

Model for Industrial Business Relocation in Eastern Europe

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Abstract. Relocation of production is an operation by which a company transfers part or all of its production capacity from one country to another or from one city to another. It is a current problem for industrial and other business, a visible consequence of the globalization of the world economy. Moving the company is an activity that involves a high consumption of resources over a long period of time so it must be treated with great responsibility. Being a long-term decision, it must be supported by research to determine all the factors involved and the effect they, individually or in groups, have on relocation. The article aims to identify, group and eliminate overlaps between the criteria considered in the literature. The paper presents a different approach compared to other research. The factors that determine the relocation based on a large number of researches have been identified. Subsequently, the factors were synthesized into 8 groups. For each group the most important measurement indicator was selected taking into account a large number of variants. 12 Eastern European countries were selected for which data were accessed on the 8 criteria used from international databases. Statistical data processing led to a multiple regression equation that allows the determination of the score obtained by each state analysed. The scores thus obtained were statistically processed and a cubic equation was established. Such relationships allow the identification of solutions that states must undertake to attract investors. The results can be used by companies, regardless of their size, as a large number of scientifically proven factors have been taken into account.

1 Introduction

Business relocation is one of the topics of interest in the countries of the world due to the spread of this phenomenon. Due to the large resources involved, relocation appears as a decision-making complex based on a number of economic, social, political and environmental factors. Relocation can be described as a strategy to move to a new location inside or outside the national gangs. The action involves a high risk due to various aspects that must be taken into account: costs, resources, labour, market legislation, natural

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environment, research and development potential, fiscal incentives granted by the authorities, infrastructure and others. The large number of variables and their dynamic and inhomogeneous characteristic make relocation a difficult decision-making act. One way to increase a company's efficiency is to use a relocation strategy. In order to remain competitive, companies organize their production globally. Thus, the value chain is divided into smaller components, the object of activity of a large number of suppliers, located in different parts of the globe, this being a key feature of European business.

The research involved the following steps:

- based on the specialized literature, a theoretical framework of the subject has been developed, which captures the dimensions of relocation and the generating causes;
- identification of the criteria considered for substantiating the relocation decision in the specialized literature;
- grouping criteria previously identified;
- for each criterion three measurement indicators are established;
- an indicator is chosen from the three previously selected;
- collection of data on Eastern European countries for each indicator;
- statistical data processing and interpretation of results.

Unlike other articles had the same object and aimed to determine the influence of a factor or a small set of factors influencing the decision to relocate research aims to measure the relative importance of a range of factors. Most research focuses on grouping the factors that determine the relocation decision. Such an approach is justified for several reasons: some criteria are qualitative others quantitative, the large number of criteria complicates mathematical modelling, lack of data for some criteria, the subjective nature of qualitative criteria and others.

It is difficult for a medium or small company to pay for the services of a consulting firm to substantiate the relocation decision. As a result, it will treat the problem as an internal decision, which it will try to solve with the help of its own employees, taking into account several decision-makers. The model designed by the authors will support them. The research aimed at substantiating the decision on the choice of location in case of relocation of production, based on existing criteria in the literature. The decision involves finding a solution or a set of solutions that offer the best relocation option in the Eastern European states considered in the research.

2 Research organization

Assessing a possible relocation of production is an option to maintain companies' competitiveness. Placing a business outside or inside borders is a strategic decision. For the change of production or global distribution there are two notions in the literature "off shoring" expression that involves the relocation of businesses outside national borders and "backshoring" term which means the return of the company to the country of origin. The terms imply the shift of domestic production to producers abroad or vice versa:

- Domestic Sourcing (Outsourcing) means that production takes place outside the company or group on non-affiliated companies, but in the country of origin;
- International Sourcing (Outsourcing) involves the production taking place outside the company or group and outside the country of origin by non-affiliated companies.
- Domestic Sourcing (Insourcing) means that production takes place within the group of companies to which the company belongs and in the country of origin.
- International Sourcing (Insourcing) means that the production takes place in the group to which the company belongs, but abroad (by affiliated companies).

Decisions are taken by the resident producer and relate to the reduction or closure of domestic production of goods or services. Business relocation is not a recent phenomenon,

and globalization has led to the intensification of the phenomenon on all continents in recent decades. Relocating a business is not an isolated issue, affecting a continent or a geographical region. It is also not a temporary problem that involves an intensification of the phenomenon in a short period of time. There are no certain activities or economic branches to be relocated. There is a diversity of activities from manufacturing to trade and services. Such a dynamic global evolution has determined the concern of researchers.

