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Article (Accepted version) (Refereed)

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Abstract

Despite a massive recent proliferation of Special Economic Zones (SEZs), there is virtually no quantitative research on what drives their dynamism. The aim of this paper is to address this gap and analyse the factors influencing SEZ performance – proxied by economic growth – in emerging countries. The paper relies on two novel datasets, using night-lights data to proxy for SEZ performance and containing a wide range of SEZ policy variables and characteristics across a large number of countries. The main results of the analysis indicate that a) zone growth is difficult to sustain over time; that b) trying to upgrade the technological component or value-added of the economy through SEZ policies is often challenging; and that c) zone size matters: larger zones have an advantage in terms of growth potential. Furthermore, country context significantly determines SEZ performance. Firms look for low cost locations, but in close proximity to large cities. Proximity to large markets as well as pre-existing industrialization also increase SEZ performance. In contrast, incentives and other program specific variables are highly context-specific and not structurally correlated with SEZ performance.

Keywords: Special Economic Zones, Developing Countries, Industrial Policy, Economic Growth

JEL Codes: O14, O24, L52

Acknowledgements: The authors wish to thank Henry Yeung and James Murphy, the editors of the paper, as well as three anonymous reviewers for their thorough comments and suggestions to earlier versions of the paper. Elliot Rasmuson, Keith Garrett, Egle Pugaciauskaite, Le Duy Binh and his team, Hanane Lahnaoui, Ding Xu and Benjamin Stewart provided invaluable support in assembling the different datasets. Tom Farole and Douglas Zeng gave generous advice throughout the project. We also would like to thank all participants of the World Bank Brown Bag Lunch discussion in Washington. D.C. – in particular Thomas Farole and Leonardo Iacovone, who acted as peer reviewers – and in seminars and conferences in Stavanger, Tokyo and Vancouver. The research was conducted under the auspices of the Competitive Industries and Innovation Program of the World Bank.

1 Introduction

The global landscape of production has changed significantly over the past decades. Many emerging countries, including, but not exclusively, China, Turkey, and a number of South-East Asian nations have successfully inserted themselves into the global economy and have become important manufacturing locations. Developing countries in general account for an ever increasing share of trade flows and foreign direct investment (FDI). Whereas the developing countries' share in total merchandise exports fluctuated between 20% and 25% at the end of the previous century (World Trade Organization, 1996), it reached 43% in 2015 (World Trade Organization, 2016). For the first time in history, developing countries received more FDI than developed countries in 2012 (UNCTAD, 2013). The resulting employment, export creation and upgrading of the technological base allowed many countries to increase their GDP per capita, decrease poverty, and improve overall living standards at unprecedented rates. While some countries achieved this through the attraction of relatively low-tech standard manufacturing industries, such as textiles, based on a traditional cost advantage, the emergence of Global Production Networks (GPNs) also contributed to this development (Baldwin, 2011; Coe & Yeung, 2015; Henderson, Dicken, Hess, Coe, & Yeung, 2002; Iammarino & McCann, 2013). The emergence of GPNs has been facilitated by improvements in transport and communication infrastructure and led to the split of production into separate functions, with specific functions located in the most cost effective places (Iammarino & McCann, 2013). Particularly since the 1980s, GPNs have fueled trade between developed and developing countries (Baldwin & Lopez-Gonzalez, 2015). This has opened up new opportunities for developing countries to not only attract production but also move up the value chain ladder.

Special Economic Zones (SEZs) have long been prominent in the policy tool box for this purpose. Developing countries have been particularly active on this front in recent years. SEZs have been promoted with the intention of boosting exports, diversifying the economy, and generating direct and indirect jobs. Developed economies have also resorted to SEZs as a way to foster economic development in their lagging regions. The early dynamism of some SEZs in parts of the developed

world, as well as some cases in China and the Asian Tigers has contributed to enhance the appeal of SEZs amongst policymakers in less developed regions and countries as a development tool.

The popularity and importance of SEZs has rocketed in the last two decades. While there were 176 zones in 47 countries in 1986, the International Labor Office (ILO) database registered 3,500 in 130 countries in 2006 (Singa Boyenge, 2007). The Foreign Investment Advisory Service (2009) estimates that, in the mid-2000s, SEZs accounted for almost 20% of exports and employed more than 60 million people in developing countries.

Most SEZs share a number of features: 1) they generally have a regulatory and incentive framework that is different from that of the rest of the country; 2) they tend to provide dedicated infrastructure services; and 3) their area of activity is clearly delineated by physical boundaries (Asian Development Bank, 2015; FIAS, 2009; World Bank, 2011). However, zones differ greatly in the application of these features, meaning that a wide variety of SEZs has emerged across the world. Even within countries, it is not infrequent for different forms of SEZs to coexist, each displaying a different mix of incentive schemes, services, industries, and target markets.

Despite often overstated claims about the impact of the zones and the diversity of economic zone policies, there is limited empirical evidence that systematically analyses how differences in the set-up of the zones impact on their performance. Hence, our knowledge as to which types of SEZs and which incentive schemes have been more successful in contributing to further the goals of the zones remains highly imperfect.

A lack of comparable cross-country data to measure SEZ outcomes and characteristics has limited quantitative research on the topic so far. The few studies which have attempted to assess SEZ performance drivers in a comparative, quantitative way rely on low numbers of observations (see Aggarwal, 2005; Farole, 2011). The most serious attempt to do this to date is Farole's (2011) covering a sample size of 49 to 77 SEZs. This means that the explanatory power of comparative studies remains rather low. Most other research has adopted a case study approach (e.g. Engman, Onodera, & Pinali, 2007; Nel & Rogerson, 2013; World Bank, 2011). Many of the cases examined represent solid

analyses of the economic dynamism and influence of individual zones and provide interesting insights about their viability and the characteristics that make them economically dynamic. However, the case-study nature of such analyses is also not without problems. More often than not research has focused on the most successful cases, raising questions about the capacity to generalize the factors behind the economic dynamism of a specific SEZ across economic, social, political, and legal contexts that often differ widely from those that have contributed to make a particular case successful.

The purpose of this paper is to overcome this important gap in our knowledge, by shedding more light on what makes SEZs – one of the most prominent development strategies of our time – work. This implies identifying the drivers of SEZ dynamism (proxied by SEZ economic growth) across countries from a comparative perspective. In order to do so, we rely on two entirely new data sets, developed in collaboration with the World Bank's Trade and Competitiveness Practice Department. The first one maps SEZs in 22 countries – mostly in the emerging world – assessing the characteristics of the zones, the incentives and enticements provided either at the zone or national level for the establishment of SEZs, as well as the socio-economic and institutional characteristics of the regions and countries in which a zone is located. The second dataset uses nightlights data as SEZ performance proxy to overcome the lack of reliable economic indicators when measuring SEZ performance.

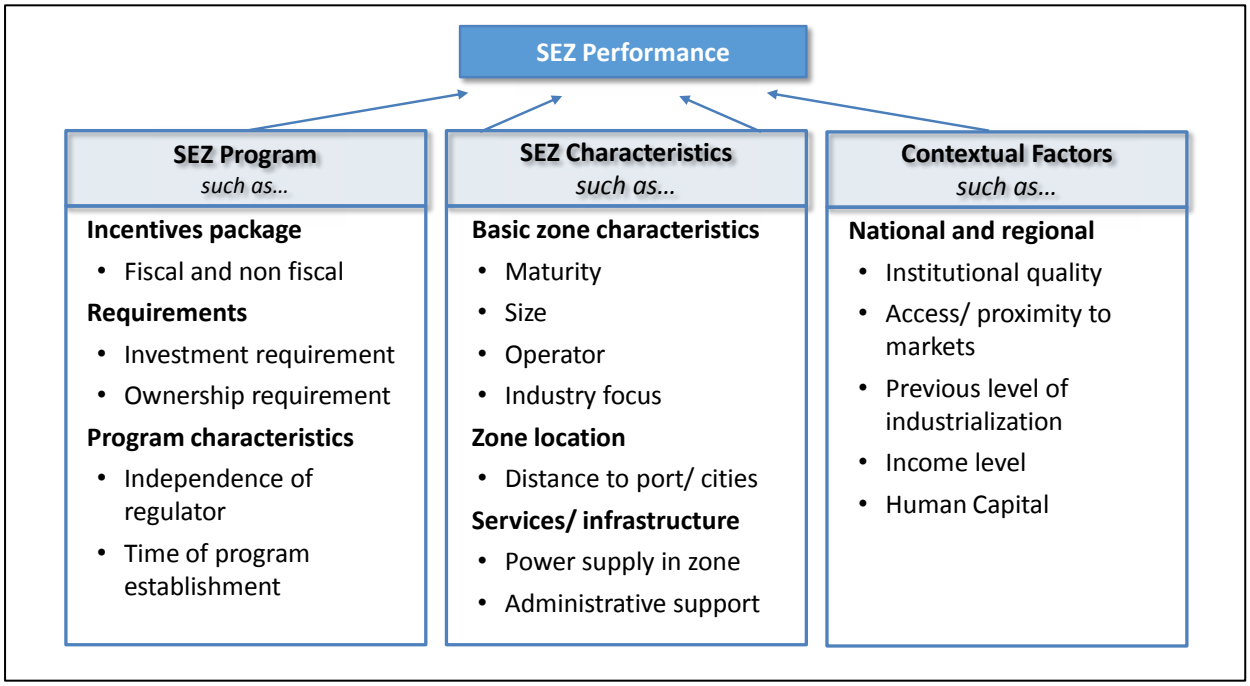
The paper is structured as follows. The next section provides an overview of the existing literature on SEZ performance determinants. Section 3 lays out the methodology of the econometric analysis and introduces the datasets. A first descriptive account and the results of the econometric analysis examining the factors behind SEZ performance are presented in Section 4 and 5. The final section introduces the conclusions and preliminary policy implications.

2 SEZ performance drivers

The academic literature and a large body of policy best practice guides identify a vast array of factors, internal and external to the SEZ programs and zones, which are assumed to affect a zone's ability to achieve its intended objectives. In order to structure our analysis, we group these factors into three categories: 1) those factors related to the SEZ program; 2) those related to each individual SEZ; and

3) contextual factors reflecting the country and or regional endowment. Figure 1 provides a schematic overview of this conceptual framework.

Figure 1 Conceptual framework of SEZ performance drivers



The first set of factors is related to the set-up and design of the overall **SEZ program**. This includes the incentives package, any requirements imposed on firms to benefit from the incentives, as well as the organizational set up of the program itself. Traditionally, fiscal incentives have been at the core of SEZ policies. The underlying reasoning is to provide companies with an advantageous cost-reducing, fiscal environment. Fiscal incentives vary from country to country and from zone to zone, but frequently include a mix of exemptions from import duties on machinery and inputs and reductions or exemptions from corporate and other local taxes. Many programs also offer subsidized utilities to companies, either through VAT exemptions or explicit subsidies (Asian Development Bank, 2015). Studies have come to differing conclusions about the effectiveness of these tax-breaks. While Rolfe, Woodward, and Kagira (2004) and Aggarwal (2005) underline the importance of the incentive package from an investor's point of view, Farole (2011) does not find any correlation between the tax holidays offered to companies and zone growth in terms of employment generation and exports. Similarly, the Asian Development Bank (2015) concludes that while many countries feel the need to

offer tax incentives, their effectiveness may be limited and well below those of other pull factors. This SEZ specific evidence is in line with the wider literature on the effectiveness of fiscal incentives for the attraction of FDI. Blonigen (2005), for instance, concludes that while the obvious expectation is for fiscal incentives to work, there is still little clarity on their real effects, given the complexity of taxation. Furthermore, in the worst-case scenario, tax exemptions, subsidies, and other incentive packages may rear a rent-seeking behavior by firms in the zone, undermining the entire viability of the SEZs scheme (Rodríguez-Pose & Arbix, 2001; World Bank, 2011).

Exemptions from national labor regulations and the facilitation of administrative services through national one-stop-shops is another popular way of providing non-fiscal benefits to companies (Asian Development Bank, 2015; OECD, 2009). While the reduction of labor protection is frequently seen with concern with regards to its social impacts (Jauch, 2002), several authors claim that more flexible labor regulations have contributed to the success of many SEZ policies (Aggarwal, 2005; Madani, 1999; Watson, 2001). Administrative facilitation through one-stop-shops is generally approved of and considered best practice by many international institutions (Asian Development Bank, 2015; Farole & Kweka, 2011).

Programs also differ in the requirements needed by companies in order to benefit from the incentive packages. As the aim of many programs is to attract foreign direct investment, some specifically target foreign companies, meaning that often only firms either partially or fully owned by foreign investors benefit from the incentives schemes. Similarly, as the aim of many policies is to increase a country's export performance, some policies impose a minimum level of exports. Finally, certain programs also require minimum investment or minimum of employment thresholds in order for the company to access the tax breaks. Despite the proliferation of such requirements, few studies have looked into the question if and how they may impact zone performance. The OECD (2009), for instance, advocates the need to remove minimum export requirements in order to avoid a bias against local firms and to ensure compliance with WTO regulations. But even in this case, it does however not say much about how such a measure would impact on SEZ performance.

