

Risk classification in international trade using methods of cluster analysis

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Abstract

For an exporter, when exporting goods or services, it is important to know the situation in the countries to which the company wishes to export. Territorial risks can have a significant impact on operations, both in the form of profits and huge losses. To assess such a risk, the exporter may rely on credit insurance companies that regularly evaluate the risks of the given country. All insurance companies attempt to collect quantitative and qualitative data as accurately as possible with the aim of conducting an in-depth analysis of potential risk. However, insurance companies have their own methodologies for evaluating international risks, which may differ according to the organisation. The article applies cluster analysis to the assessment of territorial risk based on the example of OECD countries with the aim of classifying countries according to territorial risk based on selected indices. From a practical point of view, the benefit of the article is the use of the cluster analysis method for the purpose of classifying countries according to territorial risk; it offers exporters another source of information about the country which they are interested in exporting to. From a theoretical point of view, it is beneficial to identify key indices that together represent territorial risk and thus fulfil the general definition of territorial risk.

Key words

cluster analysis, export, hierarchical methods, OECD, risk assessment, risk map, squared Euclidean distance metric, territorial risks.

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Introduction

Within international trade, it is necessary to address individual risks. It is not surprising that when exporting goods to other countries, the exporter may face

more risks than when conducting domestic trade. The basis of the transaction is a contract and the so-called international element; therefore, the term 'contract' must not be confused with the term 'transaction'. Rozehnalova & Drlickova (2015) claim that it is necessary to examine a business transaction, more precisely international business transaction as a whole – a possible set of contracts by which they are formed. The risks are of a different nature and relate to the territory to which the transaction is directed, or which affects it; to the transaction itself; or to the entities that carry out the transaction. When exporting goods, it is necessary to find out in advance all the information regarding the country of export. It is important to focus on risks such as a volatile political situation, a state of war, terrorism, strikes, riots, etc. Collectively, these risks are referred to as territorial risks, which are associated with the political, economic, financial and legal environment in the country of export. They arise from the uncertainty inherent in the political or economic developments, the occurrence of natural disasters or the introduction of administrative measures.

Every entrepreneur encounter risks during his activity, and it is no different in the case of an exporter. We can even argue that when exporting goods or services to foreign markets, the probability of occurrence of risk increases. In general, we can define risk as an achieved result that is different from the expected result due to random effects. The risks are classified differently and there is no settled terminology. We can divide risks from different points of view, areas of occurrence, in terms of their measurability, what effect they have on the result or what causes them, etc. This is also true in international trade (Reuvid, 2014; Covello, Menkes & Mumpower, 1986; Ambrus, Rayfuse & Werner, 2017). No matter how the individual authors divide the risks, they can occur simultaneously, i.e. overlap with

each other, but also complement each other. When it comes to international trade, the risks are most often divided into commercial and territorial ones; and lately currency risk has also been mentioned separately.

The most effective preventive measure is quality risk management, which includes obtaining information about individual countries that are the subject of commercial interest of the company (Ritchie & Marshall, 1993). Information can be obtained from various sources, such as international institutions and agencies, representative offices, specialist agencies, and of course the Internet. The starting point for the analysis of international risks can be an institutional rating, which is a standard international tool for assessing the creditworthiness of countries to assess their credibility. The rating indicates the degree of riskiness for foreign companies of doing business in the rated destination and the quantification of the probability that the rated country will meet its obligations. Such ratings are published by several renowned institutions, of which the main ones include Moody's, Standard & Poor's and Fitch Ratings. Various platforms can also be used (e.g. The PRS Group's International Country Risk Guide or CountryRisk.io) which assess international risks from various perspectives; or one may also make use of bespoke evaluation methodologies, which may already include sector-specific parameters.

It is precisely due to the diversity of approaches that the classification of risks differs considerably. The authors either group risks into more specific categories or into broader groups for further application. Just as the approach to risk categorisation differs, the approaches to or methods of risk assessment differ, as do the outputs of individual platforms and agencies. Due to the inconsistency of methods and procedures for determining the degree of risk, the authors determine their own calculation for the objective assessment of risk. The risks of political

and economic indicators were selected for classification. The selected countries are Organisation for Economic Co-operation and Development (OECD) countries, due to their greater diversity compared to countries that are only members of the European Union (EU). The entire territory of the state, and not only a certain part thereof, is always taken to assess the risks of these countries. Ward's method and the squared Euclidean distance metric were used for classification.

The aim of the article is to use the cluster analysis method to classify countries according to territorial risk. The intention is to identify important factors that have a significant impact on exporters and its exports and to divide and select countries in terms of these factors. The task is to create clusters of OECD countries using cluster analysis based on the degree of similarity of individual indices that define territorial risk. Groups of selected countries will be created so that each group will consist of the countries that are most similar in terms of the given indices. The aim of the analysis is the position of countries according to territorial risk, which is identified based on selected indices.

1. Literature review

Mostly of a probabilistic nature, the risks we tend to be aware of offer us the opportunity to measure or estimate them, enabling us to comprehend and justify their consequences. It can be acceptable, undesirable, beneficial, or overwhelming to us. That is why we try to know, measure, evaluate and, above all, manage risks, or to work with them comprehensively within risk management.

