Transilvania University of Brasov

THE INTERDISCIPLINARY DOCTORAL SCHOOL

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Eng. Oana Nicoleta PANAZAN

STRATEGII DE CREȘTERE PRIN RELOCAREA COMPANIILOR

GROWTH STRATEGIES THROUGH COMPANIES RELOCATION

ABSTRACT

Doctoral supervisor

Prof.dr.eng. Gavrilă CALEFARIU

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CONTENT

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INTRODUCTIONS

Currently, state borders no longer pose an obstacle. The policy of the European Union (EU) has contributed to attracting significant investments in peripheral regions, thus countering the forces that tend to concentrate activities in core regions (Basile et al., 2004).

Given the global integration of financial markets, it can be said that disruptive events (such as the COVID-19 pandemic and the armed conflict in Ukraine) alter the geography of firm location. Existing research has often discussed relocation as a response to either cost reduction or resource expansion. These approaches indicate that:

i. regulatory arbitrage and relocation, (Jensen and Pedersen, 2012);
ii. The search for resources and internationalisation (Chan, 1995; Laamanen and colab., 2012; Zhu and He, 2014);
iii. the reorganization of spatial relationships within firms (Laamanen et al., 2012).

The doctoral thesis, (Figure i.2), is structured into five chapters that cover aspects related to relocation. It examines the relationship between stock market indices, criteria, indicators, and proposed models for generating firm-scale economies. Following this introductory section, Chapter 1 provides an overview of the current context of research on relocation issues. Based on these references, several hypotheses will be developed regarding the factors and their impact on the spatial behavior of companies. The section concludes with a literature review. The objectives of the doctoral thesis are discussed in Chapter 2.

After a brief introduction, Chapter 3 presents the theoretical research applicable to relocation. Then, the general context of the relocation trend and the results of estimations from various statistical and econometric analysis models are discussed in Chapter 4, which analyzes the relocation dependence of stock indices from 20 countries. This is followed by a multicriteria analysis model that includes all administrative regions of Romania, enabling the exploration and quantification of the impact of diverse regional characteristics on relocation options. The chapter concludes with the findings on modeling destination choice for firm relocation, the implications of these results for policies and regional regulations, and the relocation software application. The final part includes the general conclusions, original contributions, dissemination of results, and future research directions, presented in Chapter 5.

The research identifies the changes generated by the COVID-19 pandemic and the conflict in Ukraine in the relocation of companies within the European Union and evaluates the relocation trends of companies in this volatile macroeconomic environment. The sustainability of companies and their ability to overcome crises mainly depend on economic, social, financial, political factors, and human resources involved in the relocation process.

This thesis consists of 229 pages, including 48 figures, 37 tables, 89 equations, and 421 bibliographic references, including 12 by the author as the sole author, 7 as the primary author, and 5 as a coauthor.

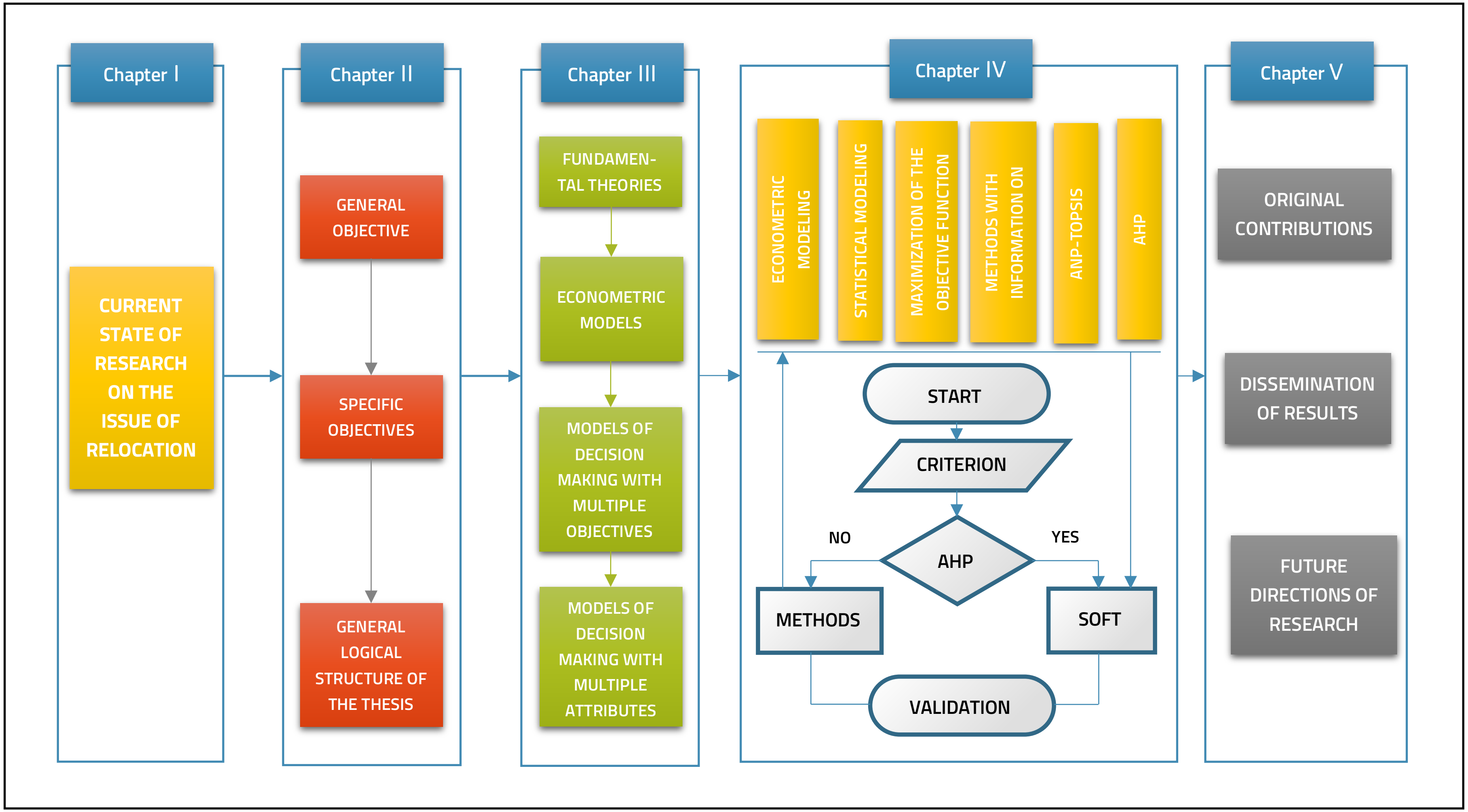


Figure i.2: The structure of the doctoral thesis

CHAPTER 1. CURRENT STATE OF RESEARCH ON THE ISSUE OF RELOCATION

Relocation has become a common phenomenon and is seen as a natural approach by businesses in western countries (Lewin and Peeters, 2006). According to Brouwer et al. (2004), there is a clear distinction between complete relocation and partial relocation. Partial relocation can involve opening a branch in another region or even moving a part of the production unit to another country to benefit from cost savings. The complete relocation involves moving an entire business. This strategic action can be encountered under various names, including relocation, international outsourcing, or global sourcing. All these terms imply:

- relocating business activities to a subsidiary or independent suppliers within or beyond national borders (Lacity et al., 2008; Contractor et al., 2010; Ellram et al., 2013; Oshri et al., 2017);
- Reintegrating activities within the boundaries of the organization (Holz, 2009; Kinkel and Maloca, 2009; Bals et al., 2016; Stentoft et al., 2016);
- reverse strategy of moving operations from within the country or from a foreign country to a location closer to the original one (Fratocchi et al., 2014), for example, moving operations to Mexico from the U.S.A. (Tate, 2014).

In this thesis, no distinction is made between the terms associated with this phenomenon. The process will be referred to as "relocation" since it encompasses all aspects: relocation to a new company-owned subsidiary, to an independent third party, or back to the headquarters (Lewin et al., 2009; Oshri et al., 2015).

Based on the objectives of this thesis, a systematic review of the scientific literature was conducted using the Web of Science database, focusing on the most relevant scholarly papers using keywords such as relocation, offshoring, near-shoring, and back-shoring. Full scientific papers that presented exploratory studies, case studies, and series of cases were considered. The bibliography of the identified and selected articles was also explored to ensure that no relevant recent findings in the field were overlooked.

The content of the selected articles was processed and the information was organized to extract important ideas and research results regarding the current state of knowledge about relocation. The results of the literature review are presented in the following subsections and in Table 1.1, where the strength of presentation represents the number of citations (https://scholar.google.com, accessed on May 25, 2023).

1.3 CONCLUSIONS

The study of the theoretical framework reflected the relocation trends. These studies demonstrate the importance of the type of relocation when assessing the heterogeneous impact of relocation on the business environment. The impact of location on the relocation decision quantified cost savings and aimed to facilitate the long-term development of organisations, financial diversification, the creation of new values, or market access for firms. These are just a few of the aspects evaluated. The causes behind organizations choosing relocation are diverse, ranging from cost savings to competitive pressure, competitiveness, or a strict fiscal framework.

From the analysis of the current state of knowledge in the field, it has been observed that there is scientific interest in the sustainable development of business environments. One direction that can be explored further is the response of stock markets to investors' perception of relocation. Studying the contagion effect of disruptive phenomena, the capital market's response to changes in organisations' corporate policies, and, last but not least, developing an information system to facilitate the analysis process are areas that can be explored.

CHAPTER 2. THE OBJECTIVES OF THE DOCTORAL THESIS

This thesis aims to provide decision makers with relevant information about the factors that determine relocation, the impact relocation has on competitiveness, the motivations and benefits of barriers, along with possible consequences of indicators.

2.1 GENERAL OBJECTIVE AND SPECIFIC OBJECTIVES

The present research study has an investigative nature. It examines relocation practices, the underlying causes, and the indicators that form the analytical framework. It seeks to support conclusions about the development of a new reference framework capable of evaluating and improving the relocation process.

The general objective of the research is to identify and quantify the factors that have an impact on firms at the scale of relocation, with the purpose of utilizing them to grow the business.

The specific objectives of this thesis are formulated within the context of the conducted research studies:

- **O. S. 1.** Identifying the specific relationships between savings on the company scale and relocation with the help of the synthesis of specialized literature.
- **O. S. 2.** Development of new methods and solutions to increase savings at the company scale through the optimal choice of location.
- **O. S. 3.** Verification, validation of proposed methods and solutions.

2.2 RESEARCH METHODOLOGY

The thesis provides the key points that led to the achievement of the overall objective and the design of an original site selection mechanism. To achieve the proposed objectives, a series of activities validated in other works already published or in the process of publication were defined. The exploratory nature of this thesis used the following research methodology:

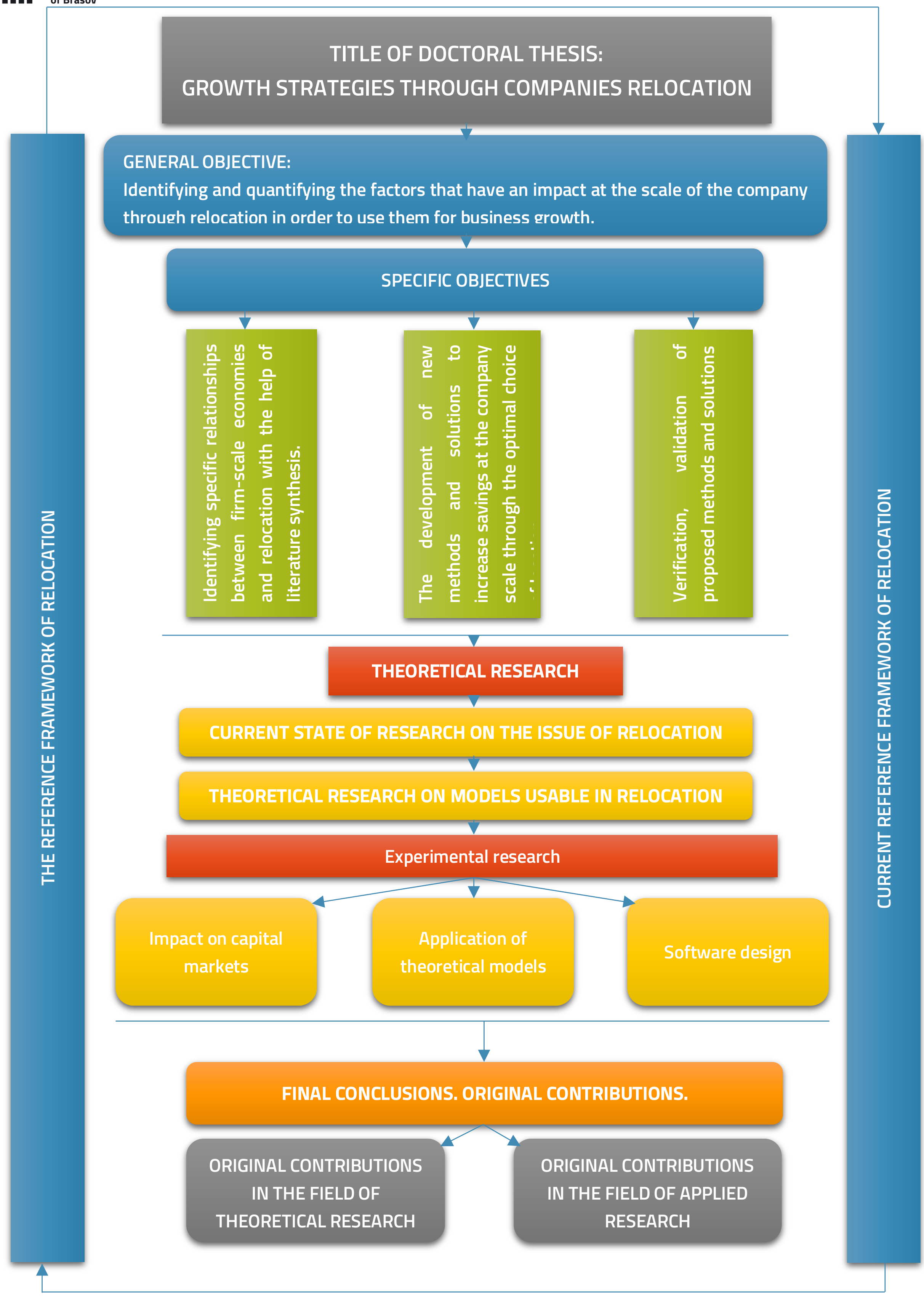


Figure 2.1 Logical diagram of the research

The correlation between the general objective of the thesis, the specific objectives, and the activities leading to its achievement provides an overall picture of this scientific research (Figure 2.1). The structure of the doctoral thesis includes the general objective, specific objectives, and the sections that contribute to their fulfilment. The literature review established the framework of relocation, leading to the identification and selection of causes, indicators, and corresponding processing methods related to relocation. Additionally, it established the correspondence between the framework and existing reference frameworks. The study also examined the impact of relocation on capital markets, which led to an evaluation of the overall impact generated by relocation. On a local level, the options for selecting the relocation site in the eight administrative regions of Romania were studied. Partial exploitation of the research was achieved through the publication of articles in indexed databases such as WoS (Web of Science) and BDI (Bibliographic Databases), while the development of the RelocateBusiness software resulted in a new tool for location selection in relocation. Lastly, the final conclusions summarize the insights gained from implementing the reference framework, experimental research, and future research directions.

CHAPTER 3. THEORETICAL RESEARCH ON MODELS USABLE IN RELOCATION

The research aimed to provide a foundation for the decision-making process regarding the selection of a relocation site based on criteria found in the specialized literature. The optimization problem solution addresses the question: "What is the optimal location option that satisfies the selected criteria to varying degrees?" In order for this thesis to answer this question, the use of decision-making models is necessary, particularly in the presence of multiple criteria, referred to as multicriteria decision models.

3.1 FUNDAMENTAL THEORIES

Within the behavioral approach, decision makers possess limited information that cannot be efficiently interpreted (Simon, 1966). Neoclassical and behavioral theories can be considered as foundations for relocation theories. However, within these theories, the societies making relocation decisions are always assumed to operate in a static environment (Brouwer et al., 2004; Pellenbarg et al., 2002).

3.1.1 OPERATIONAL RESEARCH

CO technologies have often been implemented within information technology systems, including software, hardware, databases, and code. Operational research typically follows several stages:

1. Identification of the real problem (operation):
    - defining the problem and, if applicable, identifying sub-problems to be solved.
    - establishing criteria, objectives, constraints, parameters, and requirements.
2. Formulation of the real problem as a mathematical model (mathematical formulation of the problem and construction of the mathematical model of the operation).
3. Model validation (algorithmic validation):

- executing the solving algorithm of the model to verify that the initial data and programme code do not contain errors.
- Checking the programme and results against test cases for which both inputs and outputs are known (verifying if the programme is suitable for the model).

4. Solving the model (mathematical problem).
5. Implementation of research findings, the solution algorithm as an operational tool.

3.1.2 GAME THEORY

Game theory (GT) is an approach to examining economics based on the rational choice of strategies when the outcomes depend on the unknown strategies chosen by others. It is a highly mathematical discipline that investigates various game models, defines multiple types of solution, and develops methods and algorithms to solve games and find solutions corresponding to the models studied.

3.1.3 CHAOS THEORY

The way members of an organization perceive communication influences their response and recovery after a crisis. In this regard, Fuller et al. (2020) developed a new tool that measures the perceived effects of an organization's communication on crisis management processes. Seeger (2002) suggested treating crises as chaotic systems due to their inherent unpredictability and the self-organization that occurs within them.

