The spatial impact of entrepreneurial zones: firm, city and inter-city evidence

Nebojša Stojčića, Korneliusz Pylakb and Dubravka Jurlina Alibegovićc

ABSTRACT
We investigate the impact of a decade-long, large public entrepreneurial infrastructure investment programme in an emerging European economy. Using a unique data set, we examine the short-run firm city and inter-city effects of entrepreneurial zones (EZs). EZs have a positive impact on business investment, sales and especially the export revenues of firms located within them. The positive economic effects of EZs are limited to host and neighbouring towns and cities, decrease with distance, and eventually become negative. This points to the localized nature of the effects of EZs and their potential for spatial redistribution and clustering of economic activity.

KEYWORDS
entrepreneurial zones; spillover effects; firm performance; exports; economic incentives; emerging economies

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INTRODUCTION
Throughout economic history, several schools of thought have attempted to explain how external factors influence firm competitiveness (Wurth et al., 2021), starting from work on industrial districts (Marshall, 1920) over regional clusters (Delgado et al., 2016) to regional innovation systems (Cooke et al., 1997). More recently, efforts to understand how attributes outside of firm boundaries contribute to its ability to compete have been concentrated from the entrepreneurial ecosystems (EE) perspective (Spigel, 2017; Audretsch & Belitski, 2017). From the perspective of EE, most entrepreneurial decisions and resource accumulation take place at the level of cities and towns (Spigel, 2017); and the competitive advantage of businesses is embedded in the local context of social, political, economic and cultural elements (Audretsch & Belitski, 2017).

From the EE perspective, shared cultural understandings, social networks and government policies provide fertile ground for the circulation of tacit knowledge, cooperation and learning (Spigel, 2017). These effects can be fostered by cultural and social infrastructures that are attractive to residents with high human capital (Audretsch & Belitski, 2017), incubators, science parks, co-working centres (Audretsch & Belitski, 2021), universities, locally materialized markets or physical locations (Spigel, 2017) such as those found in entrepreneurial zones (EZs). EZs belong to a group of EE material attributes (Wurth et al., 2021) that provide investors with amenities such as physical infrastructure, tax breaks, less bureaucracy and cheap labour. As such, they have the potential to improve economic performance and thus reduce the backwardness of less developed areas (Liu, 2002; Lu et al., 2019; Dawid et al., 2018; Möberg, 2015). These effects are not limited to firms within zones or to local units in which zones are located (Aggarwal, 2019; Sosnovskikh, 2017; Wang, 2013). Inter-firm linkages cause knowledge and technology spillover effects to neighbouring areas (Ciccone & Hall, 1996), therefore facilitating their convergence.

Due to their booming potential, EZs have been at the heart of entrepreneurial policy around the world and throughout human economic history, with the earliest instances recorded in ancient Greece (the island of Delos) and used as modern policy instruments since the establishment of export-processing zones in Ireland in the 1950s. However, many EZs fail due to poor policy
coordination (Alkon, 2018), weak incentives or insufficient linkages with the rest of the economy (Bartlett et al., 2019), which may indicate a poor fit between EZs and local EEs. This presents a particular problem in emerging economies, which cannot afford to experiment with the implementation of new policy instruments (Boarnt, 2001). At the same time, the nexus between EZs and EEs has not been explicitly addressed in the economic literature because of poor micro-level data availability (Ambroziak & Hartwell, 2018). Moreover, existing findings are largely inconsistent (Alkon, 2019; Billings, 2009; Neumark & Kolko, 2010; Jenkins & Arce, 2016; Cizkowicz et al., 2016), calling for a broader understanding of the impact of public investment in EZs on firm, city and inter-city economic performance in conjunction with the EE context.

Our study addresses these issues and extends previous work on the role of the local context in entrepreneurial growth (Audretsch & Belitski, 2017, 2021). We contribute to filling the research gap outlined in recent calls for more comprehensive, data-driven research on entrepreneurial activity to understand regional and local EEs and explore their context (Audretsch & Belitski, 2017, p. 2021; Fritsch et al., 2019), in particular, their individual and intrinsic features (Spigel, 2017). We investigate whether EZs effects are spatially bounded, as Audretsch and Belitski (2021) predict, or if they extend to a wider space. To this end, this study seeks to directly calculate the impact of EZs and to trace their effects several years after establishment at firm, city and inter-city levels with a rich and extensive data set covering firm and EZ populations. We evaluate the performance of firms located in EZs (treated firms) relative to that of firms outside EZs, but in the same towns or cities (non-treated firms) using treatment analysis techniques. We also use spatial econometric techniques to determine whether EZs have an impact on local economic performance and if they generate spatial spillovers to neighbouring cities and towns. In this way, we fill the lack of empirically demonstrated effects between the infrastructure of neighbouring EEs on their economic performance, recently identified by Wurth et al. (2021). To the best of our knowledge, such a comprehensive study has not been conducted before (for preliminary attempts, see Alibegovic et al., 2019).

The geographical focus of this study is Croatia, one of the emerging European economies. The emergence of EZs in Croatia dates to the 1980s, but reached its peak in 2004–13, with approximately €500 million invested in EZs during that decade. More than 23% of this amount was invested in the form of non-repayable central government incentives for EZs. By 2013, a total of 1308 EZs had been formally established, but less than one-third (451) were active. EZs were established by all towns and cities in Croatia, and in most cases one or two zones were established in every location (Alibegovic et al., 2019).

Our findings reveal that EZs contribute to increased sales and export revenues, with the role of zones in increasing export competitiveness being particularly evident. The positive performance effects of EZs are indeed spatially bounded as predicted by the EE literature (Audretsch & Belitski, 2021), but these effects are not limited to firms operating within the EZs or the local units in which the zones are located. Rather, inter-firm linkages generate spillover effects and thus have a positive impact on sales and job creation in neighbouring cities and towns. This indicates that EZs lead to the spatial clustering of economic activity. We also found that public investment in EZs facilitates city and inter-city performance effects, thus warranting support for entrepreneurial infrastructure policy incentives. Our results may be useful for potential investors, including foreign companies, policymakers and researchers investigating policy instruments to support the entrepreneurship-driven local economic development.

