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SPECIAL ECONOMIC ZONES AND LOCAL ECONOMIC ACTIVITIES IN ETHIOPIA.

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SPECIAL ECONOMIC ZONES AND LOCAL ECONOMIC ACTIVITIES IN ETHIOPIA.

Matthew Amalitinga Abagna*†

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Abstract

Do Special Economic Zones (SEZs) increase local economic activities in developing countries? This paper explores this question by examining the aggregate district economic effects of SEZs, a place-based development policy in Ethiopia. The study relies on time and district variation in the establishment of SEZs to evaluate the within-district changes in nighttime light, a proxy for district economic activities. The Difference-in-Difference estimates show an increase in the average nighttime light of SEZs districts after the SEZs became operational. The effect varies with the SEZs type. SEZs with bigger land sizes and SEZs that operate in sectors other than textiles, garment and the leather industry tend to generate more economic activities in the SEZs districts. The impact is also positive and significant for publicly managed SEZs relative to privately managed SEZs. The study further explores whether SEZs generate spillover effects on the economic activities of districts bordering the SEZs districts. Overall, there is no consistent evidence that the policy has any significant effect on the economic activities of the SEZs commuting districts.

Keywords: Special Economic Zones, Economic Activities, Nighttime light, Ethiopia, Sub-Saharan Africa.

JEL Classification: F13, O25, O38, O55, R11

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1 Introduction

SEZs[1] as a place-based policy have made a rebound in policy and academia as a policy tool for fostering economic development. The driving force behind the resurgence has been the growth miracle of the "East Asian Tigers" attributed to the pursuit of industrialisation using SEZs. China, for instance, began its market-oriented reforms by experimenting with SEZs in the coastal provinces, which subsequently became the country's manufacturing and export hubs (Alder et al., 2016; Lu et al., 2019). The Chinese experience has resulted in a proliferation of SEZs in developing countries seeking export-led economic growth and regional development. Recent estimates from UNCTAD (2019) show that there are nearly 5,400 SEZs globally, with developing countries accounting for more than half.

While there are empirical studies on the effectiveness of SEZs as a place-based policy in developed countries and among the "East Asian Tigers", example Wang (2013); Alder et al. (2016) and, Lu et al. (2019) for China and Alkon (2018)and Görg et al. (2022) for India, there are no empirical studies that explicitly look at the development outcomes of SEZs among the late-comers like the Sub-Saharan African (SSA) countries. The economic implications of the policy for these countries are likely to vary from the existing evidence because of their unique institutional arrangement and the opportunity to learn the best SEZs policy practice from the early adopters. Besides the unique institutional setting, there are also concerns that SEZs are a new trade protectionist policy that causes the reallocation of economic activities from neighbouring districts into the SEZs districts leading to a zero-sum effect (Glaeser and Gottlieb, 2009; Neumark and Kolko, 2010; Grant, 2020). These unintended impacts of SEZs raises fundamental questions of whether SEZs increase the overall economic activities of the target areas and whether developing countries like Ethiopia, with considerable fiscal constraints, should continue to extend tax breaks to SEZ firms in order to spur economic development.

This study attempts to answer these questions and extend our understanding of the policy effects beyond the developed countries and the "Asian Tigers" by providing the first empirical evidence of the local economic effects of SEZs in Ethiopia. Ethiopia is one of the countries in SSA that adopts SEZs as a central element of its industrial policy. The state is constructing industrial parks across the country to mitigate the growing regional economic disparities and nurture the domestic private sector through demonstration and competition effects and technology transfer (Oqubay et al., 2020; Tesfachew, 2021). Currently, there are 14 operational SEZs, with several additional SEZs in various planning and construction stages.

[1]SEZ is an umbrella term which encompasses Free Trade Zones, Export Processing Zones, Industrial Parks and Free-ports. Among the many benefits of SEZs is a more relaxed regulatory environment, which increases the overall ease of doing business. The direct benefits for districts hosting successful SEZs can be significant: a well-performing SEZ with solid foreign investment can create thousands of jobs while also building the capabilities of the local workforce as outside investors share expertise and know-how and enhancing regional economic activities (Farole, 2011).

The paper examines the impact of SEZs on district economic activities using nighttime light data that Henderson et al. (2012) and Michalopoulos and Papaioannou (2014) link to economic growth as a proxy for district-level economic activities. Nighttime light data which is available in small grids in each district, the smallest administrative unit in Ethiopia, is combined with district population and proximity to transportation hubs and SEZ data from 2012 to 2020 to form a comprehensive dataset for the analysis. Uses of such data overcome data availability problems that plague the study of the economic effects of SEZs in developing economies.

I employ a Difference-in-Difference (DiD) estimation strategy to compare SEZ's district nighttime light before and after the SEZs became operational with districts without SEZs. To determine the spatial reach of the SEZs effects, the analysis is extended to districts directly bordering the SEZs districts (first-level commuting districts) and districts adjacent to the first-level commuting districts (second-level commuting districts). One of the main concerns in this type of analysis is that SEZs are not randomly assigned, which may result in bias estimates. The paper addresses this concern by adopting an entropy balancing approach suggested by Hainmueller (2012) to create a balanced panel of SEZs districts matched with non-SEZs districts. The balanced panel considers the glaring pre-treatment difference between SEZs and non-SEZs districts.

The results indicate that the introduction of SEZs increases economic activities in the affected districts. The average nighttime light of districts with SEZs increases by 6 units compared to districts without SEZs over the sample period. The results are robust to an entropy balancing approach and further alternative estimation strategies. While the overall results suggest that SEZs generate no net spillover effects on the commuting districts, a heterogeneous analysis provides evidence supporting the argument that SEZs cause the reallocation of economic activities from first-level commuting districts to SEZ districts. Thus, at best it seems that the positive effects of SEZs are confined to the SEZs districts.

Overall, the results provide suggestive evidence that the country's SEZs policy enhances the local economic activities of SEZs districts. The findings are consistent with the rationale for implementing SEZs in the country, thus using incentive packages to attract highly productive firms into the SEZs location resulting in economic agglomeration. That said, the results appear to validate the concerns that SEZs have a "beggar-thy-neighbour" effect as some districts neighbouring the SEZs districts lose economic activities potentially to the SEZs districts after the SEZs become operational.

The paper contributes to the growing literature on place-based policies in developing countries. Wang (2013) explores the municipal-level economic effects of SEZs in China and conclude SEZs increase FDI and economic agglomeration in municipalities with SEZs. Subsequent studies by Alder et al. (2016) and Lu et al. (2019) also find positive effects of SEZs on sub-national investments, employment, GDP (proxied by nighttime light), wages, and firm total factor productivity in provinces with SEZs. Whereas there is consensus that SEZs lead to economic agglomeration in China, the story is different and rather disappointing in other developing countries.

In India, Cheesman (2012) documents that the Export Oriented Units (EOUs) result in technological and skills spillovers to non-SEZs firms in the host districts compared to the traditional SEZs. These findings are echoed by Alkon (2018) and Görg et al. (2022), who find no effects of SEZs on employment and firm total factor productivity in sub-nationals with SEZs. Similarly, Rothenberg et al. (2017) demonstrated that the Integrated Economic Development Zone program in Indonesia, which provides incentives to firms in lagging regions, has no impact on output, increased firm entry or welfare. These results cast doubts on the effectiveness of SEZs in extending benefits such as enhanced economic activities to areas outside the zone enclaves relative to the Chinese experience.

In Africa, although the aggregate effects of SEZs at the sub-national level are unknown, the few descriptive studies available point to a rather uninspiring performance (Farole, 2011; Farole and Moberg, 2014; Newman and Page, 2017; Frick and Rodríguez-Pose, 2021). They ascribed the unpromising performances to weak institutions that encourage destructive rent-seeking and a lack of proper planning, leading to no linkages to the local economy. While these studies at least highlight the general picture of the policy effectiveness in the sub-region, it is equally important to bring to light the empirical evidence on the SEZs and economic activities nexus to broaden our understanding and guide policymakers in the sub-region. This paper bridges this literature gap by providing the first empirical assessment of the district economic effects of SEZs in SSA using Ethiopia as a case study.

The second contribution of the paper is the advancement of the literature on the spillover effects of SEZs in developing countries by explicitly considering the reach of SEZs. Similar to the development effects of SEZs on the host districts, the available evidence on the spillovers from SEZs districts to commuting towns is also mixed. Whereas Alder et al. (2016), Zhang et al. (2018) and Lu et al. (2019) find positive effects of Chinese SEZs on the commuting areas, Alkon (2018) and Görg et al. (2022) provided contrary views on the policy impact on commuting towns in India. Görg et al. (2022) observed SEZs in India tend to have a negative effect on the productivity of firms around the SEZs. Frick and Rodríguez-Pose (2021) analysed the linkages between SEZs firms and firms outside SEZs across seven developing countries and find no spillover effects to the non-SEZs firms. To the best of my knowledge, the current paper is the first study on the spatial reach of SEZs spillover effects in the context of SSA.

The rest of the paper proceeds as follows. Section 2 provides an overview of the evolution of SEZs policy in Ethiopia, specifically the number of zones, legal framework and incentive packages for tenants and developers of SEZs. Section 3 briefly discusses the conceptual framework of SEZs and local economic activities and, thus, how the policy may induce economic activities at the host and the commuting districts. Section 4 presents data and descriptive statistics. Sections 5 and 6 present the identification strategy employed in answering the research questions and a discussion of the empirical results. The final section offers a summary, concluding remarks and policy implications.

2 Special Economic Zones in Ethiopia

The Ethiopian SEZ policy is a component of a broader development plan dubbed the "Growth and Transformation Plan[2](GTP II)". The GTP II seeks to transform the country into a low-middle-income economy by implementing economic policies that will help restructure the economy into a modern agricultural and industrial hub in Africa. Drawing inspiration from China, Ethiopia's policymakers believe SEZs will trigger industrialisation in the textile and garment industry, leather and leather products, and agro-processing sectors, which constitute the country's major economic activities. Investment in these sectors is intended to address the country's growing unemployment and spatial inequalities. In particular, the textile and garment industry, where most SEZs operate (see Figure 1[3]), is the leading employment avenue for low-skill workers and rural dwellers.

A distinctive feature of the Ethiopian SEZ policy is the institutional structure developed to facilitate collaboration across agencies dealing with SEZ policy, investment promotion, implementation of intervention across different policy sectors and the formulation of investment rules. The government modified existing institutions and instituted new ones like the Ethiopian Investment Board (EIB), which is responsible for policy, strategy and oversight of the country's investment promotion and industrial policy. Similarly, the Ethiopian Investment Commission (EIC) oversees the daily running of the SEZs with the additional mandate to conduct investment promotion and attract investors to the target sectors. The EIC further regulates SEZ developers and operators. The country's SEZ policy is implemented under the 2012 Investment Proclamation Regulation legal framework(Tesfachew, 2021).

