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Special Economic Zones – 20 years later

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Abstract

In this paper we undertake an ex-post evaluation of whether the special economic zones (SEZs) introduced in Poland in 1994 have been successful in meeting regional development objectives. We evaluate the policy on as many of its objectives as possible: employment creation, business creation (which includes attracting foreign direct investment), income or wage effects, and environmental sustainability.

We use different panel data methods to investigate this question at the powiat (nuts4 or something similar to a commune) and gmina (nuts5 or something similar to a village) levels in Poland during the 1995-2011 period. It is also possible to include numerous controls to reduce the problem of the omitted variables bias such as education level, dependency rates, state ownership, general subsidies and whether the area is urban or rural.

Our results indicate that SEZs in Poland have been successful in a number of their objectives such as private business creation. The positive effect of the policy however mainly comes through foreign direct investment (FDI), whereas the effects on e.g. investment and employment are small or insignificant. In other areas, such as securing higher income levels and locking firms into the sustainability agenda through the adoption of green technologies and reduced air pollution, we find only a small positively moderating effect of the policy on what are traditionally economically disadvantaged areas in Poland that used to be dependent on the socialist production model. Hence, despite high levels of FDI, the zones policy has not managed to overcome the legacy of backwardness or lagging regions.

The main policy implication of the paper is that SEZs may be successful in stimulating activity in the short run but the policy must be seen as one of necessary temporality and can therefore not stand alone. Before launching SEZs, policymakers must have plans in place for follow up measures to ensure the longer term competitiveness and sustainability implications of such an initiative. There is a need to understand the connection between the specific incentive schemes used (in this particular case tax incentives were used) and the kinds of firms and activities they attract, including the behavioral models that those incentives promote.

1. Special economic zones (SEZs) as a recurring topic in economics and regional development studies

Special economic zones (SEZs) is an old topic in economics and regional science dating back at least to Grubel's 1982 paper published in Weltwirtschaftliches Archiv. In that paper, Grubel offered a general theory on the welfare effects of free economic zones or what the literature over time has come to label SEZs. Grubel concluded that there is no general theoretical answer to the welfare effects as they hinge on the balance of the creation and diversion of economic activity.

According to Grubel, the existence of SEZs can be explained by a political-economy with differential preferences for deregulation that can be geographically sorted. This aspect of Grubel's paper may explain why SEZs have been so popular especially in transition countries. In these countries, the preference for SEZs over deregulation and special incentives to reconstruct the economy is likely to be highly locational due to the economic geography of socialism and the high concentration of economic activity in large plants which left some economic areas highly disadvantaged upon privatization.

The theoretical question pursued by Grubel and other authors has been a recurring question for policy-makers, most recently in the 2012 EU debates over the investment crisis in Greece and whether the country should be allowed to use this type of trade policy-related instrument to counteract the effects of the debt crisis (The Economist, 2012). It appears the question of the creation and diversion of economic activity is what the debate centers on, while a more longitudinal perspective on these zones and development suggests that we should also care about what happens when the special rules are dismantled. In fact Greece's present situation may be more a result of the recent dismantlement of similar policies (e.g. structural funds are close neighbors to SEZs as a policy tool) than a reflection of the need to (re)introduce them.

The SEZ policy as mentioned above has been used amply in recent years by transition countries such as Poland and China that are looking to leave behind the socialist model of industrialization and transition into a free market economic model, often placing foreign direct investors at the forefront as the locomotive of this new industrial development policy. Despite the theoretical contributions, few rigorous econometric studies of this particular type of trade policy exist. Therefore we seek to fill this gap in the literature with the present paper that offers a panel data evaluation of the Polish policy spanning the 1995-2011 period. In Section 2 we review some econometric studies of SEZs in China and other papers that focus more broadly

on FDI or EU regional policies.

However, in Section 2 we also observe that most of the available knowledge about SEZs comes from case studies. We can only identify one study of China by Ebenstein (2012) that is similar in scope to ours in terms of the different welfare perspectives considered. Often, as for example in Wang (2012), the scope is limited to one success factor such the attraction of FDI which is the most common factor focused upon in the literature on SEZs in developing countries, or income convergence, which is the most common factor focused on in the literature on EU regional policy. In isolation, these success factors bring us only limited insight into the static and dynamic or short and long run welfare effects of SEZ policies.

Our study is therefore the first to bring together an econometric study of a variety of welfare effects and a broad array of panel data methods. We therefore believe that our study allows us to make general policy conclusions about SEZs relevant to the European policy context.

In Section 3 we review the particular contents of the Polish policy and how its implementation has developed over time. Section 4 presents the available data along with descriptive statistics from the Polish Regional Databank published by the Central Statistical Office in Poland (GUS). In Section 5 the results from applying different types of panel data models to the data are discussed. First we present some panel data based on descriptive statistics (e.g. difference-in-difference estimates) and then we proceed to analyze the data using different estimators such as panel least squares, panel random effects and finally a panel two-stage fixed effect estimator. Section 6 concludes the paper.

2. Are SEZs effective according to existing literature?

There is a large body of empirical literature on SEZs. Most of it consists of case studies due to the difficulties of accessing relevant geographical data of the necessary quality to conduct policy analysis using econometrics (Farole, 2010, WB, 2009, Gibbon, 2008). Whereas case studies are informative, they are often inconclusive as to whether or not a certain policy can be deemed to be welfare-enhancing or not. For example, one of the largest reports published by the World Bank in 2009, the World Development Report, combined the findings of a wide range of case studies of spatially related policies and concluded that intervention in economic geography is often not desirable due to the sheer interests that agglomeration economies present for the process of development more generally. The report therefore advocated the adoption of spatially blind policies which other authors observe are in stark contrast with the European approach of supporting lagging regions (Barca et al, 2012). Following World

Bank advocacy, the question then becomes how developing countries, through better urban design and smart city structures, can deal with mega-cities and their inherent problems in more humane and sustainable ways. A more recent follow up study concluded by the World Bank in 2013 (Farole, 2013) on the same question took a more in-depth focus on the country cases of India and Indonesia (two countries that have both targeted lagging regions with their spatial policies). The study concludes that in both cases, the policies have been largely unsuccessful in meeting their objectives. The report also suggests that policies should focus more on the long-term competitiveness of the lagging regions and the firms that inhabit them, e.g. through institution-building that targets the particular objectives of achieving this and ensuring market access through facilitating connectivity between lagging regions and existing centers with high growth rates.

Meanwhile, this report also placed at the forefront the question of what will be the longer term consequences of failed policies in this particular area. Due to the enormous differences in regional development in developing countries, it seems this is an area where policy analysis has a large stake and role to play. More informed policy-making will be desirable as the demand for more democratic governance also at the regional level goes up in the developing parts of the world. Hence the search for solutions to the problem of uneven regional development continues.

A number of econometric studies have been conducted on SEZ policies in particular. FDI policies with a spatial element could also be deemed relevant to the present paper since such a policy was used purposefully in Poland as leverage in negotiations with foreign investors in particular. EU structural fund policies can also be considered similar to the SEZ policy and we will briefly review some of the more recent panel data studies in this area.

The study that comes closest to ours was conducted by Ebenstein (2012). The study evaluated the SEZ policy adopted by the Chinese government since the opening of the reform window by Deng in 1978. However, the unit of analysis is different as the dataset focuses on the development, wages, policies, and profits of individual firms and is drawn from a dataset of all major firms operating out of China and household surveys that follow the welfare of individual workers depending on their sector of employment.