The organizational set-up of the SEZ program has also been linked to the success of the policies. An independent zone regulator – expected to be shielded from political pressures as well as equipped with sufficient resources – is commonly considered to facilitate an efficient overview of SEZ program development and implementation (Farole & Kweka, 2011; OECD, 2009). As a consequence, independent regulators may lead to better economic outcomes at the zone level.

The second set of factors is made of **SEZ characteristics**, that is, characteristics that are exclusively related to the structure and layout of the zone. SEZ characteristics are generally linked to the dimension of the zone, the sectors targeted, its location, as well as to the services and infrastructure provided within the zone. In recent years, there has been a shift in the literature and among policy-makers to highlighting the importance of these factors as opposed to purely relying on the incentive package provided in the overall SEZ program (UNCTAD, 2015). Furthermore and in contrast to contextual factors, zone characteristics can be influenced and/or modified relatively easily. Hence, it is reasonable to expect that the SEZ-specific characteristics will affect the economic performance of the zone.

Among the most prominent SEZ characteristics is the maturity of the zone. Several case studies have underlined the challenge for zones to kick-start growth as well as to maintain it after the initial years of economic dynamism, as competition from other countries for FDI increases (Henderson & Phillips, 2007; World Bank, 2011). The technological content of the zone is another factor that may make a difference for economic performance. Many zones in less developed areas have aimed to attract investors in the high-tech sector as opposed to the low-tech manufacturing on which many initially dynamic zones relied (Asian Development Bank, 2015). High-tech zones are regarded as a faster and more illustrious way to achieve employment creation and economic growth. However, questions have been raised about the viability of high-tech zones in less-developed environments (Luger & Goldstein, 1991; Quintas, Wield, & Massey, 1992). The nature of the operator has also been identified as a success driver with best practice guides frequently emphasizing the advantages of private operators over publicly run zones (Farole & Kweka, 2011; OECD, 2009; Watson, 2001). Farole (2011) does however not find any correlation between the type of zone operator and SEZ performance.

An important question also concerns the location choice. SEZ policies frequently have an explicit spatial aspect, i.e. they aim to promote the economic development of certain regions. At the same time, a strategic location close to ports, consumer markets, and labor pools are elements many firms actively consider when deciding on location (Aggarwal, 2005). Several studies have stated that closeness to ports or large cities is more likely to spur zone dynamism than locating a SEZ in more remote areas (Asian Development Bank, 2015; Madani, 1999).

The type of services and infrastructure provided within the zones may also affect their economic dynamism. Traditionally many zones have provided services aimed at easing infrastructural and other challenges in the country. These services range from the existence of a dedicated customs-office to, among others, the provision of more reliable utilities – electricity supplies in particular. Increasingly zones also offer other, 'softer' services such as human resources, restaurants, housing services, and one-stop-shop facilities onsite to deal with administrative processes for the companies within the zone (Farole, 2011; World Bank, 2011). It is assumed that these services improve the attractiveness of zones and therefore have a positive impact on zone growth.

Finally, the **regional and country context** in which the SEZs are located also matters for the growth of the zone.[1] While the aim of many SEZ programs is to overcome the challenges that companies face locally, SEZ do not operate in a void and are likely to be heavily influenced by the socioeconomic characteristics, market potential, and general business climate of the host country. The country and regional context in which a SEZ operates have therefore been highlighted as key for a successful SEZ policy implementation (Farole, 2011). A number of authors stress the importance of the national investment environment and institutions for FDI (Blonigen, 2005; Daude & Stein, 2007; Portugal-Pérez & Wilson, 2012) and thus for the dynamism of SEZs. Aggarwal (2005) and Farole (2011) report a strong correlation between SEZ outcomes and the general business climate. Moreover, the attractiveness of a host country is enhanced/diminished by its proximity/distance and access (or lack

[1] This section is closely related to the more general literature which examines the determinants for FDI [see for example Groningen (2004) for an overview]. To give a full review of this stream of literature is however beyond the scope of this paper and we restrict the overview to those factors that have been more frequently highlighted in research specifically focusing on SEZs.

of it) to large markets (Madani, 1999; Rolfe et al., 2004; Watson, 2001) as well as by its industrial structure. Trade between countries decreases as distance and trade costs increase (Disdier & Head, 2008; Álvarez et al., 2018). Hence, proximity to a large national market is an attractive feature for efficiency seeking investors. Furthermore, proximity to a technologically advanced nation is regarded as particularly important for the integration into GPNs (Baldwin, 2011; Baldwin & López-González, 2015). Favorable national industrial structures with a solid pre-existing manufacturing base also increase a host country's attractiveness (Hidalgo & Hausmann, 2009). Economies primarily reliant on agricultural production will, in all likelihood, have a more difficult time convincing investors of their capabilities to produce manufacturing goods at a large scale than countries with a pre-existing industry base. Finally, a country's overall socio-economic context may be an important stimulus/deterrent for investors. Efficiency seeking investors in labor intensive sectors require a sufficiently large and cheap workforce and are therefore prone to look for cheaper locations with an abundant supply of labor. Human capital endowments affect productivity and are also assumed to play a role in making places more or less attractive for firms, in particular in the process of upgrading to higher value added products (Larrain, López-Calva, & Rodríguez-Clare, 2009; World Bank, 2011).

As this overview shows, a large amount of factors, both internal and external to the zones and to SEZ policies, are on the table as potential drivers of zone performance. While much has already been written about the impact of these factors from a case study approach, a more systematic quantitative analysis of whether these factors apply universally is still missing.

3 Methodology

3.1 Model

In order to quantitatively assess the role of the different factors potentially affecting SEZ growth, we operationalize the three sets of performance determinants described in the previous section using the following simple econometric model:

$$(1) \quad \Delta y_{i,t} = \alpha_1 + \beta_1 \text{SEZ related factors}_{i,t0} + \beta_2\, SEZ \text{ program factors}_{i,t0} + \beta_3 Country/regional\ level\ endowments_{i,t0} + \beta_4\, Structural\ nightlights\ controls + \epsilon_i$$

where

- Δy_{it} is the dependent variable, measuring the economic growth of an individual SEZ (i) at time t;
- *SEZ-related factors* depict the dimension of the zone, location, the type of sectors targeted, and the services provided. These are zone specific variables;
- *SEZ-regulatory variables* reflect the incentives offered, the requirements imposed, and the organizational set-up of the program. These variables are either national-level variables or SEZ-specific, in those cases where multiple SEZ regimes exist within a country;
- *Country/ regional context* represent the economic, social, political, and institutional factors at the country and regional level that may impact SEZ performance as well as proximity to markets;
- *Structural nightlights controls* are factors used to improve the fit of nightlights as a SEZ performance proxy (see upcoming section on SEZ performance proxy);
- ϵ_i is the robust standard error clustered at the within country-region level

3.2 SEZ growth

Ideally, the dependent variable Δy_{it} – reflecting SEZ performance – should be measured using indicators such as FDI inflows into the zones, exports from the zone, employment generation (both direct and indirect), and value-added. However, as mentioned in the introduction, the lack of such data for the great majority of SEZs in emerging countries requires an alternative approach.

Stemming from the field of remote-sensing, economists and other social scientists have increasingly resorted to light data as a proxy for economic activity in those cases where direct economic data are not readily available (Ebener, Murray, Tandon, & Elvidge, 2005; Elvidge, Baugh, Anderson, Sutton, & Ghosh, 2012; Florida, Gulden, & Mellander, 2008; Henderson, Storeygard, & Weil, 2012). Nightlight data can be extracted from the Defense Meteorological Satellite Program (DMSP) for the years 1992-2012. The dataset provides the average luminosity created by human activity going from 0 to 63 in roughly one-square-kilometer cells – the size of the cells varies with latitude – covering the majority of the world's land area.

Given the small size of the grid cells, reliable measurements can be obtained for almost any geographical area. Mellander, Lobo, Stolarick, and Matheson (2015) demonstrate that the correlation between the luminosity and alternative data for economic activity is high even at a very small scale. They use data on employment and number of firms from the Swedish Statistics Bureau, which is geocoded in cells of 250mx250m, and compare it to that stemming from nightlights data. They find a high correlation between the two. Similarly, Levin and Duke (2012) conclude in a study for Israel that nightlights are highly appropriate to proxy the extent of human activity at a small scale.

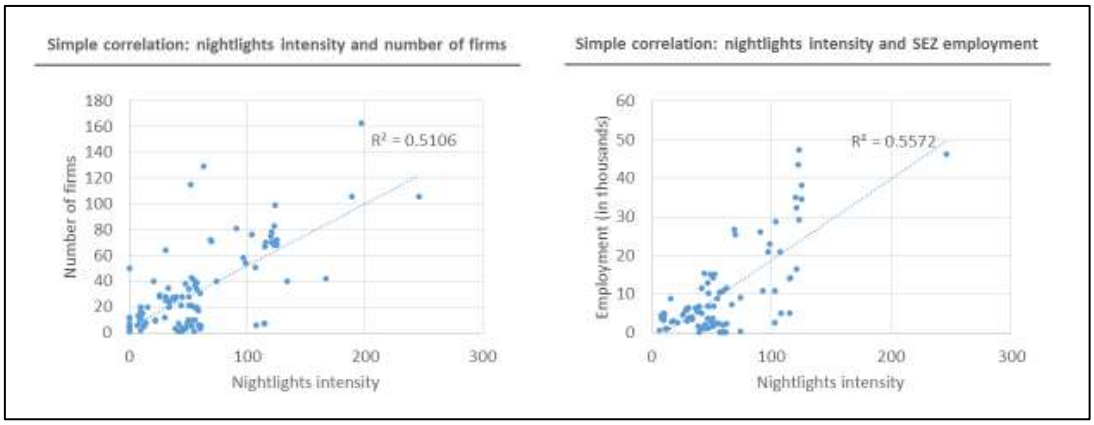
But how reliable are night-time light data when measuring the economic performance of SEZs? In order to use the nightlights data as an SEZ performance proxy, we calculate the luminosity for each zone. We identify the size, location, and centroid of each SEZ using google maps satellite imagery as well as online sources from the national SEZ authorities and the SEZ homepages. Given the size of the nightlight grid cells, we only use zones which are 50ha or larger. A circle is then drawn around the centroid as a proxy for the area of the SEZ. The night-lights within the area of the circle are assumed to reflect the economic activity within the zone.[2]

[2] To determine the length of the radius used to draw the circle, it is assumed that the SEZ has a square shape identical to the overall surface of the SEZ. A circle is then drawn around the centroid which touches each corner of the square. The resulting surface of the circle is consequently slightly larger than the actual zone. Experiments with other radius lengths were conducted, but it was found that the method chosen provided the best fit. This circle is then overlaid onto the nightlights raster file. If the perimeter of the circle (which represents the zone) intersects or passes beyond the centroid of the night-lights cell (such that the centre of the pixel is within the buffer), the pixel is included in that count. If the buffer covers more than one nightlights cell, the values of both cells are added up.

To test the suitability of the nightlights as a SEZ performance proxy, data on the number of companies and employment for a number of SEZs were collected as an alternative performance measure. Figure 2 shows a simple scatterplot between number of firms and employment and the nightlights proxy. Both graphs display a clear positive association between the alternative measures and our proxy.

To further test the fit, we ran two simple regressions, in which the number of firms and SEZ employment are the dependent variables and our nightlights proxy the explanatory variable, controlling for country fixed effects. In both cases, the nightlights are a highly significant predictor of the number of firms and the employment within the zone (see Appendix 1 for the regression results). Hence, nightlights represent a good proxy for the employment and firm creation within SEZs.

Figure 2: Correlation nightlights, number of firms and SEZ employment



It is, however, fair to state that while our proxy on average is a good predictor of SEZ performance, there is some spread around the trend line. To identify potential sources of this heterogeneity in the fit of the night-light as a proxy for SEZ performance, the satellite images of the outliers visible in the scatterplot were inspected. Location in densely populated areas, next to large highways, and/or directly on the coastline were the factors that affected the accuracy of the proxy. Zones in densely populated areas or next to highways usually reflect a higher amount of lights from outside the zone. This is in line with Levin and Duke (2012), who find that a significant amount of the lights reflected in the nightlights imagery stems from streets. In order to minimize this reflection, the level of

population density around the zone (on a scale from 1 to 3) was identified for each zone. Information as to whether specific SEZs are located next to a large water body or a highway was also recorded. These three factors were included in the regressions as structural nightlights controls in order to improve the fit of the nightlights as proxy for economic activity in the zone.