In the specialized works there are factors that favour the relocation, while other factors determine the companies not to undertake such a risky approach. In the present paper, only the factors that favour relocation were taken into account. Among the forms of relocation, the research carried out refers to international relocation (International Sourcing). The legal form under which the production moves (branches, subsidiaries, etc.) is not the subject of the paper.

The relocation of Western European businesses to the eastern states of the continent was caught by researchers. Thus, Conroy et al. (2016) followed the scope and characteristics of commercial service relocation in Central and Eastern European countries (CEEC) in the period 2000-2013 using data provided by Eurostat [1]. The article confirms that CEECs have been an area for relocating various businesses since the 2000s. Although there is an intensification of the phenomenon in Western Europe, there are few studies that develop this topic. An example of this is Kapitsinis' comparative analysis in 2019. The author studied the pre and post crisis movements of Greek small and medium-sized enterprises (SMEs) from Greece to Bulgaria [2]. The research looked at size, sector and incentives as factors for relocation and the effects of such a move on business performance. Under these conditions, the task falls on each company or consulting company that provides such services.

The causes that lead to business relocation are diverse. Next, the causes considered by authors worldwide will be extracted, not only in Europe. Most studies have demonstrated the importance of site location for company return [3]. Other authors such as Eslamipoor & Sepehriar (2014) have the opposite opinion, considering that environmental problems lead to the relocation of companies [4]. The claim is confirmed by other studies such as research initiated by Linnenluecke et al. (2011) who argue that climate change will lead to significant disruptions in the activity of companies and as a result they will have to change the location of activities. According to the authors, such a need would be determined by the impact of climate change (droughts, floods, sea level rise) on firms and disruptions to suppliers or buyers [5].

Baldwin & Okubo (2011) show that when companies are allowed to change location, new effects appear on productivity [6]. Elgar et al. demonstrated the effects of local fiscal policy on decisions to locate 3,763 units that began operations in Maine (USA) between 1993 and 1995 [7]. The study shows that a local tax policy to reduce costs can attract fewer new businesses, compared to a policy with additional costs and higher local taxes. Empirical results are determined by Poisson models and negative binomial regression. Reasons for relocation, according to research by Chan et al. (2009) are classified into four categories: reduced costs or operational efficiency (1), capacity reduction (2), finalities, consolidation and change of management (3), labour disputes and facilities (4) [8]. Ghosh et al. provides empirical evidence generated by the relocation effects on the stock exchange rate of the respective companies. The authors show that the evolution of the market price is significantly positive when relocation decisions are justified by cost reductions, and decisions determined by the self-interest of the manager cause an adverse reaction from investors [9]. Portnov & Schwartz (2008) demonstrate that the choice of location depends on the regional or national context [10]. Thus, cold and rainy areas are less attractive compared to countries or regions that offer better alternatives to investors. The advantage of location is a relative notion in the opinion of the authors, which demonstrates that the

regional and national level is more important than the international one. The model was tested empirically based on data of population growth in urban settlements located in 40 European countries. Risselada et al. (2013) demonstrate that real estate factors (age ownership and size) are not taken into account in research on company relocation decisions [11]. The model proposed by the authors evaluates the role of real estate determinants and proposes a differentiation between companies located in residential and commercial properties. Johansson & Olhager (2018) took into account several factors that they later grouped into three categories (major localization strategies): access to development skills, proximity to the market and access to low-cost production [12].

Arauzo- Carod et al. (2010) identified a large number of factors, delineated in neoclassical and institutional, and emphasize increasing the quality of data in the relocation decision [13]. Balbontin & Hensher (2019) show that land use modeling and residential location in transport systems are not taken into account when locating or moving businesses [14]. Bodenmann & Axhausen (2012) propose several variables: production factors, economic environment, significance of municipal interventions. In addition, the authors took into account the influence of other secondary variables such as: local taxes, government compatibility with business and accessibility, and the nested logit model (NL) was tested on different business sectors [15]. Sleuwaegen & Pennings (2006) based on a sample of firms that moved to Belgium found that market potential of the host regions and the salaries are determining factors in choosing the location [16]. Given the characteristics of firms, the authors showed that major firms have a greater tendency to move to distant lands.