3.1.4 COMPLEXITY THEORY

Complexity theory must address all developments in designing efficient algorithms. If the problem is to identify a correct sentence for a defendant, then this problem is not algorithmic, as it depends on philosophical and judicial issues, and therefore is not suitable. However, calculating a distance in a graph where "a" and "b" are vertices and each edge is associated with a positive cost (which can be interpreted as distance, travel time, or resource) is a problem that can be solved using algorithms. An algorithmic problem is defined by:

- description of the set of admissible entries, each of which can be represented as a finite sequence over a finite alphabet;
- describing a function that archives each admissible input into a set of correct outputs (answers, results), each of which is also a finite sequence over a finite alphabet (Wegener, 2005).

3.2 ECONOMETRIC MODELS

Forecasting is important in decision-making processes. Simple regression estimates and factor-based models were used to drive forecasts for the economic environment.

3.2.1 ECONOMIES OF SCALE

Estimating cost efficiency, relative to production volume, requires the identification of a functional structure, which can be achieved with the Cobb-Douglas production function (Cobb & Douglas, 1928).

$$TC = f(X, Z, P, T, F) \quad (3.1)$$

3.2.2 REGRESIA SIMPLĂ

Studying the dependence of the response on multifactorial influence is a current and difficult problem in mathematical statistics. As a rule, obtaining the exact dependence of the variable is a complicated problem. Sometimes impossible with a functional dependency.

An endogenous variable represents the evolution of the considered phenomenon, characterized by a single exogenous variable (Greene, 2002).

$$y_t = ax_t + b + \varepsilon_t \quad (3.8)$$

Where: $t \in [1,2,\ldots,T]$; the endogenous variable, Y; the exogenous variable, X; the error term $\boldsymbol{\varepsilon}$.

A series of restrictive assumptions are imposed on the model, the estimation of parameters a and b is determined using the least squares method provided that the sum of the squares of the errors is minimal. The estimators thus obtained will be unshifted and convergent (Greene, 2002).

3.2.3 MULTIPLE LINEAR REGRESSION

To determine the effect of certain economic and social variables on relocation, a classical multiple regression is used with an a priori framework that checks several limiting assumptions. An endogenous variable can be expressed in terms of a large number of exogenous variables, (Greene, 2002):

$$y_t = a_1 x_{1t} + a_2 x_{2t} + \ldots + a_p x_{pt} + \varepsilon_t \quad (3.35)$$

Where: p is the number of variables; $x_1, x_2, \ldots, x_p$ exogenous variables; $a_1, a_2, \ldots, a_p$ unknown parameters to be estimated; ε the error term; t=1, 2,..., T.

3.2.4 TIME SERIES

Time series are sequences of values recorded by a specific random variable over a specific period of time. For an econometric analysis of the data, the following main characteristics of the time series must be taken into account (Codirlaşu et al., 2010):

- Frequency;
- The population;
- The sample;
- Moments, (mean, standard deviation, asymmetry coefficient, kurtosis);
- Stationarity;
- Seasonality.

3.2.5 ARMA MODEL

It is also known as stationary time series model, a combination of AR and MA models. The basic expression is the following (Codirlaşu et al., 2010):

$$y_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i \, y_{t-i} + \varepsilon_t + \sum_{i=1}^{q} \beta_i \, \varepsilon_{t-1} \tag{3.46}$$

Where: y_t represents the variable observed in the period t; ε_t is the independent error term, and α și β are non-zero indeterminate coefficients.

3.2.6 MODELUL ARCH

The variance of a random variable is often assumed to be constant in traditional econometrics. In reality, financial series have heteroskedasticity, meaning that the data are stable in the long run but unstable in the short run. The general expression of the ARCH model is as follows:

$$y_t = \phi x_t + \mu_t \tag{3.47}$$

$$\sigma_t^2 = E(\mu_t^2 | \mu_{t-1}, \mu_{t-2} \ldots) = \alpha_0 + \alpha_1 \mu_{t-1}^2 + \cdots + \alpha_p \mu_{t-p}^2 = \sum_{i=1}^{p} \alpha_i \mu_{t-i}^2 \tag{3.48}$$

Where: x_t is the independent variable observed in the period t; ϕ is an undetermined coefficient different from zero; μ_t is the random error term, which is assumed to follow a normal distribution in the overall model.

3.2.7 GARCH MODEL

Bollerslev (1986) proposed a generalization of the ARCH model, called the GARCH model, which can more accurately describe the clustering tendency of volatility in financial time series. The equations are defined as follows, (Bollerslev, 1986):

$$y_t = \phi x_t + \mu_t, \mu \sim N(0, \sigma_t^2) \tag{3.49}$$

$$\sigma_t^2 = \omega + \sum_{i=1}^{p} \alpha_i \mu_{t-i}^2 + \sum_{i=1}^{q} \beta_i \sigma_{t-i}^2 \tag{3.50}$$

Where: μ_{t-i}^2 is the ARCH parameter,and σ_{t-i}^2 is the GARCH parameter. The coefficients of the ARCH and GARCH terms are denoted by α and respectively, β, and p and q are the lag order of the model. Thus, the ARCH model can be viewed as a special type of GARCH model. The advantage of the GARCH model is that heteroskedasticity can be reflected and interpreted in the model, but still, it fails to capture skewness.

3.2.8 PARCH MODEL

Taylor (1986) and Schwert (1989) proposed a PARCH model. Ding et al. (1993) generalized the GARCH model, calling it the power conditional autoregressive heteroskedasticity (PARCH) model, with the following variance equation:

$$\sigma_t^\delta = \omega + \sum_{j=1}^{q} \beta_j \sigma_{t-j}^\delta + \sum_{i=1}^{p} \alpha_i (|u_{t-i}| - \gamma_i u_{t-i})^\delta \tag{3.51}$$

Where: δ is the power parameter of the estimated standard deviation, which is generally used to assess the magnitude of the impact on the conditional variance δ >0; γ is an asymmetry coefficient, which contains the asymmetric effect up to order r, when: i=1,2,...,r; $|\gamma_i| \leq 1$ and when i$> r$; $\gamma_i = 0$; r$\leq p$.

3.2.9 COMPONENTS OF THE ARCH MODEL

The GARCH (1,1) model with conditional variance is defined, (Engle, 1982):

$$\sigma_t^2 = \omega + \alpha u_{t-1}^2 + \beta \sigma_{t-1}^2 \tag{3.52}$$

Where: ω is the long-term volatility. Suppose ω= $\omega(1 - \alpha - \beta)$, so that the equation can be written down:

$$\sigma_t^2 = \omega + \alpha(u_{t-1}^2 - \omega) + \beta(\sigma_{t-1}^2 - \omega) \tag{3.53}$$

The mean of the conditional variation, (relation 3.53) converges to the constant ω. It is replaced ω with a variable value q_t, which leads to the model ARCH (GARCH):

$$\sigma_t^2 - q_t = \alpha(u_{t-1}^2 - q_{t-1}) + \beta(\sigma_{t-1}^2 - q_{t-1}) \tag{3.54}$$

$$q_t = \omega + \rho(q_{t-1} - \omega) + \phi(u_{t-1}^2 - \sigma_{t-1}^2) \tag{3.55}$$

The following equations are obtained when an asymmetric effect is introduced into the short-term equation:

$$q_t = \omega + \rho(q_{t-1} - \omega) + \phi(u_{t-1}^2 - \sigma_{t-1}^2) + \theta_{1 z_{1t}} \tag{3.56}$$

$$\sigma_t^2 - q_t = \alpha(u_{t-1}^2 - q_{t-1}) + \beta(\sigma_{t-1}^2 - q_{t-1}) + \gamma(u_{t-1}^2 - q_{t-1}) d_{t-1} + \theta_{2 z_{2t}} \tag{3.57}$$

Where: ρ, ϕ are θ nonzero indeterminate coefficients, z is an exogenous vector variable, d_t is a dummy variable and γ is the asymmetry coefficient. When there is a positive impact, $u_{t-1} \geq 0, d_{t-1} = 0$. When there is a negative impact, $u_{t-1} < 0, d_{t-1} = 1$.

3.2.10 TGARCH MODEL

Zakoian (1994) proposed the TGARCH model to study volatility asymmetry. By inserting the virtual variables into the original model, the following equation is obtained:

$$d_{t-1} = \begin{cases} 1, u_{t-1} < 0 \\ 0, u_{t-1} \geq 0 \end{cases} \tag{3.58}$$

The TGARCH variance equation is defined as:

$$\sigma_t^2 = \omega + \sum_{i=1}^{p} \alpha_i \mu_{t-i}^2 + \sum_{j=1}^{q} \beta_j \sigma_{t-j}^2 + \sum_{k=1}^{r} \gamma_k \mu_{t-k}^2 d_{t-k} \quad (3.59)$$

The relation, (3.59) indicates that the value of σ_t^2 it depends on μ_{t-1}^2 and the conditional variance of the previous period σ_{t-1}^2.

3.2.11 EGARCH MODEL

Nelson, (1991) proposed the EGARCH model. It thus provided the variance equation in logarithmic form. The EGARCH model is more convenient for estimating the parameters of σ_t^2 because it does not impose restrictions on the model parameters.

$$ln(\sigma_t^2) = \omega + \beta ln(\sigma_{t-1}^2) + \gamma \frac{u_{t-1}}{\sqrt{\sigma_{t-1}^2}} + \alpha \left[\frac{|u_{t-1}|}{\sqrt{\sigma_{t-1}^2}} - \sqrt{\frac{2}{\pi}} \right] \quad (3.60)$$

Where: σ_t^2 is always positive, regardless of whether the coefficient on the right-hand side of the relation, (3.60) is positive or not.

3.2.12 VECTOR AUTOREGRESSION

Modeling time series with a Vector Autoregression (VAR) model allows symmetrical treatment of all variables in the model.

In the case of a two-variable VAR model, the evolution of the variable x is influenced by past values (lags) of x as well as current and past values of y. Similarly, y is influenced by its lags as well as current or past values of x. Consider the simple bivariate system (structural form of the system or primitive form):

$$\begin{aligned} x_t &= a_{11} + a_{12}x_{t-1} + a_{13}y_t + a_{14}y_{t-1} + \varepsilon_{xt} \\ y_t &= a_{21} + a_{22}y_{t-1} + a_{23}x_t + a_{24}x_{t-1} + \varepsilon_{zt} \end{aligned} \quad (3.61)$$

Where: x, y are stationary variables; ε_{xt}, ε_{zt} they are uncorrelated white noise.

The above equations constitute a first-order VAR system because the lag length is one period. Given the way the system is written, it allows x and y to influence each other.

The VAR system in standard form has the following form:

$$\begin{aligned} x_t &= a_{10} + a_{11}x_{t-1} + a_{12}y_{t-1} + e_{1t} \\ y_t &= a_{20} + a_{21}x_{t-1} + a_{22}y_{t-1} + e_{2t} \end{aligned} \quad (3.62)$$

The error e it is a combination of errors ε, because $e_t = B^{-1}\varepsilon_t$.

3.3 MODELS OF DECISION MAKING WITH MULTIPLE ATTRIBUTES

Strategic decisions, supplier evaluation and selection are some of the most important processes of organizations. The decision process has a complex structure, and decision models with multiple attributes are characterised by the following.

- finite set of variants;
- finite set of criteria;
- the variants are characterised by reference to both numerical and non-numerical criteria;
- each criterion pursues a certain goal, respectively, maximum or minimum.

From the point of view of informational content, they can be:

1. Methods without information on preferences where the decision-maker has no information on the fact that some criteria are preferred over others.
2. Criteria information methods, which group problems according to the importance given to each criterion.

3.3.1 CONJUNCTIVE METHOD

It involves the selection of variants where, for all criteria, the property is met $x_{ij} \geq x_{0j}$ for the criteria of maximum and $x_{ij} \leq x_{0j}$ for the minimum criteria, where j =1,2,...,n.

3.3.2 METHOD OF ELIMINATION BY ASPECTS WITH COMBINATION OF ALTERNATIVES

Let V' be a set of variants characterized in a certain way by means of criteria and be the value ε ∈(0,2). Probability as a variant V_i to belong to the crowd V' is:

$$p(V_i,V')=\frac{\sum_{j\in J} u(C_j)}{\sum_{k=1}^{n} u(C_k)} \tag{3.63}$$

Where $J_i=\{j|V_1\in V' \text{ if } |x_{ij}-x_{lj}|\leq\varepsilon\}$. The optimal variant corresponds to a probability $p(V_i,V')$ which registers the highest value. It is considered the utility function u:{ $C_1, C_2, C_3, C_4, C_5, C_6,...,C_n$}⟶N, $u(C_i)$ = n-(i-1), with the property u= (n, ..., 2, 1) and ε = 0,20 and each combination compared to the variants Vi $|r_{1j}-r_{ij}|$, and the actual utility of the j criteria will be compared to the variants V_i.

3.3.3 METHOD OF ELIMINATION BY ASPECTS WITH MAXIMUM VALUE

Consider the normalized matrix R, the utility function $u(C_i)$= n-(i-1), u:{ $C_1, C_2, C_3, C_4, C_5, C_6,...,C_n$}⟶N, $u(C_i)$ = n-(i-1), with the property u= (n, ..., 2, 1) and ε =0,20, and Vi= $|r_{1j}-r_{ijmax}|$ then the true utility of the criteria will identify the reduced set of variants.

3.3.4 SIMPLE ADDITIVE WEIGHTING (SAW) METHOD

The function is defined f:V⟶R, whose analytical expression is:

$$f(V_i)=\frac{\sum_{j=1}^{n} p_j \cdot r_{ij}}{\sum_{j=1}^{n} p_j} \tag{3.64}$$

Consider the normalized matrix R and the vector P=$(a_{j1}, a_{j2}, \dots, a_{jn})$. Calculation f($V_i$) will lead to the maximum value and implicitly to the variant hierarchy.

3.3.5 ANP-TOPSIS METHOD

Connecting methods analytical network process, (ANP) and Technique for Order of Preference by Similarity to Ideal Solution, (TOPSIS) captures the interdependencies and feedbacks between levels, leading to the location selection approach, (Nong, 2022). The research model, (Figure 3.3) it is structured in six stages, (Panazan și colab., 2022).

Local priorities are determined by calculating the average value of the relative importance intensity (geometric mean value):

$$\bar{a_j} = \sqrt[n]{a_{j1} \cdot a_{j2} \cdot \ldots \cdot a_{jn}} \quad (3.65)$$

Where: a_j – is the matrix element showing how many times the row criterion is more important than the column criterion; i – is the number of criteria and j=$\overline{1, n}$.

Next is the identification of the weight by normalizing the result, (relation 3.66) and normalizing the score. For i=1,...,m; j=1,...,n. (relation 3.67):

$$\bar{x_i} = \frac{\bar{a_j}}{\sum_{j=1}^{n} \bar{a_j}} \quad (3.66)$$

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i}^{m} x_{ij}^2}} \quad (3.67)$$

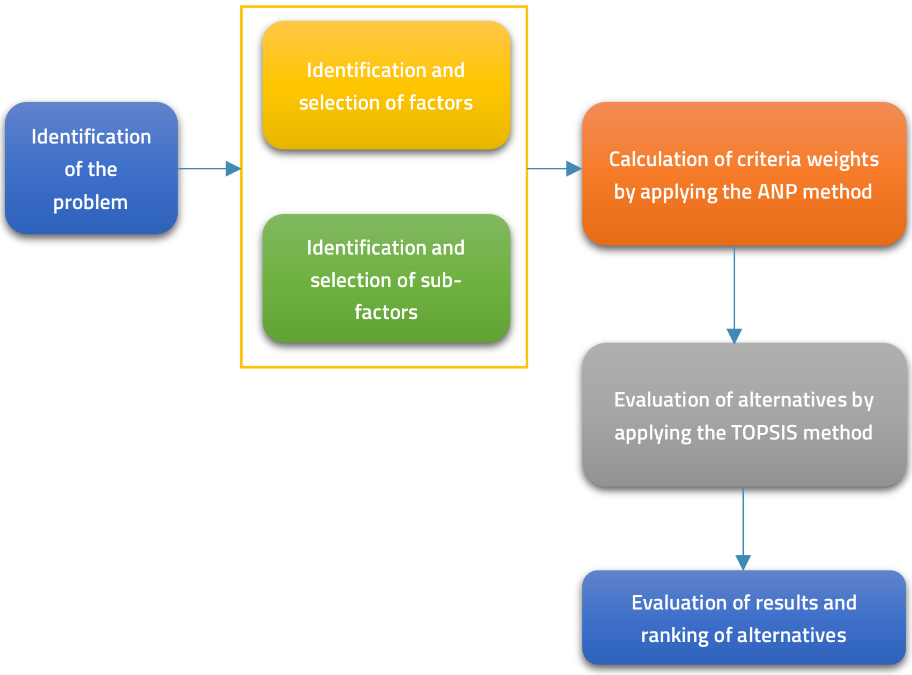


Figure 3.3 ANP-TOPSIS methodology (adapted from Panazan et al., 2022)

It continues with the setup of the weighted normalized decision matrix.

$$\sum_{j=1}^{n} w_j = 1 \tag{3.68}$$

The next step consists in the product of each column of the normalized decision matrix with its corresponding weight value. The new matrix being:

$$W'_{ij} = w_i r_{ij} \tag{3.69}$$

Once the weights of the criteria were established, the TOPSIS method was applied to establish the hierarchy (Tzeng and Huang, 2011):

Positive ideal solution:

$$A^+ = \{W_1'^+, \dots, W_n'^+\} \text{ (maximum values)} \tag{3.70}$$

Negative ideal solution:

$$A^- = \{W_1'^-, \dots, W_n'^-\} \text{ (minimum values)} \tag{3.71}$$

Each positive and negative ideal alternative was calculated separately.

$$S_i^+ = \sqrt{\sum_{j=1}^{n} \left(v_j^+ - v_{ij}\right)^2}, i = 1, \dots, m \tag{3.72}$$

$$S_i^- = \sqrt{\sum_{j=1}^{n} \left(v_j^- - v_{ij}\right)^2}, i = 1, \dots, m \tag{3.73}$$

Relative proximity to the ideal solution:

$$C_i^+ = \frac{S_i^-}{S_i^+ + S_i^-}, 0 < C_i^+ < 1 \tag{3.74}$$

3.3.6 ANALYTIC HIERARCHY PROCESS (AHP)

Saaty, (1987) developed a problem-solving framework, the Analytical Hierarchy Process, (AHP)-analytical hierarchy model. A structured method that can be used to organize and analyze complex decisions.