In professional literature and sources, risks are divided from different perspectives, but they are typically interconnected and can occur simultaneously or complement each other. It is important to conduct a comprehensive investigation of risks, as reducing

one risk may increase the possibility of another. While risks should be examined separately and independently, it is ultimately necessary to take a global view and analyse interconnected risks as a whole. Both short-term and long-term risk horizons should be considered. Additionally, there is an element of uncertainty that cannot be quantified when assessing risks. The element of uncertainty is closely related to political risk (Riegrova, 2006).

The methods of risk classification are differentiated, and the authors group risks into significantly special categories of risk or group them into broader groups for further application. Entrepreneurs in commercial practice often classify risks into several categories, including commercial, production and market risks, the risk of non-fulfilment of obligations by contracting parties, risks resulting from errors in negotiating business operations, transport risks, risks associated with non-payment for goods and services, and the risk of liability for product defects. In the field of international trade, market risks, commercial risks, transport risks, territorial risks, and currency risks are the main types of risks (Grath, 2008). Polak, Beranova and Tabas (2011) deals with the classification of risks in international trade and the subsequent possibility of evaluation. Böhm (2009) stated a further division for the area of foreign trade practice, namely into traditional and modern risks. Traditional risks include business, production, transport, liability, and legal risks. In addition, this group also includes the risks of incorrectly negotiating a business transaction, the risk of choosing a business partner, risks associated with patents and trademark protection, tariff, and non-tariff barriers, etc. Modern risks are considered such risks as payment, credit (exchange rate) and investment risks.

For the area of insurance, Böhm (2009) presents a division of risks into two basic categories, namely commercial and territorial.

In general, it can be said that commercial risks can be insured on the insurance market without major problems. The problem arises with the territorial ones, because for many reasons it is risky for commercial insurance companies to insure such risks. Territorial risks are therefore impossible or very difficult to insure with commercial insurance companies. In terms of credit insurance, Petrusheva (2016) also divides risks into commercial and non-commercial ones, which includes the risk of natural catastrophes and political risks. On the insurance market, we can meet the offer of commercial credit insurance companies, but also export credit agencies that carry out insurance activities provided by the state. These agencies can then offer special products to cover territorial and long-term commercial risks, while the state takes over guarantees for all their activities. This solves the problem of uninsurable territorial risks (Funatsu, 1986; Vavrova, 2014; Moser, Nestmann and Wedow, 2008). The relationship between risks (political, financial, and economic) and the demand for insurance was discussed in study by Lee, Chiu and Chang (2013). Bar-Niv and Bickelhaupt (1986) also evaluated the relationship between international risks and insurance, resulting in the classification thereof according to purpose, methodology, and perspective, with a division into 15 areas in total.

As already mentioned, territorial risks are a consequence of the emergence of uncertainty about future political and macroeconomic developments. The emergence and development of these quantities is difficult to determine in advance, and therefore the risk itself is difficult to determine and quantify. However, the assessment of territorial risk is of great importance for the exporter and his business activities and business transactions because these risks can greatly negatively affect his results. Territorial risk can have a significant impact, particularly on long-term international contracts and

foreign direct investment. Territorial risk can be divided into narrower groups of individual risks, but they complement each other and are dependent on each other. Therefore, under territorial risk, the following types of risk may be included:

- *Political risk*, which are risks that cannot be easily predicted and therefore have the nature of force majeure. We list here civil unrest, strikes, revolutions, wars. In addition, there may be situations where local government directly intervenes to prevent trade (such as expropriation, seizure of cargo or inability to handle goods). Benacek, Lenihan, Michalikova, Andreosso-O'Callaghan and Kan (2014) deals with political risks in more detail.
- *Commercial policy risk*, which are interventions by the state in the introduction of some administrative measures to limit exports or due to protectionism. These are restrictions in the form of embargoes, the introduction of customs duties and taxes, the establishment of hygienic or technical regulations and other restrictions.
- *Exchange rate risk*, which is related to monetary diversity and the variability of exchange rate developments on global markets. Territorial risk considers exchange rate risk associated with the impossibility of converting funds into another currency and restrictions on transfers.

Political risk assessment has the most significant impact. Political events are a very important factor simply because they are very difficult to predict in the long term. The risk of government intervention includes the risk of expropriation, breach of contract by the government, risks associated with the functioning of the judicial system and possible changes in the approach to foreign investors. There can be several reasons

for the emergence of political risks, and it is obvious that the emergence of political risk is more likely in countries with less political stability. The emergence of these risks can result in the limitation or interruption of business relations, but also in losses, whether financial or property. Benacek et al. (2014) assessed the influence of political risk as being significant, whereby the list of indicators in their research related to foreign direct investment is supplemented by as many as 11 political identifiers (business freedom, trade freedom, monetary freedom, freedom of government, fiscal freedom, property rights, investment freedom, financial freedom, freedom from corruption, education index, and government effectiveness).

The economic conditions in the country are reflected in commercial policy risk and can be a decisive factor in the success of a contract in crisis situations. The disruption also brings administrative measures that may be imposed on the foreign trade of the state. This risk is especially threatening in states that are characterised by internal instability or external conflicts, examples of which are the loss of import licenses, anti-dumping duties, and quotas on imports of certain goods, although these measures are in direct conflict with free market principles. Equally important are regulations introduced to restrict business on the domestic market. These regulations also serve to protect the domestic market and favour domestic producers. If they are violated, the export transaction does not have to be executed or sanctioned (Rožehnalová & Drlicková, 2015). The risk of imposing a trade embargo lies in the fact that if an embargo is imposed between the production and transport of goods to the customer, in most cases one will incur a loss. But it is also worth mentioning a boycott of goods, for example in the case of products produced non-ecologically or unethically.