Public aid in various forms has been considered in the research of specialists. Such a factor plays an important role in substantiating the relocation decision in adjacent countries, but at the same time it can play a detrimental role in distorting competition. Brouwer et al. (2004) analysed the determinants of permanent relocations in 21 countries over a period between 1997 and 1999 [17]. Thus, the authors showed that internal development factors cause firm relocations, and companies with a larger market move more often. The authors also demonstrate that relocations occur as a result of acquisition, merger and takeover operations. Pellenbarg et al. (2002) treat firm relocation as a particular form of localization. Such a shape allows the company to adjust and becomes one of the ways in which the company adapts to changes in markets, environmental regulations, consumer preferences and technological progress. The authors present an empirical study that addresses the relocation of relevant firms through a statistical model conducted on firms in the Netherlands [18]. Kimelberg & Williams (2013) conducted a study that groups 39 location factors in site selection and demonstrates that in addition to established factors there are other important factors such as: crime rate, facilities, housing and schools [19].

Vereecke & Van Dierdonck (2002) examine with the help of a model Ferdow's localization factors, which they delimit into stable (market proximity), less stable (work and skills) and extremely unstable (socio-political factors) [20]. According to the authors, the tax cuts or financial incentives granted at the time of purchase are temporary, influencing only the initial decision, without providing a lasting advantage. A confirmation of such results also appears in the work of Jensen (2017) having as central element the influence of financial incentives on the expansion and relocation of the business in the state of Kansas (USA) [21]. The article examines the ability of such financial incentives to determine employment. The results show that incentive programs do not have a visible impact on the expansion of companies, in terms of job creation. Ancarani et al. (2015) conducted a research based on 249 experiences in relocation. The factors taken into account by the authors were: industry, country of origin, host country and size organization [22]. Albertoni et al. (2017) performed an analysis using data from 1526 statistically processed observations. The final results show that some factors (labour cost, market entry) are

statistically significant, while others have a small impact on the relocation decision (availability of qualified people, outsourcing) [23]. Lampone et al. (2015) conducted an analysis on car parts factories belonging to MNEs in Spain [24]. The authors demonstrate that internal rivalry (determined by firms in the same group) plays a greater role than external rivalry (firm efficiency compared to competing firms) in international relocation decisions.

Weterings & Knobens (2013) examine the factors generating relocations of companies over short and long distances, conducting an analysis of Dutch companies. The study shows that short distance movements are determined by the growth of companies and implicitly the need for more space. In contrast, longer distance relocations are largely determined by regional features. Concentrating similar or related firms in a limited space, a higher level of urbanization and the intensity of research and development activities prevent firms from leaving the region on the labour market, but firms are more inclined to leave regions with a higher share of innovative firms [25]. Jiang et al. (2018) developed a model for analysing the relocation models of manufacturing industries in terms of access to transmission networks [26]. The study looked at relocation models in China's manufacturing industries from different countries. The authors demonstrate that cities in border regions are bottlenecks for industry relocation and improved transport accessibility, and rising production costs are accelerating the industrial relocation process in "fly-in" mode. Conroy et al. (2016) took into account the intensity of research and development (R&D) companies at industry level and the impact on the relocation decision. The results show that the interstate migration of US firms taken into account varies according to their research and development intensity [1].

According to a study conducted by Sunjka (2020) the main reasons for relocation are: Cost cutting, focus on core business and access to new markets [27]. Another recent study conducted in the US by Rupasingha & Marre (2020) shows that rural environment have attracted some business from urban areas [28]. The authors demonstrated that attraction factors such as: population density and proximity to urban locations, have positive statistical significance, while regional specialization and market potential, have opposite or no effect on the relocation of enterprises from urban to rural environment. Another finding of these authors is that when relocating units, locations similar to their origins are preferred. Laamanen et al. (2012) analyse relocations of headquarters, based on a data set of 52 relocations of headquarters in Europe during 1996-2006 [29]. The authors show an increasing trend towards relocation, which affects the choice of the location of the headquarters. High employment rate and high taxes are important factors that conducted to increase the probability of relocating headquarters.