Ebenstein (2012) uses a random effect approach to account for the panel nature structure of the data. Besides this structure, the analysis is conducted using single univarate regressions with the policy response variables on the left hand side and the policy variable on the right hand side (SEZ and closely related zone policies such as free trade zones, export processing zones and coastal open cities are also subject to analysis).

Although not necessarily the chosen variables by Chinese policy-makers, the policy variables evaluated include: ownership or FDI, labour productivity, profits and wages. The results of the study show that FDI, labour productivity, and profits responded very positively to the SEZ policy in China. On the other hand, the author found that there was little effect on the wages earned by workers participating in the zones. For example, the wages were not affected positively by FDI or higher productivity levels in the firms operating out of the zones. This may be because labour markets, as opposed to markets, for firm-specific capital are much more competitive, less based on human capital-specific skills and/or centrally regulated in China. The author concludes that since the cost of living is often much higher in coastal and SEZ areas that the policy has been quite detrimental to Chinese worker welfare and therefore not a policy example from which development in Asia could benefit more broadly.

While Wang's (2012) study is methodologically more comprehensive than the one conducted by Ebenstein (2012) and the dataset used is much more similar to ours (the unit of analysis is the location), its results are quite limited because it narrowly focuses on FDI and total factor productivity as the central policy objective variables (whereas Ebenstein also investigated worker welfare). Furthermore, Wang's findings do not substantially deviate from Ebenstein's with additional statistical remedies for the omitted variables bias and various types of sample biases such as selection effects.

Aggarwal (1996) conducted a number of econometric and case studies on India for the World Bank and UNIDO. Summarizing his study of India (page 4536), he concludes:

> '..the creation of zones which offer the easy option of competing on the basis of cost minimization should only be treated as a transitory policy arrangement…..(and)….not be regarded as a substitute for pursuing institutional and infrastructural improvements.'

Lessons from the literature focusing narrowly on SEZs thus suggest that the policy has been successful only for some objectives and in particular affecting the location choice of foreign investors. This is supported by related studies that report a positive impact of locational policies or institutions on the location choice of foreign investors (Cheng and Kwan, 2000, Basile et al, 2003, Crozet et al, 2004, Ledyaeva, 2009). Despite the success of attracting foreign investors to SEZs, some authors report findings that policy-created clusters do not render the same benefits for economic development as pre-existing clusters (De Propris and Driffield, 2006).

In other areas such as employment and income effects, there is still a lack of substantial evidence. Chinese experiences are in direct contrast to the general goal of income convergence since the policy is not designed for that purpose in the Chinese context. As Chinese policies in some sense are designed to exploit a spatial element of temporary differences in wages,

product and land prices it is perhaps not surprising that it affects worker welfare negatively while at the same time achieving the return of the labor force from rural to urban China. In India, on the contrary, is it clear that the regional policy targeting lagging regions has bitterly failed on the objective of income convergence (Farole, 2013).

Some studies of the EU structural funds that also aim to support lagging regions via income transfers report a positive effect on income convergence (Becker et al, 2010, Mohl and Hagen, 2010). Others report the opposite in their results (Dall'Erba and Le Gallo, 2008) or argue that the EU consists of different convergence clubs (Ramajo et al, 2008). No one has found in isolation a positive impact of the transfers for variables other than GDP per capita such as employment. Experiences with EU structural funds are therefore mixed at best where the overarching research question pursued has been that of income convergence and it seems the research has often been conducted at quite aggregate levels. This renders policy analysis in this context less meaningful as we need to address the policies at least starting from the level from which they are applied (Bradley, 2006). Only then can we start to tackle more difficult questions such as whether there are spillovers, other spatial effects or fiscal crowding out (Ederveen et al, 2006).

We found no econometric studies that report the impact of regional policies for other important aspects of economic development such as innovation, firm entry rates and the environment.

Overall the literature review shows that we may expect SEZ-type policies to be successful on some objectives such as meeting short term objectives of attracting foreign investors. Meanwhile evidence on longer term development goals, such as securing higher income levels for lagging regions and thereby income convergence, is at best mixed. A lot of important side objectives of the policies such as generation of exports, innovation, technology transfer and upgrading, and environmental sustainability aspects have not been covered in the existing literature at all. A general observation from the literature is that the success of the regional policy may depend quite a lot on the overall national institutional context and its specific developmental antecedents (Aggarwal, 1996, Rodriguez-Pose, 2012, Farole, 2013). Hence a wider comparison of country cases will be extremely useful for drawing policy implications.

3. Background and policy context of the Polish SEZs

The SEZs were introduced in Poland in 1994. The initiative was launched by the returning left-wing government in the early 1990s to combat rising income disparities across Poland and especially those that contained a regional element. The SEZ policy typically targeted high

unemployment regions at the outset of transition. During the 1950s to -80s, the East European socialist countries followed a tradition of heavy interference in the location of economic activity. At the beginning of the transition, the old production patterns were subject to sudden disruptions due to the liberalization of international trade and the introduction of hardening budget constraints in the public sector combined with privatization. This hit many regions in Poland and other transition countries hard and intervention at the state level was often necessary. However, regional authorities were not in a financial position to be able to deal with these challenges.

Hence the ad hoc construction of SEZs came into place to help alleviate the situation and attract new employment opportunities, new technologies and investment, with the aim of building a new export base. In Poland, this was combined with a slower approach to the privatization of large and medium scaled firms in the most severely affected regions. The Special Economic Zones Act of 1994 sets out the following policy objectives: 1) to develop the designated areas of economic activity, 2) to facilitate technology transfer to the zones, 3) to boost exports from the designated areas, 4) to increase the competitiveness of the goods and services produced, 5) to develop the existing industrial make-up and upgrade the economic infrastructure, 6) to create new places of employment and 7) to facilitate the adoption of sustainable technologies and energy sources.

Over time the policy has been subject to many revisions including a constant enlargement in terms of villages that have been allowed to adopt the policy, changes in specific rules concerning tax incentives and changes in the transitory regime of when the policy is expected to be faced out. Just recently the policy has been prolonged to 2026 up from 2017 as the original deadline for when the incentives had to be phased out upon Poland's EU membership. The history of the policy is described in detail by KPMG (2009) and a critical analysis is given by Gwosdz et al (2008). They describe how the policy developed from a theoretical conception of public support to backward regions into one of practice. For example, the initial idea of keeping the zones strictly concentrated to the very localized and originally designated areas broke down as early as 1997, mainly for political reasons (Gwosdz et al, 2008) (see also Figures A1 and A2 in the Appendix). Subsequently, local governors, including zone administrators and also in some cases indirectly the foreign investors themselves, have been able to bargain to make the policy applicable in areas adjacent areas to the original zones, whereby the zones over time have become 'wandering'. In other words, a supply-side policy in terms of localities offered to potential investors with special incentives turned into a policy dominated by a set of demand-side processes whereby the de facto geographical delineation of the SEZs became fuzzy.

Gwosdz et al (2008) speculate whether this was unfortunate for the development objectives.

We argue that the flexibility and bargaining space that was allowed under the Polish SEZ act in the end saved the policy. What was originally seen as a redundant supply of industrial land for development changed into a de facto demand for incentives to develop land AND existing state owned enterprises that were otherwise under threat of redundancy.

Finally, an important aspect of the Polish SEZs that is not dealt with separately in the present paper is that with Poland's accession to the EU in 2004, many of the same regions became eligible to participate in the EU structural funds. Whether the SEZs have served as a platform for putting structural funds at work in Poland would be a topic for a separate paper. In this paper we just control for any possible by-influence that general subsidies, including EU subsidies, may have on the regional development objectives under evaluation. Another important research question that arises out of this paper is whether SEZ policies and structural fund-type of policies in general will lead to stand-alone development once the policy and public support scheme is phased out.

