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Disertační práce

Prostorová analýza ekonomických ukazatelů podniku

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15. 3. 2021 Ilona Berková

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Největší poděkování patří mému školiteli, který byl během mého dlouhého studia velmi empatický, ochotný a nápomocný. Byl hlavním hnacím motorem, který mne motivoval k dokončení práce. Ráda bych také poděkovala své rodině, která mne během studia podporovala všemi směry. Závěrečné poděkování patří také mé malé dcerce, které se podařilo občas usnout, čímž mi umožnila práci po večerech dopsat.

Content

1. Introduction

The location of a company is one of the most important determinants which ensures the future successful development of the company. Every company must take into account plenty of internal and external factors that are influenced by companies, households and the public sector. The optimal combination of these factors leads to optimal localization, therefore, it is important to understand these economic factors. That's why the location of corporate activities has been a part of economics for many years. The theories and methodologies that are focused on this problem are part of regional economics.

Choosing a business location is one of the most crucial business decisions along with the choice of a legal form of business or determination of the construction of a business. It is a long-term decision that cannot be repeatedly revised, especially in the case of large enterprises. A poorly chosen location significantly reduces the chances of a newly established business to survive.

The main purpose of the thesis is the evaluation of companies' location and answering the question of where it is better to place a new company. To solve the problem, the new methodology was proposed where the company's location is considered to be its headquarters and to tackle its location the local population and the health of companies were taken into account. I try to compare the location of the company's headquarters and its establishments. Then, I recognise spatial interactions of headquarters of companies, if they tend to make clusters or not. Lastly, there is answered the question if the health of company follows the same fate as other near companies or the health is absolutely independent on near companies and if the company is doing better in a cluster or not. To fulfil the given aim, the literature overview of companies' location in the context of the economy and the assessment of companies' performance and a methodology for the evaluation of the position of companies have to be introduced. Specifically, there is introduced the methodology for the description of the positions of individual companies in homogeneous and inhomogeneous case (whether they tend to make cluster or vice versa), if the clustering is dependent on the health of companies and a way to identify a level of clustering (how the tendency of clustering is strong).

The paper is divided into 6 main chapters. In the first chapter, "Introduction", there is contained the brief outset of the papers' topic. In the chapter, "Literary Overview", there is

described theory related to the problem of location theories (regional economics, clustering, location theories, and their development) and performance assessment of companies, specifically Neumeiers' indices. The chapter, "Methodology", contains the methodology for the investigation of the location of companies in a given area. In the chapter "Results" all the outcomes are presented in detail. The chapter "Discussion" provides a comparison of the gained results with other authors. At the end of the paper, there is the conclusion of the results that summarizes the topic.

2. Literary Overview

Different economic activities benefit from different areas. For this reason, it is necessary to pay attention to regional sciences, which take into account the influence of location on economic activities.

2.1 Regional economics

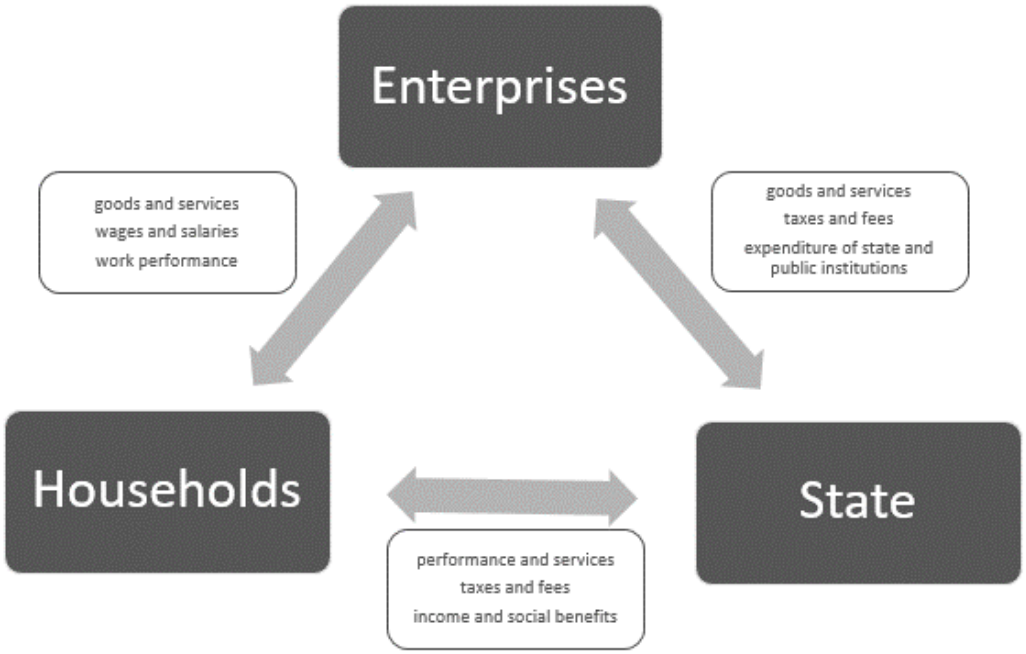
Regional economics is a summary of statements and findings of the socio-economic spatial structure. The aim of regional economics is to explain and predict economics events in space and to shape regional economic reality (Ježek et al., 2002). According to Edwards (2007), regional economics helps to determine where different types of economic activity will prosper. He claims that regional economics combines tools from microeconomics, macroeconomics, and international economics to analyse location patterns and other components of regional growth rates. Regional economics focuses on proximity and transportation costs, increasing returns to scale and externalities. Urban economists, on the other hand, are interested in the relation of the peripheral urban areas to the city itself as well as land use patterns within a city. Urban economists are particularly focused on land use, land rents, local government and local education policies, and housing, as well as social problems relating to poverty and crime.

Regional economics can be divided into regional macroeconomics and regional microeconomics. Regional macroeconomics compares the economic performance of a selected number of regions with the national economy, deals with the economic growth of regions, inter-regional differences in unemployment and inter-regional movement of production factors. In contrast, regional microeconomics is much more concerned about the localization and interaction of individual economic activities (Ježek et al., 2002).

Spatial decision-making is the result of many actors. Many authors have dealt with the issue of actors of regional development. In the Czech Republic, for example, Pospíšilová and Vajdová (2007) or Stachová et al. (2007) have dealt with this problem. They divided major actors into public sector institutions, private sector institutions, and civil society. The most common differentiation of the actors is divided into three main groups, enterprise, household, and state (public sector) groups according to Ježek et al. (2002); see in the figure below. The most important consideration of companies is where business activities will be realized. Households, as final consumers of goods and services, labour supply, entrepreneurial activities

and capital, influence regional structures in their decision-making. The public sector makes spatial decisions for things such as tax collection, infrastructure, provision of public facilities, law-enforcement, institution-building, etc.

Figure 1 Actors of regional development



Source: Own processing according to Ježek et al. (2002)

According to Ježek et al. (2002), the object of exploration of spatial economics is an economic spatial system consisting of three basic elements:

1. the distribution of economic activities,
2. movement of production factors,
3. dynamics of inhabitant structure and regional structure.

The economic activities of individual regions are directly influenced by regional policy. There is no exact definition for the concept of regional policy. The definition varies for many authors. For example, Wokoun (2003) briefly defines regional policy as a set of objectives, measures and tools to reduce excessively large socio-economic disparities across regions. According to Ježek et al. (2002), regional policy is defined as a form of government economic policy aimed at changing the deployment of economic activities and changing the performance of regions' economies. It is about influencing economic processes in partial spatial state units

through public administration (state administration and self-government). In particular, economic, social and environmental reasons exist for the existence of the regional policy.

Regional politics represents all public interventions that lead to the improvement of the geographical distribution of economic activities, respectively, to try to correct some of the spatial consequences of a free market economy for achieving two interdependent goals - economic growth and improvement of the social distribution of economic effects (Vanhove, 2018).

The main objective of regional politics is to reduce disparities between regions, harmonious development of regions, creation of common financial resources and their effective spending. In particular, the policy emphasizes on economic growth and development (Stejskal & Kovárník, 2009). Wokoun et al. (2008) argue that regional policy objectives are based on the identification of the main regional problems and on the concept of economic policy, whereby they are defined as far as possible to control their fulfilment and simultaneously evaluate the effectiveness of the used tools.

Regional problems/differences can be caused by a number of economic and non-economic factors. The principal factors are primarily factors related to economic theories, namely the relatively low mobility of labour and capital and geographical factors, especially the geographical remoteness and insufficient natural resources. Other important factors are, for example, the inadequate economic structure of the region, institutional factors and psychological factors. Secondary factors such as the external economy (technical, financial, and infrastructural), the demographic situation (lower level of education), the rigidity of costs and prices, the wide range of regional uniformity of wages for certain important inertia forces, the wide range of regional wage uniformity for certain qualifications groups, regional differences in innovation and several other factors of a different nature contribute to uneven regional development (Wokoun et al., 2008)[1].

The main actor involved in regional policy in the Czech Republic is the state and the Ministry for Regional Development. However, in recent years, the number of actors such as the European Union, regional development funds and agencies, advisory and technology centres, etc. have been increasing (Ježek et al., 2002).

[1] Localization factors are described in detail below in the Chapter 2.4.2

2.2 Region

Over the past 100 years, Urban and Regional Economics have developed enormously, but despite this development, there has been no clear definition of the fundamental concept of the region yet.

The term region can be defined as a territory within a different territorial delimitation. The primary issue of regional economic concerns the appropriate delineation of a region. Siebert (1969), for example, defined a region as a "*subsystem of a national economy*". According to the Law Regional Development Support No. 248/2000 Coll., a territorial unit is defined by the administrative boundaries of regions, districts, municipalities or associated municipalities whose development is supported.

Regions are defined as territorial units that have certain solidarity that is determined by the criterion of homogeneity or functionality. In the homogeneity criterion, territorial units are assigned to each other, according to similar economic indicators. In the criterion of functionality, territorial units are associated according to strong spatial links. These criteria are not mutually exclusive (Ježek et al., 2002).

Differences or inequalities are generally a major stimulus for social development, and their existence is desirable and necessary. On the other hand, too large differences between regions (similarly between individuals) cease to be stimulating and can have unpleasant economic and serious social and political consequences and are therefore generally considered as the negative thing. At the same time, regional inequalities are a prerequisite for more effective forms of territorial division of labour and specialization (Wokoun et al., 2008).

The literature describes many types of regions' typologies according to a variety of criteria. One of the most cited classifications is the typology of Blorevogel (2000), who distinguishes the following types of regions:

- real regions,
- regions defined by human activities,
- regions that are perceived or identified as regions.

Real Regions, Blorevogel (2000) defines as regions of scientific constructions that serve the scientific organization of reality that is constructed based on a purpose or theory. Regions

defined by human activities are created by the daily actions of individual or collective actors. The last type of region is created through social communication.

The typology of regions by Wokoun et al. (2008) is based on Blorevogel, (2000)'s typology. Wokoun et al. (2008) claim that there are descriptive regions that are defined by situational analysis based on the occurrence of representative phenomena or functions. Furthermore, according to these authors, there are normative regions that arise from political decisions based on legislation or executive requirements. There is no uniform methodology for defining descriptive regions. It depends primarily on the purpose of the delimitation, the nature of the quantities (e.g. qualitative, quantitative) and the availability of necessary data. One possible approach is, for example, cluster analysis (Matoušková, 2000).

According to Edwards (2007), there are two categories of regions, i.e. functional (operational) and administrative (political). The administrative regions are determined by political subdivisions and often become the area in which policy decisions are implemented. Ideally, but rarely, these categories signify the same geographic area.

However, economics mostly defines three types of regions: supranational, transnational and sub-national, where the first two regions are distinguished by currency, laws and customs regulations, while sub-national regions are characterized by these institutions shared with other regions of the country (Ježek et al., 2002). In the thesis, the region is considered as a subnational type, so it is not separated by formal boundaries and economic barriers.

The division of regions according to the NUTS methodology (Nomenclature of Units for Territorial Statistics) plays an important role in the European Union. The NUTS regions were established in 1988 when the EU introduced this breakdown for the needs of its Eurostat statistical office. This is mainly due to the monitoring of economic indicators and further to the evaluation of the results of the application of the regional policy of the EU Member States. NUTS units are marked with numbers indicating hierarchical order. Besides, the LAU system (Local Administrative Units) was created in parallel in 1990. These units at district and municipal levels were replaced by NUTS 4 and 5. In defining NUTS regions in the individual EU Member States, efforts were made to respect the boundaries of the original administrative units. In the Czech Republic, NUTS 3 units are individual regions, NUTS 2 are so-called "associated regions" or "cohesion regions" (Ministerstvo pro místní rozvoj České republiky, 2016).

The choice of the specific definition of a region is usually dependent on the author and his other intentions.

2.3 Clustering

The term "cluster" is not new in economics and has many definitions. This is also because the cluster of companies can be described from a geographical point of view, but also from a contractual point of view. Specifically, this thesis deals with geographical clusters.

The first mention of a cluster of companies is already from the end of the 19th century when clusters were engaged by Marshall (1890), who claims that the clustering was due to localization savings, the creation of a dedicated workforce supply, the transfer of knowledge and technical progress among companies.

For example, CzechInvest (2005) defines a cluster as: "*a geographically concentrated group of independent firms and affiliated institutions that compete with each other, but also cooperate with each other, and whose links have the potential to consolidate and enhance their competitiveness*".

The most well-known economist dealing with clustering is Michael Eugene Porter. According to Porter (1998), a cluster is a critical mass of companies in a particular location (a country, state, region or even city). He claims that: "*Clusters suggest that a good deal of competitive advantage lies outside companies and even outside their industries, residing instead in the locations at which their business units are based."* (Porter, 2000).

Clusters occur in many types of industries, in smaller fields, and even in some local industries such as restaurants, car dealerships, and antique shops. They are present in large and small economies, in rural and urban areas, and at several geographic levels (e.g., nations, states, metropolitan regions, cities). Clusters occur in both advanced and developing economies, although clusters in advanced economies tend to be far more developed (Porter, 1998). Boadway et al. (2004) claim that all economic activities tend to cluster and the clustering has an important impact on the real world. According to Jovanović (2003), it is natural that companies are looking for other similar or almost identical companies. This fact then allows the creation of clusters.

Generally, clusters represent a collaboration between companies in a particular territory or region. Clustered companies are mutually competing with each other, on the other hand, they

cooperate with each other in a certain way. The main reason for the creation of clusters is the implementation of innovations and knowledge in the business sector. Many authors agree that clustering generates benefits for businesses. According to Stejskal and Kovárník (2009), clusters have unquestionable advantages for companies, enabling them to increase productivity by accessing specialized inputs, information, and institutions. Furthermore, they increase the innovation capacity and lead to better strategic planning of the relevant region or bring a beneficial advantage to participating companies. For example, according to Porter (1998), clusters increase the productivity of outsourcing or vertical integration through improving access to specialized inputs and information, facilitating complementarities among cluster participants, improving incentives and performance measurement and to lower barriers to a new business formation that improve the environment for productivity. As the main advantage, he sees the role of a cluster in improving the rate and success of innovation. Also, according to Skokan (2004), enterprises achieve significant performance and competitive advantages through sectoral clustering, which they would have difficulty achieved alone. It is proven that companies in clusters benefit from symmetrical geographic agglomeration. McCann and Folta (2011) managed to prove that the clusters bring benefits especially to new companies or ones with a higher knowledge base. Jovanović (2003) state that clusters bring benefits in terms of knowledge externalities such as information gathering, fact processing and network production places.

One of the biggest benefits of a cluster is the advantage of locally concentrating resources and services that firms use to do business. Compared to competing companies outside the cluster, companies concentrated in the cluster can use these resources in advance and at a lower cost. At the same time, they have greater access to banking, accounting, consulting, marketing, advertising, and other services. For example, Marshall (1890) introduced the reasons why it is beneficial for companies from the same sector to be located together. He found three main reasons to concentrate:

- dissemination of knowledge and information,
- more favourable market for specialized skills (firms may easily find the necessary labour and workers may get promotion or work if the current employer does poorly),
- backward and forward linkages associated with large markets.

However, according to Marshall (1980), there are additional reasons for the spatial clustering of firms and industries as:

- lower transaction costs,
- creating barriers to entry for other companies,
- labour markets of two unrelated industries may be complementary,
- different industries may use a common resource,
- firms may use common services and social infrastructure,
- higher potential of building new infrastructure,
- creating a direct or indirect market for other companies/sector,
- etc.

However, there are also authors who claim that clustering also has its disadvantages. Baptista and Swann (1998), failed to prove this relationship significantly in their study. Their results show that if employment in a cluster is strong, the company is more likely to be innovated. On the other hand, the excess of employment in the cluster seems to cause congestion, and the disadvantages then outweigh the benefits that the cluster may have. Beaudry and Breschi (2003) were also interested in the same problem. They came to the same conclusion, namely that clustering does not lead to higher innovation performance. Lee (2009) also revealed the results that are contrary to the common dogma of cluster innovations. His results show that placement in a cluster does not affect R&D intensity. Swann (1998) emphasizes the agglomeration's negative impact on congestion and competition on both the input and output markets. Then, he says that the positive impact of a cluster is getting smaller as the cluster grows. Also, Lazerson and Lorenzoni (1999) reported a negative consequence of cultural homogeneity in the cluster. Beaudry and Breschi (2003) claim that the effects of clustering can be positive or negative and can be based on demand or supply. Porter (1990) identified four basic factors as prerequisites for the emergence of cluster competitive advantages, including:

1. input factors (e.g. skilled labour, natural resources (land), capital, scientific and technological infrastructure),
2. conditions of (domestic) demand, including a sophisticated and demanding customer base, which encourages companies to continually improve, to innovate and modernize, thus preparing companies to enter the more advanced spheres,
3. related and supportive sectors, sufficiently competitive beyond national borders, to benefit even the less developed sectors, which, through their activities and presence,

can support even less competitive sectors, as their outputs can serve as inputs to the less developed sectors,

4. corporate strategy, organizational structure and rivalry, supporting the successful development of entities.

Several so-called concentration factors contribute to the emergence of clusters. The main concentration factors include:

- supplier-customer ties - the stronger the ties, the more tied-up companies will tend to be nearby and reduce transportation costs,
- a strong market - an effort to create a strong market through clustering,
- diffusion of knowledge - easier and faster dissemination and creation of knowledge among individual cluster members (Damborský & Wokoun, 2010).

In addition to the factors supporting association, there are also deconcentrating factors:

- immobility of factors - certain production factors cannot be transported and must be processed at their location (e.g. minerals, perishable materials),
- concentration costs - for example, coordination costs increase from a certain number of companies concentrated in the cluster,
- communication technology - connection of companies is sufficiently ensured by high-quality communication technology enabling fast and reliable transfer of information. This deconcentrating factor is gaining momentum and in many cases outweighs the benefits of concentration (Damborský & Wokoun, 2010)

Fujita and Thisse (1996) tried to answer the question: "*Why do economic activities tend to agglomerate in a small number of places (typically cities)?*" They found out three main reasons for the clustering of economic activities:

- externalities under perfect competition,
- increasing returns under monopolistic competition,
- spatial competition under strategic interaction.

Our goal will also be to find whether the proximity of other companies has an impact on the performance of the company under review or whether the performance of the company is affected by the health of companies in the vicinity.

2.3.1 Agglomeration effects

As already mentioned, the spatial structure is the result of localization decisions by businesses, households and the public sector. The spatial distribution of activities affects localization conditions that arise from the activities of existing or newly established businesses. Agglomeration effects are those that arise from the spatial interaction of businesses, households, and the public sector.

Agglomeration effects are divided into:

- internal effects,
- external effects,
    - localization effects,
    - urbanization effects (Jennen & Verwijmeren, 2010).

Both internal and external agglomeration effects can influence both positively and negatively. In the case of a positive effect, they lead to the spatial concentration; in the case of a negative effect to the spatial dispersion. Internal effects indicate dependence between activities that occur in a region or already exist within the enterprise. This effect is associated with the notion of revenue from scale where production expansion leads to each new production unit being produced at a lower cost than the previous one. The external effects are the agglomeration effects that arise between economic actors (businesses, households, and the public sector) and are defined as influences that determine the economic outcome of actors but are controlled by other economic operators. External effects are further divided into localization effects and urbanization effects. Localization effects arise among businesses in one industry. So they are external from the point of view of the company, but they are internal from the branch point of view. The role of localization effects depends on the size of enterprises, where many effects are localization benefits for small businesses, but for large enterprises, these are benefits of scale (Ježek et al., 2002; Jennen & Verwijmeren, 2010).

There are many positive localization effects, such as concentration at the location of natural resources, the creation of special supplier industries, the emergence of a specialized labour

market, special research and development facilities, special infrastructure, etc. For negative effects (Ježek et al., 2002) consider, for example, rising labour costs, land price increases and the associated large regional demand for factors of production. Another negative effect can be environmental damage. Rosenthal and Strange (2003) claim that the positive localization effect at all levels of geography is labour market pooling, at zip code level it is knowledge of spillovers and at the state level, they are reliance on manufactured inputs and natural resources.

Unlike localization effects, urbanization effects arise between businesses of different disciplines and between different activities. These are positive or negative influences that affect the results of economic entities (Ježek et al., 2002).

The positive urbanization effects can be attributed to the size of the sales market, the emergence of a large skilled labour market, the existence of manufacturing services, research and development facilities, transport infrastructure, the possibility of direct economic and social contacts with other businesses and decision-makers, the existence of specialized cultural, leisure and consumer facilities. Many of these benefits are related to the size and diversification of regional markets and are emerging mainly in times of economic restructuring, in industries and businesses with high levels of uncertainty, and in young businesses or product businesses at an early stage of the production cycle. There are also negative urbanization effects, such as air pollution, congestion, and high production factors, due to the concentration of economic activities and the population (Ježek et al., 2002).

Many authors agree that the localization effect works together with the urbanization effect (Moomaw, 1981; Rosenthal & Strange, 2003; Henderson, 2003). However, Rosenthal and Strange (2003) and Henderson (2003) claim that localization effects are stronger than urbanization effects. Rubiera Morollón, F. and Viñuela, A. (2012) claim that each base spatial unit is dependent on the strength of the agglomeration effect and the distance to the main population centre. According to the research of Ciccone (2002), the agglomeration effects of Europe are only slightly lower than in the United States. Furthermore, they showed that agglomeration effects in states of Europe are not significantly different between countries.

2.4 Location theories

Ježek et al. (2002) distinguish three theoretical approaches from the perspective of spatial economics:

1. location theory,
2. theory of spatial stability,
3. regional growth and development theories.

This research belongs to the theoretical approach of location theory, and therefore, it is necessary to describe these theories in depth. A company and its activities must adapt to the framework conditions of its surroundings, and these relationships are tied to certain locations and influence the potential localization decisions of the company (Ježek et al., 2002). This situation gave rise to location theories. Location theories are focused on the geographical location of economic activities and have become an integral part of economic geography, regional science, and spatial economics. Location theory seeks to answer questions about where economic activities are located and for what reason. The location of economic activities can be determined at regional, metropolitan or narrow levels such as zone, neighbourhood, city block or individual (The Editors of Encyclopaedia Britannica, 2014). Furthermore, these theories solve problems of who produces, whether they produce goods or services, at what point and for what reason. The emergence of these theories is influenced by the need to address how the shifts in supply impact the shift in production (North, 1955).

Due to the long-term perspective of localization decisions, localization analysis has to be worked out many years ahead, which means that it is associated with a high degree of uncertainty. Localization uncertainty may be a result of the market, technological factors or a large number of factors affecting localization decisions (Ježek et al., 2002). Furthermore, Dunning and Boyd (2003) argue that due to changes in society, light localization variables or those related to them such as living standards, minimal pollution, violence, corruption, and other unacceptable social behaviour must also be taken into account.

2.4.1 Assumptions of location theories

Most location theories are built on these main assumptions:

- The production process for special goods is uniform, independent of location. Some locations are more suitable for crop production than others. Production factors cannot be replaced.
- Demand for production is separated from production and product offerings.

- Production factors such as land and natural resources are immobile compared to some factors such as capital, labour (North, 1955).

The theory based on these assumptions creates an estimate to minimize production and transport costs, and that localization will specialize in the production of special goods and services and the export of these goods to other locations (North, 1955).

2.4.2 Localization factors

Localization factors are the forces that influence the decisions about the location of the company in a space whereby the optimal combination of these factors can achieve an optimal location. These are facts that determine the suitability of the environment for economic activities. Each author presents other localization determinants, which are mainly dependent on the development of the economy which changes the development of the importance of individual production factors. For about three centuries, localization theory has been trying to clarify on what basis economic activities are deployed in space. It seeks a suitable combination of factors that influence the decision-making of entities about their activities.

Localization factor for all industries

Factors influencing business start-ups and factors that affect the development of businesses already established are important in terms of setting up and dynamics for SMEs[2]. Factors influencing business start-ups include the sectoral structure of local or regional economies, the prevailing size of enterprises, the educational level of the workforce and regional business traditions. The second group includes factors that affect the development of established businesses, such as market access and market dynamics, access to venture capital, land ownership, local (regional) economic policy, and the general attitude of entrepreneurs to the population and politicians (Ježek et al., 2002).

According to Ježek et al. (2002), localization factors must meet two conditions; that the localization factor must be reflected in the costs or revenues of the enterprise and must be spatially differentiated (not available at all sites).

For example, Jovanović (2003) claims that when looking for a place to start a business, the investor will either prefer the spatial location with the lowest-cost production function and

[2] small and medium-sized enterprises

ignore the demand side of it or emphasize demand/revenue and neglect everything else, all while maximizing profits with respect to the alternative location.

Three localization factors are listed by A. Weber:

- transportation costs,
- labour costs,
- consumer agglomerations (Predöhl, 1928).

Furthermore, A. Weber divides the factors according to the sectors of the economy in which they operate on the general and special, depending on the factors of the socio-political system on the natural-technical and socio-cultural, and on the dispersion of economic activities on regional and agglomerative factors (Predöhl, 1928).

For example, Cifranič (2016), as the most important localization factor describes six main categories; labour, market, land, infrastructure, environment, and legal social and economic conditions. Ježek et al. (2002) consider the most important location factor as relating to the purchasing and the sales markets. The localization factors of the purchasing market include natural resources, labour, suppliers of goods and services, information and access to information. The factors of the sales market are market potential, information, contacts, and business readiness in the sales market factors. Policy decisions are also a major factor in locational decision-making (Edwards, 2007). They involve the location of public facilities, which in turn may make a particular location more or less attractive to enterprises.