2.1 Methods used

The data collected by the authors were processed by various methods. Some methods are established, and others have been designed by the authors. The following are several models from the literature, developed in recent decades. Brinkman et al. (2015) developed a dynamic model to explain decisions to relocate firms to an urban economy with multiple locations and congestion externalities, demonstrating that congestion externalities increase firms' productivity by up to 8% [30]. The paper was developed based on 13 relocation consulting firms and 91 Texas economic development organizations. Bodenmann & Axhausen, (2012) took into account a sample of 54,000 Swiss firms that they statistically processed [15]. Contractor et al. (2010) demonstrate that the dispersal of value chain activities leads to a certain complexity and increased costs and propose a simultaneous analysis of relocation and outsourcing, with a model for determining the optimal degree of disaggregation and global dispersion of a firm [31]. Eslamipour & Sepehriar propose the

SWOT-AHP hybrid method [4]. Guimarães et al. propose a logit model based on maximizing random utility for modelling firm location decisions [32]. In another research, the same authors address the issue of urban agglomeration as the main determining factor of new investments. Research in Portugal has led to a study of spatial choices for newly created foreign companies [33].

Kimelberg (2014) developed an econometric model based on the information provided to intermediaries that appear in the site selection process [34]. The author points out that in addition to the characteristics of the labour market, there are other factors such as crime. Van Dijk & Pellenbarg (2000) explores the relocation of firms in the Netherlands from several points of view: origins and destinations (regions), number, distance travelled, sectoral composition and the effects of employment. The relocation decisions of the individual companies were analysed according to the characteristics of the company and the location through an orderly logit model [35]. MacCarthy & Atthirawong (2003) used Delphi method to investigate factors for international location decisions [36]. The results explain the companies' motivations for trying to produce outside national borders and the steps to be taken in location decisions. The authors identified five major factors: labour characteristics, infrastructure, costs, economic factors and government factors. In addition, authors used other ten sub-factors: reliability and quality of utilities, modes of transport, availability of labour, labour quality, wages, workers motivation, laws on government stability, telecommunications systems and industrial relations. Additional sub-factors of increasing importance include: availability of management resources, patent protection, and system and integration costs. By Felice et al. (2015) proposed a methodology for redesigning and building a production line following its relocation based on reengineering processes [37].

Zhu & He (2014) developed an econometric model based on a large set of data on the formation of new firms in China [38]. The authors took into account global, regional and local factors in developing the industrial relocation model. Econometric estimates show that the factors that affect the choice of location are largely determined by the specific capacity of the company. Chapple (2014) shows that industrial land continues to play a basic role in the economy of the 21st century. This article describes how industrial land influences the dynamics of relocation and expansion of companies in four cities in the San Francisco Bay Area. For this purpose, it uses multivariate analyses to examine the role of zoning in the expansion of the company, controlling the characteristics of the company, the industry, the characteristics of the building and the locations [39].

Ancarani et al. followed the determinants of manufacturing time and offshore experience of American and European companies before relocating to Asia. Data were collected from 249 relocation experiments completed with a move. The results show that factors such as industry, country of origin, host country and company size significantly affect the length of relocation [22]. Albertoni et al. researched whether business relocation is a form of a company's response to low performance or is motivated by certain benefits generated by disintegration such as: accessing new markets and reducing costs. The authors demonstrate statistically that when relocation has been motivated by low economic and financial performance and the need to reach new markets, the probability of moving companies increases [23].

2.2 Synthesis of causes and determinants

The researchers used various ways of grouping. Thus, Arauzo - Carod et al. (2010) formed two categories of factors (classical and institutional) [13]. Vereecke & Van Dierdonck divided the factors into three categories (stable, less stable and extremely unstable) [20]. The authors who used statistical methods delimited the factors into significant and

insignificant [23]. MacCarthy & Atthirawong (2003) proceed to a different grouping into major factors (13) and sub factors (76) [36]. Ellram (2013) explored the factors that affect the organization's decisions on the manufacturing location. The research identified 8 factors and 29 sub-factors with which it statistically determined the attractiveness of different regions of the world as locations for owned production units [40]. The main determining causes, identified from the analysis of the specialized literature, were grouped in Table 1. In its composition the authors proceeded to the synthesis of the specialized literature presented previously. Based on Table 1, the authors propose a summary of the determining causes, which avoids overlapping between the criteria and ensures a certain homogeneity of them. Thus, eight criteria were retained.

2.2.1 Access to low-cost markets

This criteria takes into account expenses related to: raw materials, consumables, fuels, spare parts, energy, water, expenses with services performed by third parties and expenses with works performed by third parties. Characteristic indicators with acres can be measured these consumptions can be: profit, prices of industrial products and import prices and others. The dynamics of the production price was considered as a standard. The production price index for an economic activity measures the average evolution of the price of all related goods and services resulting from industrial activity and sold on the domestic and non-domestic market (base year 2015 = 100).