In terms of territorial risk, we consider the exchange rate risk associated with

the impossibility of converting funds into another currency and the restriction of transfers.

Nevertheless, territorial risk does not have to be understood as a purely negative phenomenon in international trade; on the contrary, it can also represent a great opportunity. This is also proven by various studies on the relationship between risk, credit insurance and the impact on export growth (Rienstra-Munnicha & Turvey, 2005; Janda et al., 2010; Janda et al., 2013; Harvanek & Zabožník, 2015). The most important thing is to obtain as much information as possible about the impending risk and then process it further to be used in management. The authors offer the possibility of self-classification and evaluation of territorial risk based on selected indices. The purpose was to identify important indices that together represent territorial risk and thus meet the general definition of territorial risk. The most effective preventive measure is quality risk management (Hudakova et al., 2017; Hudakova et al., 2018), which includes obtaining information about individual countries that are of commercial interest to the company. Information can be obtained from various sources, such as international institutions and agencies, information from representative offices, specialist agencies, and of course on the Internet. However, Asiri & Hubail (2014) and McAleer & Hoti (2004) pointed out that all information obtained, and evaluations of individual agencies must always be compared and evaluated.

The institutional rating, which is a standard international tool for assessing the creditworthiness of countries to assess their credibility, can be the basis for the analysis of international risks. The rating indicates the degree of riskiness of doing business for foreign companies in the rated destination and the quantification of the probability that the rated country will meet its obligations. Such ratings are published by several renowned institutions, of which the

main ones include Moody's, Standard & Poor's, and Fitch Ratings. However, when setting a rating, two broad areas are considered, namely political and economic risk.

It may therefore be more advantageous for the exporting firm to orient itself directly according to the rating of credit institutions, as they are highly sensitive to planned state interventions, such as restrictions on the allocation of foreign exchange funds, payments, and lending. Investment banks and credit insurers also use ratings to calculate the risk of their portfolios (Baker and Martin, 2011). In the case of self-assessment, they compare their results with those of credit rating agencies. Each insurance company therefore has its own methodology for evaluating risk, where its goal is to always offer the most suitable insurance option.

Pahud de Mortanges & Allers (1996) stated that if specific companies already recognise the influence of political risk and approach analyses, they use some of the following methods: qualitative unstructured methods (judgment and intuition of managers, expert opinions), qualitative structured methods (the Delphi technique, standardised checklists, scenarios), quantitative methods (company-specific methods – ASPRO-SPAIR system, political risk consultants – secondary sources). They concluded that companies should develop their own models for assessing political risks. The reason for this is that on the one hand they will approach the evaluation individually, but above all they will include indicators essential to their segment in the evaluation, e.g. the mining or construction sectors will be more sensitive to environmental changes than other sectors. With that, it will be possible to proceed to the self-assessment of risks as presented in this article.

The authors of the article present and utilise the cluster analysis method to classify countries according to territorial risk. At the same time, they show that it is not necessary to work with a disproportionate number of

criteria, but the intention is to identify important factors that have a significant impact on exports and the exporter and divide selected countries in terms of these factors. It would subsequently be possible to add other important indicators, e.g. for a given industry, as already mentioned. The aim of the analysis is the categorisation of countries according to territorial risk, which is identified based on selected indices, and to compare the resulting division of countries into clusters with the OECD classification.

2. Methodology

Ward's method of cluster analysis was used for the classification of countries according to country risk. Cluster analysis is a multidimensional statistical method used to classify objects. The core of cluster analysis is the classification of objects into groups, or so-called clusters. The goal of clustering is for subjects in the same cluster to be as similar as possible and for objects from different clusters to be minimally similar or not at all similar. Interested readers are referred to, for example, Abonyi & Balazs (2007), Jajuga, Sokolowski & Bock (2002), Kim (2019), Kubler (2010), and Everit (2011) for a thorough explanation of the principles of cluster analysis. Cluster analysis has been developed in various specialised disciplines, such as biology, medicine, geography, computer science and psychology. It is gradually gaining a foothold in economic disciplines; the results can be used, for example, in market segmentation, business management, and marketing, to divide customers into market segments, to determine target markets or new product development (Halaskova and Schwarzova, 2018; Drastichova, 2018).

The input data are OECD countries and indices, based on which territorial risk can be defined. All OECD countries are analysed – Australia, Belgium, the Czech Republic, Denmark, Estonia, Finland, France, Chile, Ireland, Iceland, Italy, Israel,

Japan, South Korea, Canada, Colombia, Lithuania, Latvia, Luxembourg, Hungary, Mexico, Germany, the Netherlands, Norway, New Zealand, Poland, Portugal, Austria, Greece, Slovakia, Slovenia, the United Kingdom, Spain, Sweden, Switzerland, Turkey, and the USA.

In the review, territorial risk was divided into political risk, commercial political risk, and exchange rate risk. Territorial risks arise from political and economic events and measures, as opposed to commercial risks, which arise from the economic or financial situation of the debtor. This also led to the selection of indices which demonstrate the territorial risk. These indices were selected based on a previous analysis of the assessment methods used by selected credit insurance companies (Petrova, Krügerova

and Koziel, 2020) as well as on data accessibility. The latter was an important aspect if the analysis was to become an inspiration for exporters' own risk assessments. The model for territorial risk assessment created by the authors consists of indices which are explained in the following table (Table 1).