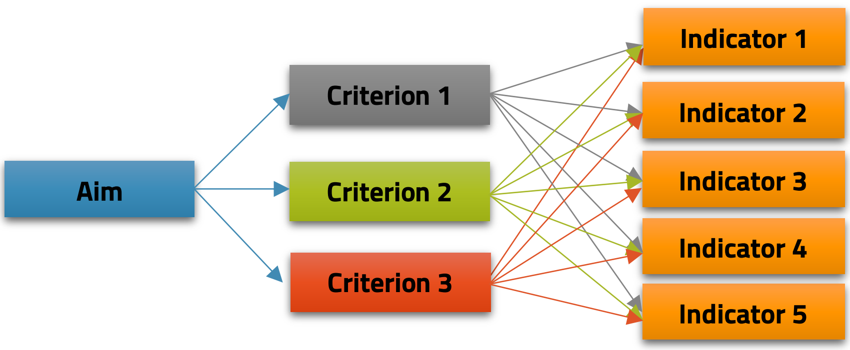


Figure 3.5 AHP Hierarchy, (modified, adapted from Saaty, 1987)

Applying the AHP method involves the following steps:

The calculation of the average value of the intensity of relative importance, (the geometric mean value) will lead to the determination of local priorities, (Relation 3.75):

$$\bar{a}_j = \sqrt[n]{a_{j1} \cdot a_{j2} \cdot \ldots \cdot a_{jn}} \tag{3.75}$$

Where: a_j – is the matrix element showing how many times the row criterion is more important than the column criterion; n– is number of criteria and j =$\overline{1, n}$

Followed by identifying the weight by normalizing the results (Relation 3.76).

$$\bar{x}_i = \frac{\bar{a}_j}{\sum_{j=1}^{n} \bar{a}_j} \tag{3.76}$$

A final step, after establishing the weights of the criteria, is the calculation of the sum of the products of the local priorities for each criterion with the weight of the respective criterion, (Relation 3.77):

$$Y_i = \sum_{j=1}^{n} \bar{x}_i \cdot \bar{x}_j \tag{3.77}$$

where: n is the number of criteria C_j, x_j is the local priority of the criterion, x_i is the local priority of the alternative variant to criterion j.

3.4 CONCLUSIONS

In predicting the long-term survival and growth of the organization, location has always played a vital role, (Marinković et al., 2018) companies are forced to make efforts to develop their skills, maintain their flexibility and capacity, (Kinkel, 2012). Therefore, the positive response of the market to investment decisions (Chan et al., 1995) and individual location decisions of units in relation to the characteristics of their economic environment, (Dubé et al., 2016) are essential factors of resettlement. According to Conroy et al., (2016) economic entities that invest in development skills will choose an advantageous location in terms of regional characteristics and political factors, thus resulting in a restoration of competitiveness due to the expansion of the market and a redefinition of the roles of the units, (Kapitsinis, 2019; Ferdows, 1997). The interdependence between the role of the firm and the production network must be taken into account, (Feldmann et al., 2013) and, last but not least, the favorable support of the government, (Eslamipoor & Sepehriar, 2014).

Increasing the competitiveness of small and medium-sized enterprises requires the effective use of mathematical models validated by application in order to promote and develop organizations. This system is constantly changing, with relative dynamic stability. Therefore, the theoretical and practical study of the development of organizations can generate viable development ideas. Business methods, strategies, make it possible to find solutions to problems through linear programming. This type of programming will generate the optimal solution capable of exploiting the opportunities offered by the market with minimal impact of disruptive factors, (Panazan et. al., 2021a). The aim is to maximize or minimize a linear function, (objective function), whose variables must meet certain conditions, to identify the existence or absence of solutions, their degeneracy.

Often the answer to a simple question leads to a complex system of solutions. Replacing the classical probabilities of game theory with quantum amplitudes creates the possibility of new effects. As an application in economic mathematics, it can be used in both target markets and auctions, (Piotrowski & Sładkowski, 2001; Piotrovski et. al., 2002). Moreover, quantum game-theoretic techniques can be used in communication (Brandt, 1999), or in the processing of information, (Lee &Johnson, 2002).

Designing a model represents the choice of endogenous variables, the structural form in which the number of equations was established, the sorting of the number of factorial variables judged to be decisive for the transformation of the endogenous variables, identifying regression equations and characterizing equivalence relations. Economic theory does not provide a precise functional form for econometric modeling. Modeling derived from two basic approaches to applied microeconomics can be used. The first approach uses the classic economics of optimization, namely the concepts of utility maximization and cost minimization. The second approach includes the Rotterdam model (Aziz, 2009; Aziz & Malik, 2010; Sulgham, 2006), which allows exact non-linear aggregation in demand systems (Deaton, A. & Muellbauer, 1980; Sulgham, 2006; Xiao et. al., 2007). The main advantages of this model are given by the arbitrary first-order approximation to any demand system, fulfilling the assumptions of choice theory and last but not least this system of demand equations is flexible in nature and easy to interpret.

The particularity of each method, the availability of data and especially the goal that the decision-makers have established lead to the different methodological approach to organizational problems. Statistical models have become important parts of the strategic management researcher's analytical arsenal. Statistical data processing can estimate patterns by analyzing the interaction between dependent variables and independent variables. The graphical interpretation of the models is decisive, considering the non-linearity of the models, the significance of the empirical results and the associated theoretical relationships. The assumptions behind the calculation assess the size of the effect and lead to the correct quantification of its magnitudes. The information package that the estimated coefficients provide leads to a correct interpretation of the analyzed phenomenon. In this sense, the application of these models is challenging for researchers and creates the opportunity for the field of strategy, by virtue of its interdisciplinary nature, to advance due to the soundness of these models.

CHAPTER 4. CONTRIBUTIONS RELATED TO THE APPLICATION OF THEORETICAL MODELS

The Literature study identified various methods used by the authors. This diversity generates a wide scope of applicability. The objective of these models is to support organizations. In this thesis, the relocation phenomenon is studied. We are looking for answers to the question: "Do we stay, do we leave, do we come back?".

4.1 ECONOMETRIC MODELING

Now, perhaps, it is not entirely clear what is meant by "where", that is, on which continent, state, or administrative region. Are we talking about locality, city, labor market region or even a larger region? We find strong reasons to explore this issue in more detail, as we have studied the phenomenon in other articles, (Gheorghe & Panazan, 2019; Gheorghe & Panazan, 2021a; Panazan et. al., 2021c).

4.1.1 CURRENT CONTEXT

This thesis quantifies the effects of relocation on stock markets, using Google Trends results to measure relocation uncertainty. Google Trends search results are weekly or monthly reports, and this low data availability prevents time series modeling using daily data.

Financial markets, economies and societies around the world are affected by disruptive events. Based on Google Trends data from January 1, 2014 to December 31, 2021 and using Exponential General Autoregressive Conditional Heteroskedastic (EGARCH) Model and Vector autoregression (VAR) the impact that relocation has on markets has been studied. As far as it has been observed, there are no studies of this effect on the capital markets.

4.1.2 DATABASE

In order to identify the state of the research, articles were accessed on the representative research portals that had as their subject the volatility of the stock markets. It was selected 20 states. The dependent variable is the daily return of the stock market indices. For each state the representative index was chosen, the complete time series was identified, consisting of daily observations in the period January 1, 2014-December 31, 2021. The source of the daily observations being the Stooq platform (https://stooq.com). Data were processed with EViews 12 software (Quantitative Micro Software, USA).

Table 4.1 Stock indices (adapted from Panazan & Gheorghe, 2023)

Stock exchange indices	Country
AEX	Netherland
ATHEX	Greece
BET	Romania
BOVESPA	Brazil
BUX	Hungary
CAC40	France
DAX40	Germany
FTSE MIB	Italy
FTSE 250	United Kingdom
IBEX	Spain
NIKKEI	Japan

OMX Vilnius	Lithuania
PX	Czech Republic
RTS	The Russian Federation
SAX	Slovakia
SHC	China
SOFIX	Bulgaria
SP500	U.S.A
WIG 20	Poland
XU100	Turkey

Weekly index volatility is calculated from daily index closing values as follows with the relationship:

$$R_{i,t} = \ln\left(\frac{\text{Index}_{\text{Friday},t}}{\text{Index}_{\text{Monday},t}}\right) \quad (4.1)$$

Google Trends is a Google website that reports and analyzes the popularity of Google search queries in different regions and languages. Although relocation is the name of the phenomenon in Romania, Internet users prefer to search using keywords in English. Accordingly, in the current research, the words "relocation", "offshoring", "near-shoring", "back-shoring", are used as search keyword series in Google Trends.

4.1.3 METHODOLOGY

The exponential-GARCH (EGARCH) model it was estimated because the selected variables experienced increased volatility and thus evidence of asymmetric effects will be obtained. Therefore, the EGARCH method proposed by Nelson, (1991) was used. The model equations are as follows:

$$h_t = \omega + \beta h_{t-1} + \alpha\varepsilon_{t-1}^2 + \gamma\varepsilon_{t-1}^2 I_{t-1} + K\pi_{i,t} \quad (4.2)$$

Where: I_{t-1} is an inactive variable that takes the value one when $\varepsilon_{t-1} < 0$ and zero otherwise. The coefficient γ detects asymmetric effects, while non-negativity restrictions will $\omega > 0$, $\alpha > 0$, $\beta \geq 0$ and $\alpha + \gamma \geq 0$ (Saltik et. al., 2016).

Nelson, (1991) proposes EGARCH which is an asymmetric alternative model. The following variance equation applies:

$$ln(\sigma_t^2) = \omega + \beta ln(\sigma_{t-1}^2) + \gamma\frac{u_{t-1}}{\sqrt{\sigma_{t-1}^2}} + \alpha\left[\frac{|u_{t-1}|}{\sqrt{\sigma_{t-1}^2}} - \sqrt{\frac{2}{\pi}}\right] \quad (4.3)$$

To establish the link between GSVI and index volatility, the model developed by Sims, (1980) was applied. Each variable in the VAR application appears as a linear combination of its past eigenvalues. Historical values of each variable are considered together with a serially uncorrelated error term, (Sims, 1980).

$$INDICE_t=\delta_1+\sum_{j=1}^{k}\theta_j\cdot INDICE_{t-j}+\sum_{j=1}^{k}\vartheta_j\cdot GSVI_{t-j}+u_{1t} \quad (4.4)$$

$$GSVI_t=\delta_2+\sum_{j=1}^{k}\psi_j\cdot SI_{t-j}+\sum_{j=1}^{k}\varphi_j\cdot INDICE_{t-j}+u_{2t} \quad (4.5)$$

Where: δ_1, δ_2 are the free terms; θ, ϑ, ψ, φ are the coefficients of the variables; and u_{1t}, u_{2t} it's white noise.

The hypothesis formulated:

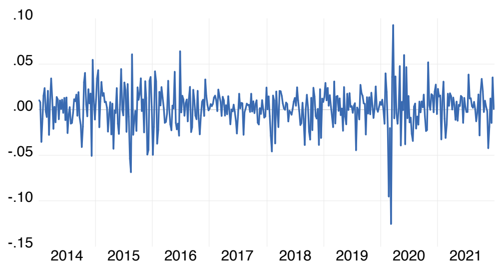
H_1: There is a strong link between GSVI and volatility over the period under review.

H_2: There is no relationship between GSVI and volatility in the analyzed period.

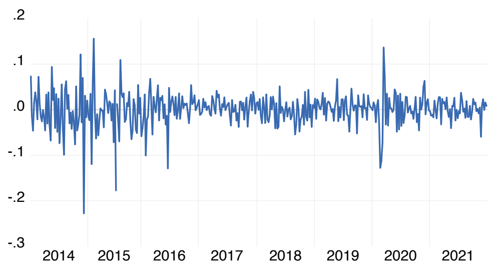
Statistical data were processed with EViews12 software (Quantitative Micro Software, SUA)

4.1.4 REZULTATE

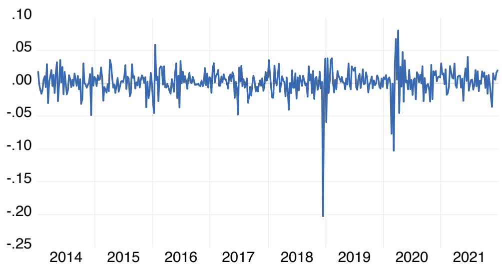
It has been observed that stock indices shows the characteristics of volatility grouping, (Figure 4.1).