4. Data and methodology used to evaluate the SEZ policy

In this section the data from the Polish regional databank published by GUS is introduced. The data quality and availability is briefly discussed. The descriptive statistics for the pooled dataset are reported as well. More detailed descriptive statistics are given in Section 5 while the methods used for their calculation are mentioned in this section. Finally, the panel data estimators are introduced and explained at the end of this section before moving to the reporting of econometric results in Section 5.

4.1 Data variables

The study variables are listed in alphabetical order in Table 1. Different equations in the study will have a different number of observations due to the availability of the particular variables included in each equation. Some of the variables that are adopted as dependent variables in the study are only available at the less detailed (nuts4) level. This is true for investments and the index of wages. The dependent variables used in the study are marked in bold in the table: emissions, employment, firms, foreign, greeninvest, invest and wages.

There is a relative large number of observations with values of zeros in the regional databank. We believe the zeros occur for two reasons. Sometimes zeros exist because of changes in the definition of territorial units. Typically this will affect the population variables. Therefore we remove all observations that have zeros for population-related variables. However, there

are also real zeros present in the data and removing these could result in data censoring. Therefore we do allow for zeros for other variables where it may be reasonable to expect that

Table 1 – Study variables

VARIABLE	DESCRIPTION	AVAILABILITY
Code	Number that identifies the territorial unit j. The code also has an alphabetic descriptor. The code is the cross section unit of analysis.	-
Dependants	Calculated as the difference between the total population and the working population. Observations of zeros are removed from the data.	1995-2011
Education	Expenditure on education, in PLN. Observations of zeros are allowed.	1995-2011
Emissions	Emission of air pollutants from manufacturing plants considered especially noxious to air purity, quoted in tons of particulates emitted from known pollutants in each geographical area. Observations of zeros are allowed.	1996-2011 (nuts4) 1996-2005 (nuts5)
Employment	Employed persons. Observations of zeros are removed from the data.	1995-2011
EUsubsidies	Revenue to finance EU-sponsored programs and projects, in PLN. Observations of zeros are allowed.	2006-2011
Firms	All firms listed in REGON (Polish company register). Observations of zeros are removed from the data	1995-2011
Foreign	Private sector firms with foreign capital participation in REGON. Observations of zeros are allowed.	1995-2011
Greeninvest	Outlays on fixed assets serving environmental protection, in ths PLN. Observations of zeros are allowed.	1999-2008
Invest	Investment outlays in enterprises, in mln PLN. Observations of zeros are allowed.	2002-2008 (nuts4)
Nuts41	A dummy for cities with powiat status	-
Nuts51	A dummy for urban gminas.	-
Population	Total population. Observations of zeros are removed from the data.	1995-2010(nuts4) 1995-2011(nuts5)
Local	Locally owned, privately held firms listed in REGON. Observations of zeros are allowed	1995-2011
SEZ	A dummy for territorial units with a special economic zone using the alpha betical listing published in KMPG, 2004 and the alphabetic descriptors in the regional database published by GUS	-
State	State owned firms in REGON. Observations of zeros are allowed.	1995-2011
Subsidies	Grand total of general subsidies in public sector revenue. Observations of zeros are allowed.	1995-2011
Wages	Average wage index with Poland=100.	2002-2011(nuts4)
Working	Population at working age, women 15-59, men 15-64. Observations of zeros are removed from the data.	1995-2010(nuts4) 1995-2011(nuts5)
Year	The year of the observation time t is the time series unit of analysis	-

Source: own estimations

the variable takes a value of 0 for some years and/or regions. Table 1 also mentions how we dealt with the problem of zeros for each of the relevant variables. Since population related variables occur in all the estimated equations, we argue that this approach appropriately deals with the impact that changing territorial units over time may have on the dataset.

The aim is to evaluate the SEZ policy on as many of its specific objectives (as explained in Section 2) as possible. However, lacking data availability in particular for exports and technology only renders it possible to achieve the research objective on some of the potential dimensions of the policy.

The empirical strategy is to adopt the dependent variables in their direct form (log transformed) while controlling for the population of firms and people within which they occur on the right hand side of the equation.

4.2 Pooled descriptive statistics

Appendix Tables A1a and A1b show the general descriptive statistics of the pooled data at the nuts4 and nuts5 levels, respectively. These descriptive statistics give access to some general observations about the relative heterogeneity of economic development at powiat and gmina levels in Poland. One interesting variable to compare in particular is the occurrence of SEZs at the two levels. For the nuts4 level, SEZs occur in 47% of all locations, whereas at the nuts5 level they only occur in 8% of all locations. This suggests as the map in Figure A2 also shows that the SEZs are quite geographically dispersed across Poland.

The most straightforward way to compare the statistics across the two geographical units is to calculate the coefficient of variation by dividing the standard deviation with the mean. The results are shown in Table 2.

Here we see that the coefficient of variation is typically three times higher for the nuts5 compared with the nuts4 level. This suggests that heterogeneity increases as the areas or locations compared decrease in size as nuts5 represents the more detailed village level whereas nuts4 represents the less detailed commune level. Hence villages are generally more different than communes in Poland. This also suggests that there is an averaging out effect moving from the specific to more general level which is common in regional datasets. Had for example all the rich villages been located in one commune and all the poor villages in another commune, the opposite result should have come about.

The above observations also suggest that the evaluation of the policy is best conducted at the level at which it is applied, at least in any initial analysis and that spillover effects can

then be dealt with in addition to but not in substitution of the analysis at the most detailed level of data availability.

Table 2 – Coefficient of variation for the dependent variables, comparing nuts4 and nuts5

	Powiat (nuts4)		Gmina (nuts5)	
	All	SEZs	All	SEZs
Emissions	2.46	2.26	6.62	2.80
Employment	2.15	1.45	6.23	2.45
Firmpop	1.99	1.41	5.41	2.52
Forfirmpop	6.18	2.47	15.14	3.85
Greeninvest	2.01	1.68	5.62	2.75
Invest	3.64	1.91	-	-
SEZs	1.06	-	3.38	-
Wages (indexed)	0.15	0.15	-	-

Source: own estimations

Across the dependent variables, the statistics in Table 2 also reveal that the most unevenly distributed variable is that of foreign owned firms, followed by investment in new capital. Firms in general are much more evenly distributed, along with investments in green technology. Wage is the most homogenous factor across space (unfortunately it is not possible to observe this variable at the more detailed nuts5 level).

4.3 Econometric methods used to analyze the data

More detailed descriptive statistics are calculated to perform the analysis using single variable methods. Generating relevant descriptive statistics for panel data is challenging due to the multi-dimensional character of the data. For example, looking at the pooled data reported above gives little information about the time series or more dynamic dimension that is inherent in the data. This is important, as one of the advantages of panel data emphasized in particular in policy analysis is that it encompasses a time perspective – that is we can observe the changes that the cross sectional units undergo individually over time.

The treatment factor in this study is the special economic zones variable and we aim to study how and whether the territorial areas affected by this policy are responsive or not to the treatment on the above mentioned dependent variables and this is naturally a process that takes place over time.

