 4. ATTs based on Callaway and Sant'Anna (2021) with non-treated and not-yet-treated as control groups.

Variables	CS (Non-treated)			CS (Not-yet-treated)		
	EDI	EMI	IMI	EDI	EMI	IMI
	(7)	(8)	(9)	(10)	(11)	(12)
ATT	-1.432 (1.236)	0.152 (0.393)	-1.851* (0.949)	-0.728* (0.393)	0.137 (0.148)	-0.741 (0.520)
Observations	573	627	629	892	897	906

Bootstrap standard errors in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

with the results from the TWFE estimations, significant treatment effects of SEZ adoption on exports diversification are found using the two-stage DiD approach. Moreover, this alternative estimation design detects some significant effects of SEZ on intensive diversification, while the extensive component of export diversification shows no reaction to SEZ deployment in SSA countries. Some significant treatment effects are also detected with the Callaway & Sant'Anna DiD estimation approach. Indeed, the model reveals a significant reduction of sectoral concentration of exports only in the specification using not-yet-treated units as the comparison group. The alternative specification using non-treated countries for comparison shows some SEZs induced exports diversification through the intensive margin.

The significant effects of SEZ implementation on the intensive margin detected with these new estimation techniques tend to give support to the second hypothesis. Indeed, both in terms of coefficient sizes and significance levels, the ATTs associated with IMI dominate the estimated effect of SEZ adoption on EMI. It should also be noted that the results from these alternative robust approaches suggest that the TWFE estimation may have underestimated the size of the ATTs. These newly estimated greater effects of SEZ deployment on exports diversification further comforts the validity of the first hypothesis.

Empirical studies on SEZ policies in the context of SSA countries are often limited due to the lack of exploitable data. The current study is no exception in that sense as some potential control variables were discarded due to insufficient data. Omitted controls include governance and infrastructure quality measures which are important determinants of the business climate. These indicators may influence the attractiveness of countries for foreign investors and are expected to have an impact on the emergence

Table 5. ATTs based on Gardner's (2021) two-stage DiD controlling for logistics and governance quality.

Variables	EDI (13)	EMI (14)	IMI (15)	EDI (16)	EMI (17)	IMI (18)	EDI (19)	EMI (20)	IMI (21)
ATT	-0.3582* (0.1976)	0.0849 (0.2088)	-0.4479* (0.2692)	-0.3639* (0.1875)	0.0592 (0.1686)	-0.4175* (0.2466)	-0.3447* (0.2031)	0.1393 (0.1680)	-0.4822 (0.3231)
Logistics quality	Controlled	Controlled	Controlled				Controlled	Controlled	Controlled
Governance quality				Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
Observations	1,013	1,013	1,013	1,050	1,050	1,050	1,013	1,013	1,013
Adj. R-squared	0.099	0.076	0.119	0.100	0.033	0.103	0.094	0.022	0.132

Bootstrap standard errors in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 6. ATTs based on Callaway and Sant'Anna (2021) controlling for logistics and governance quality.

Variables	CS (Non-treated)			CS (Not-yet-treated)		
	EDI	EMI	IMI	EDI	EMI	IMI
	(22)	(23)	(24)	(25)	(26)	(27)
<i>A. Controlling for logistics quality</i>						
ATT	−0.490** (0.196)	−2.061 (0.808)	−0.481 (0.409)	−0.547** (0.269)	−0.339 (0.311)	−0.311 (0.237)
Observations	364	433	444	829	825	841
<i>B. Controlling for governance quality</i>						
ATT	−0.961** (0.447)	0.579 (0.538)	0.109 (0.550)	−0.479 (0.321)	0.634 (0.482)	−0.360 (0.343)
Observations	569	576	590	863	849	884
<i>C. Controlling for logistics and governance quality</i>						
ATT				−0.453* (0.254)	−0.159 (0.148)	−0.153 (0.287)
Observations				806	801	821

Bootstrap standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

of new activity sectors as well as on the capacity of firms to export. Considering that SEZs are aimed at making up for the poor business climates of the countries in which they are deployed, controlling for such variables may be necessary. An imperfect yet informative attempt to overcome the data availability issue in the current study is to control for these indicators by averaging the available entries for the period observed. To capture the effect of governance quality, the average of the Rule of Law (RoL) score developed by Kaufmann, Kraay, and Mastruzzi (2010) was included in the estimations. The RoL assesses the level of confidence agents have in, and their adherence to, societal rules, including the quality of contract enforcement, property rights, law enforcement, judicial systems, and the prevalence of crime and violence. Uninterrupted RoL data starting from the year 2000 are available via the World Bank database. The quality of infrastructure on the other side has been accounted for by adding the average of the quality of trade and transport-related infrastructure measure from the Logistics Performance Index survey conducted by the World Bank. Values of the index range from 1 (low) to 5 (high). Data are available for every two-year starting from 2010. The average for each country is thus based on three observations.