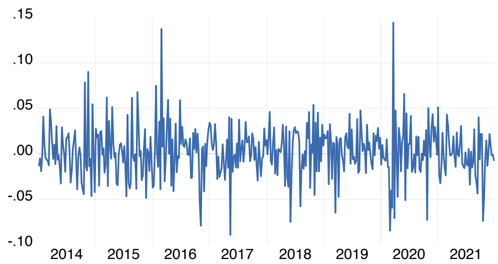
AEX



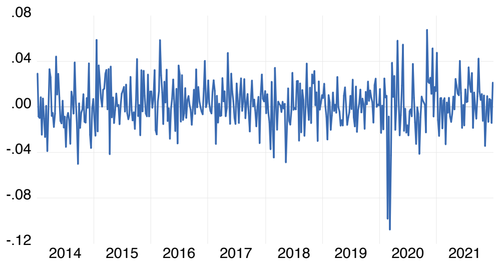
ATHEX



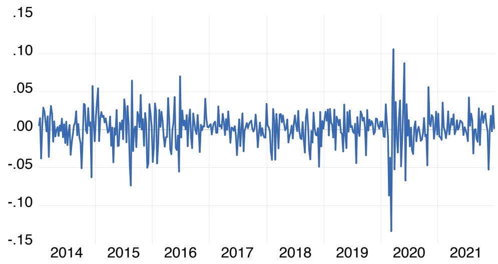
BET



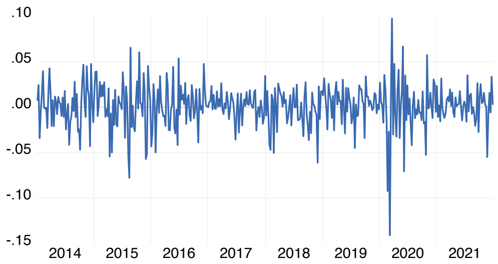
BOVESPA



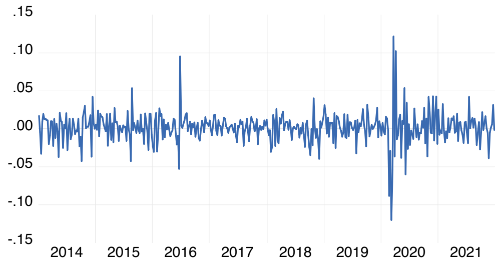
BUX



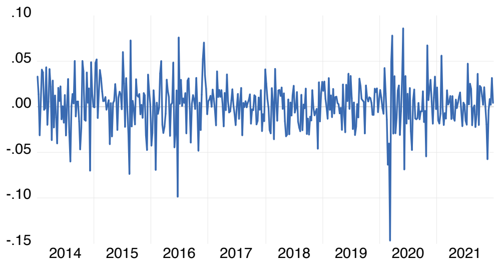
CAC40



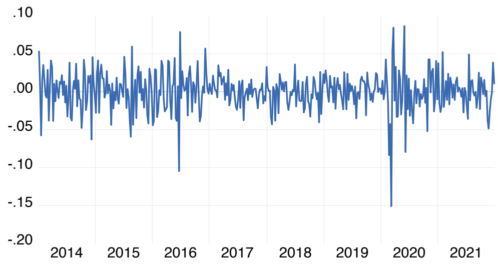
DAX40



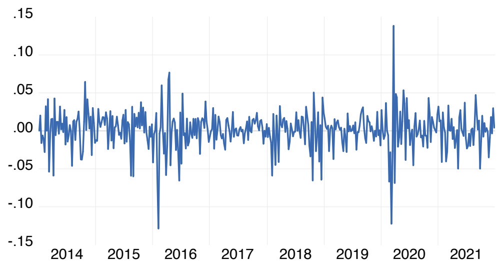
FTSE 250



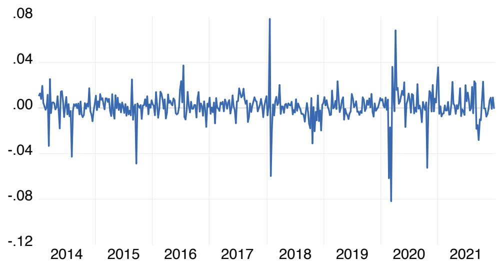
FTSE MIB



IBEX



NIKKEI



OMX Vilnius

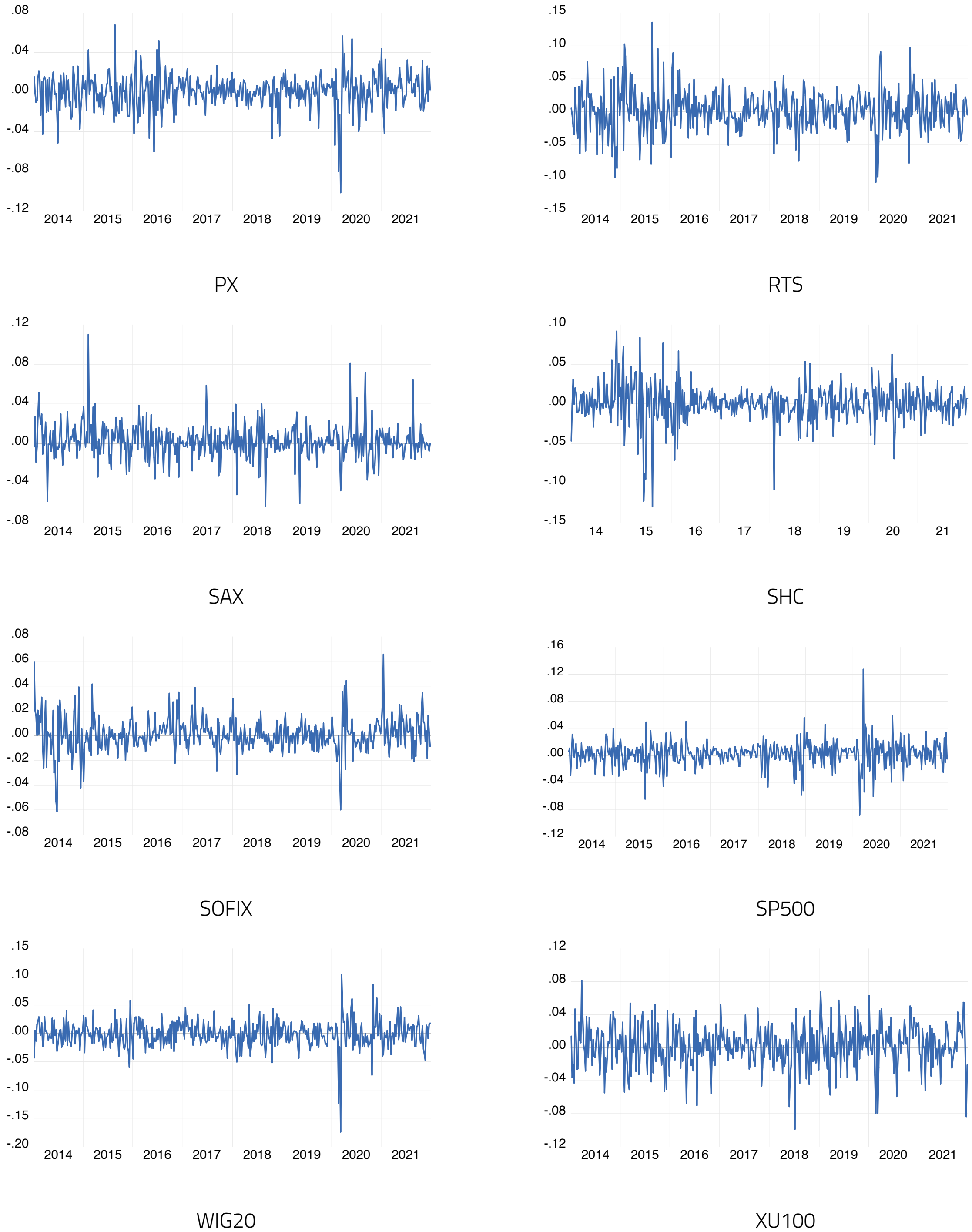


Figure 4.1 Index returns

Table 4.2 presents the descriptive statistics for all series, over the entire considered period. From the data presented, it can be stated that the analyzed time series do not follow a normal distribution. Values other than zero can be observed for all series of the asymmetry coefficient, (skewness indicator).

Table 4.2 Descriptive statistics (adapted from Panazan and Gheorghe, 2023)

Variable	Average	Median	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Probability
AEX	0.001774	0.003080	0.021543	-0.619185	7.249905	340.4676	0.0000
ATHEX	0.000451	0.003092	0.036533	-0.860736	9.392410	754.1789	0.0000
BET	0.001874	0.002387	0.020491	-2.695879	28.26051	11591.98	0.0000
BOVESPA	0.002345	0.001510	0.028507	0.322998	5.653391	129.5792	0.0000
BUX	0.002279	0.001734	0.020379	-0.422397	6.077801	176.9911	0.0000
CAC40	0.001628	0.003098	0.023234	-0.541778	7.329914	346.1490	0.0000
DAX40	0.001067	0.002045	0.023696	-0.711495	7.042633	319.1402	0.0000
FTSE250	0.001520	0.002248	0.019886	0.113516	12.25353	1488.679	0.0000
FTSE MIB	0.002143	0.004095	0.025847	-0.541258	6.267479	205.8634	0.0000
IBEX	0.000184	0.001340	0.025272	-0.614976	6.803486	277.6401	0.0000
NIKKEI	0.000873	0.001744	0.024945	-0.471856	8.085334	464.8023	0.0000
OMX VILNIUS	0.001627	0.001800	0.012565	-0.706160	15.94735	2947.294	0.0000
PX	0.000377	0.001697	0.018116	-0.710910	6.871941	295.6095	0.0000
RTS	0.001315	0.001065	0.032046	0.132805	4.488018	39.69748	0.0000
SAX	0.002128	0.000472	0.017969	0.641522	8.168554	492.7576	0.0000
SHC	9.26E-05	0.000935	0.024783	-0.757826	8.149574	493.4622	0.0000
SOFIX	0.000878	0.000424	0.014099	0.147902	6.789641	251.0493	0.0000
SP500	0.002233	0.003792	0.018992	0.093611	9.135242	654.6249	0.0000
WIG20	-0.001186	-0.001694	0.023895	-0.832462	11.43767	1285.165	0.0000
XU100	0.001778	0.002600	0.026268	-0.394862	3.780464	21.41972	0.0000
GSVI	146.3909	145.0000	44.72010	0.393471	3.294389	12.26574	0.0022

Author's calculations using EViews.

Kurtotic, (kurtosis indicator), shows the amplitude of extreme values, (Table 4.2). All measured values recorded an indicator value greater than 3. The probability of an extreme event occurring is greater than the probability of that event occurring if the distribution is normal. To establish heteroskedasticity, preliminary tests were performed to detect ARCH effects. For this purpose, the Q-test, partial autocorrelation (PAC) and autocorrelation (AC) were established (Greene, 2002).

According to the results of the Q test, the existence of serial correlation, heteroscedasticity (p-value less than 5%) is confirmed. Correlation up to gap 20 cannot be rejected. Therefore, the EGARCH model can be used for the data series. Next, the stationarity of the data series was checked using the Augmented Dickey-Fuller test (ADF), (Greene, 2002).

Table 4.5 EGARCH results

Dependent variable	Independent variable	Coefficient	Std. Error	z-Statistic	Prob.
AEX	GSVI	1.43E-05	1.53E-05	0.931651	0.3515
ATHEX	GSVI	4.72E-05	2.74E-05	1.719109	0.0856
BET	GSVI	-4.80E-05	8.66E-06	-5.537310	0.0000
BOVESPA	GSVI	2.46E-05	2.59E-05	0.948975	0.3426
BUX	GSVI	3.00E-05	1.84E-05	1.624978	0.1042
CAC40	GSVI	4.31E-05	2.12E-05	2.039376	0.0414

DAX40	GSVI	4.23E-05	1.65E-05	2.561269	0.0104
FTSE 250	GSVI	4.78E-06	1.54E-05	0.310300	0.7563
FTSE MIB	GSVI	6.49E-05	2.23E-05	2.904126	0.0037
IBEX	GSVI	4.04E-05	2.06E-05	1.963122	0.0496
NIKKEI	GSVI	2.06E-05	2.14E-05	0.961868	0.3361
OMX Vilnius	GSVI	-1.16E-05	1.41E-05	-0.824899	0.4094
PX	GSVI	4.89E-05	1.69E-05	2.890971	0.0038
RTS	GSVI	5.03E-05	2.93E-05	1.714365	0.0865
SAX	GSVI	5.59E-06	1.88E-05	0.296947	0.7665
SHC	GSVI	1.55E-05	1.69E-05	0.916928	0.3592
SOFIX	GSVI	2.06E-06	1.17E-05	0.175451	0.8607
SP500	GSVI	6.50E-06	1.62E-05	0.401918	0.6877
WIG20	GSVI	1.54E-05	2.24E-05	0.689061	0.4908
XU100	GSVI	2.17E-05	3.12E-05	0.697432	0.4855

Author's calculations using EViews.

The β term indicates the extent to which relocation news volume affects future index return volatility. Value greater than 0 indicates a positive relationship between the past and present return variance of most series, (Table 4.6). Following the application of the EGARCH (1,1) model, the conditional volatilities represented graphically in Figure 4.3 were estimated. The results are consistent with the proposed hypothesis H_1.

Table 4.6 The coefficients of the equation

Stock exchange indices	ω	β	γ	α
AEX	-1.770499	0.353479	-0.172008	0.810926
ATHEX	-0.420609	0.143241	-0.170911	0.954998
BET	-0.204488	-0.114394	-0.109526	0.963763
BOVESPA	-11.10852	0.467523	-0.131125	-0.482665
BUX	-0.179384	-0.084073	-0.071539	0.968926
CAC40	-1.288502	0.255862	-0.177996	0.858528
DAX40	-1.364340	0.332043	-0.102166	0.855347
FTSE 250	-1.309242	0.220370	-0.195607	0.859832
FTSE MIB	-1.049067	0.238119	-0.175956	0.883272
IBEX	-1.662902	0.308571	-0.160771	0.810887
NIKKEI	-1.424816	0.299781	-0.187304	0.842425
OMX Vilnius	-2.520802	0.333439	-0.021419	0.740615
PX	-1.074496	0.315475	-0.085839	0.897482
RTS	-0.550545	0.127160	-0.165476	0.934969
SAX	-1.220318	0.050576	0.246297	0.854598
SHC	-0.504507	0.328947	0.104469	0.966350
SOFIX	-2.018469	0.539265	-0.007207	0.815355
SP500	-1.750766	0.415352	-0.221358	0.824741
WIG20	-3.020661	0.316229	-0.230044	0.637311
XU100	-1.844809	0.101402	-0.048759	0.758048

Author's calculations using EViews.

According to the statistical results, the modulus of the roots of the characteristic polynomial is less than 1, therefore the equation is stable. It follows that the series are stationary and do not follow a stochastic process.

To determine the possibility of a long-term relationship between indices and GSVI a cointegration test was performed. Determining the optimal number of lags refers to Akaike Information Criterion (AIC), Schwarz Information Criterion (SC) and Hannan-Quinn Criterion (HQ) with the lowest value as well as the LR with the highest value.

Finally, a Granger causality test was performed to capture the causal relationships between the variables (Adekoya and Oliyide, 2022; Foroutan and Lahmiri, 2022). In VAR processing, the Granger causality test analyzes whether the GSVI variable causes changes in the INDEX variable. If GSVI causes INDEX, then lags of GSVI should be significant in the INDEX equation. In this case, it can be said that GSVI Granger causes INDEX or that there is unidirectional causality from GSVI to INDEX. In the study both sets of lags are statistically insignificant. There is no causal relationship between the two variables.

4.2 STATISTICAL MODELING

Relocation involves high risk due to various aspects that need to be taken into account: costs, resources, labor force, market legislation, natural environment, research and development potential, tax incentives granted by the authorities, infrastructure and others, (Gheorghe & Panazan, 2021a).

4.2.1 SYNTHESIS OF CAUSES AND FACTORS

Researchers have used various ways of grouping the causes of relocation. The research identified 8 factors and 29 sub-factors with which it statistically determined the attractiveness of different regions as locations for owned manufacturing units. Based on this framework, a synthesis of the determining causes was proposed, which avoids the overlap between the criteria and ensures a certain homogeneity of them.

Each factor corresponds to three measurement indicators considered relevant. Among them, only one indicator was selected for each factor. The selection of indicators was carried out in such a way as to avoid collinearity between the factors. The Eastern European states 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).

4.2.2 RESULT

The data were statistically processed with SPSS version 25. Using multiple linear regression, the regression equation that best approximates each of the 8 selected criteria was determined. The relationship was applied to establish the score obtained by each state considered in the analysis. It started from the general form of a multiple regression equation:

$$y = \beta_0 + \beta_1 \cdot x_1 + \beta_2 \cdot x_2 + \ldots + \beta_p \cdot x_p + \varepsilon \quad (4.6)$$

Where: p, the number of variables; $x_1, x_2, \ldots, x_p$, the independent variable; β_0, intercept; $\beta_1, \beta_2, \ldots, \beta_p$, the weight of the independent variables; ε, the error term.

The estimated multiple regression equation is:

$$\hat{y} = \beta_0 + \beta_1 \cdot x_1 + \beta_2 \cdot x_2 + \ldots + \beta_p \cdot x_p \quad (4.7)$$

Where: $\hat{y}$ is the predicted value of the dependent variable; $b_1, b_2, \ldots, b_p$, estimates of $\beta_1, \beta_2, \ldots, \beta_p$.

The dependent variable was considered the state, and the independent variables are represented by the indicators considered. The SPSS program analyzed all possible variants between variables and eliminated irrelevant variants. By relevant we mean a variant that does not present multicollinearity. The summary of the model is presented in the ANOVA Table (4.13).

Table 4.13 ANOVA (adapted from Gheorghe and Panazan, 2021a)

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: state					

From the calculation it resulted R^2 = 0,853 which means a large influence on the relationship between dependent variables. Since the variables were scaled, a Pearson correlation was chosen. It is observed in the Correlation Table that there is no significant relationship between the independent variables. If we substitute the values obtained in relation 4.7, the following form of the predictive model results:

$$Scor = 36.254 - 0.755 \cdot x_1 + 0.01 \cdot x_3 - 0.98 \cdot x_4 + 1.152 \cdot x_5 + 0.03 \cdot x_6 + 0.01 \cdot x_7 - 0.16 \cdot x_8 \quad (4.8)$$

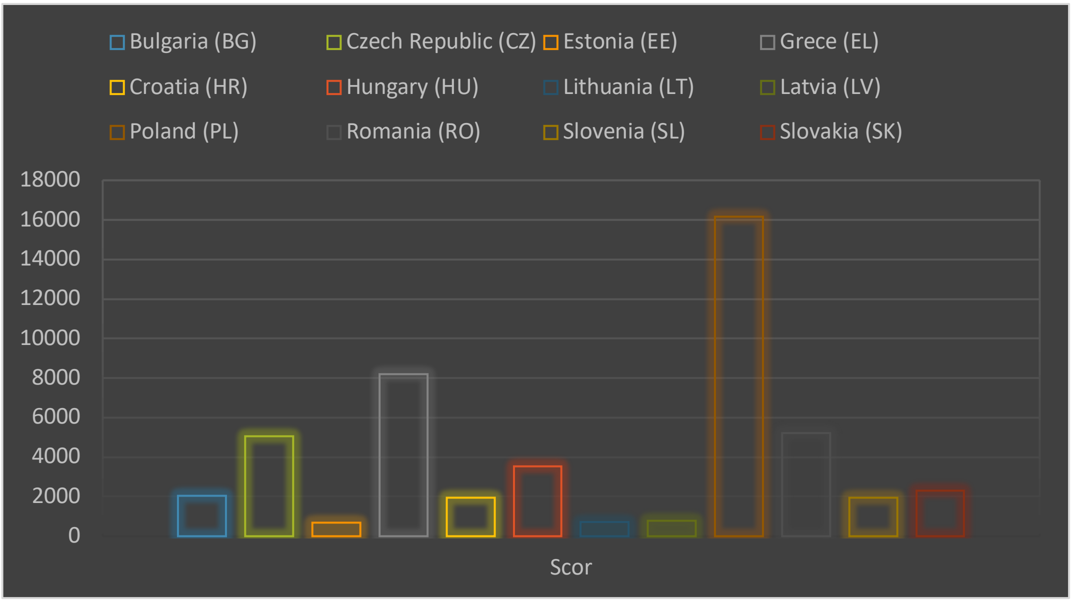


Figure 4.5 The score obtained by the analyzed states (adaptation from Gheorghe and Panazan, 2021a)

The relationship allowed scoring for each selected state, (Figure 4.5). The graph shows the scores obtained. In first place is Poland with a surprisingly high score compared to other countries. In second place is Greece, followed by the Czech Republic, Romania, and Hungary.

4.2.3 MAXIMIZATION OF THE OBJECTIVE FUNCTION

To maximize the objective function, the problem was approached using operational research techniques, (Dantzig, 1960). Solutions were identified by linear programming using Maple 2019 programs and C++ code from the CodeBlocks application. Then game theory was applied to select the optimal consumption option (Figure 4.6).