The use of night-time lights, nevertheless, does not remain without caveats. As indicated by Keola, Andersson, and Hall (2015), studies resorting to nightlights data to calculate economic activity have a tendency "to underestimate economic activities that emit less or no additional night-time light as they grow". This is particularly problematic for areas with a high dependence on agricultural activities. Given that most SEZs tend to focus on manufacturing or are mixed, our estimates should be less affected by this. Differences across manufacturing sectors and technological content are however, while probably less pronounced, still plausible. This is particularly true when considering possible increases in the technological content or value-added within the SEZ which may happen once the SEZ has matured and the labor/firm inflow has levelled out. Nightlights are less likely to be able to capture this process. Hence, the results of the analysis will have to be considered in light of these caveats.

For our regressions, we used three variations of the nightlights proxy. The main indicator is the growth rate of the nightlights emitted from the SEZ in the period of analysis. This is the absolute growth rate. Using growth rates instead of levels has the advantage that country or zone specific aspects (such as differences in lighting technology), which may differ between zones and influence the nightlights measurement, are cancelled out. To provide further nuance, we also worked with two relative growth rates: (1) the ratio of the change of the nightlight emissions within the zone compared to the change in nightlights in the entire country as well as (2) the ratio of the change of the nightlight emissions within the zone compared to the change in nightlights in the area within a 50 kilometer radius surrounding the zone. While the first indicator, zone growth, provides a measure of absolute growth and is our main dependent variable, the two latter indicators provide a relative performance measure and capture whether a zone has grown faster than the national or the surrounding area average. This allows teasing out differences in national and regional growth across countries, as less dynamic zones in rapidly growing countries or regions may often have – as a consequence of the

overall dynamism of the country/region – higher rates of growth than very dynamic zones in low growth countries/regions. These relative indicators are expected to reflect better the capacity of the SEZs to act as a motor of national and/ or regional growth within a country and are used as a robustness check.

3.3 SEZ related and program factors

Since information on the vast array of SEZ characteristics and program related variables which may drive zone growth is not readily available for a large number of SEZs, an entirely new dataset was compiled in collaboration with the World Bank's Trade and Competitiveness Practice. Information was collected for the largest possible number of SEZs using a variety of sources. These included information available online from SEZ and public authority homepages, reports from international organization, and related sources. SEZ authorities and zones were also contacted over email and phone to verify and complement the data collected online.[3]

Table 1 provides an overview of the specific variables covered in the dataset as well as the expected sign of correlation with SEZ growth.[4] A detailed description of each variable is included in Appendix 3.

The database includes 346 zones in 22 countries across the developing world and South Korea. Appendix 2 provides an overview of the country coverage and number of zones per country. The sample covers countries from all over the developing world. It is, however, biased towards countries in the East Asia and Pacific region. On the one hand, this exposes the strong proliferation of SEZ policies in this part of the world. On the other hand, this is also driven by the fact that many Latin American zones do not fulfil the size requirements related to the use of nightlights data (e.g. out of the more than 60 zones in the Dominican Republic, only 10 have the required size to be included in the

[3] Appendix 2 includes a detailed description of the database, including the specific SEZ definition and country coverage.

[4] While every effort was made to collect data on additional variables, such as the specific sectors of the firms operating within each SEZ, only those variables for which data were available for a large enough number of zones were included in the analysis.

sample). Furthermore, many countries introduced their zone program only recently, meaning that the number of zones operational during the period of analysis is limited.

Table 1: Overview SEZ related factors and SEZ program variables

Variable	Expected direction of correlation with SEZ growth
SEZ related variables	
Basic characteristics	
SEZ Size	Unclear
Number of Years Operating	Negative
High-technology Focus	Unclear
Nature of Zone Operator (Public/ PPP/ Private)	Positive for private zone operator
SEZ services and infrastructure	
Customs-office Onsite	Positive
Electricity Sub-Power Station	Positive
One-stop Shop Onsite	Positive
SEZ location	
Distance to Largest City	Negative
Distance to Closest City with at least 500K Inhabitants	Negative
Distance to Closest City with at least 300K Inhabitants	Negative
Distance to Closest Port	Negative
SEZ policy variables	
Fiscal and non-fiscal incentives	
Level of Corporate Tax Exemption	Positive
Subsidized Utilities	Positive
Exemption from Labor Regulations	Positive
National One-stop-shop	Positive
Program requirements and independence of zone regulator	
Foreign Ownership Requirement	Negative
Investment Requirement	Unclear
Independence of Zone Regulator	Positive

Table 2 provides an overview of some key characteristics of the SEZs within the dataset, i.e. the time of establishment of the zones, the sector focus, technology intensity, and size. The majority of zones have become operational since 2000 (52%). 30% were established in the 1990s and 18% before 1990. This reflects their increasing popularity as a policy tool. There is a wide variety of zones according to size: 20% of zones are smaller than 100ha; 38% range between 100ha and 200ha; 33% between 200ha

and 500ha; and the remainder (9%) is above 500ha. The largest zone included is 998ha and the smallest, 51ha.

Table 2: Characteristics of SEZs included in the dataset

Period of establishment	
Before 1990	61 (18%)
1990 to 1999	105 (30%)
Since 2000	180 (52%)
Average size	
Below 100ha	70 (20%)
Between 100ha and 200ha	130 (38%)
Between 200ha and 500ha	113 (33%)
Above 500ha	33 (9%)
Sector focus	
Manufacturing	241 (70%)
Services	1 (0.3%)
Mixed	104 (30%)
Technology intensity of industry	
Low and medium technology	274 (79%)
High-technology	72 (21%)
Zone operator	
Public	142 (41%)
PPP	116 (34%)
Private	85 (25%)

In terms of the sector, 70% of SEZs are fundamentally manufacturing zones, 30% are mixed. Only one zone in the sample is purely services focused. The near absence of service-oriented zones is due to the fact that service zones tend to be much smaller in area and thus fall through the 50ha filter. Approximately 21% of zones used in analysis contain a sectoral focus on high-technology manufacturing.

The type of zone operator is distributed between public, private, or public-private partnership (PPP), depending on the set-up of the management company. 41% of all zones are entirely publicly managed, while 25% are privately run. 34% are PPPs, involving both the private and the public sector.

3.4 Contextual factors

Finally, the third set of variables – those reflecting the country and regional endowments – is used as a base model in order to control for the contextual factors that may influence SEZ growth. At the country level, controls for the proximity of a country to large markets, the level of industrialization, GDP per capita, and the general business environment, as reflected in institutional variables, were included in the dataset. Given the importance of access to markets for companies, the coefficient for proximity to large markets can be expected to be positive. Level of industrialization, as measured by the share manufacturing of GDP, reflects the inherent capacity of the host country to produce manufacturing goods (Hidalgo & Hausmann, 2009). A higher value, keeping other things equal, should therefore be attractive to companies, leading to a positive coefficient. The natural logarithm of GDP per capita reflects a country's overall level of development and also provides an indication of wages. We do not have a strong prior on the sign of this coefficient: on the one hand, companies may require a minimum level of development in order to be attracted to an area. The sign may thus be positive. On the other, as salaries tend to be lower in poorer countries, zones in less wealthy countries may be particularly attractive for firms seeking to reduce costs. Different variables are tested in order to capture the general institutional and business environment in the host country, with the results for Rule of Law presented in the main regressions. A more stable institutional environment should be positively correlated with SEZ performance. Finally, a country nightlights growth is also included in the regression to control for the overall change in economic performance in the country. This allows us to single out whether a zone's performance was actually driven by the other characteristics included or simply followed national growth.

The country variables are complemented by a proxy reflecting the level of development and socio-economic characteristics of the region within the country the zone is located in. As mentioned above, for political and social reasons zones are frequently located in lagging regions within a country to stimulate economic activity in these areas. The ln ratio of the regional GDPpc over national GDPpc provides an indication of how well-off a region is in comparison to the national average. Values over 0 indicate that the zone has a higher GDPpc than the national average and is thus likely to be endowed

with better socio-economic characteristics, but also higher salaries. Values below 0 reflect the opposite case. The variable thus allows us to test if zones in lagging regions are performing better or worse than those located in economic cores. Complementing the national controls with this ratio also allows to control for the immediate geographical context of the SEZ, which, particularly in large countries, may be very different from the national average. Details for all variables are included in Appendix 3.

3.5 Estimation strategy

We conduct a simple OLS econometric analysis of Model (1). While nightlights data are available on a year by year basis, most explanatory variable related to SEZ policy and SEZ characteristics are fixed over time. A panel analysis is therefore not possible. To maximize the number of zones included in the analysis – especially taking into account that the SEZ phenomenon has really taken off in emerging countries in the last few years – the main period of analysis covers the period between 2007 and 2012, i.e. zone growth from 2007 to 2012, for which all variables are available. We also present a complementary set of results to add further nuance to the findings. This implies looking at each zone's growth performance in the 5 years after the zone became operational and not for the fixed period of 2007 to 2012. The aim of this exercise is to uncover the factors that facilitate the economic performance of SEZs during the initial years of operation, regardless of when they were founded. The sample for this analysis is reduced as data were not available for every zone in the sample in the period immediately after their establishment. The reduction in the dataset fundamentally concerns older zones.

4 Descriptive analysis of SEZ performance

Before turning to the econometric analysis, we examine the performance of the 346 SEZs in our dataset for the main period of analysis (2007-2012). The average of the growth rate across all SEZs is 14.7% over the entire period. A median growth performance of 2.8% and a standard deviation of 28% indicate a vast spread in growth among the SEZs. Looking at the SEZ growth rate relative to national growth presents further interesting insights. An average ratio of 0.98 shows that zones on average

have grown roughly at the same speed as the countries they are located in. Similarly to the absolute growth rate, the median is, at 0.95, lower than the national growth level. Again, there is a considerable spread with a standard deviation of 0.22. SEZ growth performance has on average, thus, been rather moderate – and far from displaying the stellar performance that often drove the design and launch of SEZs. Consequently, the ambitious goals of SEZ policies have not been fulfilled during the period of analysis. There is, moreover, a large diversity in zone performance.

For the purpose of a first descriptive analysis, the zones are grouped into different performance categories. For absolute SEZ growth, the following three groups are used: 1) shrinking, 2) stable, and 3) growing. 'Shrinking' includes those zones, whose absolute light emissions shrank by more than 5% over the period of 2007 to 2012; 'stable' zones are those that remained within a +/- 5% range over the entire period; and the 'growing' group includes those SEZs with an increase in the absolute nightlights emissions of more than 5%.[5] The zones' growth performance relative to national growth is captured in the following categories: 1) slower; 2) equal; and 3) faster. The 'slower' group includes those zones, whose ratio between zone and national growth is less than 0.9, the 'equal' group, those which are between 0.9 and 1.1, while the 'faster' group, all zones with a ratio larger than 1.1.

Figure 3: SEZ growth 2007 to 2012 - Number of SEZs in each category

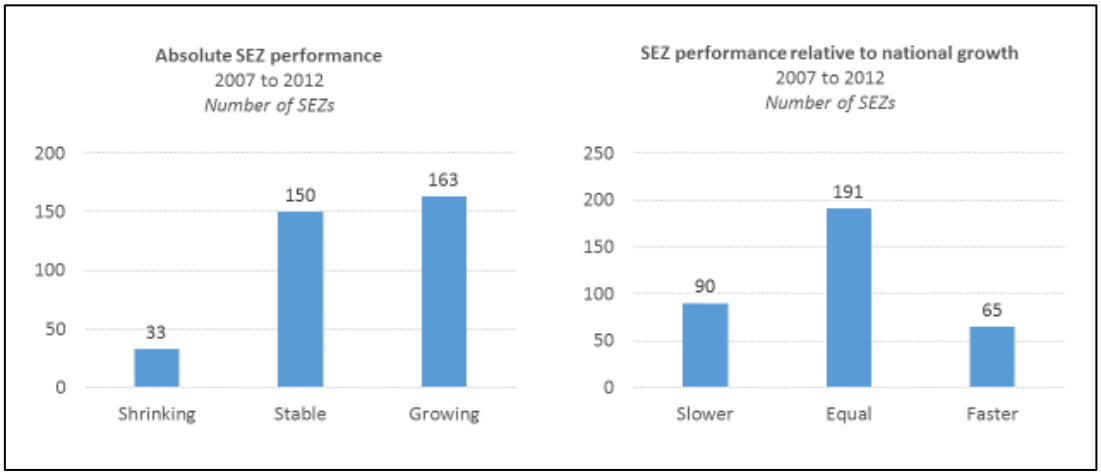


Figure 3 shows the number of zones in each of the groups. The numbers reflect the large variability in zone performance. 33 of the zones considered in the analysis shrank from 2007 to 2012, while 150 had a relatively stable performance and 163 grew. This implies that only half of the zones exhibited

[5] Growth rates refer to the entire period of analysis, not the yearly growth rate.

positive growth. Looking at the performance relative to national growth paints an even less positive picture: only 65 zones grew considerably faster than the national average, while the vast majority of zones grew at the speed of the national economy. One out of four zones grew well below the national average.