Wokoun et al. (2008) divide localization factors from several different points of view, for example:

- spatial range,
- an economic approach,
- material nature,
- dynamics approach,
- management and planning systems.

KuŞluvan (1998) identified the following factors as determinants of the companies' location:

- technological,

- economic and geographical,
- political,
- social.

The first determinant refers to the physical laws of the location and the support of infrastructure, such as motorways, airports, railways, sewers, etc., which determine the function of a possible facility. Economic and geographical determinants include people living in a locality that is worrying about daily occupational and non-occupational activities, proportionate to the ability and willingness to pay the corresponding residential costs. Those who cannot afford the most advantageous locations must choose more remote housing. This phenomenon is explained by the Host of Theory (KuŞluvan, 1998) model, where cities are already on a trade route on a historical basis. Currently, retail homes and warehouses are often located in the centre of demand where customers have easier access to stores. Political factors include zoning, which constitutes institutional consent in the community required by country legislation. Fiscal and judicial requirements are standard. The social factors that determine a location are dominance, inclination and separation, centralization and decentralization, and invasion and success. On the one hand, people are moving towards gathering into communities, but on the other hand, for some reasons, they separate themselves for certain other reasons, which results in the reservation of a country available only to a selected group. Social values vary depending on values over time and in the context of cultures.

According to Jovanović (2003), the main localization factors in the past were natural resources and the availability of technology. However, the present requires more factors for the spatial location of the company. To these factors it is necessary to assign:

- costs and prices,
- demand,
- organisation and technology,
- externalities,
- policy-related factors,
- social factors.

To evaluate the quality of the business environment in the Czech regions, Viturka (2003) divided localization factors into six basic groups, which are assigned specific factors and weightings by selected sectoral groups of economic activities:

- business factors,
- infrastructure factors,
- working factors,
- local factors,
- price factors,
- environmental factors of quality of life.

However, the division of localization factors into Soft ones and Hard ones can be considered crucial. Hard determinants are also sometimes referred to as measurable and Soft as non-measurable or subjective. The division into economic activities is not entirely clear. In general, however, Hard localization factors are those that directly affect business activity and can be directly calculated (asset acquisition, workforce, etc.). Conversely, Soft localization factors have an indirect or very small impact on an enterprise and are not included in accounting documents (quality of life, education of the population, etc.) (Damborský & Wokoun, 2010). Many authors have modified this basic division in some way. For example, Rumpel et al. (2008), divided Soft localization factors into Soft Business Localization Factors, which have a direct impact on business activity, and Soft Individual Factors that express the subjective issues of management and employees themselves. Dvořáček and Slunčík (2012) also used this typology of the factors. In their paper they divided factors into Soft, Soft individual and Hard; where Soft localization factors have a direct impact on the activity of business entities, they are subjective and non-measurable; Soft individual localization factors are personal preferences of management and self-employed, which are reflected in their work motivation and efficiency; and Hard localization factors are measurable.

Localization factors for individual industries

So far, general location factors across all sectors have been mentioned. However, there are a number of studies focused on localization factors for individual sectors of industries. For example, Verhetsel et al. (2015) deal with the logistics sector. They found out that land rent is the most important factor in the location choice of logistics companies. The second most important factor was access to a port, followed by access to a motorway, a location in a business park and an inland navigation terminal are equally important. Hesse (2004), Holguin-Veras et al. (2005), Nguyen and Sano (2010), Ozmen-Ertekin et al. (2007) have also dealt with logistic

companies. They proved that next to accessibility, the cost of land is a major location factor. Hayashi et al. (1986) were engaged in industrial companies and concluded that the most important location factor in the industry is accessibility.

Significant localization factors for the Manufacturing and Distribution industry include a good transportation system (near major interstates), strong utility systems (electric, water, wastewater, gas and well-educated workforce) and strong specialized training programs (Cohen, 2000). Rumpel et al. (2008) state that enterprises of the tertiary and quarterly sectors of the economy are most conditioned by soft location factors.

An interesting approach to localization factors is the study of Ramasamy et al. (2012), which deals with factors based on international corporate ownership, i.e. state-owned and private. The authors have found that while locally government controlled firms are attracted to natural resource-rich countries, private firms are more likely to provide value-added services than to exploit the resource itself.

From the theoretical basis of the localization factor mentioned above, we can derive the most frequently discussed localization factors:

- geographical conditions,
- economic conditions,
- politics conditions,
- market potential,
- spatial proximity to suppliers,
- spatial proximity to consumer,
- spatial proximity to information and contacts,
- transportation costs,
- labour costs,
- availability of infrastructures of various types (transport, technical, scientific, technological, etc.).

2.4.3 Development of Location theories

Localization theories have undertaken huge development due to various changes concerning the world economy, the environment, and also globalization (Fujita, 2010). Richard Cantillon, an Irish banker who lived in Paris, is considered a pioneer of special economics. The roots of spatial economics can be traced to the year 1755[3]. Cantillon examined the relationship between cities and the surrounding countryside (Brewer, 2003). The official origin of localization theories is dated to the beginning of the 19th century in Germany when there was a great development of industry and agriculture. The beginnings of these theories were focused on the geometry of the site in the two-dimensional landscape (Krugman, 1997). The founders of these theories include Johann-Heinrich von Thünen, William Alonso, Walter Christaller and Alfred Weber[4], whose models served as the basis for localization theories and were expanded to the needs of geographers, economists, and regional scientists.

The primary goal of the authors of the localization theories was to specify the factors influencing the costs of companies and to situate the company near their appropriate allocation so that its costs were as low as possible. Thus, the theory addresses the spatial arrangement of corporations, minimizing costs and then maximizing profit.

The first localization theories were focused on agricultural activities, followed by industry-focused theories. Other approaches are theories using a multi-criteria approach and modelling.

Agricultural location theories

The main representative of location theory 200 years ago was Johann-Heinrich von Thünen (1783-1850), who in his work "The Isolated State" (Der isolierte staat, 1826) addresses the relationship between the use of agricultural land and its distance from the local market. His model is based on the assumptions of perfect competition (The Editors of Encyclopaedia Britannica, 2014). Thünen's work, as a work of the founder of spatial economics, has not lost its importance up to today.

His model defines that market (city) availability can create a complete land use system, and optimal location of cities and farmland balances between transport and local costs. It considers transport costs and the urgency of the needs of each crop as essential factors. It is a simple

[3] See in: Cantillon, R. (1755). Essai sur la Nature du Commerce en Général.

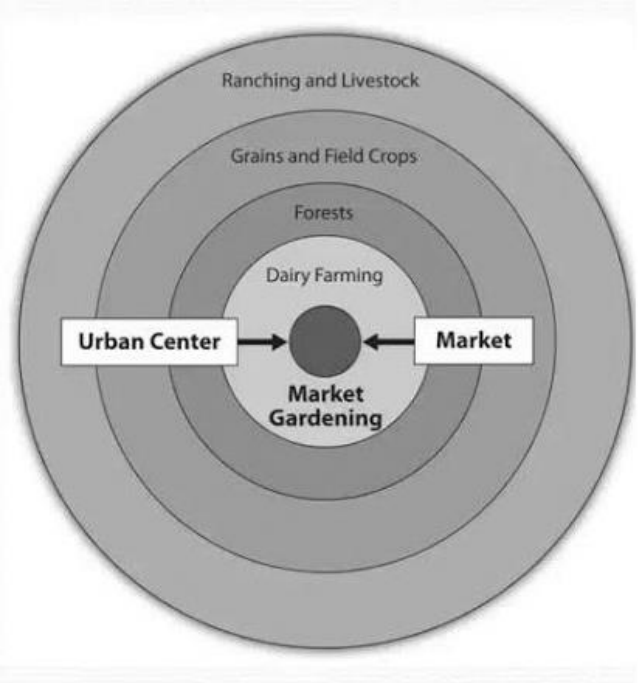
[4] See in: Thünen, J. H. von. (1826). Der isolierte Staat in Beziehung auf Landwirtschaft und Nationalokonomie, Alonso, W. (1964). Location and Land Use, Christaller, W. (1933). Theory of Central Places, Weber, A. (1929). Theory of the Location of Industries.

model in which methodological procedures for deeper localization theories have been outlined. The model assumes an isolated economy where the single market (city) is surrounded by agricultural activities that are concentrated around the market in circles. Furthermore, it assumes that transport costs relate only to distance and volume of transport and that the neighbouring farmers on the market will produce crops that have the highest market value that will give them maximum net profit. The transport costs will be the determining factor for the rent. If transport costs are low, rents will be high and vice versa. This situation tends to make the rent fall with the distance from the market or the rent reaches zero (Peet, 1969).

The Thünen model also addresses the location of intensive versus extensive agriculture in relation to the same market. Intensive agriculture will show a steep slope and will be placed closer to the market than extensive agriculture. Different crops will have different rental levels. Production of perishable goods (vegetables and dairy products) will be placed in a circle closer to the market than the less perishable crops (Peet, 1969).

There is one thing that Thünen's model does not address. The model doesn't consider the central issue of spatial economics and merely assumes the existence of a central urban market (Krugman, 1997). However, Thünen gave a very important stimulus to the theory of land use, illustrating theoretical considerations based on his experience. It is a simple theory, which can limit its practical significance (Ježek et al., 2002). The principle of the model is illustrated in the figure below.

Figure 2 Von Thünen model of localization of agricultural assets



Source: Own processing according to Thünen (1826)

William Alonso, in his paper Location and Land Use: Toward a General Theory of Land Rent, (1964), built on the Thünen model where the changes within cities were explained. He attempted to apply the city centre accessibility requirements for various types of land use (housing, commerce, and industry) (The Editors of Encyclopaedia Britannica, 2014).

According to Alonso's theory of urban structure, each type of land use has its own rent and rent curve. The curve determines the maximum amount of land rent at a particular location. Households, retailers, and industry compete for placement in line with the rental curve offer and its city access requirements. All households are trying to occupy as much land as possible with their accessibility requirements. The land is cheaper on the outskirts of town, so households with less centre accessibility are located on the outskirts of the city. These are typically high-income households. Lower-income households require greater access to the city centre, so they are also located and competing with commercial and industrial businesses. This situation tends to create a separate territorial system, as households do not want to pay commercial and industrial land prices for a central location (Alonso, 2017).

Alonso's work, based on Thünen's theory, contributed to the development of urban economics. The work attempts to make testimonies about the structure of cities in a deductive way (Ježek et al., 2002). There are many alternative models of urban structure and many critics

against this theory, for example, Maier and Čtyroký (2000), who criticize this model for its unreality. However, the model allows an easy explanation for the tendency of cities to create rings of economic activities on the periphery and reasons for economic growth approaching the centre.

Another significant contribution to localization theory is Walter Christaller's formulation of the theory of central place theory, which offers a geometric explanation of how places are created in relation to each other and why sites function as settlements, villages or cities (Berry & Harris, 1970). Theoretical considerations of this model are based on a homogeneous plane and transport links in all directions; producers maximize profit and consumers maximize benefits. The homogeneity of the area also applies to the availability of production factors, the population, and the associated supply are evenly distributed on the plane (Ježek et al., 2002). Lösch (1940) came up with the tradition of central-place theory, which analysed the location and roles of manufacturing, marketing, etc. centres serving a hypothetical evenly spread agricultural population. Lösch was against Christaller ideas with his geometric insight that market areas should be hexagonal.

Industrial localization theories

The development of industry brought with it the emergence of industrial localization theories. The first representatives of industrial localization theory are Wilhelm Roscher (1865), Albert Eberhard Friedrich Schäffle (1873) and Carl Wilhelm Friedrich Launhardt (1882). However, Alfred Weber (1929) is one of the best-known economists in this area[5].

The first representative of industrial localization theory was W. Roscher, who investigated how the location of industry affected the development of urban areas. The result of his work is that an industry with a low degree of work resorts to consumption points. Conversely, the industry with a high degree of division of labour seeks to take advantage of production benefits. Roscher's theory was based on the work of economist A. E. F. Schaffle, who claims that the decision about the location of firms is associated with distance and transport costs (Ponsard & Stevens, 1983).

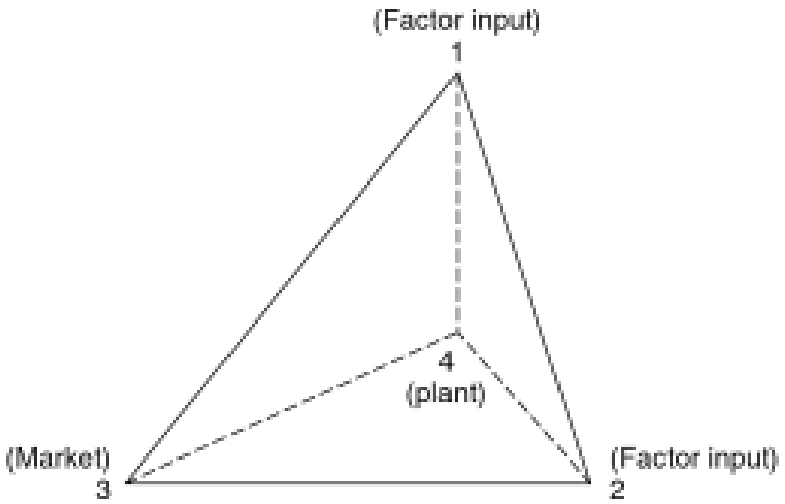
[5] See in: Roscher, W. (1865). Studien über Naturgesetze, welche den zweckmässigen Standort der Industriezweige bestimen, Schäffle, A. E. (1873). Gesammelte Aufsätze. Die Handelskrisis von 1857, Launhardt, W. (1882). Der zweckmäsigste Standort einer gewerblichen Anlage, Weber, A. (1929). Theory of the Location of Industries.

In 1885, mathematician Carl Wilhelm Friedrich Launhardt proved the relationship between land use and land rents. He called the relationship "bid-rent functions". He also explored the concept of market area analysis and spatial demand curves (Edwards, 2007).

In 1909, the German economist Alfred Weber formulated an industrial site theory in his book The Theory of Industry (Über den Standort der Industrien, 1929), where he tried to minimize production costs associated with the transport of raw materials and products and to formulate an optimal corporate location. Weber was the first one who defined the notion of localization factor; the forces that influence management's decision-making about the location of a corporation in space (Predöhl, 1928).

Weber claimed that the localization of a firm serves one or more markets and relies on one or more sources of supply. The total number of such relevant points is not less than three (Krugman, 1997). This theory is called the Localization triangle (see in the Figure 3) and seeks an optimum position for the production of a fixed-market of goods and two raw materials that geographically form a triangle. He tried to identify the least costly location of production within the triangle by identifying the cost of transporting precious raw materials from both production sites and products from the production site to the market. Important factors in transport costs are the weight of raw materials and the final commodities. Commodities that lose weight during production can be transported less costly from the production site to the market. For this reason, production plants should be located near raw materials. In cases where there is no large loss of weight in production, the total transport costs will be lower if they are close to the market. The lowest transport costs have been determined by this theory within the triangle. Weber also tried to determine an alternative location for cheap labour. Firstly, he brought in a change in transport costs against the lowest transport costs. Subsequently, he identified locations around the triangle that had lower labour costs than they did at the lowest transport cost. If the transport costs were lower than the labour costs, an alternative location was determined (Predöhl, 1928).

Figure 3 Weber's localization triangle



Source: Chan (2011)

Weber initially considered transport costs as the only factor that affects the location of an industrial unit. According to Christofakis (2014), other cost factors (labour and capital) face the same supply conditions in each area.

Modern localization theories

The development of localization theories has expanded since the second half of the 20th century with the use of multi-criteria approaches and modelling (Rumpel et al., 2008) due to large-scale globalization and the shift of the economy from the second sector to the third and fourth one[6]. The localization theories have been expanded in particular by the features of foreign activities such as the exchange rate, political risk, transnational policy and politics, and cultural differences (Popovici & Călin, 2014).

Since the first approaches were proposed, many new ideas have emerged in regional and urban economics as the economy was not primarily based on industrial production, but services and education are at the forefront. The situation of technological, economic and political changes brought with the increasing importance of Soft localization factors at the expense of the Hard ones, which are explained above. Hard localization factors were becoming widely available and losing their importance, mainly because of the globalization of the world economy, increased competition and the development of transport technologies. These reasons

[6] Third sector includes, for example, trade, transport and communications, health, education, information, administrative and government services, financial, insurance, legal and other services. Fourth sector includes science, research, education and information technology.

mean that individual countries can offer Hard factors of the same quality as other developed countries. The third and fourth sectors are also not dependent on natural resources, which is also one of the reasons why localization theories lose their importance (Rumpel et al., 2008).

Many researchers developed quantitative techniques to identify a coherent local area because they had seen the importance of agglomeration economies and the distinction between central and peripheral areas. The field that they were investigated to introduce new challenges to the way of defining regions with an economic meaning is called the New Economic Geography. There are given different names to these areas, such as Functional Economic Area, Labour Market Area, etc., but they all mean a territory that internalizes the home-to-work daily journeys of their residents (Fernández Vázquez & Rubiera Morollón, 2012).

The modern localization theories were characterized by the characteristics of foreign activities, such as the exchange rate, political risk, regulations and policies at the transnational level and cultural differences. The main processes that determine substantial changes in traditional factors were in the extension of the globalization process (Popovici & Călin, 2014). Recently, investors have been trying to find a suitable combination of both factors: localization factors and subjective factors (business, labour, regional, infrastructure factors, etc. (Krugman & Lawrence, 1993).

As already mentioned, investors' decisions must take into account the international economy because of the high impact of globalization. Therefore, modern localization theories must also be interested in this aspect. Krugman and Lawrence (1993) took this aspect into account in their work. They compared localization theories with trade theories that explain the behaviour of international production and trade. Krugman concluded that the theories are very similar in the questions they focus on and in the assumptions they make. Optimal localization production should be concentrated in one country and the theories identify specific countries or regions in which the product should be located. Trade theory does not address only the characteristics of locality production but also the relative influence of production factors required to produce specific goods or a conservative advantage in producing one product relative to another. Localization theory addresses the optimal location of production by the cost of production factors and transport costs to customers.

With the development of franchising, a localization theory focused on this type of business was created. The model is based on differences in location quality and shows how a franchiser

chooses a location to open his company in a particular location while opening a franchise branch in another location. Chaudhuri and Ghosh (2001) in their model assume that there are differences in location quality (i.e., some locations are more lucrative than others because they offer greater potential to profit). The authors managed to prove that the franchiser would choose a better location to open their own company, but would open a branch in a less lucrative place. This model explains the coexistence of owned companies and franchise branches.

Christofakis (2014) considers transport and infrastructure costs and costs related to transport services to be the most important determinant in the choice of location of economic activities. Transport plays an important role in the economy and space for interconnecting systems in the market, the movement of raw materials, goods, labour and the population in general. However, until the 19th century, the location of production activities was dependent on the availability of raw materials, natural resources, and transport routes. The importance of these factors has been significantly reduced and new factors such as transport, telecommunications, and energy are emerging. Another factor that is responsible for the ongoing agglomeration of the population and industrial areas is defined by a development policy that takes responsibility for organizing infrastructure and relieves certain industries of certain costs. In recent years the technological development and the role of innovation and R&D have had an important impact. Technological developments also have an impact on the transportation sector, enabling new infrastructure opportunities, opportunities to reduce transport costs or increased speed to reliability.

Christakis's (2014) idea is based on the basic assumptions of localization theories in which a key variable is mostly transportation. However, he discovered shortcomings that limit the full set-up with factual aspects of the spatial behaviour of the activities. His results show an increase in the impact of transportation costs and the importance of people moving, mainly due to the increase in urban commuting and the reduction of the transportation costs of products in recent years. These changes are mainly due to the large dispersion of economic activities with the trend of diversion from traditional urban centres, resulting in a distinction between residential and working areas. Combes et al. (2005) and Marcon and Puech, (2003) came up with a new approach in geographical statistics. They developed a new methodology for measuring spatial concentration or dispersion where they use location geo-data.

All location theories have been the subject of criticism over the years, given their assumptions that lead to generalizations, unreality, etc. However, the enforcement of these

assumptions is disproportionate due to the variation of the environment and many other influences.

2.5 Globalization

The decision-making of investors is largely influenced by the process of globalization, which affects not only the economic but also the political, cultural and social sphere. These spheres interact and influence the local decision-making of the subjects. Ritzer and Dean (2015) define globalization as a transparent set of processes involving increasing liquidity and increasing flows of people, objects, places, and information as well as the structures that are created. Compared to internationalization, which involves pursuing economic activities beyond national borders, globalization is a broader concept that includes the overall integration of these activities (Sýkora, 2000).

Due to the globalization process, market entry opportunities for investors have expanded. The most commonly used market entry options include export, licensing, alliances, franchising, and capital options such as acquisitions, mergers, and joint ventures. Capital inputs are considered to be the highest degree of company expansion and are more available to larger businesses.

There are many factors that influence decisions about expanding or initiating activities in a selected area. Investors, however, attribute different weight and motivation to these factors. Opinions on this issue also differ among the authors. For example, Dunning (2000) argues that an investor will be interested in entering a new country if capacity shift revenues outweigh the shift costs. Other arguments are the fixed cost of running the headquarters and the cost of setting up the operations. If the cost of running the headquarters is high and the cost of setting up the operations is low, investors will be interested in expanding their capabilities.

Blažek (2001) considers the low input prices at a branch location or the proximity of a high potential market in the selected market segment to be the main factor of foreign investment motivation. Damborský and Wokoun (2010) state that entry into an economy is influenced by the fulfilment of goals set by the corporate strategy.

2.6 Company's performance assessment

Many methods are used to evaluate the performance of companies, for example, ratio indicators and differential indicators, systems of indicators – pyramid systems of indicators and

targeted selection of indicators, and lastly, non-financial indicators (e.g. Balanced Score Card). However, in this thesis, there is a set of targeted selection indicators used to evaluate the performance of companies. The indisputable advantage of these models is their simplicity and ease of use.

Targeted selection indicators can predict the future of business behaviour and are currently a very popular tool in many disciplines. In the field of economics, they play an important role in assessing the creditworthiness and financial health of a company. The models have been discussed in economics for many years since the first targeted indicators were published by Altman (1968) and Beaver (1966)[7]. In many countries, there were efforts to find the most effective empirical methods for predicting bankruptcy.

Four classical statistical methods are used to create targeted indicators, i.e. one-dimensional analysis, risk index model, multivariate discrimination analysis and conditional probability models. Each method has its own specific assumptions, advantages and disadvantages. However, most of the developed targeted indicators are based on the last two variants (Balcaen & Ooghe, 2006). Ooghe et al., (2005) claim that most targeted indicators use statistical techniques such as multiple discriminatory analysis and multiple logistic regression, but too often the problems associated with these methods are neglected. According to the authors, it can be generally stated that too complicated procedures reduce stability, transparency and there may be a problem with data application. Vochozka (2010) further argues that the classic targeted indicators do not include the time factor in business appraisal. The result of that model is, therefore, a fixed value that is independent of time. For this reason, classic failure assessment models can be considered inappropriate. However, these models summarize information about a particular company and evaluate its appearance whether the company is approaching a failing or prosperous society.

According to Holečková (2008), the targeted indicators can be divided into bankruptcy and creditworthiness. The bankruptcy models are based on current data and answer the question of whether a given company will go bankrupt in the near future. In contrast, creditworthy models are based on theoretical knowledge that is complemented by empirical findings. Bankruptcy

[7] See in: Altman, E. I. (1968). Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy. The Journal of Finance, 1968, Vol. 23, No 4, s. 589 – 609, Beaver, W. (1967). Financial Ratios as predictors of failure. Empirical Research in Accounting Selected Studies, 1966 in Supplement to The Journal of Accounting Research, January 1967.

models aim to provide an early warning of likely bankruptcy. Creditworthy models indicate that a business owner can be satisfied with his performance because the business is able to generate value for the owner. The boundary between bankruptcy and creditworthy models is not precisely determined. Both models determine the numerical value by which they assess the company's financial health (Růčková, 2010). Ooghe et al. (2005) address the question of whether targeted indicators from different countries can simply be transformed into other countries. In general, it is not clear whether the error rate is dependent on the application of models in other countries. In their work, the authors further suggested several factors that may explain model performance. Possible factors, that may affect model portability, are model age, model origin, and company type. They also consider model features, technique, the complexity of variables and their number and definition of dependent variables as the main element influencing model portability. Also, Střeleček and Zdeněk (2012) tested different targeted indicators to demonstrate how they are able to assess the financial health of businesses. The research concluded that some models could not objectively assess the financial health of a business due to an inappropriate choice of indicators.

Due to the limited portability of targeted indicators, it is appropriate to monitor the data of Czech corporations on models that are developed for Czech conditions. Many authors have devoted themselves to the methods of enterprise evaluation in the Czech environment. The most famous of these are Grűnwald (2000), Synek, Kopkáně and Kubálková (2009), Sedláček (2007), Doucha (1995)[8] and the Neumeiers couple. In this work, the targeted indicators of the Neumaier couple will be introduced. These targeted indicators were created through discriminatory analysis and data are based solely on Czech companies. Therefore, they can only be applied to assessing the performance of Czech companies (Vochozka, 2010).

2.6.1 Neumeiers' indices

The Neumaiers' targeted indicators are presented in four variants, i.e. *IN95*, *IN99*, *IN01*, and *IN05*. The following indices can be divided according to their use into a creditor variant (*IN95*), a proprietary variant (*IN99*), a complex variant (*IN01*) and a modified complex variant (*IN05*) (Vochozka, 2010).

[8] See in: Grünwald, R. (2000). Finanční analýza pro oceňování podniku. V Praze: Vysoká škola ekonomická, Synek, M., Kopkáně, H., & Kubálková, M. (2009). Manažerské výpočty a ekonomická analýza, Sedláček, J. (2007). Finanční analýza podniku. Brno: Computer Press, Doucha, R. (1995). Bilanční analýza. Praha: Grada.