The remainder of this study is organized as follows. In the next section we provide a literature review of the firm, city and inter-city effects of EZs. The third section presents the context of the development of EZ in Croatia. The fourth section presents the empirical strategy. In the fifth section we report the empirical results. The last section concludes.

**CONCEPTUAL FRAMEWORK**

**EZs within an EE framework**

Stimulating local economic development is challenging. It requires place-sensitive strategies that support land and labour at low cost, investment in infrastructure, provision of well-trained human capital, industry–university linkages, and support for entrepreneurial culture, social networks, openness and risk-taking (Chepurenko et al., 2021; Fritsch & Storey, 2014; Fritsch & Wyrwich, 2017; Spigel, 2017). The relevance of the external environment for competitive ability, business performance and thus economic development has been known in the literature, at least since Marshall’s (1920) work on industrial districts and elaborated in the literature on competitiveness (Buckley et al., 1988), clusters and regional innovation systems (Asheim et al., 2011), and, more recently, the EE perspective (Acis et al., 2017; Audretsch & Belitski, 2017; Chepurenko et al., 2019; Fritsch & Storey, 2014; Spigel, 2017; Stam, 2015; Stam & van de Ven, 2021, 2021; Wurth et al., 2021). While all these lines of thought share common traits, in this study we rely on the EE perspective to explain the mechanism of the impact of EZs on firm and local economic performance. The central premise of this EE framework is that competitive advantage and business performance are embedded in the socio-economic and institutional contexts of cities (Audretsch & Belitski, 2017; Stam & van de Ven, 2021) or regions (Wurth et al., 2021), where most entrepreneurial decisions and resource accumulation take place (Spigel, 2017).

The EE framework identifies key factors such as local culture, networks, infrastructure and policies that drive local economic development through entrepreneurship (Audretsch & Belitski, 2021; Fritsch & Wyrwich, 2017). In recent years, research has attempted to unravel many of these factors, including their spatial boundaries, intrinsic attributes, configurations and enhancing policy...
instruments (Alkon, 2018; Wurth et al., 2021). However, these studies have focused more on the intangible elements of EE, such as culture or networks, rather than on physical infrastructure. This gap cannot be ignored, as physical infrastructure is a pillar for developing intangible proximities that improve organizational competitiveness and performance (Alder et al., 2016) and increase returns on local investments by enabling resource accumulation, savings and knowledge-sharing spillovers, interactions and opportunity recognition (Boschma, 2005; Spigel, 2017; Audretsch & Belitski, 2021).

Among the different types of physical infrastructure, entrepreneurial infrastructure such as EZs is of particular interest (Audretsch & Belitski, 2019). EZs refer to spatially limited areas equipped with different types of infrastructure, such as energy, utilities, transport and communication infrastructure. They can be general or targeted at specific sectors, such as manufacturing, services and logistics. The co-location of firms in such zones provides opportunities for knowledge-sharing and savings on infrastructure investment, allowing companies to invest in other segments of their activities. Additionally, these effects spill over beyond the boundaries of the zones as their tenants establish vertical up- and downstream linkages or interact horizontally with rivals in their cities or neighbouring areas (Alder et al., 2016).

The above reasoning lies at the heart of policy interest in EZs as one of the main and most effective EE features (Fritsch, 2013; Audretsch & Belitski, 2021). Strengthening entrepreneurship, promoting export competitiveness, attracting foreign investors and improving business productivity are among the common channels through which EZs reduce backwardness and raise living standards in the cities of their location (Alder et al., 2016; Ambrozia & Hartwell, 2018; Lu et al., 2019; Yeung et al., 2009). However, not all EZs successfully accomplish this task, and their effects are not fully understood or clear (Aldon, 2018; Moberg, 2015). Furthermore, it is not clear whether EZs affect the economic performance of neighbouring EEs (Wurth et al., 2021). In the following sections, we evoke the theoretical background of EZ effects at the firm, city and inter-city level, which our study seeks to reveal.

Firm-level effects of EZs
The performance and competitiveness of companies depend on three groups of factors: their own activities, industrial characteristics and external environmental attributes, with the latter two implying the need to integrate with the local economy (Lauridsen, 2004). Financial resources, capacity and competence-building, and the establishment of vertical and horizontal linkages with competitors, suppliers and customers for many firms present insurmountable barriers (Bartlett et al., 2019). EZs help overcome such barriers by providing administrative and professional support, creating links with vertically related business units, and sharing resources between firms (Frick & Rodriguez-Pose, 2021). In general, the impact of EZs can involve changes in economic structure, employment growth (Bartlett et al., 2019; Cizkowicz et al., 2016; Jensen, 2018), productivity (Ciccone & Hall, 1996; Lu et al., 2019) and innovation (Delgado et al., 2014), reducing economic backwardness and development disparities at regional and national levels (Rodriguez-Pose & Wilkie, 2019).

EZs facilitate vertical linkages and synergies in production and distribution chains (Bartlett et al., 2019). If EZs succeed in strengthening EEs, they can become a competitive advantage for firms (Delgado et al., 2016), facilitating the entry of new firms and attracting domestic and foreign firms from other locations (Devereux et al., 2007). Findings from numerous countries indicate a positive impact of EZ-related foreign investment on employment (Cizkowicz et al., 2016; Neumark & Kokalo, 2010), restructuring and export competitiveness (Bartlett et al., 2019; Yeung et al., 2009). Foreign ownership motivates domestic suppliers to improve their performance through technology transfer, training organizational and management support, and technical and financial assistance (Lee, 1999).