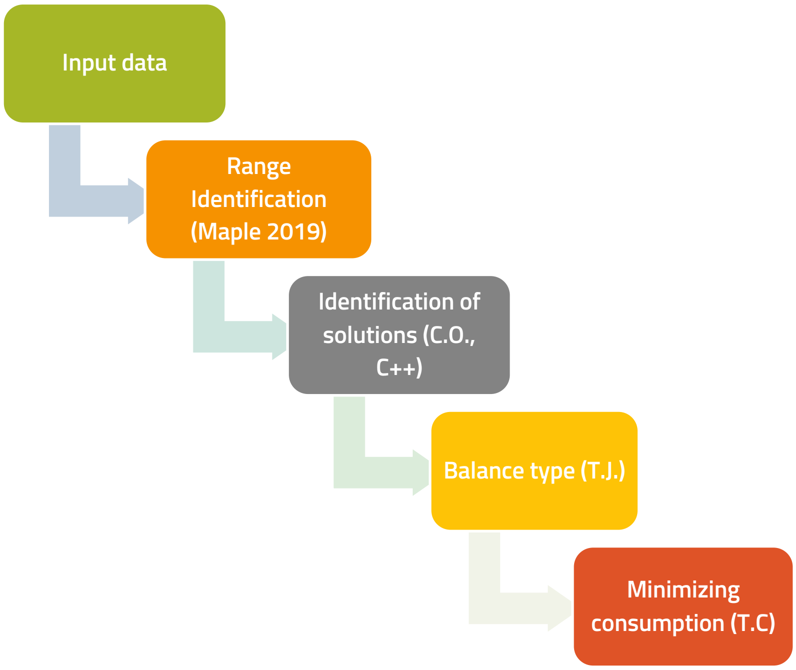


Figure 4.6 Solution steps (adapted from Panazan et al., 2021a)

Linear programming of the objective function in Maple2019 and CodeBlocks, C++ code led to efficient problem solving without the need to access other optimization programs.

4.3 MODELS OF DECISION MAKING WITH MULTIPLE CRITERIA

Multi-criteria decision making prioritizes and ranks predetermined alternatives by evaluating multiple alternative attributes. Complexity increases when there are multiple decision makers, as the final decision must reach a consensus that can at best be agreed upon, or at least accepted by the stakeholders.

4.3.1 SOLVING THE RELOCATION PROBLEM USING METHODS WITH INFORMATION ON CRITERIA

To solve the relocation problem, (Gheorghe and Panazan, 2019) the following comparison norms were considered: equivalent in EU GDP (N_1), inflation (N_2), employment rate (N_3), unemployment rate (N_4), infrastructure (N_5), VAT (N_6) and the minimum wage (N_7), (http://ec.europa.eu/eurostat/data/database accessed on date 8.03.2019). The goal is to maximize the criteria N_1, N_3, N_5, respectively minimization N_2, N_4, N_6, and N_7. The variants taken into account are represented by the states of the European Union: Bulgaria (V_1), Estonia (V_2), Latvia (V_3), Lithuania (V_4), Poland (V_5), Romania (V_6) and Slovakia (V_7). The decision matrix attached to the problem is presented in Table 4.15.

The matrix of consequences consists of the minimum criteria N_2, N_4, N_6 and N_7 and the vector of mean levels V_0= {0,28; 1,59; 0,94; 1,45; 0,83; 1,12; 1,23}. Approaching the relocation problem by the conjunctive method reduced the set of variants to the variant V_4 corresponding to Lithuania.

Substituting in relation 3.1 the values were obtained: V_1=0,583; V_2=0,584; V_3=0,613; V_4=0,607; V_5=0,375; V_6=0,429 and V_7=0,649. The maximum value by applying the method of elimination by aspects with combinations of variants was recorded for variant 7 corresponding to Slovakia.

The real utility of the criteria led to the following results of the studied variants: V_1=0,286; V_2=0,357; V_3=0,250; V_4=0,357; V_5=0,893; V_6=0,393; V_7=0,357; The multitude of variants comes down to V_5 , respectively Poland.

To address the relocation problem by the simple additive weighting method was calculated $f(V_i)$, (chapter 3, relation 3.2) and the values were obtained: $f(V_1)$=1,08; $f(V_2)$=0,96; $f(V_3)$=0,94; $f(V_4)$=1,00; $f(V_5)$=1,41; $f(V_6)$=1,04; $f(V_7)$=1,03. The maximum value is recorded for variant five, corresponding to Poland.

4.3.2 INTEGRATED ANP-TOPSIS MODEL

The hybrid ANP-TOPSIS method captures the interdependencies and feedbacks between levels, drives the site selection approach, and simultaneously considers environmental, economic, political, and social policies (Nong, 2022). The research model is structured in six stages: problem identification, selection of factors, selection of sub-factors, calculation of criteria weights with the ANP method, evaluation of alternatives by application of the TOPSIS method and discussions regarding the ranking of alternatives.

4.3.2.1 CRITERIA AND FACTORS

Some details of the methodology adopted and applied are presented in the following: data were collected for each country for the period 2017–2020 from the Eurostat database, (www.eurostat, accessed 01.03.2022). A summary of the criteria it was proposed to ensure homogeneity. Most refer to the human resources available in the countries considered in the analysis.

The aim of the research is to anticipate the barriers, the competitiveness of the relocation motivations, although in this uncertain context the motivations are clearly defined, and the selected states are: Belgium (S_1); Bulgaria (S_2); Czech Republic (S_3); Denmark (S_4); Germany (S_5); Estonia (S_6); Ireland (S_7);

Greece (S_8); Spain (S_9); France (S_{10}); Croatia (S_{11}); Italy (S_{12}); Cyprus (S_{13}); Latvia (S_{14}); Lithuania (S_{15}); Luxembourg (S_{16}); Hungary (S_{17}); Malta (S_{18}); Netherlands (S_{19}); Austria (S_{20}); Poland (S_{21}); Portugal (S_{22}); Romania (S_{23}); Slovenia (S_{24}); Slovakia (S_{25}); Finland (S_{26}); Sweden (S_{27}); Iceland (S_{28}); Norway (S_{29}); Switzerland (S_{30}); Montenegro (S_{31}); North Macedonia (S_{32}); Serbia (S_{33}) and Turkey (S_{34}).

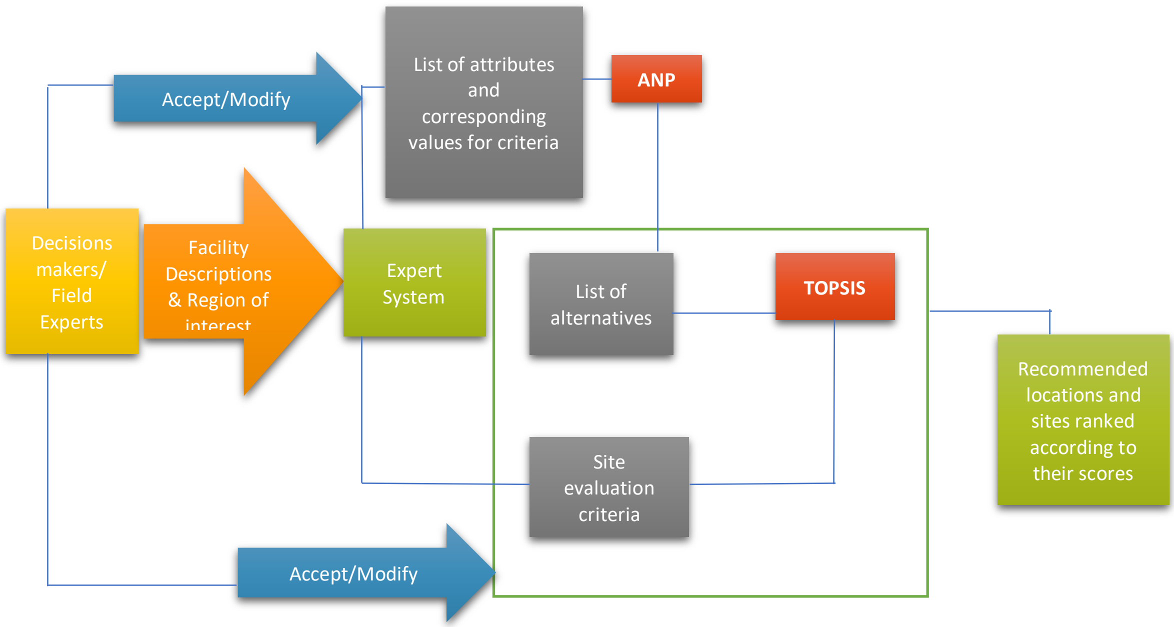


Figure 4.7 The conceptual model of the research (adaptat după Panazan și colab., 2022)

4.3.2.2 RESULT

The ANP method illustrated the structure of the model and the interdependence of the criteria (Figure 4.7). In the first stage, the results were normalized, and the decision matrix followed.

This analysis shows that integrated ANP-TOPSIS model have been applied to evaluate and prioritize relocation strategies in Europe. It was decided to apply the ANP due to the possible dependencies between criteria, indicators, and alternatives. Calculations' results, the relative proximity of the ideal solution (Ci + related to (3.28)), are presented in Table 4.22 (calculations separated from the positive ideal point Si + based on (3.26) and the negative point Si + based on (3.27)).

Table 4.21 The positive/negative solutions (adapted from Panazan et al., 2022)

State	2017		2018		2019		2020	
	Si+	Si-	Si+	Si-	Si+	Si-	Si+	Si-
Belgium	2.57E-01	4.13E-02	2.55E-01	4.57E-02	2.51E-01	4.65E-02	2.53E-01	4.02E-02
Bulgaria	2.76E-01	1.28E-02	2.76E-01	1.21E-02	2.74E-01	9.92E-03	2.71E-01	1.13E-02
Czech Republic	2.43E-01	5.24E-02	2.39E-01	5.49E-02	2.33E-01	5.64E-02	2.38E-01	5.01E-02
Denmark	2.71E-01	1.95E-02	2.72E-01	1.79E-02	2.68E-01	1.76E-02	2.65E-01	1.90E-02
Germany	3.53E-02	2.82E-01	3.55E-02	2.81E-01	3.70E-02	2.77E-01	3.19E-02	2.77E-01
Estonia	2.85E-01	5.91E-03	2.84E-01	6.91E-03	2.80E-01	6.20E-03	2.80E-01	4.78E-03

Ireland	2.75E-01	1.42E-02	2.75E-01	1.38E-02	2.70E-01	1.42E-02	2.70E-01	1.33E-02
Greece	2.51E-01	4.02E-02	2.48E-01	4.64E-02	2.45E-01	4.62E-02	2.53E-01	3.47E-02
Spain	1.60E-01	1.35E-01	1.62E-01	1.35E-01	1.56E-01	1.38E-01	1.53E-01	1.35E-01
France	1.33E-01	1.56E-01	1.47E-01	1.44E-01	1.44E-01	1.42E-01	1.45E-01	1.39E-01
Croatia	2.82E-01	6.53E-03	2.81E-01	6.64E-03	2.77E-01	7.10E-03	2.76E-01	7.06E-03
Italy	2.01E-01	9.79E-02	1.99E-01	9.91E-02	1.91E-01	1.02E-01	1.90E-01	1.01E-01
Cyprus	2.85E-01	1.47E-02	2.80E-01	2.72E-02	2.76E-01	2.75E-02	2.79E-01	1.39E-02
Latvia	2.81E-01	1.00E-02	2.78E-01	1.31E-02	2.75E-01	1.18E-02	2.76E-01	7.97E-03
Lithuania	2.82E-01	9.77E-03	2.79E-01	1.37E-02	2.74E-01	1.38E-02	2.74E-01	1.08E-02
Luxembourg	2.79E-01	3.45E-02	2.79E-01	3.31E-02	2.74E-01	3.39E-02	2.74E-01	3.39E-02
Hungary	2.67E-01	3.74E-02	2.63E-01	3.87E-02	2.59E-01	3.91E-02	2.61E-01	3.56E-02
Malta	1.77E-01	1.19E-01	1.77E-01	1.17E-01	1.74E-01	1.17E-01	1.78E-01	1.14E-01
Netherlands	2.26E-01	8.92E-02	2.26E-01	8.66E-02	2.22E-01	8.78E-02	2.19E-01	8.43E-02
Austria	2.48E-01	4.92E-02	2.45E-01	5.18E-02	2.41E-01	5.22E-02	2.45E-01	4.63E-02
Poland	1.69E-01	1.25E-01	1.75E-01	1.19E-01	1.66E-01	1.23E-01	1.67E-01	1.21E-01
Portugal	2.73E-01	1.72E-02	2.73E-01	1.62E-02	2.69E-01	1.58E-02	2.69E-01	1.49E-02
Romania	2.70E-01	1.97E-02	2.67E-01	2.17E-02	2.62E-01	2.31E-02	2.60E-01	2.25E-02
Slovenia	2.82E-01	7.38E-03	2.81E-01	7.61E-03	2.76E-01	7.90E-03	2.76E-01	7.16E-03
Slovakia	2.68E-01	3.83E-02	2.67E-01	3.75E-02	2.62E-01	3.82E-02	2.64E-01	3.40E-02
Finland	2.61E-01	2.84E-02	2.61E-01	2.79E-02	2.57E-01	2.73E-02	2.57E-01	2.63E-02
Sweden	2.44E-01	4.59E-02	2.41E-01	4.77E-02	2.41E-01	4.43E-02	2.37E-01	4.63E-02
Iceland	1.77E-01	1.19E-01	1.77E-01	1.17E-01	1.73E-01	1.16E-01	1.70E-01	1.17E-01
Norway	2.61E-01	3.37E-02	2.61E-01	3.30E-02	2.58E-01	3.22E-02	2.57E-01	3.29E-02
Switzerland	2.56E-01	4.39E-02	2.54E-01	4.70E-02	2.50E-01	4.45E-02	2.45E-01	5.06E-02
Montenegro	2.89E-01	1.43E-03	2.88E-01	1.70E-03	2.83E-01	8.51E-03	2.77E-01	2.83E-02
North Macedonia	1.71E-01	1.22E-01	1.77E-01	1.18E-01	1.74E-01	1.18E-01	1.66E-01	1.19E-01
Serbia	1.66E-01	1.25E-01	1.68E-01	1.21E-01	1.65E-01	1.21E-01	1.70E-01	1.18E-01
Turkey	1.63E-01	1.31E-01	1.71E-01	1.24E-01	1.67E-01	1.25E-01	1.60E-01	1.29E-01

These results have given the countries ranking (Figure 4.8). The main results are:

- Germany is the best solution for relocation in all periods analyzed, followed by France with a difference of 0.384, Spain with 0.426 and Turkey with 0.454. Therefore, Germany is the best choice for business location due to its modern infrastructure and the stability of its political and economic environment.
- Poland, Hungary and Austria have been one of the most attractive countries for companies in the last two decades. However, there is a reduction in the score after 2019;
- The Czech Republic and Slovakia were two favorite destinations for Western European companies. In the case of the Czech Republic, there is a reduction in the score after 2019, while Slovakia registered a sharp decrease in the rating throughout the period;
- In Romania the results show a capping of the score after 2019;
- Bulgaria registered a decrease in the score for the entire analyzed period. A similar trend is manifested in Greece, Cyprus, Malta, and Serbia especially after 2019;

- In the case of Slovenia, a turning point in 2019 can be identified, materialized by the consistent decrease of the score;
- The Baltic countries have had an approximately similar evolution. If in the case of Estonia and Latvia there is a decrease in the score after 2018, in Lithuania the trend is to cap;
- There are several countries that have had an increase score, such as Croatia, Northern Macedonia, and Montenegro;
- Germany, Switzerland, Spain and Italy are characterized by a considerable increase in the score. A similar dynamic, but with a lower growth rate we meet in Iceland;
- Norway, the Netherlands, Belgium had an oscillating evolution but with growth trends after 2019;
- We find a distinct situation in Turkey. Although there was a sharp decrease in the score in 2018 and 2019, there is an increase in 2020. The increase in score can be justified by the geostrategic position that this country has.

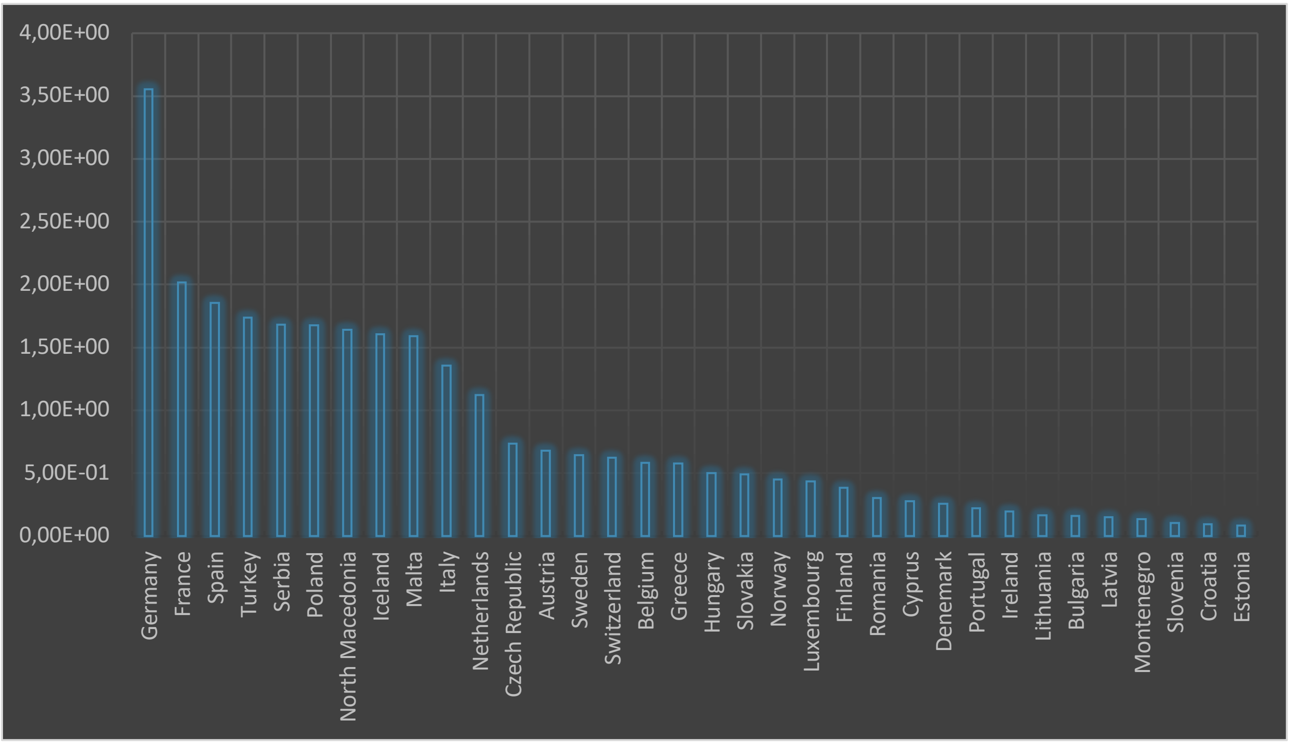


Figura 4.8 The Rank of the considered countries in the research. (Adapted from Panazan et al., 2022)

The criteria and sub-criteria taken into account in the analysis and their dynamics during the analyzed period were presented in the study. Such a phenomenon will cause considerable changes in the human resources market, (HR), a field also related to the geographical areas of material and financial flows, (Destefanis et al., 2021).