Neumaiers' indices belong among the most accurate indices for Czech companies. This is confirmed, for example, by Sušický (2011), who evaluated the usability of Czech and foreign bankruptcy models on the condition of Czech companies, even with regard to their sector. The Neumaiers' indices appeared in his work as one of the best rated. Sich (2015) had similar results which showed that the *IN05* model estimates reliable results for both small and medium-sized businesses. Neumaierová and Neumaier (2008) report the advantages and disadvantages of the *IN05* index which can be generally applied to other their indices. The advantages include the ease of calculation, the transparency of financial indicator algorithms, the use of publicly available information about business management, the possibility of using it also on companies trading on capital markets, providing clear results (except for the grey zone interval) and the suitability as a complement to the solution of the indicator system. On the other hand, the disadvantages of this indicator include the need to take into account that the model was built on medium and large enterprise data, based solely on annual business performance data and is merely an indicative characteristic where it is not possible to answer the question of how the enterprise has achieved their performance.

Index IN95

The *IN95* index is primarily focused on the company's ability to meet its obligations in a timely manner and is composed of indicators that are considered significant in the area of financial health assessment and are most commonly found in the resulting identifiers. Each indicator is assigned a weight that was determined as the ratio of the significance of the indicator given by the frequency of its occurrence in 1994. Each sector[9] has a different level of weighing of indicators that have been set at more than 1,000 Czech enterprises (Neumaier & Neumaierová, 1995).

It is an index that is able to use the outputs of Czech financial reporting and also includes the peculiarities of the Czech economic situation. The success rate of this index is greater than 70 % (Neumaierová & Neumaier, 2002).

The model *IN95* is described below (Neumaier & Neumaierová, 1995).

$$IN95 = V_1 * x_1 + V_2 * x_2 + V_3 * x_3 + V_4 * x_4 + V_5 * x_5 - V_6 * x_6 \quad (1)$$

x_1	total assets / foreign capital
x_2	EBIT / interest expense

[9] Sectors are classified according to professional classification of economic activities (CZ-NACE)

x_3	EBIT / total assets
x_4	total revenues / total assets
x_5	current assets / current liabilities
x_6	overdue liabilities / total revenues
V_{1-6}	sector scales

The *IN95* index determines a numerical characteristic that, if it is greater than 2, represents a company with good financial health, if the value is less than 1, the enterprise is financially unstable. In a situation where the index value is between 1 and 2, the company cannot be classified as healthy or vice versa (Neumaier & Neumaierová, 1995).

Index IN99

The modified *IN99* Index was compiled based on data from nearly 1,700 businesses in 1999, for which the economic profit was calculated, i.e. the company's ability to generate value for the owner of the company (Neumaierová & Neumaier, 2002).

The equation of the model IN99 is defined as (Kubíčková & Kotěšovcová, 2006):

$$IN99 = -0{,}017 * x_1 + 4{,}573 * x_2 + 0{,}481 * x_3 + 0{,}015 * x_4 \quad (2)$$

x_1	foreign capital / total assets
x_2	EBIT / total assets
x_3	total revenues / total assets
x_4	current assets / current liabilities

The authors divided the companies according to whether they formed a positive or negative value of economic profit. Furthermore, a linear discriminatory analysis was conducted to identify the indicators that most explain the difference between the two groups of companies. The significance of these indicators is reflected in their weights. The success rate of this index is set at 85 % (Neumaierová & Neumaier, 2002).

If the company reaches values greater than 2.07, positive economic profit is generated. If the index is below 0.684, the company generates a negative economic profit. Enterprises with values between 0.684 and 2.07 are in the so-called grey zone, i.e. the result cannot be accurately determined (Kubíčková & Kotěšovcová, 2006).

Index IN01

The *IN01* Index, which was created in 2002 and tested on nearly 2,000 businesses, is trying to combine previous indices, i.e. *IN95* and *IN99*. The reliability of the index classification is

reported by the authors for the value-producing companies at 67 % and for the businesses that go into bankruptcy at 86 % (Neumaierová & Neumaier, 2002).

The model *IN01* is computed as below (Kubíčková & Kotěšovcová, 2006):

$$IN01 = 0{,}13 * x_1 + 0{,}04 * x_2 + 3{,}92 * x_3 + 0{,}21 * x_4 + 0{,}09x_5 \quad (3)$$

x_1	total assets / foreign capital
x_2	EBIT / interest expense
x_3	EBIT / total assets
x_4	total revenues / total assets
x_5	current assets / current liabilities

An enterprise with an index value greater than 1.77 generates value for owners, a company with a value less than 0.75 goes into bankruptcy, and enterprises with a value between these values are part of the grey zone (Kubíčková & Kotěšovcová, 2006).

Index IN05

The latest index of Neumaier and Neumaierová, (2005) is the *IN05* index, which is an actualized version of the *IN01* model with 2004 data. The success rate of the *IN05* index for prosperous businesses is around 80 % and for bankrupt companies 77 %.

The equation to compute the *IN05* is (Neumaier & Neumaierová, 2005):

$$IN05 = 0{,}13 * x_1 + 0{,}04 * x_2 + 3{,}97 * x_3 + 0{,}21 * x_4 + 0{,}09x_5 \quad (4)$$

x_1	total assets / foreign capital
x_2	EBIT / interest expense
x_3	EBIT / total assets
x_4	total revenues / total assets
x_5	current assets / current liabilities

In this model, the x_2 indicator is modified to a non-standard indicator that has a specified condition where the value of this indicator is limited to a maximum of 9. This is done to prevent the overweighting of the importance of other ratios. In this index, there is a minimal change in weights compared to the previous option, but there is a significant change in the classification rule of this index. If the index value is greater than 1.6, the enterprise creates value, and if the index is less than 0.9, the enterprise goes bankrupt. Between these values, businesses are again in the grey zone (Neumaier & Neumaierová, 2005).

This model was included in the methodology for the evaluation of a company's performance because it is the most up-to-date model and a model created for Czech companies. Furthermore, according to Kopta (2009), this model demonstrates high usability alongside the other three tested models (financial health index OP, Gurčík's index and Index IN99).

3. Methodology

In this chapter, there are introduced aims of the thesis, dataset and used analyses.

3.1 Aim

The main aim of the dissertation is to recognize the spatial relationships of the headquarters of companies. Firstly, the thesis is focused on spatial analysis of relationships between individual companies within individual sectors. In this analysis, there may occur relationships where companies:

a) are spatially independent of each other,
b) tend to form clusters,
c) tend to evenly cover the space.

Secondly, I try to describe the spatial behaviour of companies according to their health. The following relationships are expected to occur:

a) companies are spatially independent of each other,
b) near firms meet the same fate,
c) near firms meet a different fate.

Then, I try to find out if the company located in a cluster is doing better or not. Lastly, I would like to propose a new econometric model for the recognition of spatial interaction of companies according to their health in the inhomogeneous case.

3.2 Data description

In the empirical analysis, the company's location is considered to be its headquarters. A set of headquarters of small and medium companies in three regions located in the Czech Republic, i.e. Jihočeský, Plzeňský and Vysočina regions was used. These regions were chosen not to affect the results because of the similar characteristics in these regions. The main source of economic wealth in these sectors is the Primary sector, further economic-social level in these regions is almost the same, especially the dynamic of development and the quality of life (Martinčík, 2008). The data set was collected in 2015 by database Albertina Gold and contains information from the financial reports of the companies from the year 2013.

The classification of the companies into the given sectors was selected using the adjusted CZ-NACE methodology ver. 1.1[10] according to the core business that is the main product of the companies. Based on their economic activities, the companies were divided into 13 sectors. The data set contains 10 201 headquarters of companies and their full addresses. Some descriptive analysis to understand the localization pattern is displayed in the **Table 1** below.

Table 1 Descriptive analysis of the observed window

Code of sector	Sector	Region	Number of companies	Number of companies making a value	Number of companies going bankrupt	Number of companies in the grey zone
A	Agriculture, forestry and fishing	Total	747	334	233	180
		Jihocesky	312	146	109	57
		Plzensky	163	64	55	44
		Vysocina	272	124	69	79
B	Mining and quarrying	Total	20	7	9	4
		Jihocesky	10	3	5	2
		Plzensky	7	3	3	1
		Vysocina	3	1	1	1
D	Manufacturing industry	Total	2191	1113	709	369
		Jihocesky	861	418	319	124
		Plzensky	622	320	186	116
		Vysocina	708	375	204	129
E	Production and distribution of electricity, gas and water	Total	243	120	92	31
		Jihocesky	113	52	48	13
		Plzensky	700	42	22	6
		Vysocina	60	26	22	12
F	Construction	Total	1229	604	445	180
		Jihocesky	569	270	216	83
		Plzensky	324	158	124	42
		Vysocina	336	176	105	55
G	Wholesale and retail trade, repair of motor vehicles	Total	2124	1087	712	325
		Jihocesky	918	454	314	150
		Plzensky	585	289	216	80
		Vysocina	621	344	182	95
H	Transport, storage and communication	Total	437	157	251	29
		Jihocesky	226	75	133	18
		Plzensky	130	52	69	9
		Vysocina	81	30	49	2

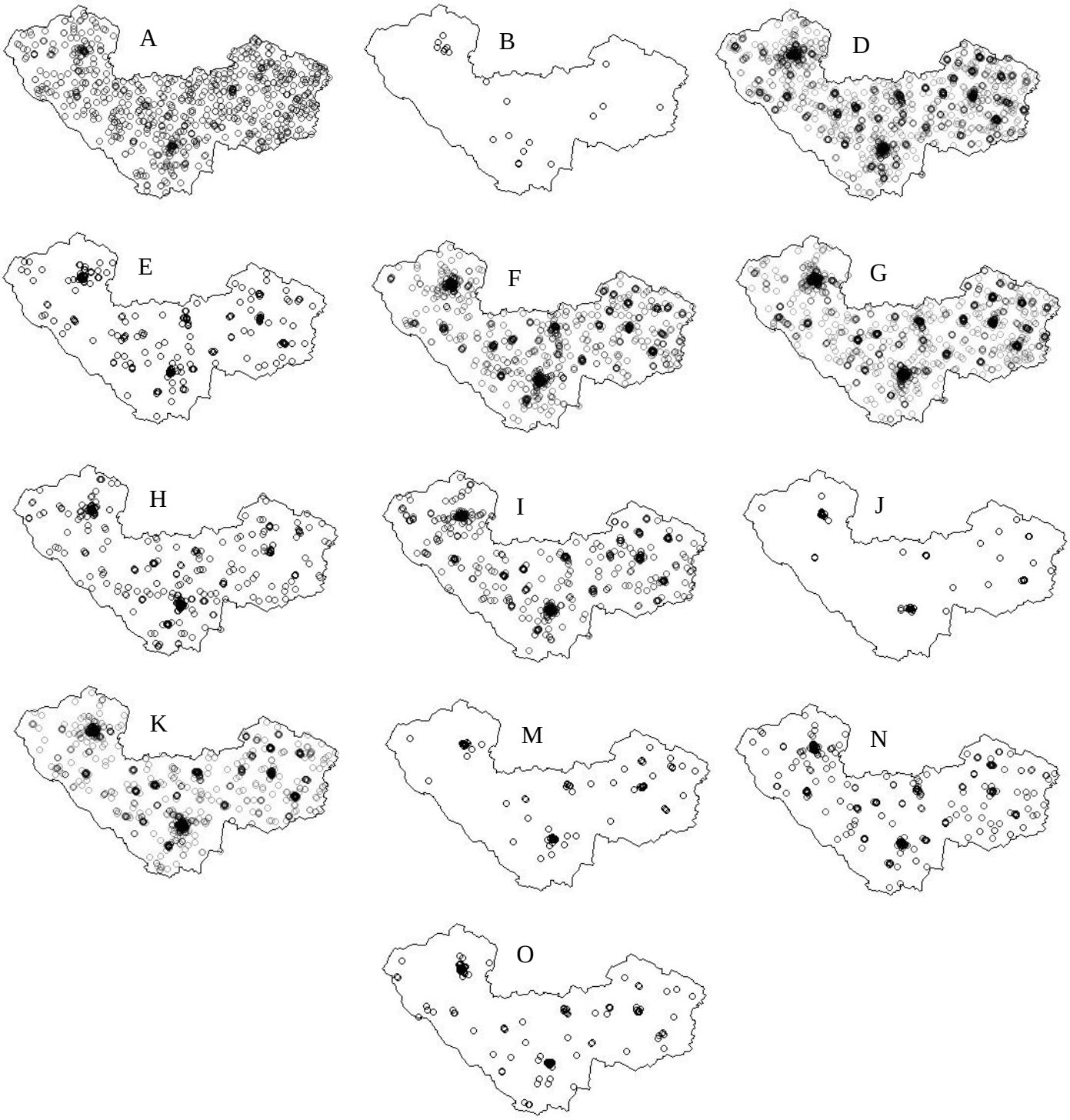
[10] Český statistický úřad, & Odbor obecné metodiky. (2008). Klasifikace ekonomických činností (CZ-NACE). Český statistický úřad.

I	**Accommodation and food service activities**	Total	650	345	184	121
		Jihocesky	276	146	76	54
		Plzensky	212	125	55	32
		Vysocina	162	74	53	35
J	**Financial intermediation**	Total	72	45	18	9
		Jihocesky	25	15	7	3
		Plzensky	27	18	7	2
		Vysocina	20	12	4	4
K	**Real estate activities, renting and business activities**	Total	1734	957	589	188
		Jihocesky	913	466	348	99
		Plzensky	446	276	126	44
		Vysocina	375	215	115	45
M	**Education**	Total	99	49	40	10
		Jihocesky	49	24	17	8
		Plzensky	18	10	8	0
		Vysocina	32	15	15	2
N	**Health and social care, veterinary activities**	Total	455	346	76	33
		Jihocesky	180	133	37	10
		Plzensky	171	130	27	14
		Vysocina	104	83	12	9
O	**Other community, social and personal services**	Total	168	74	79	15
		Jihocesky	76	32	36	8
		Plzensky	62	29	30	3
		Vysocina	30	13	13	4

Source: Own processing

All the sectors in the observed area were analysed. The spatial distribution of companies of all sectors in the regions is displayed in the **Figure 4.** It is clear that the companies tend to make clusters by concentration on some specific positions in the observed window. At the first glance, we can see that companies are more concentrated in areas of towns that's why the population was taken into the account.

Figure 4 Positions of companies in different sectors

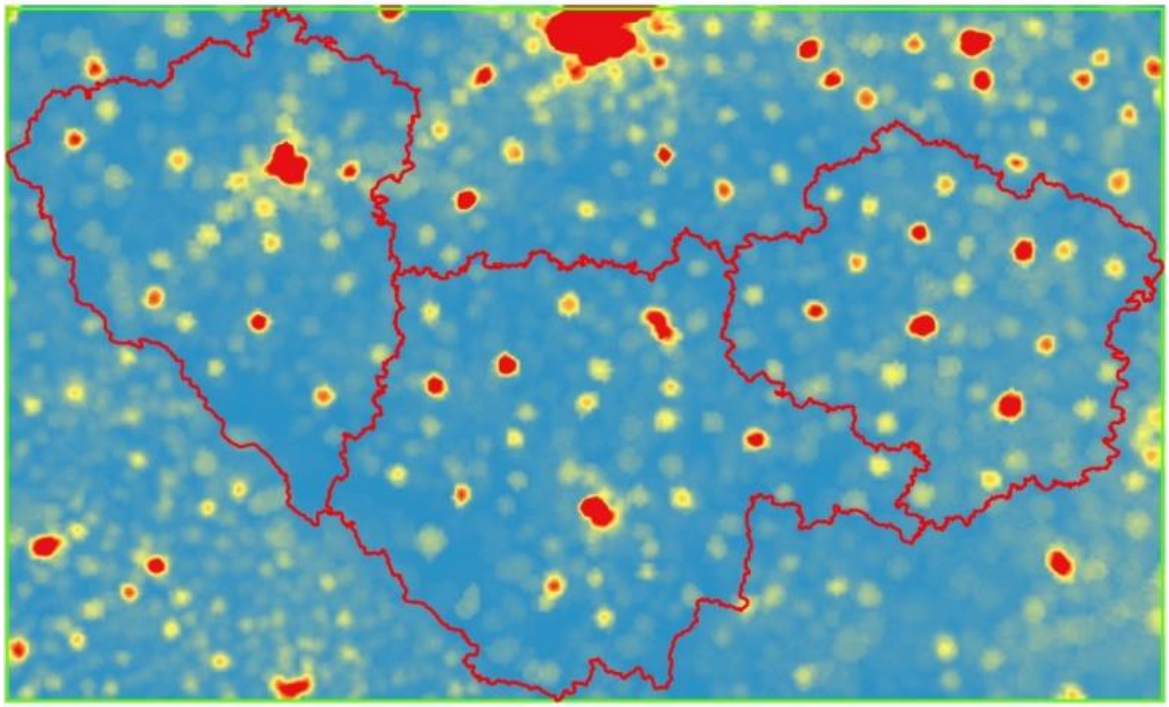


Source: Own processing

We cannot consider that the density of companies is the same in the whole observation window. For this reason, it was necessary to use tools for inhomogeneous analysis. The inhomogeneous approach is more realistic in large observation areas and areas with

geographical features like mountains where the concentration of companies is not as common. In the proposed methodology it was supposed that the location of companies is adapted to a variable point density, in this case, population. The Population density in the given area is depicted in **Figure 5** below where the observation area is highlighted with the red curve. The values with low population density are blue and with high population density are displayed in red.

Figure 5 Population density



Source: Own processing

To take population into account, a matrix population for each *2x2* km in the observed window in Geographic Information System was generated. The population values were given for the year 2011 and interpolated by Inverse Distance Weighing Method with the power *0.3*.

3.3 Analysis

Companies can be established in different locations. To find out the spatial phenomena of the companies, a statistical test that provides information about the behaviour of the companies in space have to be introduced. The methodology was prepared for the headquarters of companies. However, this is not a requirement. If the location of the company was not considered to be its headquarter, but rather its real place of business, more accurate results

would be achieved, especially in the Wholesale and retail trade, repair of motor vehicles sector and within large companies, where the results for the headquarters are limited.

In this section, Ripley's *K*-function and its derived Besag's *L*-function that is used for the determination of the distribution of the companies in the research is introduced. Then, the inhomogeneous point process, especially the method of local scaling is explained. Lastly, the locally scaled mark-weighted *K*-function is introduced. This function was created for the purposes of this work and has never been used before.

3.3.1 *K*-function analysis

It was considered that companies' positions form a point process. The most important activity in point processes is to summarize data sets by numerical and functional characteristics. The second-order characteristics offer a way to present statistical information about interactions among the points in different distances. Probably the most commonly used and the most popular functional second-order summary characteristics for the analysis of point patterns are Ripley's *K*-function *K*(r), Besag's *L*-function *L(r)* and the pair correlation function *g(r)*. Illian et al., (2008) believe that these distance-based functions are more powerful than the other summary characteristics because of their way of statistical presentation of distributional information of point patterns. Further *L*-function provides the easiest interpretation because of its linear form.

Ripley's *K*-function was proposed by B. D. Ripley and describes the spatial dependence between events in point patterns (Ripley, 1976). This function calculates the expected number of additional events located in a ball surrounding a randomly chosen event and quantifies spatial dependence and clustering (e.g. Diggle, 1983; Ripley, 1976).

In the homogeneous case, the *K*-function (Ripley, 1976) is defined as

$$K(r) = \lambda^{-1} E(number\ of\ points\ falling\ at\ a\ distance \leq r\ from\ an\ arbitrary\ point)$$

where *E(.)* indicates the expectation operator and λ (density) represents the mean number of events per area and is considered to be constant. $\lambda K(r)$ can be interpreted as the expected number of points within a distance *r* of an arbitrary point of the process. The empirical homogeneous *K*-function is defined as

$$\widehat{K}(r) = \frac{|W|}{n(n-1)} \sum_{i=1}^{n} \sum_{\substack{j=1 \\ j \neq i}}^{n} 1\{d_{ij} \leq r\}\, e_{ij}(r) \qquad (5)$$

where $|W|$ is a total study area, d_{ij} is Euclidean spatial distance between the i^{th} and j^{th} observed points, n is a total number of points and e_{ij} is edge correction weight[11] used in estimating the K-function of a point pattern.

For complete spatial randomness (points are distributed completely randomly and independently in the area, abbreviated by CSR), K-function is equal to $K(r) = \pi r^2$, for $r > 0$. Significant deviations from this hypothesis represent alternative hypothesis, e.g. clustering for $K(r) > \pi r^2$, for $r > 0$ or inhibition for $K(r) < \pi r^2$, for $r > 0$ (Ripley, 1976).

To determine whether the distribution of companies is significantly different from CSR, L-function is commonly used. The L-function is a transformation of the K-function proposed by Besag (1977) and presents the same information as K-function. On the other hand, L-function has graphical advantages. The L-function in the two-dimensional case is formulated:

$$L(r) = \sqrt{\frac{K(r)}{\pi}} \text{ for } r \geq 0 \tag{6}$$

In the practical interpretation CSR leads to $L(r) = r$, $L(r) > r$ indicates clustering of point pattern while $L(r) < r$ indicates repulsion of point in the interpoint distance r (Illian et al., 2008).

3.3.2 Inhomogeneous spatial point patterns

For inhomogeneous point processes, various models differing in the specification of how the interactions between points depend on the local density of points have been suggested. There is used local scaling for modelling the inhomogeneity (Hahn et al., 2003). This approach yields models for patterns that are homogeneous up to the local scale factor. The inhomogeneity is obtained by local scaling of the template process with a location-dependent scaling factor (in this study it is the population or density of companies). If the scaling factor is constant, then the point process behaves like a template. There is assumed that modelling of inhomogeneous space the local scaling method is more plausible, because of its transformation of distances and not a change in the number of firms, as it happens in the traditional inhomogeneous method.

The main aim of local scaling is to find global summary characteristics that are adapted to variable point density by a mechanism of rescaling distances relative to local point density. This is achieved by replacing distance measures used in the density with locally scaled analogy defined by a location-dependent scaling function (Hahn et al., 2003). Due to the local scaling

[11] See, for example, Baddeley et al. (2016).

pattern, distances become shorter in the regions with low population density and longer in the regions with high population density.

The locally scaled version of *K*-function modifies distances (d_{ij}^*) for each pair of points x_i, x_j by rescaling factor $s(x_i, x_j)$. The rescaled distance for each pair of data points x_i, x_j is defined as

$$d_{ij}^* = \frac{\|x_i - x_j\|}{s(x_i, x_j)} \tag{7}$$

where the rescaling factor is computed as (Baddeley et al., 2015)

$$s(x_i, x_j) = \frac{1}{2}\left(\frac{1}{\sqrt{\hat{\lambda}(x_i)}} + \frac{1}{\sqrt{\hat{\lambda}(x_j)}}\right) \tag{8}$$

where $\hat{\lambda}$ denotes the empirical density of points. When investigating the location of companies, $\hat{\lambda}$ will be estimated using the population density function. If we are interested in the location of companies with regard to their health (see below), the density of the point process is estimated non parametrically by kernel-based estimation.

3.3.3 Locally scaled mark-weighted *K*-function

To find out if the health of companies is influenced by the surrounded companies the marks describing the health of companies must be added to the model. The second-order characteristic that provides exploratory analysis among marks in point pattern is mark-weighted *K*-function. The mark-weighted *K*-function has a very similar form as *K*-function but the marks are also taken into account. In the case of locally scaled mark-weighted *K*-function, it was necessary to modify the distances with local scaling.

The locally scaled counterpart of mark-weighted *K*-function can be estimated by:

$$\widehat{K_t}(r) = \frac{\sum_{x_i x_j \in W}^{\neq} t\left(m(x_i), m(x_j)\right) 1(d_{ij}^* \le r) e_{ij}(r)}{\widehat{c_t}\,\hat{\lambda}^2} \text{ for } r \ge 0 \tag{9}$$

where the d_{ij}^* are modified distances by local scaling, $m(x_i), m(x_j)$ are marks of the points of point process in observed window *W* describing the health of companies, $\hat{\lambda}$ denotes non-constant intensity function, and $\widehat{c_t}$ is an estimator of mean test function *t* of marks that is given by:

$$\widehat{c_t} = \sum_{i=1}^{n} \sum_{j=1}^{n} t(m_i, m_j)/n^2 \tag{10}$$

The shape of the function *t* determines the tested relationship. E.g., the summary characteristic $\widehat{c_t}$ is based on the test function $t(m_i, m_j) = m_i m_j$ when we tried to identify if the health of the firm is influenced by the health of other companies surrounded by. In this way, the following phenomenon will be achieved; the higher the value of the function, the more the companies of the same financial health are attracted. The value of this function reaches its maximum at the moment when the health of companies is identical. When we wanted to find out if the companies are healthier when they are located in clusters or not, the test function $t(m_i, m_j) = m_i$ was used. If the value of the function reaches high values, it means that the company in the cluster is doing better and vice versa.

3.3.4 Global envelopes

The most common way to find out differences in the empirical distribution of companies from a given null model is by using an exploratory tool called envelope tests that are often used in spatial statistic and were introduced by Besag (1977) and Ripley (1976). However, in our study, Global envelope tests are used as they are more exact and also offer a graphical interpretation (Myllymäki et al., 2017). These tests generate an acceptance band by computing function for *n* simulated patterns of the null model. The Global envelope tests reject the null hypothesis if the observed function is not completely inside the envelope. Their undeniable advantages are that they allow the selection of the significance level α and they yield *p-values* and provide graphical representation.

Global envelope tests offer more approaches. In this study, we recommend using a test where the critical bounds of the function are ordered according to the measure *erl* (extreme rank length), which is defined by Myllymäki et al. (2017). The significances in this paper were identified by *erl* Global envelope test, which was computed using *999* simulations. The significance level of *5 %* was used.

3.3.5 Level of clustering

To compare the tendencies towards clustering between the sectors the level of clustering was determined in homogeneous and inhomogeneous analyses. The level of clustering was defined as

$$\frac{L^*(r) - L^*_{central}(r)}{L^*_{upp}(r) - L^*_{central}(r)} \tag{11}$$

where $L^*_{central}(r)$ is the value of the estimated *L*-function in a given argument *r* obtained for the null model, i.e. in/homogeneous Poisson process of given sector and $L^*_{upp}(r)$ is the value of the simulated upper band of the envelope for the null model in a given argument *r*. The argument of interest was chosen to be equal to the rescaled distance of *0.5*.

3.3.6 Other analyses

Comparison of two final values for individual sectors was performed by the Two-sample paired t-test. The significance level of *5 %* was used in the analyse.