Unlike TWFE estimations, which by construction allow only time-varying control variables, the alternative methods employed here admit non-varying covariates. The average measures of governance and logistics quality can thus be included in the estimations of the ATTs. Tables 5 and 6 display the treatment effects after including each new control variable separately then jointly. The stimulating effect of SEZ implementation on exports diversification remain significant for all the two-stage DiD specifications as well as for most of the estimations based on the Callaway and Sant'Anna's approach. The dominance of the intensive margin component over the extensive margin also appear to hold when accounting for governance and logistics quality separately in the two-stage DiD estimations. In all the other specifications however, the ATTs on the IMI become non-significant after accounting for the new controls both separately and jointly.

4. Conclusions

In conclusion, this paper has delved into the relationship between special economic zones (SEZs) and export diversification in Sub-Saharan Africa (SSA). Export

diversification is a crucial goal for developing countries, as it not only promotes economic growth but also mitigates the risks associated with volatile commodity prices and external shocks. SEZs, as instruments of industrialization policies, have been increasingly adopted by SSA countries with the aim of attracting foreign direct investment (FDI) and fostering the development of new industries.

Through a meticulous empirical analysis using robust difference-in-differences estimation techniques, the study reveals several key findings. Firstly, the implementation of SEZs appears to have a significant positive impact on export diversification in SSA countries. This finding aligns with the initial hypothesis and underscores the potential of SEZs as catalysts for economic growth through trade diversification. Secondly, the study highlights the nuanced nature of the impact, suggesting that SEZs predominantly influence export diversification through the intensive margin rather than the extensive margin. This implies that African SEZs have contributed more significantly to enhancing the balance and competitiveness of existing export sectors rather than spurring the creation of entirely new sectors. Furthermore, the study highlights the importance of considering various factors influencing export diversification, such as income levels, trade openness, competitiveness, and capital investments. While higher levels of income and trade openness appear to induce further sectoral concentration of exports, real effective exchange rates depreciations and increased capital investments are found to foster both overall export diversification and the balancing the exports basket.

Overall, this study contributes to the existing literature by offering a comprehensive analysis of the impact of SEZ adoption on export diversification. The results suggest that while SEZs hold promise as tools for economic development, policymakers should carefully consider the design and implementation of these zones to maximize their effectiveness in promoting export diversification and sustainable growth in the region. For instance, the ineffectiveness of African SEZs in stimulating new export sectors may be rooted in the predominance of fiscal incentives as attraction tool. While fiscal incentives like tax breaks and one-stop shops can influence the final location of investment within a country, they may not be sufficient on their own to drive sustained economic growth within SEZs, particularly in African countries. Instead, policymakers should focus on addressing underlying economic deficits and investing in critical infrastructure to enhance the attractiveness and competitiveness of SEZs.

Notes

1. A notable exception in the African context highlighted by Farole (2011) is the case of Ghana where the implementation of single factories licensed as free zones companies but allowed to be located anywhere in the country amassed more than 2.8 billion USD of FDI.
2. Referred to as HMCFMEC models.
3. See Callaway and Sant'Anna (2021) for identification of ATTs with covariates included.
4. Two-stage DiD estimations are performed using the “did2s” R package (Butts & Gardner 2021) and the Callaway & Sant'Anna estimators are obtained via the Stata module “csdid” (Callaway and Sant'Anna 2021; Sant'Anna and Zhao 2020; Rios-Avila, Callaway, and Sant'Anna 2022). Note that all equations account for control variables. However, the corresponding coefficients are not reported after the use of “did2s” and “csdid” which only display the ATTs.
5. The IMF Export Diversification and Quality database from which data for diversification indices are extracted for this study, uses trade flows at the 4-digit SITC (Revision 1) level. This corresponds to 625 potential export lines.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Appendices

Appendix 1. Computation of the export diversification index

Following Cadot, Carrère, and Strauss-Kahn (2011), let N be the total number of potential export lines and μ be the export value in USD for each line. Note that N will depend on the export categorization system and on the level of aggregation of items.⁵ Consider K subgroups within the entire set of potential export lines. The first subgroup includes the products traditionally exported by country i . This corresponds to products that were exported in the first period observed. The second subgroup includes nontraded products. These are items for which no exports are observed for all periods observed for country i . The last subgroup is composed of new export lines. These correspond, at time t , to products that have been nontraded in at least the two previous years and then exported in the two following years by country i . Note that while the ‘New’ subgroup may vary overtime for country i , the ‘Traditional’ and ‘Non-traded’ subgroups remain unchanged.