To classify territorial risk, the risks of political and economic indicators available from the World Bank, OECD, and data from the World Risk Index are presented. A bespoke formula for determining territorial risk was created, composed of individual indicators. The number of objects (N) is equal to the number of countries in the OECD; therefore, $N = 37$. The number of variables (p) was set to $p = 7$ based on selected indicators.

Table 1. Input data

	Indicator	Abbreviation	Source	Unit	Interval	Year
1	Political Stability and Absence of Violence/Terrorism Index	<i>PSi</i>	<i>World Bank</i>	score	-2.5 – 2.5	2019
2	Gross government debt	<i>GGd</i>	<i>OECD</i>	% GDP	0 – 100	2018/2019
3	Government Effectiveness Index	<i>GEI</i>	<i>World Bank</i>	score	-2.5 – 2.5	2019
4	Control of Corruption Index	<i>CCi</i>	<i>World Bank</i>	score	-2.5 – 2.5	2019
5	Rule of Law Index	<i>RLi</i>	<i>World Bank</i>	score	-2.5 – 2.5	2019
6	Trust in government	<i>Tig</i>	<i>OECD</i>	%	0 – 100	2018
7	Natural disasters	<i>Nd</i>	<i>WorldRiskIndex</i>	%	0 – 100	2020

Source: Bündnis Entwicklung Hilft (2020), OECD (2020a; 2020b), the World Bank (2020), own elaboration

Index identification:

- The *Political Stability and Absence of Violence/Terrorism Index* estimates the likelihood of political instability, politically motivated violence and terrorism in a country. The indicator can take on values ranging from -2.5 to 2.5.
- *Gross government debt* expresses the ratio of government debt to GDP. It measures general government gross debt as a percentage of GDP.
- The *Government Effectiveness Index* includes such indicators as the quality of public services, the degree of

independence from political pressures, the formulation and implementation of policy, the government's commitment to policy, etc. The indicator can again take on values in the range of -2.5 to 2.5.

- The *Control of Corruption Index* represents the level of perception of corruption in the public sector. Index range -2.5 to 2.5.
- The *Rule of Law Index* reflects such indicators as the quality of contract enforcement, property rights, the functioning of the police and judiciary, the level of crime and violence. Everything then represents the level of trust of the people of the given state in the rules of society and the level of their compliance. The index takes values from -2.5 to 2.5.
- *Trust in government* indicates the proportion of people who state that they have confidence in the national government. The data show the proportion of respondents who answered "yes" to the question "Do you trust the

national government in this country?"

The sample of respondents represents the national population aged 15 and over. The indicator is expressed as a percentage of all respondents.

- *Natural disasters* express the level of natural risk, the risk of natural disasters in a given country. The index is influenced by the frequency and intensity of natural disasters in a given country, but also by the country's ability to prevent and cope with a given disaster. Vulnerability is influenced, for example, by socio-economic aspects and readiness to solve a crisis. This index not only evaluates the risks themselves and their impacts, but also coping with a natural disaster and adapting to the future.

After identifying political and economic indicators, the authors verified multicollinearity, or the presence of interdependence of variables. The so-called *Variance Inflation Factor* (VIF) was used to verify multicollinearity:

$$VIF_i = \frac{1}{1 - D_j} \quad (1)$$

where D_j is obtained when the j -th independent variable is regressed against the remaining independent variables.

Authors (James et al., 2013; Tamura et al., 2019; Esley et al., 1980) have stated that there is a strong multicollinearity if $VIF > 10$; these values can then seriously affect and skew the results.

In Table 2, we see that for the dependent variable GE_i the value of VIF is < 10 for most

indices, but for two (CC_i and RL_i), $VIF > 10$, which indicates the presence of strong multicollinearity; therefore, these indices had to be excluded from the subsequent analysis. This multicollinearity verification procedure had to be repeated for each variable, which was always determined to be dependent.

Table 2. Verification of multicollinearity

Model		Coefficients ^a					Collinearity Statistics	
		Unstandardised Coefficients		Standardised Coefficients	t	Sig.		
		B	Std. Error	Beta				
1	(Constant)	0.121	0.106		1.140	0.263		
	CCi	-0.024	0.096	-0.035	-0.252	0.802	0.063	15.845
	RLi	0.849	0.113	1.057	7.489	0.000	0.061	16.355
	Tig	0.003	0.002	0.079	1.487	0.148	0.431	2.319
	Nd	0.005	0.010	0.020	0.491	0.627	0.757	1.321
	PSi	-0.096	0.047	-0.113	-2.054	0.049	0.405	2.470
	GGd	0.000	0.000	0.014	0.355	0.725	0.769	1.300

a. Dependent Variable: GEI

Source: SPSS, own elaboration

Because the selected variables differ in terms of the type of units, the data must be standardised to avoid skewing the results.

Standard deviation or z-score was used for standardisation:

$$y_{ij} = z = \frac{x_{ij} - \bar{x}_j}{s_{x_j}} \quad (2)$$

where the column diameter $\bar{x}_j$ is subtracted from the original value of x_{ij} and divided by the column standard deviation s_{x_j} .

Using clustering by means of Ward's method and the squared Euclidean distance metric, groups of similar OECD countries are defined in terms of territorial risk.