4.3.1 Panel descriptive statistics

To compile descriptive statistics for panel data that reveal more about the dynamics of the dependent variables y, first, a simple difference-in-difference statistic is calculated. This is done by running the regression in Equation 1 for the first (t=1) and last (t=T) year of observation, where the difference-in-difference statistic is obtained as βt=T - βt=1. The statistic gives us the average effect over time span T of running the SEZ policy experiment. The reason we would still maintain it as a descriptive statistic is that it does not account for common statistical problems inherent in regression analysis.

$$\text{Eq.1} \qquad y_{jt=1}=\alpha_0+\alpha_{t=1}SEZ_j+\epsilon_{jt=1}$$

To check how much this statistic is affected alone by other available control factors we also calculate the difference-in-difference statistic including all the relevant control factors available:

$$\text{Eq.2} \qquad y_{jt=1}=\alpha_0+\alpha_{t=1}\,SEZ_j+\beta_i\kappa_{jt=1}+\epsilon_{jt=1}$$

4.3.2 Panel data estimators

After compiling the time-varying descriptive statistics, we jump to panel data analysis as the best strategy to analyze the data given the available information. The simplest type of panel data analysis is performed on the data as if it were cross-sectional data. This is called a pooled panel data regression (where y is the dependent variable and x is an explanatory variable) and is also commonly referred to as panel least squares:

$$\text{Eq.3.a} \qquad y_{jt}=\alpha_0+\beta x_{jt}+\epsilon_{jt}$$

In this equation we can then adopt the policy as a simple dummy variable to investigate whether the level in the dependent variable is affected by the policy while controlling for other factors that in competition with our main variable could explain the difference in the observed levels. In this analysis it is implicitly assumed that the policy works independent of any of the other explanatory variables, e.g. it is not conditional on other factors such as education level in order to have any impact:

$$\text{Eq.3.b} \qquad y_{jt}=\alpha_0+\alpha_1 SEZ_j+\beta x_{jt}+\epsilon_{jt}$$

An alternative approach to reducing heterogeneity in panels is to estimate a random or fixed effect model. The random effect model has advantages when we want to study fixed effects that are collinear with the cross sectional fixed effects as the correlation within the cross sec-

tion is only accounted for with an additional error term (or here two errors as we also take into account correlation in the time series to reduce problems of serial correlation):

$$\text{Eq. 4.a} \qquad y_{jt}=\alpha_0+\beta x_{jt}+\sigma_j+\tau_t+\epsilon_{jt}$$

$$\text{Eq. 4b} \qquad y_{jt}=\alpha_0+\alpha_1 SEZ_j+\beta x_{jt}+\sigma_j+\tau_t+\epsilon_{jt}$$

The fixed effect model must be considered superior in cases where we suspect that there are underlying structural factors that have a strong determining impact on our economic variables. This is often the case in regional datasets such as ours.

We therefore use the two-stage fixed effect model as proposed by Kripfganz and Schwarz (2012) to solve the problem of collinearity between the fixed effects and the SEZ dummy. In the first stage we estimate the ordinary two-way fixed effect model without the SEZ dummies which takes the following form:

$$\text{Eq.5.a} \qquad y_{jt}=\alpha_j+\lambda_t+\beta x_{jt}+\epsilon_{jt}$$

Using this equation we obtain an estimate of each territorial unit's fixed effect for the response variable y. In the second stage we investigate if this fixed effect differs across economic areas with and without the SEZ policy:

$$\text{Eq.5.b} \qquad \alpha_j=\alpha_0+\alpha_1 SEZ_j+\epsilon_j$$

5. Statistical results

This section presents the main statistical results of the study. First the panel descriptive statistics are presented. After that we show the comparative results of applying the different panel data estimators to the dataset.

5.1 Difference-in-difference estimates

Table 3 presents the difference-in-difference statistics for the dependent variables: employment effects, business creation effects (general firm population, foreign firm population and investment), income effect and environmental (emissions and green investment) impact. These first results are only indicative and descriptive and even though we go beyond descriptive statistics in Equation 2 by controlling for other relevant variables using multivariate regression analysis, these results are purely repeated cross sectional statistics and do not exploit nor account for the efficiency properties of panel data.

Table 3 – Difference-in-difference estimates for the SEZ policy

Equation			1			2
Difference at time:	D(t=1)	D(t=T)	DiD	D(t=1)	D(t=T)	DiD
Dependent vars:						
Log Employment (nuts5)	1.70***	1.76***	0.06***	0.08***	0.07***	-0.01***
Log Firmpop (nuts5)	1.48***	1.40***	-0.08***	-0.01	-0.07***-	-0.06***
Log Forfirmpop (nuts5)	1.22***	1.57***	0.35***	0.16***	0.12**	-0.04***
Log Investment (nuts4)	0.53***	0.48***	-0.05***	0.09	0.12**	0.03***
Wages (nuts4)	1.17	1.00	-0.17	-2.00*	-1.30	0.70*
Log Emissions (nuts5)	2.55***	1.98***	-0.57***	0.38***	0.28***	-0.10***
Log Greeninvest (nuts5)	2.47***	2.81***	0.34***	-0.06	0.18	0.24

Source: own estimations

For the employment effect the descriptive statistics suggest without additional controls that SEZs have a much higher level of employment compared to other villages at the nuts5 level. Quantitatively the effect of an SEZ on employment is estimated to be in the order of 170% higher employment and increasing over time. However, once we control for other relevant factors such as population structure and number of firms, most of the difference disappears. A small positive effect of SEZs on employment at around 8% remains when adopting additional controls. An obvious reason for this result is that SEZs may provide for a sorting that attenuates employment differences at this level of geographical detail. For example, many people that work in SEZs will typically live with their dependants in adjacent villages that offer little employment. Hence once we take into account such structural differences between economic areas we still register a small positive effect of the policy on employment. However, this effect is slightly declining rather than increasing over time according to the equation with controls.

Moving to the 2nd to 4th rows in Table 3, the focus is on business creation effects by using firm populations, foreign firm populations and investments as dependent variables. Before adopting additional controls, SEZs are positive outliers in terms of business creation. For overall firm population and investments, the effects are declining over time, e.g. net entry rates are smaller than for other economic areas at the village level over time. It may be because the zones typically favor larger investors that we observe a tendency for new firm creation to go down over time. There is a very strong effect in particular for attracting foreign investors as business creators or entrepreneurs to the zones. Similarly, we observe at the level of investment (which is only available at the Nuts4 level and which may explain why the effect is less strong) that areas with SEZs have more business creation when measured on the level of investment. Introducing additional controls moderate the results somewhat. Again, we see that the effects of the SEZ policy on the dependent variables are smaller and sometimes somewhat less signi-

ficant when we include controls for other relevant variables. In particular, the foreign firm factor may be dominant so that it in itself absorbs the explanatory power when used as a control in equations that have other dependent variables such as e.g. investment. This suggests that the observed effect may run through other factors rather than the policy itself and we must therefore also be concerned about other omitted variables biases.

The results for investigating the effect of the SEZ policy on income by using the wage index at the nuts4 level as a dependent variable is rather inconclusive. We detect a weak systematic relationship between the special zones and the level and development in wages over time. The equation with controls (equation 2) suggests that SEZs exist significantly below the average income level in Poland and that the policy has a slightly moderating effect in a positive direction over time, e.g. the policy has helped to somewhat reduce the income gap that exists between SEZs and other economic areas in Poland.

The last two rows show the descriptive results for the dependent variables related to the impact of the policy on the environment. SEZs typically exist at a much higher level of emissions, e.g. emissions are estimated to be more than 200% above other economic areas. Even though the difference is much smaller for Equation 2, we see the same result with and without controls - that emissions are quite significantly reduced in areas affected by the SEZ policy. This could be due in part to a higher level of green investment as registered in the last row. However, this effect disappears when controlling for other factors. Again, we think this result is because of the control for foreign ownership in particular with Equation 2. It is possible that general subsidies, including EU structural funds that often target the environment, could also explain why the effect of the policy disappears once we introduce such additional control factors.