Figure 4 depicts the average SEZ growth performance per country. The y-axis plots zone growth, while the x-axis shows the ratio of zone over national growth. Countries above the horizontal line had SEZs that grew on average. Those below the line shrank. Among those countries included in the study, only zones in Pakistan experienced absolute negative growth rates during the period of analysis. Zones in Malaysia, Lesotho, Jordan, South Africa, and South Korea remained on average relatively stable. The remaining countries display a strong increase in nightlights within the zones.

The picture is, however, less favorable when we consider the growth performance of the zones relative to national growth. The majority of countries has an average ratio below 1 (to the left of the vertical line) indicating that nightlights in the zones grew less than in the country as a whole. Even countries where the absolute zone growth was dynamic, such as in Kenya, Turkey, and Ghana, SEZ growth was lower than overall national growth. In other countries with a high absolute growth, such as Vietnam and Russia, zones grew faster than the national average. However the ratio of average zone growth relative to national economic growth never exceeds 1.06.

Figure 4: Average SEZ growth per country:
absolute and relative to national growth, 2007 - 2012

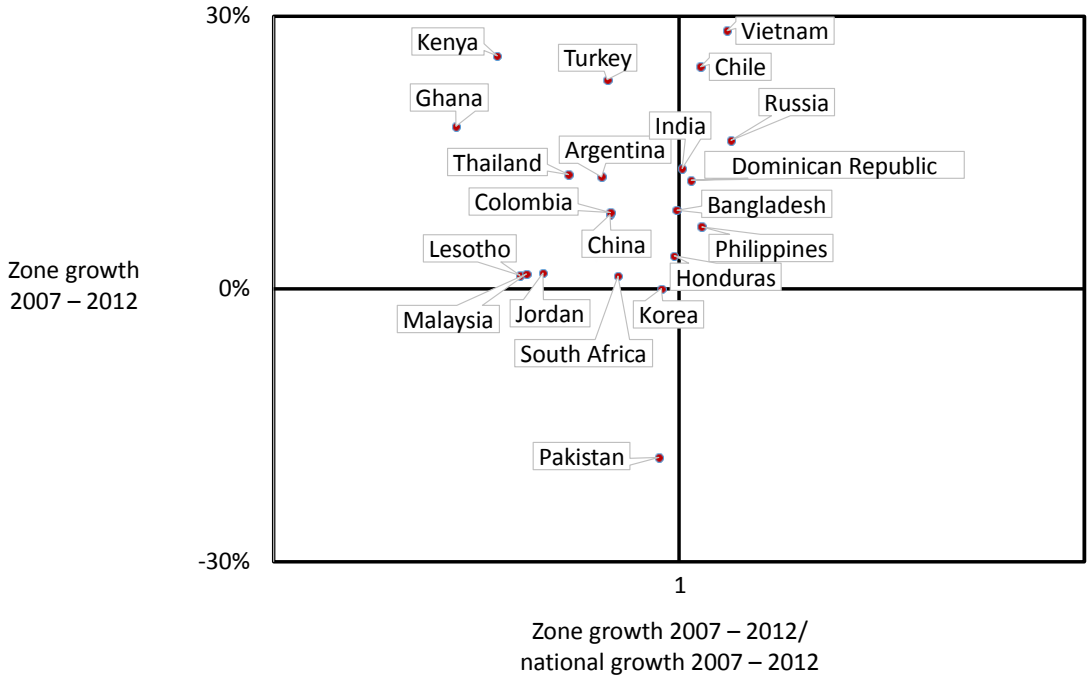
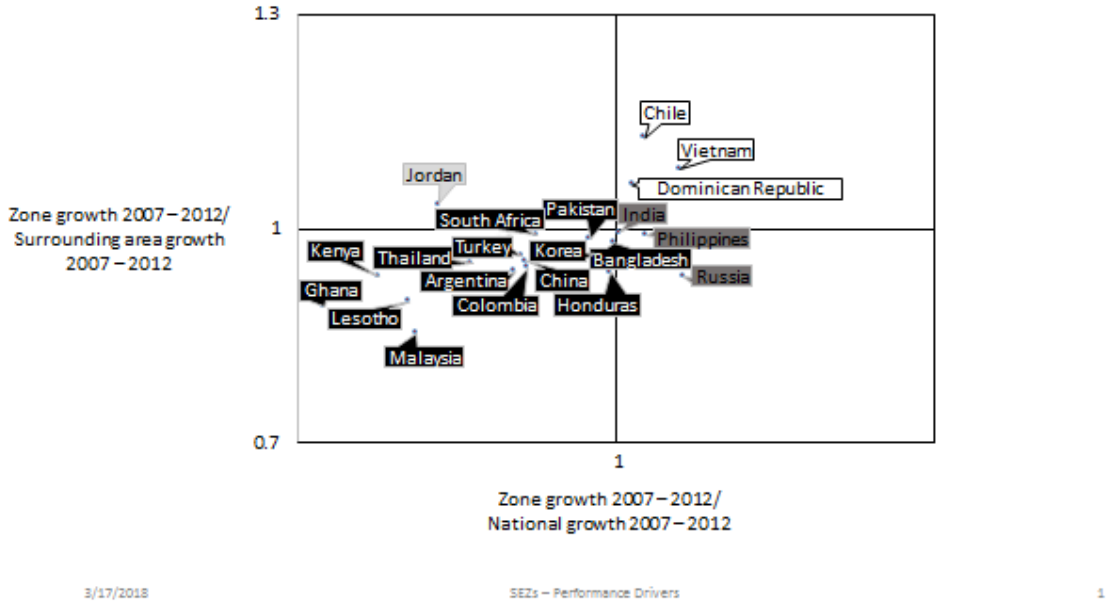


Figure 5: Average SEZ growth per country:
relative to surrounding area growth and relative to national growth, 2007 - 2012



Note: White = the country's zones grew on average at a similar pace as or faster than their surrounding areas and the country average.
Light Grey = the country's zones grew on average at a similar pace or faster than their surrounding areas, but grew at a slower pace than the country average.
Black = the country's zones grew on average slower than their surrounding areas and the country average.
Dark Grey = the country's zones grew on average at a similar or faster pace than the country average, but grew at a slower pace than their surrounding areas.

We repeat the exercise by comparing the relative national growth performance to the SEZs' growth in relation to the growth of the surrounding area (Figure 5). In three countries, Chile, the Dominican Republic, and Vietnam (dark green), the zones grew both faster than their surrounding area as well as the country average. Jordan is the only country where zones grew on average faster than the surrounding area despite growing slower than the national average (light green). In India, the Philippines, and Russia, SEZs grew on average faster than or at a similar pace as the country's average, but the zones grew at a slower pace than their surrounding area (those countries colored in light red). In the remaining countries, the zones grew on average both slower than the surrounding areas and the country as a whole.

5 Econometric analysis

5.1 Main regressions

To determine which of the potential drivers of SEZ growth should be included in the regressions, the full model is built up in a step-by-step approach. We start by introducing all zone related characteristics individually – first without controls and then including country dummies in order to test their robustness (Table 3). We then proceed the same way with the policy variables, using contextual controls as base model instead of country dummies for the robustness check (Table 4).[6] Based on these regressions, Table 5 presents the full model where zone characteristics, policy variables, and the contextual factors are regressed simultaneously. Each regression also includes the structural nightlights controls and initial luminosity within the zone to improve the fit of the nightlights as SEZ performance proxy.

The econometric results for the zone characteristics and absolute SEZ growth present a consistent picture (Table 3). The maturity as well as the size of the zone are consistently significant and robust to the inclusion of country dummies (Columns 1 to 4). A high-tech focus of the zone is significant, but only in the regression without country dummies (Column 7). In contrast, all other variables related to the operation of the zone, the infrastructure provided, and the zone location are not significant. These results hold when the zone characteristics are considered and when contextual factors are used as controls instead of country dummies (see Appendix 4). The insignificant results of the variables reflecting zone infrastructure and services are somewhat counterintuitive, given their prominent role in the literature and best practice guides. However, they should be taken with a pinch of salt due to potential measurement errors: a one-stop-shop can be available on paper, but not necessarily function or function efficiently in reality. This is something that the dataset cannot capture.

[6] The base model instead of country fixed effects is preferred, since most of the policy variables apply to all zones within a country.

Table 3: Zone related variables. Dependent Variable: SEZ growth 2007 to 2012

Basic zone characteristics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Years in Operation	-0.00759***	-0.00450***						
	(0.00174)	(0.00170)						
Size			0.00124***	0.00103***				
			(0.000180)	(0.000202)				
Operator								
PPP					-0.0611	-0.0372		
					(0.0419)	(0.0402)		
Private					-0.0142	-0.0213		
					(0.0447)	(0.0429)		
High-tech focus							-0.0552*	-0.0384
							(0.0294)	(0.0287)
Country dummies	-	Yes	-	Yes	-	Yes	-	Yes
Structural nightlights controls and initial lights	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	345	345	345	345	343	343	345	345
R-squared	0.167	0.304	0.323	0.393	0.113	0.292	0.110	0.293

Zone infrastructure and services

	(9)	(10)	(11)	(12)	(13)	(14)
Customs-office Onsite	-0.0666	-0.0470				
	(0.0423)	(0.0519)				
Electricity Sub-Power Station			0.00960	-0.0190		
			(0.0362)	(0.0346)		
One-stop Shop Onsite					-0.0592	-0.0147
					(0.0383)	(0.0418)
Country dummies	-	Yes	-	Yes	-	Yes
Structural nightlights controls and initial lights	Yes	Yes	Yes	Yes	Yes	Yes
Observations	336	336	334	334	345	345
R-squared	0.116	0.300	0.102	0.285	0.115	0.291

Zone location

	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
Distance Largest City	3.86e-05	-1.26e-05						
	(2.92e-05)	(3.12e-05)						
Distance closest Major Port			-1.25e-05	1.83e-05				
			(5.31e-05)	(5.25e-05)				
Distance closest City with at least 500k Inhabitants					6.25e-05	0.000122		
					(4.98e-05)	(0.000119)		
Distance closest City with at least 300k Inhabitants							0.000158	0.000174
							(0.000113)	(0.000105)
Country dummies	-	Yes	-	Yes	-	Yes	-	-
Structural nightlights controls and initial lights	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	345	345	344	344	344	344	344	344
R-squared	0.111	0.291	0.104	0.290	0.108	0.294	0.112	0.296

Robust standard errors in parentheses, clustered at within country regional level

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

The correlations between the regulatory variables and the absolute growth performance of SEZs (Table 4) are less consistent. Only two out of the seven regulatory variables presented in Table 4 – subsidized utilities and the foreign ownership requirement – are significant even when contextual

factors are controlled for. In contrast, exemption from labor regulations and the existence of an investment requirement for firms located in the zones are only significant if contextual factors are not taken into account. They thus seem to pick-up country effects. The remainder of the regulatory variables is insignificant. It is also worth noting that the subsidized utilities variable is negatively associated with zone performance (Column 4).

Table 4: Regulatory variables. Dependent Variable: SEZ growth 2007 to 2012

Fiscal and non-fiscal incentives

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Corporate Tax Exemption	-0.000108	-0.00328						
	(0.00343)	(0.00285)						
Subsidized Utilities			-0.0488	-0.0871**				
			(0.0453)	(0.0360)				
Exemption from Labor Regulations					-0.155***	-0.00516		
					(0.0522)	(0.0407)		
National One-stop-shop							0.0129	0.0374
							(0.0392)	(0.0345)
Contextual controls	-	Yes	-	Yes	-	Yes	-	Yes
Structural nightlights controls and initial lights	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	345	345	345	345	345	345	345	345
R-squared	0.104	0.272	0.110	0.278	0.121	0.269	0.105	0.271

Program requirements and independence of program regulator

	(9)	(10)	(11)	(12)	(13)	(14)
Foreign Ownership Requirement	-0.259*	-0.486***				
	(0.154)	(0.169)				
Investment Requirement			-0.160***	0.0858		
			(0.0282)	(0.0571)		
Independence of Zone Regulator					-0.0597	-0.0405
					(0.0407)	(0.0336)
Contextual controls	-	Yes	-	Yes	-	Yes
Structural nightlights controls and initial lights	Yes	Yes	Yes	Yes	Yes	Yes
Observations	345	345	345	345	345	345
R-squared	0.109	0.281	0.159	0.273	0.113	0.272

Robust standard errors in parentheses, clustered at within country regional level

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

As a final step in determining the baseline empirical model, combined regressions in which the different types of variables of Model (1) – zone characteristics, SEZ program factors, and regional and country characteristics – are run in succession (Appendix 4). While some individual policy variables become significant in these combined regressions, they again lose their significance once zone characteristics as controls are included. The R^2 is also considerably higher in the estimations

containing SEZ specific variables (Appendix 4, Columns 1, 2, and 3) than in those considering SEZ program variables (Appendix 4, Columns 4 and 5). The picture that emerges is thus one in which zone specific characteristics play a more consistent and stronger role in driving SEZ performance, while the results for the regulatory policies are less consistent and overshadowed by the contextual and zone specific controls.