The division of countries into clusters will be performed using Ward's method, where the distance between the g -th cluster and the unification of clusters h and h' can be marked using a formula:

$$D_{g(h,h')} = \frac{(n_h + n_g)D_{gh} + (n_{h'} + n_g)D_{gh'} - n_g D_{hh'}}{n_h + n_{h'} + n_g} \quad (3)$$

This method is very effective, but relatively small clusters are formed. The distances of objects are expressed by the squared

Euclidean distance. The squared Euclidean distance metric was used for the calculation, which is typical of Ward's method:

$$D_{ES}(x_i, x_j) = \sum_{l=1}^m (x_{il} - x_{jl})^2 \quad (4)$$

After the multicollinearity test, two variables had to be discarded and five variables were retained: *PSi* – Political Stability and Absence of Violence/Terrorism

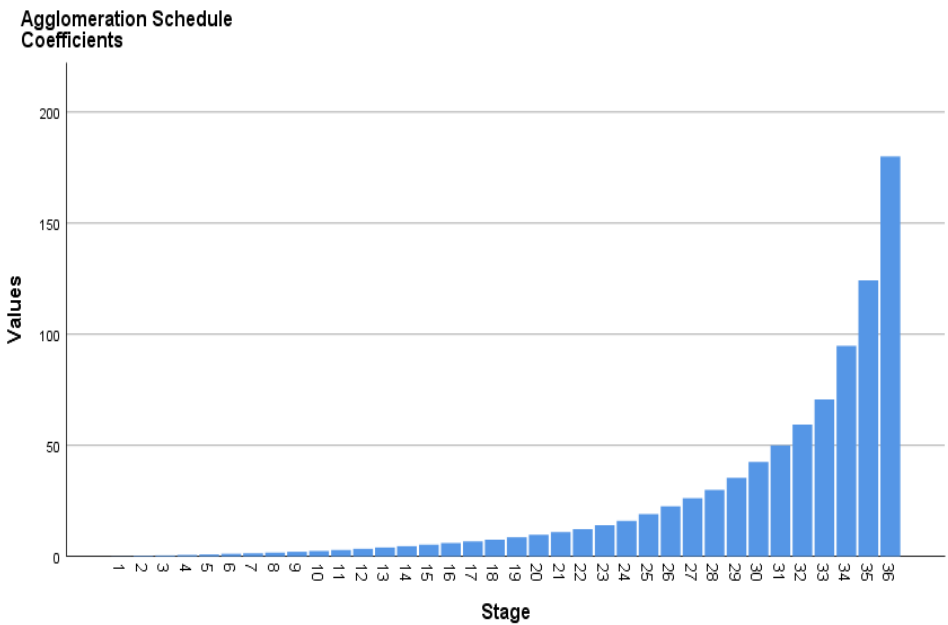
Index, *GGd* – Gross Government Debt Index, *GEi* – Government Effectiveness Index, *Tig* – Trust in Government Index, *Nd* – Natural Disasters Index.

3. Research results

In this part of the paper, the results of cluster analysis are presented. By interpreting the graph (Figure 1), the final number of clusters was set at four. The results are shown in

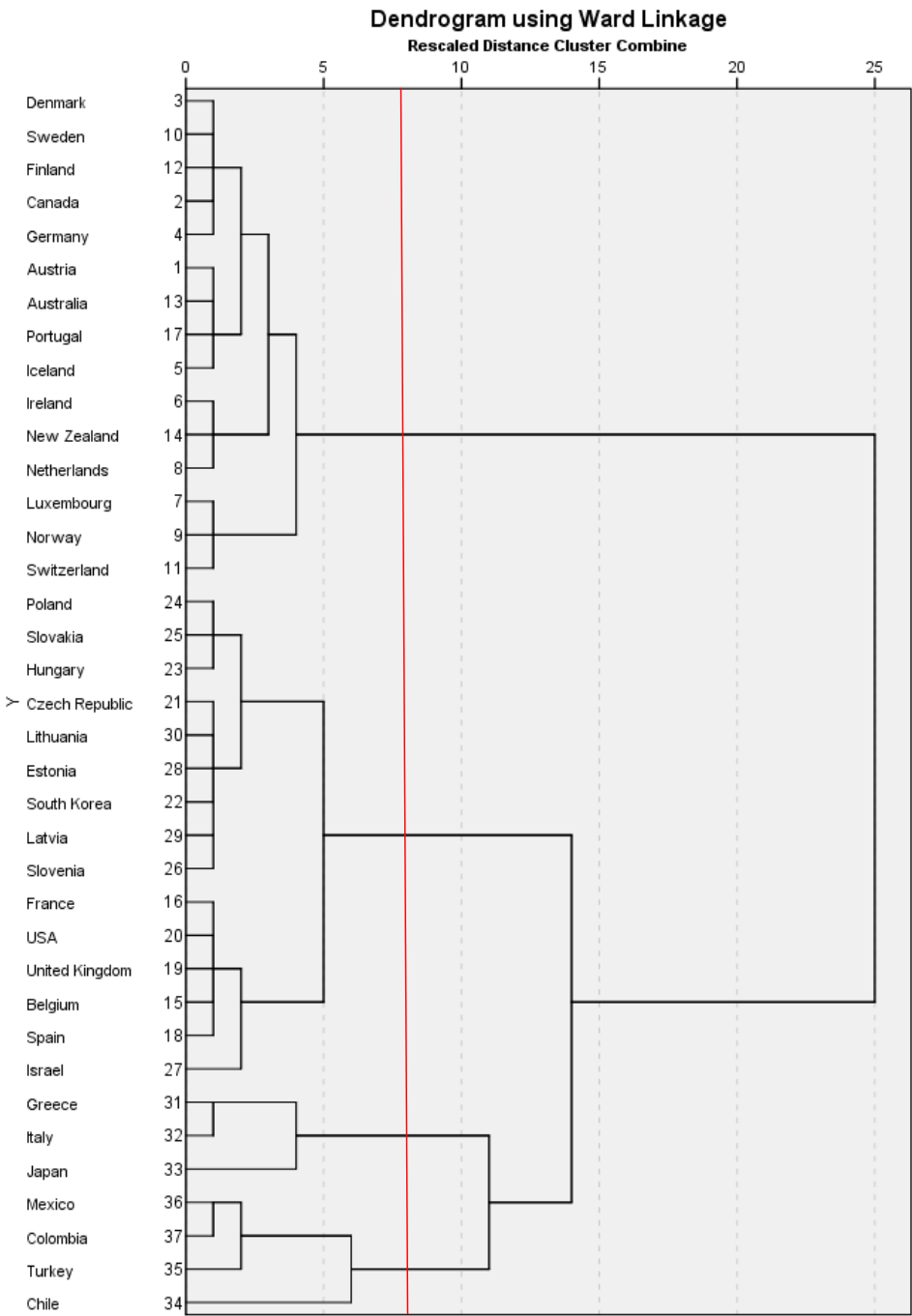
the dendrogram (Figure 2), which is a typical output of hierarchical methods in cluster analysis. Cluster 1 consists of 15 countries, while cluster 2 also consists of 15 countries, cluster 3 three countries and cluster 4 four countries.