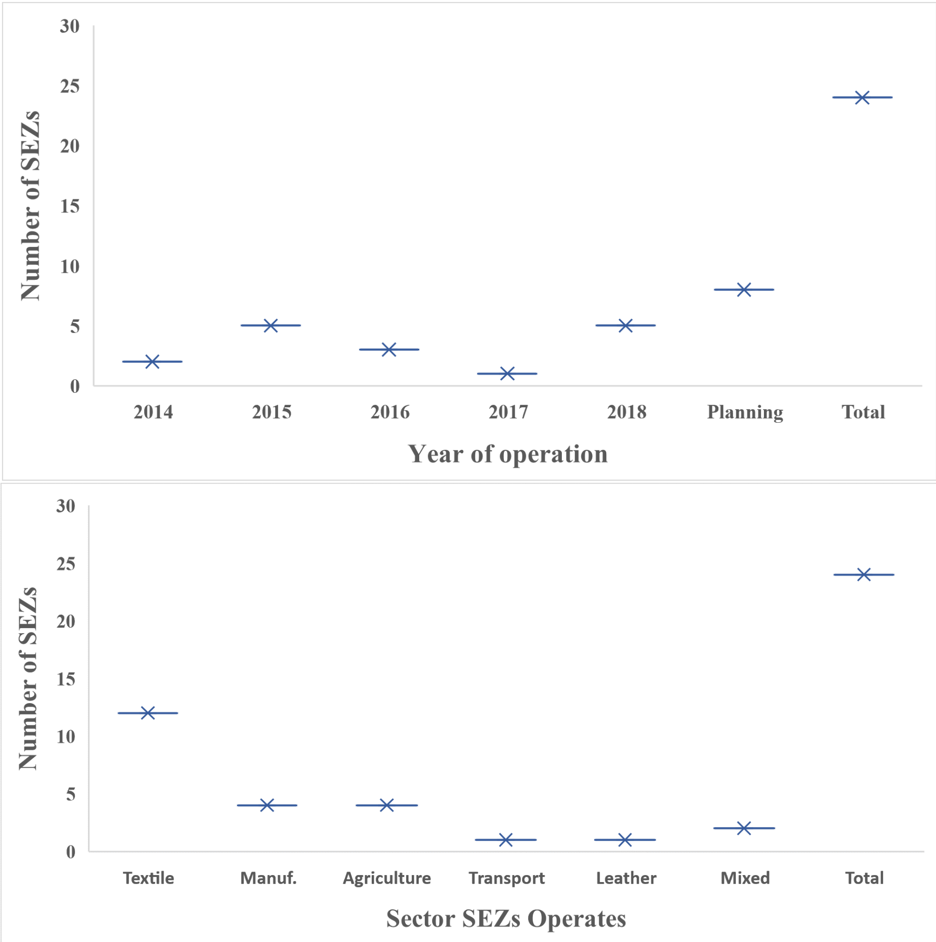
The Bole Lemi SEZ (phase 1), one of the country's modern state-owned SEZs, is the first SEZ commissioned after the 2012 Investment Proclamation Regulation. Subsequently, more state and privately-owned parks have been inaugurated. Presently, there are twenty-four[4] SEZs, of which fourteen are operational. Private developers own seven

[2]See the Federal Democratic Republic of Ethiopia Growth and Transformation Plan II (GTP) (201/16-2019/20), available at: https://www.greengrowthknowledge.org/national-documents/ethiopia-growth-and-transformation-plan-ii-gtp-ii

[3]The figure includes inactive SEZs, thus SEZs under construction.

[4]SEZ related information available at: https://investethiopia.gov.et/index.php/investment-opportunities/other-sectors-of-opportunity/government-and-private-parks.html.

Figure 1: SEZs by Year and Sector of Operation



SEZs, while the remaining seven are state-owned. The private SEZs are developed and managed by private developers, with the Ethiopian government providing the needed infrastructure (roads, electricity, etc.) within the parks (Giannecchini and Taylor, 2018).

Common to every place-based policy, firms operating in state and private SEZs enjoy some fiscal and non-fiscal incentive packages. The fiscal incentives available to all SEZs in the country include the following:

- Investors are given an income tax exemption for a maximum of 10 years, while developers get 15 years.
- Loss during the income tax exemption period is carried forward after the exemption period.
- Export tax exemption for all products except for hides and skins.
- Customs duty exemption for capital goods, construction materials, and personal effects.
- SEZs firms benefit from export credit guarantee schemes that ensure exporters receive payment for goods shipped overseas if the customer defaults.

The non-fiscal incentives comprise the following:

- Guarantee against expropriation, payment of compensation equivalent to the prevailing market value of the investment in case of expropriation.
- Foreign investors are free to repatriate in convertible foreign currency profits and dividends, principal and interest payments on external loans, proceeds from the sale or liquidation of an enterprise, and compensation paid.
- Exporters are allowed to indefinitely retain and deposit up to 30% of their foreign exchange earnings in a bank account. They can also make use of the remaining 70% balance within 27 days.
- The National Bank of Ethiopia imposes no export price control.

In addition to the fiscal and non-fiscal incentives, each SEZ has a one-stop services centre for processing and issuing investment permits, tax clearance and business licences, work permits, and banking services. The one-stop service centre reduces the bureaucracy and the potential rent-seeking by government officials during business registration. Each SEZ has a dedicated power sub-station to ensure a constant power supply. Other amenities provided by the state include waste treatment facilities, fire brigades, and health posts.

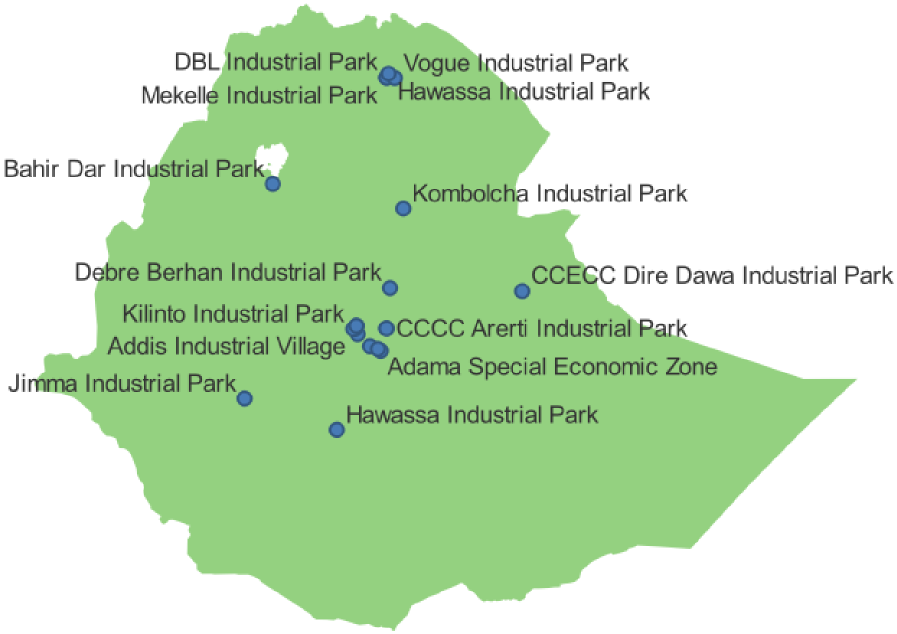
The SEZs are not uniformly distributed across the country (see Figure 2) but are situated along key development corridors with a distinct speciality. The location arrangement allows the SEZs to specialise, leading to economies of scale and the formation of economic clusters. The economic clusters are expected to increase the export performance of the country and enhance the skills of the local labour force by developing a pool of trained industrial workers. The long-term prospects are to enhance backward and forward linkages in the broader economy as the clusters serve as a mechanism for firms outside and within the zones to interact, leading to technological upgrading and enhanced productivity of local firms.

A snapshot of the cost vis-à-vis the performance of the country's SEZ policy highlights that by June 2018, total capital invested in SEZs during the preceding three years period is approximately $180 million annually, accounting for 5% of the country's inward FDI. Nearly 70,000 jobs were created by the SEZs by the end of the 2019 fiscal year, with women accounting for 80% of the country's SEZs employees. Within the same period, exports from the SEZs reached $142 million, accounting for 5% of the country's total manufactured goods exports[5].

On the whole, the country's SEZ policy provides an additional economic development tool to revitalise existing industrial fabrics and promote rapid sub-national economic de-

[5]Data from "Reflecting on the "how" of Ethiopia's industrialisation push" a 2020 policy report produced by The Tony Blair Institute for Global Change. Report available at: https://institute.global/advisory/reflecting-how-ethiopias-industrialisation-push

Figure 2: Map showing the locations of Ethiopia Special Economic Zones.



velopment. However, the increasing number of SEZs carries immense opportunity costs for the country. The government finances the construction of the SEZs with debt instruments, and tax revenue is forgone during the tax breaks, further exacerbating the country's fiscal deficit.

3 Conceptual Framework

The economics literature extensively documents the benefits and the drivers of agglomeration economies (Duranton and Puga, 2004; Baldwin and Okubo, 2006; Rosenthal and Strange, 2020). As first hypothesised by Marshall (1920), a reduction in transportation costs is one of the reasons why firms locate close to one another. For instance, suppliers of inputs in a large industrial enclaves of downstream firms can exploit economies of scale while benefiting from timely delivery, lower inventory costs and specialised inputs tailored to their needs. According to Newman and Page (2017), this results in higher returns for upstream firms and easy access to a broader range of customer inputs. Also, workers with skills relevant to the sector in which the clusters operate will move closer to the clusters, further attracting additional firms that deem the abundant skilled labour supply relevant to their industry since there is a better matching of workers to jobs. Finally, the possible exchange of knowledge between workers and entrepreneurs is also more likely when firms are in close proximity (Jaffe et al., 2000).

These benefits presume that areas with dense economic activities tend to flourish primarily due to the productivity benefits that emerge from firms in proximity to one another. The benefits associated with agglomeration, therefore, favour the application of place-based policies like SEZs that influence the location choice of firms as an effective tool for accelerating economic activities in lagging regions. The tax breaks, subsidies, and the relaxed regulation associated with SEZs imply that they will attract high-productivity firms capable of increasing investment, creating employment and demanding inputs from the local economy as emphasised by (Duranton and Puga, 2004). Over time, suppliers to the SEZ firms and the local employees are likely to move closer to the SEZs to reduce transportation costs and take advantage of the productivity and knowledge spillovers from the SEZs, ultimately resulting in the increased economic activities of the SEZ districts.