The benefits associated with locating in these zones are particularly important for manufacturing firms (Marshall, 1890). The proximity of firms within the same industry allows for the sharing of physical and technological infrastructure, the transfer of knowledge, the exchange of employees, the pooling of resources, and through these processes the increase in technological and cost competitiveness of firms (Alder et al., 2016; Delgado, 2020; Delgado et al., 2016; Henderson, 2003; Lu et al., 2019). Moreover, once manufacturing firms are located in an EZ, backward and forward linkages are created within and between sectors, relating to suppliers and partners in the former and customers in the latter (Amendolagine et al., 2013; Jenkins & Arce, 2016; Lauridsen, 2004; Ottaviano & Puga, 1998). However, in less developed regions, it can be difficult to create and strengthen such linkages because of a lack of appropriate workforce skills (Bartlett et al., 2019), adequate accessibility, high local prices, and poor institutional and government quality (Frick & Rodriguez-Pose, 2021; Aldon, 2018).

Zones also generate demand for labour, wage increases (Lu et al., 2019; Wang, 2013) and improved working conditions through competition between firms for the most skilled and talented workers (Cizkowicz et al., 2016) as a way to retain their human capital and encourage the transfer of knowledge and technology from their competitors (Glass & Saggi, 2002; Liu, 2008), albeit with some exceptions (Wang et al., 2010). Firms in zones are incentivised to attract the best employees by offering higher wages and better working conditions because of the advantages in location-related costs and benefits, including localized labour and technology, tax advantages, physical infrastructure, proximity to market and sources of materials (Alder et al., 2016; Lee, 1999), resulting in greater employment, increased output, higher capital investment and superior productivity (Lu et al., 2019). This allows us to formulate the first hypothesis as follows:
City and inter-city effects of investment in EZs

The linkages and synergies of EZs transcend zonal boundaries (Amendolagine et al., 2013) and may have positive (Ciżkowicz et al., 2016), negative (Alkon, 2018; Neumark & Kolko, 2010) or very limited (Lu et al., 2019) effects on the economic activity of host and non-host areas (Amendolagine et al., 2013; Jenkins & Arce, 2016). Positive effects of EZs have been reported within and between localities in terms of employment (Ciżkowicz et al., 2016; Neumark & Kolko, 2010), restructuring and export competitiveness (Bartlett et al., 2019; Yeung et al., 2009). These effects have the potential to promote convergence and economic development across space. From a policy perspective, they form the core of argument for local and regional authorities (Montinola et al., 1995) and central government (Ng & Tang, 2004) investment in EZ formation and development.

Firms operating within EZs provide vertical and horizontal spillovers of knowledge and technology to domestic suppliers, distributors and rivals in terms of technology transfer, training, organizational and management support, and technical and financial assistance (Lee, 1999), as well as imitation of and access to superior inputs. The proximity to sources of external knowledge helps neighbouring firms (including those outside of EZs) to reduce the cognitive, transactional, and organizational costs of searching for new knowledge (Audretsch & Belitski, 2020a). The ability to substitute knowledge-generating activities through knowledge spillovers reduces asymmetric information about new knowledge and increases market access for new technologies, thus making local firms more competitive. However, for this to happen, firms need to possess certain levels of internal absorptive capacity, skills, and knowledge about the methods and ways to evaluate, recognize and implement external knowledge (Audretsch & Belitski, 2020b).

The implications of the above knowledge spillover mechanism for local economic performance are multiple. On the one hand, the ability to spread knowledge and technology as well as competitively priced and quality intermediates (Jenkins & Arce, 2016) may facilitate the entry of new firms and attract firms from other locations (Devereux et al., 2007). The diversity and quality of inputs facilitate access to knowledge, skills and innovative business practices that would otherwise not be available (Delgado et al., 2014). The cost benefits of EZs put pressure on other firms to increase cost efficiency. This implies that by attracting firms with high knowledge spillover potential, EZs can reduce the constraints of domestic firms in generating knowledge and thus make the entire location more competitive. At the same time, weak domestic absorptive capacity may reduce the potential of knowledge spillovers and induce firms located within EZs to seek partners outside the local context, thus offsetting the potential positive spillover effects on the local economy. This allows us to develop our second hypothesis:

**Hypothesis 2: Investment in EZs positively impacts local economic performance in host cities.**

According to the concept of EEs, their effects may have spatial impact not only in cities (Audretsch & Belitski, 2017) but also entire regions (Wurth et al., 2021). This is particularly the case when local collaboration is limited by a low local knowledge base and absorptive capacity (Audretsch & Belitski, 2020b). Hence, it can be assumed that EZs can also affect the economic activity and performance of neighbouring towns and cities (Alibegovic et al., 2019; Delgado et al., 2014; Delgado & Zeuli, 2016; Frick et al., 2019; Jenkins & Arce, 2016).

The intercity effects of EZs can occur through several channels. The cost-efficiency pressure exerted by EZs on external firms can lead to the relocation of businesses from other areas and increase market entry rates in the localities surrounding EZs, negatively impacting the economic activity of other towns and cities (Billings, 2009; Neumark & Kolko, 2010; Wilder & Rubin, 1996). The flow of labour between firms, even outside the zones, generates externalities and improves the efficiency of resource allocation and the performance of firms in neighbouring cities (Ciżkowicz et al., 2016; Henderson, 2003) by reducing extensive learning costs (Liu, 2008). However, the attraction of the most skilled and talented workers towards zones may leave non-zone firms with an inferior workforce, which may be transmitted to other cities if they do not compensate for the growing gap between them and EZ firms (Frick & Rodríguez-Pose, 2019). Modern technological advances facilitate collaboration between firms and spillover effects over greater distances within a country (Frick & Rodríguez-Pose, 2021). It has been hypothesized in the literature whether these effects extend spatially and how wide their spatial extent is, but to the best of our knowledge no previous study has attempted to model spatial EZ effects as a specific component of EE. This allows us to formulate the final hypothesis:

**Hypothesis 3: Investment in EZs positively influences economic performance outside their host cities.**

**PUBLIC INVESTMENT IN ENTREPRENEURIAL ZONES IN CROATIA**

The analysis is set in Croatia, a small and open emerging European economy with a growing entrepreneurial environment. EZs in Croatia are part of entrepreneurial infrastructure, which also includes institutions supporting entrepreneurship such as local and regional development agencies, science and technology parks, business incubators, entrepreneurial centres, business parks, competence centres, and free zones. They provide amenities to entrepreneurs such as energy, utilities, transport and communication infrastructure. EZs are created for a specific type of activity and can be manufacturing, service and logistics zones. Their establishment serves the strategic aims of sustainable economic development, improved living
standards and economic convergence by strengthening entrepreneurship and general economic activity, increasing the share of manufacturing in the structure of the economy, and creating new jobs. Between 2004 and 2013, the Croatian government launched a large-scale project of land donations to cities and towns to establish EZs. Through these donations, 1308 EZs were established. However, in more than one-third of 556 Croatian towns and cities, the process was stopped soon after it started due to local bureaucratic barriers. Elsewhere, the central government approved land grants worth about 700 million Croatian kuna (approximately €92.4 million) for the activation of EZs, combined with over 3 billion kuna (approximately €396 million) of investment from local governments (regional and municipal). Less developed districts received more investment from both sources than their developed counterparts, suggesting that EZs are located in places that really need development (Pamic & Belullo, 2018). Figure 1 shows the volume of local (a) and central government (b) investment in established EZs in the Croatian NUTS-3 regions.

The process of public investment in EZs took place during one of the most severe economic crises in Croatian history, when many firms in Croatia and the rest of Central and Eastern Europe struggled with stringent bank lending policies that made it difficult for them to maintain liquidity, investment, and competitiveness. These challenges were also present in the post-crisis period (Vujanovic et al., 2021), suggesting that access to EZ amenities (i.e., lower costs of infrastructure development and grant opportunities to strengthen competitiveness and entrepreneurial competence) may have played an important role in the economic performance of EZ firms, towns and cities with which they were linked. Our data set allows us to trace the effects of these zones on firms located in them, their towns and cities, and neighbouring localities three years after the end of the programme and a time when the country was well on the way to economic recovery.

DATA AND EMPIRICAL STRATEGY

Data sets
Our empirical strategy is undertaken at the firm and city levels of aggregation. As such, it combines several data sources. In the first step, we obtained financial data on the population of firms from the Croatian Financial Agency (FINA), a public agency to which all companies must submit their annual financial reports. The second data source originated from the Croatian State Audit Office. In 2014, an audit of public investments in EZs between 2004 and 2013 took place. From the audit reports, we extracted data on the amount invested in EZs by central and regional (local) governments. Finally, we obtained access to the register of firms that operated in EZs in 2016, three years after the end of the programme from the Croatian Ministry of Economy, Entrepreneurship, and Crafts.

These three sources gave us access to data on approximately 74,000 companies (i.e., the population of active firms in Croatia in 2016) distributed across all 556 Croatian towns and cities, of which 1523 operated in one of the EZs. We constructed a unique firm-level data set that allowed us to assess the impact of location in EZs on the performance of firms located within their boundaries (measured by sales, exports, wages and business investment) on the performance of firms operating in the same cities and towns but located outside EZs to test Hypothesis 1. Firm-level data were then aggregated at the level of individual towns and cities to construct measures of local economic performance. The aggregated data set was used to test our other hypotheses, that is, to analyse the city (Hypothesis 2) and inter-city (Hypothesis 3) impact of public investment in the EZs on local economic performance, also defined as aggregate sales, exports, wages and business investment.

Empirical strategy for firm-level analysis
The impact of EZs on firms located within their boundaries was analysed using the nearest neighbour matching (NNM) procedure from the family of treatment estimators (Imbens & Wooldridge, 2009; Guerzoni & Raiteri, 2015). Treatment analyses evaluate the performance of a category of treated observations (in our case, firms located in EZs) relative to the performance of non-treated observations (in our case, firms outside the EZs but in the same towns or cities) by matching treated and non-treated firms based on characteristics that are as similar as possible. These techniques are widely used to analyse the impact of public policies or incentives (treatments) across a wide range of fields, such as entrepreneurship, exports and innovation (Stojicic et al., 2020).

Treatment estimators are also known as potential outcome models because each observation (individual, firm, etc.) in the model has a defined outcome for each treatment level. Taking \( y_1 \) as the potential outcome of an individual treatment recipient (e.g., a firm located in an EZ), \( y_0 \) would correspond to the outcome that would have been obtained if no treatment had been received (e.g., a firm outside an EZ). In practice, only one of the potential outcomes was observed, resulting in a missing variable bias. Treatments, such as location within EZs, are prone to non-random assignment bias in the treated category. As a quasi-experimental approach and a non-parametric method, the NNM procedure addresses this issue. It relies on the conditional independence assumption (CIA), which suggests that selection into the treatment is as good as random, subject to a set of observable covariates. For this reason, the control group must be formed from non-treatment units (e.g., firms not located in EZs) that share many characteristics with treated firms.

The NNM procedure progresses in two stages. In the first stage, the propensity scores of the probability of receiving treatment (located in the EZ) are estimated using probit or logit estimation. In the second stage, the propensity score distance between the treated and untreated groups is minimized by selecting one control observation for each treated unit. In the pairing procedure, we perform exact matching on the origin of firm
ownership (domestic or foreign) and on the type of local administrative unit (town or city); that is, we match treated firms to those with the same ownership type and those in the same towns or cities. The final result is calculated as the difference in the average potential outcomes between the two groups (treated and non-treated). This is known as the average treatment effect on the treated (ATT) and takes the following form:

$$ATT_{nnm} = \frac{1}{N} \sum_{i=1}^{N} (Y_i(1) - Y_i(0))$$

where $Y_i(1)$ and $Y_i(0)$ are the average potential outcomes of the treated and non-treated groups of unit $i$, and $N$ is the number of all units (firms) $i$.