Figure 1. Graph for determining the final number of clusters



Source: SPSS, own elaboration

Figure 2. Dendrogram after using Ward’s method



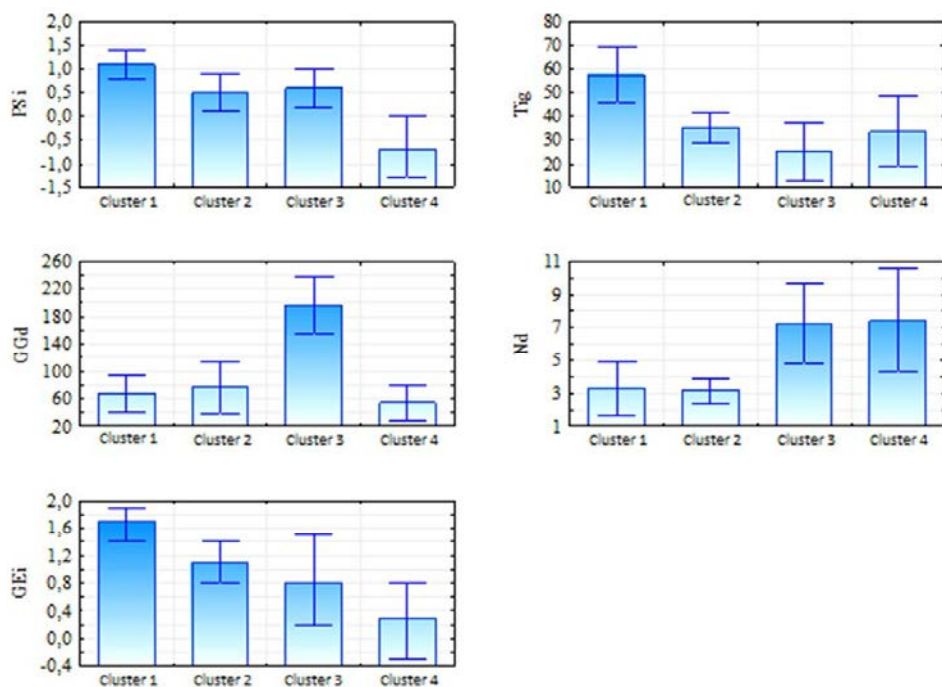
Source: SPSS, own elaboration

Descriptive Statistics											
Ward Method Statistic	N	Range		Mini- mum	Maxi- mum	Mean	Std. Devi- ation	Variance	Skewness		Kurtosis
		Statis- tic	Statis- tic	Statis- tic	Statis- tic	Statistic	Statistic	Statistic	Std. Error	Statis- tic	Std. Error
3	PSi	3	0.75	0.29	1.04	0.5983	0.39307	0.155	1.368	1.225	.
	GGd	3	83.23	155.50	238.73	196.5767	41.62544	1732.678	0.116	1.225	.
	GEi	3	1.18	0.41	1.59	0.8181	0.66622	0.444	1.718	1.225	.
	Tig	3	24.00	14.30	38.30	25.1000	12.17867	148.320	0.852	1.225	.
	Nd	3	4.89	4.75	9.64	7.2133	2.44521	5.979	-0.067	1.225	.
	Valid N (list- wise)	3									
4	PSi	4	1.55	-1.34	0.21	-0.6878	0.65179	0.425	1.022	1.014	1.746
	GGd	4	54.33	34.80	89.13	54.1800	25.08250	629.132	1.289	1.014	0.954
	GEi	4	1.22	-0.16	1.06	0.2558	0.54617	0.298	1.782	1.014	3.404
	Tig	4	31.00	25.00	56.00	33.8500	14.80867	219.297	1.966	1.014	3.890
	Nd	4	7.02	5.03	12.05	7.4250	3.15406	9.948	1.735	1.014	3.183
	Valid N (list- wise)	4									