Spatial proximity to an SEZ may also generate agglomeration effects (Kline and Moretti, 2014; Newman and Page, 2017; Frick et al., 2019). Districts bordering the SEZs districts may witness spillover effects based on the interaction between firms within and outside the SEZs. The existing literature shows that place-based policies such as SEZs sometimes increase real estate prices in the host districts due to increased economic activities (Koster and Van Ommeren, 2019). If the prices of real estate increase, many firms may opt for other districts close to but not in the SEZs, gradually leading to an increase in the economic activities of the commuting districts. The SEZs effects on the economic activities of the commuting districts may attenuate with distance to the SEZs, with the first-level commuting districts likely to experience more spillovers relative to the second-level commuting districts. Alternatively, we may also expect some commuting districts' economic activities to shrink over time after the nearest SEZs become operational due to the relocation of firms from those commuting districts to the SEZs districts to exploit spillovers from the SEZs, thereby creating negative externalities to the commuting districts.

Although the general expectations are that SEZs will increase economic activities in the host districts and sometimes in the commuting districts, it is often conditioned on the level of interaction between firms in the SEZs and firms in the local economy (Neumark and Kolko, 2010; Zhang et al., 2018). When SEZ firms import their inputs, local firms have few incentives to set up production centres near the SEZs. In such circumstances, SEZs will not produce additional benefits in the SEZ districts besides attracting FDI, creating employment opportunities and increasing exports. This is particularly common to SEZs that repackage and provide warehousing facilities for multinationals to store their products and re-export to other countries.

In summary, the ability of SEZs to either increase economic activities in the SEZs and commuting districts or cause the reallocation of economic activities from districts bordering the SEZs districts into SEZs districts is not automatic. The effect depends on the level of linkages between the SEZs and the local economy as well as the level of economic activities in the host districts. SEZs that interact with the local economy in the areas of inputs and labour are more likely to produce economic benefits beyond the zones than SEZs without any linkages to the local economy.

4 Data and Descriptive Statistics

The paper measure economic activities at the district level using nighttime light data from 2012 to 2020. Given the lack of disaggregated data, this forms the best proxy for local economic activity. Nighttime light data is produced by the National Centre for Environmental Information[6]. I extract the average light intensity via GeoQuery[7] which allows for the aggregation of satellite data such as nighttime light intensity at customizable geographic boundaries and time frames.

Nighttime light intensity is available as mean, minimum, maximum, count and the sum[8] of nighttime light intensity within given geo-boundaries at monthly and yearly frequency. Each pixel of the image captured by the satellite represents an area of about one square kilometre on the Earth's surface. A pixel is associated with a digital number indicating the brightness of the place in the night, with 0 representing the lowest value; thus, no recorded nighttime light and 63 as the highest nighttime light. These numbers are aggregated over time (day, month and year) to become an indicator of the area's economic activities. For this research, the outcome variable is the average nighttime light intensity of all the pixels in each district in each calendar year.

Henderson et al. (2012) and Gibson et al. (2021) have shown that there is a strong correlation between nighttime light and economic activities at the national and sub-national levels. There are several ways that nighttime light reflects economic development. Take developing countries, for instance; major economic activities (development) often concentrate on infrastructure (building of roads, bridges, railways and airports, and the upgrading of telecommunications networks and power grids), which emits nighttime light. Consequently, the sky at night increasingly becomes brighter, signifying the economy's expansion over space and time. Similarly, a decreasing nighttime light may also signal a decline in economic activities over space and time. Generally, more pixels will begin to lose light in areas mired in conflict and disasters because of limited human activities and, by extension, a decline in economic activities.

[6]I used the annual Visible Infrared Imaging Radiometer Suite (VIIRS) nighttime lights, specifically product Version 2. The average values and the background pixels of this product are masked. The VIIRS nighttime light is cloud-free and available for 2012-2020. Persistent lighting, including gas flares and ephemeral events like fires, have been discarded, leaving only nighttime light emanating from human activities.

[7]GeoQuery is accessible: http://geo.aiddata.org/query/!/

[8]Mean is the average light recorded at a given geoboundary at a given time, minimum refers to the minimum value of nighttime light measured within each unit of analysis, and the maximum value is the value of nighttime light measured within each unit of analysis. Count and sum are the total counts of pixels per unit of analysis and the sum of values measured within each unit of analysis, respectively.

Districts (Wereda), the third-level administrative unit of Ethiopia, are the unit of analysis. Runfola et al. (2020) provide the country's third-level administrative boundaries as shape files. The most recent version, (2019[9]) shape files contain all districts with their boundaries, names and postcodes. District population data from 2012 to 2020 also come from the United States Census Bureau[10] and the United Nations Office for the Coordination of Humanitarian Affairs, Ethiopia country Office[11]. I also calculated each district's total land area (in hectares) using ArcGIS. The final sample districts exclude districts with missing observations in population, limiting the sample to 600 districts. The excluded districts are new districts carved out from the existing districts resulting in the missing population data at the beginning of the sample.

The shape files do not provide information on districts with operational SEZs, so I rely on the latitudes and longitudes of the SEZs provided by Openzone Map[12] to identify the SEZs districts by plotting the SEZs coordinates on the district geoboundaries using ArcGIS. Districts that witnessed the introduction of an SEZ constitute the treated districts with a dummy variable equalling 1 and zero for districts without active SEZs (the control districts). In all, 14 SEZs turn on in 10 districts during the sample period.

SEZs program-specific variables, including SEZ's operational date, ownership, and sector of operation, are collected via internet search. Ethiopia's annual investment reports, which contain detailed feasibility studies and news articles about various activities of the country's SEZs are on the official website of the Ethiopian Investment Commission[13]. Variables such as district distance to the capital city, district distance to the nearest airport, inland port and railway station are constructed using Openzone Map, Google and Bing Maps. I also constructed a dummy variable equalling 1 if an SEZ is active in a district and zero otherwise. Table 1 provides an overview and definitions of the variables used in the study (Summary statistics are provided in Appendix A7).

Figures 3 and 4 show the land size and the population distribution between SEZs districts and districts without SEZs, respectively. SEZs districts, on average, are smaller in land size relative to non-SEZs districts. While SEZs districts have land sizes exceeding 250,000 hectares, few non-SEZs districts have land sizes above 1,000,000 hectares. The SEZs districts are also more populated than the non-SEZ districts, as shown in Figure 4. Figure 5 also presents the locations of SEZs, airports and the country's inland ports. The figure reveals that the country's SEZs are closer to critical transportation infrastructures,

[9]The 2019 version of Ethiopia's third level administrative boundaries is available here:https://www.boundaries.org/index.html

[10]https://www.census.gov/geographies/mapping-files/time-series/demo/international-programs/subnationalpopulation.html

[11]https://www.unocha.org/ethiopia

[12]Open Zone Map maps nearly every economic zone in the world with information on zone type, ownerships, activity status, and distance to the nearest port and airport. The Adrianople Group maintains Open Zone Map available at:https://www.openzonemap.com/

[13]Ethiopian Investment Commission website (https://investethiopia.gov.et/) report detail information about locations and ownerships of SEZs

Table 1: Data Description for Selected Variables

Variable	Variable Description
Capital (km)	Distance of the district to the national capital
Railway (km)	Distance of the district to the nearest railway station
Airport (km)	Distance of the district to the nearest airport
Port (km)	Distance of the district to the nearest inland port
Nighttime light	Annual Average nighttime light per district
Population	Annual district population
Zone	Dummy if a district has an operational SEZs
First Districts	Dummy if a district directly borders a SEZs district
Second Districts	Dummy if a district directly borders a first district
Landsize (hectares)	District land size measured in hectares

Table 2: Pre-treatment Means Between SEZs and Non-SEZs Districts

	SEZs Districts				Non-SEZs Districts			
	Mean	Variance	N	Districts	Mean	Variance	N	Districts
Capital	147.1	14695	90	10	444.9	189445	5310	590
Airport	71.2	8525	90	10	264	54595	5310	590
Port	386	43946	90	10	392.5	53315	5310	590
Population	235432	1.64e+10	90	10	133348	7.44e+09	5310	590
land-size	70326	2.92e+09	90	10	132792	3.18e+10	5310	590

such as airports and ports, compared to districts without SEZs.

The descriptive statistics suggest that the country's SEZs policy targets more populated districts and districts closer to key trade and transport infrastructures like inland ports and airports. This is consistent with the general literature on place-based development policies in developing countries, suggesting the policy often targets more developed areas. They target populated areas for the abundant labour supply and for local firms to absorb the knowledge and technology spillovers (Lu et al., 2019). SEZs also sell a significant part of their finished products to the international market and therefore require access to transportation infrastructure, explaining why the country's SEZs are situated near its inland ports and airports.

Table 2 presents the group means for treated and control districts for a set of district-level characteristics such as district distance to the nearest port, airport, capital city, railway station (all measured in kilometres) and district population. The summary statistics highlight that SEZs districts are significantly different from the control districts in terms of population and distance to transportation hubs. These differences between the control and treated districts may result in inaccurate estimates of the policy effects on district economic activities.