4.3.3 ANALYTIC HIERARCHY PROCESS (AHP)

The business environment is constantly changing, disruptive factors are constantly changing the economic geography. The COVID-19 pandemic and the armed conflict in Ukraine are just the latest phenomena that entrepreneurs are still dealing with. If the Covid-19 pandemic transformed the whole world and showed certain social, medical and financial limits (Gheorghe and Panazan, 2023), the effect that the conflict has on relocation decisions cannot be estimated.

4.3.3.1 METHODOLOGY

The selected criteria (Table 4.23) reflect the dynamics and demographic structure of the population, migration, labor force, research and development. The measurement indicators (Appendix 2, Appendix 3, Appendix 4, Appendix 5, Appendix 6, Appendix 7, Appendix 8, Appendix 9) selected capture the evolution of these factors.

The definition in the form of a hierarchy of objectives, of the decision criteria, leads to the modeling of the multi-criteria decision problem in deterministic conditions (Table 4.22) in the eight administrative regions of Romania: North-East (A_1), South-Muntenia (A_2), West (A_3), Center (A_4), South-East (A_5), South-West Oltenia (A_6), North-West (A_7) and Bucharest-Ilfov (A_8).

4.3.3.2 RESULT

In this case, the AHP method is considered to establish a comparison of the alternatives. Comparison matrices are used to establish the weight of each criterion. These matrices are constructed in a sequential manner where the comparison is established at each level. Weights were thus established for each indicator.

Table 4.34 Global priorities

	2014	2015	2016	2017	2018	2019	2020	2021	Rank
A_1	1.50E-01	1.51E-01	1.50E-01	1.49E-01	1.49E-01	1.49E-01	1.49E-01	1.52E-01	1
A_2	1.47E-01	1.46E-01	1.46E-01	1.46E-01	1.45E-01	1.45E-01	1.44E-01	1.38E-01	2
A_3	9.84E-02	9.88E-02	9.96E-02	9.99E-02	9.92E-02	9.96E-02	1.00E-01	9.64E-02	7
A_4	1.16E-01	1.16E-01	1.15E-01	1.16E-01	1.16E-01	1.17E-01	1.17E-01	1.15E-01	6
A_5	1.27E-01	1.27E-01	1.27E-01	1.26E-01	1.26E-01	1.26E-01	1.25E-01	1.20E-01	5
A_6	1.00E-01	9.99E-02	1.00E-01	9.89E-02	9.89E-02	9.83E-02	9.73E-02	9.47E-02	8
A_7	1.30E-01	1.31E-01	1.30E-01	1.31E-01	1.31E-01	1.32E-01	1.32E-01	1.28E-01	4
A_8	1.30E-01	1.31E-01	1.32E-01	1.34E-01	1.35E-01	1.35E-01	1.37E-01	1.56E-01	3

These weights were applied equally in the evaluation of the alternatives in order to obtain an objective assessment for each region.

MDM methods are only tools that recommend solutions to decision makers. Within this chapter, the following ranking of the regions resulted, (Table 4.34) and the evolution of the regions in the analyzed periods, (Figure 4.9).

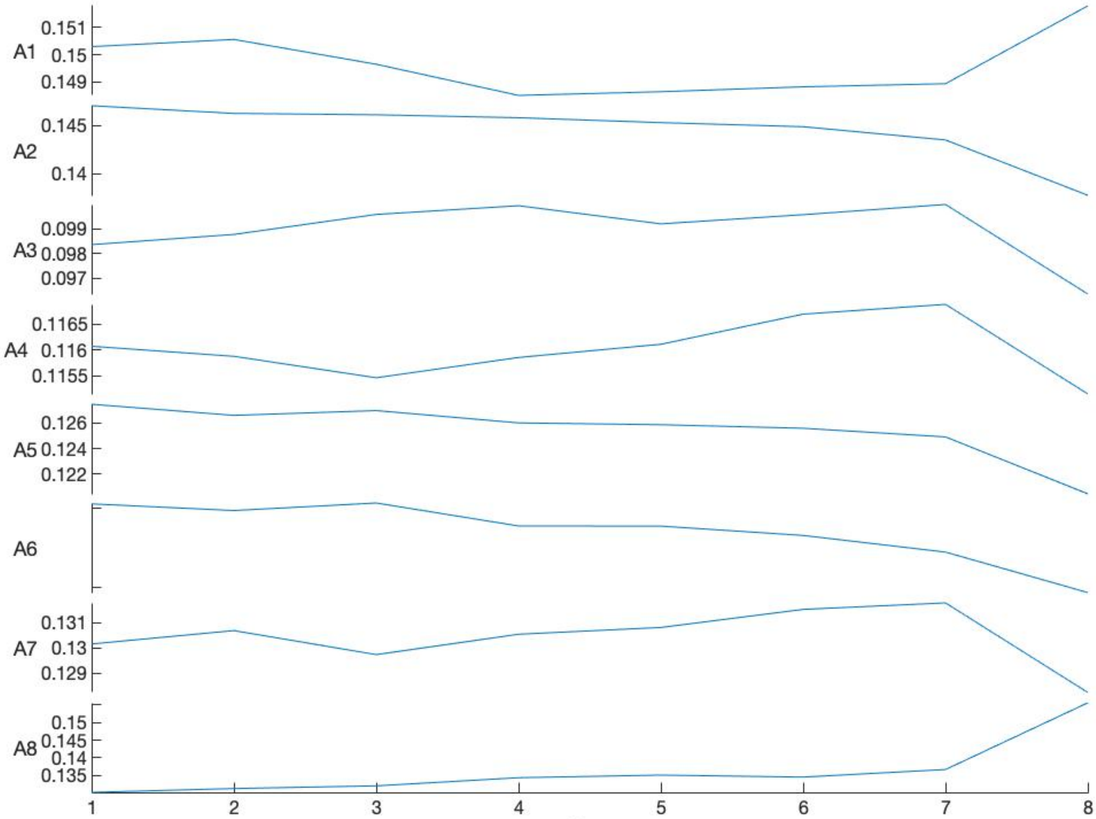


Figure 4.9 Evolution of the regions

4.4 PROGRAM STRUCTURE

Dynamic program analysis and optimization is emerging as a promising technique for improving performance. Using information gathered at runtime, the dynamic build system can identify and implement profitable optimizations.

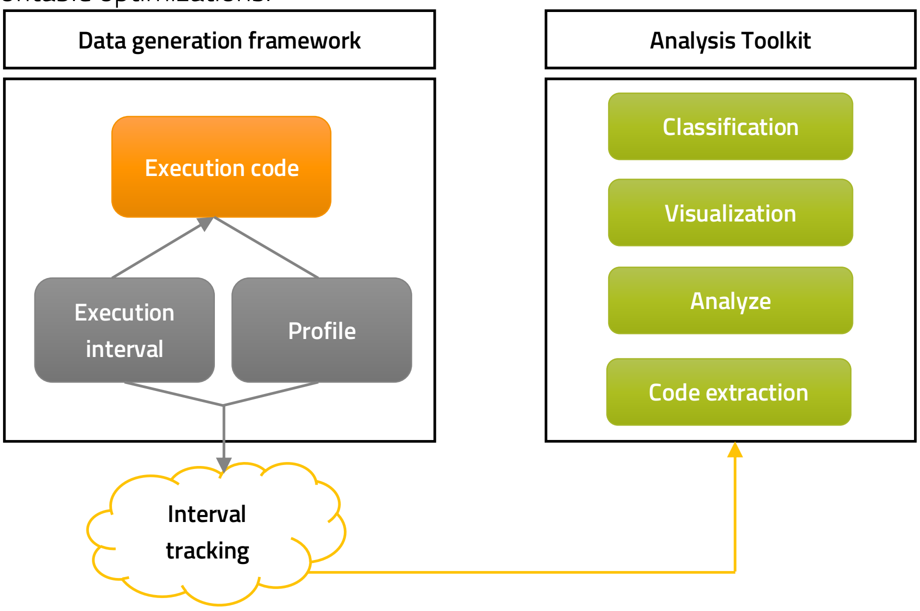


Figure 4.10 Framework for phased behavior analysis (adapted from Sherwood et al., 2001)

The Java paradigm for executing programs is a two-step process, (Figure 4.10). First, the source is converted to a platform-independent intermediate representation consisting of information stored in class files (Lindholm and Yellin, 1996). The second stage of the process involves specific conversions, followed by code execution. The application is designed to perform dynamic site selection measurements. The application was made in IntelliJ IDEA in the Java programming language.

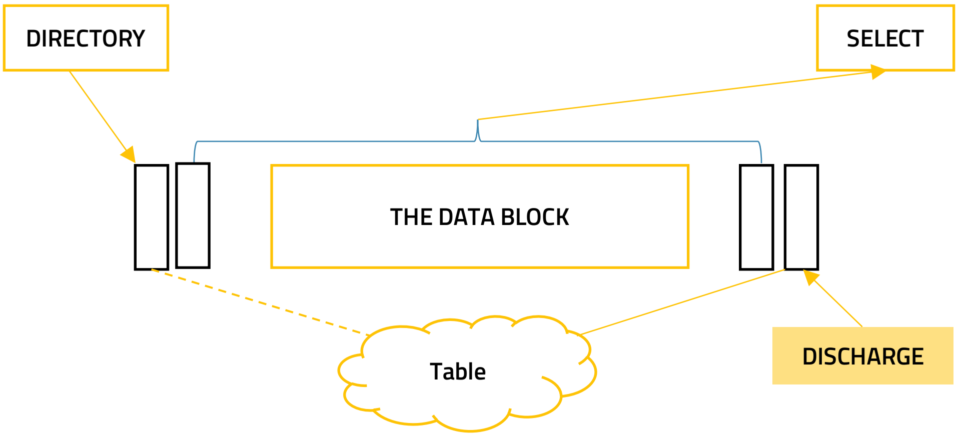


Figure 4.11 SQLite architecture (adapted from Sherwood et al., 2001)

SQLite is the application's standard file system. The records are in the database folder, from where they are selected using the SELECT statement. Here, the block is an in-memory table of SQLite, which provides performance by avoiding the problem of exclusive control of database files and by using a method of mass storage of records, (Figure 4.11).

The automated process corresponding to the construction of a software system and the associated processes, (compiling the source code, running automated tests, packaging the binary code) contains the following categories, (Walls, 2015):

- Automatic build utility. Generates the artifacts corresponding to the build during compilation and/or code editing. The Gradle tool was used to design the application, which allows adding more dependencies and external libraries for Java.
- Auto build servers. Software systems that run automated build utilities at predefined time periods or when certain events occur.

The interface design was done in the SceneBuilder application, and the files are of FXML type, saving them in the resource area (Figure 4.14).

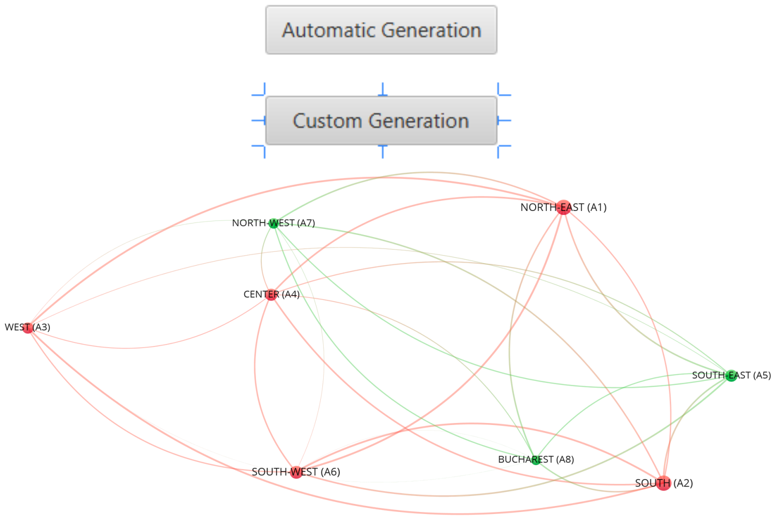


Figure 4.14 Application interface

A Gradle build is configured using specific files and its associated tasks. In the case of the application, the build consisted of several projects. Each build had a settings.gradle file in the root of the project.

The controllers were implemented, being associated to a single FXML file. They are responsible for the logic of the interface components.

The controller class assigned to the main menu. It contains two functions that manage the click action of the buttons, (Figure 4.14).

Logging tools allow different types of messages to be logged from the source code for various purposes: debugging, warning, analysis. Most tools define different levels for messages. In the application we have the error message. Configuration was done via configuration text files and can be turned off or on at runtime.

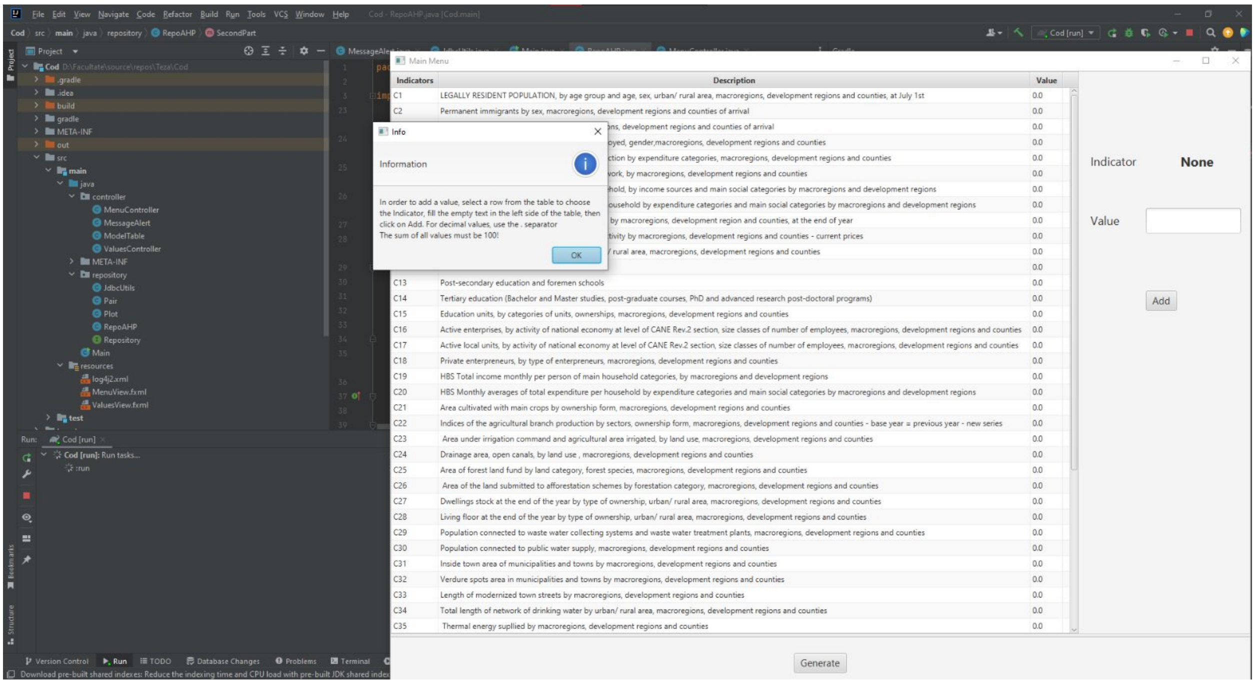


Figure 4.19 Preparation of the associated vector

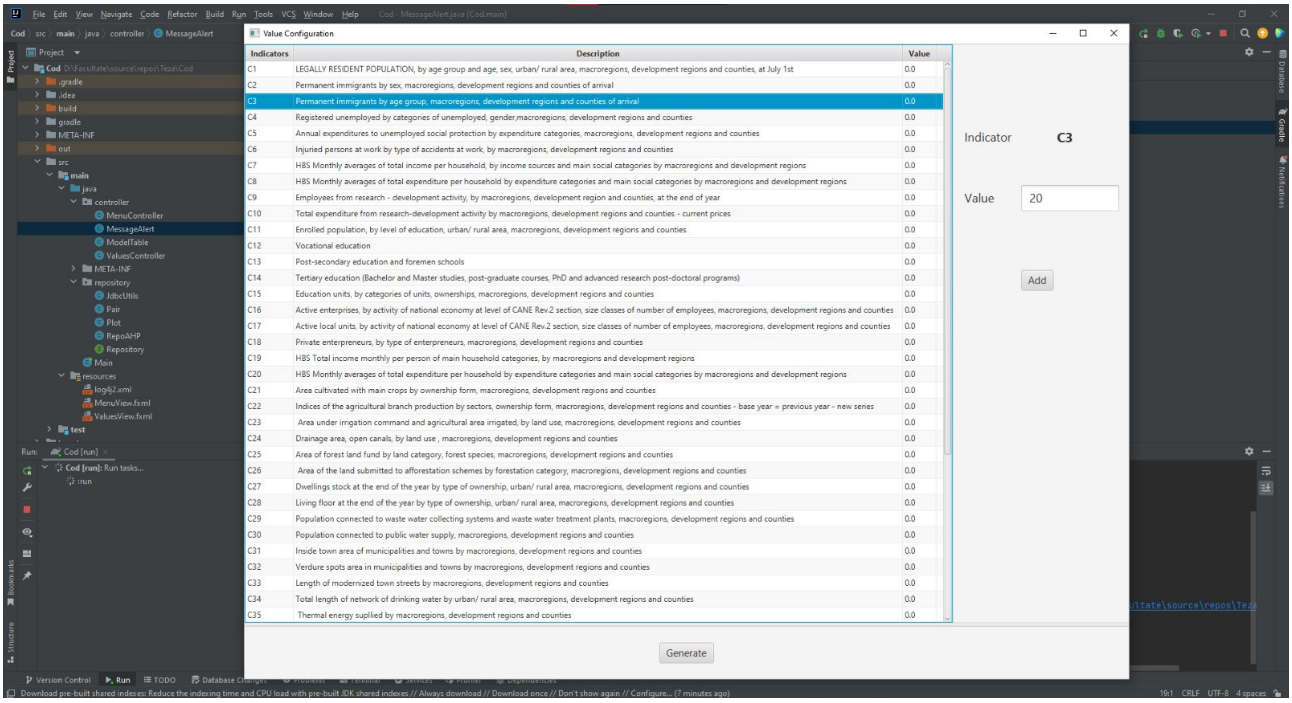


Figure 4.20 Selection of indicators

Functions waiting for some action in the interface are always active, (handleGenerateButton, handleRowSelected and handleAddButton). In handleRowSelected the ModelTable element that was clicked in the table is returned. The selection can be any cell of the table, the row of the selected cell will be taken. Selecting a table row automatically fills in the value to the right of the indicator. Layout that facilitates interaction, (Figure 4.20).