Source: SPSS, own elaborating

Here values such as range of variation, mean, standard deviation, variance, skewness, and kurtosis are displayed. However, individual clusters were characterised by means and standard deviations. The minimum and maximum are not especially significant, as there may be outliers in some countries, which does not say a great deal about the cluster. By contrast, the mean and standard deviation characterise all the countries of a given cluster. The range of variation, as the difference between the minimum and maximum, is not significant

for similar reasons – it is only the difference between the values of two countries, while the standard deviation is a better measure of variability in the sense that it is calculated from the values of all countries in the cluster. Skewness and kurtosis are related to the normal distribution of data and have minimal link to content interpretation. Therefore, the means and standard deviations of the individual variables for each cluster were chosen for interpretation, which were displayed using range graphs (see Figure 3).

Figure 3. Range graphs of means and standard deviations of variables

Source: own elaboration

Cluster 1 – This cluster consists of the most developed OECD countries. Based on the range graphs, it can be stated that the countries in the first cluster are characterised by the highest values of *PSi*, *GEi* and *Tig*. It is *Tig* that differs most significantly between the countries of the first cluster and the other clusters, which can therefore be interpreted as meaning that a higher level of *Tig* is typical of countries in the first cluster compared to other clusters. The lower value of *Nd* distinguishes the first cluster from the third and fourth clusters, while the value of this index is comparable in comparison with the second cluster. Among the variables, *GGd* has the lowest resolution of the five variables monitored for the first cluster, as its values are comparable to the values for the second and fourth clusters and distinguish only the third cluster. Thus, the high values of the variables *Tig*, *PSi* and *GEi* can be described as typical of the first cluster specifically.

Cluster 2 – Looking at the range graphs, it can be stated that for the second cluster of countries, none of the five monitored variables is significantly distinguished from the other clusters. *PSi* values are comparable to the third cluster, *GGd* values are comparable to the first and fourth clusters, *Tig* values are comparable to the fourth cluster and partially to the third, and *Nd* index values are comparable to the first cluster. The most different values for the second cluster, although not significantly so, are those of *GEi*, which are lower than the corresponding values for the first cluster of slightly more developed countries, slightly higher than for the third cluster of countries with high levels of government debt, and significantly higher than for the fourth cluster.

Cluster 3 – For the third cluster of countries, the most strongly differentiating variable is *GGd*, the values of which are significantly higher for this cluster than for the

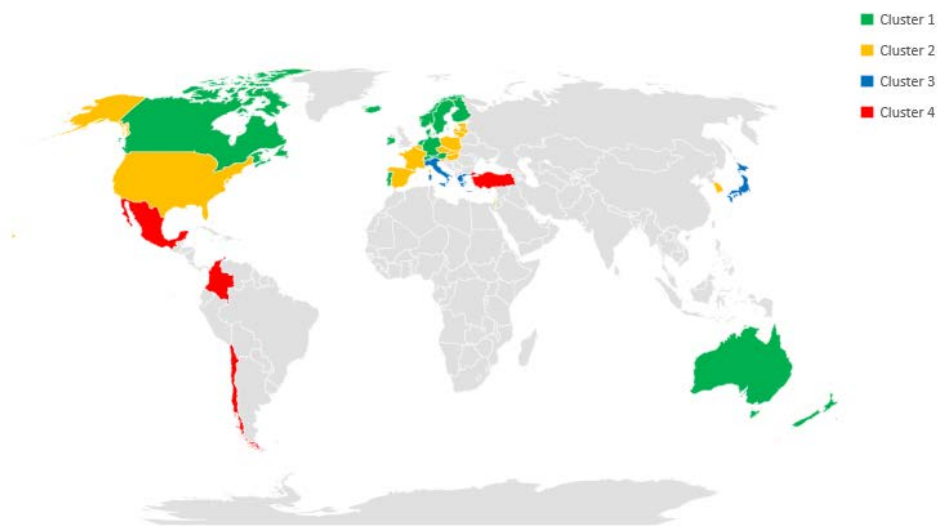
other three clusters. The resolution of the other four variables is minimal compared to GGd . The values of PSi are lower than for the first cluster of the most developed OECD countries, comparable to the second cluster of less developed countries and significantly higher than for the fourth cluster of the lowest rated countries. The values of Tig are the lowest for this cluster compared to other clusters; however, due to the high values of standard deviations, this is not a difference that can be said to characterise the third cluster. Nonetheless, it is worth noting that the correlations of GGd with other variables revealed the most negative and at the same time statistically significant correlation with Tig , which shows that high levels of indebtedness are often associated with lower levels of trust in government. The third cluster may be the group of countries where this phenomenon occurs most frequently,

because in comparison with other clusters it has the highest values of GGd and at the same time the lowest values of Tig .

Cluster 4 – Countries included in the fourth cluster are assessed as riskier according to the OECD methodology, as well as that of most credit insurance companies. Based on the range graphs, it can be stated that the countries in this cluster are characterised by the lowest values of PSi and the lowest values of GEi . The values of the other three variables do not differentiate the fourth cluster from its counterparts as clearly, because the values of GGd are comparable to the first and second cluster, the values of Tig are comparable to the second cluster and the values of Nd are comparable to the third cluster.

The results of the overall cluster analysis can be seen in Figure 4 in the form of a map of OECD countries categorised by individual clusters.