2.2.2 Human resource

Human resource accumulates information related to the active population, unemployment, vacancies, level of training, earnings, labour costs. Some studies have used GDP per capita or personal income per capita to measure labour costs. During the research, three indicators were initially considered: the average hourly wage, the dynamics of the number of people employed in the industry (2015 = 100) and the number of employees aged between 20 and 64 years (thousand people). From the indicators considered, the average hourly wage (euro/h) was selected. The data cover the whole economy for enterprises with at least 10 employees (excluding public administration and agriculture).

2.2.3 Research and development

The indicators that can characterize this aspect can be: R&D expenditures at national level, R&D personnel at national level, community innovation, high technology industry and services, human resources in science and technology, digital economy and society. The authors chose government budget allocations for research and development because they cover not only government funded research and development conducted in government institutions and development in the other national sectors (education, business enterprise, private non-profit organizations) as well as abroad (inclusive international organizations).

2.2.4 Fiscal policies

Fiscal policies can be represented by a large number of indicators. Initially selected: taxes and social contributions as a percentage of GDP, taxes on products as a percentage of GDP, taxes and duties as a percentage of GDP. The authors established that the detailed collection of taxes and social contributions as a percentage of GDP was representative.

2.2.5 Environmental factors

Environmental factors which can be taken into account can be: greenhouse gas emissions and air pollutants, material flows and resource productivity, environmental taxes, environmental protection costs, environmental goods and services, waste, chemicals, etc. Authors considered as representative the revenues from environmental taxes, the annual productivity of resources (euro/kg), the revenues from environmental taxes and rate of material use (%). Environmental tax revenues group total tax revenues by environmental tax categories: energy taxes, transport taxes and the amount of resource and pollution taxes. The data presented are expressed as a percent from gross domestic product (GDP).

2.2.6 Real estate factors

Real estate factors group aspects related to building permits, land prices, construction prices, etc. The indicators considered were: the price of agricultural land (euro / ha), the dynamics of building permits calculated for industrial constructions (2015 = 100), the evolution of the construction cost of new industrial buildings (2015 = 100). Agricultural land price statistics provide the price of one hectare of free agricultural land in the reference period (one calendar year).

2.2.7 Infrastructure

Infrastructure was characterized by the following indicators: car, rail and inland waterway networks, rail transport - length of railways (km), number of commercial airports (with over 15,000 passengers per year).

Table 1. Synthesis of causes and factors.

Cause	Source
Environmental issues or climate change	Eslamipoor & Sepehriar (2014), Pellenbarg et al. (2002), Linnenluecke et al. (2011)
Interruptions from suppliers or customers	Linnenluecke et al. (2011), Ellram (2013)
Increase productivity	Baldwin & Okubo (2014); Ellram (2013)
Free trade	Baldwin & Okubo (2014)
Decreased costs or operational efficiency	Chan et al. (2009), Ghosh C. et al. (1995), Balbontin & Hensher (2019), Jiang et al. (2018), De Felice et al. (2015), Albertoni et al. (2017), Zhu & He (2014), Pellenbarg si colab. (2002), Ellram (2013)
Capacity reduction	Chan et al. (2009)
Change of management, labour disputes, facilities	Chan et al. (2009)
The result of acquisitions, mergers and acquisitions	Brouwer et al. (2004)
Adaptation to changes in markets	Pellenbarg et al. (2002), Ancarani et al. (2015), Ellram (2013)
Consumer preferences	Pellenbarg et al. (2002)
Technological progress	Pellenbarg et al. (2002)
Agglomeration outsourcing	Brinkman et al. (2015)
Complexity of operations	Balbontin & Hensher (2019)
Urban congestion or need for space	Guimarães et al. (2003), Weterings & Knoben (2013)
Internal and external rivalry	Lampon et al. (2015)
Economic growth	Weterings & Knoben (2013)

Host country	Ancarani et al. (2015), Ellram (2013)
Industry	Ancarani et al. (2015)
The size of the company	Ancarani et al. (2015)
Transport	Ellram (2013)

2.2.8 Market

Market was characterized by indicators: adjusted purchasing power GDP per capita, population (million) and turnover dynamics in industry taking into account the internal market (2015 = 100).

Table 2. Criteria measurement indicators.