At the beginning of the work, *100* companies were observed if their headquarters are identical to their establishment. The companies were chosen randomly using the RANDBETWEEN function in Excel, with each of the companies in the data set being assigned an identification number. The company's official website, its annual reports and, in several cases, direct communication with the company's employee were used to determine whether the registered office is identical to the company's establishment. The distance between the two addresses was determined from the portal www.mapy.cz.

4. Results

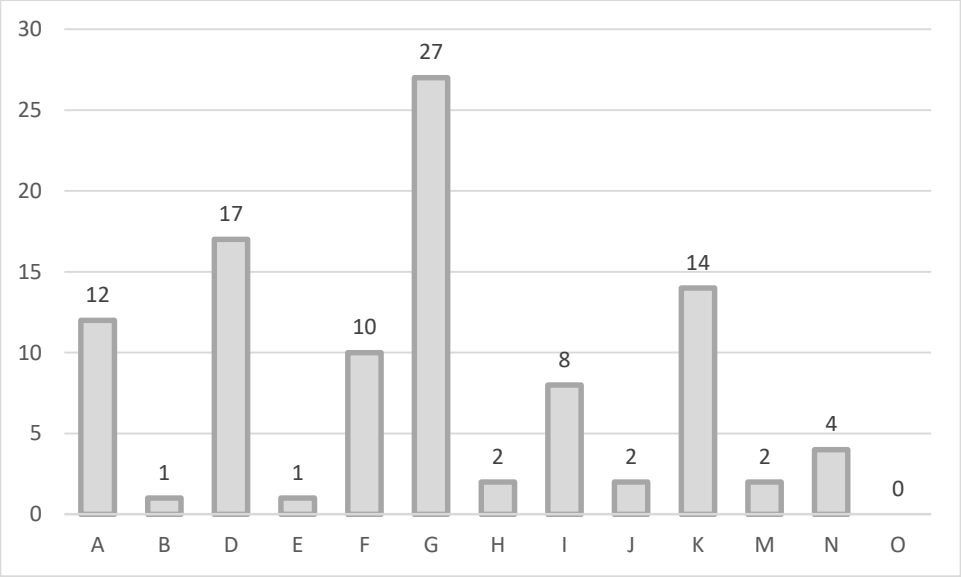
This chapter describes the obtained results of the research. Firstly, it was found out how many companies have the same headquarter as their real establishment to determine the transferability of the results to the real location of companies according to their establishments and not only according to their headquarters. Then, the results of how the headquarters are located in the homogeneous and inhomogeneous case are presented. Lastly, the health of each company is taken into account.

4.1 Analysis of company headquarters and their establishments

Firstly, it was analysed how many companies are actually carried out at their registered office and how many of them have their registered office completely outside their operations.

The analysis was performed on 100 randomly selected companies, the distribution of the selected companies in the sectors is shown in the **Figure 6**, where the X-axis shows the individual sectors under the codes defined in the chapter 3.2. and Y-axis describes the number of randomly chosen companies. The information on whether the company's registered office is equal to their establishment is shown in **Table 2** below. A random selection of companies is very similar to the distribution of companies in individual industries in the observation window.

Figure 6 Distribution of selected companies



Source: Own processing

Table 2 Analysis of headquarters and establishments

Code of the sector	Headquarter = establishment	Headquarter ≠ establishment
A	10	2
B	0	1
D	14	3
E	1	0
F	7	3
G	21	6
H	2	0
I	4	4
J	1	1
K	10	4
M	2	0
N	3	1
O	0	0
Total	**75**	**25**

Source: Own processing

From the in detail examined *100* companies, *75* had the same headquarters as their establishments. Only *25* of them had establishments at a different address, i.e. *75 %* of companies operate at the company's registered office. Furthermore, it was found out that *79 %* of companies have their establishments within *1* km of their headquarters and even *90 %* of companies have their headquarters from an establishment within *10 km*.

More details regarding the conformity of the registered office and establishments of companies at different distances are given in the table below. The longest distance of the headquarter from its establishment was *153.8 km* and the shortest distance was *500 m*.

Table 3 Analysis of headquarters and establishments according to distances

Headquarter = establishment	Percentage of companies
in 10 km	90 %
in 5 km	85 %
in 2 km	82 %
in 1 km	79 %
the same	75 %

Source: Own processing

The remaining *10 %* of companies, whose registered office is not within *10* km to their establishment, can be considered as noise in the data, which does not seriously affect the agglomerative statistics, which are done from *90 %* of correctly located localities. Small deviations in location up to *5 - 10* km will not significantly affect the contribution of individual companies in the used spatial, agglomerative statistics. Large changes in location in *10 %* of cases will not significantly affect the overall agglomerative statistics. Since the mention above it is possible to interpret the results obtained in the analyses below applied to corporate headquarters to the location of companies in general.

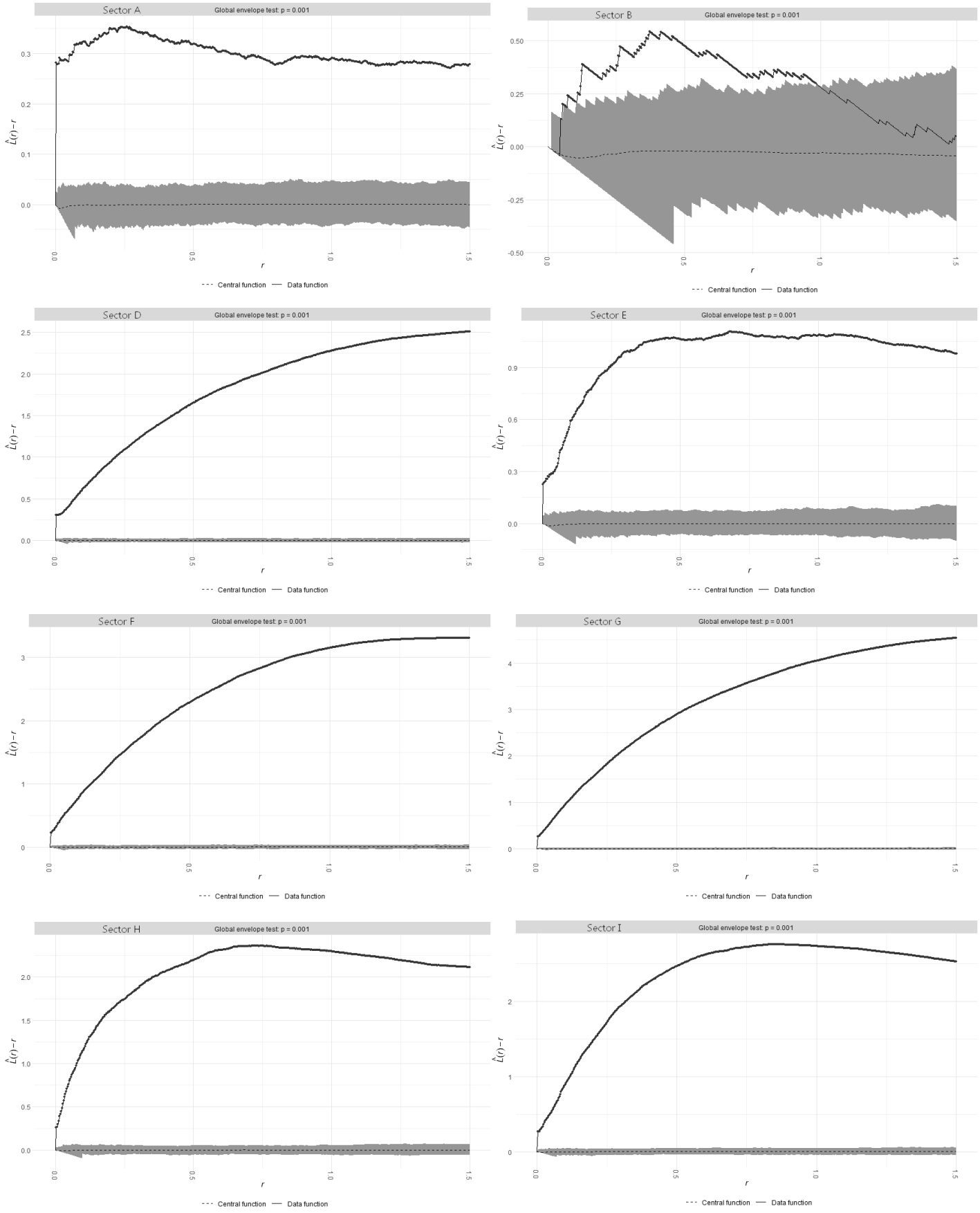
4.2 Positions of companies' headquarters in the homogeneous case

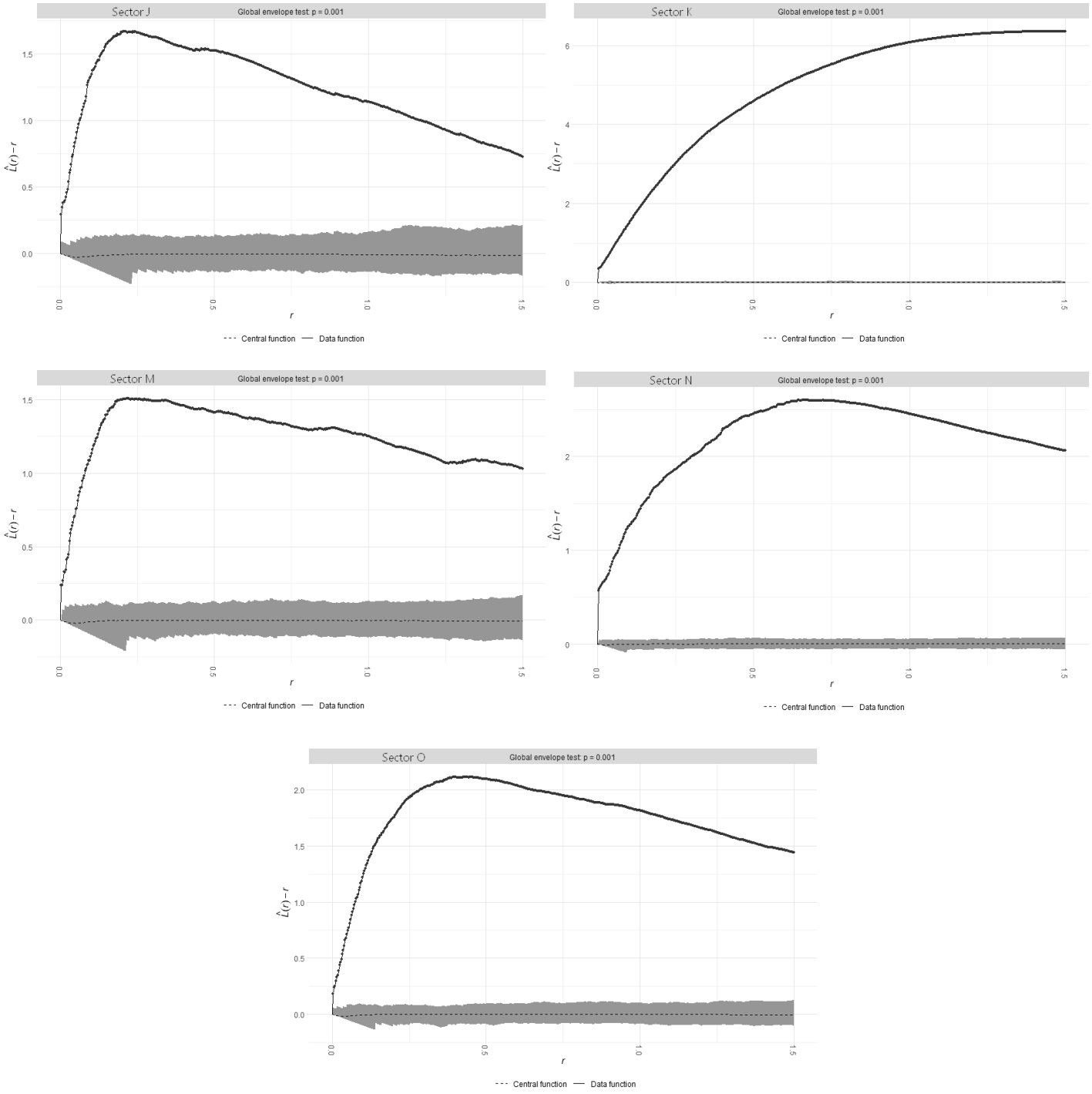
In this chapter, the position of companies in the homogeneous case was tested. Each plot in the **Figure 7** shows the $L(r) - r$ function estimated from *999* simulations of the homogeneous Poisson process (solid line). The grey zone shows the corresponding *95%* global envelope under the null hypothesis.

From the figure, it is clear that companies have a strong tendency to make clusters. This is confirmed by the *p-values* of *0.001* in each sector. The *p-values* reject the null hypotheses that the companies are located randomly.

The results of the analysis below show significant tendencies of clustering. There are positive external agglomeration effects in which the spatial interaction of businesses arise. Then, in the next step, if the population is the factor that can explain the agglomeration effect of companies is tested.

Figure 7 Behaviour of the estimated L-function





Source: Own processing

4.3 Positions of companies' headquarters in inhomogeneous case

At the first glance, from the **Figure 8**, it could be seen that companies are more concentrated in areas of towns. For that reason, the spatial behaviour of the companies in the inhomogeneous case where the inhomogeneity was given by population density was tested. The null hypothesis

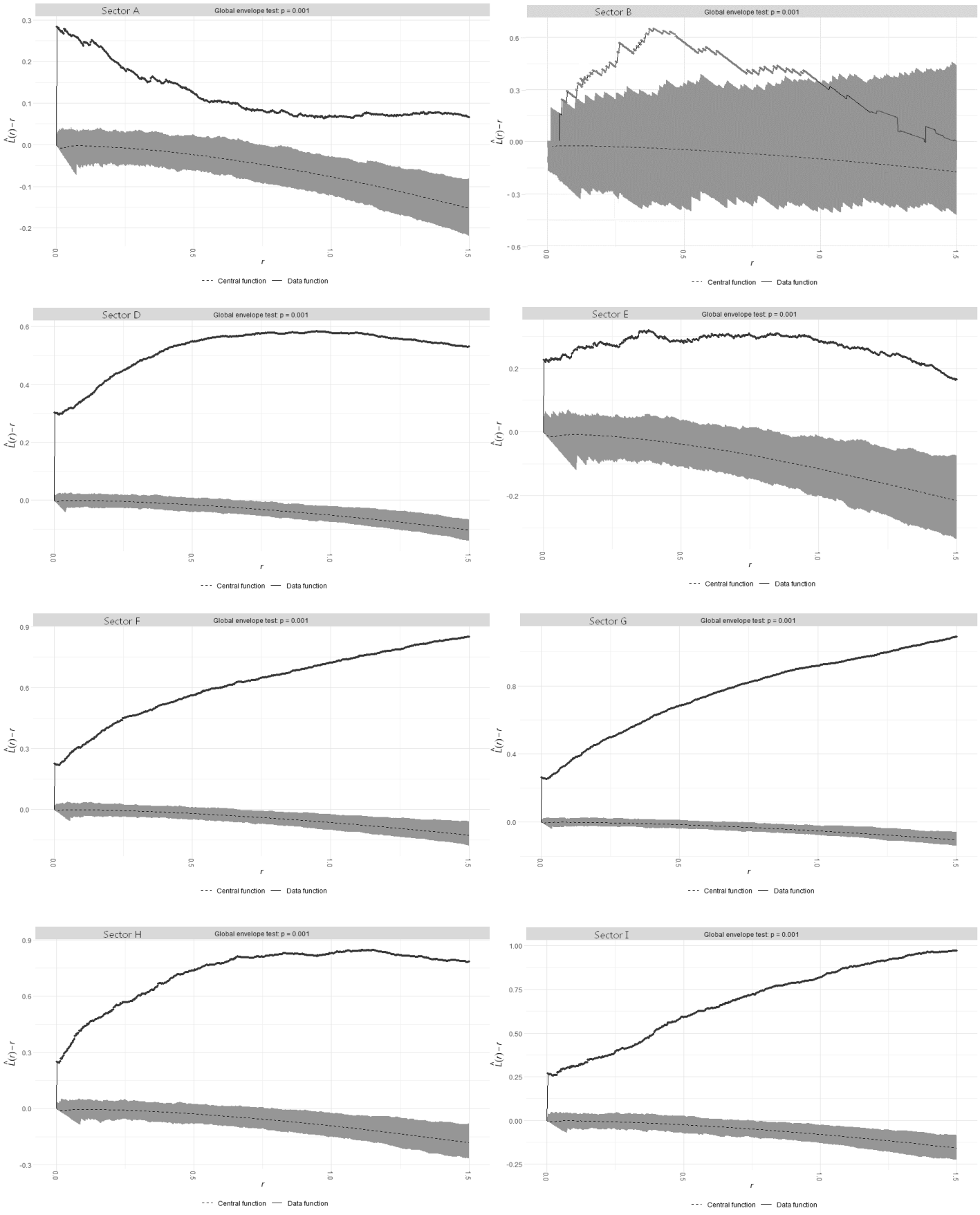
of the point process corresponds to the inhomogeneous Poisson points process where the intensity is equal to population density This analysis aimed to determine whether only the population is able to explain the position of firms.

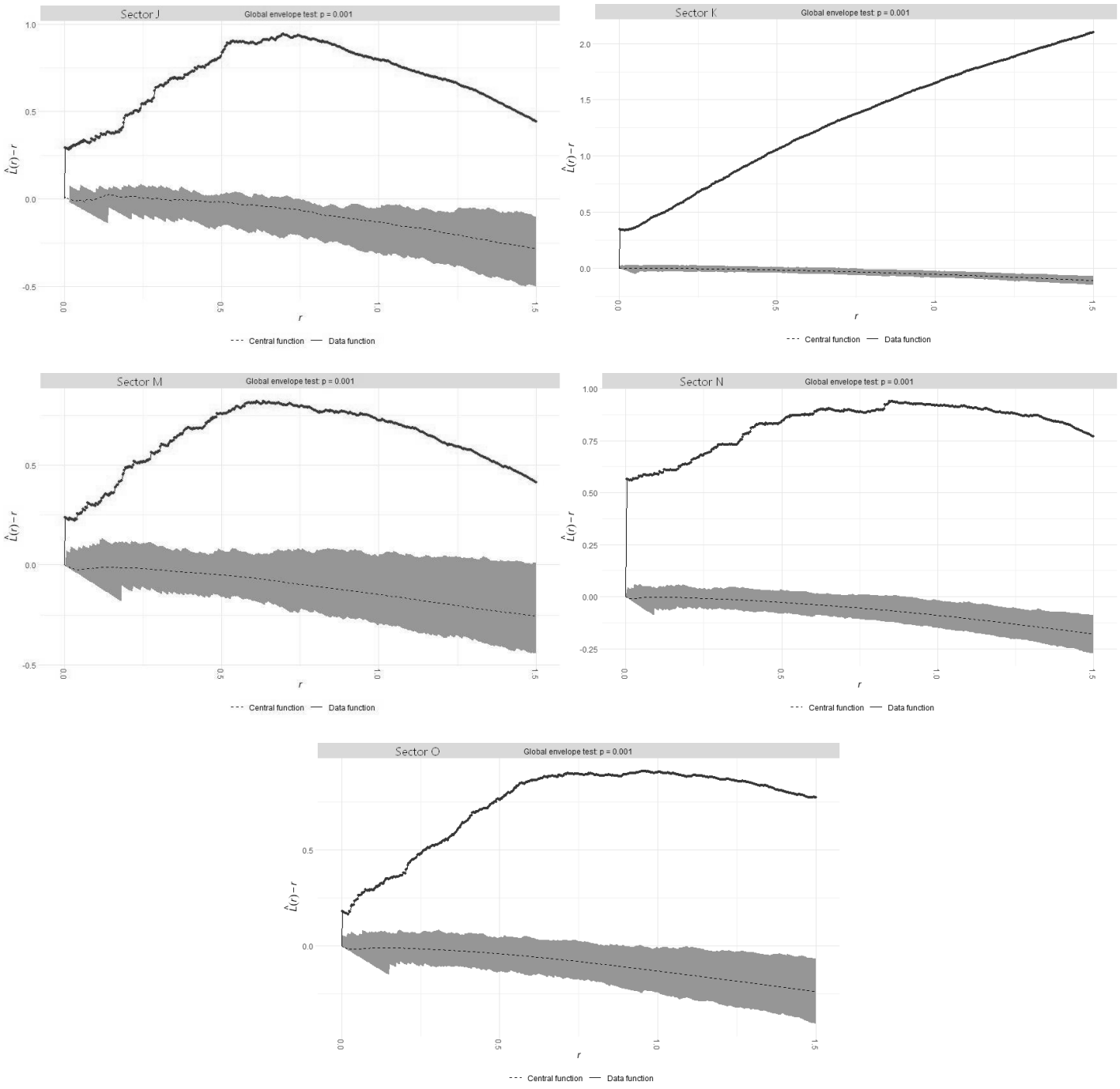
Figure 8 below shows results for the location of companies together with the population. The solid line depicts the behaviour of the estimated locally scaled *L*-function of the sector, dashed lines depict the function in the null hypothesis and the grey zone depicts the corresponding *95%* confidence envelopes under the null hypothesis. The distance *r* is not given in km in the case of a locally scaled function. It is a modified distance, which is modified by population density. Modified distances are between all points. Then, distance with a value of *1* describes the distance of the evenly distributed points in the space. Therefore, it can be described as an average distance to close neighbours.

Generally, values of locally scaled *L*-function outside the envelopes represent the distance where the spatial concentration or dispersion is significant. At the first glance, we can reveal a strong phenomenon of spatial clustering in each modified distance *r*. In all sectors, the strong tendency of clustering can be observed. That is confirmed by *p-values* of *0.001* in all sectors that reject the hypothesis that companies are completely spatially random when the population is taken into account. Spatial concentration cannot be totally explained by the population given in the observed area and there must be other factors describing the location for headquarter of companies.

This analysis has also proven positive external agglomeration effects. Positive agglomeration effects could be caused by many factors such as concentration in the place of natural resources, creation of special supply sector, creation of a specialized labour market, the existence of special research and development facilities, special infrastructure, etc. We found out that the agglomeration effect can be explained by population only partly and there must be an effect of other factors. For this reason, the impact of the health of companies was examined in further analyses.

Figure 8 Behaviour of the estimated locally scaled *L*-function





Source: Own processing

4.4 Level of clustering

For more accurate identification of the clustering force, the level of clustering was detected. In this case, the level of clustering was found out for modified distance $r = 0.5$ in each sector

and is listed in the **Table 4**, where *r* corresponds to approximately half of the average modified distance to the nearest neighbours.

In order to compare the homogeneous and inhomogeneous case of spatial analysis of companies, local scaling was applied in both cases. In the homogeneous case, the lambda was determined as a constant function, in the inhomogeneous case the lambda was determined as the population.

Table 4 Level of clustering in *r = 0.5*

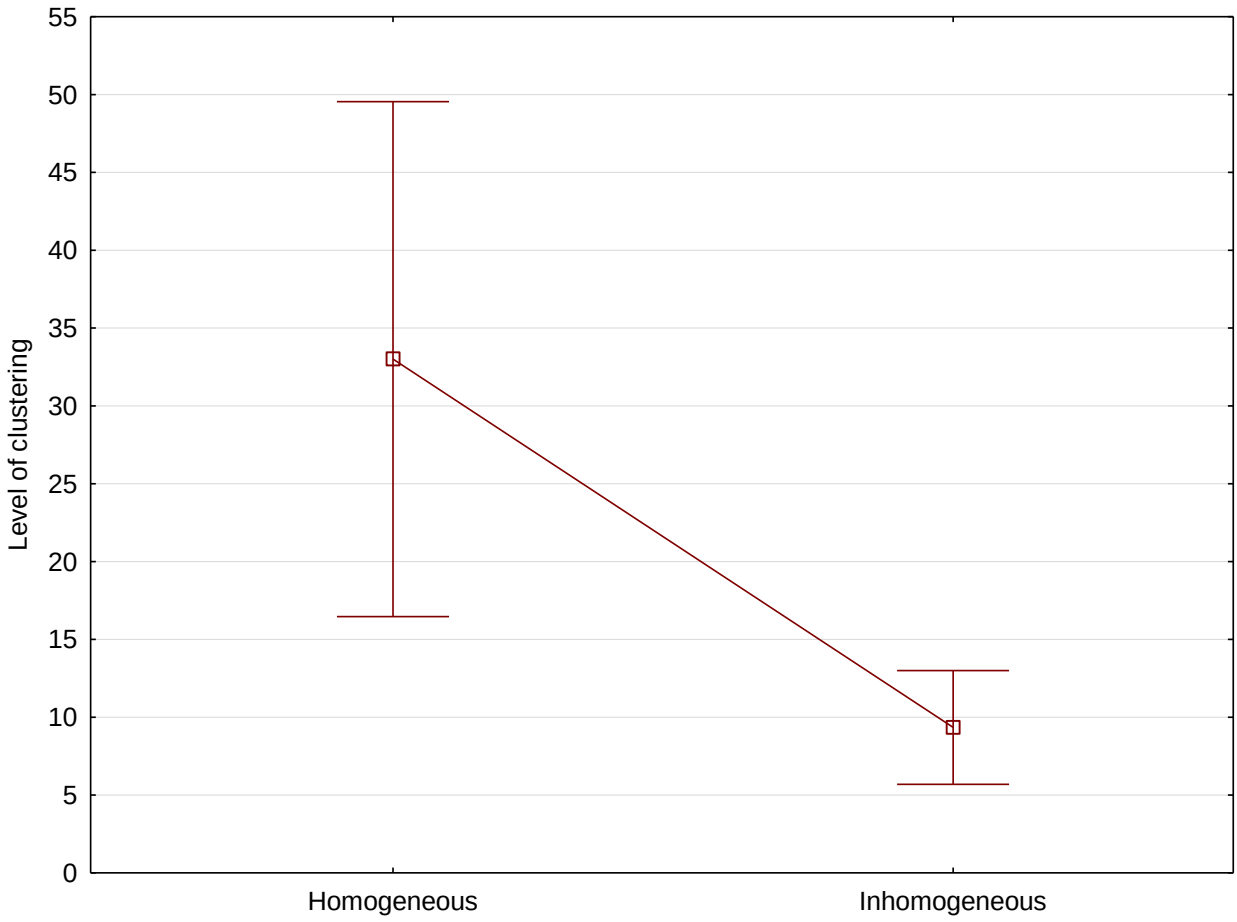
Sector	Homogeneous case	Inhomogeneous case
Agriculture, forestry and fishing	0.762	0.298
Mining and quarrying	1.778	2.222
Manufacturing industry	45.833	15.278
Production and distribution of electricity, gas and water	13.816	3.684
Construction	53.571	13.096
Wholesale and retail trade, repair of motor vehicles	71.951	15.854
Transport, storage and communication	35.577	12.019
Accommodation and food service activities	45.455	9.855
Financial intermediation	8.636	4.733
Real estate activities, renting and business activities	88.235	20.588
Education	7.857	4.286
Health and social care, veterinary activities	30.012	10.564
Other community, social and personal services	25.602	9.036

Source: Own processing

The **Table 4** reveals that the level of clustering is significantly lower in all sectors for the inhomogeneity given by population, except for the Mining a quarrying sector. The higher value of clustering level in the Mining and quarrying sector in the inhomogeneous case is because there is a very low number of companies in this sector. The significantly lower values in the inhomogeneous case are confirmed by *p-value* of *0,001961* of the Two-sample paired t-test (*test statistics = -3.94046*). The graphical interpretation is shown in the **Figure 9** below.