Figure 4. Classification of OECD countries into clusters according to Ward's method



Source: own elaboration

One-way ANOVA was also used to test the differences between clusters (Table 4). This makes it possible to assess the influence of individual variables on the classification into clusters and to verify the differences

between individual clusters. Based on the resulting ANOVA, it may be said that all clusters differ statistically from each other in terms of all variables. All variables are statistically significant at the 0.05 significance

level ($\alpha = 0.05$). The F-statistics are highest for the *Political Stability and Absence of Violence/Terrorism Index* (PSi) and the *Government Effectiveness Index* (GEi). However, this does not affect significance.

Table 4. One-way ANOVA

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
PSi	Between Groups	10.699	3	3.566	23.926	0.000
	Within Groups	4.919	33	0.149		
	Total	15.618	36			
GGd	Between Groups	45776.050	3	15258.683	14.007	0.000
	Within Groups	35947990	33	1089.333		
	Total	81724.040	36			
GEi	Between Groups	7.553	3	2.518	21.278	0.000
	Within Groups	3.905	33	0.118		
	Total	11.458	36			
Tig	Between Groups	5363.691	3	1787.897	17.037	0.000
	Within Groups	3463.086	33	104.942		
	Total	8826.777	36			
Nd	Between Groups	95.286	3	31.762	12.186	0.000
	Within Groups	86.011	33	2.606		
	Total	181.297	36			

Source: SPSS, own elaboration

4. Discussion

After determining our own indices for the classification of territorial risk and the

subsequent division of countries into clusters, we can compare the results with the OECD classification – see Table 5.

Table 5. Comparison of clusters with OECD classification

Cluster	Countries in the cluster	OECD classification
1	Denmark, Sweden, Finland, Canada, Germany, Austria, Australia, Portugal, Iceland, Ireland, New Zealand, Netherlands, Luxembourg, Norway, Switzerland	0
2	Poland, Slovakia, Hungary, the Czech Republic, Lithuania, Estonia, South Korea, Latvia, Slovenia, France, the USA, the United Kingdom, Belgium, Spain, Israel	0
3	Greece, Italy, Japan	0

Cluster	Countries in the cluster	OECD classification
4	Chile	0
	Mexico	3
	Colombia	4
	Turkey	5

Source: own elaboration

It may be seen that most countries are classified as non-risk and are in category 0. The only exceptions are Turkey, Mexico, and Colombia. This result is also comparable with the results of the cluster analysis, as part of which these countries were included in cluster 4, albeit Chile, which was placed in category 0 of the OECD classification, was also included in this cluster. However, it is important to remember that the OECD classification uses the CRAM model in its methodology, and it considers several factors, as well as the payment experience reported by participants. Based on the final score, the country is then included in one of eight categories. The results of the applied cluster analysis are therefore comparable to the OECD classification. However, only a limited number of indicators are considered, based on which countries are divided into clusters. The number of indices was limited not only due to the choice of the applied method, but also due to the availability of data – not all indicators calculated by the OECD are publicly available.

Conclusions

Cluster analysis was applied to the input data – OECD countries and pre-selected indicators that characterise the territorial risk. There were 37 objects altogether, represented by individual OECD countries and seven variables – selected indices which represent political and economic indicators that have been available and drawn from the World

Bank, OECD, and World Risk Index data. Ward's method, which may be classified as a method of hierarchical cluster analysis, was used.

Based on the results of the method, four clusters were determined, which, after description and evaluation of the character thereof, were compared by assessing the riskiness of OECD countries. The OECD classifies most countries in category 0, which includes non-risk countries. The only exceptions are Turkey, Mexico, and Colombia. In comparison with the results of cluster analysis, Chile was also included in the fourth cluster. The results of the applied cluster analysis are therefore comparable to the OECD classification. However, only a limited number of indicators are considered, and the experience of exporters is not taken into consideration. The number of indices was limited not only due to the choice of the applied method, but also due to the availability of data – not all indicators calculated by the OECD are publicly available. The results of the cluster analysis were then displayed on a world map.

At first glance, it might seem that the division of countries into individual clusters based on Ward's method is surprising and inconsistent. However, after a closer examination of the reasons for the inclusion of individual countries in a particular cluster, these make sense and fit a logical whole. Thus, it is suddenly possible to look at individual countries through a completely different prism.

It is clear to the authors of the article that even this method of dividing individual countries has its limitations. One of the main limitations may be the lack of data with which to work. On the other hand, it is possible to work with the input data further, for example by extending them or, conversely, narrowing them according to the specific requirements for the division into clusters.

However, the authors see the fundamental benefit of grouping countries in the fact that for both entrepreneurs and other stakeholders (such as insurance companies), clustering offers another source of information about the country which they are interested in exporting to. On the one hand, entrepreneurs usually do not have the capacity or knowledge to assess the situation in individual countries in detail (therefore, for example, the OECD has also chosen a simple classification of risk assessments on a scale from 0 to 7). On the other hand, the assessment of the riskiness of a given country according to a simple number may not always have adequate informative value. The division of countries into clusters allows the entrepreneur to use the knowledge of one country (or group of countries) to obtain an idea of other countries included in the same cluster. As can be seen from the comparison made in Table 3, the countries rated OECD risk level 0 are in all four clusters. The cluster analysis thus enables stratification even within individual degrees of risk. As mentioned by the authors, this allows stakeholders to obtain a clearer idea of the situation in each country, or to obtain information for a specific situation by choosing the appropriate indicators.

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