To overcome this potential bias, I employ entropy balancing, a multivariate reweighting method described in Hainmueller (2012). Entropy balancing allows users to reweight a dataset such that the covariate distributions in the reweighted data satisfy a set of specified moment conditions. Entropy balancing is preferred in the study to other matching methods because it explicitly imposes balancing constraints on the different observable

Figure 3: Distribution of Land-size of SEZs and Non-SEZs districts

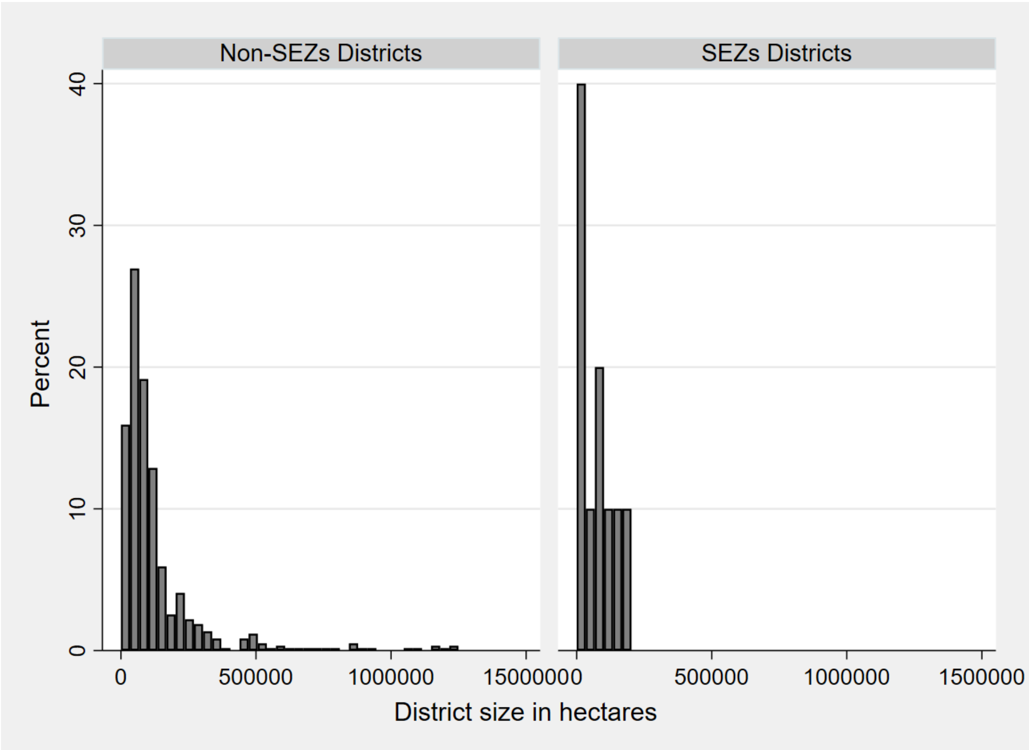
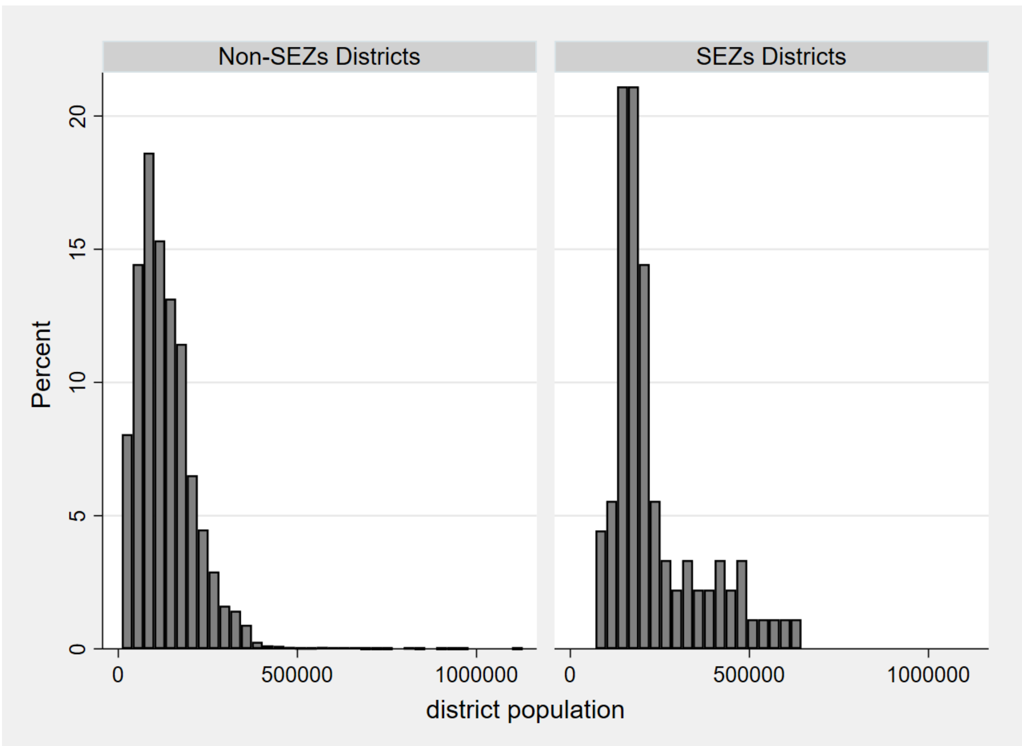


Figure 4: Distribution of Population of SEZs and Non-SEZs districts



characteristics rather than being assumed in matching methods. As a result, it minimises the risk of the control districts being significantly different from the treated districts besides the treatment (Hainmueller and Xu, 2013; Egger et al., 2022). Table 3 shows the

Figure 5: Map Showing the Distribution of SEZs, Airports and Railway Stations in Ethiopia.

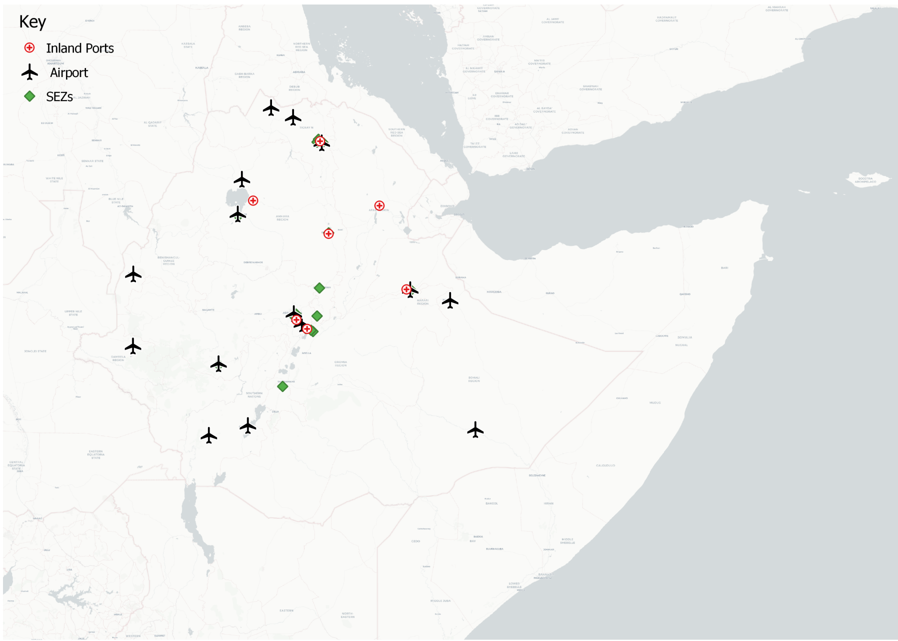


Table 3: Entropy Balancing of Districts covariates (1st and 2nd moments)

	SEZs Districts				Non-SEZs Districts			
	Mean	Variance	N	Districts	Mean	Variance	N	Districts
City	147.1	14695	90	10	147.1	24867	5310	590
Airport	71.2	8525	90	10	71.2	83275	5310	590
Port	386	43946	90	10	386	80747	5310	590
Population	235432	1.64e+10	90	10	235431	5.57e+10	5310	590
land-size	70326	2.92e+09	90	10	70327	3.34e+09	5310	590

results for the entropy balancing for all the covariates that are likely to determine the treatment status. The first two columns show the mean and variance for treated districts, and the following two columns provide similar results for the control districts. After applying the entropy balancing methodology, the treated and the control districts now display similar characteristics in terms of mean and variance.

4.1 Synthetic Control Analysis

The reliability of a quasi-experimental comparison rests on the assumption that the control and the treatment units would have pursued a similar trend in the absence of the treatment. So, before proceeding to the formal econometric analysis to gauge the effectiveness of the policy on the economic activities of the host and neighbouring districts and to directly attribute the treatment effect to the policy, I create a synthetic comparison unit for the Bole Lemi SEZs, one of the first SEZs to turn on within the sample period.

According to Abadie and Gardeazabal (2003), a synthetic unit is the weighted combination of the controlled units. The optimal combination of the weights should match the treated unit as closely as possible regarding the outcome predictor. The effective use of a synthetic approach requires that only the treated unit is affected by the policy for all the periods in the pre-treatment used to create the synthetic unit. In other words, untreated units that may be exposed to the policy overflow should be excluded from the donor pool in determining weights for the synthetic unit. All commuting districts to SEZ districts are dropped from the donor pool to comply with this assumption. The SEZs commuting districts are likely to be exposed to the treatment because of their proximity to the SEZs. Other SEZs districts are also excluded from the districts used as donor pools.

Using the log of average nighttime light as the outcome variable, Figure 5 compares the actual Bole Lemi zone (in solid lines) with the synthetic Bole Lemi zone in dashed lines before and after it became operational in 2015. The trend lines for the counterfactual and the treated unit followed each other closely in both periods, indicating that the weighing achieves both the first and second-order purpose of equalising the pre-trends for real and the counterfactual Bole Lemi SEZs[14]. A few years into the treatment, the average nighttime light of the real Bole Lemi SEZs surpasses the counterfactual, representing the program's treatment effect on the treated district. In the absence of the treatment, the average nighttime light of both units would have taken a downward trend towards the end of the sample, just like the synthetic unit. The figure also indicates that SEZs' economic effects take time to manifest. For the Bole Lemi SEZ, it took about four years for the effect to become noticeable.

5 Empirical Framework

5.1 Estimation strategy

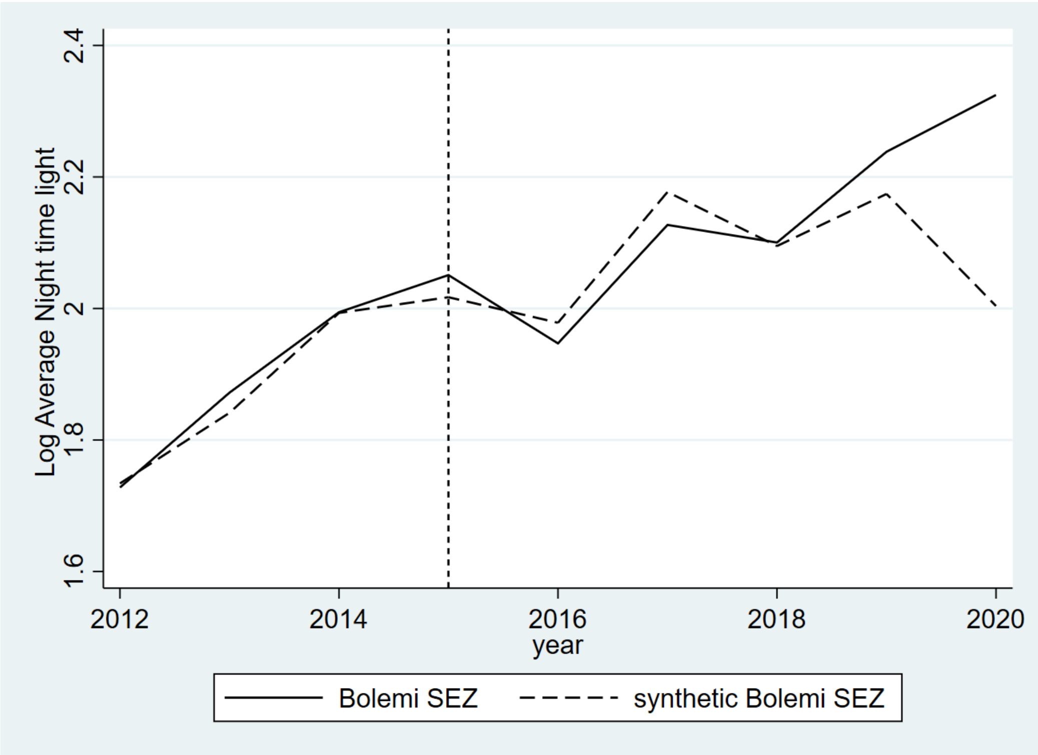
The identification strategy of the impact of SEZs on the district's economic activities is based on the variation in location and timing of SEZs' entry across districts in the country. I apply a Difference-in-Difference (DiD) estimation strategy to compare districts' economic activities before and after turning on the SEZs with changes among districts without SEZs. Districts with SEZs are the treated districts with SEZ_{it}= 1 if district i has operational SEZs in year t and zero otherwise. The estimating equation is:

$$y_{it} = \beta_0 + \beta_1 SEZ_{it} + POP_{it} + \phi_i + \lambda_t + \epsilon_{it} \qquad (1)$$

where y_{it} is the outcome variable, namely the average nighttime light of district i at time t. β_1 captures the effect of SEZ on the economic activities of SEZs districts. POP_{it} is district

[14] The actual and the predicted weights of the Bole Lemi SEZs is presented in Appendix A1.

Figure 6: Bole Lemi SEZ versus the Synthetic Bole Lemi SEZ



Notes: The solid line shows the trend line for Bole Lemi Zone, and the dashed line shows the synthetic Bole Lemi Zone. The vertical dashed line indicates the year in which the Bole Lemi Zone was introduced.

population. ϕ_i is the district fixed effects term capturing observed and unobserved time-invariant districts characteristics, and λ_t is year fixed effect capturing potential shocks across districts. ϵ_{it} is the error term. Standard errors clustered at the district level.

As discussed in the conceptual framework, districts that directly border SEZ districts may witness an overflow of economic activities from the SEZ districts. Proximity to the SEZs potentially boosts economic activities as new light manufacturing firms and retailing activities may spring up to provide auxiliary services to the SEZs. Alternatively, SEZs may also divert economic activities from the commuting districts by encouraging the migration of economic activities to the SEZ districts, resulting in a negative spillover. To determine whether SEZs produce spillover effects, I extend the analysis to the commuting districts to see the spatial impact of policy. For the first-level commuting districts, treatment is = 1 if district i is a first-level commuting district for an active SEZ and zero otherwise. The treatment date is the year in which the SEZs enter into force[15].

$$y_{it} = \beta_0 + \beta_1 District1_t + POP_{it} + \phi_i + \lambda_t + \epsilon_{it} \qquad (2)$$

[15] For instance, if district A has SEZs which turns on 2014 and its commuting districts are B, C, and D, then for B, C, and D treatment year are also 2014. Although there are districts neighbouring more than one district hosting SEZs, the earliest treatment date is taken; thus, the first SEZs to turn on the neighbouring districts.

Similarly, the second-level commuting districts may also experience spillover effects in the same fashion as the first-level commuting districts. So, the analysis is further extended to this category of districts to determine the geographical reach of the SEZs spillovers. Treatment is equal 1 if district i is a second-level commuting district and zero otherwise. Treatment year is the year in which the first-level commuting district treatment turns on[16]. The following specification is applied:

$$y_{it} = \beta_0 + \beta_1 District2_t + POP_{it} + \phi_i + \lambda_t + \epsilon_{it} \qquad (3)$$

Again y_{it} is the outcome variable, average nighttime light of district i at time t.

6 Results and Discussions

6.1 Special Economic Zone Districts

Table 4 presents results on the effect of SEZs on the growth of average nighttime light of districts hosting operational SEZs relative to non-SEZs districts. Column (1) presents the baseline regression results, while column (2) reports results which include weights from entropy balancing. Column 3 contains results that include weights from entropy balancing but exclude the commuting districts in the control districts. The exclusion of the commuting districts provides a cleaner comparison group devoid of treatment contamination that may result in a biased estimate of the treatment effects. The three specifications include district and year-fixed effects.

The effects of SEZs on nighttime light are consistently positive and statistically significant at 1% and 5% levels under the first two approaches and the last method, respectively. The results in column 1 show that the implementation of SEZs is associated with a 0.057 growth in average nighttime light compared to districts without SEZs. The specification in columns 2 and 3 consider the potential difference between SEZ and non-SEZ districts prior to treatment and the non-random assignment of SEZs to districts by including the weights from entropy balancing. The results are very similar to those in column 1, signifying that the increase in average nighttime light of the host districts is less driven by the difference in characteristics of the SEZs and non-SEZs districts but by the policy.

Since nighttime light intensity positively correlates with the intensity of local economic activities[17], the sharp rise in the nighttime light emissions in SEZs districts implies an

[16] For instance, if district A is a commuting district which has its treatment turned on 2014 and its neighbouring districts are B, C, and D, then B, C, and D treatment date is also 2014. Although there are districts neighbouring more than one SEZ and commuting district, the earliest treatment date is taken

[17] Several studies shown that nighttime light positively correlates with local economic activities and can therefore serve as a good proxy for local GDP. Elvidge et al. (2012); Henderson et al. (2012) have examined the relationship between nighttime light and economic activities and Alder et al. (2016); Frick et al. (2019) adopted nighttime light as a proxy to study the impact of SEZs on local economic activities in China and other developing countries.

Table 4: SEZs and Host Districts Local Economic Activities

	Baseline	Entropy Balance	No Commuting districts
SEZs dummy	0.0573***	0.0551***	0.0982**
	(0.0133)	(0.0127)	(0.0347)
Population	0.445***	0.486**	-0.9890
	(0.1335)	(0.1557)	(1.2406)
Constant	-16.7500***	-54.7800***	-181.700***
	(3.2127)	(11.6944)	(54.2994)
Observations	5,396	5,396	4,452
Number of Districts	592	592	489
District Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes

Standard errors in (), and clustered at the district level.

*, **, and *** for 10%, 5% and 1% levels.

increase in local economic activities in those districts relative to non-SEZs districts.

6.2 Spillover Effects on Commuting Districts

This section presents results on the impact of SEZs on the economic activities of districts closer to the SEZs districts. SEZs may also generate positive or negative externalities to the commuting districts depending on the interaction between firms in the SEZs and firms in the local economy. The policy may also produce negative spillovers if it causes the reallocation of economic activities (manufacturing, employment opportunities) from other districts to the SEZs districts. Alternatively, positive externalities may also arise from the diffusion of knowledge from SEZs firms to firms outside SEZs and the increase in market access in the commuting districts due to the SEZs.

To determine the spatial reach of SEZs' economic effects, the paper followed the existing identification assumption, which stipulates that SEZs' spillover effects attenuated with distance to the SEZs (Neumark and Kolko, 2010; Alder et al., 2016). The study considers the spillover effects on two district categories, districts directly bordering the SEZs districts and districts adjacent to the districts bordering the SEZs districts. Based on the identification assumption, the effect (negative or positive) expect to be substantial in districts directly bordering the SEZs districts. I constructed a binary indicator indicating districts that fell within the two categories and ran separate regressions using (2) and (3).

Table 5 presents the results for the first-level and second-level commuting districts in panels A and B, respectively. The first column contains the baseline estimation, while the second column presents results with weights from entropy balancing. Column 3 results are based on a restricted sample that excludes the commuting districts[18] from the control

[18]SEZs districts and the second-level commuting districts are dropped in the case of the first-level

districts. The three specifications include district and year-fixed effects. For the first-level commuting districts, the policy has a positive and statistically significant spillover effect on district-level economic activities. However, the positive effect becomes negative and insignificant once the specification takes into account the pre-treatment difference among the commuting districts. The coefficient in column 3, which excludes the SEZs districts as the control districts, is also positive but statistically insignificant. The inconsistent estimates of the policy impact on the first commuting districts clearly demonstrate that SEZs do not increase the economic activities of districts directly bordering districts with active SEZs. The positive effect on the baseline estimation is likely driven by unobserved factors rather than the policy.

For the second-level commuting districts, the results are positive and insignificant in column 1, where the specification does not include weights from the entropy balancing. The coefficient, however, becomes negative and insignificant with the inclusion of the weights from the entropy balancing. Similarly to the first commuting districts, the results for the second-level commuting districts are also positive but insignificant under the restricted sample.

As shown above, there is no consistent evidence to show that districts closer to districts with operational SEZs either witness an increase in economic activities or a reallocation of economic activities from these districts into the SEZs districts after the entry of SEZs.

6.3 Treatment Heterogeneity

In Ethiopia, SEZs differ in several ways. There are SEZs that are built and managed by the state (state-owned), and SEZs are also built and managed by private investors (privately owned). Besides the ownership, SEZs also differ based on their economic activities, land size and the year in which the SEZs began operation. The impact of SEZs on local economic activities might therefore vary with these SEZs' characteristics. I explore this potential heterogeneity using separate policy indicators for the various SEZs types[19]. Each policy indicator replaces the single treatment indicator in (1) and (2) for the host and commuting districts, respectively.

Table 6 presents the results of the heterogeneous effects of the entering of SEZs on the economic activities of the host and the first-level commuting districts. Column 1 contains

commuting districts. SEZs districts and the first-level commuting districts are dropped in the case of the second-level commuting districts.

[19] A dummy for state-owned SEZs taking the value 1 and zero otherwise. A dummy for privately-owned SEZs taking the value 1 and zero otherwise. Dummies for early and later treated SEZs that take the value of 1 if the SEZs became operational before 2017 and after 2016, respectively. The final two dummies are the size dummy representing SEZs with a total land size above 177 hectares as big SEZs, those with land sizes below 177 hectares as small SEZs, and sector dummies that take the value 1 if the SEZs operate in the textile and garment sector respectively

Table 5: Effect of SEZs Entry on Local Economic Activities of Commuting Districts

	Baseline	Entropy Balancing	No commuting districts
Panel A			
District1	0.0007***	-0.0171	0.0099
	(0.0001)	(0.0138)	(0.0156)
Population	0.5000***	1.060***	0.7140
	(0.1250)	(0.2171)	(0.5600)
Constant	-4.9459***	-1.897	-26.4800
	(1.5777)	(8.365)	(24.6512)
Panel B			
District2	0.0001	-0.0193	0.0001
	(0.0001)	(0.0120)	(0.0002)
Population	0.465***	1.009**	0.6710***
	(0.1330)	(0.3470)	(0.1081)
Constant	-3.8642**	5.8417	-6.9956
	(1.805)	(20.8503)	(1.4191)
Observations (A)	5396	5396	4,650
Number of Districts (A)	592	592	511
Observations (B)	5396	5396	4,955
Number of Districts (B)	592	592	544
District Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes

Standard errors in (), and clustered at the district level.