The highest concentration of companies is located in the town even when the impact of the population is removed. Geographic concentration is stronger than population because it could help to amplify production and innovation benefits, specifically to reduce transaction costs, increase information flow, improve specialized needs and be stronger in a competitive environment. Many companies realise the advantages of clustering of companies as they realize the synergy effect that this clustering brings.

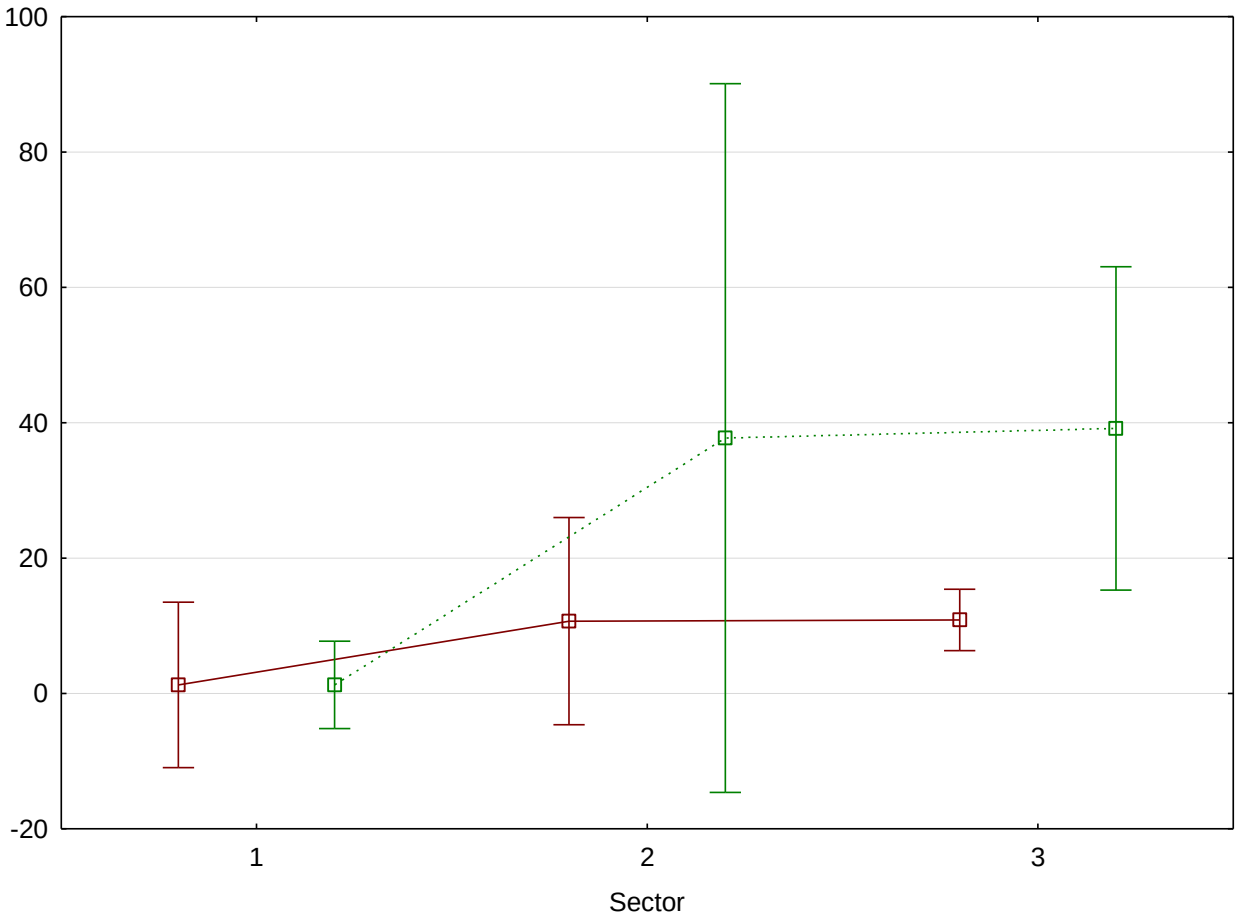
Figure 9 Comparison of clustering level in homogeneous and inhomogeneous case



Source: Own processing

Subsequently, it was tested whether there is a difference in the level of clustering between superior sectors (Raw Material Sector, Manufacturing Sector, Services Sector). In order to carry out this analysis, it was necessary to assign the individual sectors to the corresponding superior sector. Due to the low amount of data to determine the statistical significance of differences between superior sectors, ANOVA was not used, because the variability within these groups does not correspond to the variability of the index that was measured. In this case, it would be necessary to estimate the variability of each index, but this is no longer a reminder of this work. The comparison of superior sectors was thus made only by sight. A graphical representation of this analysis is in the figure below.

Figure 10 Comparison of clustering level of superior sectors in homogeneous and inhomogeneous case



Source: Own processing

The value on the X-axis indicates the Raw Material Sector (1), the Manufacturing Sector (2) and the Services Sector (3). Values of the level of clustering are depicted on the Y-axis. The analysis of the sectors in the case of homogeneity is shown in green, in the case of inhomogeneity in red.

At the first glance, from the figure, it is clear that in the homogeneous case, the Raw Material Sector shows lower values than the Services Sector. In the inhomogeneous case, no significant difference in the level of clustering between superior sectors can be identified. An interesting phenomenon is the Manufacturing Sector, which has a larger variance of the level of clustering in the homogeneous case compare to the inhomogeneous case. In the case of the application of the population to the analysis, the level variance in the Manufacturing and Services Sectors were reduced. Only in the Raw Material Sector the dispersion of the clustering level increased, which was caused specifically by the Mining and quarrying sector, in which there are few companies.

Based on these results, it can be stated that in the analysis of the locality of companies, it is more appropriate to use an inhomogeneous case where the inhomogeneity is given by the population. Only in the case of the Raw Material Sector is it possible to consider a homogeneous case. However, even the population cannot explain the clustering precisely, so in other analyses, other factors were taken into account based on reality according to the intensity of the estimated point process.

4.5 Position of companies influenced by the health

In this chapter, the health of companies is taken into account. There are answered the questions if the health of the firm is influenced by the health of other near companies or not and if the companies are healthier in the cluster or not in all the observed sectors. Given that lambda was defined in this analysis directly by the intensity of the point process, all factors that affect the location of companies are taken into account here. The analysis directly reflects the fact; it is not just a model, however the reality.

Firstly, there was tested the spatial interaction between the health of companies for all the sectors separately while checking for geographic heterogeneity using locally scaled mark-weighted *L*-function, where the summary characteristic c_t was based on the test function $t(m_1, m_2) = m_1 m_2$. The null hypothesis in the analysis says that the behaviour of companies is random and doesn't depend on the health of other companies. Secondly, I tried to find out if the companies of all sectors are healthier when they are located near to other companies in the same sector or not. The summary characteristic c_t was based on the test function $t(m_1, m_2) = m_1$. In this analysis, the null hypothesis says that the health of companies does not depend on whether the company is in a cluster or not.

The results of the analysis are reported in the figures where Global envelope tests for *999* simulations of locally scaled mark-weighted *L*-functions are depicted with a solid line. The corresponding *95 %* confidence envelopes of the null hypothesis are grey and the function in the null hypothesis is depicted by dashed lines. The values of *L*-function outside the global envelopes represent the normalized distances where the spatial concentration or dispersion is significant.

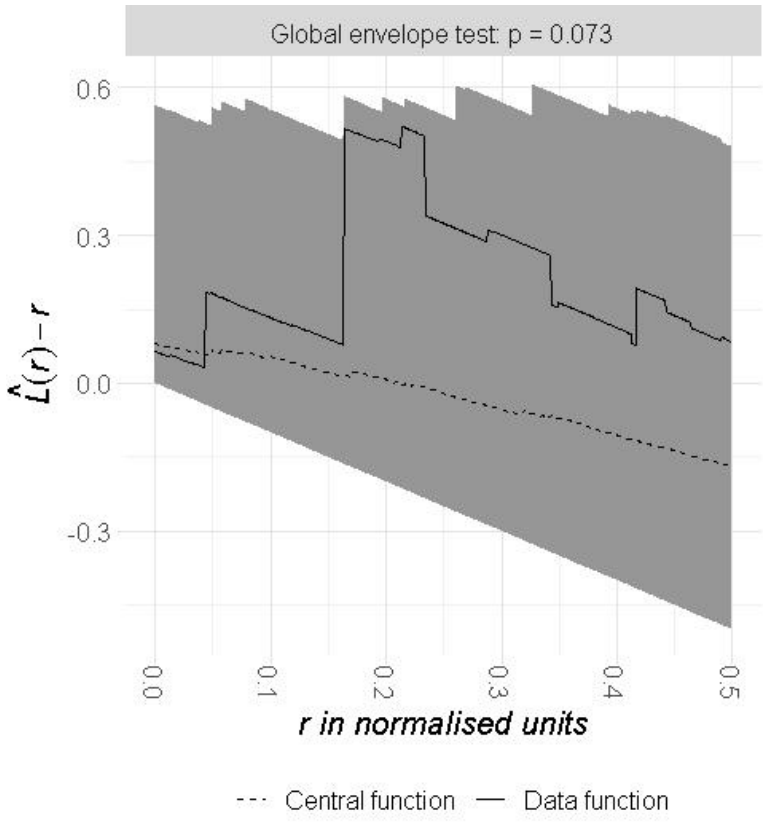
4.5.1 Agriculture, forestry and fishing

Sector Agriculture, forestry and fishing includes companies whose main activities are related to the use of plant and animal natural resources. This group includes activities such as the

cultivation of crops, livestock breeding, logging and the production of crops and animal products on agricultural holdings or their acquisition from the wild (Český statistický úřad & Odbor obecné metodiky, 2008).

The analysis of the health of Agriculture, forestry and fishing companies depending on other companies is shown in the **Figure 11**. The dependence of the health of a company on its proximity to the cluster is depicted in the **Figure 12**.

Figure 11 Estimated locally scaled mark-weighted *L*-function of test function *m1m2* for the sector Agriculture, forestry and fishing

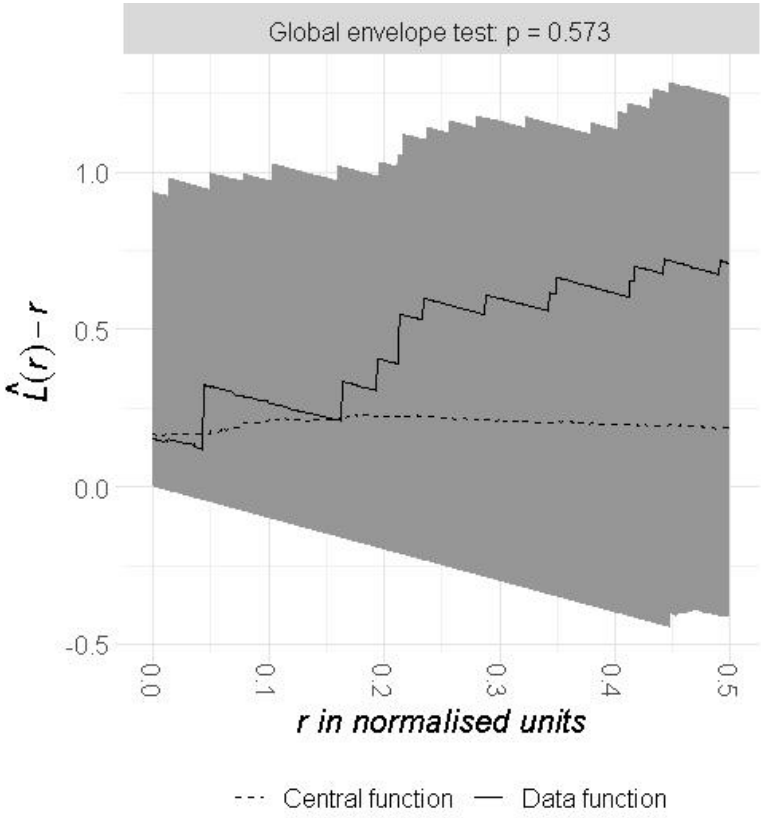


Source: Own processing

From the **Figure 11**, it is clear that the null hypothesis cannot be rejected. The health of companies in the sector Agriculture, forestry and fishing is not dependent on the health of the same companies located nearby.

Then, the impact of the cluster on the health of the company was tested. The results are depicted in the Figure below.

Figure 12 Estimated locally scaled mark-weighted *L*-function of test function *m1* for the sector Agriculture, forestry and fishing



Source: Own processing

Even in this case, the null hypothesis could not be rejected. This means that the health of the company is not affected by whether the company is in a cluster of similar companies or not.

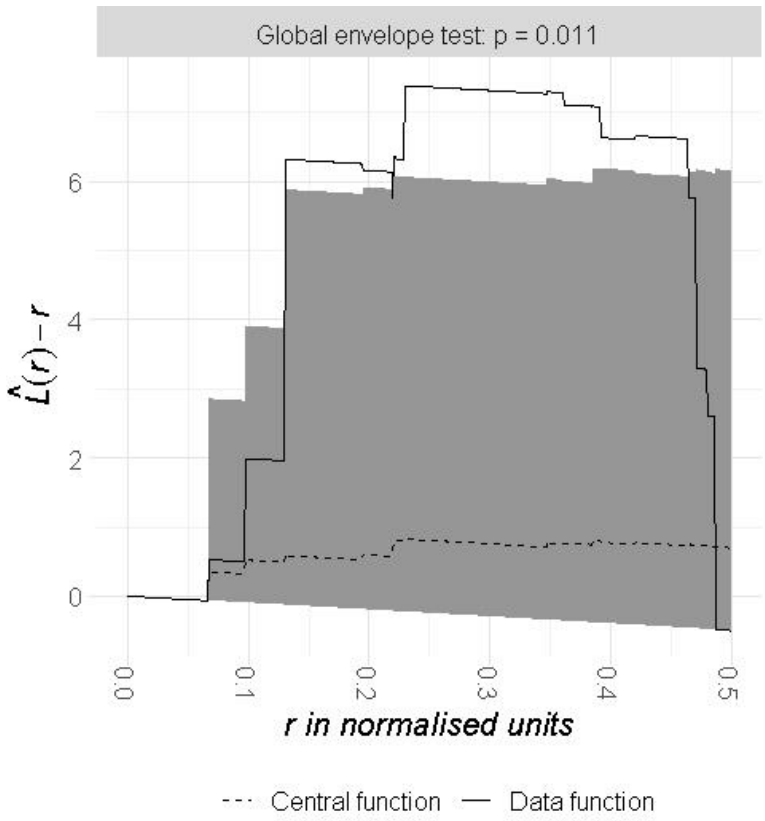
There may be many arguments for these trends. I see the character of this sector as the most important reason. Especially the fact, that this sector is significantly dependent on natural resources. Companies in this sector are more interested in agriculturally lucrative places, i.e. close to natural resources, more fertile land, close to ponds, etc.

4.5.2 Mining and quarrying

The sector Mining and quarrying involves the extraction of minerals that occur in nature in solid, liquid or gaseous state. Companies that specialize in ancillary activities, such as crushing, grinding, cleaning, drying, sorting, ore concentration, liquefaction of natural gas and agglomeration of solid fuels are also included (Český statistický úřad & Odbor obecné metodiky, 2008).

The analysis of the location of headquarters of companies from the sector mining and quarrying are shown in the following two plots.

Figure 13 Estimated locally scaled mark-weighted *L*-function of test function *m1m2* for the sector Mining and quarrying

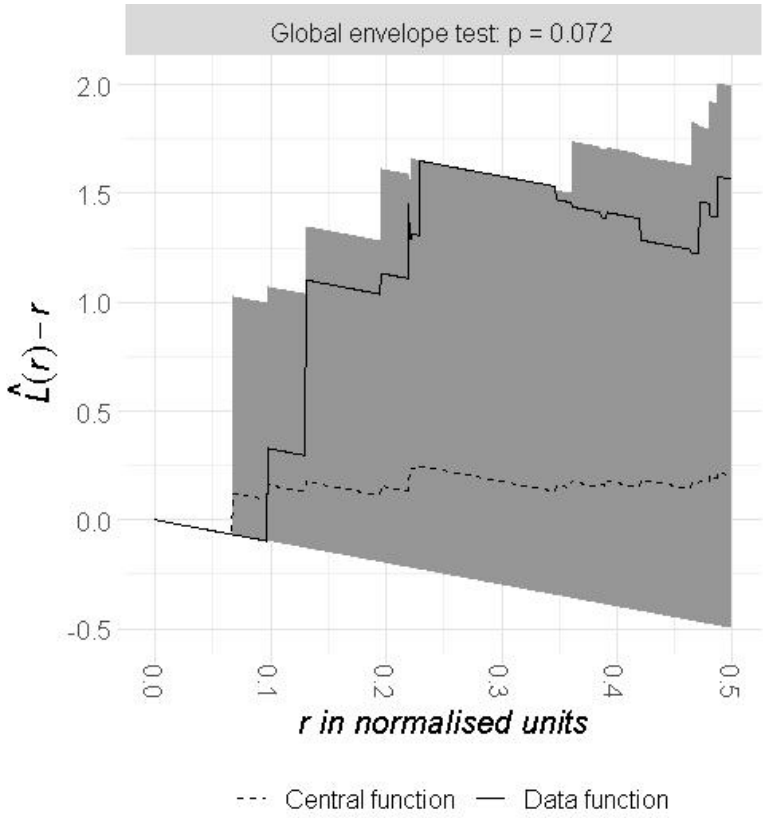


Source: Own processing

The results for spatial interaction between the health of companies (**Figure 13**) show that the location of the headquarters of companies in this sector is significantly dependent on the health of the surrounding companies of the same sector (*p-value = 0.011)*. Specifically, there are attracted companies with the same health. These companies are influenced by similar companies in the modified medium to long distances.

When testing whether the company is doing better in the cluster or not, it was found out that the health of the company is not dependent on the cluster in any way. The situation is depicted in the **Figure 14** below.

Figure 14 Estimated locally scaled mark-weighted *L*-function of test function *m1* for the sector Mining and quarrying



Source: Own processing

The results for this sector can be significantly affected by the fact that there are only *20* companies in the analysed observed area. The conclusions of the first analysis, i.e. that the health of companies is directly dependent on the health of surrounding companies, may be caused by the fact that companies are clustered at places with natural sources. If it is an economically lucrative natural resource, then it is natural that companies around the place will do well and vice versa. The results of the second analysis show that the health of companies does not depend on whether the company is in a cluster or not. This hypothesis could be rejected at the level of significance of 8 % and higher. In that case, it would be necessary to state that the companies in this sector are doing better in the cluster than outside it.

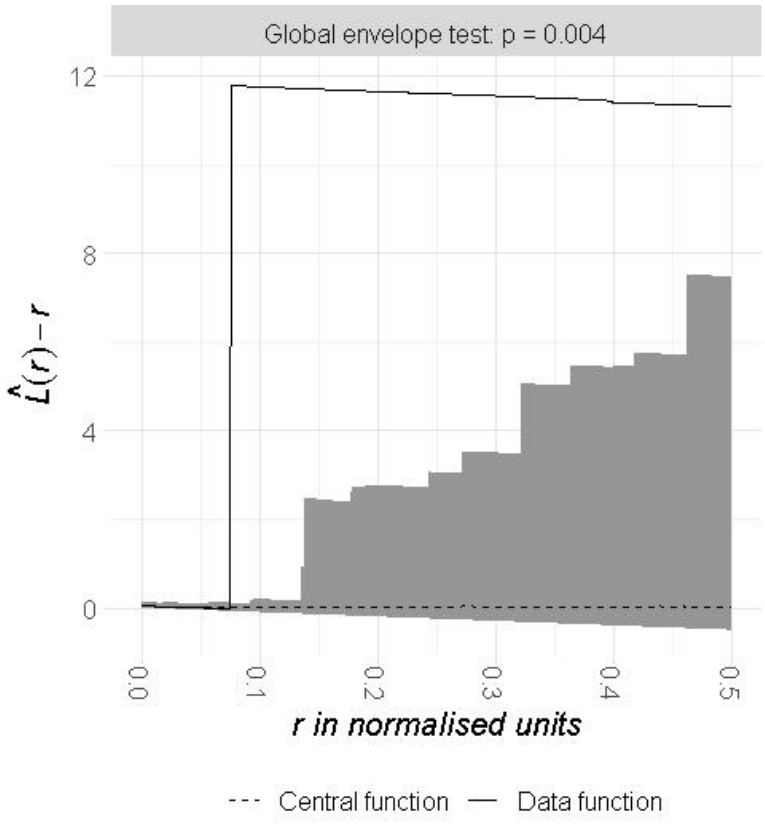
These analyses showed that companies' clusters are made up of companies with similar health. However, to a better understanding of the behaviour of this sector, it would be necessary to analyse more companies.

4.5.3 Manufacturing industry

The manufacturing industry is a large sector. The sector involves the mechanical, physical or chemical conversion of materials or components into new products (goods). Materials, substances and raw materials that are used as inputs to the processing industry are products of agriculture, forestry, fishing and aquaculture, mining, quarrying or may be products of other processing activities. The result of the production process is either finished products intended for use or consumption or semi-finished products intended for further processing or processing (Český statistický úřad & Odbor obecné metodiky, 2008).

In the case, if the health of the company depends on the health of similar companies in the observed area, it was found that there is a significant dependence. In this sector, it was necessary to reject the null hypothesis (*p-value = 0.004*). This situation is depicted in the **Figure 15**.

Figure 15 Estimated locally scaled mark-weighted *L*-function of test function *m1m2* for the sector Manufacturing industry



Source: Own processing

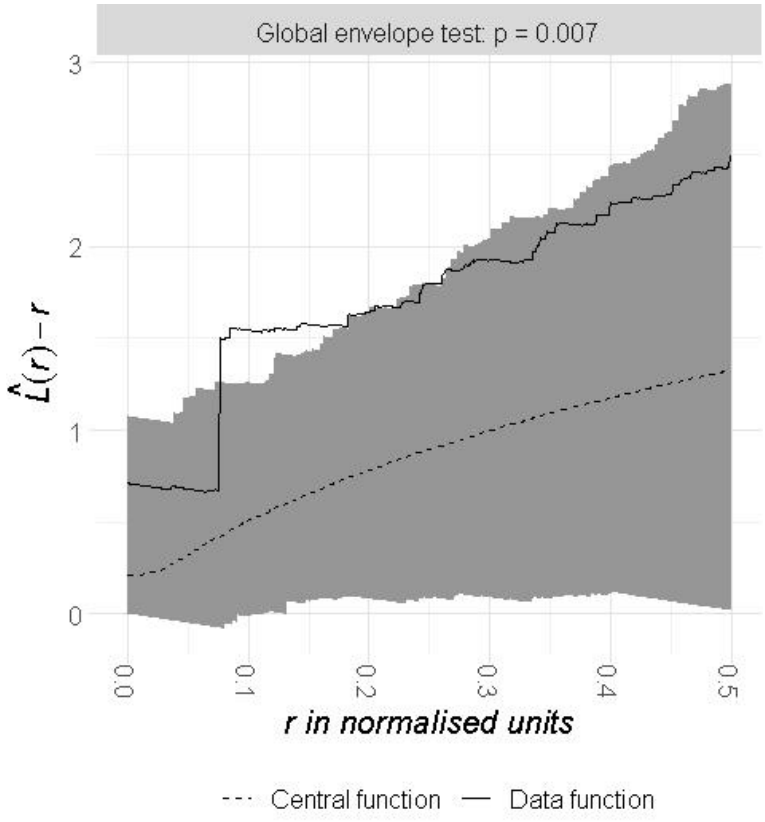
The figure above shows that the health of companies in this sector is spatially dependent. The health of companies in the Manufacturing industry sector is influenced by companies from

the same sector located in medium modified distances. Firms in this sector are very diverse, but the dependence on firms' health outweighs their diversity.

The reason that the health of companies is directly dependent on the health of companies in medium modified distances may be due to innovation and know-how. Companies in close proximity know each other well, so they are more interested in companies farther away so that they can learn from them.

The null hypothesis had to be rejected even in the case of the question of whether the company is doing better when it is placed in a cluster of similar companies or not. The results revealed that companies in the Manufacturing industry are healthier if they are located in a cluster of the same companies in medium modified distances **Figure 16**.