Criteria	Measuring indicators
Access to low-cost markets	Production prices in industry (2015 = 100)
	Production prices in industry, internal market (2015 = 100)
	Producer prices in industry, domestic market - annual data
Human resources	Average hourly wage
	Number of people employed in industry (2015 = 100)
	Number of employees aged between 20 and 64 (thousands)
Research and development	Gross domestic product on R&D
	R / D expenses (euro / inhabitant)
	People with tertiary education and / or employed in science and engineering (thousands)
Fiscal policies	Taxes and social contributions as a percentage of GDP
	Taxes on products as a percentage of GDP
	Taxes as a percentage of GDP
Environmental factors	Income from environmental taxes
	Annual productivity of resources (euro / kg)
	Material utilization rate (%)
Real estate factors	Agricultural land price (euro / ha)
	Number of building permits for residential constructions (2015 = 100)
	The cost of construction of new residential buildings (2015 = 100)
Infrastructure	Car, rail and inland waterway networks
	Rail transport - length of railways (km)
	Number of commercial airports (with over 15,000 passengers per year)
Market	GDP adjusted purchasing power per capita
	Population (mil.)
	Turnover in industry, internal market (2015 = 100)

The indicators considered for measuring the factors are presented in Table 2. Each factor corresponds to three measurement indicators considered relevant by the authors. From these, only one indicator was selected for each factor. The selection of indicators was carried out in such a way as to avoid collinearity between factors. The Eastern European countries considered were: Bulgaria (BG), Czech Republic (CZ), Estonia (EE), Greece (EL), Croatia (HR), Hungary (HU), Lithuania (LT), Latvia (LV), Poland (PL), Romania

(RO), Slovenia (SL) and Slovakia (SK). The data presented in tables 3 and 4 correspond to 2019 and were taken from international databases [41].

Table 3. Final indicators.

Criteria	Indicator	BG	CZ	EE	EL
Production costs	Production prices in industry (2015 = 100)	108.4	96.9	102.2	108.9
Human resources	Average hourly wage	6.0	13.5	13.4	16.4
Research and development	R / D expenses (euro/inhabitant)	73.2	408.3	341.9	217.9
Fiscal policies	Taxes and social contributions as a percentage of GDP	30.3	36.1	33.3	41,9
Environmental factors	Income from environmental taxes	1,903.74	4,594.86	889.55	7,085.00
Real estate factors	Agricultural land price (euro/ha)	5,382	8,095	3,461	12,604
Infrastructure	Car, rail and inland waterway networks	807.0	1,254.0	0.0	2,500.0
Market	GDP-adjusted purchasing power per capita	16,500.0	28900	26,100.0	20,700.0

Table 4. Final indicators (continuation).

HR	HU	LT	LV	PL	RO	SL	SK
100.2	108.3	106.7	104.6	101.1	110.8	103.3	101.3
11.1	9.9	9.4	9.9	10.7	7.7	19.1	12.5
147.4	101.6	173.2	220.9	185.6	55.0	475.4	142.5
38.7	36.5	30.4	31.3	36.0	26.8	37.7	34.6
1,921.62	3,298.86	921.31	900.30	14,070.41	4,731.71	1,605.11	2,245.98
3,395	4,862	3,959	3,922	10,991	5,339	18,752	3,789
1,313.0	1,527.0	505.0	0.0	3,797.0	912.0	533,3	720.0
20300	22800	26000	21500	22700	21700	27600	21900

In organizing the data processing, the authors took into account that the addition of several independent variables to a multiple regression does not cause an increase in the quality of the estimate. Adding more independent variables can make things worse, as there is a risk of overfitting and multicollinearity. The central idea was to add the most appropriate variables. The addition of independent variables will cause a greater number of relationships to be established between them. As a result, not only are the independent variables potentially related to the dependent variable, but they can be related to each other. Due to multicollinearity and overfitting, several preliminary checks were performed before performing the multiple regression analysis: correlations (Tables 6 and 7), scatter plots, and simple regression between the dependent variable to see how they correlated.

3 Results and discussions

Data from Tables 3 and 4 were statistically processed with the program SPSS variant 25. With the help of multiple linear regression we aimed to determine the regression equation that best approximates each of the 8 selected criteria. The relationship thus determined was

applied to establish the score obtained by each state considered in the analysis. We started from the general form of a multiple regression equation:

$$y = \beta_0 + \beta_1 \cdot x_1 + \beta_2 \cdot x_2 + \dots + \beta_p \cdot x_p + \varepsilon \tag{1}$$

in which p is the number of variables, x_1, x_2, \dots, x_p independent variables, β_0 intercept, $\beta_1, \beta_2, \dots, \beta_p$ weight of independent variables, ε error term.