In our analysis, we include a categorical variable for foreign ownership among control variables, as it is often associated with superior skills, knowledge and technology in emerging European economies such as Croatia (Stojcic & Orlic, 2020). Firm size is measured by the natural logarithm of the number of employees and its squared term. The model also includes the natural logarithm of the amount of public production subsidies received by individual firms. The natural logarithms of the share of enterprises in the city divided by the number of enterprises in the country and the share of enterprises in the industry in the total number of enterprises in the city control for urbanization and localization externalities, respectively. The net entry of firms controls for market dynamics. Finally, we control for the distance of the local administrative unit from the regional (county) centre and the type of local administrative unit as a town or city. Table 1 provides the definitions of the variables, while for their descriptive statistics, see Table A1 in the supplemental data online.

**Empirical strategy for city and inter-city analysis**

Our analysis also investigates whether public investment in EZs had any positive impact on the local economic performance of towns and cities in which these zones were located, and if these investments created spatial spillover effects on the economic performance of other towns and cities. As explained previously, data on the level of public investment in EZs from both central and regional (local) governments were taken from the audit reports of the public investment programme in EZs between 2004 and 2013. These data refer to the total amount of public investment made for this purpose to individual towns or cities. Data from the FINA data set were aggregated at the level of all 556 Croatian towns and cities to construct measures of local economic performance three years after the programme ended (in 2016).

The nature of our objectives in this part of the analysis makes spatial econometric methods a logical candidate for an estimation technique. Since we are only able to measure performance in one year (2016), we have used a spatial autoregressive cross-sectional technique in which the local economic performance (sales, exports, wages and private business investment) of towns and cities is modelled as a function of the same performance achieved in other towns and cities in the same year, the level of central and regional (local) government public investment in EZs achieved over the duration of public investment programme in EZs (2004–13), and a set of control variables.

Among the control variables, we include the unit labour costs, the share of labour costs in sales revenue of a town or a city to control for its cost competitiveness, the net entry of firms in a town or a city to measure business dynamism, the distance of a town or city from the county administrative centre, and the population density of a town or city as a proxy for demand and workforce availability. The model also incorporates the share of
Table 1. Description of variables used in the analysis at firm level.

| Variable          | Definition                                                                 |
|-------------------|-----------------------------------------------------------------------------|
| **Dependent variables** | Sales (ln) Sales revenues of an enterprise in 2016                          |
|                   | Exports (ln) Export revenues of an enterprise in 2016                       |
|                   | Average wages (ln) Average wage paid by an enterprise in 2016               |
|                   | Investment (ln) Amount of enterprise investments in 2016                    |
| **Treatment variable** | Zone Categorical = 1 if an enterprise is located in an enterprise zone     |
| **Control (matching) variables** | Foreign Categorical = 1 if an enterprise is majority foreign owned |
|                   | Size (ln) Number of employees of an enterprise                               |
|                   | Size2 (ln) Number of employees of an enterprise squared                      |
|                   | Subsidies (ln) Share of public production subsidies in the total revenues of an enterprise |
|                   | Urbanization (ln) Share of enterprises in the city (town) in the number of enterprises in the country |
|                   | Localization (ln) Share of enterprises in the industry in the number of enterprises in the city |
|                   | Net entry Entry minus exits of enterprises from a city (town) with a lag of one period |
|                   | Distance (ln) Distance of a city (town) from the county (regional) administrative centre (km) |
|                   | Type of locality Categorical = 1 if the local administrative unit is a city (town) (reference category) |

Source: Authors.

public production subsidies in the revenue of enterprises based in a town or city, the Ellison–Glaeser specialization index, and the share of imports in the total revenue of local businesses. Finally, dummy variables were included for each county. The specification used to examine the impact of public investment in EZs on the local economic performance of city \(i\) is defined as:

\[
\ln \text{Performance}_i = c_0 + \rho \sum_{j=1, j \neq i}^{n} w_{ij} \ln \text{Performance}_j + \beta_1 \text{Govin}_i + \beta_2 \text{Regin}_i + \gamma_3 \text{Ulc}_i + \gamma_4 \text{Entry}_i + \gamma_5 \text{Distance}_i + \gamma_6 \text{Density}_i + \gamma_7 \text{Subsidies}_i + \gamma_8 \text{Specialization}_i + \gamma_9 \text{Imports}_i + \sum_{k=1}^{21} \text{County}_k + u_i
\]

where the dependent variables are defined as natural logarithms of local economic performance: sales, exports, wages and private business investment. The term:

\[
\sum_{j=1, j \neq i}^{n} w_{ij} \ln \text{Performance}_j
\]

refers to the interaction effect between the dependent variable of a town or a city \(i\) and all other cities \(j\), \(j \in 1, \ldots, i - 1, i + 1, \ldots, 556\). The \(ij\)-th component of the non-negative spatial weights matrix \(W_{556 \times 556}\) in equation (2) is \(w_{ij}\), while the spatial autoregressive coefficient (\(\rho\)) measures the impact of changes in the local economic performance of other cities \(j\) in city \(i\) (and vice versa). Since our model takes a semi-logarithmic (log-linear) form, the coefficients \(\beta\) are city-level semi-elasticities of public investment in EZs, while \(\gamma\) refers to the semi-elasticities of the control variables.