Linked the TextField and Button components to their corresponding IDs in the associated FXML file using the fx:id attribute. Thus, the FXML file and the controller class have been properly bound, and the textField and submitButton variables will reference the UI components allowing the input text to be retrieved using textField.getText().

If the check was executed without errors, the new value is added to the table on the line of the selected criterion. After inserting the value, (right window) we add the weight, and it appears in the table for confirmation.

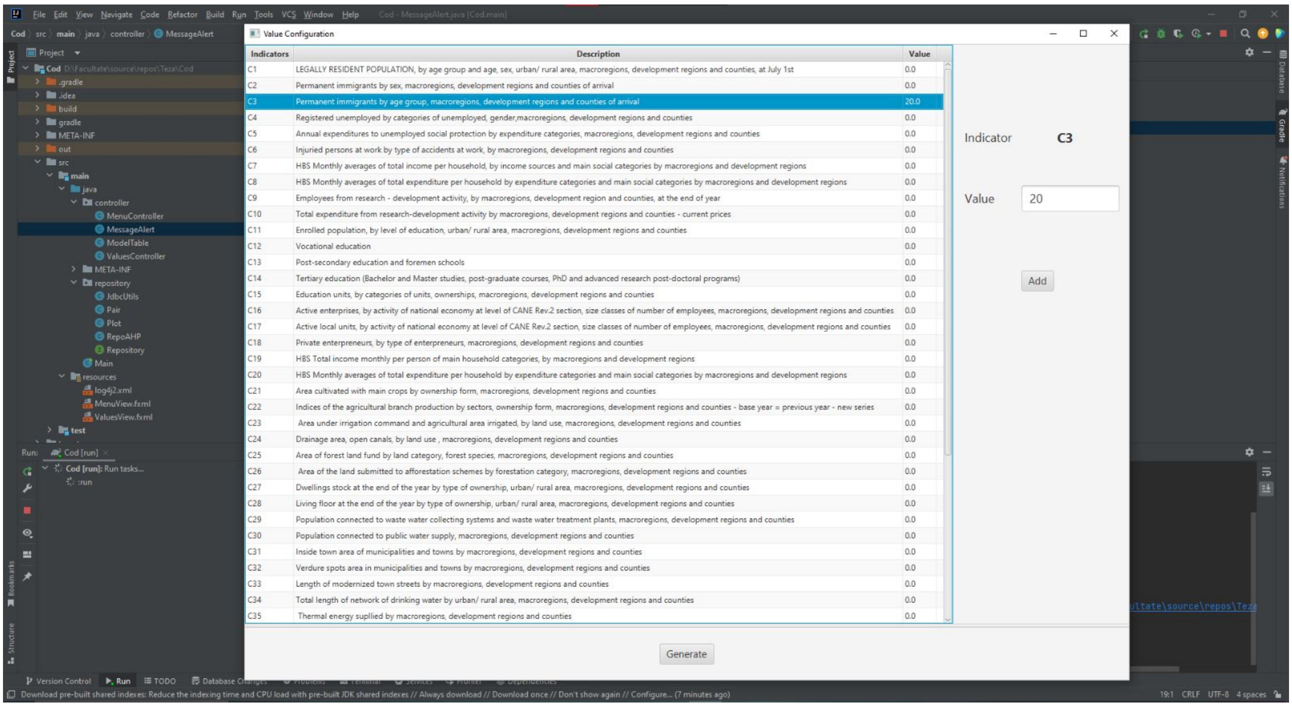


Figure 4.23 Indicator selection and weighting

When accessing the handleGenerateButton function, the sum of the elements on the Value column is checked. This must be 100. If the condition is met, a new vector is created containing the elements in the Value column divided by 100, so that the vector of priorities sums to unity, (1). The condition that the sum should be 100 was chosen to make it easy for users to assign values. If the sum of the chosen criteria values is not correct this error popup is displayed and the current sum is displayed to guide the correction.

The Pair class, (Figure 4.29) was used to manage the ranking vector, which has in its composition an identification parameter, (ID). This represents the number of the administrative region and an integer value that represents the total of the values obtained each year from AHP processing. This class will be used to generate the graph where the regions are ordered in descending order based on the cumulative values.

The Plot class (Figure 4.30) keeps a vector composed of eight elements (the number of years under analysis). May be extended as data becomes available. It is used to generate the graph of the evolution of the regions for each year.

The Repository is initialized, a new Stage window is prepared. The Repository and Stage parameters created in the menu controller are sent and the window is displayed. A Properties variable is created that calls the bd.config configuration file that provides the connection to the database.

Users can choose the result generated by the automatic processing or they can choose to assign their own values to the priority vector following its rules.

4.4.1 RUNNING THE PROGRAM

Start the application by accessing the Gradle section of the IntelliJ application, access the application task and choose the run option (Figure 4.34).

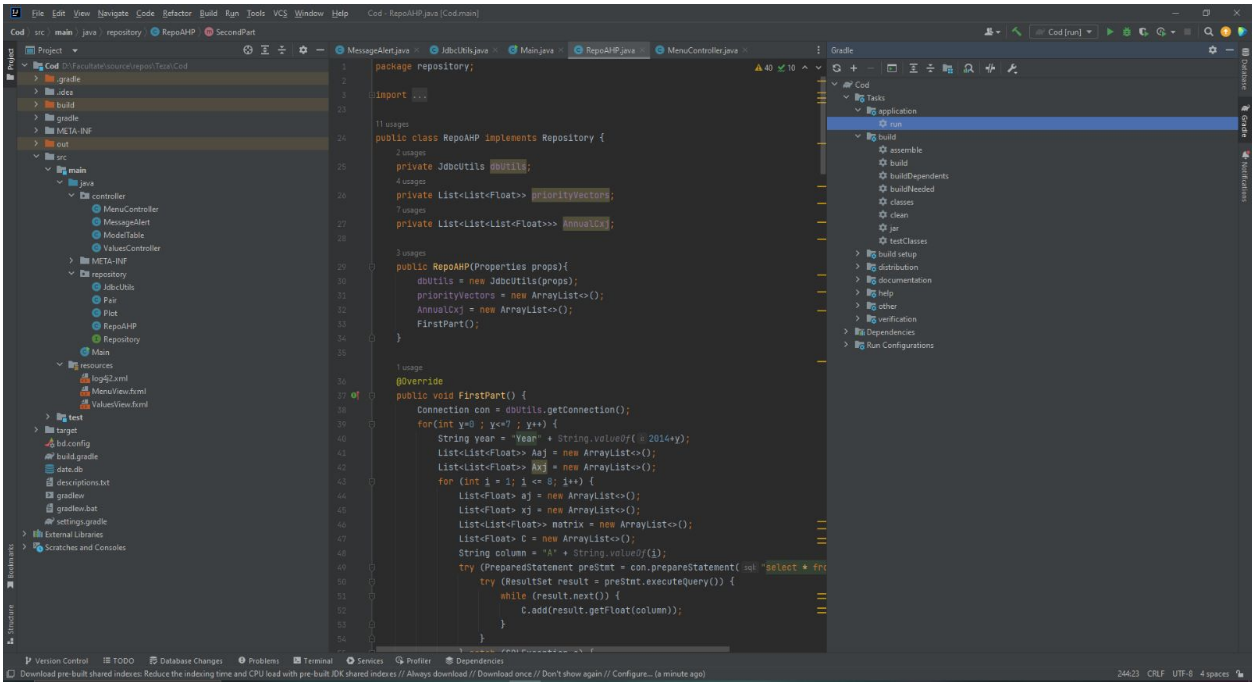


Figure 4.34 Startup program

After starting the application, the program interface opens, (Figure 4.35).

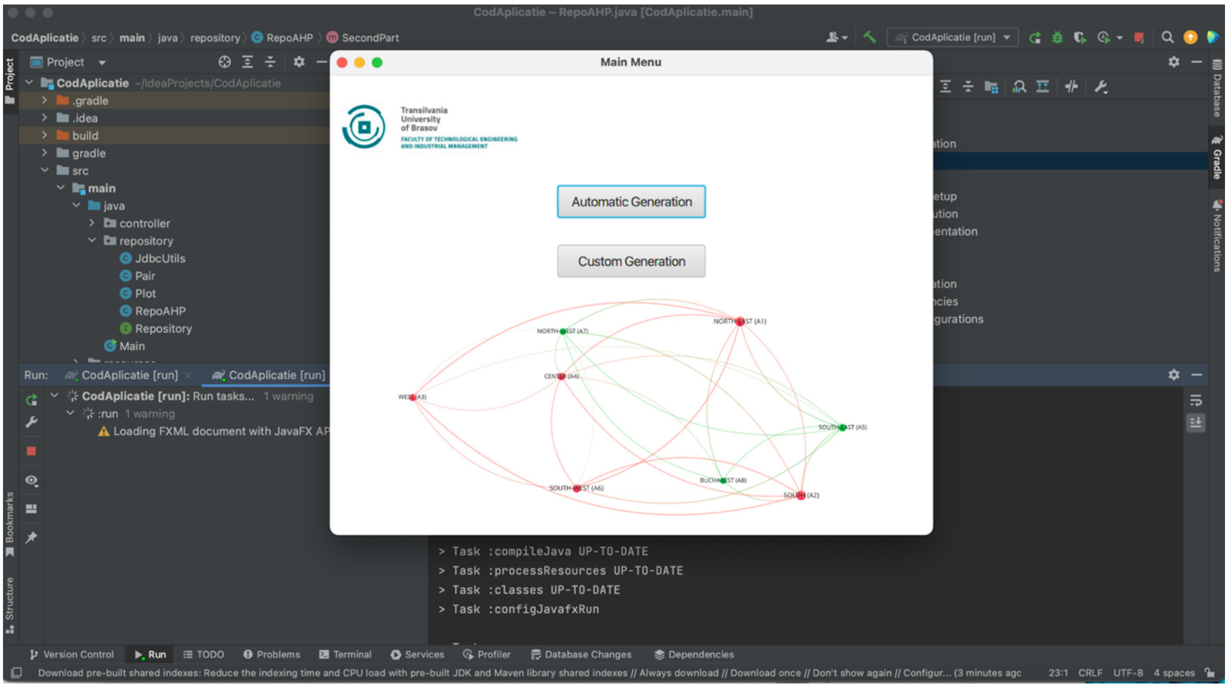


Figure 4.35 Program interface

When opting for automatic generation, the program returns the ranking of the regions and their evolution (Figure 4.36).

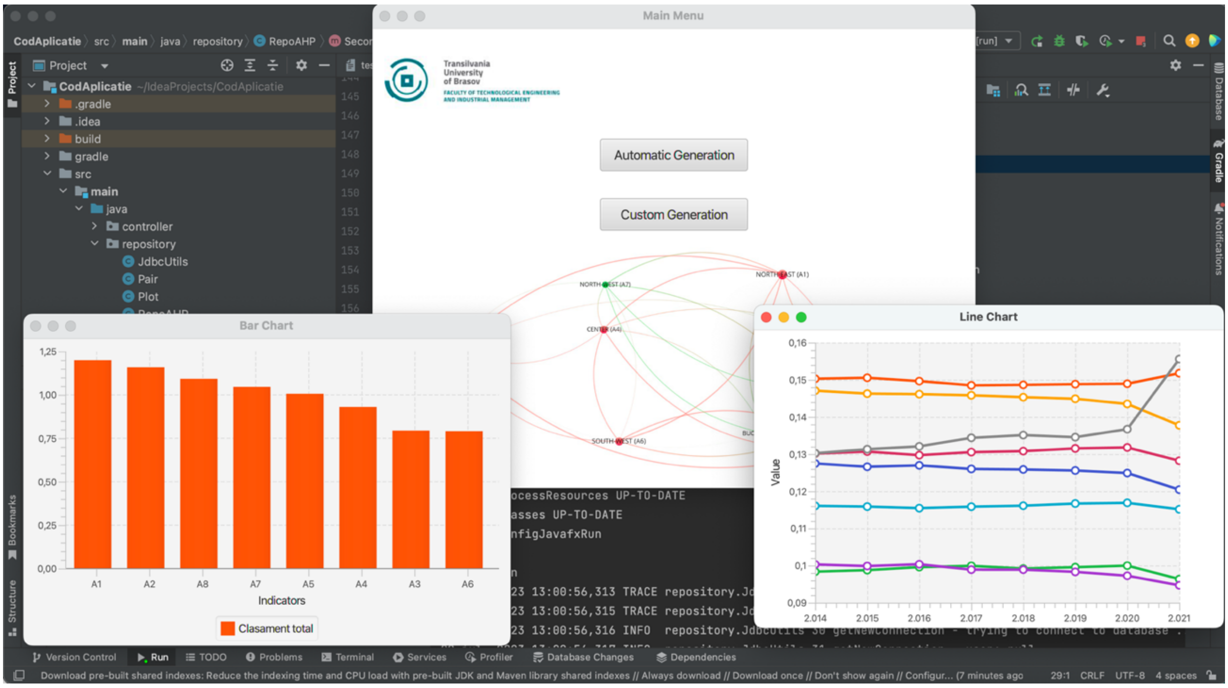


Figure 4.36 Results of the automatic generation

If the user opts for custom generation and chooses the values of the priority vector, the program will generate the results according to the given weights, (Figure 4.37)

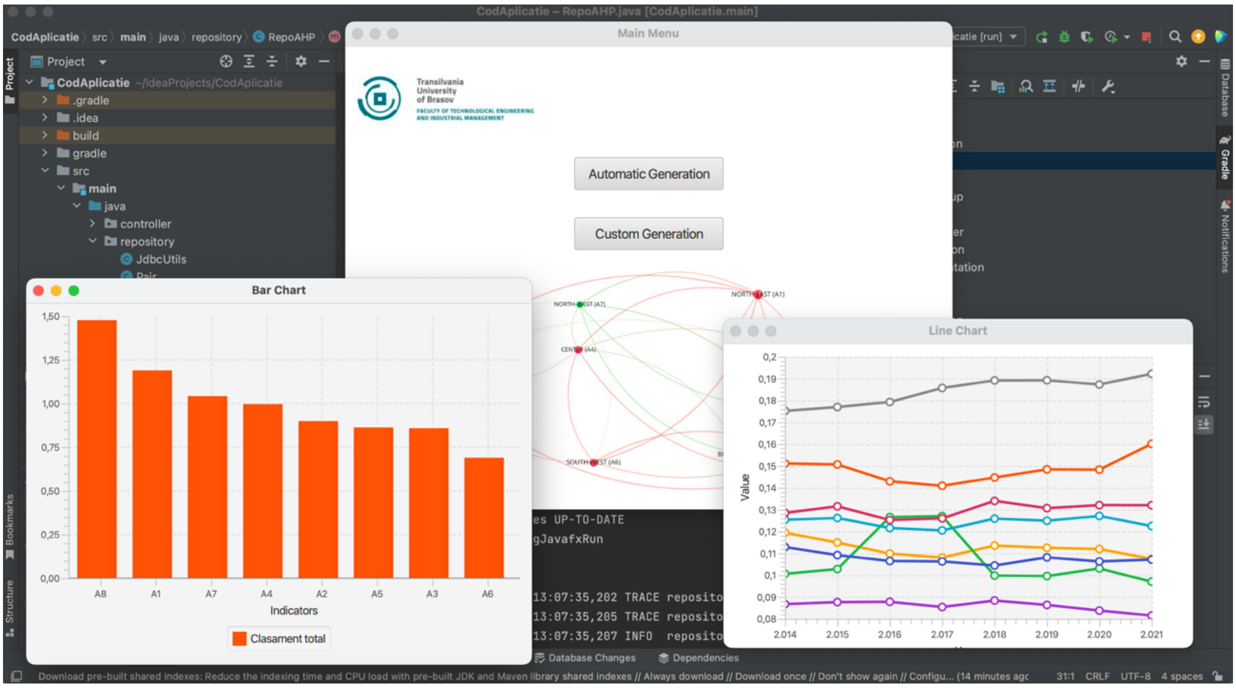


Figure 4.37 Graphics generated by the application using the custom vector.