Based on the results of Tables 3 and 4 (and Appendix 4), Table 5 introduces the full model. To make the estimations as parsimonious as possible given the limited sample size, we only introduce those variables which were either significant in the previous regressions (such as zone size and years in operation) or for which the literature provides a strong prior on how they should affect zone performance (e.g. the nature of the operator, location, corporate tax exemptions). Table 5 provides an overview of the results. We start by presenting the effect of SEZ specific characteristics, using country fixed effects and then sequentially add contextual and SEZ policy specific variables.

Table 5: Main regression analysis. Dependent Variable: SEZ growth 2007 to 2012

VARIABLES	(1) **Zones variables + country fixed effects**	(2) **Zone + contextual variables**	(3) **Zone + contextual + policy variables**	(4) **Zone + contextual + policy variables**
SEZ specific variables				
Initial lights in zone	-0.000988***	-0.000990***	-0.000986***	-0.000992***
	(0.000179)	(0.000166)	(0.000167)	(0.000164)
Years in Operation	-0.00303**	-0.00330***	-0.00393***	-0.00439***
	(0.00143)	(0.00125)	(0.00138)	(0.00141)
Size	0.0931***	0.0943***	0.0924***	0.0937***
	(0.0199)	(0.0186)	(0.0185)	(0.0182)
High-Tech Focus	-0.0400*	-0.0485**	-0.0318	-0.0372*
	(0.0239)	(0.0214)	(0.0223)	(0.0222)
Operator				
PPP	-0.00974	-0.0190	-0.00566	-0.00288
	(0.0342)	(0.0330)	(0.0331)	(0.0329)
Private	0.0102	-0.0158	-0.0237	-0.0283
	(0.0428)	(0.0329)	(0.0379)	(0.0384)
Distance largest city	-0.00725***	-0.00456*	-0.00477*	-0.00556**
	(0.00271)	(0.00262)	(0.00248)	(0.00253)
SEZ program variables				
Corporate Tax Exemption			0.00255	-0.0787**
			(0.00351)	(0.0311)
* ln GDP pc				0.00918**
				(0.00357)
Subsidized Utilities			-0.0595	-0.0240
			(0.0429)	(0.0447)
National One-stop-shop			-0.0201	0.0295
			(0.0411)	(0.0370)
Foreign Owner. Req.			-0.414**	-0.438**
			(0.187)	(0.188)
Independent Zone regulator			-0.0233	-0.0116
			(0.0279)	(0.0265)
Contextual factors				
Reg. / nat. GDPpc	-0.107***	-0.0848***	-0.0900***	-0.0926***
	(0.0378)	(0.0313)	(0.0338)	(0.0328)
Proximity to Large Markets		0.0104***	0.0111***	0.00939***
		(0.00327)	(0.00347)	(0.00350)
Industry (% of GDP)		0.375**	0.346**	0.374**
		(0.158)	(0.166)	(0.157)
Rule of Law		0.0145	-0.0282	-0.0474
		(0.0392)	(0.0388)	(0.0367)
GDPpc 2007		-0.0268	-0.00127	-0.0711*
		(0.0243)	(0.0275)	(0.0380)
Country nightlights growth		0.301***	0.317**	0.101
		(0.113)	(0.147)	(0.140)
Constant	1.295***	0.710***	0.498	1.400***
	(0.0802)	(0.225)	(0.308)	(0.446)
Country fixed effects	Yes	-	-	-
Structural nightlights controls	Yes	Yes	Yes	Yes
Observations	343	343	343	343
R-squared	0.422	0.388	0.401	0.408

Robust standard errors in parentheses, clustered at within country regional level

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

NOTE: Structural controls are the population density around the zone and whether the zone is located directly next to a highway or a water body

Of the six SEZ specific variables included in the regressions, four show a consistently significant correlation with SEZ performance and one displays a significant connection in 3 out of the 4 regressions. First, the results of the analysis display, as expected, a certain convergence in zone growth. The initial level of lights within the zone is negatively correlated with zone economic performance in all regressions, regardless of the level of controls included. This implies that more established zones in 2007 grew at a slower pace than younger zones and that zones that were created at the beginning of the period of analysis. Not surprisingly, SEZs grew faster in the initial years of their life, with their economic dynamism plateauing as they matured.

A second factor that confirms that older, more established zones are generally less dynamic is that the coefficient for the number of years the zone had been in operation by 2007 is consistently negative and statistically significant in all four regressions. This result is robust to the inclusion of initial level of lights in the estimation. Hence, the coefficient cannot be considered as driven by lower levels of initial light for newer zones. The economic dynamism of the zones is thus relatively short-lived. Growth is higher in the early years of the zone and peters out with time. More established zones in our sample, once everything else is controlled for, are less economically dynamic. This is in line with much of the literature that has stressed the challenge of maintaining economic performance after an initial dynamic period (World Bank, 2011). Caution must, however, be exercised when interpreting these results. Mature zones may upgrade technologically and move to higher-value added production, which may not be captured by changes in nightlights. While this has been the case in some East Asian zones, such as Shenzhen, this does not necessarily always reflect the experience in many other countries. Furthermore, the majority of the zones in the sample were established in the late 90s and early 2000s, meaning that it is unlikely that they were already in the process of upgrading by 2007.

Third, zone size matters. The size of the SEZ is positively and significantly correlated with zone performance. Larger zones have an advantage over smaller ones when it comes to growth potential.

Fourth, the results provide consistent evidence that the distance to the largest city is negatively correlated with zone performance. Zones located further away from the main city in the country are

less dynamic, holding other things constant. This is in line with expectations and the large body of literature which emphasizes the strategic role of zone location (Asian Development Bank, 2015; Madani, 1999). Alternative city distances were also considered, including distance to the closest city of either more than 1 million or 500 thousand inhabitants and distance to the closest major port, but the results of the analysis provide no consistent evidence to support the role of large cities – beyond that of the main city in the country – or to ports. SEZs have therefore benefited from proximity to the largest and often more accessible agglomeration in the country, but the benefits of greater agglomeration and accessibility do not expand beyond the primary city.

Fifth, the more economically dynamic SEZs in emerging countries during the period of analysis have been those with a lower technological component. The indicator depicting the presence of high-technology zones displays negative and statistically significant coefficients in three out of the four regressions, albeit with relatively low significance levels. While this coefficient should be interpreted cautiously due to the potential inability of nightlights to capture the technological content of the SEZ, in emerging countries SEZ growth has been, on average, higher in zones specialized in low-tech, low-cost manufacturing products and not in those targeting sectors with a higher technological component and value added. This result reflects the challenge zones often located in areas with inauspicious conditions for the development of high-tech – lacking sufficient skills to generate and/or absorb new knowledge; with research centers, universities, and firms below the technology frontier; and frequently with limited externalities and capacity to generate and absorb knowledge spill-overs – face when aiming to move away from more standard manufacturing and up the value chain (Asian Development Bank, 2015; World Bank, 2011; Rodríguez-Pose, Tselios, Winkler & Farole, 2011). It also indicates the risks of technology-driven shortcuts to economic development in many parts of the world, where the conditions for the rapid development and assimilation of new technology are simply not there (Rodríguez-Pose & Hardy, 2014). Developing countries should thus not expect to be able to directly jump into high-tech SEZs, but may rather need to go through developing labour-intensive industries initially and then upgrade technologically, once more advanced industrial capabilities have been developed.

Finally, the nature of the zone management – i.e. public vs. private vs. PPP operator – does not matter as much as frequently assumed: there is no sign that private operators are more effective than public ones or vice versa. This is in line with Farole (2011) and may indicate a strong context dependency for this variable: it is frequently the case that whether zones are operated by the private or public sector is dependent on country level policy-making and legislation.

In brief, the results of the zone specific variables point to a number of structural features that are closely connected to zone performance. Zone growth is difficult to sustain over time and the largest benefits accrue shortly after start of operations and wane as the zone matures. Larger SEZ have an advantage over smaller ones. Moreover and despite a recent push to upgrade SEZs from being purely labor intensive 'sweatshops' of standard, low value-added manufacturing products to locations for industries with a greater technology component, low-tech manufacturing zones have been the most dynamic during the period of analysis. Finally, a strategic location in close proximity to the largest city in the country is beneficial for zone performance. The insignificant results of the other variables likely reflect a large degree of variability and context dependency in terms of these characteristics and their impact on growth.

Program variables (Table 5, Columns 3-4) tend to have a more limited association with zone performance than zone-specific characteristics. Only two of the five program variables related to incentive packages, program requirements, and set up – among those reported in the analysis, as excluded variables are always insignificant – are significant. Hence, specific aspects of the program design of the zones – which have been the object of considerable attention in past research – are not sufficient in and of themselves to explain zone level growth.

There is also a limited connection between incentive packages and SEZ growth. Both variables for corporate tax exemption and subsidized utilities have an insignificant coefficient in column 3 of Table 5. This implies that incentives on their own cannot explain zone performance. When we test for a varying effect of corporate tax breaks depending on the level of development, the results, however, become highly significant (Table 5, Columns 4): the main term is negative and its interaction with

GDP per capita is positive. The impact of corporate tax holidays hence depends on the level of development: the impact is negative for poorer countries, but becomes positive for wealthier ones. The tipping point is at a GDP per capita of 5100US$, where corporate tax exemptions start to have a positive correlation with zone performance. Tax breaks may thus be an effective tool to attract investments at higher levels of development in emerging countries, but not in those at the bottom of the scale.

The second significant result is the negative correlation between the foreign ownership requirement and SEZ growth. Imposing, therefore, a minimum participation level of foreign firms on SEZ companies hinders SEZ dynamism. This finding lends support to best practice guides that frequently advocate the removal of foreign ownership requirements in order to minimize the distortions created by favoring foreign companies over local ones (OECD, 2009).

The remaining program variables – availability of a one-stop shop and the independence of the zone regulator – display insignificant coefficients throughout. Most program factors are thus not drivers of SEZ growth. These results go counter claims in many best practice guides, which have underlined the importance of program characteristics for the viability of SEZs (Asian Development Bank, 2015; OECD, 2009).

From a program design perspective we can therefore conclude that corporate tax exemptions can play an important role in stimulating growth in SEZs, but only under certain circumstances. Furthermore, interventions such as imposing foreign ownership requirements can be detrimental for SEZ performance. By contrast, the type of program set-up and other benefits are less relevant than anticipated.

Last but not least, examining the results of the contextual factors provides some interesting insights. Proximity to large markets delivers significant and positive coefficients, signaling a beneficial effect of being close to the customer base and/ or production hubs, as is the case of the previous industrialization level. This in line with much of the case study literature that emphasizes the importance of ‘traditional’ locational advantages (Madani, 1999; Rolfe et al., 2004; Watson, 2001) as

well as newer findings which suggest that proximity to technologically advanced nations facilitates the integration into GPNs (Baldwin & López-González, 2015). It also highlights the challenge that countries with an economic structure dominated by agriculture face if they attempt to industrialize through SEZ policies.

In contrast to previous studies stressing the salience of the general business environment (Aggarwal, 2005; Daude & Stein, 2007; Farole, 2011), rule of law is insignificant in our analysis. Experimentation with alternative measures of the quality of institutions at a national level, such as the Ease of Doing Business Rank, also delivers insignificant results. Local business environments therefore have limited sway over the performance of SEZs. This may also be related to the low-tech, low value added dimension behind many SEZs. When the main factors of SEZ growth are related to low labor costs, proximity to large markets, and some background in industry, the quality of national institutions may matter less than when the more complex networks and value chains related to high tech manufacturing are required to be in place.

The ratio between regional GDP per capita and national GDP per capita is negative and highly significant throughout, further underlining the importance of low-cost environments for the performance of SEZs. Consequently, SEZs in poorer areas of a country – albeit with a reasonable accessibility to the main city – have performed better than those in better off regions. Traditional wage-based advantages remain of great importance for firms seeking a location in a SEZ in an emerging country.

Finally, while GDP per capita levels in 2007 are insignificant apart from one regression (Column 4), the growth of lights from 2007 to 2012 in the whole country is strongly significant. It displays a positive correlation with SEZ growth in two out of three regressions. This positive correlation suggests that zones grow faster in rapid growth environments.

The analysis of the contextual factors, hence, underscores that firms in SEZs still seek, overall, low cost locations in less developed areas of the countries and in close proximity to the main city (Rodríguez-Pose, Tselios, Winkler & Farole, 2011), and with easy access to North American and

European markets. Previous industrialization also plays a role in the economic performance of zones. By contrast, institutional factors are less relevant for SEZ economic dynamism.