By including the spatial lag of the dependent variable, we expect that the effects of EZs on other cities are realized through linkages between the home business sector and businesses in other areas. The spatial distance between towns and cities is modelled using three distinctive spatial weight matrices. In the baseline specification, spatial correlation is restricted to neighbouring towns and cities using the contiguity spatial weights matrix. We then allow an extended spatial correlation using a contiguity spatial weights matrix, including first- and second-order adjacent spatial units (neighbours and neighbours of neighbours). Finally, we allow for full spatial correlation across the entire population of towns and cities using the inverse distance spatial weights matrix. This allows us to assess the extent to which the effects of EZs are spatially bounded. In line with common practice, the elements of all spatial weight matrices are standardized.

As noted by LeSage and Pace (2009), spatial models cannot be interpreted based on parameter estimates because changes in the performance of one spatial unit create so-called feedback loops, a partial feedback effect that passes through another spatial unit and returns to the original one. For this reason, it was necessary to take an additional step and calculate direct (within-city) and indirect (inter- or between-city) effects before interpreting the results. For this reason, our findings can be interpreted in terms of direct and indirect effects. Table 2 provides the variable description used to estimate city and inter-city effects, while Table A2 in the supplemental data online provides their descriptive statistics.

**ANALYSIS**

The analysis was conducted in several steps as previously described. We first examine whether location within an EZ induces additionality effects on sales, exports, wages and private investment of firms located within its boundaries. We then examine whether public investment in EZs induces positive intra- and inter-city effects on the same economic outcomes aggregated at the town or city level.
Table 2. Description of the variables used in the analysis of city and inter-city effects.

| Variable                | Definition                                                                 |
|-------------------------|-----------------------------------------------------------------------------|
| **Dependent variables (performance)** |                                                                           |
| Sales (ln)              | Sales revenue in 2016 of companies in a town or a city                      |
| Exports (ln)            | Export revenue in 2016 of companies in a town or a city                     |
| Average wages (ln)      | Average wage paid in 2016 by companies in a town or a city                  |
| Employment (ln)         | Number of employees in 2016 in companies in a town or a city                |
| **Investment in enterprise zones (EZs)** |                                                                                   |
| Govinv                  | Value of investment in EZs by central government in 2004–13 (land donation) |
| Reginv                  | Value of investment in EZs by local (cities or counties) governments in 2004–13 |
| **Control variables**   |                                                                                   |
| ULC (ln)                | Share of labour costs in sales revenue in 2016                               |
| Entry                   | Entry minus exits of enterprises from a town or a city in t – 1              |
| Distance (ln)           | Distance of a town or a city from the county (regional) administrative centre (km) |
| Density (ln)            | Population density of a town or a city                                        |
| Subsidies (ln)          | Share of public production subsidies in total enterprise revenues           |
| Specialization          | Ellison–Glaeser index of specialization (geographical concentration)         |
| Imports                 | Share of imports in total revenues of local enterprises                      |
| County dummies          | Categorical = 1 for each county                                              |

Source: Authors.

The strong effects of EZs on exports could be related to our findings (see Table A3 in the supplemental data online) that foreign-owned firms have higher chances of being in EZs. One of the motives for the location of foreign firms in emerging European economies such as Croatia is the exploitation of cost advantages, such as those found in EZs. This result is consistent with the arguments of the EE literature on the benefits of EZs. This results in domestic activities being confined to low-value-added standardized segments of the value chain (Stojcic et al., 2021) and presents potential for the creation of backward linkages with local EEs, as noted by Liu (2008).

Table 3. Impact of enterprise zones (EZs) on companies operating within them.

| Performance measure         | EZ effect     |
|-----------------------------|---------------|
| Sales revenues (ln)         | 0.109 (0.021)*** |
| Export revenues (ln)        | 1.123 (0.246)*** |
| Average wage (ln)           | 0.009 (0.015)  |
| Business investment (ln)    | 0.038 (0.012)*** |

Note: ***, ** and *Significance at the 1%, 5%, and 10% levels, respectively. Standard errors are shown in parentheses. Nearest-neighbour matching estimates.

Source: Authors’ calculations.

City and inter-city effects of EZs

One of the theoretical justifications for the existence of EZs is to have positive spillover effects on other firms in their area and to neighbouring towns and cities. The EZ infrastructure in Croatia was financed from two public sources between 2004 and 2013, namely, land donations from the central government and financial investments from county and city governments. From a policy perspective, it is important to assess whether one or both channels improve the economic performance of businesses in cities and their adjacent areas.

Table 4 presents the results of the main variables of interest: those referring to central and local government investments in EZs. In each model, the local (direct) effects refer to the cities and towns where the EZs are located and the spatial (indirect) effects refer to the effects on neighbouring areas. Table 4 shows that investment in EZs has positive effects on sales and export revenues, wage levels, and business investment, and that these effects are mainly driven by central government investment. The size and significance of local (direct) effects are relatively stable and somewhat stronger in the case of sales, private business investment and exports than in the case of wages. The inter-city (spatial) effects of EZ investments are found in terms of sales and business investment. These effects are positive on adjacent areas but turn negative once a full spatial correlation is allowed.

This part of the study clearly indicates that most of the effects fall in the cities where the investments are made, while the spatial effects are limited to neighbouring areas and decrease with distance from EZs. This finding has several important implications. First, it appears that investments in EZs lead to redistributive effects and spatial concentration of economic activity. Second, our

Effects of EZs at the firm level

Using the NNM procedure, we evaluated the performance of firms located within EZs compared with their counterparts operating in the same cities but outside the EZs’ boundaries. The results of the analysis (Table 3) reveal that location in EZs established in the period 2004–13 affects three out of four analysed dimensions of firm performance. Firms located in EZs have higher sales revenues, invest more than those located outside the zones and generate more than twice as much export revenue as similar firms located outside EZs due to locational advantages. This is consistent with the arguments of the EE literature on the beneficial effects of physical infrastructure and provides partial support for our first hypothesis (Boschma, 2005; Spigel, 2017; Audretsch & Belitski, 2021).
findings confirm the arguments in the EE literature about the spatially bounded effects of these systems or their individual features. Third, our findings point to spillover effects between neighbouring EE infrastructures on economic performance. Fourth, our findings point to one bottleneck in local EEs which is related to local public investment, as central government investments seem to be the main driver of positive city and inter-city effects. This is even more surprising if one knows about the high population of EZs to the economic performance of businesses and high human capital. Somewhat surprisingly, the contribution of EZs to the economic performance of businesses and EZs has not been discussed in the EE literature. This is even more surprising if one knows about the high popularity of this instrument among policymakers interested in local entrepreneurship-driven economic development.