*, **, and *** for 10%, 5% and 1% levels.

the results for SEZs that switched on before 2017, while column 2 presents results for SEZs that switched on after 2016. Columns 3 and 4 contain results for SEZs operating in the textile, garment and leather industry and SEZs in engage in other economic activities, while columns 5 and 6 present results for SEZs with bigger land sizes and small land sides. The final columns, 7 and 8, show results for privately and publicly owned SEZs.

For the host districts, the results are positive and statistically significant at the 1% level for SEZs that were turned on before 2017, while the results for late-treated districts are positive but insignificant. The results for the early treated SEZ districts reaffirm the results from the synthetic control that suggest that the policy effects take time to manifest. Although the sector dummies are both positive and significant at the 1% level, districts with SEZs operating in other sectors of the economy other than the textiles and garment industry generate more economic activities. Districts with SEZs operating in other sectors of the economy saw an 8-unit increase in average nighttime light compared to a 5-unit increase for districts with SEZs in the textile sector. Similar to the results on the sector dummies, the results are also positive and significant for big and small SEZs. Districts with active SEZs bigger in land size, however, witness more economic activities relative to districts with SEZs smaller in land size, as shown in columns 5 and 6, respectively. Finally, the results are only positive and significant for publicly owned SEZs.

SEZs have an ambiguous heterogeneous impact on the local economic activities of the first-level commuting districts. Districts directly bordering districts with SEZs that turned on after 2016, SEZs engage in textile, garment and leather, and other economic activities, and SEZs bigger in land sizes tend to lose economic activities after these SEZs turn on. The effects are larger for first-level commuting districts bordering SEZs operating in other sectors of the economy other than textile, and SEZs bigger in land sizes. On the other hand, commuting districts in close proximity to districts with SEZs smaller in land sizes saw a growth in their average nighttime light after the SEZs became operational.

Overall, the impact of SEZs on the economic activities of the host districts and the first-level commuting districts is heterogeneous. Bigger SEZs and SEZs into other economic activities generate more economic activities in the SEZs districts relative to the other SEZs. The heterogeneous spillover effects suggest that SEZs cause the reallocation of economic activities from the immediate commuting districts, as some districts close to active SEZ districts experience a negative growth in their average nighttime light after the SEZs began operation. While the data limitation[20] prevents further exploration of the mechanisms that SEZs cause the reallocation of economic activities from the first-level commuting districts, it probably points to the migration of economic activities from these districts into the SEZs districts.

The kind of investment and probably the location of the SEZs explains the heterogeneous treatment effect with regard to the public and private SEZs. While the government may prioritise social equality over economic viability and develop SEZs in areas with limited economic opportunities, they tend to address the issues concerning infrastructure connectivity, supply access and labour skills before establishing the SEZs. In Ethiopia, each of the state SEZs are provided with basic infrastructures such as power substations and roads and are also sited in districts with access to railways and airports, making the SEZs districts more attractive to firms. On the other hand, private investors, whose sole motive is profit making, will focus on areas with easy access to raw materials and labour without creating the needed infrastructure and ecosystem for SEZs firms to interact with the local firms, which will result in increased economic activities.

Also, state SEZs are generally larger in land size and are occupied by different firms producing different products. This is another potential explanation for why public SEZs are better at driving economic activities in the SEZs districts, as the results suggest, relative to privately owned SEZs. In the case of Ethiopia, private SEZs, except for the Eastern Industrial Park, are generally smaller in land size and are often occupied by a single firm producing single or multiple products, limiting their ability to create economic agglomeration in the host districts.

[20] The nature of the data, particularly the outcome variable, the nighttime light, does not differentiate among the value added by the different sectors in the local economy. Ideally, I would prefer to split the analysis according to the various sectors in the districts and examine the effects of SEZs across sectors. However, data limitations prevent me from doing such an analysis.

Table 6: Heterogeneity Analysis-SEZs Districts

	(1) Early	(2) Late	(3) Textile	(4) Others	(5) Big SEZs	(6) Small SEZs	(7) Private	(8) Public
Panel A								
SEZs	0.0754***	0.0078	0.0477***	0.0784***	0.0853***	0.0398***	0.0001	0.0551***
	(0.0136)	(0.0070)	(0.0120)	(0.0061)	(0.0093)	(0.0066)	(0.0001)	(0.0135)
Observations	5396	5396	5396	5396	5396	5396	5396	5396
Districts	592	592	592	592	592	592	592	592
Panel B								
District1	0.0002	-0.0010***	-0.270***	-1.446***	-0.421***	1.729***		0.178
	(0.0005)	(0.0002)	(0.0648)	(0.1488)	(0.0407)	(0.2389)		(0.174)
Observations	5396	5396	5306	5306	5184	5229		5301
Districts	591	591	582	582	573	577		585
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in (), and clustered at the district level.

*, **, and *** for 10%, 5% and 1% levels.

6.4 Event Studies

An emerging methodological literature highlights the shortcomings of the Two-Way Fixed Effects Estimator (TWFE) in case of multiple treatment periods (Borusyak et al., 2021; Goodman-Bacon, 2021; Callaway and Sant'Anna, 2021). They argued that the TWFE is particularly not robust when treatment is staggered across time, and the average effects of taking up the treatment vary over group and period. Under such circumstances, the TWFE specification may underestimate the treatment effect.

Given the plausible drawbacks of using TWFE regression in a DiD setting with variation in treatment timing, I follow a recent methodology paper by Callaway and Sant'Anna (2021) on estimating causal treatment effects on multiple treatment periods. In the Callaway and Sant'Anna (2021) estimator, the treatment effect is estimated for each cohort in each calendar year using the never treated group as a control group for each treatment cohort. The treatment effect of each cohort is combined to create a weighted average relative to each period. The weights are the relative size of the treatment effect for the treated cohort.

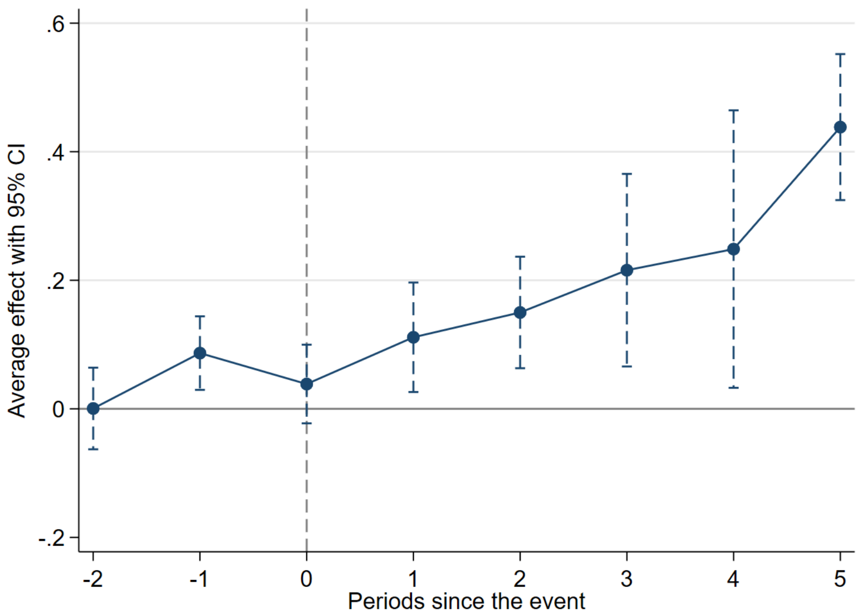
Similar to the TWFE set-up, treatment refers to districts that have their SEZs turned on from 2014 to 2018, and the control districts are districts without operational SEZs. I estimate the event study using the specification below

$$y_{it} = \sum_{j=-2}^{5} \beta sez_{it} + POP_{it} + \alpha_i + \lambda_t + \epsilon_{it} \qquad (4)$$

Where y_{it} is the average nighttime light for district i in year t, sez_{it} is the treatment indicator 1 for districts with operational SEZs and zero for districts without operational SEZs. Both treated and control districts are observed two years before the first SEZs became operational, and the events window is restricted (binned) to five years after treatment. As highlighted by Schmidheiny and Siegloch (2019), binning imposes implicit assumptions that enable the identification of dynamic policy effects. POP_{it} is the district level population, α_i is district fixed effects, λ_t is year fixed effects and ϵ_{it} is the error term. standard errors are clustered at the district level. The parameter of interest is β, which captures the dynamic treatment effects before and after treatment. The same estimation strategy is applied to the commuting districts. Thus, the first-level commuting districts take the value of 1 and zero otherwise, while the second-level commuting districts also take the value 1 and zero for non-second-level commuting districts.

Figure 7 reports the results of the event studies for districts with active SEZs. The parallel trend assumption does not hold for the SEZs districts. Night light emitted during the construction stage of the SEZs might be accounting for the non-flattened pretends. Nevertheless, the post-treatment effects suggest that the turning on of SEZs leads to a substantial increase in the average nighttime light of the host districts. The average nighttime light of the host districts increased from 1 unit to about 5 units, 5 years after the first district got treated.

Figure 7: Effects of SEZs on the Economic Activities of SEZs Districts



Figures 8 and 9 present the results for the first and second-level commuting districts, respectively. Similar to the SEZs districts, the parallel trend assumption does not appear to hold for first-level commuting districts, and also, there is no visible distinction between the pre-treatment and post-treatment outcomes, suggesting that there are no significant effects of the policy on the first-level commuting districts economic activities. While the parallel trend assumption appears to hold for the second-level commuting districts, the post-treatment outcome does not provide convincing evidence that the policy has any effect on the second-level commuting districts.

The result from the dynamic event study approach is consistent with the results from the Two-Way Fixed Effects estimation approach that indicates that the country's SEZs policy has some positive and statistically significant effects on the local economic activities of the host districts but does not generate any spillovers effects to the commuting districts.