5.2 Robustness tests

In order to test the robustness of these results, we conduct a number of robustness checks (Table 6). First, we are interested in examining whether our results hold once countries that contribute the largest number of zones to the sample are excluded from the regressions. This allows assessing if the results are driven by the experience of one specific country. For this purpose, we first exclude all zones located in Vietnam and then those located in South Korea (the two largest contributors to the sample with 101 and 64 zones respectively). We also test whether the results change if we exclude China's zones given their relatively large number and differing growth patterns. Secondly, we re-run the same regressions, but using the two alternative dependent variables introduced in section 3.2. Instead of the zones' absolute growth rate, we resort to the relative growth rates: the growth rate of the SEZ relative to national growth and relative to growth in its surrounding area.

For the robustness tests, we rely on the most complete estimations including SEZ characteristics, SEZ policy variables and contextual factors. Table 6 presents the results. To facilitate the comparison between the results, Column 1 includes the coefficients of the main regressions presented in the previous section.

Table 6: Robustness checks. Dependent Variable: SEZ performance 2007 to 2012

VARIABLES	(1) Zone growth **base sample**	(2) Zone growth **excl. Vietnam**	(3) Zone growth **excl. South Korea**	(4) Zone growth **excl. China**	(5) **Zone/ national growth**	(6) **Zone/ surrounding area growth**
SEZ specific variables						
Initial lights in zone	-0.000992***	-0.000743***	-0.00111***	-0.000901***	-0.000803***	-0.000834***
	(0.000164)	(0.000169)	(0.000206)	(0.000171)	(0.000138)	(0.000148)
Years in Operation	-0.00439***	0.000695***	0.001000***	0.000851***	-0.00365***	0.000794***
	(0.00141)	(0.000208)	(0.000201)	(0.000188)	(0.00120)	(0.000150)
Size	0.0937***	-0.00269**	-0.00812***	-0.00441***	0.0756***	-0.00404**
	(0.0182)	(0.00123)	(0.00174)	(0.00140)	(0.0152)	(0.00163)
High-Tech Focus	-0.0372*	-0.0153	-0.0423	-0.0338	-0.0280	0.000979
	(0.0222)	(0.0237)	(0.0265)	(0.0231)	(0.0185)	(0.0212)
Operator						
PPP	-0.00288	-0.0120	-0.0534	-0.00989	-0.00470	0.0445
	(0.0329)	(0.0272)	(0.0456)	(0.0331)	(0.0273)	(0.0609)
Private	-0.0283	0.00172	-0.0660	-0.0407	-0.0225	0.0212
	(0.0384)	(0.0439)	(0.0402)	(0.0390)	(0.0319)	(0.0347)
Distance largest city	-0.00556**	-4.19e-06	-5.35e-05**	-6.10e-05*	-0.00440**	-5.15e-06
	(0.00253)	(2.00e-05)	(2.63e-05)	(3.11e-05)	(0.00209)	(2.86e-05)
SEZ program variables						
Corporate Tax Exemption	-0.0787**	-0.0544*	-0.0912***	-0.0679**	-0.0562**	-0.0718***
	(0.0311)	(0.0307)	(0.0320)	(0.0316)	(0.0261)	(0.0244)
* ln GDP pc	0.00918**	0.00644*	0.0107***	0.00809**	0.00662**	0.00838***
	(0.00357)	(0.00349)	(0.00365)	(0.00363)	(0.00297)	(0.00276)
Subsidized Utilities	-0.0240	-0.0353	0.00360	-0.0427	-0.0230	-0.0274
	(0.0447)	(0.0454)	(0.0555)	(0.0424)	(0.0378)	(0.0528)
National One-stop-shop	0.0295	0.00485	0.00981	0.0212	0.0237	0.0468
	(0.0370)	(0.0384)	(0.0599)	(0.0384)	(0.0310)	(0.0399)
Foreign Owner. Req.	-0.438**	-0.260	-0.794***	-0.206	-0.357**	-0.405**
	(0.188)	(0.165)	(0.252)	(0.228)	(0.162)	(0.202)
Independent Zone regulator	-0.0116	0.0244	0.0254	-0.00806	-0.00583	0.00850
	(0.0265)	(0.0299)	(0.0381)	(0.0270)	(0.0216)	(0.0263)
Contextual factor						
Reg. / nat. GDPpc	-0.0926***	-0.0894**	-0.0661**	-0.0954***	-0.0722***	-0.0178
	(0.0328)	(0.0341)	(0.0333)	(0.0340)	(0.0270)	(0.0466)
Proximity to Large Markets	0.00939***	0.00643*	0.0131**	0.0116***	0.00686**	0.00603*
	(0.00350)	(0.00345)	(0.00543)	(0.00422)	(0.00297)	(0.00338)
Industry (% of GDP)	0.374**	0.213	0.338**	0.441**	0.264**	0.200
	(0.157)	(0.159)	(0.162)	(0.176)	(0.132)	(0.183)
Rule of Law	-0.0474	-0.0445	-0.0409	-0.0524	-0.0382	-0.0224
	(0.0367)	(0.0322)	(0.0456)	(0.0381)	(0.0313)	(0.0292)
GDPpc 2007	-0.0711*	-0.0293	-0.0741	-0.0654*	-0.0476	-0.0567*
	(0.0380)	(0.0418)	(0.0514)	(0.0378)	(0.0331)	(0.0306)
Country nightlights growth	0.101	0.215	0.0771	0.149	-0.652***	-0.453***
	(0.140)	(0.151)	(0.184)	(0.136)	(0.124)	(0.127)
Constant	0.501	0.212	0.460	0.379	1.992***	1.347***
	(0.371)	(0.387)	(0.407)	(0.401)	(0.391)	(0.255)
Country dummies	-	-	-	-	-	-
Structural nightlights controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	343	243	279	310	343	343
R-squared	0.408	0.434	0.415	0.402	0.354	0.231

Robust standard errors in parentheses, clustered at within country regional level
*** p<0.01, ** p<0.05, * p<0.1
NOTE: Structural controls are the population density around the zone and whether the zone is located directly next to a highway or a water body

By and large, the results hold throughout the robustness tests. Most of the coefficients retain their signs, while also maintaining their significance (or insignificance). Some variables lose significance in one or two of the regressions (i.e. distance to largest city, industrial share, and foreign ownership requirement), but still have the right signs. These minor changes are likely driven by the lower number of observations when specific countries are excluded, rather than reflecting a structural change in the relationship. Additionally, it is not surprising that some coefficients differ in the regression where the ratio of zone growth relative to that of the surrounding area is used. Distance to the largest city can influence both the regional and the zone growth rate.

The one notable exception in the robustness tests is the coefficient for high-technology focused zones. While retaining the negative sign in all but one regression, it loses its significance throughout. Again, this may be a consequence of the lower sample size and thus lower predictive power. However, this result calls for further caution when interpreting the coefficient for high-technology focused zones, as already suggested in the previous section

5.3 Five-year growth rates

The analysis for the period between 2007 and 2012 contains zones at different stages of development: some nascent, some more mature. As the results of the previous sections show, the maturity of zone has a bearing on its overall performance and limits the perception of what drives the dynamism of SEZs start-ups. Hence, in order to get a clearer picture of the factors behind zone take-off, we analyse what determines zone performance in the first five years after the start of operations. This implies that the period of analysis is different for each zone, covering the phase between t_0 (start year) and t_5 (five years after the establishment of the zone). This can only be done for a reduced sample, as the founding of the SEZ needs to take place after 1992, when the nightlights data become available. The sample for this analysis contains 252 zones, in contrast to the 343 considered in Tables 3, 4, and 5.

Furthermore, the SEZ dataset currently only contains information for the policies applicable in the years from 2007 onwards. We therefore have to exclude the SEZ program related explanatory variables from the 5 years growth regressions. All other explanatory variables remain the same as in

the previous section with one exception: as each zone's performance is measured from its start date, the years in operation variable is substituted by a variable which reflects the year the zone became operational. This allows controlling for the fact that zones started operating at different points in time and therefore may have been exposed to different economic environments.

Table 7 provides an overview of the results. Two dependent variables are considered: the absolute growth rate of the zone (Table 7, Columns 1-3) and zone growth relative to national growth (Table 7, Columns 4-6). Columns 1 and 4 show the results taking into account only the SEZ characteristics. In columns 2 and 5 the contextual controls are introduced, whereas country dummies substitute those in columns 3 and 6. Country dummies have the advantages in this context that they pick up some of the effects of the SEZ policies which cannot be included individually in this section.

Table 7: SEZ growth in the early years of operation. Dependent Variable: SEZ growth after 5 years of start of operations

VARIABLES	(1) Zone growth	(2) Zone growth	(3) Zone growth	(4) Zone/national growth	(5) Zone/national growth	(6) Zone/national growth
SEZ specific variables						
Initial lights in zone	-0.00156***	-0.00136***	-0.00129***	-0.00118***	-0.00116***	-0.00111***
	(0.000246)	(0.000278)	(0.000277)	(0.000242)	(0.000252)	(0.000317)
Year established	-0.00180	0.00588	-0.0103	0.0101*	0.00485	0.00996
	(0.00864)	(0.00792)	(0.00762)	(0.00592)	(0.00655)	(0.00631)
Size	0.00145***	0.00132***	0.00108***	0.00115***	0.00114***	0.00107***
	(0.000254)	(0.000302)	(0.000312)	(0.000257)	(0.000282)	(0.000365)
High-Tech Focus	-0.0754	-0.0494	-0.0756	-0.0468	-0.0470	-0.0609
	(0.0544)	(0.0426)	(0.0502)	(0.0389)	(0.0359)	(0.0370)
Operator						
PPP	-0.00806	0.124	0.138	0.135*	0.117	0.176*
	(0.0647)	(0.0954)	(0.0946)	(0.0740)	(0.0790)	(0.103)
Private	-0.0386	0.00619	-0.0960	0.0345	0.0168	-0.0419
	(0.0591)	(0.0545)	(0.0778)	(0.0473)	(0.0501)	(0.0649)
Distance largest city	-7.84e-05	-9.10e-05**	-0.000101**	-9.11e-05***	-7.89e-05**	-8.38e-05**
	(6.16e-05)	(4.56e-05)	(4.85e-05)	(3.33e-05)	(3.94e-05)	(3.72e-05)
Contextual factors						
Ratio regional/national GDPpc	-0.0263	-0.0393	0.00699	-0.0791***	-0.0357	-0.0756***
	(0.0192)	(0.0246)	(0.0229)	(0.0170)	(0.0225)	(0.0273)
Industry (% of GDP)		-0.00108			0.000690	
		(0.00505)			(0.00467)	
Proximity to Large Markets		-0.478*			-0.324	
		(0.278)			(0.278)	
Rule of Law		-0.0133			-0.0355	
		(0.0687)			(0.0612)	
GDPpc in year operational		-0.0218			-0.0191	
		(0.0493)			(0.0428)	
Country nightlights growth		0.557***			-0.430***	
		(0.122)			(0.106)	
Constant	3.948	-11.27	20.52	-19.14	-8.341	-19.09
	(17.27)	(15.77)	(15.21)	(11.83)	(13.01)	(12.61)
Structural controls	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	-	-	Yes	-	-	Yes
Observations	252	252	252	252	252	252
R-squared	0.240	0.355	0.413	0.247	0.302	0.305

Robust standard errors in parentheses, clustered at regional level
*** p<0.01, ** p<0.05, * p<0.1
NOTE: Structural controls include whether the zone is located directly next to a water body.

The results lend further support to some of the findings for SEZ specific characteristics presented in Tables 3 to 5. Zone size remains positively correlated with zone growth, indicating a stronger growth performance of larger zones in the first five years of establishment. The negative impact of distance to the largest city is also confirmed. Zones which are located further away are less dynamic than those closer to the largest city. The coefficient for the high-tech dummy remains negative throughout, but is not significant. Furthermore, neither the year of zone establishment nor the nature of the operator make a difference for zone performance. We find no evidence of either an early mover advantage or

of a ‘learning-from-past-errors’ effect, as more recent zones have not had a better economic performance in their first five years of life than those that were founded earlier.

In terms of the contextual factors, most indicators are insignificant with the exception of country nightlights growth and the ratio between regional and national GDPpc. The latter is, however, only significant in two out of the six regressions. The national growth of nightlights displays the same dynamics as those reported in Tables 5 and 6: it is strongly and positively correlated with absolute zone growth while it is negatively correlated with the relative growth rate. Proximity to markets is negatively correlated, but only in one regression and at the 10% level. This suggests that the result should not be overly emphasized. The remainder of the contextual controls is insignificant.