The aim of our study was to investigate the firm, city and inter-city effects of EZs. In doing so, we contributed to filling three recently identified research gaps: the need for entrepreneurial activity research to focus more on the local context matters for entrepreneurial activity research to focus more on the local context (Audretsch & Belitski, 2017), the lack of support for Hypotheses 2 and 3, but our findings suggest that local EEs also require support from higher levels of government to achieve the desired outcomes.

**DISCUSSION AND CONCLUSIONS**

Both the entrepreneurship and economic geography literature agree on the importance of local context matters for firms’ ability to compete (Audretsch & Belitski, 2021). At both the theoretical and empirical levels, efforts have been made to determine which features of the local environment may facilitate and constrain the performance of local businesses and localities as a whole. This search includes cultural and social factors (Spigel, 2017), physical infrastructure (Audretsch & Belitski, 2017) and, more recently, inter-ecosystem linkages (Wurth et al., 2021). While most studies share the notion that the availability of physical infrastructure matters for the competitiveness of firms (Adler et al., 2016), the emphasis in past studies has been on infrastructure such as incubators, universities or physical infrastructure attractive to populations with high human capital. Somewhat surprisingly, the contribution of EZs to the economic performance of businesses and EZs has not been discussed in the EE literature. This is even more surprising if one knows about the high popularity of this instrument among policymakers interested in local entrepreneurship-driven economic development.

**Table 4. City and inter-city effects of public investment in enterprise zones (EZs).**

| Outcome/effect | First neighbours | First and second neighbours | Full spatial correlation |
|---------------|-----------------|-----------------------------|-------------------------|
|               | Local (direct)  | Spatial (indirect)          | Local (direct)          | Spatial (indirect) |
| Sales (ln)    |                 |                             |                         |
| Central government investment | 0.01*** | 0.001***                    | 0.02***                 | 0.0003**           | 0.02*** | −0.002*** |
|               | (0.002)         | (0.0001)                    | (0.002)                 | (0.0001)           | (0.002) | (0.0005)  |
| Local government investment | 0.001** | 0.00004**                   | 0.001**                 | 0.00002*           | 0.002*** | −0.0002*** |
|               | (0.0005)        | (0.00002)                   | (0.0005)                | (0.00001)          | (0.0005) | (0.0001)  |
| Export (ln)   |                 |                             |                         |
| Central government investment | 0.07*** | 0.01                         | 0.07***                 | 0.007              | 0.07*** | −0.02      |
|               | (0.014)         | (0.008)                     | (0.014)                 | (0.007)            | (0.014) | (0.013)   |
| Local government investment | 0.003 | 0.001                         | 0.004                  | 0.0004             | 0.005    | −0.001     |
|               | (0.003)         | (0.001)                     | (0.003)                 | (0.0005)           | (0.003) | (0.001)   |
| Wages (ln)    |                 |                             |                         |
| Central government investment | 0.001** | −0.000001                    | 0.001**                 | −0.000001          | 0.001*   | −0.00003   |
|               | (0.0004)        | (0.000002)                  | (0.0004)                | (0.00000)          | (0.0004) | (0.00002)  |
| Local government investment | 0.0002* | −0.0000002                   | 0.0002*                 | −0.000000          | 0.0002*  | −0.000001  |
|               | (0.0001)        | (0.000000)                  | (0.0001)                | (0.00000)          | (0.0001) | (0.00000)  |
| Business investment (ln) |       |                             |                         |
| Central government investment | 0.02*** | 0.001**                      | 0.02***                 | 0.001              | 0.02*** | −0.005***  |
|               | (0.005)         | (0.0005)                    | (0.005)                 | (0.004)            | (0.005) | (0.001)   |
| Local government investment | 0.0004 | 0.00002                      | 0.001                  | 0.0002             | 0.001    | −0.0002    |
|               | (0.001)         | (0.0001)                    | (0.001)                 | (0.0003)           | (0.001) | (0.0002)  |
| Observations  | 556            | 556                         | 556                    |

Note: ***, ** and *Significance at the 1%, 5%, and 10% levels, respectively. Detailed printouts are available in Tables A6–A8 in the supplemental data online.

Source: Authors’ calculations.
(Wurth et al., 2021) and the need for a more comprehensive data-driven approach to understanding regional and local EE (Fritsch et al., 2019; Audretsch & Belitski, 2021). Overall, at the local level, our results strengthen the findings of other studies that EZs support their firms in increasing sales revenue (Lu et al., 2019; Neumark & Kolko, 2010) and private business investment in capital assets (Ciżkowicz et al., 2016; Lu et al., 2019). EZs are particularly important for export competitiveness (Bartlett et al., 2019; Yeung et al., 2009), suggesting that EZs help firms overcome the rather high sunk costs of exporting, such as the acquisition of knowledge, technology, skills and fixed assets (Liu, 2008; Wang et al., 2010), as well as integration into global value chains (Schindler & Kanai, 2021). This would be an insurmountable barrier for many companies, especially small and medium enterprises, which can be overcome by networking with companies in the industry or related industries and with the EZ management department to acquire knowledge and share tangible and intangible resources (Jenkins & Arce, 2016; Lauridsen, 2004).