Figure 8: Effects of SEZs on the Economic Activities of First-level Commuting Districts

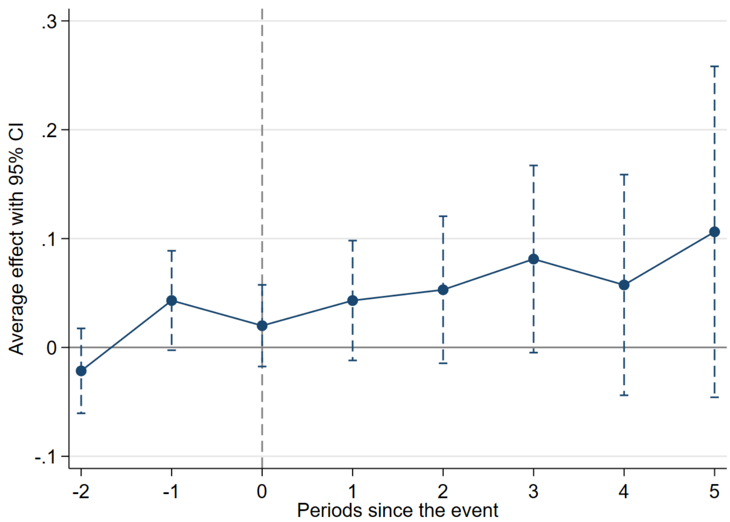
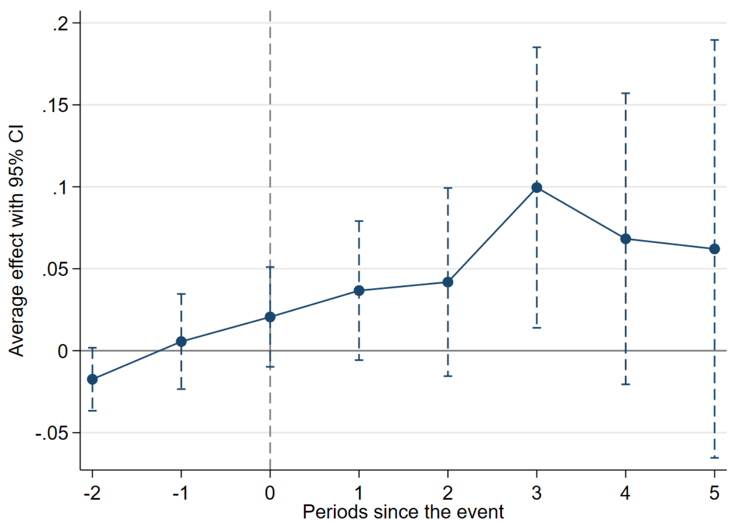


Figure 9: Effects of SEZs on the Economic Activities of Second-level Commuting Districts



7 Conclusion

Special Economic Zones (SEZs) are fraught with uncertainty regarding their development effects, yet governments in developing countries continue to aggressively use the policy to increase their participation in global value chains and improve the economic conditions of the local economy. In the past decade, Ethiopia has committed resources to establish state-owned SEZs and facilitate Private-Public Partnerships for investors to establish private SEZs. This is an attempt to position the country as a regional manufacturing hub. The state goal has been to create employment and economic opportunities, particularly for low-skill people and rural communities.

While the country committed resources to establish SEZs and continues to lose tax revenue due to the tax exemptions extended to firms in the SEZs, the evidence remains scant on the impact of the policy on local economic activities. This paper fills this literature gap by investigating the effects of SEZs policy on the host district's (Wereda) economic activities and the spillover effects on the neighbouring districts. District, the unit of analysis, the lowest administrative unit in Ethiopia, and the geocoded data allowed me to restrict the analysis and the policy effect within the boundaries of the unit of analysis, which constitute the novelty of this paper. The staggered adoption and synthetic control methods are also a novelty to SEZ analysis.

The study provides the first empirical evidence of the impact of SEZs on the economic activities at the local level in Ethiopia. The country's Special Economic Zones policy showed a moderate positive effects on host districts' economic activities over the sample period. On average, districts with operational Special Economic Zones had their nighttime light increased by 6 units, reflecting a growth in local economic activities relative to non-SEZ districts. In addition, this paper extends the current work in SEZs by estimating the policy spillover effects on the neighbouring districts economic activities.

While the overall results showed no consistent evidence of the policy's impact on the commuting districts, results from the heterogeneity analysis suggest that the policy had some impact on the economic activities of the commuting districts. For SEZs that turned on after 2016, SEZs in textile and other activities and the bigger SEZs tend to have a negative and significant effect on the first-level commuting districts, signalling that these types of SEZs cause the reallocation of economic activities from the first-level commuting districts. On the other hand, districts directly bordering SEZs districts with small SEZ land sizes also gained economic activities after they became operational. I do not find any spillover effects on the economic activities of the second-level commuting districts. Given that the country SEZs are at their early stage of operation, the results should be regarded as preliminary aggregate effects of the policy on district-level economic activities.

I argue that in the case of Ethiopia that, firms (economic activities) tend to locate closer to the SEZs to take advantage of the agglomeration economies and the first-class infrastructure that comes with the zones. This, therefore, explains the positive impact of the policy on the host districts economic activities and the ambiguous spillover effects on the first-level commuting districts vis-à-vis the null effect on the second-level commuting districts.

There are limitations to the research results. First, it does not capture economic activities that result in no additional nighttime light, like agricultural and forestry-related economic activities[21]. The nighttime light is less likely to capture all value-added activities in the agriculture sector and forestry-related activities, so the results should be considered with this caveat. Secondly, the inability to separate the nighttime light into various economic activities prevented the studies from investigating the multiple channels that the policy contributes to local-level economic activities as well as the particular economic activities that the policy has a substantial impact on. Future research may use firm-level data such as the Ethiopia manufacturing survey data once the survey covers the same firms and districts over sufficient time to unearth the mechanism that the policy has on economic activities and the specific sectors that are affected by the policy.

Notwithstanding the study limitations, the results have some policy implications for developing countries currently implementing SEZs policy. Since publicly owned SEZs perform better in promoting economic activities around them, the state should focus on establishing SEZs in lagging regions to boost economic activities that lead to long-term balanced development. This will potentially address issues such as unemployment and rural-urban migration common among developing countries.

[21] This caveat may lead to underestimating the economic effects of SEZs on district economic activities as noted by (Keola et al., 2015). The caveat is, however, less significant because the country SEZs focus on manufacturing activities but plausible given that agriculture accounts for nearly 40% of the country's GDP in 2021, as contained in the reports of the Central Statistical Agency of Ethiopia. Accessible via the CountrySTAT page at: http://ethiopia.countrystat.org/

References

Abadie, A. and Gardeazabal, J. (2003). The economic costs of conflict: A case study of the Basque Country. *American Economic Review*, 93(1):113–132.

Alder, S., Shao, L., and Zilibotti, F. (2016). Economic reforms and industrial policy in a panel of Chinese cities. *Journal of Economic Growth*, 21(4):305–349.

Alkon, M. (2018). Do special economic zones induce developmental spillovers? Evidence from India's states. *World Development*, 107:396–409.

Baldwin, R. E. and Okubo, T. (2006). Heterogeneous firms, agglomeration and economic geography: spatial selection and sorting. *Journal of Economic Geography*, 6(3):323–346.

Borusyak, K., Jaravel, X., and Spiess, J. (2021). Revisiting event study designs: Robust and efficient estimation. *arXiv preprint arXiv:2108.12419*.

Callaway, B. and Sant'Anna, P. H. (2021). Difference-in-differences with multiple time periods. *Journal of Econometrics*, 225(2):200–230.

Cheesman, A. (2012). *Special economic zones & development: Geography and linkages in the Indian EOU scheme*. Development Planning Unit, University College London.

Duranton, G. and Puga, D. (2004). Micro-foundations of urban agglomeration economies. In *Handbook of Regional and Urban Economics*, volume 4, pages 2063–2117. Elsevier.

Egger, P. H., Koethenbuerger, M., and Loumeau, G. (2022). Local border reforms and economic activity. *Journal of Economic Geography*, 22(1):81–102.

Elvidge, C. D., Baugh, K. E., Anderson, S. J., Sutton, P. C., and Ghosh, T. (2012). The night light development index (nldi): a spatially explicit measure of human development from satellite data. *Social Geography*, 7(1):23–35.

Farole, T. (2011). *Special economic zones in Africa: Comparing performance and learning from global experiences*. World Bank Publications.

Farole, T. and Moberg, L. (2014). It worked in china, so why not in africa? the political economy challenge of special economic zones. Technical report, WIDER Working Paper.

Frick, S. A. and Rodríguez-Pose, A. (2021). Special economic zones and sourcing linkages with the local economy: Reality or pipedream? *The European Journal of Development Research*, pages 1–22.

Frick, S. A., Rodríguez-Pose, A., and Wong, M. D. (2019). Toward economically dynamic special economic zones in emerging countries. *Economic Geography*, 95(1):30–64.

Giannecchini, P. and Taylor, I. (2018). The eastern industrial zone in Ethiopia: Catalyst for development? *Geoforum*, 88:28–35.

Gibson, J., Olivia, S., Boe-Gibson, G., and Li, C. (2021). Which night lights data should we use in economics, and where? *Journal of Development Economics*, 149:102602.

Glaeser, E. L. and Gottlieb, J. D. (2009). The wealth of cities: Agglomeration economies and spatial equilibrium in the united states. *Journal of economic literature*, 47(4):983–1028.

Goodman-Bacon, A. (2021). Difference-in-differences with variation in treatment timing. *Journal of Econometrics*, 225(2):254–277.

Görg, H., Mulyukova, A., et al. (2022). Place-based policies and agglomeration economies: Firm-level evidence from special economic zones in india. Technical report, Kiel Institute for the World Economy (IfW Kiel).

Grant, M. (2020). Why special economic zones? Using trade policy to discriminate across importers. *American Economic Review*, 110(5):1540–71.

Hainmueller, J. (2012). Entropy balancing for causal effects: A multivariate reweighting method to produce balanced samples in observational studies. *Political Analysis*, 20(1):25–46.

Hainmueller, J. and Xu, Y. (2013). Ebalance: A stata package for entropy balancing. *Journal of Statistical Software*, 54(7).

Henderson, J. V., Storeygard, A., and Weil, D. N. (2012). Measuring economic growth from outer space. *American Economic Review*, 102(2):994–1028.

Jaffe, A. B., Trajtenberg, M., and Fogarty, M. S. (2000). Knowledge spillovers and patent citations: Evidence from a survey of inventors. *American Economic Review*, 90(2):215–218.

Keola, S., Andersson, M., and Hall, O. (2015). Monitoring economic development from space: Using nighttime light and land cover data to measure economic growth. *World Development*, 66:322–334.