While these results should be interpreted with some caution due to the lower number of observations, they lend further support to the notion, found in the analysis for the period 2007 to 2012, that larger zones in closer proximity to the largest city, but in relatively cheap locations display the best overall performance.

6 Conclusions

The aim of this paper was to analyse the factors driving SEZ growth in emerging countries. To overcome the challenge of limited data availability for SEZ outcomes and characteristics, we assembled an entirely new dataset with information on SEZ characteristics and programs as well as contextual factors across 346 zones in 22 emerging countries, which were operational by or before 2007. Nightlights were used as a proxy for SEZ performance.

While there is certainly no shortage of research which has focused on the lessons learnt from SEZ policies around the world using case study approaches, the analysis conducted in this paper is the first to deal with the economic dynamism of SEZs from a quantitative perspective covering a large number of zones across emerging countries. The change in approach and method has delivered results that to a certain extent confirm, but also refute part of the dominating knowledge about the viability and influence of SEZs on economic development in the emerging world.

First and foremost, SEZs on the whole cannot be considered as a growth catalyst in emerging countries. Despite considerable variation in their performance across and within countries, their overall economic dynamism does not exceed that of the countries where they are located, casting doubts about claims that portray them as a panacea for growth.

Moreover, the results of the zone specific econometric analysis point to some crucial structural features behind the economic performance of SEZs. Key results include that a) zone growth is difficult to sustain over time; that b) trying to upgrade the technological component or value-added of SEZs is challenging, as zones focused from the beginning on high-tech sectors have performed worse than those in low-cost, labor intensive sectors; and that c) zone size matters: larger zones seem to have an advantage in terms of growth potential.

Country- and regional-specific context further determine SEZ performance. Zones in relatively poor areas, but not too far away from the largest city in the country and in countries with relatively easy access to the main developed markets of the world have displayed the greatest economic dynamism. Zones in countries with a history of pre-existing industrialization have also been favored.

Incentive packages to attract firms to SEZs and ownership and management schemes, by contrast, have had limited influence in the economic growth of the zones. Factors such as the type of operator of the zone – private, public, or PPP – corporate tax exemptions, or sundry subsidized utilities do not seem to have affected the economic performance of zones across the emerging world. The backbone of most SEZ policies, corporate tax breaks, also has played a relatively minor role in zone dynamism, which has been limited to the more developed countries in the sample. Hence, the role of factors such as tax breaks, the presence of an independent zone regulator, or non-fiscal benefits, such as the availability of a national one-stop-shop, is much more context dependent that hitherto thought and there is no guarantee that the provision of these sort of support, incentives, and/or subsidies bears fruit in terms of zone dynamism.

The findings of the analysis have important policy implications. They stress the fact that SEZ policies in emerging countries do not take place in a vacuum and certain pre-conditions need to be met for

these policies to maximize the returns of SEZs. Closeness to attractive markets is essential as is the pre-disposition of the economy. A country dominated by agriculture will have difficulty to industrialize through SEZ policies alone. Furthermore, a cost advantage through a low cost labor base is likely to remain an attractive feature for firms and continue to affect the dynamism of zones and their surrounding areas. Policy-makers should therefore consider carefully whether a SEZ program can credibly achieve the desired outcomes in a given country context. Moreover, even in places where zone programs have a greater potential to succeed, the effects are likely to be limited in time. Hence, SEZ policies cannot substitute for wider structural reforms aimed at enhancing the potential for the development of economic activities, as well as the absorptive capacity in the country. Finally, there is a high degree of context dependency for SEZ policies. Whether a country requires an independent zone regulator, a private or a public operator, or certain services are more or less needed in a specific zone, depends essentially on the precise context where the zone operates. Different combinations may be effective in different contexts.

The research presented here represents an important change in approach with respect to previous analyses about what determines the economic dynamism of SEZs. However, it is certainly not without limitations. First, the analysis measures economic growth based on nightlights data. Nightlights are an increasingly common alternative for measuring economic activity in those areas of the world were economic data either do not exist or are not reliable. However, their use is not exempt from controversy, in particular with regards to capturing technological upgrading. Second, the definition of SEZs – in part conditioned by the use of nightlights as a proxy for economic growth – discards a large number of small SEZs, as well as those that, despite being planned, did not take off or became operational after 2007. The sample remains highly dependent on data availability in some countries in some specific geographical areas of the world (e.g. East Asia vs. Africa). Finally, the gathering of data about the characteristics and programs and incentives associated to the SEZs is limited to the type of information that can be readily quantified. This implies a loss of information particularly regarding 'soft' aspects, such as those relating to the quality of services provided at zone level or about the political will driving zone implementation, both at the zone and at the national level. Consequently,

while, on the whole, the approach represents a considerable step forward in our understanding of what makes SEZs across the emerging world tick, given the caveats associated to the approach, the results must still be considered with some caution. Further research, for example to understand the ability of mature low-tech zones to technologically upgrade and around 'soft' aspects of zone management, would be a desirable way to address many of the questions about the economic performance of SEZs in emerging countries that remain unanswered.

References

Aggarwal, A. (2005). Performance of export processing zones: a comparative analysis of India, Sri Lanka and Bangladesh. In *Working Paper No.155*. New Delhi: Indian Council for Research on International Economic Relations.

Álvarez. I.C., Barbero, J., Rodríguez-Pose, A. and Zofío, J.L. (2018) Does institutional quality matter for trade? Institutional conditions in a sectoral trade framework. *World Development* 103(3), 72-87. doi:10.1016/j.worlddev.2017.10.010

Asian Development Bank. (2015). *Asian Economic Integration Report 2015. How can Special Economic Zones catalyze economic development?* Manilla, Philippines: Author.

Baldwin, R. (2011). Trade And Industrialisation After Globalisation's 2nd Unbundling: How Building And Joining A Supply Chain Are Different And Why It Matters. *NBER Working Paper Series*, 17716. doi:10.3386/w17716

Baldwin, R., & López-González, J. (2015). Supply-chain Trade: A Portrait of Global Patterns and Several Testable Hypotheses. *World Economy, 38*(11), 1682-1721. doi:10.1111/twec.12189

Blonigen, B. (2005). A Review of the Empirical Literature on FDI Determinants. *Atlantic Economic Journal, 33*(4), 383-403. doi:10.1007/s11293-005-2868-9

Coe, N. M., & Yeung, H. W. C. (2015). *Global production networks: Theorizing economic development in an interconnected world*. Oxford: Oxford University Press.

Daude, C., & Stein, E. (2007). The quality of institutions and foreign direct investment. *Economics & Politics, 19*(3), 317–344. doi:10.1111/j.1468-0343.2007.00318.x

Disdier, A.-C., & Head, K. (2008). The puzzling persistence of the distance effect on bilateral trade. *Review of Economics and Statistics, 90*(1), 37-48. doi:10.1162/rest.90.1.37

Ebener, S., Murray, C., Tandon, A., & Elvidge, C. C. (2005). From wealth to health: modelling the distribution of income per capita at the sub-national level using night-time light imagery. *International Journal of Health Geographics, 4*(1). doi:10.1186/1476-072X-4-5

Elvidge, C. C., Baugh, K., Anderson, S., Sutton, P., & Ghosh, T. (2012). The night light development index (NLDI): a spatially explicit measure of human development from satellite data. *Social Geography, 7*(1). doi:10.5194/sg-7-23-2012

Engman, M., Onodera, O., & Pinali, E. (2007). Export Processing Zones: Past and future role in trade and development. In. Paris: OECD Publishing.

Farole, T. (2011). *Special Economic Zones in Africa: Comparing Performance and Learning from Global Experience*. Washington D.C.: The World Bank.

Farole, T., & Kweka, J. (2011). *Institutional Best Practices for Special Economic Zones: An Application to Tanzania*. Retrieved from http://siteresources.worldbank.org/INTRANETTRADE/Resources/SEZTanzaniaPolicynoteFinal.pdf

FIAS. (2009). Special Economic Zones. Performance, Lessons Learned, and implications for Zone Development. In. Washington D.C.: The World Bank Group.

Florida, R., Gulden, T., & Mellander, C. (2008). The rise of the mega- region. *Cambridge Journal of Regions, Economy and Society, 1*(3), 459-476. doi:10.1093/cjres/rsn018

Henderson, J., Dicken, P., Hess, M., Coe, N., & Yeung, H. W.-C. (2002). Global production networks and the analysis of economic development. *Review of International Political Economy, 9*(3), 436-464. doi:10.1080/09692290210150842

Henderson, J., & Phillips, R. (2007). Unintended consequences: social policy, state institutions and the 'stalling' of the Malaysian industrialization project. *Economy and Society, 36*(1), 78-102. doi:10.1080/03085140601089853

Henderson, J. V., Storeygard, A., & Weil, D. N. (2012). Measuring Economic Growth from Outer Space. *American Economic Review, 102*(2), 994-1028. doi:10.1257/aer.102.2.994

Hidalgo, C. A., & Hausmann, R. (2009). The building blocks of economic complexity. *Proceedings of the National Academy of Sciences of the United States of America, 106*(26), 10570-10575. doi:10.1073/pnas.0900943106

Iammarino, S., & McCann, P. (2013). *Multinationals and Economic Geography: Location, Technology and Innovation*. Cheltenham, U.K.: Edward Elgar.

Jauch, H. (2002). Export processing zones and the quest for sustainable development: a Southern African perspective. *Environment and Urbanization, 14*(1), 101-113. doi:10.1177/095624780201400109

Keola, S., Andersson, M., & Hall, O. (2015). Monitoring Economic Development from Space: Using Nighttime Light and Land Cover Data to Measure Economic Growth. *World Development, 66*, 322. doi:10.1016/j.worlddev.2014.08.017

Larrain, F., López-Calva, L. F., & Rodríguez-Clare, A. (2009). *Intel: A Case Study of Foreign Direct Investment in Central America*. Retrieved from https://www.hks.harvard.edu/centers/cid/publications/faculty-working-papers/cid-working-paper-no.-58

Levin, N., & Duke, Y. (2012). High spatial resolution night-time light images for demographic and socio-economic studies. *Remote Sensing of Environment, 119*, 1-10. doi:10.1016/j.rse.2011.12.005

Luger, M. I., & Goldstein, H. (1991). *Technology in the garden: research parks and regional economic development*. Chapel Hill: Chapel Hill : University of North Carolina Press.

Madani, D. (1999). *A Review of the Role and Impact of Export Processing Zones. World Bank Policy Research Working Paper.* Washington D.C.: The World Bank.

Mellander, C., Lobo, J., Stolarick, K., & Matheson, Z. (2015). Night-Time Light Data: A Good Proxy Measure for Economic Activity? *Plos One*(10), 18. doi:10.1371/journal.pone.0139779

Nel, E., & Rogerson, C. (2013). Special Economic Zones in South Africa: Reflections from International Debates. *Urban Forum, 24*(2), 205-217. doi:10.1007/s12132-012-9184-7

OECD. (2009). Towards Best Practice Guidelines for the Development of Economic Zones. Retrieved from https://www.oecd.org/mena/competitiveness/44866585.pdf

Portugal-Pérez, A., & Wilson, J. S. (2012). Export Performance and Trade Facilitation Reform: Hard and Soft Infrastructure. *World Development, 40*(7), 1295-1307. doi:10.1016/j.worlddev.2011.12.002

Quintas, P., Wield, D., & Massey, D. (1992). Academic- industry links and innovation: questioning the science park model. *Technovation, 12*(3), 161-175. doi:10.1016/0166-4972(92)90033-E

Rodríguez-Pose, A., & Arbix, G. (2001). Strategies of Waste: Bidding Wars in the Brazilian Automobile Sector. *International Journal of Urban and Regional Research, 25*(1), 134-154. doi:10.1111/1468-2427.00302

Rodríguez-Pose, A., & Hardy, D. (2014). *Technology and industrial parks in emerging countries: panacea or pipedream?* Heidelberg and New York: Springer.

Rodríguez-Pose, A., Tselios, V., Winkler, D. and Farole, T. (2013). Geography and the determinants of firm exports in Indonesia. *World Development* 44, 225-240. https://doi.org/10.1016/j.worlddev.2012.12.002

Rolfe, R. J., Woodward, D. P., & Kagira, B. (2004). Footloose and tax free: Incentive preferences in Kenyan export processing zones. *South African Journal of Economics, 72*(4), 784-807. doi:10.1111/j.1813-6982.2004.tb00134.x

Singa Boyenge, J.-P. (2007). *ILO database on export processing zones (Revised)*. Retrieved from Geneva: http://staging.ilo.org/public/libdoc/ilo/2007/107B09_80_engl.pdf

UNCTAD. (2013). *World Investment Report. Global Value Chains: Investment and Trade for Development.* New York and Geneva: United Nations Conference on Trade and Development.