The greatest benefits achieved closer to the EZ confirm the spatially bounded nature of EE (Audretsch & Belitski, 2021) and testify to the existence of local knowledge and technology diffusion mechanisms between firms in the immediate environment. However, these effects are not limited to firms operating in zones or local communities. Firm-to-firm interactions generate spillover effects on the performance of neighbouring cities, which contradicts the results of Bartlett et al. (2019) and Lu et al. (2019), but suggest the existence of performance effects between EE suggested by Wurth et al. (2021) and empirically confirmed by Liu (2008) for foreign firms and their backward linkages. However, these spillover effects diminish and eventually disappear or even become negative with distance. These findings are consistent with the smaller impact of Polish EZs on neighbouring counties, as reported by Ciżkowicz et al. (2016).

Exports appear to be the main mechanism driving all the zonal effects. The impact on export revenues is strictly localized and several times higher than the impact on other indicators. This suggests that zones bring benefits to exporters, such as benefit transfer to related firms and integration into value chains (Amendolagine et al., 2013; Schindler & Kanai, 2021). Future business-related infrastructure interventions should therefore be designed to emphasize the attractiveness of the export economy rather than focusing on particular sectors. These localized export economies, along with the beneficial spillover effects of increased sales revenues, can therefore be seen as an intermediate product of the integration of local firms with both local suppliers and partners and global customer value chains (Jenkins & Arce, 2016).

Together with all previous evidence, this suggests that investments in EZs have the strongest impact on exporters, which points to a natural reprogramming of those zones into export processing zones (EPZs) that are more globally successful than regular EZs. However, this should be done with caution, as our conclusion contradicts the findings of Ciżkowicz et al. (2016), who did not identify any spatial effects of Polish EZs on investment outside the zones, either in the host county or in neighbouring counties. Although they do not offer an empirical explanation, they suggest that foreign firms located mainly in EZs may be too advanced to cooperate or compete with local firms and only induce a low-skilled service sector demand for labour. The same applies to Chinese EZs, which do not show a spatial effect either, pointing to zone alienation and attracting much larger firms than areas outside the EZ as possible reasons (Lu et al., 2019). Another explanation states that when a multinational firm establishes an exclusive supplier in a local area, this contributes to a decrease in backward linkages and local welfare, or when resources, materials and intermediate goods are imported from the EZ to the firm (Bartlett et al., 2019).

The results of the study show the positive impact of EZs on local economic performance and reveal the mechanism behind this process. Zones improve the performance of firms within their boundaries and the local economy as a whole. We confirmed Glass and Saggi’s (2002) theoretical model that an increasing number of economic agents in EZs increases labour demand, which induces competition for the best workers by offering better employment conditions, both to gain access to local knowledge and to prevent its outflow. Our analyses confirmed that EZs induce wage increases at the local level (Wang, 2013) and provide a basis for improving the performance and competitiveness of economic agents thereafter (Liu, 2008), contrary to the findings of Lynch and Zax (2011).

The results obtained are consistent with the existing literature, but reveal more detailed spatial mechanisms of EZ establishment and functioning. EZs, understood as investments in entrepreneurial infrastructure, aim to balance economic development across the country and across regions (Ambrozik & Hartwell, 2018). Successful EZs are expected to accelerate local economic activity by supporting entrepreneurship, attracting domestic and foreign investors (Alibegovic et al., 2019; Delgado & Zeuli, 2016; Wang, 2013), introducing new technologies, and creating market opportunities within and outside the country (Amendolagine et al., 2013; Wang et al., 2010). Evidence from other countries, such as Taiwan, Korea, and India (Aggarwal, 2012) provide support for public investment in EZs. In Poland, proximity within zones has been found to facilitate the success of firms within their boundaries (Ciżkowicz et al., 2016). Zones have also been found to increase demand for services in adequately populated areas (Frick & Rodríguez-Pose, 2021).

We conducted the analysis over a three-year time horizon following the completion of the EZ investment programme. It is therefore difficult to discuss the long-term effects of these measures, which is a limitation of this study. However, some evidence suggests that locally targeted incentives do not induce economic growth in the medium to long run (five years) because of frequent firm closures and the lack of exact matches with the local labour...
market and available services, resulting in a lack of self-sustaining economic returns (Givord et al., 2018). Similarly, O’Keefe (2004) highlights employment effects, pointing out that they do not last longer than six years and even become negative after this time. By analysing the time horizon of our research, we may conclude that, on the one hand, the implementation of zones in Croatia has shown promising short-term effects as a first step towards sustainable development, but on the other hand, it needs to be investigated from a longer perspective in the future.

Finally, every study has its limitations. Research on the effects of instruments such as EZs is rare and valuable because of the lack of data to support such analyses. Our study adds to the existing body of knowledge while being conducted in the context of a developing European economy. Moreover, within the current framework, we could not measure the long-term effects of the EZ. Future research should confirm the robustness of our results by investigating whether they hold true in other contexts and over different time periods. There are other effects of EZs that may be equally important, such as those on business innovation, which were not explored in our study. These issues remain a challenge for future research.

Future incentives for EZs development should also include measures applied in some local units to attract entrepreneurs and fill the zones, such as removing financial barriers, supporting cooperation networks, and mediating the removal of administrative barriers for entrepreneurs. These mechanisms are particularly important for zones planned for creation in remote and underdeveloped areas with low economic activity, as achieving a critical mass of entrepreneurs for sustainable zone development may prove particularly difficult in such areas.

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NOTE

1. Before interpreting the results, all model diagnostics were evaluated (see Tables A4–A5 and Figure A1 in the supplemental data online), which fully support the validity of our model. For expository convenience, we report only the results of the treatment analysis. For the results of the first stage (determinants of the probability of location in EZ), see Table A3 online.

ORCID

Nebojša Stojčić @ http://orcid.org/0000-0001-6638-8771
Korneliusz Pylak @ http://orcid.org/0000-0001-7812-1281
Dubrevačka Jurlina Alibegović @ http://orcid.org/0000-0002-0424-7583

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