To further investigate the effect of the policy we move to different panel data estimators that can address both common issues in econometric analysis including in particular investigating for omitted variables biases that relate to the structural characteristics of the SEZs. We expect the result of this analysis will be to substantiate and add statistical robustness to the results obtained with the descriptive statistics.

5.2 Employment effect in panel regressions

Table 4 compares the panel regressions for the employment effect. Notice that all reported standard errors are robust to heteroscedasticity in the cross section. Generally serial correlation is high as is to be expected given the longitudinal nature of the study. Once including a random (2nd column) or fixed (3rd column) effect, the serial correlation coefficient is typically reduced to around 0.5. Serial correlation is therefore not further addressed in this study.

Some of the features of the panel estimators adopted in this study have been introduced above. Here, the difference that occurs between column 2 and 3 is emphasized. Any difference between the random and fixed effect estimator may occur for two reasons.

The fixed effect estimator is fully robust to any omitted variable bias that has a structural or time invariant character. Hence if omitted variables that are time invariant such as, for example, the location of an SEZ on a traditional trade route, render important explanatory power this might change the obtained statistical estimate for the variable of interest which is the SEZ dummy.

Table 4 – Panel regressions for the employment effect of the SEZ policy, nuts5 level (villages)

Equation	3.b	4.b	5.a and 5.b
Method	PLS	Panel, RE	Two-step Panel, FE
Standard errors	White, CS	Clustered robust	White, CS
Dependent variable:	log Employment	log Employment	log Employment
Intercept	-0.70*** (0.21)	**-4.01*** (0.15)**	**0.01 (0.01)**
SEZ	**0.08*** (0.01)**	**0.12*** (0.03)**	**-0.19*** (0.03)**
URBAN	**0.17*** (0.05)**	**0.53*** (0.03)**	**0.12*** (0.03)**
Log Working	**0.46*** (0.17)**	**0.78*** (0.03)**	**0.93*** (0.05)**
Log Dependants	**0.09 (0.16)**	**0.58*** (0.03)**	**0.40*** (0.04)**
Log State	**0.29*** (0.03)**	**0.01(0.01)**	**0.06*** (0.01)**
Log Local	**0.33*** (0.05)**	**-0.07*** (0.01)**	**-0.01(0.01)**
Log Foreign	**0.10*** (0.01)**	**0.04***(0.01)**	**0.02***(0.01)**
Log Education	**0.37*** (0.05)**	**0.04*** (0.01)**	**0.06*** (0.01)**
Log Subsidies	**-0.39*** (0.05)**	**-0.06*** (0.01)**	**-0.02*** (0.01)**
Region effects	none	random	fixed
Year effect	none	random	fixed
Number of obs	**59,669**	**59,669**	**59,669**
Nuts5 regions	**3,823**	**3,823**	**3,823**
Years	17	17	17
R^2/LL	**0.85**	**0.77**	**0.98**
ρ	**0.89**	**0.77**	**0.66**

Source: own estimations

Another major difference obtained here between the random and fixed effect model concerns how the separate estimates for SEZs are obtained. With the random effect estimator in Equation 4b, the intercept is obtained as an average for all SEZs. Whereas in Equation 5b, each SEZ is assigned an individual intercept with the first stage fixed effect estimate which is then analyzed for a common SEZ component in the second stage. Outlier regions will therefore carry more weight when estimating a common intercept for all SEZs. Overall, the fixed effect estimator must therefore be considered the most robust estimator in all respects. We can the-

refore also conclude that SEZs do not have a general positive effect on employment during the period of study. Rather, traditional factors including the general presence of foreign investors irrespective of their participation in SEZs have a positive impact on employment. This is a quite surprising result given the objectives of the SEZ policy, but perhaps not from the perspective that the villages receiving support are the structurally lagging regions and especially with respect to unemployment. The policy has not been able to overcome that legacy during the current horizon of the policy.

5.3 Business creation effects in panel regressions

In this section we report the panel data results for the business creation effect of the SEZ policy. Since the dependent variables are all firms in general (Table 5) and foreign firms (Table 6) in particular we drop the control variables for private local firms Local and foreign firms Foreign as both will be pervasive to the dependent variable. The control for state firms is maintained from the perspective that business creation in transition countries is often related with privatization, e.g. firm creation often happens via the conversion of a state owned firm into a private firm. (Typically we also find that the presence of state owned firms contributes positively to business creation.)

Table 5 – Panel regressions for the firm creation effect of the SEZ policy, nuts5 level (villages)

Equation	3.b	4.b	5.a and 5.b
Method	PLS	Panel, RE	Two-step Panel, FE
Standard errors	White, CS	Clustered robust	White, CS
Dependent variable:	log Employment	log Employment	log Employment
Intercept	-2.68*** (0.11)	-2.25*** (0.10)	0.09*** (0.01)
SEZ	0.04*** (0.00)	-0.06*** (0.02)	0.24*** (0.03)
URBAN	0.15*** (0.01)	0.22*** (0.03)	0.82*** (0.03)
Log Working	2.10*** (0.13)	1.83*** (0.02)	0.64*** (0.10)
Log Dependants	-1.23 ***(0.13)	-1.02*** (0.02)	0.07* (0.04)
Log State	0.22*** (0.01)	0.19(0.01)	0.02** (0.01)
Log Education	0.06 (0.06)	-0.05*** (0.01)	0.00 (0.01)
Log Subsidies	-0.06 (0.07)	0.07*** (0.01)	0.00 (0.0)
Region effects	none	random	fixed
Year effect	none	random	fixed
Number of obs	61,985	61,985	61,985
Nuts5 regions	3,823	3,823	3,823
Years	17	17	17
R^2/LL	0.91	0.89	0.99
ρ	0.91	0.78	0.66

Source: own estimations

The most robust estimator (fixed effects) renders the result of a positive effect on business creation in general and the creation of foreign firms in particular via the SEZs. As for generating new investment, which is another major objective with the SEZ policy, we find little effect.

Table 6 – Panel regressions for the foreign firm creation effect of the SEZ policy, nuts5 level (villages)

Equation	3.b	4.b	5.a and 5.b
Method	PLS	Panel, RE	Two-step Panel, FE
Standard errors	White, CS	Clustered robust	White, CS
Dependent variable:	log Employment	log Employment	log Employment
Intercept	-6.49*** (0.18)	-5.72*** (0.26)	-0.10*** (0.01)
SEZ	0.16*** (0.01)	0.11** (0.06)	0.41*** (0.06)
URBAN	0.27*** (0.02)	0.40*** (0.07)	0.95*** (0.06)
Log Working	2.78*** (0.08)	1.57*** (0.04)	0.17** (0.08)
Log Dependants	-2.04*** (0.09)	-0.89*** (0.03)	0.54*** (0.09)
Log State	0.10*** (0.01)	0.19*** (0.01)	0.06*** (0.01)
Log Education	0.33** (0.14)	-0.02*** (0.01)	-0.04 (0.04)
Log Subsidies	-0.34** (0.14)	0.03*** (0.01)	0.01 (0.03)
Region effects	none	random	fixed
Year effect	none	random	fixed
Number of obs	62,005	62,005	62,005
Nuts5 regions	3,823	3,823	3,823
Years	17	17	17
R^2/LL	0.61	0.55	0.96
ρ	0.97	0.87	0.73

Source: own estimations

Surprisingly, the results of the fixed effect estimator in Table 5.3c also suggest that the presence of foreign firms does not explain private investment in general. Rather we find that investment is complementary to the working population and that most of the variation in investment is explained by unobserved structural and time factors that are absorbed by the fixed effects. One reason for the poor results for investment may also be the period of study, as Poland experienced its own recession in the early 2000s and the latter part of the period for which data is available on investment coincided with the first phases of the global financial crisis. Hence the period of data availability for this particular data series may be quite unfortunate and less representative for the full period of study.