Estimated multiple regression equation is:

$$\hat{y} = \beta_0 + \beta_1 \cdot x_1 + \beta_2 \cdot x_2 + \dots + \beta_p \cdot x_p \tag{2}$$

where \hat{y} is predicted value of dependent variable, b_1, b_2, \dots, b_p estimates of $\beta_1, \beta_2, \dots, \beta_p$.

The dependent variable was considered the state, and the independent variables are represented by the indicators taken into account. The SPSS program analysed all possible variants between variables and eliminated one by one all variants that are not relevant. By relevant we mean a variant that does not present multicollinearity. The model summary is presented in the ANOVA (Table 5).

Table 5. ANOVA.

Model	Sum of square	Df	Mean square	F	Sig.
Regression	121.950	7	17.421	3.310	
Residual	21.050	4	5.263		
Total	143.000				0.32
Dependent variable: country					

From calculation result $R^2 = 0.853$ which means a big influence on the dependent variable relationship. The choice of a large number of factors leads to more relevant results, but there are situations in which such an effort can cause artificial growth of R^2 . The study continued with an analysis of the relationship between independent variables. For this step, an analysis of the bivariate correlation between the independent variables was performed in tables 5 and 6. Since the variables were of the scale type, a Pearson correlation was chosen. It is observed in the correlation table that there is no significant link between the independent variables, except for variable 2, excluded from the predictive model. If we replace the values obtained in relation 2, the following form of the predictive model results:

$$Score = 36.254 - 0.755 \cdot x_1 + 0.01 \cdot x_3 - 0.98 \cdot x_4 + 1.152 \cdot x_5 + 0.03 \cdot x_6 + 0.01 \cdot x_7 - 0.16 \cdot x_8 \tag{3}$$

Table 6. Bivariate correlation between independent variables.

Criteria	Correlation	Producer prices in industry	Average hourly salary	Gross domestic expenditure on R&D	Taxes and social contributions as a percentage of GDP
Producer prices in industry	Pearson Correlation	1	-0.366	-0.572	-0.361
	Sig. (2-tailed)		0.241	0.052	0.249
Average hourly salary	Pearson Correlation	-0.366	1	0.805	0.720
	Sig. (2-tailed)	0.241		0.002	0.008
Gross domestic expenditure on R&D	Pearson Correlation	-0.572	0.805	1	0.395
	Sig. (2-tailed)	0.052	0.002		0.204
Taxes and	Pearson	-0.361	0.720	0.395	1

social contributions as a percentage of GDP	Correlation				
	Sig. (2-tailed)	0.249	0.008	0.204	
Environmental tax revenues	Pearson Correlation	-0.080	0.033	-0.103	0.285
	Sig. (2-tailed)	0.804	0.918	0.751	0.369
Agricultural land prices	Pearson Correlation	-0.042	0.718	0.582	0.509
	Sig. (2-tailed)	0.897	0.009	0.047	0.091
Road, rail and navigable inland waterways networks	Pearson Correlation	-0.054	0.063	-0.176	0.489
	Sig. (2-tailed)	0.867	0.846	0.585	0.107
Purchasing power adjusted GDP per capita	Pearson Correlation	-0.485	0.559	0.787	0.127
	Sig. (2-tailed)	0.110	0.059	0.07	0.694

The relationship allowed to establish the score for each state selected in the analysis. Results were shown in Figure 1. The graph shows the scores obtained by each state considered in the analysis. In first place is Poland with a surprisingly high score compared to other states. In second place is Greece, followed by the Czech Republic, Romania and Hungary.

Table 7. Bivariate correlation between independent variables (continuation).

Criteria	Correlation	Environmental tax revenues	Agricultural land prices	Road, rail and navigable inland waterways networks	Purchasing power adjusted GDP per capita
Producer prices in industry	Pearson Correlation	-0.080	-0.042	-0.054	-0.485
	Sig. (2-tailed)	0.804	0.897	0.867	0.110
Average hourly salary	Pearson Correlation	0.033	0.718	0.063	0.559
	Sig. (2-tailed)	0.918	0.009	0.846	0.059
Gross domestic expenditure on R&D	Pearson Correlation	-0.103	0.582	-0.176	0.787
	Sig. (2-tailed)	0.751	0.047	0.585	0.07
Taxes and social contributions as a percentage of GDP	Pearson Correlation	0.285	0.509	0.489	0.127
	Sig. (2-tailed)	0.369	0.091	0.107	0.694
Environmental tax revenues	Pearson Correlation	1	0.387	0.940	-0.076
	Sig. (2-tailed)		0.214	0.08	0.814
Agricultural land prices	Pearson Correlation	0.387	1	0.379	0.306
	Sig. (2-tailed)	0.214		0.224	0.333
Road, rail and navigable	Pearson Correlation	0.940	0.379	1	-0.177