UNCTAD. (2015). *Enhancing the Contribution of Export Processing Zones to the Sustainable Development Goals*. Retrieved from http://unctad.org/en/PublicationsLibrary/webdiaepcb2015d5_en.pdf

Watson, P. (2001). *Export Processing Zones: Has Africa Missed the Boat? Not yet!* Retrieved from Washington, D.C.: http://siteresources.worldbank.org/EXTEXPCOMNET/Resources/2463593-1213887855468/15_EPZsHasAfricaMissedtheBoat.pdf

World Bank. (2011). *Special Economic Zones. Progress, Emerging Challenges and Future Directions*. Washington, D.C.: Author.

World Trade Organization. (1996). Participation of developing countries in World Trade: Overview of major trends and underlying factors. WT/COMTD/W/15 [Press release]. Retrieved from https://www.wto.org/english/tratop_e/devel_e/w15.htm

World Trade Organization. (2016). *World Trade Statistical Review 2016*. Retrieved from https://www.wto.org/english/res_e/statis_e/wts2016_e/wts2016_e.pdf

Appendix 1 – Regressing nightlights on SEZ firms and employment

VARIABLES	(1) SEZ employment	(2) Number of Firms
Nightlights within zone	177.3***	0.363***
	(23.77)	(0.0567)
Country dummies	Yes	Yes
Constant	-7,859***	9.740
	(1,909)	(9.635)
Observations	104	135
R-squared	0.556	0.524

Robust standard errors in parentheses, clustered at the regional level
*** p<0.01, ** p<0.05, * p<0.1

Appendix 2 – Compiling the SEZ dataset

In order to identify which of the vast array of factors have a systematic bearing on SEZ performance, comparative data about SEZ characteristics and policies had to be collected from scratch. For this purpose, a workable definition of SEZs is needed. The definition has to embrace not only conceptual but also practical considerations, linked to the suitability of the zone for the use of nightlights data as a proxy for its performance as well as data availability. Consequently, all zones included in the dataset fulfil the following five criteria:

- A *differentiating regulatory framework and/or incentive scheme* is the essential differentiator in order to define what constitutes a SEZ. This is in line with most literature and allows establishing the all-important distinction between SEZs and other types of industrial parks.
- A *focus on manufacturing or services* within the zone with the objective of singling out and eliminating zones that are primarily commercial and logistics hubs.
- The presence of *clear territorial boundaries* in order to be able to better delimit performance using nightlight data. This implies that some SEZ schemes, such as single factory zones or large wide zones, are excluded from the analysis.
- A *minimum size of 50ha* in order to increase the reliability of the nightlights measurement as a proxy for zone performance. This is determined by the size of the grid-cells in the nightlights dataset; the data is furthermore restricted to zones with a *maximum size of 1000ha* to ensure a better comparability of the zones.
- The SEZs had to be *operational by the year 2007,* meaning that at least one company had started operations within the SEZ by then. This criterion ensures that a reasonable variation in the nightlights can be detected between start of operations and 2012, which is the last year for which nightlight data are available.

For the selection of the countries covered in the database, a number of factors were considered such as geography, income levels, and maturity of zone programs. The objective was to allow for a

considerable variation in SEZ experiences to be represented in the sample. The selection was furthermore guided by more practical considerations regarding data availability for a given country, time of establishment of the SEZ policy, as well as type and number of SEZs.

In each targeted country, the aim was to identify the entire population of zones and filter them based on their fulfilment of the five criteria. For each of the qualifying zones, information was collected for SEZ-specific and program-related variables using a variety of sources. These included information available online from SEZ and public authority homepages, reports from international organizations, and related sources. We, furthermore, reached out to SEZ authorities and zones over email and phone to verify and complement the data collected.

The resulting sample includes 346 zones in 22 countries across the developing world and South Korea. Table 1 provides an overview of the resulting country coverage and number of zones per country.

Overview SEZs per country

Countries	Number of zones
East Asia & Pacific	255 (73%)
China	33
Philippines	29
Malaysia	6
South Korea	64
Thailand	20
Vietnam	103
Europe & Central Asia	40 (10%)
Turkey	36
Russia	4
Middle East and North Africa & Sub-Saharan Africa	6 (2%)
Ghana	1
Jordan	1
Kenya	1
Lesotho	1
Nigeria	1
South Africa	1
Latin America & Caribbean	26 (7.5%)
Argentina	4
Chile	3
Colombia	6
Dominican Republic	10
Honduras	3
South Asia	19 (5%)
Bangladesh	8
India	8
Pakistan	3
Total	346 (100%)

Appendix 3 – Variable description

Variable	Description	Source
SEZ performance		
SEZ growth	$(Yi_{,1} - Yi_{,0})/ Yi_{,0}$: Growth rate of the sum of nightlights of the pixels that compose the SEZ surface over period of analysis	Based on National Centers for Environmental Information https://ngdc.noaa.gov/eog/dmsp/downloadV4composites.html
SEZ growth relative to national growth	Ratio of change in SEZ light intensity $(Yi_{,1}/Yi_{,0})$ over change of country light intensity $(Y_{country\ ,1}/ Y_{country,0})$	Based on National Centers for Environmental Information https://ngdc.noaa.gov/eog/dmsp/downloadV4composites.html
SEZ growth relative to surrounding area growth	Ratio of change in SEZ light intensity $(Yi_{,1}/Yi_{,0})$ over change of light intensity in 50KM circle around zone $(Y_{\ surrounding\ area\ ,1}/ Y_{\ surrounding\ area,0})$	Based on National Centers for Environmental Information https://ngdc.noaa.gov/eog/dmsp/downloadV4composites.html
SEZ related variables		
Years in Operation	Number of years zone has been operating in 2007	All SEZ related variables are from the newly assembled dataset. Information obtained as described in the body of this paper.
Size	SEZ size in hectares	
High-Tech Focus	Dummy = 1 if the zone either 'self-proclaims' on their advertising material that they specifically target high-tech sectors or if companies established are within high-tech sectors, as defined by OECD	
Operator	Nature of zone operator: 0 = public, 1 = PPP, 3= private Variable takes into account whether the public sector is involved in the development of the zone and/ or provides the land	
Customs-office Onsite	Dummy = 1 if SEZ provides dedicated customs office within the zone	
Electricity Sub-Power Station	Dummy = 1 if SEZ has its own Sub-power station onsite	
One-stop Shop Onsite	Dummy = 1 if SEZ provides ones-top-shop services onsite	
Distance Largest City	Road distance in kilometers to the largest city in the country	
Distance closest Major Port	Road distance in kilometers to the closest major port	
Distance closest City with at least 500k Inhabitants	Road distance in kilometers to the closest city with at least 500,000 inhabitants	
Distance closest City with at least 300k Inhabitants	Road distance in kilometers to the closest city with at least 300,000 inhabitants	
SEZ program variables		
Corporate Tax Exemption	Index based on the level of tax exemption and the number of years granted over a 20 years horizon. This index can take values from 20 – reflecting a company that is 100% exempt from paying corporate income tax over the entire 20 year horizon – to 0 – indicating 0% exemption in any of the years.	All regulatory variables are from the newly assembled dataset. Information obtained as described in the body of this paper.
Subsidized Utilities	Dummy = 1 if firms within the SEZ benefit from subsidized utilities	
National	Dummy = 1 if one-stop-shop services are	

Variable	Description	Source
One-stop-shop	available to companies within the SEZ from a national authority	
Foreign Ownership Requirement	% of firm ownership required to be hold by foreign company in order for firm to be able to locate within SEZ	
Investment Requirement	Dummy = 1 if regulation require a minimum investment by firms in order to establish themselves in the SEZ	
Independence of Zone Regulator	Dummy = 1 if zone regulator is an independent entity	
Contextual factors		
Ratio regional / national GDPpc	Natural logarithms of Regional GDP per capita / Country GDP per capita	Regional dataset sourced from Gennaioli, LaPorta, López-de-Silanes & Shleifer http://scholar.harvard.edu/shleifer/publications?page=1
Proximity to Large Markets	Sum of the inverse distances from each country to the US and European Union	Based on distances from http://www.distancefromto.ne
Industry (% of GDP)	Industry, value added (% of GDP) in the beginning of the period of analysis	World Development Indicators
Rule of Law	Rule of Law indicator in the beginning of the period of analysis. Values range from -2.5 to 2.5.	Kaufmann, Daniel, Aart Kraay and Massimo Mastruzzi (2010). "The Worldwide Governance Indicators: Methodology and Analytical Issues"
GDPpc	Natural logarithm of the GDP per capita in the beginning of the period of analysis (constant 2010 US$)	World Development Indicators
Country nightlights growth	Growth rate of the sum of lights within the country in the period of analysis	Based on National Centers for Environmental Information https://ngdc.noaa.gov/eog/dmsp/downloadV4composites.html
Regional GDPpc	GDPpc for the within country region the SEZ is located in	Regional dataset sourced from Gennaioli, LaPorta, López-de-Silanes & Shleifer http://scholar.harvard.edu/shleifer/publications?page=1
Structural nightlights controls		
Population density around SEZ	Population density in immediate vicinity of the zone: 1 = isolated, i.e. almost no buildings around zone; 2 = sparsely populated; 3 = densely populated	Based on visual inspection of SEZ sites in googlemaps satellite view
Waterbody	Dummy = 1 if zone is located directly next to a waterbody	Based on visual inspection of SEZ sites in googlemaps satellite view
Highway	Dummy = 1 if zone is located directly next to a highway	Based on visual inspection of SEZ sites in googlemaps satellite view

Appendix 4 – Combined regressions: zone characteristics, regulatory variables and SEZ performance

Dependent Variable: SEZ nightlights growth from 2007 to 2012

	(1)	(2)	(3)	(4)	(5)	(6)
SEZ specific variables						
Initial lights in zone	-0.00111***	-0.00108***	-0.000990***	-0.000278***	-0.000277***	-0.000992***
	(0.000158)	(0.000192)	(0.000166)	(5.21e-05)	(5.21e-05)	(0.000164)
Years in Operation	-0.00487***	-0.00339**	-0.00330***			-0.00439***
	(0.00136)	(0.00149)	(0.00125)			(0.00141)
Size	0.00112***	0.00101***	0.000943***			0.000937***
	(0.000168)	(0.000201)	(0.000186)			(0.000182)
High-Tech Focus	-0.0321	-0.0375	-0.0485**			-0.0372*
	(0.0227)	(0.0245)	(0.0214)			(0.0222)
Operator						
PPP	-0.0287	-0.0204	-0.0190			-0.00288
	(0.0334)	(0.0356)	(0.0330)			(0.0329)
Private	-0.0256	-0.000892	-0.0158			-0.0283
	(0.0334)	(0.0453)	(0.0329)			(0.0384)
Distance largest city	-6.01e-06	-3.72e-05	-4.56e-05*			-5.56e-05**
	(2.55e-05)	(3.15e-05)	(2.62e-05)			(2.53e-05)
SEZ program variables						
Corporate Tax Exemption				-0.00183	-0.0253	-0.0787**
				(0.00337)	(0.0312)	(0.0311)
* GDPpc 2007					0.00264	0.00918**
					(0.00360)	(0.00357)
Subsidized Utilities				-0.0689*	-0.0586	-0.0240
				(0.0410)	(0.0417)	(0.0447)
National One-stop-shop				0.0706*	0.0874**	0.0295
				(0.0381)	(0.0397)	(0.0370)
Foreign Ownership Requirement				-0.496***	-0.502***	-0.438**
				(0.165)	(0.164)	(0.188)
Independent Zone regulator				-0.0366	-0.0337	-0.0116
				(0.0312)	(0.0308)	(0.0265)
Contextual factors						
Ratio regional / national GDPpc			-0.0848***	-0.115***	-0.115***	-0.0926***
			(0.0313)	(0.0376)	(0.0375)	(0.0328)
Proximity to Large Markets			0.375**	0.689***	0.702***	0.374**
			(0.158)	(0.180)	(0.173)	(0.157)
Industry (% of GDP)			0.0104***	0.00981***	0.00919**	0.00939***
			(0.00327)	(0.00343)	(0.00374)	(0.00350)
Rule of Law			0.0145	-0.0200	-0.0257	-0.0474
			(0.0392)	(0.0365)	(0.0365)	(0.0367)
GDPpc 2007			-0.0268	-0.0566**	-0.0769**	-0.0711*
			(0.0243)	(0.0275)	(0.0339)	(0.0380)
Country nightlights growth			0.301***	0.560***	0.499***	0.101
			(0.113)	(0.156)	(0.140)	(0.140)
Constant	0.229***	0.285***	0.0105	0.281	0.481	0.501
	(0.0700)	(0.0727)	(0.210)	(0.214)	(0.341)	(0.371)
Country dummies	-	Yes	-	-	-	-
Structural nightlights controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	343	343	343	345	345	343
R-squared	0.348	0.405	0.388	0.294	0.294	0.408

Robust standard errors in parentheses, clustered at the within country regional level
*** p<0.01, ** p<0.05, * p<0.1