Table 7 – Panel regressions for the investment effect of the SEZ policy, nuts4 level (communes)

Equation	3.b	4.b	5.a and 5.b
Method	PLS	Panel, RE	Two-step Panel, FE
Standard errors	White, CS	Clustered robust	White, CS
Dependent variable:	log Employment	log Employment	log Employment
Intercept	-14.91*** (1.06)	-19.20*** (0.85)	-0.00 (0.05)
SEZ	0.12*** (0.02)	0.07 (0.05)	0.01 (0.07)
URBAN	-0.05 (0.05)	-0.34*** (0.08)	-0.21** (0.10)
Log Working	1.67*** (0.26)	1.66*** (0.34)	1.63*** (0.29)
Log Dependants	-1.49*** (0.24)	-2.14*** (0.25)	0.43 (0.50)
Log State	-0.06*** (0.02)	-0.03 (0.06)	0.11 (0.07)
Log Local	0.36*** (0.03)	0.44*** (0.13)	-0.01 (0.20)
Log Foreign	0.04*** (0.01)	0.15*** (0.04)	0.13 (0.11)
Log Education	1.70*** (0.12)	1.12*** (0.08)	-0.04 (0.06)
Log Subsidies	-0.96*** (0.06)	0.18* (0.11)	0.12 (0.11)
Region effects	none	random	fixed
Year effect	none	random	fixed
Number of obs	2,654	2,654	2,654
Nuts5 regions	380	380	380
Years	17	17	17
R^2/LL	0.77	0.75	0.92
ρ	0.69	0.56	0.14

Source: own estimations

5.4 Income (wage) effect in panel regressions

The wage, or average worker's income effect of the SEZ policy, is reported in Table 8. Note that wages in the study are captured with a commune level wage index that deviates as an index from the national average (Poland=100). Somewhat in opposition to the difference-in-difference estimates, we find no positive or negative effect of SEZs on wages. Note that this result is obtained while holding other factors such as foreign direct investment constant. Hence we can quite robustly conclude that while foreign investors contribute positively to the wage development of workers in Poland this behavior is not strongly associated with the SEZ policy. Furthermore it is the educated, urban workers in Poland that experienced relative wage increases during the period of study. In this respect, SEZ workers do not have ant advantage over other workers in similar localities as themselves.

Table 8 – Panel regressions for the income effect of the SEZ policy, nuts4 level (communes)

Equation	3.b	4.b	5.a and 5.b
Method	PLS	Panel, RE	Two-step Panel, FE
Standard errors	White, CS	Clustered robust	White, CS
Dependent variable:	log Employment	log Employment	log Employment
Intercept	67.86*** (11.10)	28.78 (18.63)	-35.02 (77.62)
SEZ	-1.06*** (0.19)	-1.24 (1.15)	-1.26 (1.11)
URBAN	10.35*** (0.88)	8.84*** (1.99)	7.79*** (1.46)
Log Working	4.13 (4.33)	-1.90 (3.29)	3.24 (5.32)
Log Dependants	6.73*** (2.43)	8.32*** (2.38)	3.57 (2.83)
Log State	-0.69** (0.33)	-1.20* (0.64)	-0.66 (0.41)
Log Local	-1.22 ** (0.55)	0.64 (1.57)	-2.60*** (0.96)
Log Foreign	0.01 (0.15)	1.50*** (0.58)	0.97*** (0.32)
Log Education	19.90*** (2.86)	-0.94 (1.33)	1.88*** (3.07)
Log Subsidies	-24.73*** (1.51)	0.14 (1.47)	2.03 (1.41)
Region effects	none	random	fixed
Year effect	none	random	fixed
Number of obs	3,412	3,412	3,412
Nuts5 regions	380	380	380
Years	9	9	9
R^2/LL	0.36	0.26	0.96
ρ	0.95	0.92	0.48

Source: own estimations

5.5 Environmental impact in panel regressions

Tables 9 and 10 report the environmental impact of SEZs. As many SEZs are traditional industrialized areas in Poland that, after the change in the direction of the policy in 1997, also came to incorporate older plants it is not surprising that SEZs incorporate above average polluting industry in Poland. Therefore many of the structural aspects of the SEZs in themselves make them prone to attracting more polluting industry including the fact that SEZs are often located in non-urban villages and communes.

The SEZ policy, despite its underlying sustainability agenda, does not appear to have had a strong dampening effect on the environmental legacy of the zones. The time perspective offered by the difference-in-difference statistics suggests that there is a small positive dampening effect of the policy in terms of reducing omissions slightly over time. Overall the policy is associated with generally highly polluting activities compared with the national average at any point in time over the policy horizon.

Table 9 – Panel regressions for the emission effect of the SEZ policy, nuts5 level (villages)

Equation	3.b	4.b	5.a and 5.b
Method	PLS	Panel, RE	Two-step Panel, FE
Standard errors	White, CS	Clustered robust	White, CS
Dependent variable:	log Employment	log Employment	log Employment
Intercept	-10.11*** (0.41)	-8.08*** (0.50)	-0.18*** (0.03)
SEZ	0.39*** (0.02)	0.59*** (0.12)	0.42*** (0.10)
URBAN	1.27*** (0.06)	1.79*** (0.13)	1.68*** (0.10)
Log Working	1.93*** (0.27)	0.48*** (0.10)	0.96*** (0.14)
Log Dependants	-0.84*** (0.24)	0.96*** (0.09)	-0.18*** (0.06)
Log State	0.56*** (0.05)	-0.14*** (0.03)	-0.14*** (0.03)
Log Local	-0.32*** (0.03)	0.03 (0.02)	0.14*** (0.04)
Log Foreign	-0.02** (0.01)	-0.11*** (0.02)	-0.12*** (0.02)
Log Education	0.52*** (0.11)	0.02 (0.02)	0.09*** (0.03)
Log Subsidies	-0.55*** (0.10)	-0.06*** (0.02)	-0.01 (0.02)
Region effects	none	random	fixed
Year effect	none	random	fixed
Number of obs	36,349	36,349	36,349
Nuts5 regions	3,751	3,751	3,751
Years	10	10	10
R^2/LL	0.47	0.41	0.963
ρ	0.92	0.84	0.63

Source: own estimations

Whereas foreign investors in general reduce omissions, their attraction to SEZs is not associated with a general conformity to this behavioral pattern according to the results obtained with the fixed effect panel estimator. These findings for emissions are quite consistent with the related results for the adoption of green technologies.

Firms that are located in SEZs are not more likely to adopt green technologies; the policy does not appear to have any impact on adoption rates, especially when we look at the results obtained with the most robust estimator. Again, it does it appear that foreign investors generally exhibit a positive impact on the environment and in combination, the results suggest especially for environmental sustainability that there is a tendency with the zones policy to lead to a degradation in the standards normally exhibited and associated with foreign investors. Overall this suggests that the policy has a number of down side effects because of the type of foreign investors that it attracts which could relate specifically with a policy instrument that focuses solely on the cost side of operations.