Kline, P. and Moretti, E. (2014). Local economic development, agglomeration economies, and the big push: 100 years of evidence from the Tennessee Valley Authority. *The Quarterly Journal of Economics*, 129(1):275–331.

Koster, H. R. and Van Ommeren, J. (2019). Place-based policies and the housing market. *Review of Economics and Statistics*, 101(3):400–414.

Lu, Y., Wang, J., and Zhu, L. (2019). Place-based policies, creation, and agglomeration economies: Evidence from China's economic zone program. *American Economic Journal: Economic Policy*, 11(3):325–60.

Marshall, A. (1920). Principles of economics. london. macmillan and co. limited.

Michalopoulos, S. and Papaioannou, E. (2014). National institutions and subnational development in africa. *The Quarterly journal of economics*, 129(1):151–213.

Neumark, D. and Kolko, J. (2010). Do enterprise zones create jobs? evidence from california's enterprise zone program. *Journal of Urban Economics*, 68(1):1–19.

Newman, C. and Page, J. M. (2017). Industrial clusters: The case for special economic zones in africa. Technical report, WIDER Working Paper.

Oqubay, A., Lin, J. Y., et al. (2020). *The Oxford Handbook of Industrial Hubs and Economic Development*. Oxford University Press, USA.

Rosenthal, S. S. and Strange, W. C. (2020). How close is close? the spatial reach of agglomeration economies. *Journal of Economic Perspectives*, 34(3):27–49.

Rothenberg, A. D., Bazzi, S., Nataraj, S., and Chari, A. V. (2017). When regional policies fail: An evaluation of indonesia's integrated economic development zones.

Runfola, D., Anderson, A., Baier, H., Crittenden, M., Dowker, E., Fuhrig, S., Goodman, S., Grimsley, G., Layko, R., Melville, G., et al. (2020). geoboundaries: A global database of political administrative boundaries. *PLoS One*, 15(4):e0231866.

Schmidheiny, K. and Siegloch, S. (2019). On event studies and distributed-lags in two-way fixed effects models: Identification, equivalence, and generalization. *Equivalence, and Generalization (January 2019)*.

Tesfachew, T. (2021). Industrial Parks in Ethiopia: Newcomer Advantages. *Enterprise and Economic Development in Africa*, pages 259–275.

UNCTAD (2019). World investment report 2019: Special economic zones. In *United Nations Conference on Trade and Development*. United Nations Geneva, Switzerland.

Wang, J. (2013). The economic impact of special economic zones: Evidence from chinese municipalities. *Journal of Development Economics*, 101:133–147.

Zhang, X., Tezera, D., Zou, C., Wang, Z., Zhao, J., Gebremenfas, E. A., and Dhavle, J. (2018). Industrial park development in ethiopia: Case study report. *Inclusive and Sustainable Industrial Development Working Paper Series WP*, 21:2018.

Appendix A1: Actual and Predicted weights for Bole Lemi and Synthetic Bole Lemi SEZ

	Bolemi	Synthetic Bolemi
lpopulation	12.99916	11.78367
lnlight(2014)	1.995663	2.111375
lnlight(2013)	1.873517	1.989311
lnlight(2012)	1.729546	1.845522

Appendix A2: SEZs Effects on Host Districts Using Alternative clustering

	(1)	(2)
SEZs Dummy	0.0550***	0.0551***
	(0.0072)	(0.0071)
Population	0.487***	0.486**
	(0.0264)	(0.1557)
Constant	-54.78***	-54.78***
	(6.2610)	(11.6944)
Observations	5396	5396
Zones	70	70
Zone x District FE	Yes	Yes
Year FE	Yes	Yes

Standard errors in () and clustered at the regional level.

*, **, and *** for the 10%, 5% and 1% levels, respectively.

Appendix A2 and Appendix A3 present results with regional/district fixed effects and clustering at the regional level. The district-fixed effects are interacted with regional fixed effects. The interaction term jointly captures time-invariant shocks at the district and regional levels. Regions are the second-level administrative units in Ethiopia, which contains several districts. The standard errors are clustered at the regional level. Column 1 contains results without the entropy balance and Column 2 present results with entropy balance.

Appendix A3: SEZs Effects on Commuting Districts Using Alternative clustering

	(1)	(2)	(3)
Panel A			
District1	-0.0054*	-0.0171***	0.0017***
	(0.0021)	(0.0051)	(0.0004)
Population	0.850***	1.060***	0.6100***
	(0.0554)	(0.0531)	(0.0035)
Constant	-4.9459***	-1.9005	-6.861***
Panel B			
District2	-0.0045	-0.0198***	0.0031
	(0.0030)	(0.0058)	(0.0024)
Population	0.840***	1.004***	0.538***
	(0.0504)	(0.0703)	(0.0520)
Constant	-3.3306	6.3390	-8.7329*
	(3.3593)	(5.2640)	(3.2247)
Observations	5396	5396	5306
Zones	70	70	70
Zone x District FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Standard errors in () and clustered at the regional level.

*, **, and *** for the 10%, 5% and 1% levels, respectively.

Appendix A4:List of Special Economic zones by Sector and Year of Operation

SN	SEZ	Ownership	Sector	Year	Size
1	Huajian	Private	Textile	2014	138
2	George	Private	Leather	2016	86
3	Eastern	Private	Mixed	2014	400
4	Vogue	Private	Textile	2015	177.5
5	DBL	Private	Textile	2015	78.05
6	Arerti	Private	Manuf.	2018	100
7	Bole	State	Textile	2015	177
8	Hawassa	State	Textile	2015	300
9	Mekelle	State	Textile	2016	100
10	Adama	State	Textile	2018	100
11	Kombolcha	State	Textile	2016	75
12	Jimma	State	Textile	2018	40
13	BahirDar	State	Textile	2018	125
14	DebreBerhan	State	Textile	2018	1100
15	Kilinto	State	Pharma.	2015	337
16	DireDawa	State	Mixed	2017	150
17	Bole Lemi	State	Textile	Construction	176
18	CCECC	Private	Mixed	Construction	100
19	Yirgalem	State	Agriculture	Construction	
20	Airlines	State	Transport	Planning	
21	Kingdom	State	linen	Planning	
22	Bure	State	Agriculture	Planning	
23	Bulbula	State	Agriculture	Planning	
24	Baeker	State	Agriculture	Planning	

Ownership indicates whether the SEZ are state or privately owned. The sector is the specific economic activity that the SEZs engage in. Year and Size refer to the year the SEZs started operating and the total land area measured in hectares.

Apendix A5: Variables and their Sources

Variable	Source	Period
nighttime light	Earth Observation Group	2012-2020
District Population	United States Census Bureau	2012-2020
District distance to the Airport	GIS	Constant
District distance to the port	GIS	Constant
District distance to Railway	GIS	Constant
District distance to Capital City	GIS	Constant
District land sizes	QGIS	constant

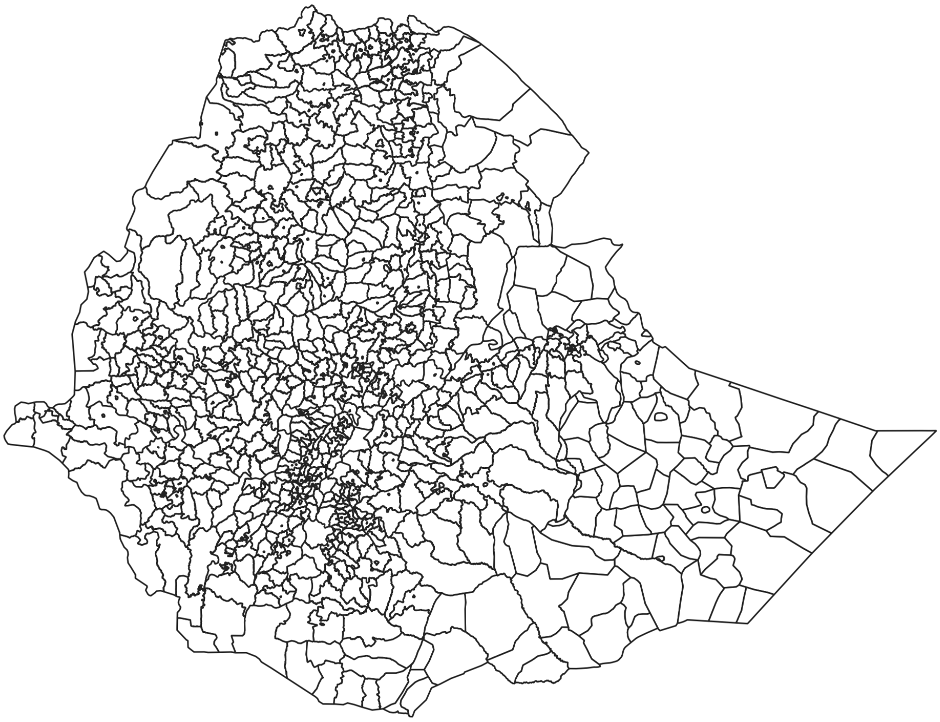
Apendix A6: SEZs Included in the Empirical Analysis

	SEZ	Ownership	Sector	Operational year	Size (Hectares)
1	Huajian	Private	Textile	2014	138
2	George	Private	Leather	2016	86
3	Eastern	Private	mixed	2014	400
4	DBL	Private	Textile	2015	78.05
5	Arerti	Private	Manuf.	2018	100
6	Bole	State	Textile	2015	177
7	Hawassa	State	Textile	2015	300
8	Adama	State	Textile	2018	100
9	Kombolcha	State	Textile	2016	75
10	Jimma	State	Textile	2018	40
11	BahirDar	State	Textile	2018	125
12	DebreBerhan	State	Textile	2018	1100
13	Kilinto	State	Pharma.	2015	337
14	DireDawa	State	Mixed	2017	150

Apendix A7: Summary Statistics for District Characteristics

	Obs	Mean	StD	Min	Max
Id	5,400	317.68	181.767	1	600
Year	5,400	2016	2.58	2012	2020
District	5,400	299.24	171.94	1	596
Land size	5,400	131751.2	177030	0	1249329
SEZ size	5,400	3.03	27.55	0	400
Nighttime light	5,400	0.20	1.62	0.01	27.21
Population	5,400	135049.1	88048.88	9806	1129155
Airport Distance	5,400	260.78	233.31	1.8	2412
Capital City Distance	5,400	439.98	433.58	2.9	8574
Railway Distance	5,400	356.18	270.20	1	2622

Appendix A8: District Administrative boundaries in Ethiopia (2020 version)



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