Let N_k be the total number of products in each subgroup and μ_k the average export value per subgroup. The intensive and extensive margin indices are country i in year t as follows:

$$EMI_{i,t} = \sum_k \left(\frac{N_{k,i,t}}{N} \right) \left(\frac{\mu_{k,i,t}}{\mu_{i,t}} \right) \ln \left(\frac{\mu_{k,i,t}}{\mu_{i,t}} \right) \tag{5.1}$$

and

$$IMI_{i,t} = \sum_k \left(\frac{N_{k,i,t}}{N} \right) \left(\frac{\mu_{k,i,t}}{\mu_{i,t}} \right) \left[\frac{1}{N_k} \sum_{j \in k} \left(\frac{x_j}{\mu_k} \right) \ln \left(\frac{x_j}{\mu_k} \right) \right], \tag{5.2}$$

where x_j represents the export value of product j . The Theil index of exports is the sum of the two margins.

Appendix 2. Treatment and control groups

Table A1. List of countries per group

Country	Treatment	SZE adoption
Togo	1	1989
Cameroon	1	1990
Kenya	1	1990
Mauritius	1	1990
Nigeria	1	1992
Ghana	1	1995
Zimbabwe	1	1996
Mozambique	1	1998
South Africa	1	1999
Tanzania	1	2002
Gambia	1	2005
Senegal	1	2007
Zambia	1	2007
Cote d'Ivoire	1	2008
Madagascar	1	2008
Angola	1	2009
Gabon	1	2010
Rwanda	1	2011
Congo, Dem. Rep.	1	2012
Sierra Leone	1	2012
Benin	0	-
Burundi	0	-
Central African Republic	0	-
Chad	0	-
Comoros	0	-
Guinea-Bissau	0	-
Malawi	0	-
Mali	0	-
Niger	0	-
Sao Tome and Principe	0	-
Seychelles	0	-
Somalia	0	-

Appendix 3. Descriptive statistics

Table A2. Descriptive statistics

Variable	Mean	Std. Dev.	Min	Max	Observations
<i>A. Full sample</i>					
EDI	4.308818	.9316272	1.784281	6.330621	1,440
EMI	.6590604	.7020673	-.061267	3.233945	1,438
IMI	3.596383	.998329	1.568666	5.960357	1,440
log (GDP per capita)	6.907431	.9341371	5.119464	9.628238	1,312
Trade openness	59.13072	28.65666	6.320343	225.0231	1,182
Investment	20.02317	9.948408	-2.424358	89.38105	1,131
REER	144.4329	104.4214	24.75845	1954.183	1,320
Domestic credit	16.77035	18.89965	.0077258	142.422	1,205
<i>B. Treated group</i>					
EDI	4.087293	1.009597	1.784281	6.330621	900
EMI	.5589058	.5750672	-.0584639	3.233945	898
IMI	3.529629	.9735089	1.659763	5.846324	900
log (GDP per capita)	7.085316	.8928171	5.119464	9.628238	856
Trade openness	62.13393	26.72338	6.320343	152.5471	770
Investment	20.99109	10.46818	-2.424358	89.38105	731
REER	144.9682	121.7379	24.75845	1954.183	845
Domestic credit	19.77815	22.77803	.0077258	142.422	751
<i>C. Control group</i>					
EDI	4.678025	.6313343	2.120005	6.115582	540
EMI	.8256139	.8480774	-.061267	2.86956	540
IMI	3.707639	1.029708	1.568666	5.960357	540
log (GDP per capita)	6.573507	.9192948	5.392851	9.572786	456
Trade openness	53.51792	31.22576	20.0568	225.0231	412
Investment	18.25427	8.657378	2.732897	60.15617	400
REER	143.4807	62.86607	71.15722	418.1472	475
Domestic credit	11.79489	7.110437	.4025806	38.88238	454
<i>D. Not-yet-treated group</i>					
EDI	4.211717	.97382	1.784281	6.330621	630
EMI	.6437058	.6060974	-.0584639	3.233945	629
IMI	3.569033	.9926765	1.659763	5.846324	630
log (GDP per capita)	7.034461	.9107771	5.119464	9.628238	586
Trade openness	58.45415	26.83092	6.320343	152.5471	500
Investment	20.20998	11.49288	-2.424358	89.38105	464
REER	161.7345	141.0526	24.75845	1954.183	594
Domestic credit	16.0997	16.48749	.0077258	105.5439	494