4.5 CONCLUSIONS

The disruptive phenomena of the analyzed period, 2014-2021, have changed the dynamics of financial markets, economies and societies globally. The COVID-19 pandemic had a major impact (Valls Martínez and Cervantes, 2021; Gheorghe and Panazan, 2023; Panazan and Gheorghe, 2023). Using Google Trends data for the period January 1, 2014 - December 31, 2021, it was found that the relocation generated uncertainty in the financial markets. A first contribution is the study of the influence of relocation on capital markets. Until now, according to the literature study, the effects of relocation on stock market indexes have not been analyzed. Another contribution is the use of Google Trends data to measure the uncertainty resulting from the relocation of organizations. Previous studies of market uncertainty, such as the use by Baker et al. (2020) of a US newspaper-based equity market volatility tracker and Ramelli and Wagner's (2020) count of mentions of COVID-19 during US firms' conference calls share the same rationale as this thesis' use of Google Trends data. Relocation has created disruptions in the capital markets, and the influence of this operation may be accentuated if organizations, in large numbers, choose to relocate from or to a particular area.

In order to substantiate the decision regarding the relocation of industrial businesses, several determining factors were selected from the specialized literature. An approach based on a large number of factors and a different grouping of them compared to other researches it was proposed. The factors were grouped into 8 categories. For each category, several indicators were identified from which the most representative one was extracted. There were 8 indicators for which data were extracted using international databases. The data thus collected were statistically processed with the help of the Statistics 25 program.

A case study involving the choice of location of an industrial business in Eastern Europe was presented. The result demonstrates the capability and efficiency of the model that can help decision makers to better evaluate different decision-making options. The proposed model is not limited to choosing a business location. The list of selected criteria and decision alternatives are not the only options. Thus, several relocation alternatives can be included, several hierarchies can be established or the problem can be detailed. However, it could lead to more calculations as the number of criteria and alternatives increases. Therefore, the development of a computational model is useful to facilitate the decision-making process. The large number of considered criteria and indicators allow a correct choice of the Eastern European state.

Choosing an optimal location is a concern, not only to identify the location capable of offering organizations the opportunity to reduce their costs, to be close to raw materials, to the market or to have access to qualified human resources, but also to prevent risks associated with relocation. The current context is characterized by instability. The COVID-19 pandemic has led to a reduction in the activity of companies. Some industrial sectors were more affected than others, depending on the field in which they operated. Today's reality requires a risk-focused approach. Minimizing relocation risks is an important criterion.

The investigation of location selection as a step in organizational growth includes methods, resources, and mechanisms. The results of the study indicate that infrastructure and human resources are key factors in site selection. An essential part of economic operations is the selection of qualified people. It is important to remember that human resources play a crucial role in the efficient functioning of any company. Lower risk locations become preferred, even if they do not bring cost savings. Another important aspect is keeping the company's assets safe without exposing them to risk. After the pandemic, the risk of relocation is a major concern for companies. One view of this process was provided, a combined multi-criteria decision-making (MCDM) approach to assess the states that offer the most favorable conditions for resettlement by querying a large database and the type of criteria and indicators.

The methodology is based on the evaluation of the locations with the help of the chosen indicators. The selection is based on the positional ranking approach and the rank of the places is determined using the MCDM model. The method allows the selection of the location that meets the specified criteria and has relevant characteristics. Future research will look at how the method is applied to site selection, taking into account the importance of the criteria and recent developments in Europe.

The performance of the company largely depends on the evaluation of the choice of location. MCDM's approach to location assessment is rational, practical, objective and unbiased. This approach suggested a new way of thinking. To evaluate the site using HR indicators, which could increase the value of the business. The value of human resources in the era of the knowledge economy is undeniable. Therefore, it is crucial to consider both the economic state of development and the role that human resources (HR) departments play in this context. ANP-TOPSIS is a simple, scientific and logical technique. Countries were ranked and criteria assessed using an integrated ANP-TOPSIS model. From the results of the analysis, "infrastructure" is the criterion that can help reduce risks, costs and economic development. The research results reinforce the importance of infrastructure in substantiating the relocation decision. The strategic positioning of the company, the expansion, or following the current context, the narrowing of the geographical area are essential aspects in the relocation of a business.

In this thesis, the AHP method was applied to hierarchically classify the administrative regions in Romania for the purpose of relocating organizations. The study had 10 criteria and 48 indicators. The criteria and indicators were selected based on ten axes in which there is information about: population, (demography, migration, labor force, standard of living), development skills, business environment, environment, (environmental factors, utilities, local government) and infrastructure.

The AHP method considers several criteria to evaluate the decision-making process. The main criterion for establishing the location in one of the administrative regions of Romania is the environmental one. In future studies, the developed method and criteria could be applied to different types of cities in Romania. This could help to understand site selection and application criteria in the urban or suburban environment of a city. Changing the criteria according to the reality of the city is also appropriate. Adding new criteria such as new transport technologies, including electric or autonomous vehicles, is also a relevant option.

CHAPTER 5. FINAL CONCLUSIONS. ORIGINAL CONTRIBUTIONS. DISSEMINATION OF RESULTS. FUTURE DIRECTIONS OF RESEARCH

More recent research on the location decision suggests a move away from the search for resources, primarily cost advantage towards the search for strategic assets, or more complementarity of assets and activities, (Morganti and De Giovanni, 2022). This aspect includes a greater interest in knowledge creation, value creation and capture, (Merino et al., 2021).

5.1 FINAL CONCLUSIONS

The present thesis contributes to the existing specialized literature on the relocation of companies, thanks to the extended approach to the phenomenon. The impact of relocation on capital markets was studied, partial hierarchies of the states included in the analysis in different time periods were obtained, and relocation in the administrative areas of Romania was analyzed. The time period analyzed was eight years, and the data were downloaded from the National Institute of Statistics (INS).

The relocation process begins with the reasons for relocation. This aspect is either due to a situation in their current location, (push factor) or due to a pull factor, where a different location attracts these businesses due to certain characteristics (Van Dijk and Pellenbarg, 2000). Therefore, there could be scope for regional administration to influence these push and pull factors. Which leads to the idea that local government should relate to the three axes that define the resettlement framework: push, pull and retention.

5.2 ORIGINAL CONTRIBUTIONS

The present thesis represents an innovative approach to the development model of organizations through relocation. It represents the support for the development of a performance strategy, which integrates sustainable development based on performance indicators, carried out with the support of a state-of-the-art reference framework.

The present thesis is relevant and innovative, because it is the first study of its kind in the field of sustainable development of organizations, through which a connection is made between the three areas of sustainability: economic, social, environmental, to which are added the aspects of organizational management, adapted to the context of the current environment: organizational governance, population and its demographic structure, internal and international migration, work practices, environment, business statistics, standard of living, public utilities of local interest, local territory administration, infrastructure, community involvement and development.

5.2.1 ORIGINAL CONTRIBUTIONS IN THE FIELD OF THEORETICAL RESEARCH

i. It was highlighted the role of the companies' sustainable development strategy which has a central role in the organization's competitive strategy, in that it determines the other strategies: the professional development strategy, the partnership and networking strategy, the community engagement strategy, the transfer strategy.
ii. It was developed a conceptual model of the new relocation reference framework, which integrates existing organizational requirements and existing measurement indicators into current international reference frameworks.
iii. A qualitative study was carried out in the specialized scientific literature from the Web of Science database, by going through over 120 bibliographic references, about relocation considered representative, from which the most relevant location selection methods were extracted and retained causes and indicators of resettlement confirmed by meta studies.
iv. The key pillars that companies must consider for sustainable development have been established: organizational capacity and management; environmental responsibility; economic performance; social responsibility. The decision to relocate a business was substantiated. The results of this original research on defining the key pillars and rationale for the relocation decision that organizations must consider for sustainable development have been published in the International Journal of Economics and Management Systems, in a paper of which I am co-author;

v. A study was conducted on the risk of bankruptcy in an organization. The results of these research were published in the journal RECENT, indexed in BDI databases. Paper for which I am the first author.

vi. Maximization and minimization of the objective function have been identified. The results of this research were published in the IOP Conference Series: Materials Science and Engineering, in a paper of which I am the first author.

vii. It have been identified economies of scale in an organization. The results of these researches were published in the MATEC Web of Conferences conference, a paper of which I am the first author.

viii. The causes determining the relocation were defined. The results of this original research on defining the causes and indicators of resettlement have been published and are being published in the conferences:
   - *MATEC Web of Conferences,* paper of which I am co-author;
   - *International Symposium in Management - Management, Innovation and Entrepreneurship in Challenging Global Times (22-23 October 2021, Timisoara, Romania),* paper of which I am the first author.

ix. It have been identified the economic context of development and the role that the human resources department plays in this framework. The results of this original research were published in the journal Human Systems Management, indexed Clarivate Q3, JCI 0.44, on which I am first author.

x. The 48 indicators that make up the site selection software matrix have been identified and described.

xi. It was designed the RelocateBusiness software application that facilitates the analysis process and allows a numerical evaluation in a reasonable time.

5.2.2 ORIGINAL CONTRIBUTIONS IN THE FIELD OF APPLIED RESEARCH

i. The dynamics of the stock market indicators were identified. According to the research, they followed the evolution of the economy as a whole. The results of these original researches are accepted for publication and were supported within the *International Symposium in Management - Management, Innovation and Entrepreneurship in Challenging Global Times* (22-23 October 2021, Timisoara, Romania), researcg of which I am co-author.

ii. The volatility of stock returns on the Romanian capital market was identified. The results of these original researches were supported in the International Scientific Conference "*Business and Management*", indexed article Clarivate, proceedings paper. Work of which I am co-author.

iii. The average period in which the shares reach the minimum value, the average period in which they return to the pre-pandemic value and the ranking of the results according to the object of activity of the companies listed on the BVB have been established. The results of these original researches were supported in the *International Scientific Conference "Business and Management*", indexed article Clarivate, proceedings paper. Work on which I am the first author.

iv. The major shocks generated by the pandemic, which had a negative effect on the stock market indices, were identified. The results of these original researches were presented at the *International Scientific Conference "Business and Management",* non-indexed article under publication. Work on which I am the first author.

v. The link between the categories that make up the global index of the health system and the volatility of the stock market in the states considered in the analysis was confirmed. The results of these original researches were presented at the *International Scientific Conference "Business and Management",* non-indexed article under publication. Work of which I am co-author.

vi. The influence of relocation on capital markets was identified. Until now, according to the studies carried out, the contagion effect of the relocation on the stock market indices has not been analyzed.

vii. Google Trends data was used to measure the uncertainty resulting from the relocation of organizations.

viii. The causes and indicators of relocation that ensure an optimal choice of location have been identified. The results of this original research have been published and are being published in conferences:

- *MATEC Web of Conferences,* research on which I am co-author;
- *International Symposium in Management - Management, Innovation and Entrepreneurship in Challenging Global Times (22-23 October 2021, Timisoara, Romania),* the research on which I am first author.

ix. The human resources criterion was identified as a key factor in the selection of locations and the changing trend of the direction of relocation due to the COVID-19 pandemic. Eastern European countries are no longer as attractive for companies choosing to relocate compared to the pre-pandemic period. States with more stable economies, characterized by lower risks, appear to become more attractive to companies that relocate their facilities. The results of this original research were published in the journal Human Systems Management, indexed Clarivate Q3, JCI 0.44, the research on which I am first author.

x. The theoretical research was applied and the results of the evaluation of the 48 indicators were presented, which constitute a good example for users interested in relocation in administrative areas in Romania.

xi. It was identified as the fundamental criterion within the analyzed aspects, which is the criterion of environmental factors.

xii. The development of theoretical methods was validated in practice through the development of an IT system, RelocateBusiness, which facilitates the analysis process.

xiii. It was formulated conclusions regarding the implementation of the location selection software.

5.3 DISSEMINATION OF RESULTS

Dissemination of scientific research results contributes to increasing the prestige of IOSUD by the presence in the fundamental scientific stream of published papers: **seven** articles as first author and **five** articles as co-author. Among them an article **is Clarivate indexed Q3, JCI 0,44 and two articles are Clarivate indexed proceedings paper.** In total, the published papers obtained **five citations.**

List of published articles or articles or in the process of being published:

i. Gheorghe, C., and Panazan, O. (2019). Decisional Model of Relocating a Business in the Context of Current Economic Challenges. International Journal of Economics and Management Systems, 4. https://www.iaras.org/iaras/filedownloads/ijems/2019/007-0014(2019).pdf

ii. Panazan, O., and Gheorghe, C. (2020). Aspects of Risk in the Defence Industry from Romania. RECENT, 21(1), 4–12. https://doi.org/10.31926/recent.2020.60.004

iii. Gheorghe, C., and Panazan, O. (2021a). Model for Industrial Business Relocation in Eastern Europe. MATEC Web of Conferences. https://doi.org/10.1051/matecconf/202134307011

iv. Gheorghe, C., and Panazan, O. (2021b). DETERMINANTS OF THE SHARES PRICE ON THE BUCHAREST STOCK EXCHANGE DURING COVID-19 PANDEMIC. Article currently under publication supported at the *SIM 2021 Conference: 16th International Symposium in Management - Management, Innovation and Entrepreneurship in Challenging Global Times* (22-23 October 2021, Timișoara, Romania)

v. Panazan, O., Gheorghe, C., and Calefariu, G. (2021a). The methodology of economic recovery of commercial companies in crisis conditions. IOP Conference Series: Materials Science and Engineering, 1009, 012044. https://doi.org/10.1088/1757-899x/1009/1/012044

vi. Panazan, O., Gheorghe, C., and Calefariu, G. (2021b). Model of indirect Expenses Distribution for Determining Economies of Scale. MATEC Web of Conferences, 343, 07009. https://doi.org/10.1051/matecconf/202134307009

vii. Panazan, O., Gheorghe, C., and Calefariu, G. (2021c). IS EASTERN EUROPE A CHOICE FOR RELOCATION? AN EMPIRICAL ANALYSIS BY APPLYING AHP METHOD. Article currently under publication supported at the *SIM 2021 Conference: 16th International Symposium in Management - Management, Innovation and Entrepreneurship in Challenging Global Times* (22-23 October 2021, Timisoara, Romania).

viii. Gheorghe, C., and Panazan, O. (2022). THE INFLUENCE OF SPECIFIC INDICATORS ON THE VOLATILITY OF SHARES ON THE BUCHAREST STOCK EXCHANGE DURING THE COVID-19 PANDEMIC. In International Scientific Conference „Business and Management ". https://doi.org/10.3846/bm.2022.697

ix. Panazan, O., and Gheorghe, C. (2022). STUDY ON THE AREAS AFFECTED BY THE COVID-19 PANDEMIC IN ROMANIA. In International Scientific Conference „Business and Management ". https://doi.org/10.3846/bm.2022.700

x. Panazan, O., Gheorghe, C., and Calefariu, G. (2022). Relocation trends determined by increasing risks in Eastern Europe: An ANP-TOPSIS approach. *Human Systems Management*, 1–14. https://doi.org/10.3233/hsm-220062

xi. Gheorghe, C., and Panazan, O. (2023). EFFECT OF HEALTH SYSTEM PERFORMANCE ON VOLATILITY DURING THE COVID-19 PANDEMIC: A NEURAL NETWORK APPROACH. Accepted article, in progress for publication supported at the BM 2023 Vilnius Tech Conference, *"13th International Scientific Conference „Business and Management 2023"*, 11-13 mai 2023, Vilnius Lithuania.

xii. Panazan, O., and Gheorghe, C. (2023). GOVERNMENT RESPONSE STRINGENCY INDEX: AN ALTERNATIVE FOR THE VOLATILITY DETERMINING DURING PANDEMICS. Accepted article, in progress for publication supported at the BM 2023 Vilnius Tech Conference, *"13th International Scientific Conference „Business and Management 2023"*, 11-13 mai 2023, Vilnius Lithuania.

5.4 DIRECȚII VIITOARE DE CERCETARE

Future research can lead to understanding the links between uncertainty and business outcomes. It could investigate how the government affects resettlement, security provided, cost savings. Quantifying the damage to the global economy may lead to the discovery of additional elements.

Another approach would be to add new indicators. This would enable more accurate location identification and add the much-needed dynamic component to the current context. Structuring the preparation phase would benefit relocation and is, at this time, an area that needs further investigation. Furthermore, the success and effects that relocation has on organizations should be thoroughly studied to identify the influence of time on relocation outcomes and contexts. The next step could be to investigate the economic and social impact of relocation on both developed and emerging economies.

The research can be extended to better understand the causal relationships between variables. Another step would be to consider collecting data that would allow a clearer distinction between types of relocations. Companies' relocation strategies for different value-added activities could also be analyzed. The appropriate type of assistance in each region could be determined, assistance with planning and environmental regulations. Relocating to an industrial zone can involve permitting processes from several different agencies that regulate construction, zoning, environmental quality and health. Businesses would benefit from streamlining and coordinating regulatory processes.

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