Figure 16 Estimated locally scaled mark-weighted *L*-function of test function *m1* for the sector Manufacturing industry



Source: Own processing

This result may be influenced by the fact that there are more diverse companies in this sector, whose processes are interconnected and complementary. It is therefore more advantageous for companies to be in a cluster of other companies, as it is easier for them to transfer their semi-finished products to another company, which will create a new product from them. This

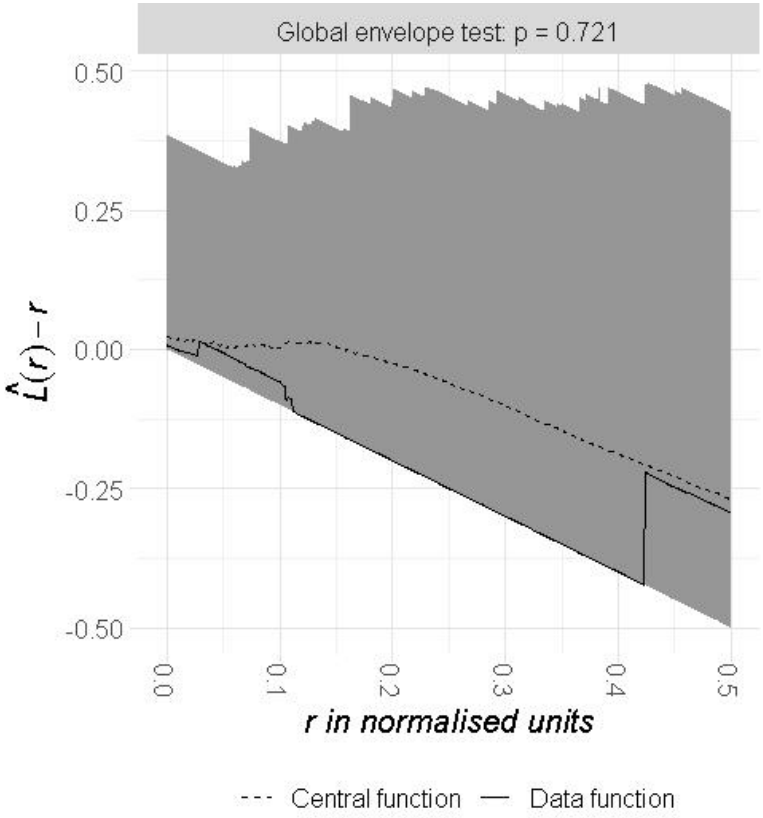
is also true vice versa. It is more advantageous when a company that is further in the production chain is closer to other companies that supply it with products for further processing.

4.5.4 Production and distribution of electricity, gas and water

This sector includes the supply of electricity, gas, steam, hot water, etc. through a permanent network of infrastructure, lines, distribution and pipelines. There is included the distribution of electricity, gas, steam, hot water, etc. to industrial areas or residential buildings. This sector, therefore, covers the operation of installations that generate, regulate and distribute electricity or gas., production and supply of heat, and air conditioning. There are also companies whose activities are related to the management of various types of waste, remediation of contaminated sites and activities related to water supply (Český statistický úřad & Odbor obecné metodiky, 2008).

In the **Figure 17**, the estimated locally scaled mark-weighted *L*-function describing the dependence of the health of companies on the health of other companies located nearby. In this sector the null hypothesis cannot be rejected, meaning there is no relationship between location and health of companies.

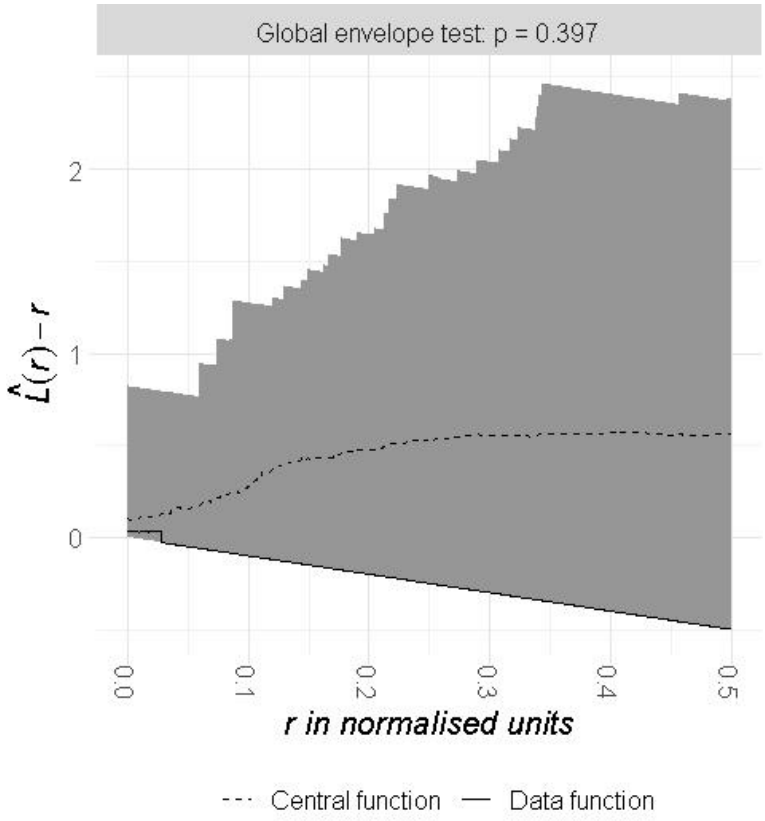
Figure 17 Estimated locally scaled mark-weighted *L*-function of test function *m1m2* for the sector Production and distribution of electricity, gas and water



Source: Own processing

When testing whether the company is satisfied in the cluster or not, it was again not possible to reject the null hypothesis. Companies in this sector are therefore independent of whether they are located in a cluster or not. The situation is depicted in the **Figure 18**.

Figure 18 Estimated locally scaled mark-weighted *L*-function of test function *m1* for the sector Production and distribution of electricity, gas and water



Source: Own processing

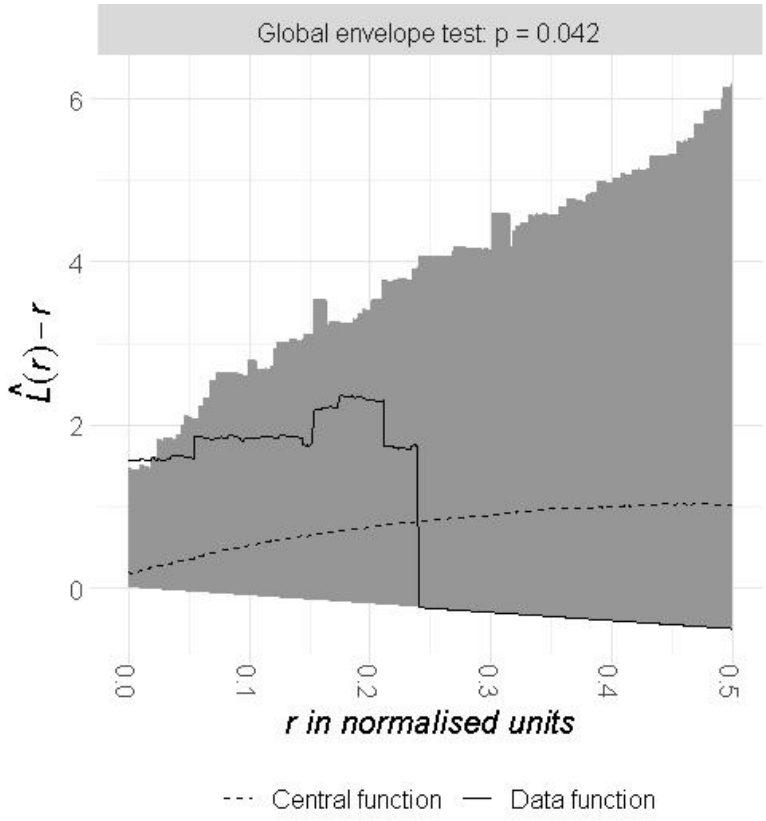
There may be several reasons for this behaviour. The first of them could be caused, similarly to sector Agriculture, forestry and fishing, for example, dependence on natural resources like dams, mountains, rivers and so on. The second reason may be politics. These companies operate in a designated distribution area, which is determined by the technical and construction capabilities of the connection but above all by agreements between the companies.

4.5.5 Construction

This sector includes specialized and non-specialized construction activities. This includes work on new constructions, repairs, superstructures and reconstructions of buildings and engineering works, construction of prefabricated buildings on the construction site and buildings of a temporary nature (Český statistický úřad & Odbor obecné metodiky, 2008).

The following two plots show whether the health of companies affects the health of another company (**Figure 19**) and whether the company is doing better near other companies (**Figure 20**).

Figure 19 Estimated locally scaled mark-weighted *L*-function of test function *m1m2* for the sector Construction



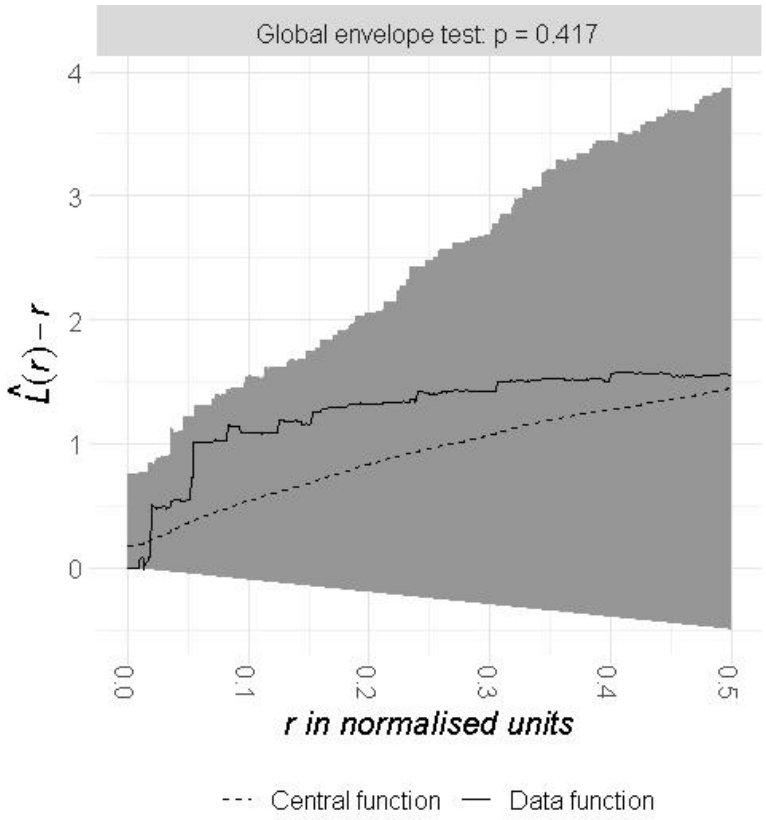
Source: Own processing

In the case of the first analysis, the null hypothesis of firms' independence of health had to be rejected (*p-value = 0.042*). It turned out that companies in the Construction sector state the same health as the companies located in the short distances modified by local scaling.

The situation that the health of companies is affected at short modified distances in this sector may be because close companies are very often involved in the same project. For example, in large construction, several companies work together; one supplying bricks, the other concrete, a third roof, etc. If this is a profitable project, it is clear that these companies will do well. However, if they work together on a loss-making project, their health will be endangered.

On the contrary, in the case of the hypothesis that the health of companies is independent of whether the company is located in a cluster or not, it was not possible to reject the null hypothesis.

Figure 20 Estimated locally scaled mark-weighted *L*-function of test function *m1* for the sector Construction



Source: Own processing

The fact of whether the company's health depends on whether it is in a cluster or not has proved inconclusive. This fact was outweighed by the fact that the health of companies depends on the health of nearby companies in the same industry, as described above.

The analysis of this sector presents the behaviour that a cluster of firms includes either firms that are doing well or, conversely, firms that are failing. There are no clusters of these companies of different health in this sector.

4.5.6 Wholesale and retail trade, repair of motor vehicles

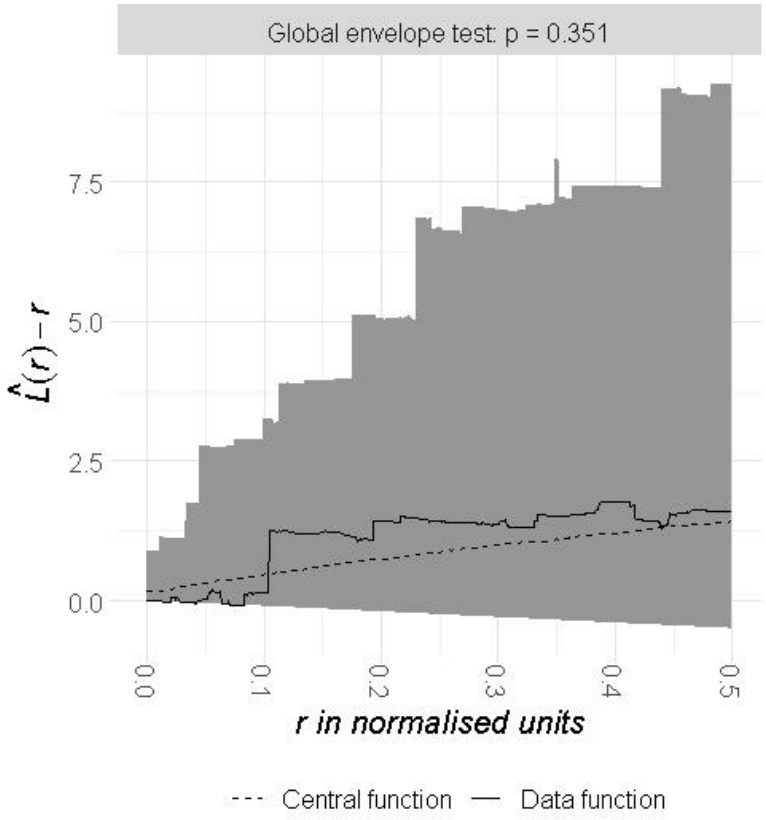
Sector Wholesale and retail trade, repair of motor vehicles include the purchase and sale without further processing of any kind of goods and the provision of services related to the sale of goods. Wholesale and retail are the latest articles in the distribution of goods. This sector also includes the maintenance and repair of motor vehicles and motorcycles (Český statistický úřad & Odbor obecné metodiky, 2008).

The **Figure 21** below shows the situation of whether there is a relationship between the health of companies located close to each other. In that case, the null hypothesis cannot be

rejected. The health of companies in the Wholesale and retail trade, repair of motor vehicles sector is independent of the health of other companies in the same sector.

The analysis failed to demonstrate a significant relationship between the health of individual companies and their locality. Therefore, the performance of the company will not be affected by the performance of another close company in the same industry, but other factors will play a crucial role here. Primarily, these factors could be sales strategy, well-targeted marketing, company image, capable salespeople or sales representatives, etc.

Figure 21 Estimated locally scaled mark-weighted *L*-function of test function *m1m2* for the sector Wholesale and retail trade, repair of motor vehicles

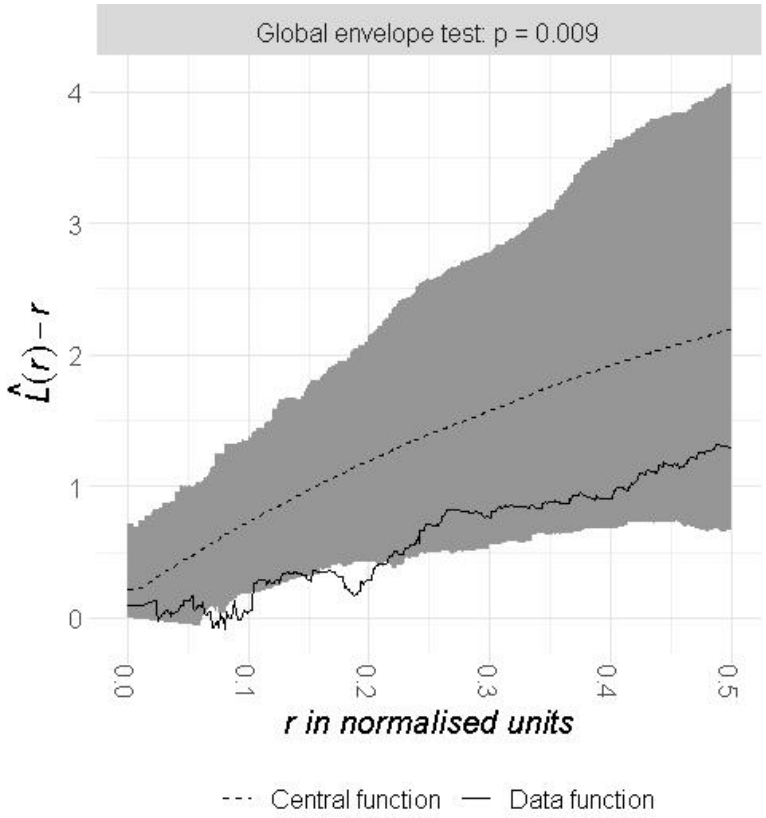


Source: Own processing

Then, in the **Figure 22**, there is shown the satisfaction of companies if they are located in a cluster of other companies in the same sector.

An analysis of this sector revealed a result, namely that companies do worse if they are close to other similar companies in modified short and medium distances. This result in this sector is not so surprising, as these companies are in strong competition.

Figure 22 Estimated locally scaled mark-weighted *L*-function of test function *m1* for the sector Wholesale and retail trade, repair of motor vehicles



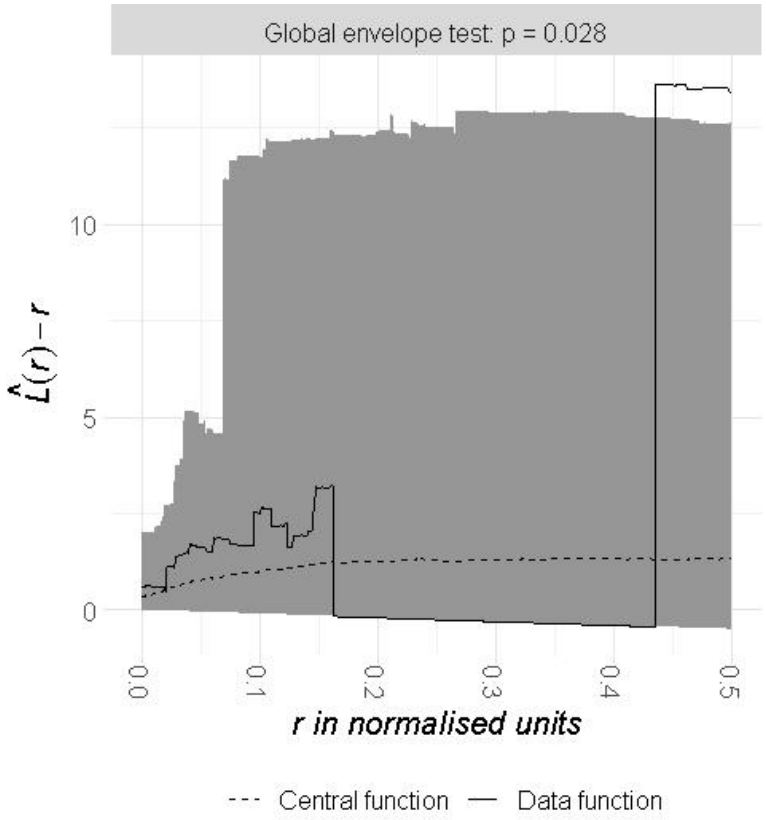
Source: Own processing

4.5.7 Transport, storage and communication

Companies in this sector focus on passenger and freight transport activities, regular or irregular, by rail, by pipeline, by road, water or air, and related activities, such as terminal activities, parking and storage facilities, transhipments, etc. This section includes the rental of a transport device with a driver or an operator. This also includes postal and courier activities. Then, there are also companies that produce and distribute information and cultural products, provide resources for the distribution of these products and the mediation of data transmission or communication, activities in the field of information technology, data processing and other information activities (Český statistický úřad & Odbor obecné metodiky, 2008).

Also for the sector Transport, storage and communication, analyses of the health of companies were performed depending on their location. The **Figure 23** shows whether a company's health depends on the health of other companies in its vicinity, and **Figure 24** shows whether a company's health is affected by the company's location in the vicinity of other companies in the same industry.

Figure 23 Estimated locally scaled mark-weighted *L*-function of test function *m1m2* for the sector Transport, storage and communication

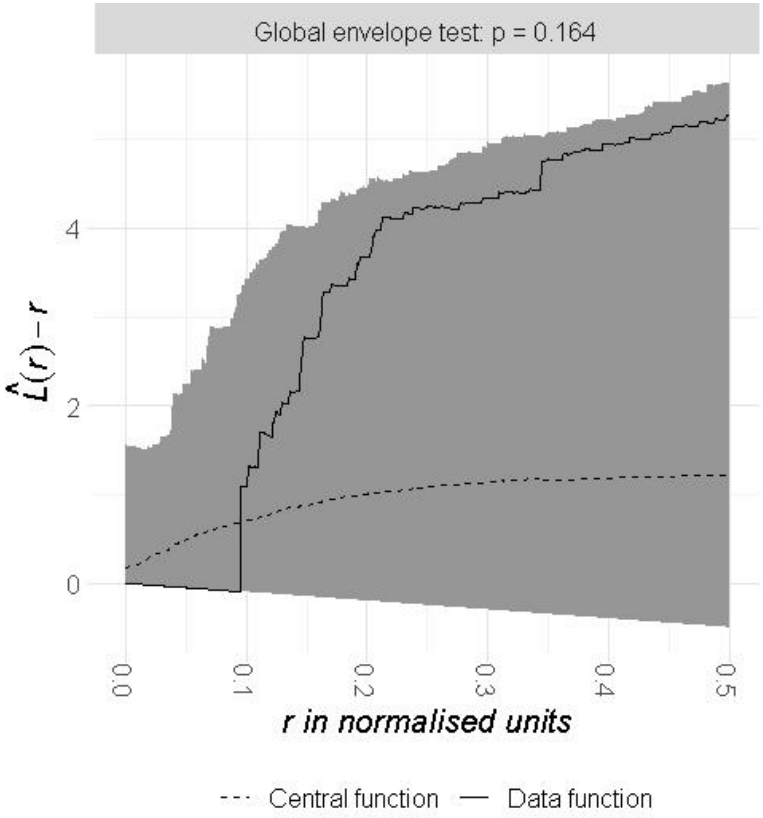


Source: Own processing

In the first analysis of this sector, it was necessary to reject the null hypothesis about the independence of the company's health on the health of other companies (*p-value = 0.028*). The results show that the health of a company is affected by the health of other companies located at longer modified distances, so that good companies attract good companies and bad companies attract bad companies.

In this sector, it is interesting that this type of company is affected by the health of companies in modified long distances. The explanation for this fact may be that these are companies that have their activities at least tied to a particular location. Many of them operate online, or transport companies use outsourcing services for long-distance transport.

Figure 24 Estimated locally scaled mark-weighted *L*-function of test function *m1* for the sector Transport, storage and communication



Source: Own processing

Conversely, in the case of the second analysis, it was not possible to reject the null hypothesis. The results failed to reveal any dependence of the company's health on whether it is located in a cluster or not.

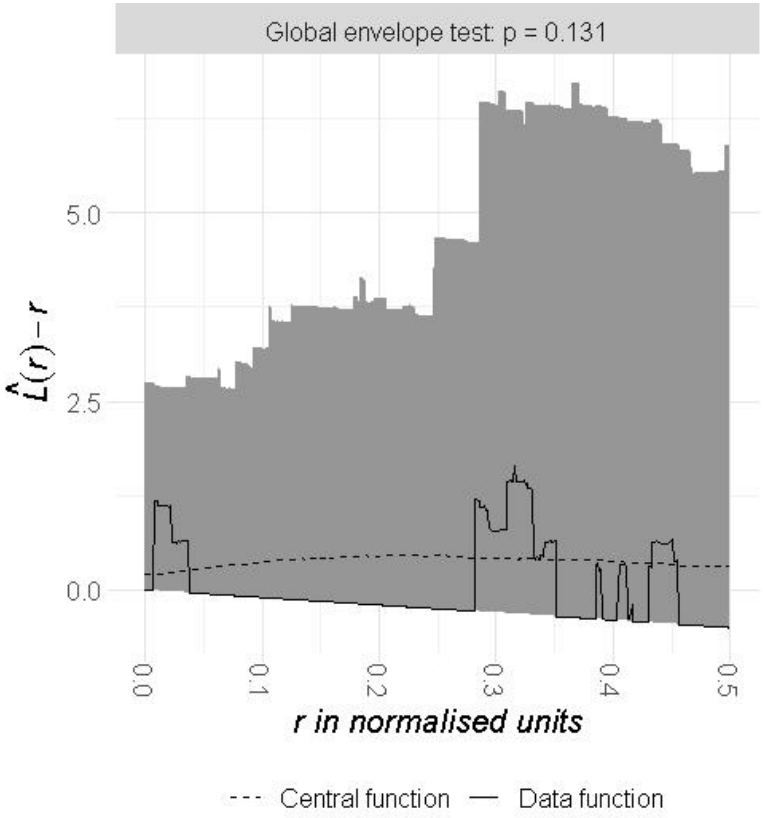
Companies in the sector Transport, storage and communication do not care whether they are located in a cluster or not, for the reason stated above, i.e. they do not have activities directly dependent on the location.

4.5.8 Accommodation and food service activities

Accommodation and food service activities operate short-term guest accommodation and provide complete meals for immediate consumption (Český statistický úřad & Odbor obecné metodiky, 2008).

In the **Figure 25** below there is depicted estimated locally scaled mark-weighted *L*-function of the dependence of the health of companies for the sector Accommodation and food service activities.

Figure 25 Estimated locally scaled mark-weighted *L*-function of test function *m1m2* for the sector Accommodation and food service activities

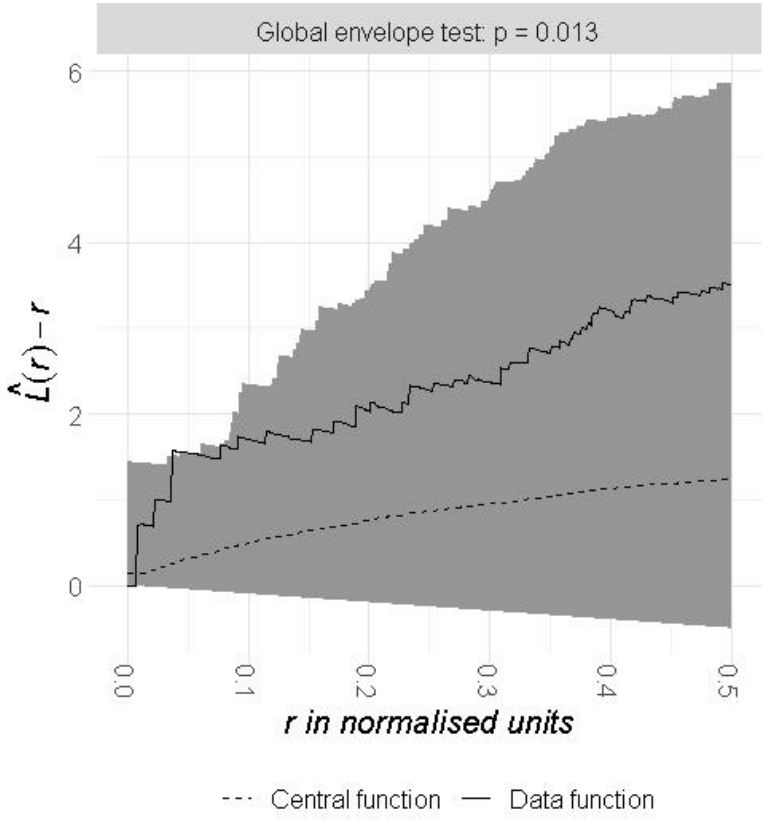


Source: Own processing

The result of this analysis is that it is not possible to prove the dependence of the company's health on the health of other companies in the sector and there must be a different factor affecting the performance of the companies. I consider consumer preferences to be one of these factors, and how the company is able to respond flexibly to these preferences. Furthermore, there is almost perfect competition in this sector, as it includes a large number of companies offering a similar product and there are almost no barriers to entering this sector, market information is easily available, etc.