inland waterways networks	Sig. (2-tailed)	0.08	0.224		0.581
Purchasing power adjusted GDP per capita	Pearson Correlation	-0.076	0.306	-0.177	1
	Sig. (2-tailed)	0.814	0.333	0.581	

The research continued with the determination of the curve that best approximates the scores obtained by the analysed states (Fig. 1).

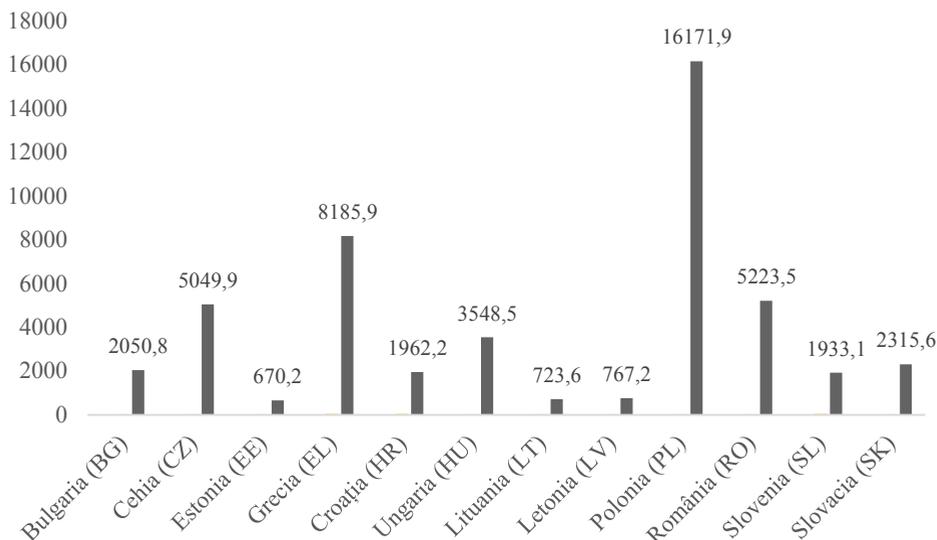


Fig. 1. The score obtained by the analysed states.

Using simple linear regression, several types of lines or curves were simulated to obtain the regression equation. Several models were established: linear ($R^2 = 0.13$), logarithmic ($R^2 = 0.19$), quadratic ($R^2 = 0.32$), cubic ($R^2 = 0.82$), exponential ($R^2 = 0.06$). The curve that best approximates the scores is given by the cubic model and has the following shape:

$$y = 5601.177 - 2344.523 \cdot score + 537.199 \cdot score^2 - 30.393 \cdot score^3 \quad (4)$$

4 Conclusions

In order to substantiate the decision regarding industrial business relocation, several determining factors were selected from the literature. The authors propose an approach based on a large number of factors and propose a different grouping of them compared to other research. The grouping of factors was done in 8 categories. For each category, several indicators were identified from which the most representative was extracted. There were 8 indicators for which data were extracted using international databases. The data thus collected were statistically processed using the Statistics 25 program.

A case study involving a choice of the location of an industrial business in Eastern Europe was presented. The result demonstrates the capacity and efficiency of the model that can help decision makers in better evaluating the different decision-making options. The proposed model is not limited to choosing the location of a business. The list of selected criteria and decision alternatives are not the only options. Thus, it can include several relocation alternatives, it can establish more hierarchies or it can detail the problem.

However, it could lead to more calculations as the number of criteria and alternatives increases. Therefore, the development of a calculation model is useful to facilitate the decision-making process. The large number of criteria considered and indicators allow a correct choice of the state in Eastern Europe.

Future research will include several characteristic indicators for each determinant. Another orientation can be to identify the most appropriate indicator, while reducing the number of factors if the data will be statistically processed. In this way, the results will better shape the expectations of companies and will reduce the risk of relocation. Another possibility is the share of indicators and factors, as the model in its current form considers indicators and factors of equal importance.

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