Table 10 – Panel regressions for the green investment effect of the SEZ policy, nuts5 level (villages)

Equation	3.b	4.b	5.a and 5.b
Method	PLS	Panel, RE	Two-step Panel, FE
Standard errors	White, CS	Clustered robust	White, CS
Dependent variable:	log Employment	log Employment	log Employment
Intercept	**-7.53*** (0.47)**	**-7.29*** (0.54)**	**-0.02 (0.04)**
SEZ	**0.17*** (0.04)**	**0.29*** (0.10)**	**0.20 (0.13)**
URBAN	**-0.04 (0.05)**	**0.35*** (0.11)**	**-0.09 (0.13)**
Log Working	**2.39*** (0.58)**	**0.77*** (0.27)**	**-0.23 (0.43)**
Log Dependants	**-1.67*** (0.53)**	**0.24 (0.23)**	**1.66*** (0.54)**
Log State	**0.06* (0.03)**	**-0.03 (0.05)**	**-0.20*** (0.05)**
Log Local	**0.77*** (0.09)**	**0.55*** (0.09)**	**0.06 (0.12)**
Log Foreign	**-0.07 (0.04)**	**0.05 (0.05)**	**0.13** (0.05)**
Log Education	**1.14*** (0.18)**	**0.62*** (0.12)**	**0.01 (0.09)**
Log Subsidies	**-1.12*** (0.18)**	**-0.61 (0.12)**	**0.12** (0.05)**
Region effects	none	random	fixed
Year effect	none	random	fixed
Number of obs	**36,500**	**36,500**	**36,500**
Nuts5 regions	3,758	3,758	3,758
Years	10	10	10
R^2/LL	0.28	0.27	0.55
ρ	0.43	0.29	0.13

Source: own estimations

6. Discussion of the results and conclusion of the study

In this paper we set out to evaluate the relative success of Poland's SEZs that were introduced in 1994 using a longitudinal perspective. The aim is to evaluate the policy on as many of its priorities or objectives as possible and given the availability of detailed regional data at the nuts4 and nuts5 levels in the Polish regional databank. While there may be interregional spillovers that argue for a broader approach to policy evaluation, any policy evaluation should initially start at the level at which the policy is applied. That is what we set out to do in this first econometric study of SEZs in Poland. Combining these objectives we evaluate the policy on the factors of employment, business creation including private investment, wage or income effect and environment.

The difference-in-difference statistics suggest along with the pooled panel and random effects estimates that SEZs are slightly above the national average in terms of employment and that there has been no dynamic development in this impact factor over the policy horizon. The fixed

effect estimator which is deemed to be robust to any omitted variables bias suggests the opposite - that SEZs, despite the influence of the policy on business creation, have been ineffective in generating a higher level of employment among the SEZ areas in particular and that these areas throughout the period continue to perform below the average village in terms of generating places of employment. However, especially for employment, the comparison across SEZs and other village sized areas is difficult to make since SEZs do not have many typical village style features such as offering both a place to live and work.

In terms of business creation, we find this is where the SEZ policy has been mostly successful so far and we estimate that most of the effect comes about through the attraction of FDI into the special economic zones. Here we also suggest that the policy change that came in 1997 whereby new areas were allowed to use the policy that was designated originally to 17 confined greenfield areas is part of the reason why the SEZ policy has been able over time to meet its target objectives in this respect. Many large scale foreign investors acquired existing plants under privatization and it was often in the interest of other follow up investors to be located adjacent to the pioneer investors. The data on investment does not give the same positive account of the SEZs. In fact, the fixed effect model means most capital investment must be explained by structural and time factors in combination with working population as the only time variant locational element that is positively and strongly associated with investment levels. Neither the SEZ policy nor FDI is able to significantly explain the geographical distribution of investment. A hindering factor may be that data is only available for quite as short span and at the nuts4 level. It makes the particular results for the investment aspect relatively incomparable with the other parts of the econometric analysis.

The wage or income effect of the SEZ policy is absent. Again, we propose that this is related to the specific structural features of the SEZs and also associated with the below average employment impact which may tend to create a natural ceiling on wage developments. Groups that led wage developments in Poland during the period of study were the urban, educated workers and those employed by foreign firms in general but not in particular attached to the SEZs.

For environmental sustainability we offer the first result on this aspect of SEZs. Here also the welfare impact of the policy appears to be negative and appears to have led to more rather than less negative externalities. We suggest that the policy may involve a certain element of downgrading standards among foreign investors in general. Whereas foreign investors on average pollute less, this impact does not come through when looking at SEZs in isolation. Similarly, whereas foreign investors in Poland on average are more likely to adopt green technologies we find the opposite is true when focusing specifically on the impact of the SEZ policy on the environmental objectives.

The study opens up for a wealth of new questions on SEZs and related public policies such as the EU structural funds and other similar policies targeting FDI or innovation (e.g. cluster generation) by using place as a means to decide who is to receive special incentives. In view of the ample usage of such policies, it is worrisome from a policy evaluation perspective that so little is known about the long run impact of these policies on factors such as business creation and the longer run competitiveness effect on the firm and the region.

Our study is among the first to take a step in that direction. Our results as discussed above supported other findings that brought into question the more long run impact of these place-based policies. A major worrying factor is whether or not it is a good idea for developing and transition countries to market their space through cost-based incentives such as tax incentives alone. The very nature of the policy may be the seed of the continued legacy of problems with upgrading and shifting out of an industrialization scenario that is purely cost based and prone to race-to-the-bottom type of situations. Here it would be relevant to try to compare the usage of tax based incentives with other types of incentives such as those that target the innovation activities, quality orientation or seek to set minimum standards among the firms involved in the special incentives schemes.

Our literature review shows that there are no ex-post studies of what happens after the special incentives have been dismantled. Poland, with its very solid regional databank, will therefore be an interesting case on which to do follow up studies. Our review of the literature also suggests that in order to draw solid policy advice across countries, it is necessary to connect the impact analysis of individual SEZ schemes in a comparative institutional perspective whereby one can also start to understand whether and how the underlying national institutional framework affects their relative success and failure. Finally we also identified a gap in terms of studies that focused on other impact factors besides FDI, productivity, and income differences such as in particular innovation, exports and other aspects of technological, environmental and quality upgrading.

References

Aggarwal, A. (2006). Special economic zones: revisiting the policy debate. Economic and Political Weekly, 4533-4536.

Barca, F., McCann, P., & Rodríguez-Pose, A. (2012). The case for regional development intervention: place-based versus place-neutral approaches*. Journal of Regional Science, 52(1), 134-152.

Basile, R., Castellani, D., & Zanfei, A. (2003). Location choices of multinational firms in Europe: the role of national boundaries and EU policy. Univ. of Urbino, Economics, Mathematics & Statistics Working Paper, (78).

Becker, S. O., Egger, P. H., & Von Ehrlich, M. (2010). Going NUTS: The effect of EU Structural Funds on regional performance. Journal of Public Economics, 94(9), 578-590.

Bradley, J. (2006). Evaluating the impact of European Union cohesion policy in less-developed countries and regions. Regional Studies, 40(02), 189-200.

Cheng, L. K., & Kwan, Y. K. (2000). What are the determinants of the location of foreign direct investment? The Chinese experience. Journal of international economics, 51(2), 379-400.

Crozet, M., Mayer, T., & Mucchielli, J. L. (2004). How do firms agglomerate? A study of FDI in France. Regional Science and Urban Economics, 34(1), 27-54.

Dall'Erba, S., & Le Gallo, J. (2008). Regional convergence and the impact of European structural funds over 1989–1999: A spatial econometric analysis*. Papers in Regional Science, 87(2), 219-244.

De Propris, L., & Driffield, N. (2006). The importance of clusters for spillovers from foreign direct investment and technology sourcing. Cambridge Journal of Economics, 30(2), 277-291.

The Economist (2012). Government proposes introduction of „special economic zones". The Economist. August 29th 2012.