Then the **Figure 26** shows whether the health of the company depends on its location in a cluster or not.

Figure 26 Estimated locally scaled mark-weighted *L*-function of test function *m1* for the sector Accommodation and food service activities



Source: Own processing

On closer observation, the health of companies in sectors Accommodation and food service activities is better when they are close to other companies from the same sector in short modified distances. In that case, the null hypothesis was rejected by the *p-value* of *0.013*.

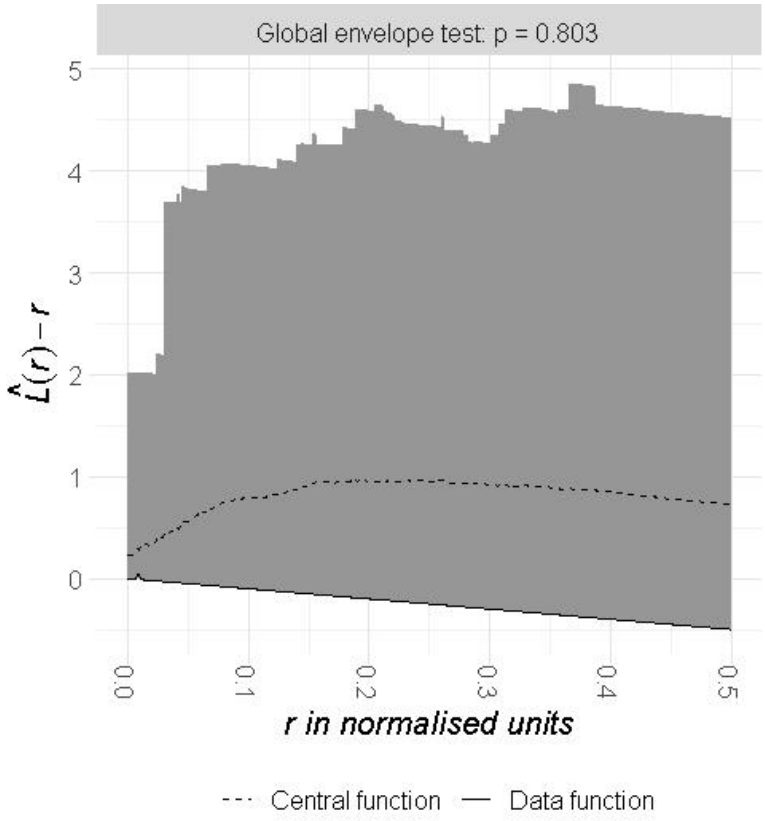
This result may be influenced by the fact that these companies are mainly concentrated on places of interest in some way, such as popular tourist areas.

4.5.9 Financial intermediation

This sector includes companies providing financial services, including insurance and reinsurance, pension fund activities and financial services support activities. They also focus on activities with holdings of assets, such as the activities of holding companies, funds and similar financial entities (Český statistický úřad & Odbor obecné metodiky, 2008).

The following two plots show the results of the performed analyses. Whether the health of companies depends on the health of near similar companies in the observed area is shown in the **Figure 27**. Whether the health of companies depends on its position in the cluster is shown in **Figure 28**.

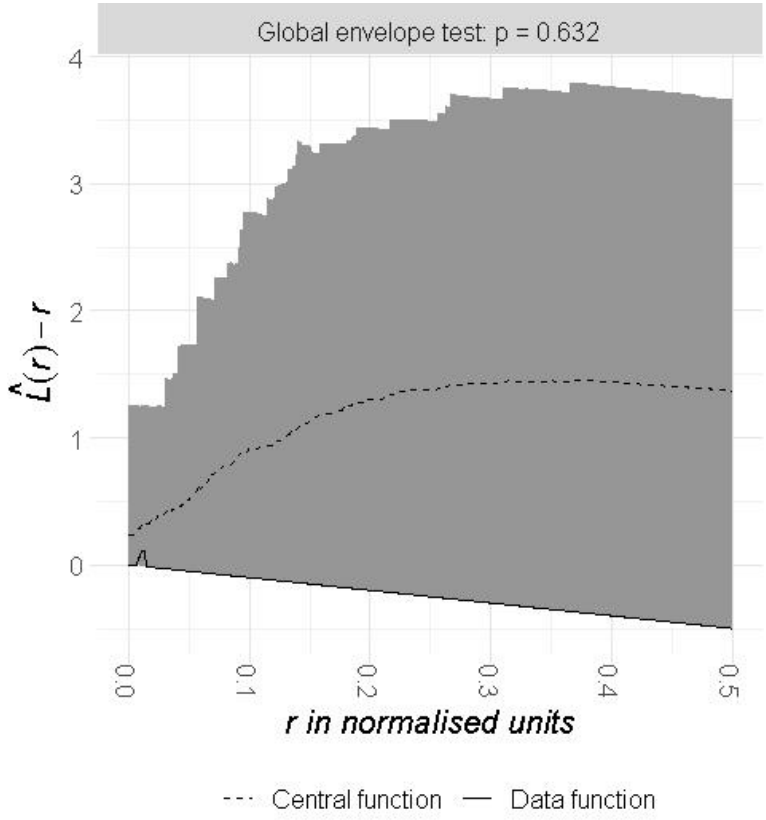
Figure 27 Estimated locally scaled mark-weighted *L*-function of test function *m1m2* for the sector Financial intermediation



Source: Own processing

In both **Figure 27** and **Figure 28**, there was not possible to reject the given null hypotheses. The health of a company does not depend on the health of other companies, nor on whether it is located in a cluster or not.

Figure 28 Estimated locally scaled mark-weighted *L*-function of test function *m1* for the sector Financial intermediation



Source: Own processing

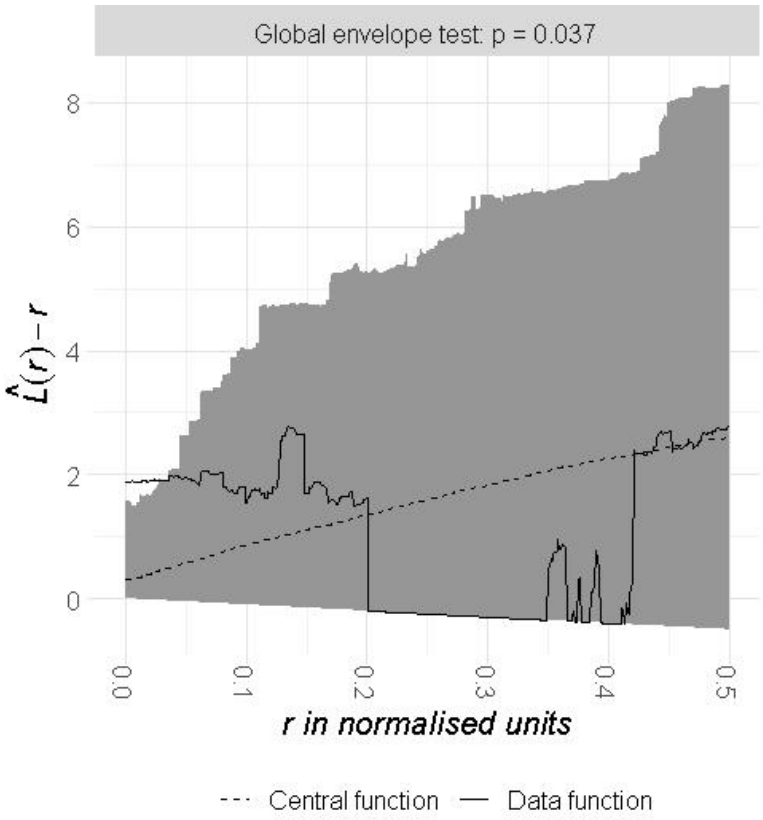
These results could be caused by many factors. One of these factors may be, for example, that some of these companies operate online or in person at various locations outside the company.

4.5.10 Real estate activities, renting and business activities

These companies are engaged in the sale or purchase of the real estates, the provision of other services related to real estate, such as real estate valuation. Activities in this section may be carried out with own or leased property and may be carried out for remuneration or on a contractual basis. The section also includes construction work associated with the maintenance of own or leased buildings. This includes companies whose activities are asset management. This also includes companies providing, for example, legal or accounting services, management consulting, architectural and engineering activities, technical testing and analysis, etc. (Český statistický úřad & Odbor obecné metodiky, 2008).

The **Figure 29** shows the answer to the question of whether the health of a company of Real estate activities, renting and business activities sector depends on the health of companies of the same sector located around.

Figure 29 Estimated locally scaled mark-weighted *L*-function of test function *m1m2* for the sector Real estate activities, renting and business activities

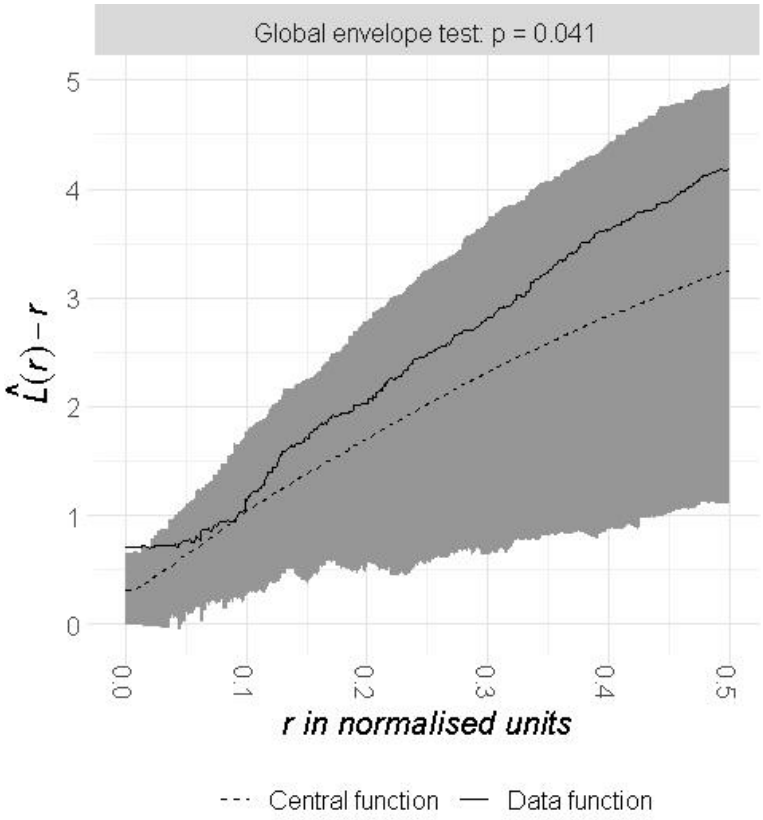


Source: Own processing

At first glance, it is clear from the **Figure 29** that there is a dependence of the company's health on the health of similar companies in the area. This fact is confirmed by the *p-value* of *0.037*, which rejects the null hypothesis of mark independence, i.e. the health of companies. The results show that companies of the same health are attracted in short modified distances.

Similar conclusions were reached in the case of the second analysis. Here, also, the null hypothesis was rejected (*p-value = 0.041*). The companies of the Real estate activities, renting and business activities sector are doing better when they are close to other companies in short modified distances.

Figure 30 Estimated locally scaled mark-weighted *L*-function of test function *m1* for the sector Real estate activities, renting and business activities



Source: Own processing

These results may be affected by the same factor as in the case of the Accommodation and food service activities sector. The lucrative location will also play an important role in this sector. Naturally, companies in this sector will do similarly in the same location. Therefore, it will be interesting to establish another company in a place where other companies are concentrated, especially those that are doing well. For them, it means that there is a lucrative area that should produce an economic profit for the new company.

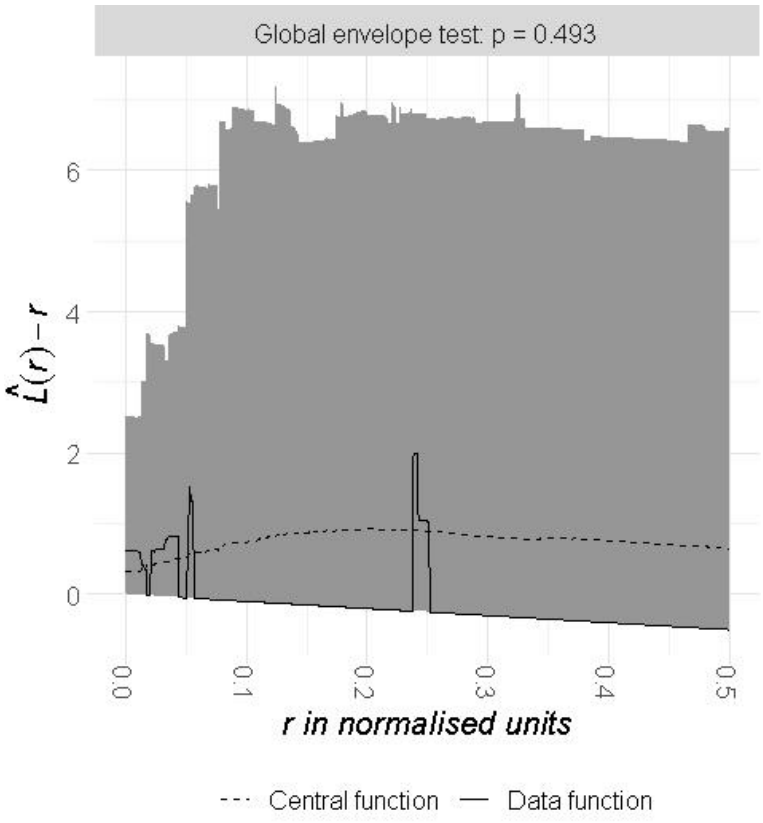
4.5.11 Education

This sector includes education at all levels and for all professions, which includes education by various institutions of the regular school system at various levels, as well as adult education, literacy programs, etc. The sector also includes companies providing education at various levels of military schools and academies, prison schools, both public and private education (Český statistický úřad & Odbor obecné metodiky, 2008).

The analysis of companies focusing on education if the health of these companies depends on the health of companies in the same sector is shown in the **Figure 31**. The situation if the

health depends on its proximity of the cluster is shown the **Figure 32**. Both of these figures are inserted below.

Figure 31 Estimated locally scaled mark-weighted *L*-function of test function *m1m2* for the sector Education



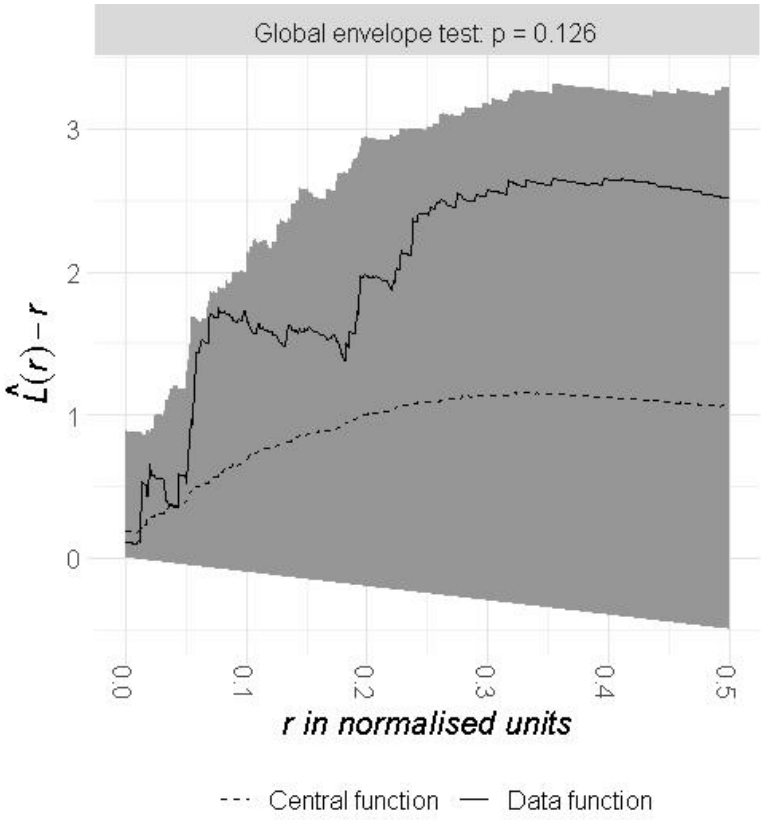
Source: Own processing

In the case of examining the dependence of the company's health on the health of other companies, it was not possible to reject the null hypothesis in this sector. Therefore, the health of companies behaves completely independently, whether it is located near companies that are heading for bankruptcy or prosper.

This situation can be caused by the fact that in this sector there are specific companies that are mainly focused on non-profit activities and are dependent on subsidies and sponsorship. Another important factor in this sector will certainly be the name and its reputation with the public.

Then, the impact of the cluster on the health of the company was tested. The results are depicted in the Figure below.

Figure 32 Estimated locally scaled mark-weighted *L*-function of test function *m1* for the sector Education



Source: Own processing

Even in this case, the null hypothesis could not be rejected. This leads to the conclusion that the health of the company of the Education sector is not affected by its location in a cluster of similar companies.

The results of this analysis can be explained by the fact that in the Education sector there are companies that they are not desirable to cluster too much. Their goal is to deploy according to educational needs. Many of these companies are distributed based on population. Therefore, economic profit does not play a crucial role here. Then, this is compensated by various subsidies and contributions to the operation of the organization.

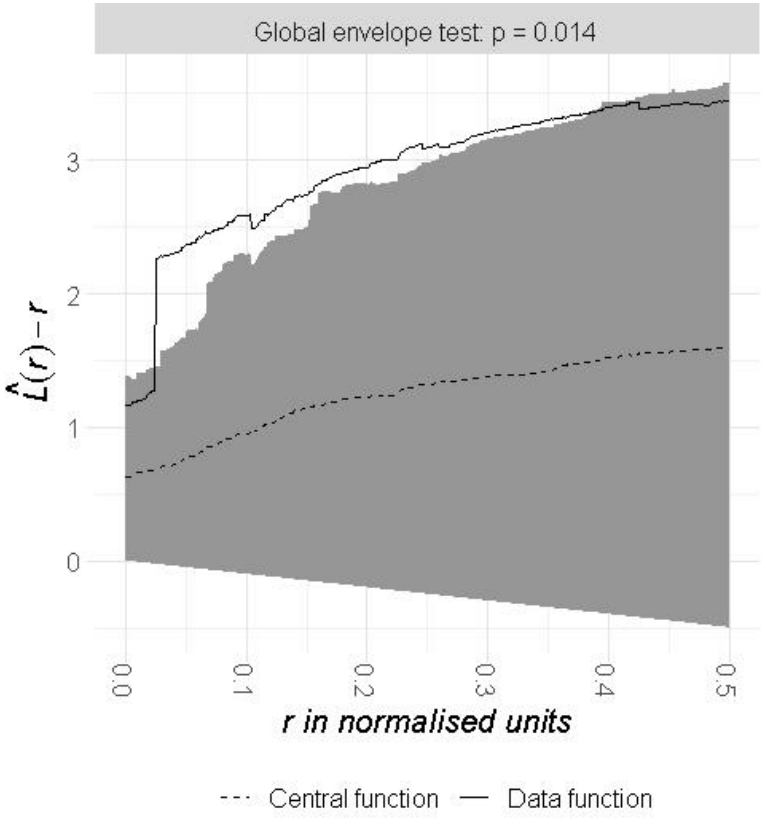
4.5.12 Health and social care, veterinary activities

This sector includes companies providing health and social care services. These activities range from medical care in hospitals and other facilities through institutional care with a certain share of medical care to social care activities without medical care (Český statistický úřad & Odbor obecné metodiky, 2008).

The analysis of the location of headquarters of companies of the sector Health and social care, veterinary activities are shown in the following two figures.

The **Figure 33** reveals a significant health dependence of companies. This fact is supported by the *p-value* of *0.014*. The health of a company is influenced by the health of companies in the same sector at almost all modified distances.

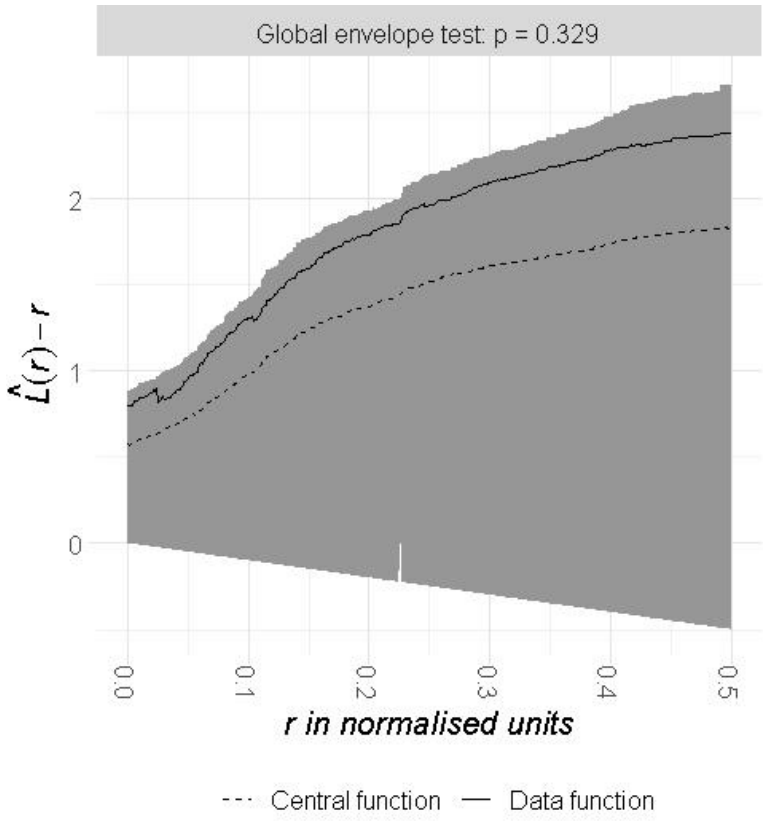
Figure 33 Estimated locally scaled mark-weighted *L*-function of test function *m1m2* for the sector Health and social care, veterinary activities



Source: Own processing

When testing whether the company is doing better in the cluster or not, there were not found any dependences on the cluster. The situation is depicted in the **Figure 34** below.

Figure 34 Estimated locally scaled mark-weighted *L*-function of test function *m1* for the sector Health and social care, veterinary activities



Source: Own processing

The fact that a company's health does not depend on whether it is in a cluster of other similar companies can be explained similarly as in the case of the Education sector. There are also mainly organizations dependent on subsidies and other contributions. Their deployment depends on the needs of society. The result of the first analysis, which showed that companies are doing just as well as similar companies in all modified distances, could be explained by the fact that companies are dependent one external state financial support. If the financial support from the state is good, all companies in this sector will do better. In the case of a decrease in the income of this support, all these companies will do worse.

The results of these analyses also showed that clusters of companies are formed by companies of similar health. Clusters of companies in this sector are therefore of two types, i.e. clusters of companies that are doing well or clusters of companies that are doing badly.

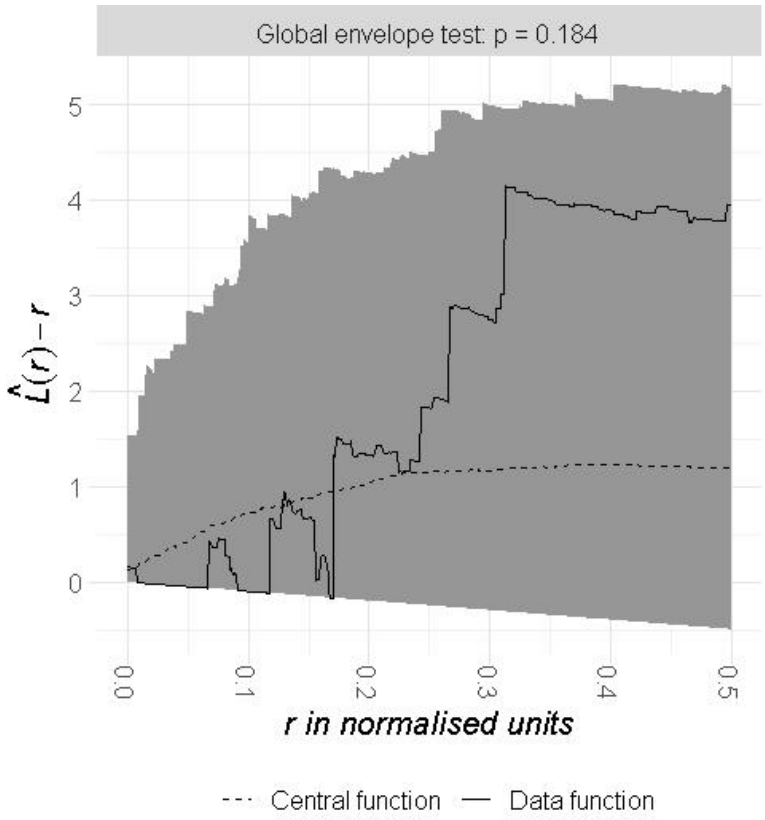
4.5.13 Other community, social and personal services

Companies in this sector are engaged in a wide range of activities that cover the various interests of the general public and concern culture, entertainment and leisure; it includes live

performances, the operation of museums, casino activities, sports and recreational activities. It also includes companies that could not be classified into other classification groups (Český statistický úřad & Odbor obecné metodiky, 2008).

In the **Figure 35**, the estimated locally scaled mark-weighted *L*-function describing the dependence of health of companies on the health of other companies located nearby for the sector Other community, social and personal services. In this sector, the null hypothesis of mark independence cannot be rejected.

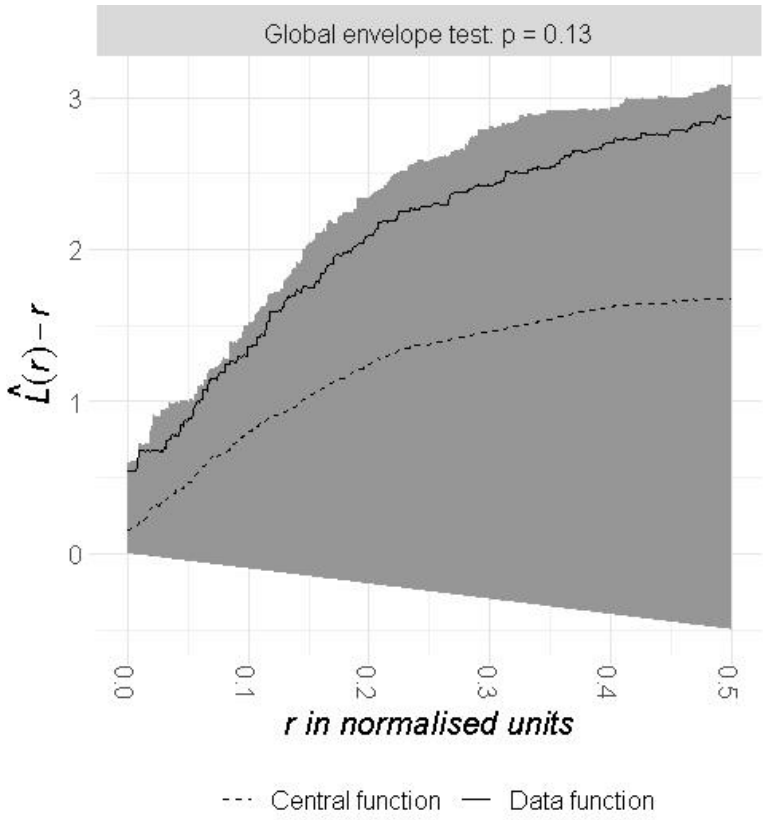
Figure 35 Estimated locally scaled mark-weighted *L*-function of test function *m1m2* for the sector Other community, social and personal services



Source: Own processing

When testing whether the company is satisfied in the cluster or not, again, it was not possible to reject the null hypothesis. Companies in this sector are therefore independent of whether they are located in a cluster or not. The situation is depicted in the **Figure 36**.

Figure 36 Estimated locally scaled mark-weighted *L*-function of test function *m1* for the sector Other community, social and personal services



Source: Own processing

Companies in the sector Other community, social and personal services are specific in that way they are mainly focused on non-profit activities and are dependent on subsidies and sponsorship. Their distribution may also depend on areas of increased need except for the population. For example, social activities will be more located in excluded localities.

5. Discussion

The future location of economic activities is one of the most challenging, long-term and important questions in economics. For this reason, the issue of the spatial location of the companies has been dealt with by many authors. According to Jovanović (2003), the question of where companies would locate, relocate or stay is very demanding and intricate. Many papers are studying the geographic distribution of corporate headquarters (Daniels, 1979) as in this thesis. To compare the results gained in the thesis with the classical localization theories is not easy, as there was dealt with individual sectors separately in the thesis. In contrast, classical localization theories were focused mainly on agriculture or industry. In our case, the results are more detailed, because of the more specific industry classification. Then, we use advanced statistical methods compared to classical theories where the authors guessed the conclusions.

The papers try to explain the economic mechanism of firms' clustering by applying different methods. The first localization theories were based primarily on geometry. At the end of the 20th century, however, statistical methods and modelling began to use. For example, to identify clustering of firms *D*-function was firstly used by Sweeney and Feser (2010) on companies in the southeast of the USA. They were followed, for example, by Marcon and Puech (2003) with companies in Paris, France or Albert, Casanova and Orts (2012) who analysed firms in Madrid, Spain. The bivariate *K*-function to study the location of companies in Italy was used by Giuseppe Arbia et al. (2008). Sweeney and Gómez-Antonio (2016) used Gibbs models as a framework for studying industry localization. Many authors popularized the use of *K*-function on the location of companies. There could be named the papers of Marcon and Puech (2003), Quah and Simpson (2003), Giuseppe Arbia et al. (2008), Giuliani et al. (2014) or Combes et al. (2005). In this thesis, the *K*-function was used with its local scaled variation. Then, there is firstly introduced the Locally scaled mark-weighted *K*-function in order to express the dependence of the firm health and its location.

There are existing few studies focused on the inhomogeneous space of companies. The inhomogeneous *K*-function to analyse the spatial concentration of companies was solved by Arbia et al. (2012) who was concentrated on spatial concentration on five sectors of high-tech manufacturing in Milan, Italy. Further Mori, Nishikimi and Smith (2005) studied companies' localization by *D*-index. In the analysis, they removed the effect of regional population size. Sweeney and Feser (2010) and Marcon and Puech (2003) used *D*-function that considers

density variations to analyse if small companies are more concentrated than big ones. There is the main difference between the thesis and the existing literature. Although I was concentrated on the study of the location of companies in inhomogeneous space as others, I used a different method, specifically Local scaling. The method has never been used on companies before. Even though, it brings a more natural way of treating inhomogeneity. In the local scaling approach, the distances between firms are treated differently when the density of firms changes. I.e. the short distances in high density are treated similarly as the long distances in low density. This is more natural than the classical view of inhomogeneity where clusters can be built only up to a certain distance. In the locally scaled approach, we can assume cluster also in low firm density with a further reach of the cluster.

In this paper, the variable for inhomogeneity was given by population. This variable was chosen according to other studies, For example, Mori et al. (2005) consider population as the main location factor in their study too. Also, Porter (1998) claimed that strong clusters are often concentrated in particular geographic areas, especially in a single city or metropolitan region. Klier and Testa (2002) also concluded that a location with a higher population is preferred for the company's headquarters. Similar results were obtained by Devereux et al. (2007) when they presented that companies are being placed in areas where the mass or density of economic activity is high. These authors also revealed that the new company is more likely to be located close to larger markets. Similar results were presented by Jovanović (2003), who mentions that companies are located in places with higher demand (i.e. in the place where most manufacturers are located, regardless of the characteristics of the location).

The results in this thesis revealed that all the sectors tend to clustering in inhomogeneous space where the inhomogeneity is driven by population. These conclusions were reached, furthermore, by Devereux et al. (2007) who claim that firms in more agglomerated industries choose to locate new plants near to other plants within the same industry. With interesting results about the distribution of companies came Venables (1995), who claims that adding more firms to a location reduces the profitability of the location. This situation should generate an outcome where firms are geographically dispersed. Nevertheless, dispersed outcomes are unstable, and firms tend to concentrate in a few locations. Porter (1998) found out that clustering of firms is a source of economic growth and prosperity in the area because clusters increase the current (static) productivity of constituent firms or industries, the capacity of cluster participants for innovation and productivity growth, stimulate new business formation that

supports innovation and expands the cluster. There were other authors who found the advantages of clusters. Krugman (1997) said that the idea of clustering of producers in given locations generates benefits. The main reasons for the concentration of firms according to Marshall (1890) were location savings, creation of specialized workforce stock and transfer of knowledge and technical progress among firms. According to Stejskal and Kovárník (2009), the main argument for the formation of clusters is the implementation of innovation and knowledge in sectors.

There are studies that investors' decisions don't only depend on geographical factors. The location of business activities is primarily dependent rather on macro and microeconomic factors. Cohen (2000) revealed major influences on location decision-making of companies about a city for the company. He revealed there are three main factors that can explain the decision about location, e.g. technology, business organisation and government policies (education, speeding-up the permitting process and simplifying bureaucracy and the (un)importance of tax incentives. Then the study of Devereux, Griffith and Simpson (2007) found the effect of industrial structure and agglomeration externalities on the location of new companies. Also, Matouschek and Robert-Nicou (2005) explored the role of human capital investments in the location decisions of firms, or Devereux et al. (2007) failed to demonstrate a significant dependence of the choice of the location of the new company on fiscal activities, grants. For that reason, in the thesis, the marks describing microeconomic factors especially the health of companies that are indirectly united with the business organization were added to the point process. The performance of companies was taken into account in the paper of Tonts and Taylor (2010). However, they addressed the performance of companies at the regional level and not at the sector level, as in the case of this thesis. There have been no studies describing if the health of companies influences their location in a given sector as in this thesis yet.

In the thesis, there were not revealed any differences in the level of clustering between the type of sectors (Raw Materials, Industry, Service or Education). This idea differs from the opinion of Sweeney and Gómez-Antonio (2016) who claims that the clustering will be significantly stronger among companies from the high-tech industry and knowledge sectors.

Different sectors revealed different results in the main analyses. Either there was a situation where the company's dependence on the health of other companies or its placement in the cluster could not be revealed, or there was any dependence. In the case of the existence of the dependence, it was the dependence mostly positive. Only in the sector Wholesale and retail

trade, repair of motor vehicles has it been shown that if the company is near to other companies in the same sector, it has greater problems with its performance. This result was surprising because many authors state that the clustering of economic activities in the same location generates benefits (Krugman, 1997). Stejskal and Kovárník (2009) claim that clusters have unquestionable advantages for companies, enabling them to increase productivity by accessing specialized inputs, information, and institutions. Already in 1979 Papageorgiou informed that locating companies into clusters leads to higher productivity and profitability. These companies also have a higher tendency to innovate and grow faster. They are also able to achieve higher aggregate profits, lower unit prices and face increased demand than more dispersed companies. Also, according to Skokan (2004) enterprises achieve significant performance and competitive advantages through sectoral clustering, which they would have difficulty achieved alone. The same idea is confirmed by a study by Schmitz (1999), who revealed that the reason for the preference to stay in the cluster is that the firms are not only providers of information, but also they are recipients too. This difference may be because many authors did not take into account individual sectors separately as in this thesis.

6. Conclusion

Localization theories are focused on choosing a location for economic activities with regard to optimal resources. These theories are considered to be the starting point for the emergence of regional sciences, which are based on the discovery of specific characteristics that influence the location of activities. Choosing the right location is one of the most important decisions for a company.

Then, the problem of localization has been solved deeply in history when the settlement of localities was dependent on available livelihoods and suitable climatic conditions. The first localization theories were focused on agriculture as they were created at a time when this sector was very widespread. Due to the development of industry, industrial localization theories have emerged, followed by modern localization theories. Localization theories have evolved greatly since they were developed in connection with the development of the environment, conditions and, above all, the influence of globalization. Due to these constantly changing conditions, it is not possible to determine a universal localization factor that is linked to specific market size or type. Companies influence both households (by providing work, selling services and goods) and the state (investment, taxes). Therefore, it is important for these entities to create an interesting environment for companies that would attract them and thereby contribute to economic development. Every start-up company that wants to expand and be successful must consider the localization of the factory.

This work deals with the theoretical foundations of the spatial location of firms and industries (location theories), what preceded their origin and what their initial ideas were based on. The main aim of the thesis is to describe the spatial distribution of the headquarters of companies. The thesis deals with the justification of the location of headquarters of companies in a certain sector, as well as with sundry requirements and stimulation that influence the decision about the location in a certain space. In particular, whether the company should think of a location close to another successful company, or vice versa, a company that is not successful and is threatened by bankruptcy. Information from companies from 2013 located in Jihočeský, Západočeský and Vysočina region in the Czech Republic were used in the analysis. This research can help to understand the location phenomena of companies because the choice of a suitable location for a company and its economic activities is one of the most important decisions in the company. Then, there is proposed the new methodology, specifically,

modification of mark weighted *K*-function for inhomogeneous space that can help future researchers.

At the beginning of this work, it was found out how the headquarter of the company corresponds with its establishments. The research found that *75 %* of companies have the same location for their establishments and headquarters. *79 %* of companies have their registered office identical to the establishment or the establishment is a maximum of *1* km away from the establishment. And even *90 %* have the same headquarters as an establishment or an establishment within a maximum distance of *10* km. This finding leads to the fact that the results of the analysis of the location of the company's headquarters were implemented on its establishments.

Secondly, we tried to find out if the companies are more located in areas where people are more concentrated. To determine whether the population can explain the clustering of firms, the level of clustering was set. There was compared the level of clustering in the homogeneous case and the inhomogeneous case (when the population was taken into account). The research has revealed that the population can partially explain the clustering of firms. As part of this analysis, the level of clustering within the Primary, Secondary and Tertiary sectors was also compared. Here, it was found out that the results of inhomogeneous analyses reached significantly lower values than the results in the homogeneous case. As it was not possible to prove that the population would fully explain the clustering of firms, in further analyses, the analyses were completely detached from the population. The population was replaced with the density of the point process of companies.

Geographic concentration is stronger than population because it helps to amplify production and innovation benefits, specifically to reduce transaction costs, increase information flow, improve specialized needs and be stronger in a competitive environment. Many companies probably realise the advantages of location in a cluster where the whole is more than the sum of its parts. Firms may also tend to clustering more than it is determined by the population because agglomerations are withdrawing jobs from a longer distance. It could be caused by the fact that the population is more scattered around the agglomeration.

However, the main aim of the thesis was to ask whether companies can potentially benefit from locating near to other companies. Thus, I tried to recognize the spatial relationships of companies according to their performance. I expected that the performance of companies could

be spatially independent or spatially dependent. Then, I tried to recognize if the company located in the cluster is healthier or not. To fulfil the aim, there is introduced a new statistical tool, specifically locally scaled mark-weighted *K*-function. The tool is based on mark-weighted *K*-function that was modified for inhomogeneous space, specifically by the local scaling approach, where the inhomogeneous space was defined directly by the intensity of the point process. This function can help with the description of the behaviour of mark point pattern in inhomogeneous space.

When the health of companies was taken into account there were two questions I tried to answer:

- Is the health of the firm influenced by the health of other companies surrounded by? (*m1m2*)
- Are companies healthier when they are located in clusters or not? (*m1*)

The results demonstrating the answer to these questions are summarized in the **Table 5** below. The null hypothesis in the Table (H_0) describes the sector following a locally scaled point process with an independent marking model. The health of companies in this sector doesn't depend on other companies. When the null hypothesis was rejected ($\boldsymbol{H_1}$), there are significant interactions between the health of companies.

Table 5 Position of companies according to their health

Code	Sector	*m1m2*	*m1*
A	Agriculture, forestry, fishing	H_0	H_0
B	Mining and quarrying	$\boldsymbol{H_1}$	H_0
D	Manufacturing industry	$\boldsymbol{H_1}$	$\boldsymbol{H_1}$
E	Production and distribution of electricity, gas and water	H_0	H_0
F	Construction	$\boldsymbol{H_1}$	H_0
G	Wholesale and retail trade; repair and maintenance of motor vehicles	H_0	$\boldsymbol{H_1}$
H	Transport, storage and communication	$\boldsymbol{H_1}$	H_0
I	Accommodation and food service activities	H_0	$\boldsymbol{H_1}$
J	Financial intermediation	H_0	H_0
K	Real estate activities, renting and business activities	$\boldsymbol{H_1}$	$\boldsymbol{H_1}$
M	Education	H_0	H_0
N	Health and social care, veterinary activities	$\boldsymbol{H_1}$	H_0
O	Other community, social and personal services	H_0	H_0

Source: Own processing

When the spatial interaction influenced by the performance of companies was tested, the different tendencies though sectors were revealed. There were found out strong interactions

between the performances of companies in 6 sectors where the companies follow the same fate as the companies close to them. There were only differences in the distance of influenced companies. Specifically, the performance in Construction sector and Real estate activities, renting and business activities are influenced by companies located in the short distances, the health of companies in Mining and quarrying, Manufacturing industry sector is influenced by companies located in medium modified distances, the health of companies in sector Transport, storage and communication is affected by companies located in longer distances and in the sector Health and social care, veterinary activities the health is influenced by companies in all distances. In other sectors, the null hypothesis couldn't be rejected.

Then, when the analysis was focused on the second question if the companies are healthier when they are located near to other companies of the same sector or not, the results were different though sectors again. There were revealed interaction for short modified distances only in the sectors Manufacturing industry, Wholesale and retail trade; repair and maintenance of motor vehicles, Accommodation and food service activities, and Real estate activities, renting and business activities. The first three sectors revealed that the companies have better performance if they are located in a cluster of similar companies. Controversially, the sector Wholesale and retail trade; repair and maintenance of motor vehicles showed that the companies of this sector located in clusters are not healthier. There may be many reasons for this trend that would need to be justified by further analysis.

The analyses succeeded in revealing certain regularities that may explain the trend of the location of company headquarters in individual sectors. For example, sectors Agriculture, forestry, fishing and Production and distribution of electricity, gas and water show similar behaviour, which may be due to a certain dependence on natural resources, while in sector Production and distribution of electricity, gas and water there may be moreover political reasons (distribution area). In the sector of Mining and quarrying, similar behaviour could be expected as in the already mentioned sectors. Nevertheless, there is a deviation. The results of this industry reveal that the health of companies is directly dependent on similar companies in the area. However, even here, a certain connection with natural resources, where these companies are concentrated could be seen. If it is an economically lucrative natural resource, then it is natural that the companies around the place will do well and vice versa. However, there are very few companies in this sector and for a better understanding and more accurate results, it would be necessary to perform the analysis with a larger sample.

Similar results were obtained in the sector of Education, Health and social care, veterinary activities and Other community, social and personal services. These sectors include mostly non-profit organizations dependent on subsidies and sponsors. For this reason, analyses of these sectors failed to demonstrate the dependence on the health of companies. Another factor that may play a significant role in deciding on the location of a company in the sector might be that the location of these companies is rather dependent on the needs of the society in the area. For example, in the case of sector Other community, social and personal services, these needs may be excluded sites. Only in the case of sector Health and social care, veterinary activities it has been shown that the health of companies is directly interlinked, which can be explained by the fact that the finances of these companies are largely dependent on one source, i.e. the state budget.

Within the sector Manufacturing industry, dependencies in both analyses were demonstrated. As these are manufacturing companies, dependence on similar companies can be caused by the transfer of know-how and innovation. The fact that these companies are doing better in a cluster of similar companies can be explained by the fact that the processes of these companies are interconnected and complementary. The proximity to these companies thus brings positive benefits.

The explanation for the dependence on the health of other companies in close proximity in the case of sector Construction may be that these companies are cooperating on the same project. This dependence then outweighed the fact that the health of companies would depend on whether it is located in a cluster or not.

Very interesting and unique results were obtained in the case of sector Wholesale and retail trade; repair and maintenance of motor vehicles. In the case of the first analysis, it was not possible to prove the dependence of the company's health on the health of other companies, which may be due to sales strategy, well-targeted marketing, company image, capable salespeople or sales representatives… However, the second analysis revealed that these companies do worse if they are placed in a cluster of other companies in the same sector. There is a really strong competition.

Similar results were achieved in sector Transport, storage and communication and Financial intermediation. These sectors express certain independence of their activities on the place where they are located (transport companies, online work, etc.), which may have played a significant

role in failing to demonstrate health dependence on the cluster location or other companies in the area. Only in the sector, Transport, storage and communication, there has been proven a dependence on the health of companies that are located in long modified distances. This can be explained by the fact that transport companies use outsourcing services of other transport companies.

For sectors Accommodation and food service activities and Real estate activities, renting and business activities, it was possible to prove the fact that if the company's registered office is located in a cluster of similar companies, this company is doing better. The justification for this fact may be a lucrative location or places of interests. Naturally, companies of these sectors will do similarly in the same location. However, in the case of sector Accommodation and food service activities, the dependence of the company's health on the health of other companies in the sector could not be demonstrated. Thus, there must be a different factor affecting the performance of the companies. I consider consumer preferences to be one of these factors, and how the company is able to respond flexibly to these preferences. Furthermore, there is almost perfect competition in this sector, as it includes a large number of companies offering a similar product and there are almost no barriers to entering this sector, market information is easily available, etc.

In summary in the thesis, there was found out that the firms are more located in areas where the population density is high. In particular, companies agglomerate significantly more than the population itself allows. Then, it was revealed that the rules about locating a new company near to other similar company are different within the sectors. Similar results were found when examining whether it is better to place a company close to another company that is doing well or not. Even in this case, the results varied depending on the selected sector.

Analyses of this thesis could be used as a key that can help with choosing a suitable locality for a starting new company. However, there is no straightforward answer to where a company should be located. It must be noted that location theories are of limited application since the generality. There is predominantly assumed only a few variables that are not sufficient in the real world. Furthermore, due to the influence of globalization, there is an impression that the location of companies lacks importance. To propose a model that can more properly explain the reality, further investigation is needed. It would be necessary to add more variables to the model, for example, time, availability of technologies and capital, personal preferences, a geographical distance of competition, the proximity of suppliers, industrial site, raw materials,

community, imperfect competition, externalities, etc. to understand the distribution of headquarters of companies. Rather, they are theoretical models that can give us guidance on how to choose a destination.

7. Acknowledgments

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8. Summary and Keywords

8.1 Summary

To choose a good location for a company is one of the most important long-term decision of the company's owners because this decision cannot be changed and ensures the future successful development of a company. That's why the location of corporate activities has been a part of economics for many years. This work also deals with this issue.

The purpose of the thesis is the recognition of spatial relationships of the headquarters of companies. Firstly, there are observed spatial relationships between individual companies within individual sectors. Secondly, there are answered the questions if the health of the company follows the same fate as other near companies or is absolutely independent and if the company is doing better in a cluster or not. In particular, whether the company should think of a location close to another successful company, or vice versa, a company that is not successful and is threatened by bankruptcy. Lastly, a new econometric model for recognition of spatial interaction of companies according to their health in the inhomogeneous case is proposed.

To fulfil the given aim, the literature overview of companies' location in the context of the economy and the assessment of companies' performance and a methodology for the evaluation of the position of companies have to be introduced. Specifically, there is introduced the methodology for the description of the positions of individual companies in homogeneous and inhomogeneous case (whether they tend to clustering or vice versa), if the clustering is dependent on the health of companies and a way to identify a level of clustering (how the tendency of clustering is strong).

In the analysis, the set of headquarters of small and medium companies in three regions located in the Czech Republic, i.e. Jihočeský, Plzeňský and Vysočina regions were used. The data set was collected in 2015 by database Albertina Gold and contains information from the financial reports of the companies from the year 2013. The classification of the companies into the given sectors was selected using the adjusted CZ-NACE methodology ver. 1.1 according to the core of the business that is the main product of the companies. Based on their economic activities, the companies were divided into 13 sectors. The data set contains 10 201 companies and their full addresses.

To tackle the location of companies, the local population and the health of companies were taken into account. The methodology is based on a point process theory. Since the population is unevenly distributed and companies choose their locations according to the size of the local population, it was not possible to use homogeneous models and thus the local scaling principals were used for modelling the inhomogeneity. The inhomogeneous approach is more realistic in large observation areas and areas with geographical features like mountains where the concentration of companies is not as common. The results were obtained by application of Ripley's *K*-function and its derived Besag's *L*-function that is used for the determination of the distribution of the companies in our research. Lastly, the locally scaled mark-weighted *K*-function was introduced to determine the dependence of the firm health and its location. This function has never been used before. As a mark, the health of the company was taken into account, specifically Neumeiers' indices.

Firstly, it was found out how the headquarter of the company corresponds with its establishments. The research found that *75 %* of companies have the same location for their establishments and headquarters. *79 %* of companies have their registered office identical to the establishment or the establishment is a maximum of *1 km* away from the establishment. And even *90 %* have the same headquarters as an establishment or an establishment within a maximum distance of *10 km*. This finding leads to the fact that the results of the analysis of the location of the company's headquarters can be implemented on its establishments.

Then, the analyses of this work revealed that companies in all industries tend to strong clustering. We managed to prove that companies are more located in areas where people are more concentrated. On the other hand, there has to be an influence of other factors that can explain clustering completely. The geographic concentration of companies is stronger than population because it helps to amplify production and innovation benefits, specifically to reduce transaction costs, increase information flow, improve specialized needs and be stronger in a competitive environment. Many companies probably realise the advantages of location in a cluster where the whole is more than the sum of its parts. As it was not possible to prove that the population would fully explain the clustering of firms, the analyses were completely detached from the population. The population was replaced with the density of the point process of companies.

However, the main aim of the thesis was to ask if the health of the firm is influenced by the health of other companies surrounded by and if the companies are healthier when they are

located in clusters or not. These analyses were solved by locally scaled mark-weighted *K*-function and different tendencies though sectors were revealed. There were found out strong interactions between the performances of companies in 6 sectors where the companies follow the same fate as the companies close to them. There were only differences in the distance of influenced companies. Specifically, the performance in Construction sector and Real estate activities, renting and business activities are influenced by companies located in the short distances, the health of companies in Mining and quarrying, Manufacturing industry sector is influenced by companies located in medium modified distances, the health of companies in sector Transport, storage and communication is affected by companies located in longer distances and in the sector Health and social care, veterinary activities the health is influenced by companies in all distances. In other sectors, the null hypothesis couldn't be rejected. Then, when the analysis was focused on the question if the companies are healthier when they are located near to other companies or not, the results were different though the sectors again. There were revealed interaction only in the sectors Manufacturing industry, Wholesale and retail trade; repair and maintenance of motor vehicles, Accommodation and food service activities, and Real estate activities, renting and business activities. The first three sectors revealed that the companies have better performance if they are located in a cluster of similar companies. Controversially, the sector Wholesale and retail trade; repair and maintenance of motor vehicles showed that the companies of this sector located in clusters are doing worse.

Analyses of this thesis could be used as a key that can help with choosing a suitable locality for starting a new company. However, there is no straightforward answer to where a company should be located. It must be noted that location theories are of limited application since the generality. There is predominantly assumed only a few variables that are not sufficient in the real world. It would be necessary to add more variables to the model, for example, availability of technologies and capital, personal preferences, a geographical distance of competition, the proximity of suppliers, industrial site, raw materials, community, imperfect competition, externalities, etc. to understand the distribution of headquarters of companies. Rather, they are theoretical models that can give us guidance on how to choose a destination.

8.2 Keywords

Location theories, Clustering, Health of companies, Local scaling, Locally Scaled Mark-weighted *K*-function, Global envelope test

9. References

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