Ebenstein, A. (2012). Winners and Losers of Multinational Firm Entry into Developing Countries: Evidence from the Special Economic Zones of the People's Republic of China. Asian Development Review, 29(1).

Ederveen, S., Groot, H. L., & Nahuis, R. (2006). Fertile soil for structural funds? A panel data analysis of the conditional effectiveness of European cohesion policy. Kyklos, 59(1), 17-42.

Farole, T. (2010). Second Best? Investment Climate and Performance in Africa's Special Economic Zones. Policy Research Working Paper. The World Bank.

Farole, T. (Ed.) (2013). The Internal Geography of Trade: Lagging Regions and Global Markets. The World Bank.

Gibbon, P. (Ed.) (2008). Export Processing Zones as an economic development strategy. Danish Institute for International Studies study for Danish Foreign Ministry.

Grubel, H. G. (1982). Towards a theory of free economic zones. Weltwirtschaftliches Archiv, 118(1), 39-61.

Gwosdz, K., Jarczewski, W., Huculak, M., & Wiederman, K. (2008). Polish special economic zones: idea versus practice. Environment and planning. C, Government & policy, 26(4), 824.

KPMG (2011). Special Economic Zones. KPMG in Poland.

KPMG (2009). A guide to special economic zones in Poland. KPMG in Poland.

Kripfganz, S., & Schwarz, C. (2012). Estimation of Linear Dynamic Panel Data Models with Time-Invariant Regressors. Paper presented at the Econometric Society's Australasia Meeting, Melbourne, Summer.

Ledyaeva, S. (2009). Spatial econometric analysis of foreign direct investment determinants in Russian regions. The World Economy, 32(4), 643-666.

Mohl, P., & Hagen, T. (2010). Do EU structural funds promote regional growth? New evidence from various panel data approaches. Regional Science and Urban Economics, 40(5), 353-365.

Ramajo, J., Márquez, M. A., Hewings, G. J., & Salinas, M. M. (2008). Spatial heterogeneity and interregional spillovers in the European Union: Do cohesion policies encourage convergence across regions?. European Economic Review, 52(3), 551-567.

Rodríguez-Pose, A. (2012). Trade and regional inequality. Economic geography, 88(2), 109-136.

Tödtling, F., & Trippl, M. (2005). One size fits all?: Towards a differentiated regional innovation policy approach. Research policy, 34(8), 1203-1219.

Wang, J. (2012). The economic impact of special economic zones: evidence from Chinese municipalities. Journal of Development Economics.

World Bank (2009). World Development Report 2009: Reshaping Economic Geography. Washington D.C.

Appendix

Figure A1

Source: Polish Agency for Foreign Direct Investment.

Figure A2

Source: KPMG (2011). Special Economic Zones. KPMG in Poland.

Table A1 – Descriptive statistics for the pooled data, nuts4 level

	DEPENDRATE	EDUCATION	EDUCPERCAP	EMISSIONS	EMPLOYMENT
Mean	0.34	70153902.12	644.15	411.03	22435.50
Median	0.33	48032457.86	627.36	122.00	12853.50.
Maximum	0.43	2259244559.03	1936.65	22130.00	29478.00
Minimum	0.24	821725.00	30.54	0.00	1927.00
Std. Dev.	0.03	103140358.79	280.96	1011.45	48303.29
Skewness	0.42	10.38	0.32	7.68	11.02
Kurtosis	2.75	171.14	3.32	95.41	159.10
Observations	6023	6402	6023	6029	6402

	EMPRATE	EUSUBSIDIES	FIRMPOP	FORFIRMPOP	GREENINVEST
Mean	0.28	6304787.24	8804.62	131.23	17424.76
Median	0.25	2259831.76	5475.00	35.00	8336.60
Maximum	0.87	317706014.37	344261.00	21515.00	930831.00
Minimum	0.09	0.00	498.00	0.00	20.00
Std. Dev.	0.11	16440882.35	17543.65	809.75	35087.47
Skewness	1.39	9.65	11.17	18.84	8.86
Kurtosis	5.62	136.66	168.77	403.48	153.46
Observations	2274	6402	6402	3773	6023

	INVEST	POPULATION	PRIVFIRMPOP	SEZ	SOERATE
Mean	236.64	101746.56	8519.44	0.47	0.04
Median	89.95	76464.00	5257.00	0.00	0.04
Maximum	20536.70	1720398.00	339862.00	1.00	0.14
Minimum	2.90	20934.00	443.00	0.00	0.01
Std. Dev.	860.31	116492.29	17234.20	0.50	0.02
Skewness	15.41	8.26	11.26	0.12	1.14
Kurtosis	296.16	97.58	171.18	1.01	5.34
Observations	2654	6023	6402	6477	6402

	SUBSIDIES	SUBSPERCAP	WAGES	WORKING POPULATION
Mean	57722089.10	568.25	83.94	67982.89
Median	42323872.50	565.66	80.70	50152.00
Maximum	1328301842.00	1766.81	183.60	1162721.00
Minimum	403492.00	10.46	58.60	13149.00
Std. Dev.	67538785.44	278.01	12.49	79491.91
Skewness	7.13	0.28	2.54	8.11
Kurtosis	91.26	2.95	13.39	94.32
Observations	6402	6023	3791	6023

Source: own estimations

Table A2 – Descriptive statistics for the pooled data, nuts5 level

	DEPENDRATE	EDUCATION	EDUCPERCAP	EMISSIONS	EMPLOYMENT
Mean	0.35	7322433.72	456.61	71.19	2883.12
Median	0.34	3013159.00	469.49	0.00	631.00
Maximum	0.53	2259244559.03	3786.36	21955.00	829478.00
Minimum	0.20	0.00	0.00	0.00	0.00
Std. Dev.	0.04	36049838.66	403.84	471.29	17963.17
Skewness	0.43	29.69	0.43	19.00	28.70
Kurtosis	2.92	1375.63	2.63	550.91	1085.05
Observations	62005	62028	62005	36368	62028

	EMPRATE	EUSUBSIDIES	FIRMPOP	FORFIRMPOP	GREENINVEST
Mean	0.199578	1379462	1155.492	19.09073	2240.780
Median	0.152030	51188.78	367.0000	2.000000	259.0000
Maximum	9.386262	7.01E+08	344261.0	21515.00	930831.0
Minimum	0.000000	0.000000	0.000000	0.000000	0.000000
Std. Dev.	0.197427	9150624	6254.298	289.6951	12593.02
Skewness	15.83803	34.65197	29.78089	47.43619	24.12538
Kurtosis	580.9874	1967.421	1236.679	2712.672	1089.367
Observations	62005	22063	62028	62028	36509

	POPULATION	PRIVFIRMPOP	SEZ	SOERATE	SUBSIDIES
Mean	13285.74	1118.62	0.08	0.04	5994294.28
Median	6907.00	352.00	0.00	0.04	954488.00
Maximum	1714446.00	339862.00	1.00	0.33	1328301842.00
Minimum	0.00	0.00	0.00	0.00	0.00
Std. Dev.	43623.14	6136.16	0.27	0.03	23648122.19
Skewness	21.97	30.07	3.19	1.75	22.27
Kurtosis	684.05	1257.58	11.20	9.47	795.27
Observations	62028	62028	65093	61988	62028

	SUBSPERCAP	WORKING POPULATION
Mean	443.0578	8877.702
Median	403.4525	4446.000
Maximum	3341.043	1162721.
Minimum	0.000000	0.000000
Std. Dev.	419.8986	29647.13
Skewness	0.622328	21.51263
Kurtosis	2.548369	660.5023
Sum Sq. Dev.	1.09E+10	5.45E+13
Observations	62005	62028

Source: own estimations